MINISTRY OF TRANSPORT, VIETNAM

STUDY FOR SUPPORTING ITS STANDARDS & OPERATION PLAN DEVELOPMENT IN VIETNAM

APPENDIX 3 – 8

January 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.
NEXCO EAST ENGINEERING CO., LTD.
ALMEC CORPORATION

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APPENDIX 3:
DRAFT MESSAGE/DATA STANDARDS

The Draft Message/Data Standards defines message list and data dictionary in order to establish inter-operability of message and data. The message list comprises the items below.

- Name of message
- Equipment component on one side of interface
- Equipment component on the other side of interface
- Names of Included data sets
- Names of Major Included data elements

The data dictionary comprises the attributes below.

- Name of data element
- Definition
- Presentation category
- Form of representation
- Data type of data element values.

DRAFT MESSAGE/DATA STANDARDS

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (2) CCTV Monitoring (3) Event Detection (by Image) (4) Vehicle Detection (5) Traffic Analysis (6) Weather Monitoring (7) Traffic Event Data Management (8) Traffic Supervision (9) VMS Indication (10) Mobile Radio Communication (11) Traffic Information	(12) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

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1. General Outlines

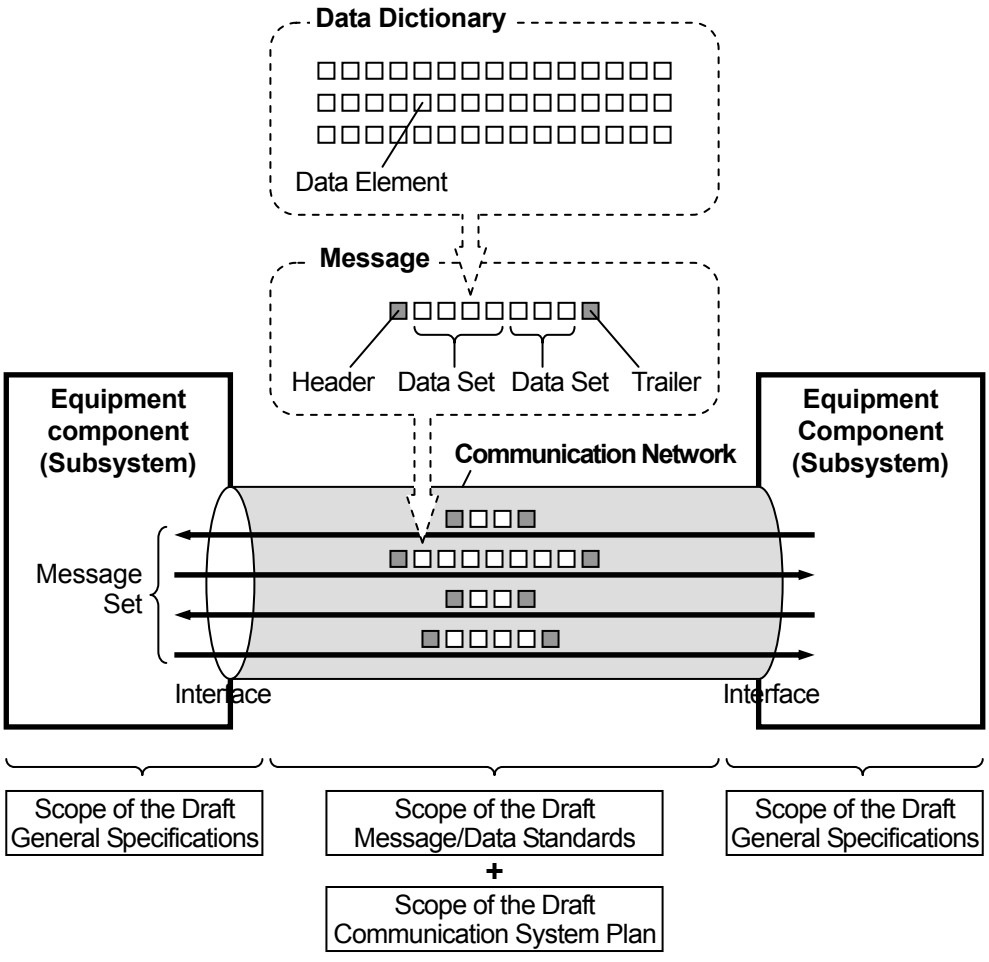
ITS consists of many pices of equipment, which are illustrated as the equipment packages in the diagrams of system architecture in the Draft Design Standards and the Draft General Specifications. Provisions for securing compatibility of the equipment packages are defined in the Draft General Specifications.

However, the equipment packages need to be connected with each other by communication network in order to exchange messages and data between them, to actualize the system and to provide intended services. For this purpose, inter-operability of message/data and connectability of interfaces need to be secured by preparing the standards for ITS as follows:

- Draft General Specifications → Compatibility of equipment packages
- Draft Message/Data Standards → Inter-operability of message/data
- Draft Communiaction System Plan → Connectability of interfaces.

Herein, the Draft Message/Data Standards are to be developed which consist of message list and data dictionary.

Figure 8.1 Conceptual Illustration of Standards for ITS



2. Scope

This Draft Message/Data Standards deal with message list and data dictionary regarding message/data exchange among roadside on the expressway network throughout Vietnam including access sections of arterial roads, the Main Centers, road management offices and toll office of the expressway for actualizing services to be provided by ITS.

3. Message List

A number of messages need to be exchanged among equipment packages for actualizing services of ITS. A list of major messages comprises the items below is shown in the following tables.

- Name of message
- Equipment component on one side of interface
- Equipment component on the other side of interface
- Names of Included Data Sets
- Names of Major Included Data elements

Table 3.1 Message List

Name of Message	A Pair of Equipment Components on Both Side of Interface through Which Message is Exchanged		Names of Included Data Sets	Names of Major Included Data elements
Incident Input Message	Data Input Device	Traffic Event Data Server	Incident Data Set	Date
				Time
				Roadside Equipment ID
				Incident Status
			Image Recognition Result Data set	Date
				Time
				Roadside Equipment ID
				Image Recognition Result Status
Incident Input Message	Traffic Event Data Server	Traffic Information Server	Incident Data Set	Date
				Time
				Roadside Equipment ID
				Incident Status
			Image Recognition Result Data set	Date
				Time
				Roadside Equipment ID
				Image Recognition Result Status
Vehicle Detection Message	Vehicle Detector	Traffic Analysis Processor	Vehicle Detection Data Set	Date
				Time
				Roadside Equipment ID
				Cumulative Number of Vehicles
				Vehicle Speed (1)
				Vehicle Length (2)
				:
				Vehicle Speed (N)
				Vehicle Length (N)
Traffic Congestion	Data Input Device	Traffic Event	Traffic Congestion	Date*
				Time*

Input Message		Data Server	Data Set	Roadside Equipment ID*
				Cumulative Number of Vehicles*
				Average Vehicle Speed*
				Traffic Congestion Status**
Weather Observation Message	Weather Sensor	Weather Data Server	Weather Observation Data Set	Date
				Time
				Roadside Equipment ID
				Measurement date
				Precipitation
				Wind speed
				Visibility
				Temperature
				Alert status of precipitation
				Alert status of wind speed
				Alert status of visibility
				Alert status of temperature
Significant Weather Input Message	Data Input Device	Traffic Event Data Server	Weather Data Set	Date*
				Time*
				Roadside Equipment ID*
				Precipitation*
				Wind Speed*
				Visibility*
				Temperature*
				Heavy Rain Status**
				High Wind Status**
				Low Visibility Status**
				High Temperature Status**
Significant Weather Input Message	Traffic Event Data Server	Traffic Information Server	Weather Data Set	Date*
				Time*
				Roadside Equipment ID*
				Precipitation*
				Wind Speed*
				Visibility*
				Temperature*

				Heavy Rain Status**
				High Wind Status**
				Low Visibility Status**
				High Temperature Status**
Construction Work Input Message.	Data Input Device	Traffic Event Data Server	Construction Work Data Set	Date
				Time
				Line ID
				Kilometer Post
				Construction Work Status
Construction Work Input Message.	Traffic Event Data Server	Traffic Information Server	Construction Work Data Set	Date
				Time
				Line ID
				Kilometer Post
				Construction Work Status
Traffic Regulation Input Message	Data Input Device	Traffic Event Data Server	Traffic Restriction Data Set	Date
				Time
				Line ID
				Kilometer Post
				Traffic Restriction Status
Traffic Regulation Input Message	Traffic Event Data Server	Traffic Information Server	Traffic Restriction Data Set	Date
				Time
				Line ID
				Kilometer Post
				Traffic Restriction Status
Traffic Event Message	Traffic Supervising/ Control Server	Traffic Event Data Server	Traffic Event Data Set	Date
				Time
				Traffic Event Data ID
				Causal Traffic Event Data ID
				Line ID
				Kilometer Post
				Road Link ID
				Place Name ID
				Traffic Event Category ID
				Traffic Event Class ID

				Main Center Check Status Office Check Status Existing/Removed Status
VMS Indication Message	Traffic Event Data Server	VMS Center Controller	VMS Indication Data Set	Date Time Roadside Equipment ID Traffic Event Class ID Place Name ID Causal Traffic Event Class ID Causal Place Name ID
VMS Indication Message	Traffic Event Data Server	Traffic Information Server	VMS Indication Data Set	Date Time Roadside Equipment ID Traffic Event Class ID Place Name ID Causal Traffic Event Class ID Causal Place Name ID
VMS Control Input Message	Data Input Device	VMS Center Controller	VMS Control Input Data Set	Roadside Equipment ID Free text Indicated of “Under Repaire” Turn Off/On
VMS Control Message	VMS Center Controller	VMS	VMS Control Data Set	Roadside Equipment ID LED Elements Control Data Turn Off/On
CSS Control Input Message	Data Input Device	VMS Center Controller	CSS Control Input Data Set	Roadside Equipment ID Free Digit Turn Off/On
CSS Control Message	VMS Center Controller	CSS	CSS Control Data set	Roadside Equipment ID Led Elements Control Data Turn Off/On
Parking Lot Input Message	Data input Device	Traffic Information Server	Static Parking Information Dataset	Date Time Handicap Access Information Parking lot entrance location

				Parking lot features
				Parking ot fill time
				Parking lot hours of operation
				Parking lot identity
				Parking lot type
			Dynamic parking information data set	Date
				Time
				Parking lot entrances State
				Parking lot identity
				Parking lot occupancy
				Parking lot state
Toll Price Input Messsage	Data input Device	Traffic Information Server	Toll Price Information Data Set	Date
				Time
				Toll Price
				Toll Price application time
				Line ID
				Vehicle class for toll collection
Toll Price Message	Toll Management Server	Lane Server	Toll Price Data Set	Line ID
				Toll Price
				Vehicle class for toll collection
Toll Price Message	Lane Server	Roadside Controller	Toll Price Data Set	Line ID
				Toll Price
				Vehicle class for toll collection
ETC Message	OBU	Roadside Controller	OBU Registration Data Set	OBU ID
				Date
				License number
				Vehicle class
			OBU Passage Dataset	Tollgate ID
				Lane Server ID
				Date
				Time
				Toll amount
			IC-Card Contract Data Set	IC-card ID

				Issuer ID
				Issue terminal ID
				Date of issue
				Date of expiry
			IC-Card Passage History Data Set	Tollgate ID
				Lane Server ID
				Date
				Time
				Toll amount
			Transaction Data set	Termination sign *
				Permanently voided code **
				Transaction counter ***
Touch& Go Message	IC-Card R/W	Lane Server	IC-Card Contract Data Set	IC-card ID
				Issuer ID
				Issue terminal ID
				Date of issue
				Date of expiry
			IC-card passage history data set	Tollgate ID
				Lane server ID
				Date/time
				Toll amount
			Transaction Data set	Termination sign *
				Permanently voided code **
				Transaction counter ***
IC-Card Recharge Message	IC-Card	IC-Card Recharger	IC-Card Recharge Data set	Deposit terminal ID
				Date of deposit
				Amount of deposit
				Prepaid balance
Transaction Collection Message	Lane Server	Toll Management Server	Transaction Collection data set	Lane server ID
				Date/time
				OBU ID
				Vehicle class

				License number (by OBU)
				Termination sign
Toll Collection Message	Toll Management Server	Toll Management Center Server	Toll Collection Data Set	Tollgate ID
				Date/time
				Sum of toll amount
				License number (by scan)
				Enforcement status
				Transaction data frames

Note: * : Data to be automatically generated, ** : Data to be manually input

4. Data Dictionary

Messages foregoing include a number of data sets consist of a set of data elements. A dictionary of major data elements comprises the attributes below is shown in the following tables.

- Name of data element
- Defintion
- Presentation category
- Form of representation
- Data type of data element values.

The attributes above are defined as mandatory in ISO/IEC 11179 (see Table 5.1). Additionally, in ISO/IEC 11179, three attributes below also are defined as mandatory; however, these are not included in the data dictionary because of insufficiency of discussion on them.

- Maximum Size of Data Element Values
- Minimum Size of Data Element Values
- Permissible Data Element Values

Table 4.1 Data Dictionary

Name of Data Element	Definition	Representation Category	Form of Representation	Data Type of Data Element Values
Amount of deposit	The amount of electronic money deposited to the prepaid account	Character	TEXT	INT
Average Speed	The measured average speed of a vehicle passing through a specific given location	Character	TEXT	INT
Axle load measurement data	The measured vehicle axle load for indentifying overloaded truck,	Character	TEXT	INT
Causal Place Name	The name of a place where a causal traffic event occurred, and inputted manually by a road operator for VMS Indication	Character	TEXT	CS
Causal Place Name ID	A unique identifier for a place where the causal traffic event occurred	Character	CODE	CS
Causal Traffic Event Class ID	A unique identifier for a causal traffic event data class	Character	CODE	CS
Causal Traffic Event Data ID	An unique Identifier for a causal traffic event data	Character	CODE	CS
Date	A date with format of day, month and year	Character	TEXT	CS
Date / Time	A Date/Time with format of Day, Month, Year/Hour,Minute, Second, Mini second.	Character	TEXT	CS
Date of deposit	The date with format of day, month and year of depositing money on an IC Card.	Character	TEXT	CS

Date of expiry	A date with format of day, month and year when the IC card, OBU or barcode ticket would be expired	Character	TEXT	CS
Date of issue	A date with format of day, month and year when issuing an IC Card, an OBU or a barcode ticket	Character	TEXT	CS
Dense Fog Status	Extent of dense fog obtained by weather monitoring	Character	TEXT	CS
Deposit terminal ID	An unique identifier of a terminal device (such as vending machines) with functions of electronic money recharging in an IC Card	Character	CODE	CS
Driving lane information	An unique numerical identifier for identifing a lane	Character	CODE	CS
Enforcement status	Status of toll collection transaction for indicating the transaction if it is enforced or not	Character	CODE	CS
Existing/Removed Status	Existence/removal of a traffic event	Character	TEXT	CS
Heavy Rain Status	Extent of heavy rain obtained by weather monitoring	Character	TEXT	CS
High Temperature Status	Extent of high temperature obtained by weather monitoring	Character	TEXT	CS
High Wind Status	Extent of high wind obtained by weather monitoring	Character	TEXT	CS
IC-Card ID	An unique identifier for an IC Card	Character	CODE	CS
Invalidated IC Card ID	An unique identifier for an IC Card in the invalidation list	Character	CODE	CS
Invalidated OBU ID	An unique identifier for an OBU in the validation list	Character	CODE	CS

Issue terminal ID	An unique identifier for an IC Card, ticket issuing terminal device	Character	CODE	CS
Issuer ID	An unique identifier for a IC Card Issuer or OBU issuer or ticket issuer	Character	CODE	CS
Kilometer Post	Kilometer post of the place where a traffic event occurred	Character	TEXT	CS
Lane Server ID	An unique Identifier for a Lane Server	Character	CODE	CS
License number	A license plate number of a vehicle identified by the information stored in an OBU at the time of registation or by Vehicle detection and classification system.	Character	CODE	CS
License Plate Number Data	A static image of license plate number of a vehicle recognized by vehicle detection	Image	IMAGE	Binary
License Plate Number Information	An unique identifier for a vehicle, that follows the regulations of existing Circular No 06/2009/TT-BCA(C11) of Ministry of Public Security of Viet Nam.	Character	TEXT	CS
Line ID	A unique numerical Identifier for a expressway where a traffic event occurred	Character	CODE	CS
Location ID information	An unique identifier for identifing a location	Character	TEXT	CS
Main Center Check Status	Approval/disapproval status of the Main Center on mobile data input	Character	TEXT	CS
Measurement Date/Time	A date/time with format of day,month, year/hour,minute, second when measurement is taken	Character	TIMESTAMP	CS
Kilometer Post of Causal Place Name	Kilometer Post of a place where a causal traffic event occurred	Character	TEXT	CS
Kilometer Post of Traffic Event	Kilometer Post of a place where a traffic event occurred	Character	TEXT	CS

OBU ID	A unique Identifier for an OBU installed on a vehicle, inputted in the OBU at the time of registration	Character	CODE	CS
Office Check Status	Approval/disapproval of the road management office on mobile data input	Character	TEXT	CS
Permanently voided code	A numerical value which is used to determine the status of an IC card/OBU if it is permanently voided or not	Character	CODE	CS
Photographed date/time	A date (with format of day,month, year/hour, minute, second) when a vehicle photo was taken at the time of axle load measurement	Character	TIMESTAMP	CS
Place Name	The name of a place where a traffic event occurred, and inputted manually by a road operator for VMS Indication	Character	TEXT	CS
Place Name ID	A unique Identifier for a place where the traffic event occurred	Character	CODE	CS
Prepaid balance	The remaining amount of electronic money in an IC Card	Character	TEXT	INT
Reliability of recognition	The reliability of license plate number recognition measured in percentage	Character	TEXT	INT
Road Link ID	A unique numerical Identifier for a expression sub-section where the traffic event occurred	Character	CODE	CS
Roadside Equipment ID	A unique Identifier for a road side equipment	Character	CODE	CS
Self-diagnostic result	Operation status of roadside equipment component that detected by self-dianostic fuction	Character	CODE	CS
Sum of toll amount	A sum of colleted toll amount of vehicles of all classed passing through the tollgate	Character	TEXT	INT
Temperature	Air temperature measured by a weather sensor	Character	TEXT	INT

Termination sign	A termination sign for indicating a toll collection transaction has finished completely.	Character	CODE	CS
Ticket serial number	A unique identifier for a barcode ticket	Character	CODE	CS
Ticket Type	A unique numerical value for determining the ticket type	Character	TEXT	INT
Time	A time with format of hour, minute, second and mini second	Character	TIMESTAMP	CS
Toll amount	A toll charge collected by the system when a vehicle is passing through an Exit of a tollgate in ETC, Touch&Go toll collection or Manual toll collection.	Character	TEXT	INT
Toll amount of Class 1	Toll amount of class-1 vehicles	Character	TEXT	INT
Toll amount of Class 2	Toll amount of class- 2vehicles	Character	TEXT	INT
Toll amount of Class 3	Toll amount of class-3 vehicles	Character	TEXT	INT
Toll amount of Class 4	Toll amount of class-4 vehicles	Character	TEXT	INT
Toll amount of Class 5	Toll amount of class-5 vehicles	Character	TEXT	INT
Toll amount of Class 6	Toll amount of class-6 vehicles			
Toll amount of Class 7	Toll amount of class-7 vehicles			
Toll amount of Class 8	Toll amount of class-8 vehicles			

Toll amount of Class 9	Toll amount of class-9 vehicles			
Toll amount of Class 10	Toll amount of class-10 vehicles			
Toll amount of Class 11	Toll amount of class-11 vehicles			
Toll Company ID	A unique identifier for a Toll collection company	Character	CODE	CS
Entry Tollgate ID	A unique identifier for a tollgate through that the vehicle entries the expressway	Character	CODE	CS
Exit Tollgate ID	A unique identifier for a tollgate through that the vehicle exists the expressway	Character	CODE	CS
Tollgate ID	A unique identifier for a tollgate	Character	CODE	CS
Traffic Event Category ID	A unique Identifier for a traffic event category	Character	CODE	CS
Traffic Event Class ID	A unique Identifier for a traffic event data class	Character	CODE	CS
Traffic Event Data ID	An unique Identifier for a traffic event data	Character	CODE	CS
Traffic Event Class	An unique numerial identifier of traffic event class. There are 18 traffic event classes as follows: 1. Traffic accident 2. Broken-down vehicle 3. Left obstacles 4. Reversing vehicle 5. Vandalism			

	6. Natural disaster 7. Congestion 8. Crowdedness 9. Heavy rain 10. High wind 11. Dense Fog 12. High air temperature 13. Construction work 14. Expressway closure 15. Lane closure 16. Entry closure 17. Speed limitation 18. Warning information			
Traffic Volume	Number of vehicles passing through a specific location	Character	TEXT	INT
Traffic volume of all vehicles (through a tollgate)	Total number of vehicles passing through a toll gate measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 1	Total number of class-1 vehicles passing through a toll gate, measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 2	Total number of class-2 vehicles passing through a toll gate, measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 3	Total number of class-3 vehicles passing through a toll gate, measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 4	Total number of class-4 vehicles passing through a toll gate ,, measured by vehicle detection	Character	TEXT	INT

Traffic volume of Class 5	Total number of class-5 vehicles passing through a toll gate and measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 6	Total number of class-6 vehicles passing through a toll gate and measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 7	Total number of class-7 vehicles passing through a toll gate and measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 8	Total number of class-8 vehicles passing through a toll gate and measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 9	Total number of class-9 vehicles passing through a toll gate and measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 10	Total number of class-10 vehicles passing through a toll gate and measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 11	Total number of class-11 vehicles passing through a toll gate and measured by vehicle detection	Character	TEXT	INT
Traffic volume of Class 12	Total number of class-12 vehicles passing through a toll gate and measured by vehicle detection	Character	TEXT	INT
Transaction counter	A numerical value which is used to ensure the current transaction is not interfered	Character	TEXT	INT
Vehicle class for toll collection	An unique numerial identifier of vehicle classs for toll collection. According to the regulation of Ministry of Finance, there are 12 vehicle classes as follows: 1. Class 1: Car with less than 12 seats; Truck with total weight under 2 tons; Mass transit buses 2. Class 2: Car with 12 seats to 30 seats ; Truck with total weight of 2 tons to 4 tons 3. Class 3: Car with 31 seats or more; Truck with total weight of 4 tons to less than 10 tons	Character	TEXT	CS

	4. Class 4: Truck with total weight of 10 tons to less than 18 tons; 20ft-container truck 5. Class 5: Truck with total weight of 18 tons upward; 40ft-container truck 6. Class 6: Military sedan car 7. Class 7: Military truck 8. Class 8: Police car with less than 7 seats 9. Class 9: Police car with from 7 seats upward 10. Class 10: Police dedicated vehicles, including road inspection vehicles, communication vehicle, mobile radio communication vehicle 11. Class 11: Police truck 12. Class 12: Police two/three-wheel motorbike			
Vehicle class for traffic data	An unique numerial identifier of vehicle classsification for traffic data. According to the TCVN 4054:2005 Highway-Specification for Design, there are 5 vehicle classes as follows: 1. Class 1: Motorbike (175m3 cylinder or bigger) 2. Class 2: Sedan car of various types 3. Class 3: Truck with 2 axles or more; Bus with less than 25 seats 4. Class 4: Truck with 3 axles or more; Large Bus 5. Class 5: Truck with trailer; Bus with trailer	Character	TEXT	CS
Vehicle class for Overloading Regulation	An unique numerial identifier of vehicle classsification for traffic data. According to the Circular 07/2010/TT-BGTVT of MOT, there are 11 vehicle classes as follows: 1. Class 1: Singleunit truc with 2 axles 2. Class 2: Single-unit truck with 3 axles 3. Class 3: Single-unit truck with 4 axles	Character	TEXT	CS

	4. Class 4: Single-unit truck with 5 or more axles 5. Class 5: Tractor with trailer/semi-trailer, 3 axles 6. Class 6: Tractor with trailer/semi-trailer, 4 axles 7. Class 7: Tractor with trailer/semi-trailer, 5 or more axles 8. Class 8: 2-axle single-unit truck with trailer/semi-trailer, that have sigle axles or double axles or triple axles 9. Class 9: 3-axle single-unit truck with trailer/semi-trailer, that have sigle axles or double axles or triple axles 10. Class 10: 4-axle single-unit truck with trailer/semi-trailer, that have sigle axles or double axles or triple axles 11. Class 11: 5-or more-axle single-unit truck with trailer/semi-trailer, that have sigle axles or double axles or triple axles			
Vehicle detection information	An unique serial number assigned to each vehicle passing time through a lane	Character	CODE	CS
Vehicle Information (Image)	A static image file of vehicle in front-view, or static image of extracted part of vehicle license plate number	Image	IMAGE	Binary
Vehicle Length	The length of a detected vehicle passing through a specific location	Character	TEXT	INT
Vehicle weight	Gross weight of heavy truck measured by total axle load of the heavy truck	Character	TEXT	INT
Video Image of Event	A static image of a detected Event	Image	Image	Binary
Visibility	Visibility measured by a weather sensor	Character	TEXT	INT
Wind Speed	Wind velocity measured by a weather sensor	Character	TEXT	INT

5. Data Attributes in ISO/IEC 11179 for Reference

ISO/IEC 11179 defines basic attributes for specifying data elements.

Data processing and electronic data interchange heavily relies on accurate, reliable, controllable and verifiable data recorded in databases. One of the prerequisites for a correct and proper use and interpretation of data is that both users and owners of data have a common understanding of the meaning and representation of the data elements. To facilitate a shared view of data elements, a number of attributes have to be defined.

The summary of the data attributes is shown in the following table.

Table 5.1 Data Attributes in ISO/IEC 11179

Attribute Category	Name of Data Element Attribute	Obligation	Data Type	Definition
Identifying	Name	M	CS	Single or multi word designation assigned to a data element.
	Identifier	C	CS	A language independent unique identifier of a data element within a Registration Authority.
	Version	C	CS	Identification of an issue of a data element specification in a series of evolving data element specifications within a Registration Authority.
	Registration Authority	C	CS	Any organization authorized to register data elements.
	Synonymous Name	O	CS	Single word or multi word designation that differs from the given name, but represents the same data element concept.
	Context	C	CS	A designation or description of the application environment or discipline in which a name and/or synonymous name is applied or originates from.
Definitional	Definition	M	CS	Statement that expresses the essential nature of a data element and permits its differentiation from all other data elements.
Relational	Classification Scheme	O	CS	A reference to (a) class(es) of a scheme for the arrangement or division of objects into groups based on characteristics which the objects have in common, e.g. origin, composition, structure, application, function, etc.
	Keyword(s)	O	CS	One or more significant words used for retrieval of data elements.
	Related Data Reference	O	CS	A reference between the data element and any related data. NOTE: The referred data may be registered in the same data element dictionary or in other dictionaries, repositories.
	Type of Relationship	C	CS	An expression that characterizes the relationship between the data element and related data.
Representational	Representation Category	M	CS	Type of symbol, character or other designation used to represent a data element.
	Form of Representation	M	CS	Name or description of the form of representation for the data element, e.g. ‘quantitative value’, ‘code’, ‘text’, ‘icon’, etc.
	Data Type of Data Element Values	M	CS	A set of distinct values for representing the data element value, e.g. ‘character’, ‘ordinal number’, ‘integer’, ‘scaled’, ‘bit’, ‘relational’, etc.
	Maximum Size of Data Element Values	M	INT	The maximum number of storage units (of the corresponding data type) to represent the data element value. e.g. in the case ‘datatype’ has instance ‘character’, maximum size of data element value: ‘17’ means that data element shall have a maximum of 17 characters.
	Minimum Size of Data Element Values	M	INT	The minimum number of storage units (of the corresponding data type) to represent the data element value, e.g. in the case ‘datatype’ has instance ‘character’, minimum size of data element

				value: ‘10’ means that data element shall have a minimum of 10 characters.
	Layout of Representation	C	CS	The layout of characters in data element values expressed by a character string representation.
	Permissible Data Element Values	M	CS	The set of representations of permissible instances of the data element, according to the representation form, layout, data type and maximum and minimum size specified in the corresponding attributes. The set can be specified by name, by reference to a source, by enumeration of the representation of the instances or by rules for generating the instances, e.g. data element ‘radio frequency’ has a domain which ranges from 3 KHz to 300 GHz.
Administrative	Responsible Organization	O	CS	The organization or unit within an organization that is responsible for the contents of the mandatory attributes by which the data element is specified.
	Registration Status	C	CS	A designation of the position in the registration life-cycle of a data element.
	Submitting Organization	O	CS	The organization or unit within an organization that has submitted the data element for addition, change or cancellation/withdrawal in the data element dictionary.
	Comments	O	CS	Remarks on the data element.

Note, M: Mandatory, C: Conditional, O: Optional, CS: Character String, INT: Integer.

APPENDIX 4:
DRAFT COMMUNICATION SYSTEM PLAN

The Draft Communication System Plan provides the General Plan and the Draft Design Standards of communication system in order to establish connectability of communication network.

- General Communication System Plan
- Design Standards of Communication System.

The General Plan of Communication System shows the discussion results on the items below.

- Locations of Main Centers and network structure
- Communication network management
- Terminal layer for roadside equipment
- Basic procedure of expressway operation
- Integration of roadside equipment control
- Transmission method.

The Design Standards of Communication System specifies required conditions to realize communications among the Main Centers, road management offices, toll offices, other offices and pieces of roadside equipment relative to expressway operation.

DRAFT COMMUNICATION SYSTEM PLAN

(Ver.1.0: Final Version of the Study Results)

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- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (2) CCTV Monitoring (3) Event Detection (by Image) (4) Vehicle Detection (5) Traffic Analysis (6) Weather Monitoring (7) Traffic Event Data Management (8) Traffic Supervision (9) VMS Indication (10) Mobile Radio Communication (11) Traffic Information	(12) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outline

The Draft Communication System Plan provides the General Plan and the Draft Design Standards of communication system in order to establish connectability of communication network.

- General Communication System Plan
- Design Standards of Communication System.

The General Plan of Communication System shows the discussion results on the items below.

- Locations of Main Centers and network structure
- Communication network management
- Terminal layer for roadside equipment
- Basic procedure of expressway operation
- Integration of roadside equipment control
- Transmission method.

The Design Standards of Communication System specifies required conditions to realize communications among the Main Centers, road management offices, toll offices, other offices and pieces of roadside equipment relative to expressway operation.

2. Scope

This Draft Communication System Plan deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in the Main Centers, road management offices and toll offices of the expressway network for actualizing communication system for ITS.

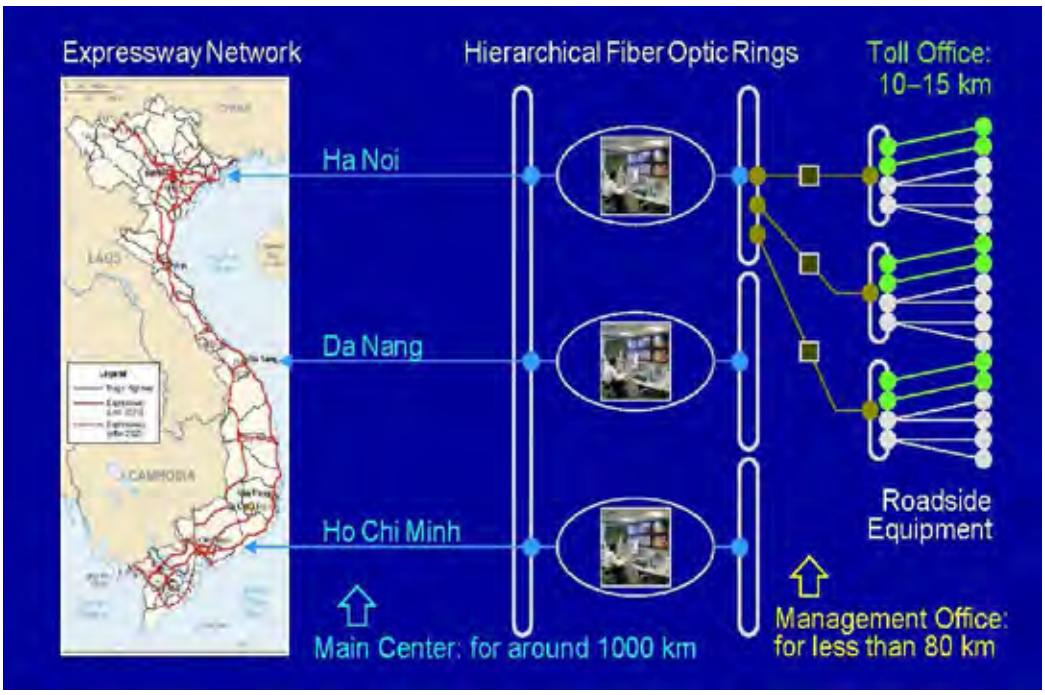
3. Locations of Main Centers and Network Structure

1) Locations of Main Centers

For the following reason, three main centers in Ha Noi, Da Nang and Ho Chi Minh are to be implemented for the inter-city expressway network over the entire country.

- Communication network and roadside equipment of ITS is to be installed stepwise from around Ha Noi, Da Nang and Ho Chi Minh, keeping pace with expressway construction
- Data traffic for operating ITS is to concentrate around Ha Noi and Ho Chi Minh where the expressways will be constructed at high density
- The appropriate jurisdictional range of the main center is assumed around 1000km, and it will become larger as the advancement of technology in the future.

Figure 3.1 Locations of the Main Centers

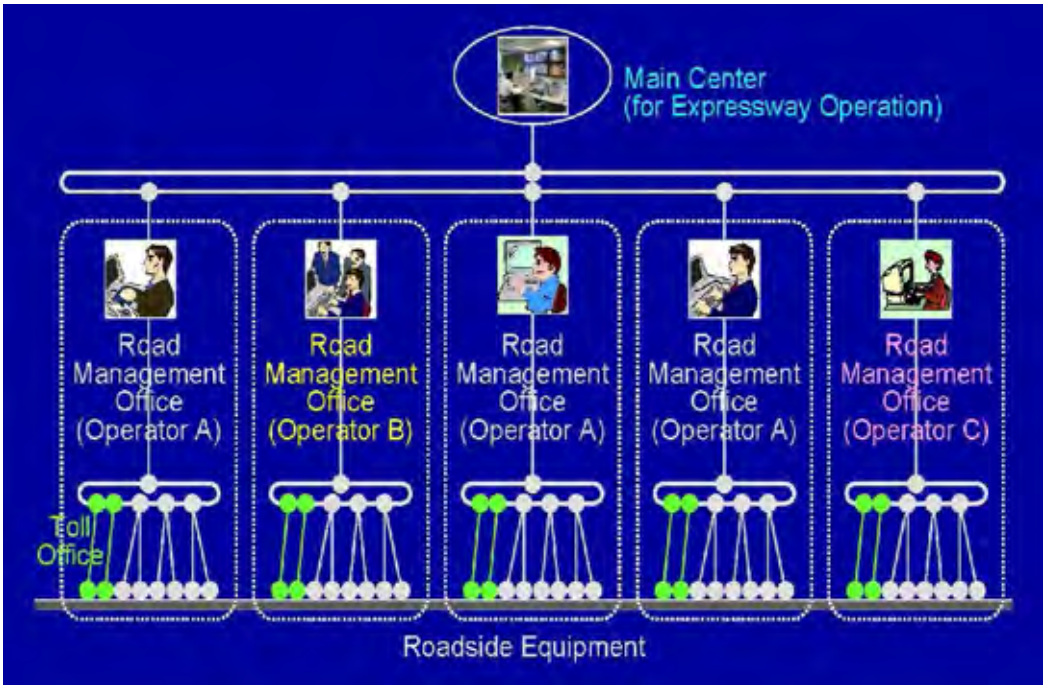


Source: VITRANSS2 Study Team

2) Network Structure

The expressway network in Vietnam will be operated being shared by many different road operators; however, the total framework for expressway operation needs to be integrated into a hierarchical structure. The framework for traffic control is illustrated in the following figure.

Figure 3.2 Hierarchical Network Structure

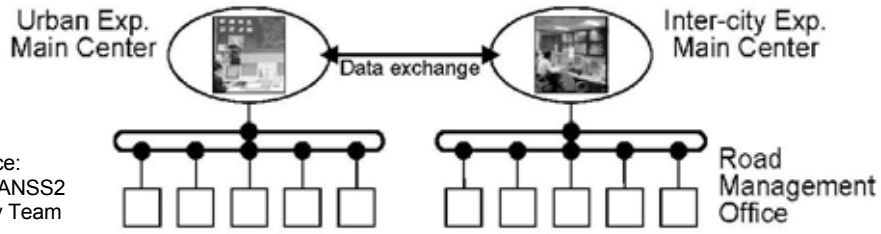


- **Roadside Equipment and Toll Offices:** Many pieces of roadside equipment are to be connected to communication nodes in toll offices or outside. A toll office is located at a tollgate, which includes two or more tollbooths, and is in charge of toll collection.
- **Road Management Offices:** One or more road management offices need to be set up on an expressway section. The road management offices are in charge of patrol for surveying current traffic conditions on the expressway, and the toll offices and the communication nodes on the section are to be controlled by the road management office.
- **Main Centers:** The Main Centers need to be set up in the principal cities such as Ha Noi, Da Nang and HCMC. The Main Center is in charge of traffic regulations, traffic control and traffic information dissemination, and the management offices are to be integrated controlled by the Main center.

3) Cooperation in Metropolitan Areas

Traffic information and other road services need to be provided to the users continuously on the road network; accordingly, traffic data is to be exchanged between the main centers for the inter-city expressways and for the urban expressways in the metropolitan area.

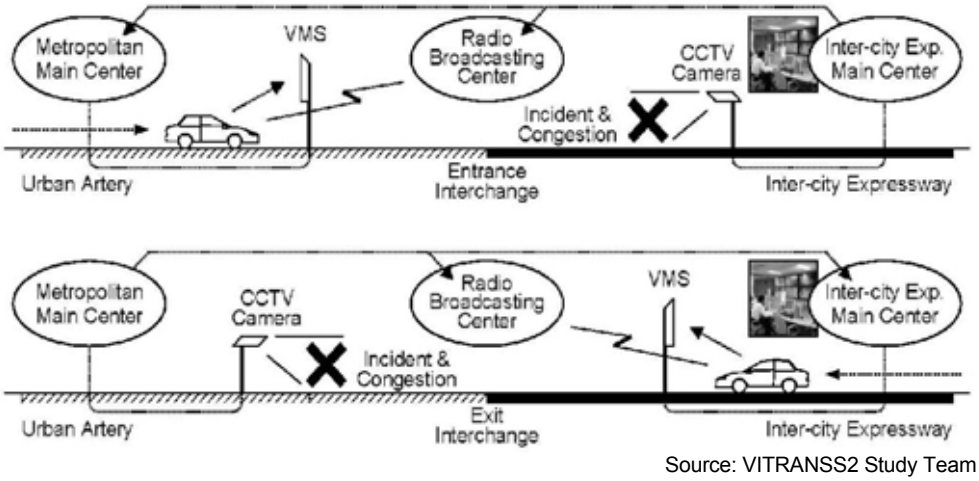
Table 3.3 Cooperation in Metropolitan Areas



Source:
VITRANSS2
Study Team

Information of incidents and traffic congestion on the inter-city expressways needs to be provided to the drivers on the urban arteries in advance of coming up to the entrance interchange for avoidance of their influence. Similarly, information of the event on the urban arteries is to be provided to the drivers on the inter-city expressways in advance.

Figure 3.4 Data Exchange between Main Centers Necessary in Metropolitan Areas

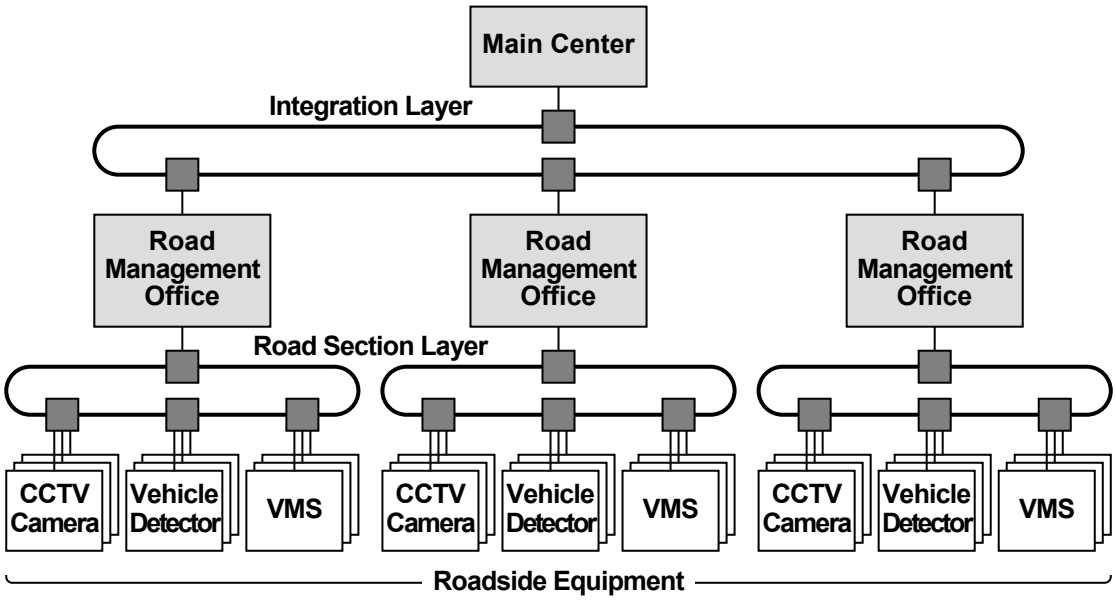


Source: VITRANSS2 Study Team

4. Communication Network Management

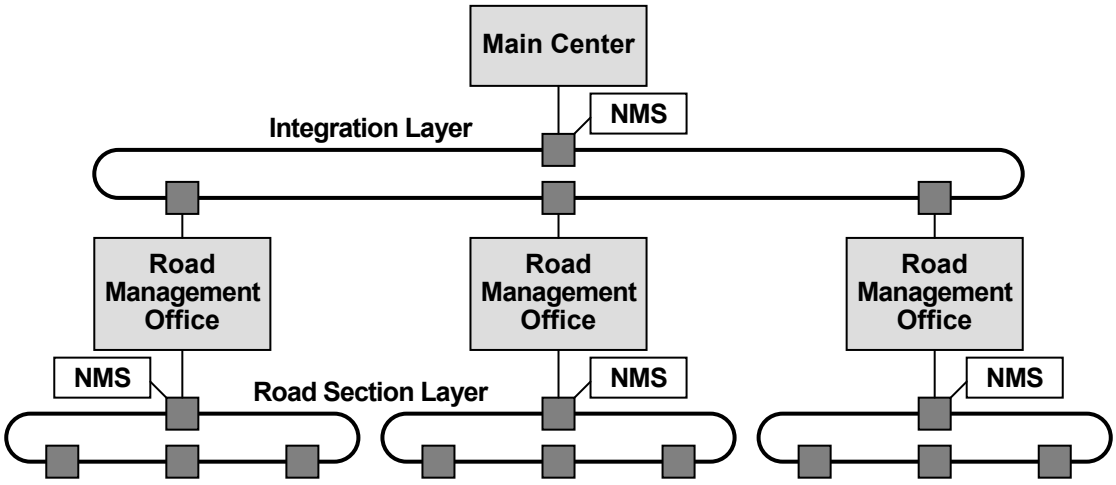
For road operation, hierarchical communication network needs to be established. The reason is that fiber optic rings of road section layer for connecting a road management office and pieces of roadside equipment are to be installed section by section keeping pace with the road construction; however the integration layer is necessary for connecting the Main Center and road management offices for total road operation.

Figure 4.1 Hierarchical Network Structure



The network needs to be managed by using NMS (Network Management System). However, there is no compatibility among NMSs supplied by different suppliers. Adequate organization needs to be set up to manage the hierarchical communication network for road operation.

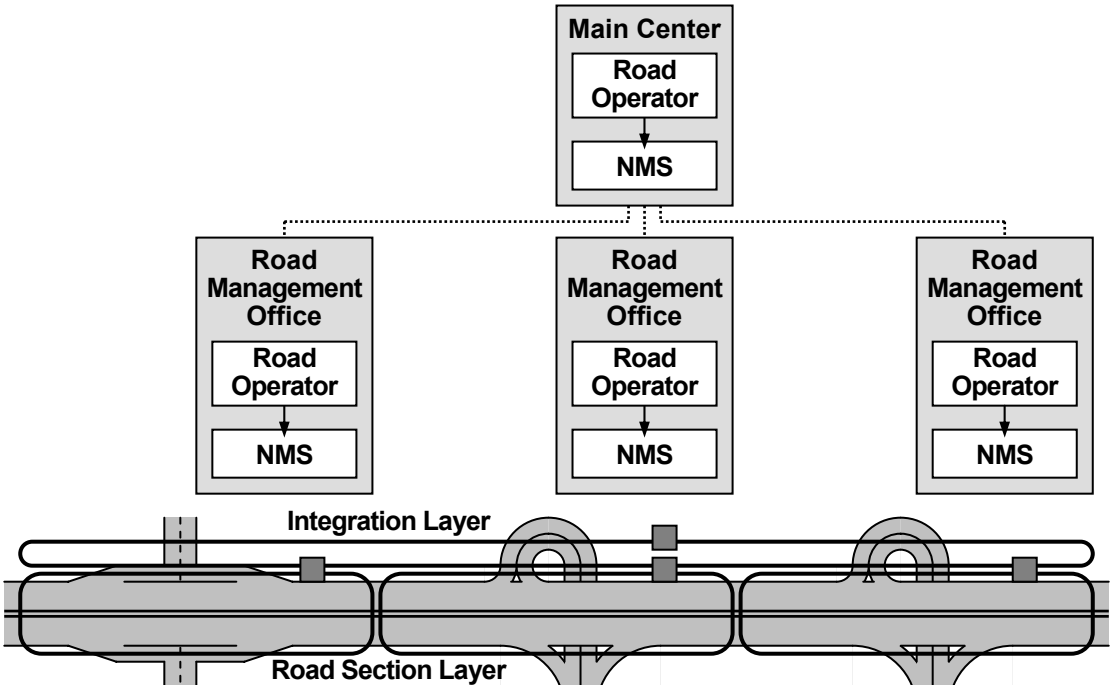
Figure 4.2 Communication Network Management



1) Case-1: Management Respectively by the Road Operators

Communication network consists of roadside layer and integration layer, and both layers are to be managed respectively by the road operators.

Figure 4.3 Management Respectively by the Road Operators

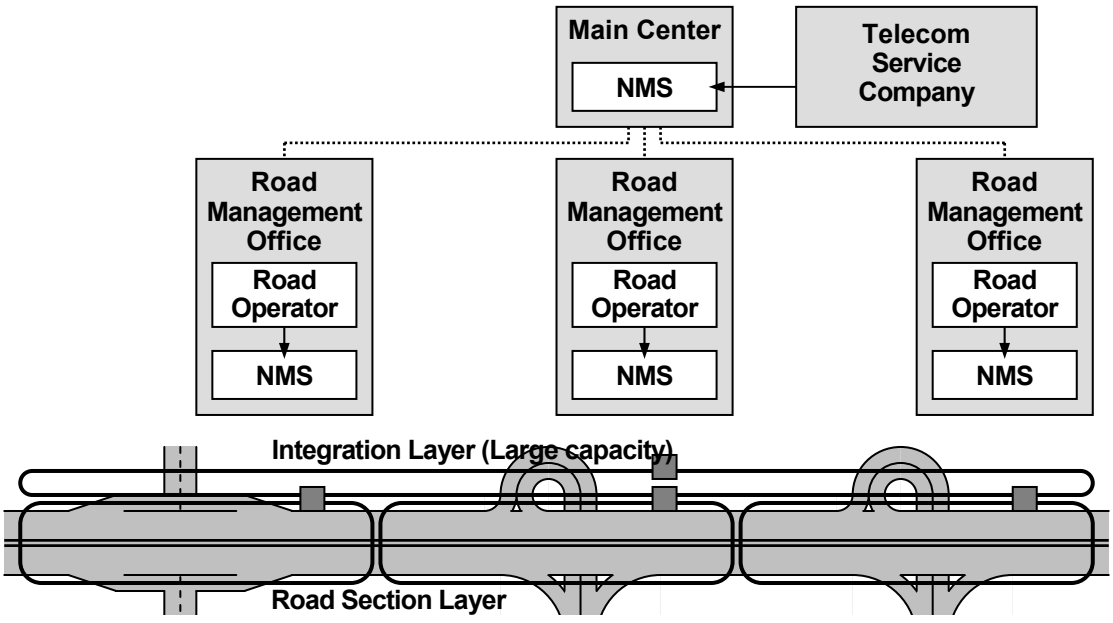


Note: Roadside layer: for connecting a road management office and pieces of roadside equipment, Integration layer: for connecting the Main Center and road management offices, NMS: Network Management System.

2) Case-2: Management by the Road Operators with Integration by a Telecom Service Company

Communication network consists of roadside layer managed respectively by the road operators and integration layer managed by a telecom service company.

Figure 4.4 Management by the Road Operators with Integration by a telecom service Company

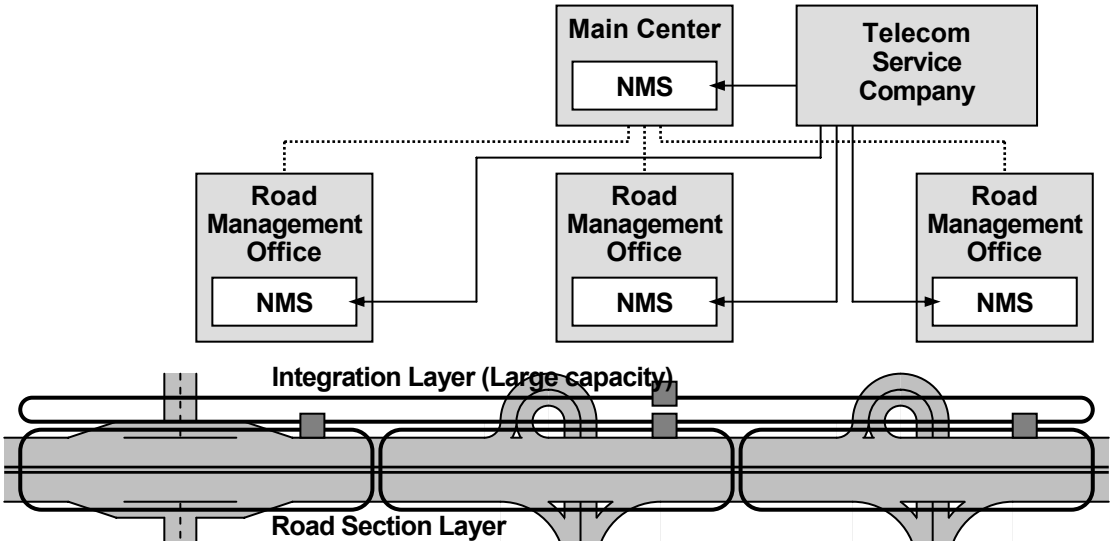


Note: Roadside layer: for connecting a road management office and pieces of roadside equipment, Integration layer: for connecting the Main Center and road management offices, NMS: Network Management System.

3) Case-3: Operation Totally by a Telecom Service Company

Communication network consists of roadside layer and integration layer, and both layers are to be managed totally by a telecom service company.

Figure 4.5 Operation Totally by a Telecom Service Company

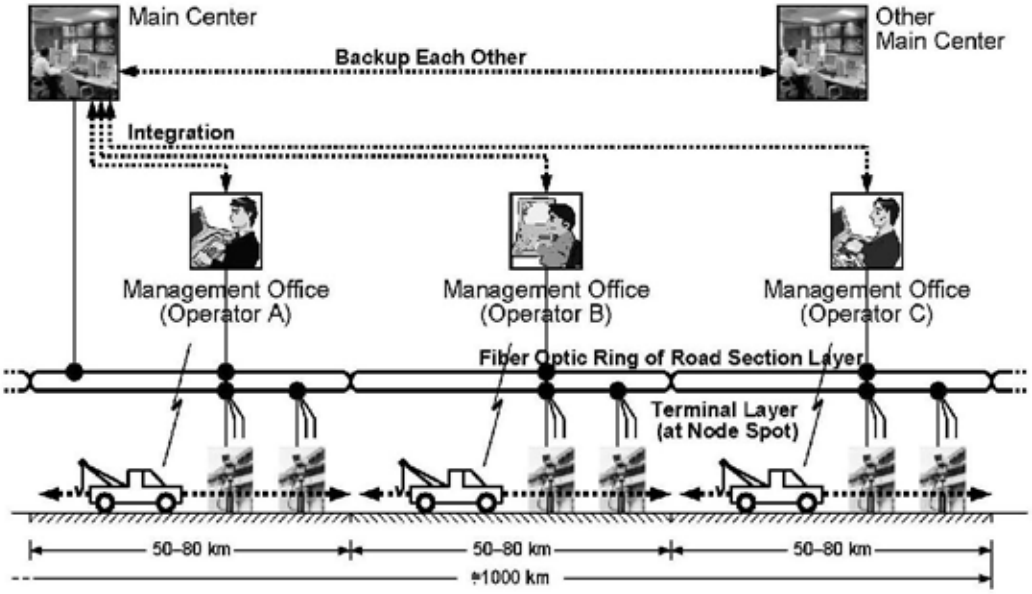


Note: Roadside layer: for connecting a road management office and pieces of roadside equipment, Integration layer: for connecting the Main Center and road management offices, NMS: Network Management System.

5. Terminal Layer for Roadside Equipment

The functions of ITS are to be actualized by the equipment organized hierarchically through the backbone network as shown below. The roadside equipment is connected to fiber optic ring of the road section layer at the node spots and is operated remotely from the Main Center or the road management office. The road managemnet offices are to be integrated by the main center for the efficient road operation.

Figure 5.1 Hierarchical Structure on Backbone Network



	Node Spot					
	Interchange	Barrier Tollgate	Through Lanes	Junction	Tunnel	Rest Area
CCTV	✓	✓	✓	✓	✓	
Event Detector	✓		✓	✓	✓	
Vehicle Detector	✓	✓	✓	✓		
Weather Sensors			✓			
VMS/SGM	✓	✓	✓	✓	✓	
ETC	✓	✓				
Touch&Go	✓	✓				
Axle Load Scale	✓	✓				
Emergency Telephone	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
Radio Communication	✓	✓	✓	✓	✓	✓
Wired Communication	✓	✓	✓	✓	✓	✓

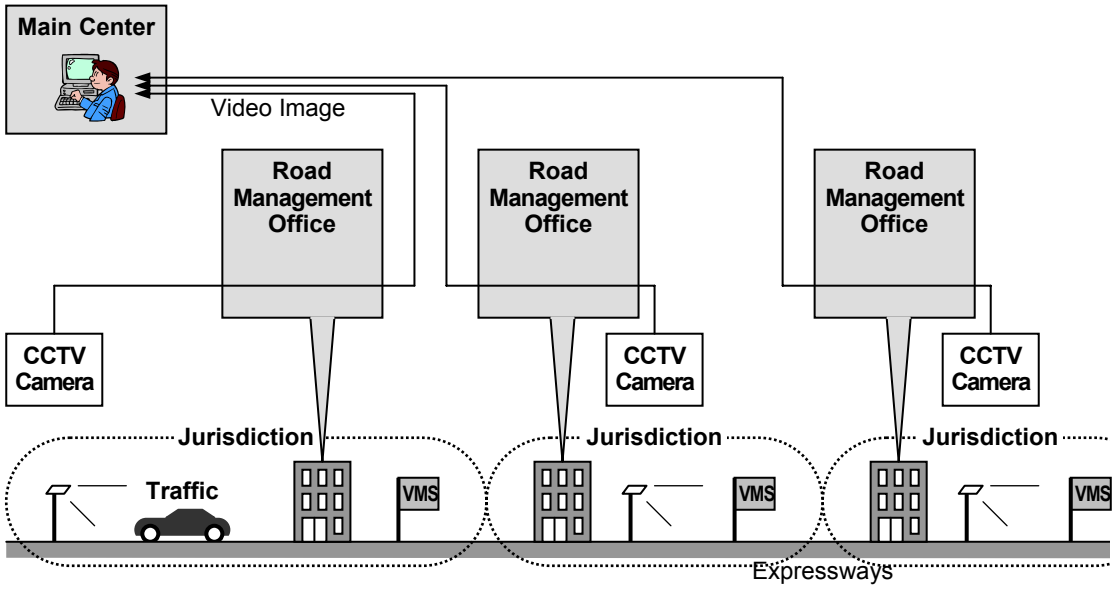
Source: VITRANSS2 Study Team

6. Basic Procedure of Expressway Operation

1) Routine Monitoring

Routine road/traffic monitoring is to be delegated to the Main Center for integrated traffic information/control with a wider view on the expressway network. CCTV cameras are to be controlled directly from the Main Center.

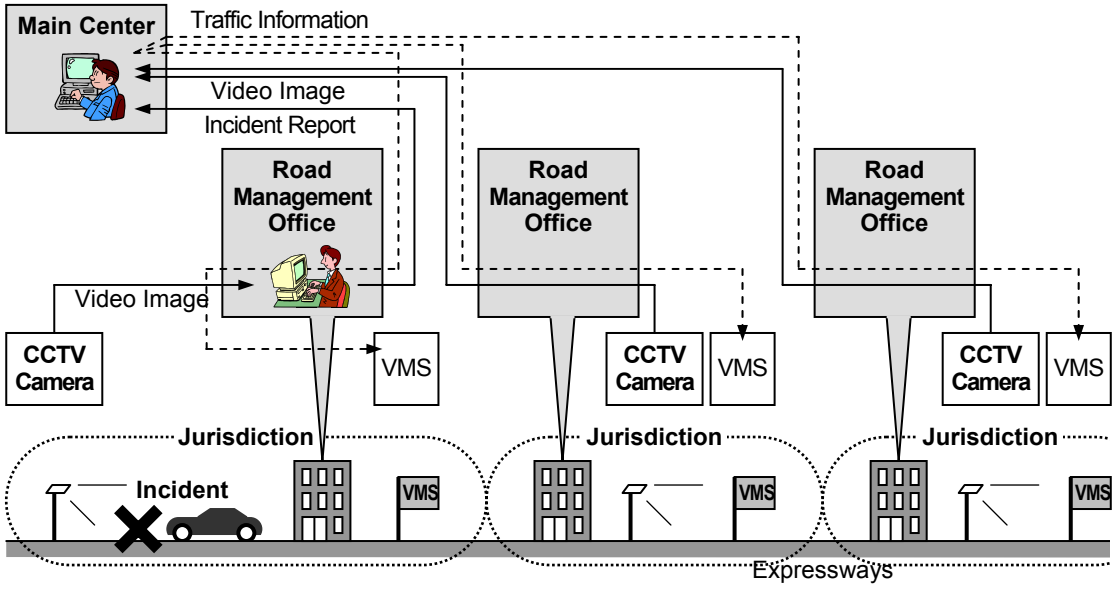
Figure 6.1 Routine Monitoring



2) Operation at Occurrence of Incident

Road/traffic monitoring at occurrence of incident is to be conducted respectively by the road management office in charge for appropriately addressing/clearing the incident. CCTV cameras at incident site are to be controlled from the road management office in charge, and the other CCTV cameras and VMS are to be controlled from the Main Center.

Figure 6.2 Operation at Occurrence of Incident



3) Procedure of Traffic Event Data Management

The following three procedures, of which details are shown in the following figures, are to be allowed for inputting traffic event data:

- By an operator in the Main Center
- By an operator in the road management office
- By patrol personnel on site through a mobile data input terminal.

It is required in either case to receive approval of responsible persons in the Main Center and the road management office. Through this doubled approval, traffic event data can be generated appropriately even in the case that operating body of the Main Center who is in charge of traffic information/control and that of road management office who is in charge of patrol for current traffic condition surveillance are different. The inputted data without the approval by the Main Center and/or that by the road management office is to be given the status non-approved, and is not to be used for traffic information/Control.

Figure 6.3 Traffic Event Data Input by Staff in the Main Center

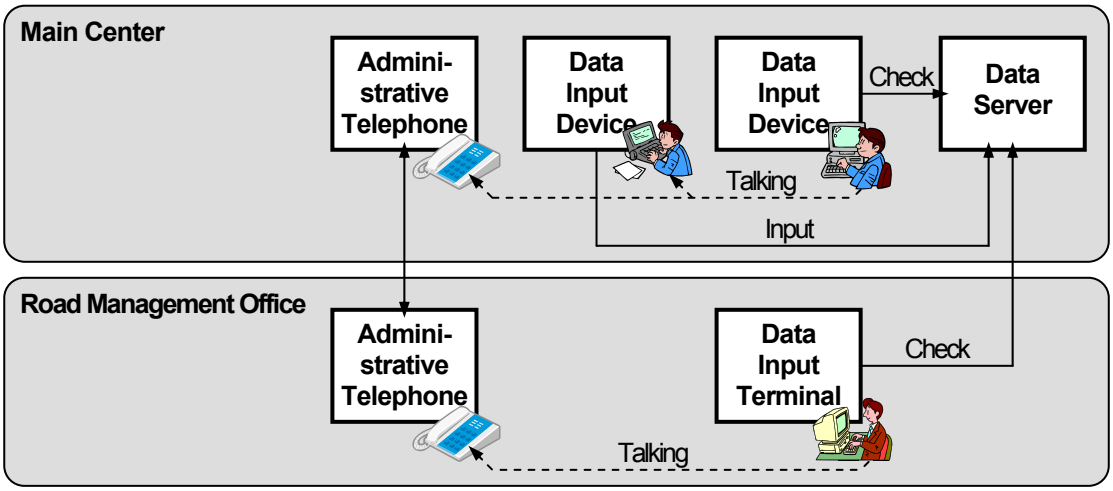


Figure 6.4 Traffic Event Data Input by Staff in Road Management Office

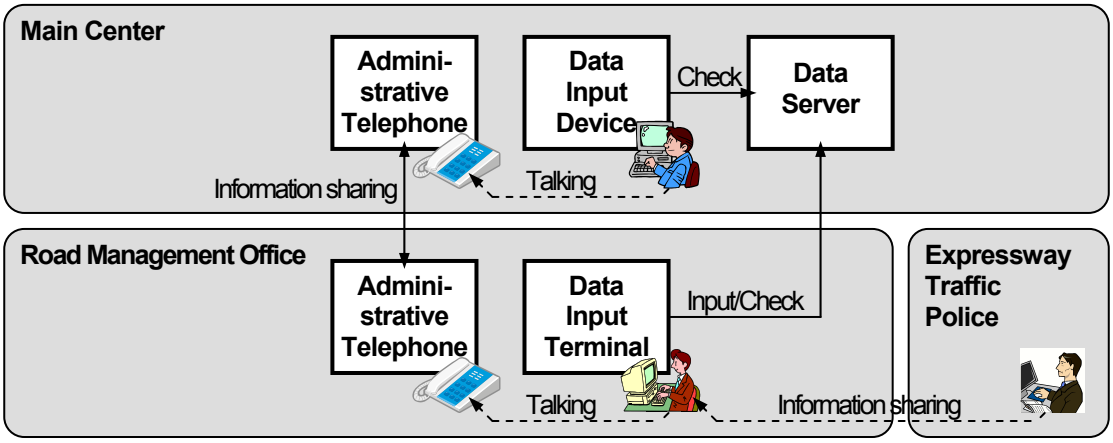
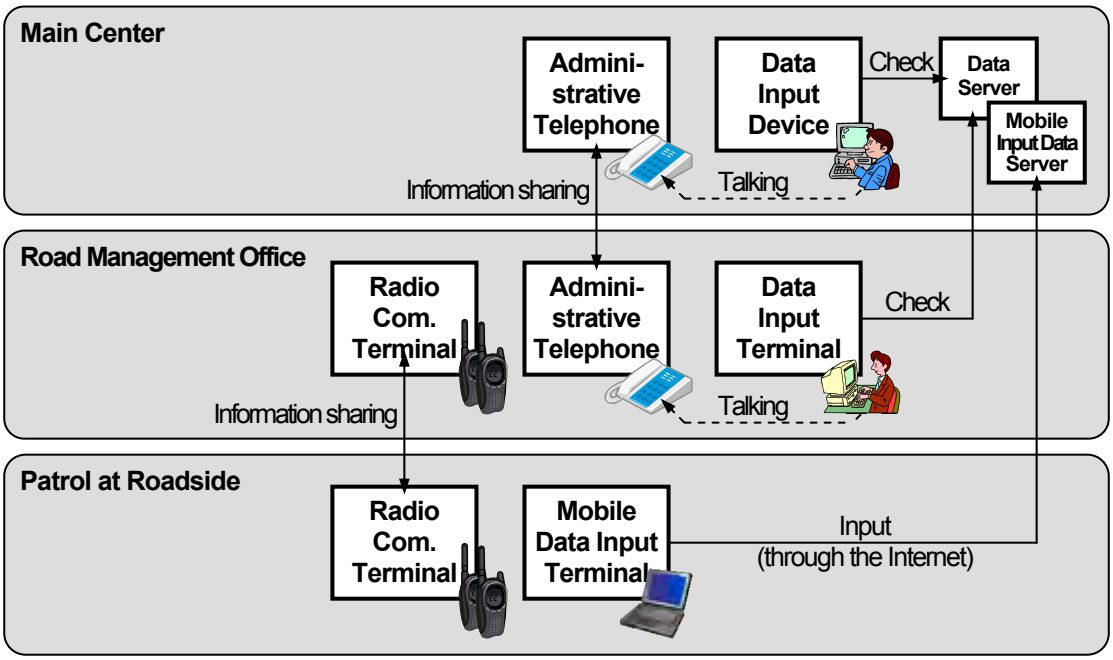


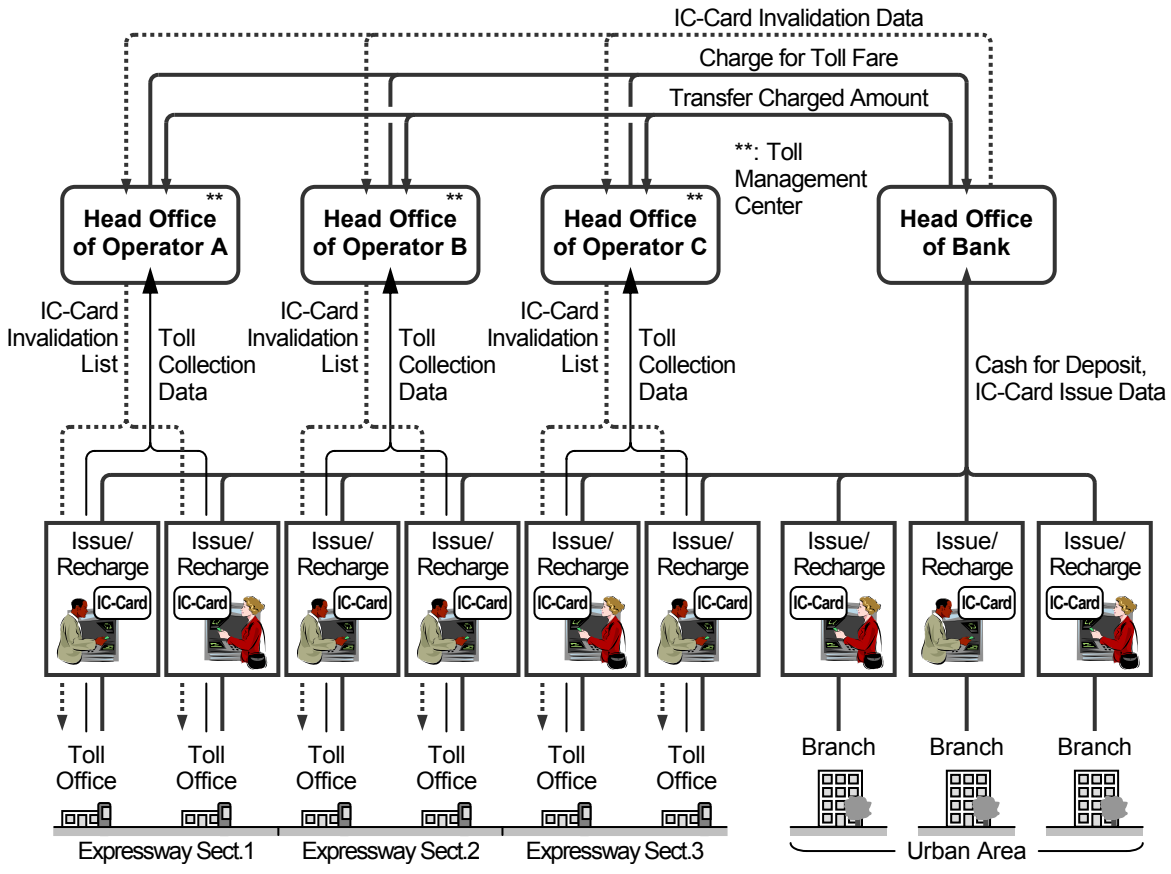
Figure 6.5 Traffic Event Data Input by Patrol Staff at Roadside



4) Procedure of Toll Collection and Settlement

Procedure of data exchange for toll collection and settlement is shown in the figure below. The toll management center is to be set up in the head offices of each road operator.

Figure 6.25 Framework for IC-Card Operation



7. Integration of Roadside Equipment Control

1) Roadside Equipment for Traffic Information/Control

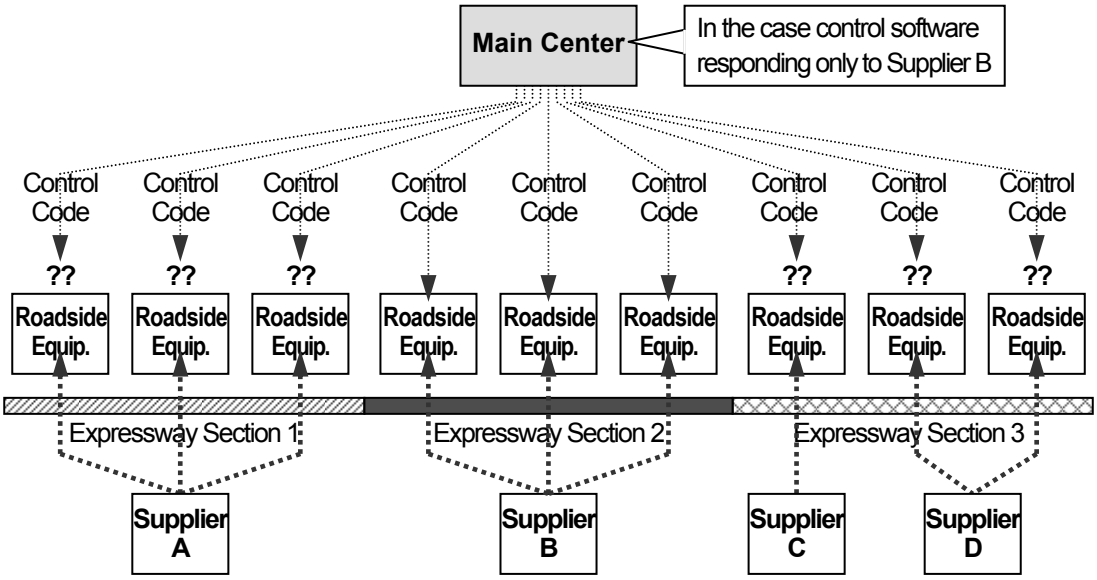
(1) Necessity of Integration of Roadside Equipment Control

As mentioned in Chapter 6, routine monitoring and control of traffic is to be conducted by controlling pieces of roadside equipment under the main center. Actual roadside equipment control is performed through control codes transmitted from the main center.

On the other hand, implementation of roadside equipment is conducted in construction projects of individual road sections based on the expressway construction schedule. Consequently, it is usual that suppliers who install pieces of roadside equipment are different according to the road sections.

But in many cases, control codes are not compatible among the pieces of roadside equipment manufactured by different suppliers. On that account, it is impossible to control all pieces of roadside equipment spread on the different road sections directly by the system installed at the center construction, but countermeasures are necessary to make it possible.

Figure 7.1 Control Codes Incompatible among Different Suppliers



Additionally, a large number of CCTV cameras are to be installed for traffic information/control along with the increase in the total length of expressways. Hence, it is another reason of the necessity of integration of roadside equipment control to hold down rising video image data volume from the CCTV cameras.

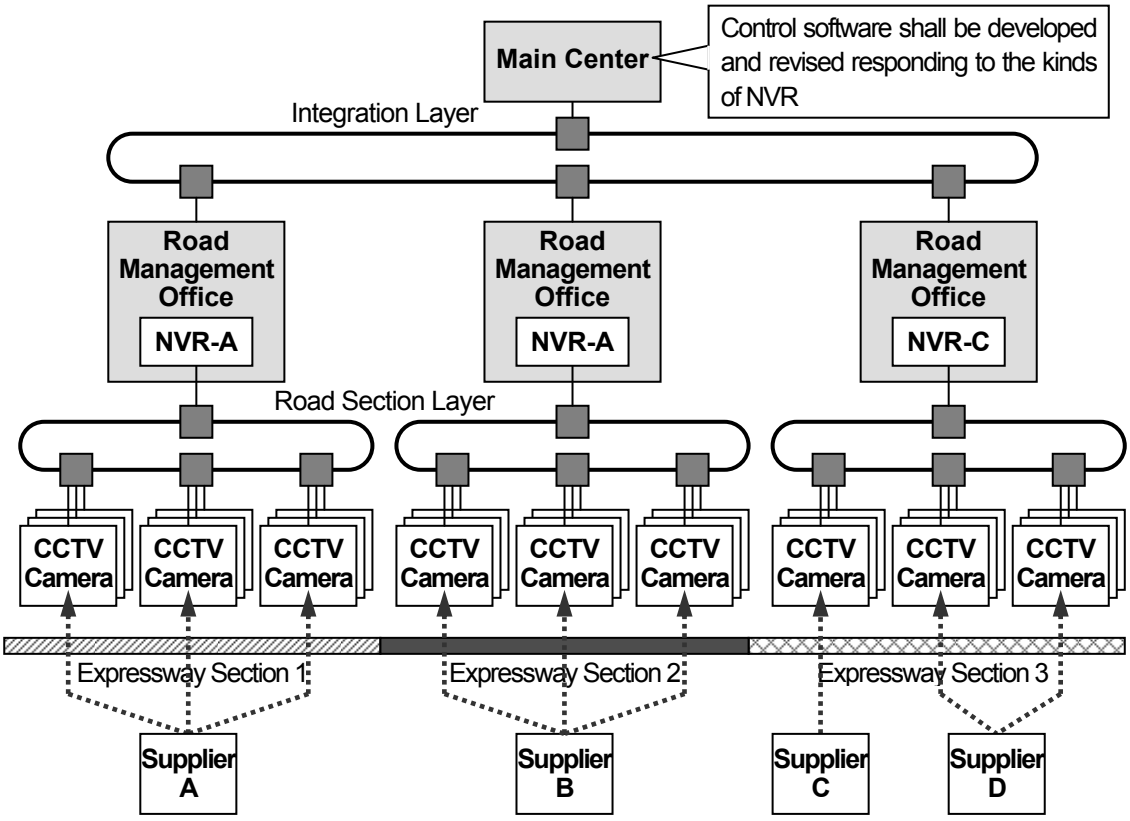
Integration measures for controlling roadside equipment including CCTV camera and VMS are to be discussed in the following pages.

(2) Integration of CCTV Camera Control

NVR (Network Video Recorder) is useful as an integration tool for controlling many CCTV cameras installed by different suppliers. In the Study, NVRs are assumed to be installed at communication nodes or in road management offices as shown in the figure below. Herewith, in the figure, control codes need to be generated only for NVR-A and NVR-C in the Main Center and variety of control codes can be reduced. Concurrently, video image data volume sent to integration layer can be reduced as well.

However, disclosure of control codes is requisite on NVR, and in the case of rising in the number of NVR, control software in the Main Center needs to be revised responding to that.

Figure 7.2 Integration of CCTV Camera Control

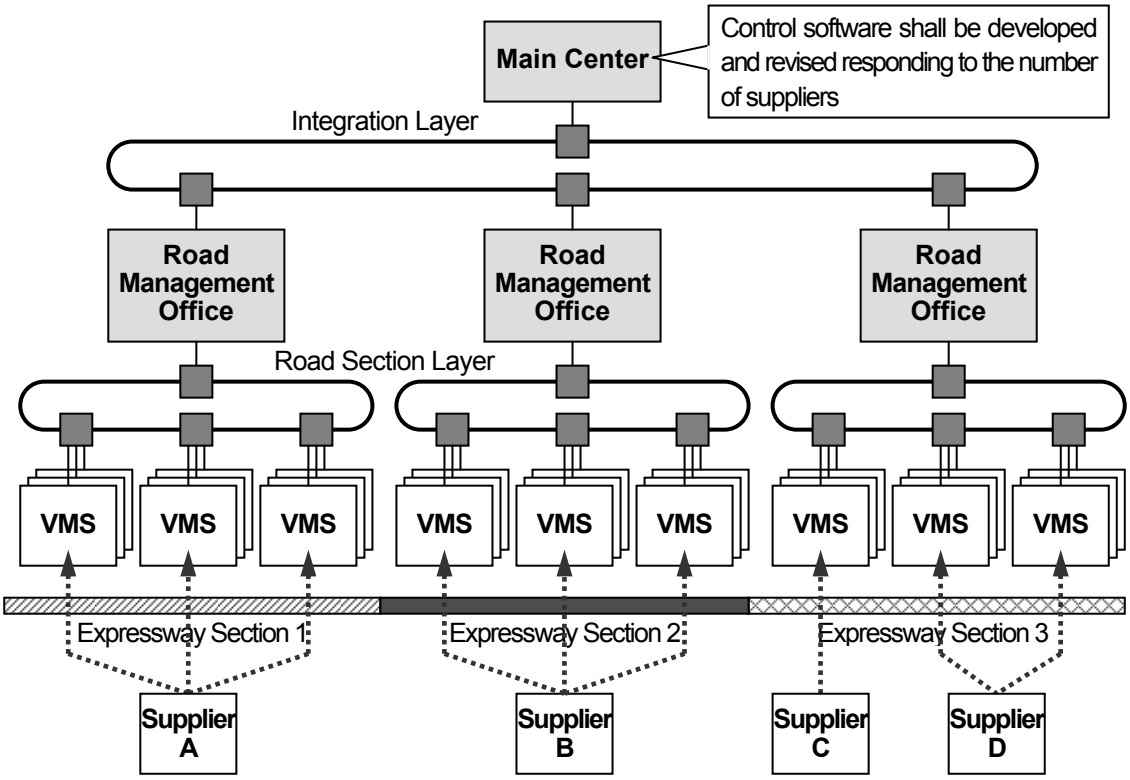


Note, NVR can be installed at communication nodes or in road management offices.

(3) Integration of VMS Control

There is no effective integration tool for controlling many VMSs installed by different suppliers, and control codes need to be generated in the Main Center as many as the number of suppliers who installed VMS. Hence, for VMS installation, suppliers need to be obligated to disclose technological information, and the VMS control software in the Main Center needs to be revised responding to new entrants of suppliers.

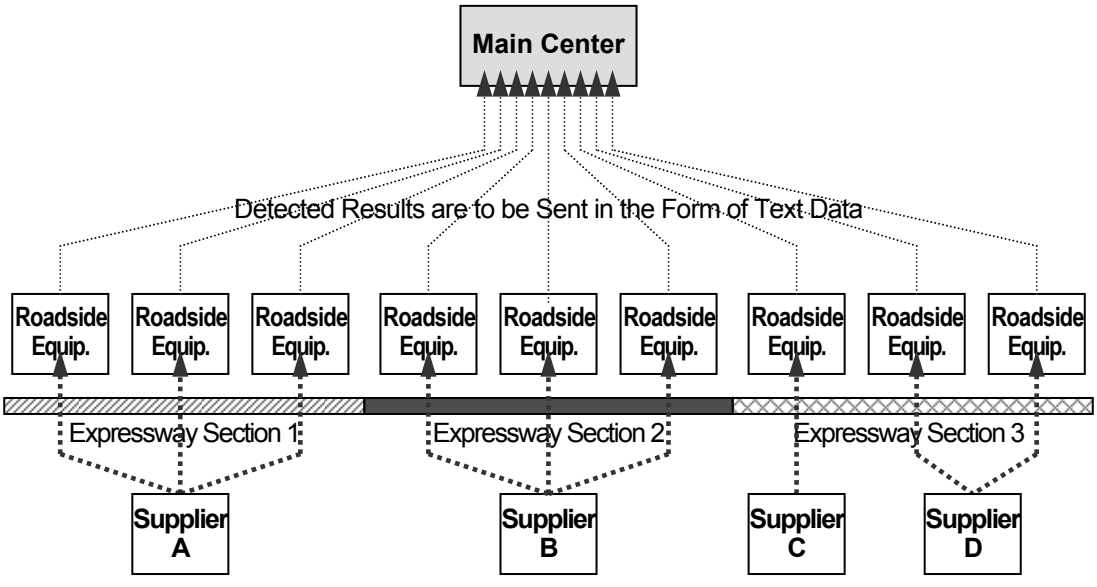
Figure 7.3 Integration of VMS Control



(4) Other Detectors/Sensors

Excluding CCTV camera and VMS, other detectors/sensors need not particular control codes generally. All kinds of detected results are converted to text data and are sent simply to the Main Center. Hence, there are no causes for problems on integration of control, even in the case pieces of equipment are installed by different suppliers.

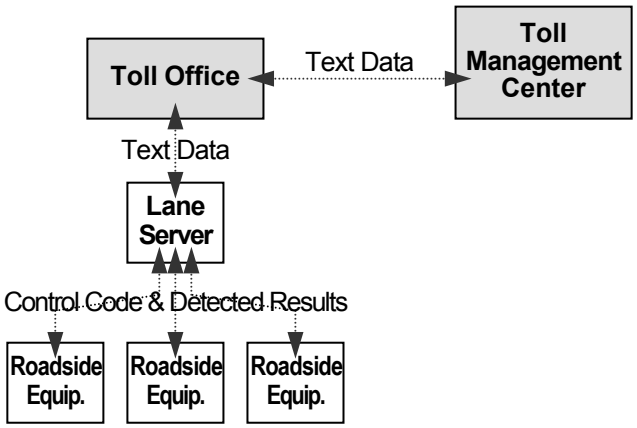
Figure 7.4 Transmission of Detected Results by Detectors/Sensors



2) Roadside Equipment for Automated Toll Collection

Pieces of roadside equipment for automated toll collection are controlled under a lane server and their detected results also managed by the server. Data exchanges with higher level systems in toll office and others are conducted by using text data, so that there are no causes for problems on integration of control.

Figure 7.5 Roadside Equipment Control and Transmission of Detected Results for Automated Toll Collection



3) Roadside Equipment for Overloading Regulation

Similarly to the case of automated toll collection, pieces of roadside equipment for overloading regulation are controlled under a roadside server and their detected results also managed by the server. Data exchanges with higher level systems are conducted by using text data, so that there are no causes for problems on integration of control.

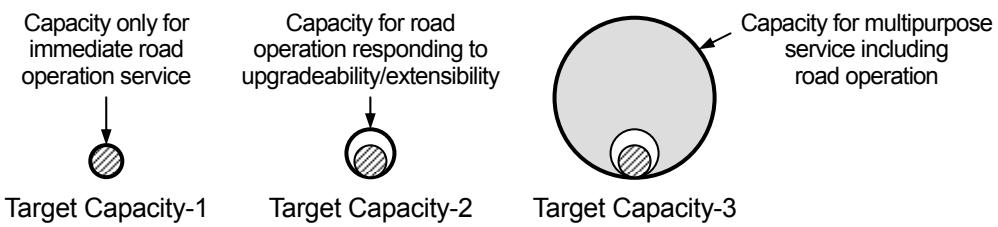
8. Transmission Method

Transmission Capacity

Transmission capacity is one of important factors for selecting suitable transmission method, which is to respond to the scope of the service to be provided through it. Three typical concepts below can be proposed for setting target capacity of the communication network.

- Target capacity-1: only for the immediate road operation service
- Target capacity-2: for the road operation service responding to upgradeability/extensibility
- Target capacity-3: for the multipurpose service including the road operation.

Figure 8.1 Target Capacity of Communication Network for Road Operation



Source: VITRANSS2 Study Team

Generally, the target capacity-2 and the target capacity-3 are suitable for expressway operation using ITS, and IP over SDH and IP over G-Ethernet are to be recommended as suitable transmission methods for the target capacity-2.

However, the communication system is to be used for broader purpose to achieve efficient road operation getting profits through communication system operation. For such purpose, IP over SDH/DWDM and IP over TDM/DWDM are more suitable transmission method. That can realize the concept of target capacity-3.

Bandwidth Guarantee

Telephone is to be used for emergency call and directive any time need arises, and that requires bandwidth guarantee to create a stable link between the initiating and receiving parties. SDH can provide this function and is suitable for the integration layer of the hierarchical communication network for ITS.

Figure 8.2 Concepts of Bandwidth Guarantee and Best Efforts

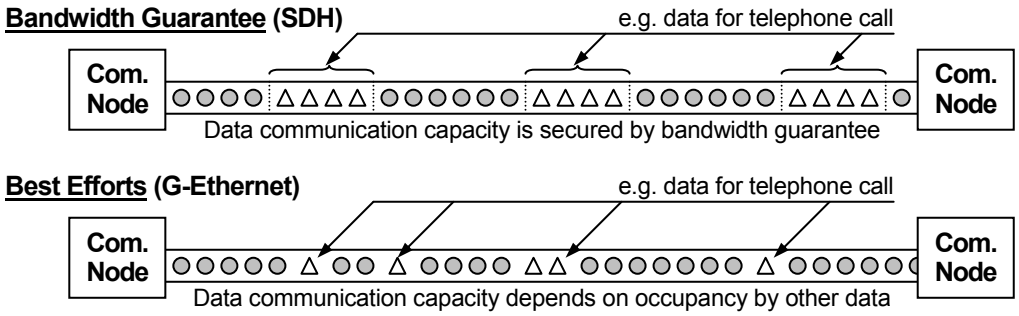


Table 8.1 Comparison of Transmission Methods

	IP over ATM	IP over G-Ethernet	IP over SDH	IP over ATM/DWDM	IP over TDM/DWDM	IP ovrer SDH/DWDM
Communication Node	ATM	Media Converter	SDH	DWDM	DWDM	DWDM
Interface of Ethernet	Available	Available	Available	Available	Available	Available
Maximum Capacity	0.6 Gbps	40 Gbps	40 Gbps	1 Tbps	1 Tbps	1 Tbps
Capacity for Additional Service	Not Sufficient	Not Sufficient	Not Sufficient	Sufficient	Sufficient	Sufficient
Bandwidth Guarantee	Capable	Not Capable	Capable	Capable	Capable	Capable
Network Management	Capable	Not Capable	Capable	Capable	Capable	Capable
Compatibility	Low	High	High	High	Low	High
Implementation Cost	Low	Average	Average	High	High	High
Track Records in Telecom Service	--	--	--	--	Adopted by VNPT	Adopted by Viettel
Grading	Not Suitable	Recommended	Recommended	Not Suitable	Comparable	Comparable

Note, **: leasing of lines is one of the simple additional services using the remaining capacity of communication network.

9. Design Standards of Communication System

9.1 Relevant Regulations and Standards

The clauses in the Draft Standards of Communication System are developed on the basis of or in reference to the following relevant regulations and standards. Some of the relevant regulations and standards need to be applied to specific ITS implementation projects in combination with the clauses in the Draft Standards of Communication System.

(1) ITU-T G.107: The E-model: a computational model for use in transmission planning
(2) ITU-T G.114: One-way transmission time
(3) ITU-T G. 1541: Network performance objectives for IP-based services
(4) ITU-T H.320: Standards for video conferencing
(5) ITU-T H323: Visual Telephone systems and equipment
(6) IEEE 802.3: Ethernet (Carrier Sense Multiple Access with Collision Detection)
(7) ITU-T G.803: Architecture of transport networks based on the synchronous digital hierarchy (SDH)
(8) ITU-T G.703: Physical/Electronical characteristics of hierarchical digital interface
(9) ITU-T G.652: Characteristics of a single-mode optical fibre and cable
(10) ITU-T G.655: Characteristics of a non-zero dispersion-shifted single-mode optical fibre and cable
(11) ITU-T Y1541: QoS Standards for IP Networks and Services
(12) BS 7430: 1998: Code of practice for earthing
(13) BS 6651:1999 Lightning Protection
(14) NEXCO Design Manual
(15) QCVN 9:2010/BTTTT: National technical regulation on earthing of telecommunication stations
(16) QCVN 2:2010/BTTTT: National technical regulation on physical/electrical characteristics of hierarchical digital interfaces
(17) QCVN 3:2010/BTTTT: National technical regulation on bit error rate of digital transmission path
(18) QCVN 7:2010/BTTTT: National technical regulation on optical interfaces for network interconnection equipments relating to the Synchronous Digital Hierarchy
(19) TCN 68-153:1995 : Cable duct and cable connected box Technical standard
(20) TCN 68-254:2006: Telecommunication outside plants Technical specifications

The required standardization criteria in Vietnam and the referential relation with the relevant regulation/standards are summarized in the following table.

<Standardization Criteria>

- National: To be standardized by the Government
- Local: To be standardized by MOT

<Referential relation with the Relevant Regulation/Standards>

- The clause is developed on the basis of ## : the relevant regulations/standards
- The clause is developed originally in reference to ## : the relevant regulations/standards
- The clause is to be applied specific ITS implementation project in combination/reference

with ## : the relevant regulations/standards.

Table 9.1 Standardization Criteria and Referential Relation with Relevant Regulation/Standards

Clause	Standardization Criteria	Referential Relation with Relevant Regulation/Standards
Requirements for Telephone Exchange (9.3) (1)	Local	Developed originally in reference to (14)
Requirements for Center/Roadside (9.3) (2)	Local	Developed originally in reference to (14)
Requirements for Mobile Radio Communication (9.3) (3)	Local	Developed originally in reference to (14)
System Configuration (9.4)	Local	Developed originally in reference to (14)
Communication Traffic: (9.5.1) • Voice Communication • Data and Image Transmission	Local	Developed originally in reference to (14)
Basic System Component : (9.5.2) • National Layer • Integration Layer • Road Section Layer • Terminal Layer • Switching System • Network Management System (NMS) • Transmission Media	Local	Developed originally in reference to (14)
Redundancy (9.5.3)	Local	Developed originally in reference to (14)
Synchronous System (9.5.4)	Local	Developed originally in reference to (14) and (8)
End-to-end Network Performance (9.5.5)	National	Developed originally in reference to (5) and (11)
Interface Requirements (9.5.6)	National	Developed originally in reference to (8) and (16)
Transmission System (9.5.7) • IP/G – Ethernet • IP/G – Ethernet/SDH • IP/G –Ethernet/SDH/ WDM	National	Developed originally in reference to (8)
System Design Of Integration Layer: (9.6.2) • Transmission Capacity • Transmission Distance • Transmission Equipment Component	National.	Developed originally in reference to (8) and (16)
System Design Of Road Section Layer (9.6.3)	National	Developed originally in reference to (8) and (16)

• Transmission Capacity • Transmission Distance • Transmission Equipment Component		
Roadside Equipment Component Layer (9.6.4)	National	Developed originally in reference to (6)
Network Topology (9.7.1)	Local	Developed originally in reference to (6)
Numbering Plan (9.7.2) • Numbering Plan For Directive Telephone • Numbering Plan For Administrative Telephone • Connection Method Of Administrative Telephone.	Local	Developed originally in reference to (14) and ITU-T Recommendation E.164
Major Component of Switching System (9.7.3) • Main Center • Road Management Office	Local	Developed originally in reference to (14)
Circuit Capacity between Switching System (9.7.4)	Local	Developed originally in reference to (14)
Terminal Telephone Set (9.7.5) • Directive Telephone • Administrative Telephone • Emergency Telephone	Local	Developed originally in reference to (14)
Function of NMS (9.8.2) • Monitoring Alert And Notification Function • Resource Management Function • Performance Monitoring Function • Testing Function • Switching Function to redundant Equipment Component **.**	Local	Developed originally in reference to (14)
Monitoring Target of NMS (9.8.3)	Local	Developed originally in reference to (14)
Installation Location of NMS (9.8.4)	Local	Developed originally in reference to (14)
Outline of Emergency Telephone System (9.9.1)	Local	Developed originally in reference to (14)
Installation Criteria of Emergency Telephone at Roadside. (9.9.2)	Local	To be applied in combination/reference with (14), (12), (8) and (16)
System design conditions (9.10.2) • Coverage Area of mobile Radio Communication • Circuit Configuration • Location of Base Station	Local	To be applied in combination/reference with (14)

• Assignment of mobile terminal equipment component • Standby of Radio Equipment component • Leaky coaxial Cable • Backup electric Power Supply Facility • Function relative to Directive communications		
Communication System (9.10.3) • Radio Frequency Band • Communication Method	National	To be applied in combination/reference with (14) and current effective regulations of Ministry of Information and Communication
Speech Quality (9.10.4) • Consideration of speech Quality • Measurement method of input signal strength of receiver and noise intensity.	National	Developed originally in reference to (14), and CISPR standard.
Radio Wave Propagation (9.10.5)	National	Developed originally in reference to (14)
Antenna Supporting Pole (9.10.6)	Local	Developed originally in reference to (14)
Location of Equipment Components (9.11)	Local	Developed originally in reference to (14)
Major Equipment component of SW and Telephones (9.11.1) • SW for Directive communication at Main Center • SW for Others at Main Center • Directive Communication Console • Terminal for Administrative Telephone at Main Center • SW for Directive Communication at Road Management Office • SW for Others at Road Management Office • Terminal for Directive Communication at Road Management Office • Terminal for Administrative Telephone at Road Management Office • Receiving Telephone of Emergency Call • SW for Directive Communication at Toll Office	Local	Developed originally in reference to (14)

• SW for Others at Toll Office • Terminal for Directive Communication at Toll Office • Terminal for Administrative Telephone at Toll Office • Emergency Telephone Set		
Major equipment Component of Transmission (9.11.2) • Transmission Equipment Component at Main Center • Transmission Equipment Component at Road Management Office • Transmission Equipment Component at Node to be installed at Toll Office	Local	Developed originally in reference to (14)
Major equipment component of Radio Communication (9.11.3) • Radio Communication Console at Road Management Office • Base Station for Radio Communication • Terminal for Radio Communication	Local	Developed originally in reference to (14)
Major equipment component of Optical Fiber Cable (9.11.4)	Local	Developed originally in reference to (14)
Notional System (9.12.2)	Local	Developed originally in reference to (14)
Conduit Category (9.12.3)	National	Developed originally in reference to (14), (19) and (20)
Conduit diameter and number of cables (9.12.4)	National	Developed originally in reference to (14), (19) and (20)
Linearity of Main Conduit (9.12.5)	National	Developed originally in reference to (14), (19) and (20)
Electromagnetic induction countermeasure (9.12.6)	National	Developed originally in reference to (14), (19) and (20)
Conduit in earthwork sections (9.12.7) • Embedding location • Installation Depth of conduits and protection soil • Conduit installation indication	National	Developed originally in reference to (14), (19) and (20)
Bridge elevated segment conduit (9.12.8) • Location to install conduit • Embedded conduit • Attached conduit	Local	Developed originally in reference to (14)

• Expansion joint		
Hand hole and manhole (9.12.9) • Required Dimensions of MH/HH • Locations of installation and span • Number indication	National	Developed originally in reference to (14), (19) and (20)
Preparation for Stepwise Implementation (9.13)	Local	Developed originally in reference to (14)

9.2 Definitions of Terms

- **Administrative telephone:** Telephones between the persons in charge of road operation for routine work.
- **Bandwidth:** A data transmission rate; the maximum amount of information (bits/second) that can be transmitted along a channel.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.
- **Conduit:** A piping system used for protection and routing of network cables. Conduit may be made of metal, plastic, fiber, or fired clay. Flexible conduit is available for special purposes.
- **Data Logger**: A device for receiving and storing measurement data from weather sensors
- **Directive Telephone:** Telephones between a officer commanding and the persons in charge of road operation when an incident occur or a traffic restriction is needed.
- **DWDM:** Dense Wavelength Division Multiplexing - an optical technology used to increase bandwidth over existing fiber optic backbone
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **G-Ethernet:** Gigabit Ethernet (GbE or 1 GigE) is a term describing various technologies for transmitting Ethernet frames at a rate of a gigabit per second, as defined by the IEEE 802.3-2008 standard.
- **Integration Layer:** Communication network among one Main Center and its related road management offices
- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods

and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)

- **Leaky Coaxial Cable:** The cable is leaky in that it has gaps or slots in its outer conductor to allow signal to leak into or out of the cable along its entire length.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Media Converter:** A device that converts signals from one media type to that of another
- **Mobile Radio Communication:** Refer to wireless communications systems and devices which are based on radio frequencies, and where the path of communications is movable on either end
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **NMS:** A central set of software programs providing network-based control of disparate hardware elements; also, the software and hardware used in bridging, routing and other network functions.
- **NVR:** A completed hardware box or software only that receives digital video streams and images from network cameras and records them onto a data storage device. Recording, playback, and panning, tilting, zooming for PTZ cameras is controlled remotely via a network computer.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Road Section Layer:** Communication network among one road management office and its related nodes
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.
- **Telephone Exchange:** This functional package allows to send an emergency call and a request for help to the Main Centers and road management offices at an incident occurrence by telephones installed at roadsides, rest areas and tunnel sections and by administrative telephones installed at the toll offices, and allows to send directives to the units concerned at an instant for clearing incidents and enforcing traffic regulations.
- **Terminal Layer:** Communication network between one node and its related SW-HUB which is connected with roadside equipment components and weather sensors
- **Toll Office:** A toll office is located at a tollgate, which includes two or more tollbooths, and is in charge of toll collection.

- **Transmission Method:** The method of sending, propagating and receiving an analogue or digital information signal over a physical point-to-point or point-to-multipoint transmission medium, either wired, optical fiber or wireless. Transmission technologies and schemes typically refer to physical layer protocol duties such as modulation, demodulation, line coding, equalization, error control, bit synchronization and multiplexing.
- **UHF:** Ultra high frequency (UHF) designates a range of electromagnetic waves with frequencies between 300 MHz and 3 GHz (3,000 MHz), also known as the decimetre band or decimetre wave as the wavelengths range from one to ten decimetres (10 cm to 1 metre)
- **VHF:** VHF (Very high frequency) is the radio frequency range from 30 MHz to 300 MHz
- **Video Controller**: A video card, video adapter, graphics-accelerator card, display adapter or graphics card is an expansion card whose function is to generate and output images to a display.
- **WDM:** Wavelength-Division Multiplexing (WDM) is a technology which multiplexes a number of optical carrier signals onto a single optical fiber by using different wavelengths (colours) of laser light. This technique enables bidirectional communications over one strand of fiber, as well as multiplication of capacity.

9.3 Requirements

1) Requirements for Telephone Exchange

- System shall be capable of receiving notification of incident occurrence promptly from road user and of identifying the user's location on the expressway.
- System shall be capable of receiving report of current traffic conditions on the expressways and of incident occur promptly from the operators in the toll management office and the rest area.
- System shall be capable of switching and connecting the interactive voice and emergency directions between Main Center, road management offices and toll management offices.
- System shall be capable of sending directives to the units concerned at an instant and on a top-priority at any time for clearing incidents and enforcing traffic regulations.
- System shall be capable of receiving notification of incident occurrence generally within 20 minutes, and sending road operation vehicles to the incident site generally within 1 hour.
- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.
- In the case, part or whole of procurement and operation & maintenance related to the

telephone exchange is to be outsourced to another organization such as telecommunications carrier or operator, it should be outsourced based on the mutually agreed document such as contract with making clear system demarcation point and each responsibility.

2) Requirements for Center/Roadside Communication

- System shall be capable of exchanging data including video image among roadside equipment on the expressways, the Main Center and road management offices.

- System shall be capable of transmitting interactive voice communications between Main Center, road management offices and toll management offices.

- System shall be capable of transmitting directives to the units concerned at an instant and on a top-priority at any time for clearing incidents and enforcing traffic regulations.

- System shall be capable of identifying location of problems that occurrence on communication network and of recovering them by automatically switching network.

- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.

- In the case, part or whole of procurement and operation & maintenance of the center/roadside communication is to be outsourced to other organization such as telecommunications carrier or operator, it should be outsourced based on the mutually agreed document such as contract with making clear system demarcation point and each responsibility.

3) Requirements for Mobile Radio Communication

- System shall be capable of receiving report of current traffic conditions on the expressways and of incident occur promptly from the operators in the toll office and the rest area.

- System shall be capable of sending directives to the units concerned at an instant for clearing incidents and enforcing traffic regulations.

- System shall be capable of receiving notification of incident occurrence within 20 minutes, and sending road operation vehicles to the incident site within 1 hour.

- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.

- The license required for the system shall be obtained from Radio Frequency Directorate of Ministry of Information and communication, and necessary cost shall be disbursed.

9.4 System Configuration

Figure 9.1 System Configuration for Telephone Exchange

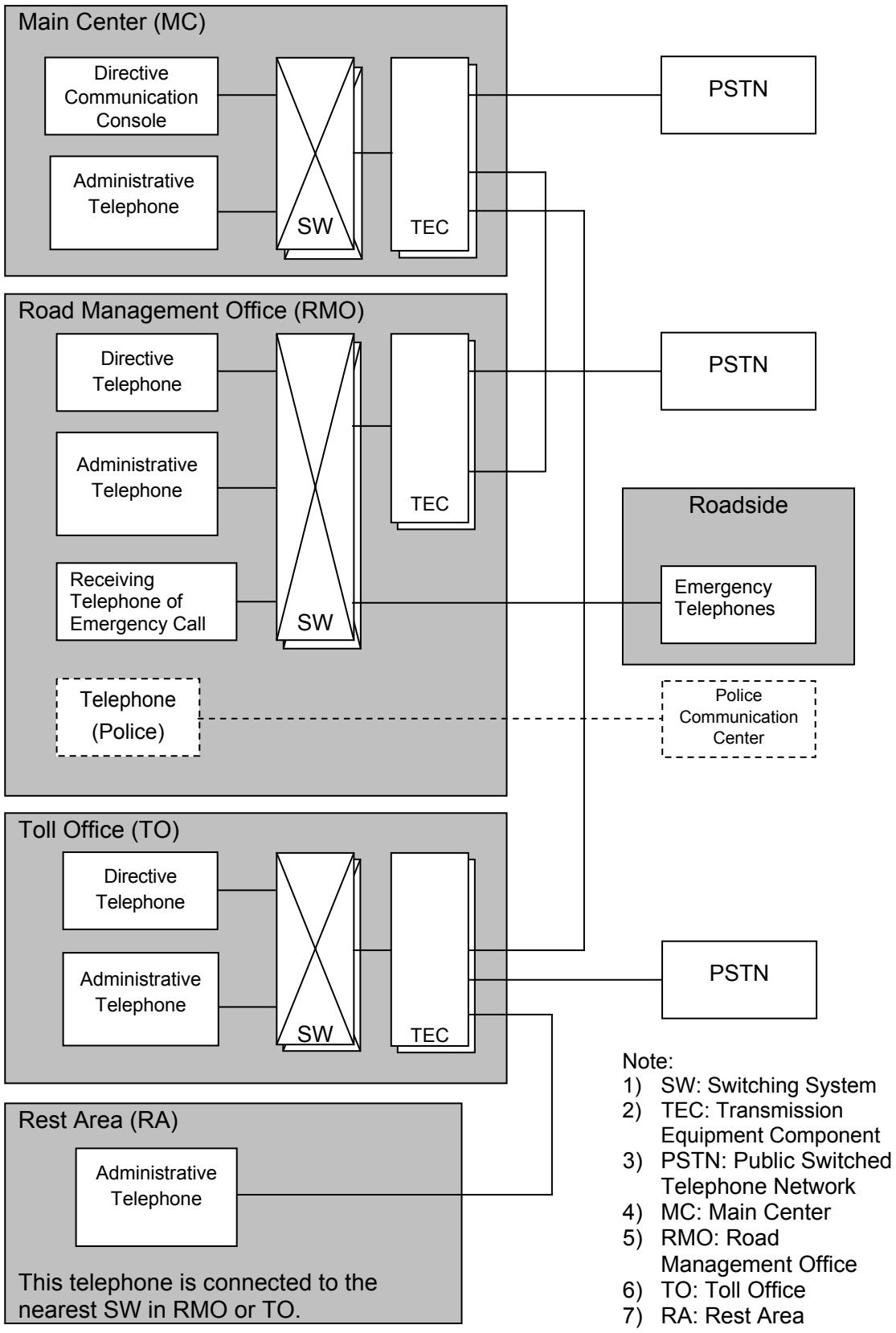
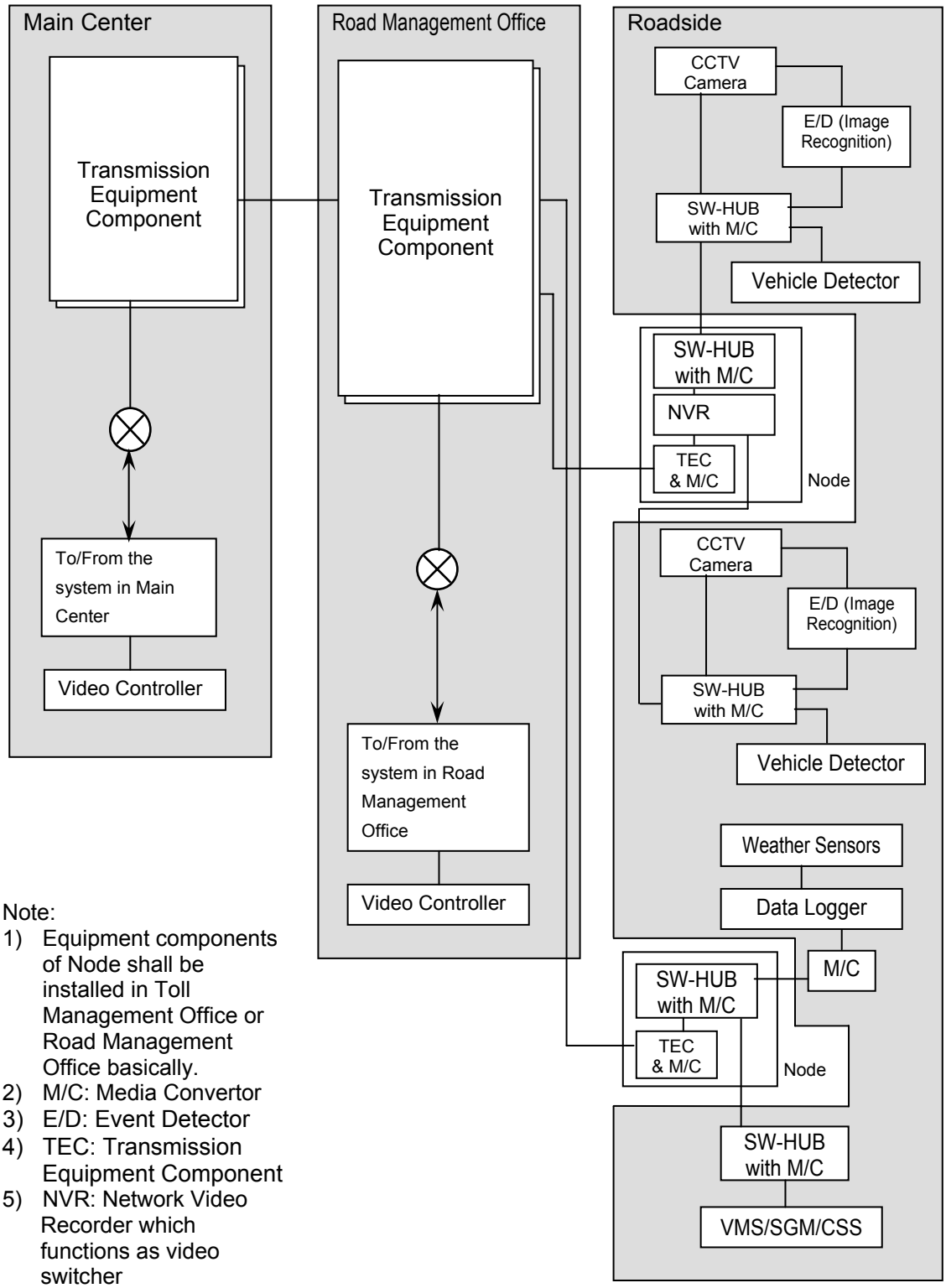
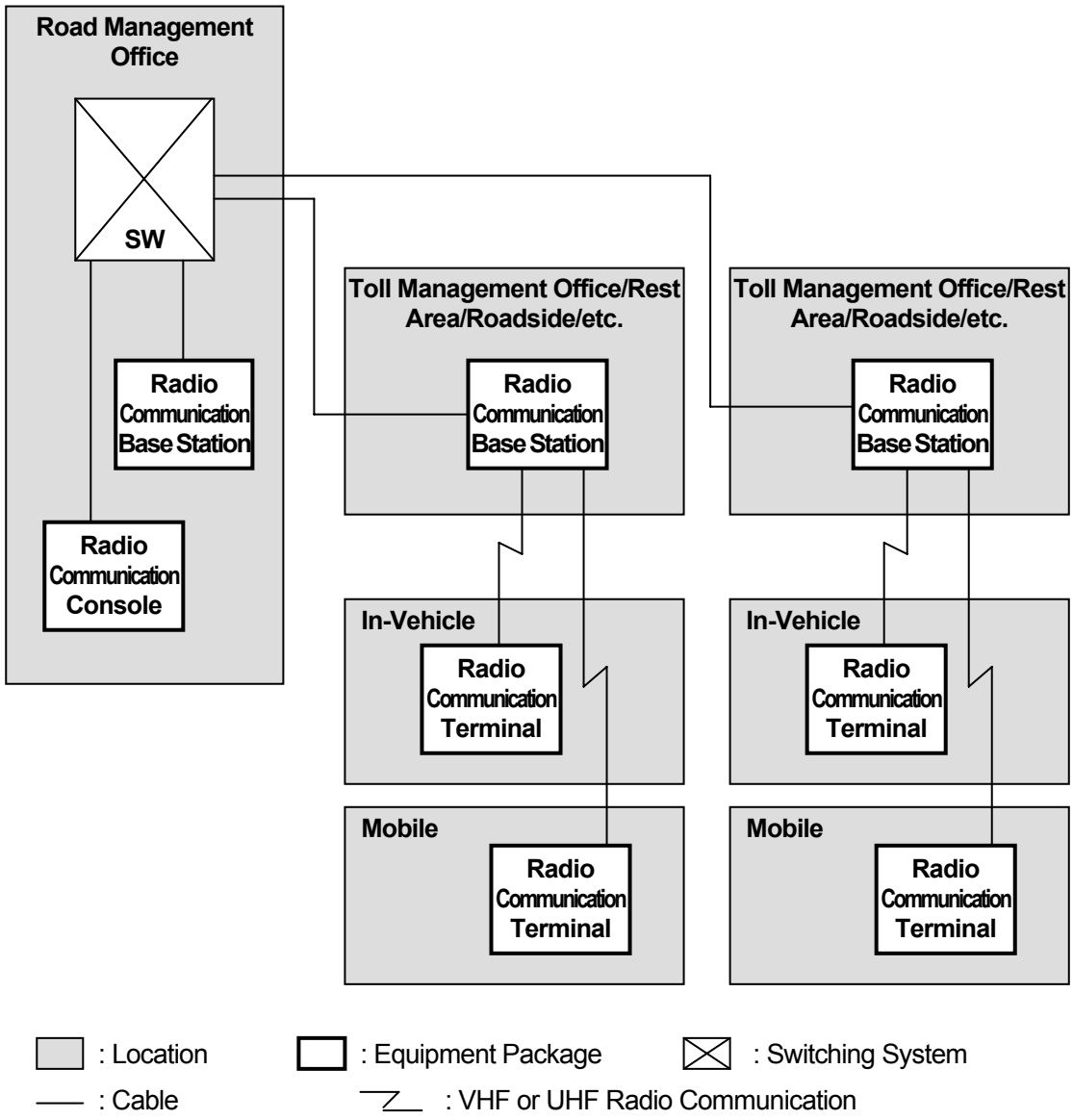


Figure 9.2 System Configuration for Center/Roadside Communication



Note:
1) Equipment components of Node shall be installed in Toll Management Office or Road Management Office basically.
2) M/C: Media Convertor
3) E/D: Event Detector
4) TEC: Transmission Equipment Component
5) NVR: Network Video Recorder which functions as video switcher

Figure 9.3 System Configuration for Mobile Radio Communication



9.5 Basic Concept of the Switching and Transmission Systems

9.5.1 Communication Traffic

There are following communications traffic necessary for expressway management.

1) Voice Communication

(1) Directive communication
(2) Administrative telephone
(3) Emergency telephone

2) Data and Image Transmission

(1) Image transmission monitored by CCTV camera
(2) Serial types of data obtained by roadside equipment components such as vehicle detectors and weather sensors.
(3) Several types of data which is to be transmitted to roadside equipment components such as VMS, SGM, CSS

9.5.2 Basic System Component

The communications system is composed of the following layers and components:

(1) National Layer

Communication network among the Main Centers

(2) Integration Layer

Communication network among one Main Center and its related road management offices

(3) Road Section Layer

Communication network among one road management office and its related nodes

(4) Terminal Layer

Communication network between one node and its related SW-HUB which is connected with roadside equipment components and weather sensors

(5) Switching System

The system which is to be realized required switching function for directive communication, administrative telephone, and emergency telephone.

(6) Network Management System (NMS)

The system to be capable of monitoring the operation conditions of communication network, capable of monitoring the connection conditions of various types of equipment components, and when the fault occurs, it shall be detected immediately and it shall be capable to notify it to the operating staff.

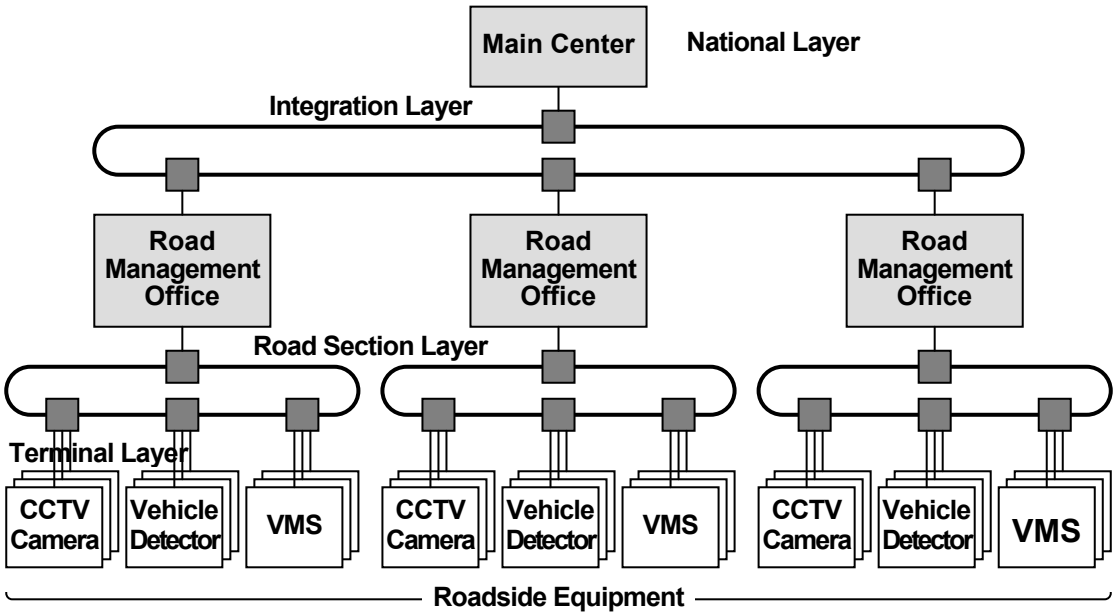
(7) Transmission Media

The media realizing voice communication and data transmission between equipment components in various network layers.

The optical fiber cable is to be applied for integration layer and road section layer. As for the terminal layer, the optical fiber cable is to be applied for transmitting relatively far equipment components, however if the equipment component location is within the coverage of metal cable, the metal cable is applied.

The above component is shown in the following figure.

Figure 9.4 Hierarchical Network Structure



9.5.3 Redundancy

Redundancy is to be applied for the equipment components and optical fiber cables of integration layer, road section layer; however, the equipment components and cables of terminal layer is not required redundancy.

9.5.4 Synchronous System

The network synchronous system is to be applied to the equipment components of the integration layer. The network synchronous is realized by providing one clock by authorized organization, and other equipment components shall be followed the provided time by this clock. If the network of telecommunications carrier is to be utilized, the clock of the connecting network shall be subject to the carrier's clock.

9.5.5 End-to-End Network Performance

(1) Bit error rate for End-to-End: Max. 1×10^{-6}

(2) Transmission loss of directive communication from directive communication console to directive telephone: within 18 dB

(3) Transmission loss of emergency telephone from roadside telephone set to receiving telephone of emergency call to be installed in RMO: within 22dB

(4) Transmission loss of administrative telephone for End-to-End: within 26dB

(5) Connection loss of directive communication and emergency telephone shall not be allowed.

(6) Connection loss of administrative telephone: Max. 10%

(7) Network performance of voice communication shall be complied with the conditions of Class 0 specified in ITU-T Y1541.

9.5.6 Interface Requirements

The interface between various equipment components should be efficient and economical provided that interface requirements of the equipment components to be connected are fulfilled.

9.5.7 Transmission System

There are several transmission systems to be applied for each network layer shown in the item 8.2 above. Basic concept is TCP/IP and there are alternatives for lower layers. The sample combination is shown below;

Figure 9.5 Alternatives of Transmission System

<table>
<tr><td>(1)</td><td>(2)</td><td>(3)</td></tr>
<tr><td>IP</td><td>IP</td><td>IP</td></tr>
<tr><td rowspan="3">G-Ethernet</td><td>G-Ethernet</td><td>G-Ethernet</td></tr>
<tr><td rowspan="2">SDH</td><td>SDH</td></tr>
<tr><td>WDM</td></tr>
</table>

(1) IP/G-Ethernet

This combination is assumed to be applied to the terminal layer between terminal equipment components and nodes. However, it is preconditions that each sensor or detector data is converted to the transmittable data over Ethernet in the equipment component such as data logger or lane server before transmitting to the corresponding switching hub of the roadside

equipment components.

(2) IP/G-Ethernet/SDH

This combination is assumed to be applied to the road section layer between road management office and nodes, the integration layer between the Main Center and road management office, and the national layer between the Main Centers.

(3) IP/G-Ethernet/SDH/WDM

If the estimated traffic is huge, and transmission capacity is required to upgrade, one alternative approach is introduction of WDM.

In general data collection is originated from upper layer server or equipment component, and stored data in lower layer server or equipment component are to be fetched by upper layer server.

If the roadside equipment component is required to be controlled by other equipment component in the Main Center or road management office, device driver or other necessary information is required to disclose for system integration whenever necessary.

9.6 Transmission System Design

9.6.1 Outline of Transmission System

Transmission system is composed of the following four (4) layers;

(1) National layer
(2) Integration layer
(3) Road section layer
(4) Terminal layer

The system design concept of ach layer is shown below.

9.6.2 System Design of Integration Layer

The appropriate transmission system should be applied as integration layer taking the following conditions into account.
(Under consideration of more appropriate system such as SDH or others)

1) Transmission Capacity

The transmission capacity should be considered based on the following communications traffic categories, and appropriate capacity should be selected taking economic efficiency into account.

(1) CCTV camera image to be installed by each road management office

(2) Various data such as traffic volume, vehicle speed, precipitation, and wind speed obtained by vehicle detector and weather sensor

(3) Various data to be disseminated through VMS, SGM, and CSS

(4) Interactive voice communication such as directive communication, administrative telephone and emergency telephone

Each traffic volume is estimated based on the assumption shown below. In this process, upstream traffic flow is mainly checked because monitoring images obtained by CCTV camera and transmit it to Main Center are the major traffic.

(a) Communication traffic for monitoring image obtained by CCTV camera is required approximately 2Mbps.

(b) In Road Section Layer, approximately 30 CCTV camera is assumed to be installed for one node. (For every two (2) km, CCTV camera is assumed to be installed for monitoring purpose. In addition to this, another cameras for vehicle detection purpose is to be installed. For 80km road section, total number of cameras will be approx. 180.)

(c) It is assumed that six (6) nodes will be established in one (1) road management office which manages approx. 80 km expressway section. (Each node is assumed to be installed at toll office. It is also assumed that approx. six (6) toll offices will be established along the 80 km expressway section.)

(d) Maximum number of simultaneous video image monitoring at the Main Center will be assumed approx. 20 locations. Therefore introduction of network video recorder (NVR) at nodes and video controller at the Main Center in order to reduce the traffic volume is considered reasonable and proper instead of transmitting whole image transmitting to the Main Center.

(e) Data communication traffic originated by vehicle detector and weather sensor is rather small compared with CCTV camera, and those approximate communication traffic is shown in the following table.

(f) The interactive voice communication traffic is assumed approximately equivalent to 100 circuits for one (1) road management office including its related toll offices.

The above conditions are summarized in the following table.

Table 9.2 Communication Traffic (Upstream)

No.	Traffic Category	Traffic per One Node	Traffic per Road Management Office	Traffic per One Main Center
1	Images obtained by CCTV Camera	60 Mbps (for 30 cameras)	12 Mbps(in case 6 recorded video images are selected)	40 Mbps (for 20 cameras)
2	Vehicle Detectors	Approx. 64 kbps	Approx. 0.384 Mbps	Approx. 7.68 Mbps
3	Weather Sensors	Approx. 10 kbps	Approx. 0.02 Mbps	Approx. 0.4 Mbps
4	Voice Communication	－	Approx. 6.4Mbps	Approx. 128Mbps
	Total		Approx. 20 Mbps	Approx. 180 Mbps

The communication traffic from one (1) road management office is estimated approx. 20 Mbps. One (1) Main Center will manage approx. twenty (20) road management offices in future, and maximum twenty (20) locations will be monitored at the Main Center using video controller and NVR. As a whole, approx. 180 Mbps communication traffic is estimated in Integration Layer.

As for the downstream traffic, the required traffic categories are voice and data for VMS, SGM, and CSS, similar traffic volume check is necessary to select the appropriate system.

2) Transmission Distance

The transmission distance of the optical fiber cable is limited based on the receivable optical signalling level, and it is different from the optical cable characteristics, however it is recommended to prepare the plan to install one repeater in 40 km transmission distance. The repeater is recommended to install indoors such as toll office.

As for the node, it is also recommended to install in the toll office where road management staff is working continuously; however, if there is no toll office where it is required, it is necessary to install in the box or cabinet with air conditioning function.

3) Transmission Equipment Components

The appropriate transmission equipment component is required to be applied based on the transmission system

9.6.3 System Design of Road Section Layer

The appropriate transmission system should be applied as road section layer taking the following conditions into account.
(Under consideration of more appropriate system among SDH, Ethernet, etc)

1) Transmission Capacity

Reference is made to Clause 9.6.2, and appropriate capacity is recommended to select based on the forecasted communication traffic.

2) Transmission Distance

The transmission distance of the optical fiber cable is limited based on the receivable optical signalling level, and it is different from the optical cable characteristics, however it is recommended to prepare the plan to install one repeater in 40 km transmission distance.
The node is recommended to install in the building such as toll office as long as possible in the system design of the road section layer. The repeater is also recommended to install indoors.

3) Transmission Equipment Components

The appropriate transmission equipment component is required to be applied based on the transmission system.

9.6.4 Roadside Equipment Component Layer

As for the system design of roadside equipment component layer, what kind of data is to be transmitted is to be specified in each related general specifications particularly between various roadside equipment components and SW-HUB to be connected directly. As for the section between the said SW-HUB and node, the Ethernet connection is supposed to be applied basically.

9.7 Switching System Design

9.7.1 Network Topology

Network topology for interactive voice communications are shown below.

Table 9.3 Network Topology for Interactive Voice Communications

Interactive Voice Communicaition	Objective Networks	Network Topology
Directive Telephone	Among Main Centers	Mesh (Full Connection)
	Between MC and RMO, Between MC and TO	Star
Emergency Telephone	Between RMO and Telephone set	Tree
Administrative Telephone	Among Main Centers	Mesh (Full Connection)
	Between MC and RMO	Conbination of Star and Ring
	Between RMOs	Ring
	Between RMO and TO, and Between RMO and RA	Star

Note: MC: Main Center, RMO: Road Management Office, TO: Toll Office, RA: Rest Area

9.7.2 Numbering Plan

There are two different numbering plan of the switching network for directive telephone and administrative telephone including emergency telephone shown as follows. The code allocation such as office code is required to determine referring the following samples.

As for the connection of the road management offices which are implemented prior to effectiveness of this Design Standard, the connection will be made through the public switched telephone network for temporary basis, and when the timing of equipment component renewal, it is recommended to prepare the specific plan how to connect those road management offices.

1) Numbering Plan for Directive Telephone

Directive Telephone number is composed of the following five (5) digits. The directive telephone is effective only in the area managed by a Main Center. Therefore there is no number to distinguish the other Main Center Management Region.

L AB CD

Where

L: Directive class (The specific number is shown as sample.)

8: Downstream directive from directive communication console in the Main Center to individualized directive telephone.

6: Downstream directive from directive communication console in the Main Center to all directive telephones.

3: Upstream directive from directive telephone in the road Management office to directive communication console in the Main Center

AB: Office code for the Main Center and road management offices (The specific number is shown as sample.)
Specific number is allocated for the Main Center and individual road management Offices. The number is recommended to utilize commonly with administrative telephone number. The sample is shown below;
20: Ha Noi Main Center
21 – 39: Road management offices under management of Ha Noi Main Center
40: Da Nang Main Center
41 – 69: Road management offices under management of Da Nang Main Center
60: Ho Chi Ming Main Center
61 – 79: Road management offices under management of HCM Main Center

C: Interchange Number
The Interchange number is allocated for the expressway section managed by one (1) road management office. The number is recommended to allocate from north or east to south or west in ascending order.

D: Duty category Number (The specific number is shown as sample.)
1: Road management office (Administrative office)
2: Operator in charge who monitor the traffic condition
3: Traffic management (manager of patrolling crew and vehicles)
4: Toll Office
5: Information desk (it will be required when service area is developed.)
6-9: spare number

2) Numbering Plan for Administrative Telephone

Administrative telephone number is composed of the following seven (7) digits.

A B CD EFG

Where

A: Calling category (The specific number is shown as sample.)
1: Reserved as special number
8: Outgoing call number for other Main Centers Management Region
9: Reserved for maintenance use
0: Outgoing call connecting to PSTN

B: Number for the Main Center Management Region (The specific number is shown as sample.)
2: Ha Noi Region
4: Da Nang Region
6: Ho Chi Ming Region

CD: Office code for the Main Center and road management offices (The specific number is shown as sample.)

Specific number is allocated for the Main Center and individual road management offices. Code C is able to allocate from 2 to 7 except for 0, 1, 8,9, and Code D is able to allocate from 0 to 9 respectively. The applicable number for code C and D is shown in the following tale. One road management office will manage approx. 80 km expressways section, and in future, the number of road management offices will be estimated approx. 60. Therefore the code CD from 20 to 79 is considered to be enough to cover future developed conditions. The allocatable number as CD code is shown in the following table.

Table 9.4 Numbering Plan for Administrative Telephone

C\D	0	1	2	3	4	5	6	7	8	9
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										

Allocatable Area of CD Code

The sample CD code is shown below;
20: Ha Noi Main Center
21–39: Road management offices under management of Ha Noi Main Center
40: Da Nang Main Center
41-69: Road management offices under management of Da Nang Main Center
60: Ho Chi Ming Main Center
61–79: Road management offices under management of HCM Main Center

E: Interchange Number

The Interchange number is allocated for the expressway section managed by one (1) road management office. The number is recommended to allocate from north or east to south or west in ascending order.

FG: Extension Number

Extension number required for one road management office including its related toll office and emergency telephone is allocated.

3) Connection Method of Administrative Telephone

The administrative telephone should be capable to connect in the following method;

(1) Call within one road management office
It should be capable to connect by sending the number of EFG.

(2) Call between the Main Center and road management office or between road management

offices under one Main Center Management Region
It should be capable to connect by sending the number of CDEFG.

(3) Call from a Main Center to another Main Center or between road management offices under different Main Centers
It should be capable to connect by sending the number of ABCDEFG.

(4) Call to PSTN
It should be capable to connect by sending the number of 0+(the number of PSTN).

9.7.3 Major Component of Switching System

Switching system is composed of directive network and administrative network including emergency telephone respectively. The standard component of the system is shown in the following table;

(1) Main Center

Table 9.5 Equipment Components for Main Center

Equipment Component	Quantity
Switching Equipment Component for Directive Communication	One (1) Set
Switching Equipment Component for Administrative Telephone	One (1) Set
Line Control Unit	One (1) Set
Directive Communication Console	The number of Directive Communication Console in the Traffic Control Room in Main Center should be decided taking total expressway management kilometres and traffic volume into account. It is noted that at least two consoles should be installed for operation and back up.

(2) Road Management Office

Table 9.6 Equipment Components for Road Management Office

Equipment Component	Quantity
Switching Equipment Component for Directive Communication	One (1) Set
Switching Equipment Component for Administrative Telephone	One (1) Set
Line Control Unit	One (1) Set

9.7.4 Circuit Capacity between Switching Systems

Circuit capacity between switching equipment components should be designed properly and efficiently under the conditions specified in this document.

9.7.5 Terminal Telephone Set

1) Directive Telephone

The number of telephone set and installation location of directive telephone is shown in the following table.

Table 9.7 Location/Quantity of Directive Telephones

Location	Q'ty	Remarks
Road Management Office		
Administrative Office	1	
Operator in charge who monitor the traffic condition	1	
Manager desk for patrol crew and vehicles	1	
Traffic Police Office	1	
Toll Office		
Manager	1	
Service Area		Assumption of future development condition
Information Desk	2	To be installed one set for each direction.

The directive telephone set shall be capable to notify it to the receiver as directive by buzzer or flashing light.

2) Administrative Telephone

The number of telephone set and installation location of administrative telephone is shown in the following table.

Table 9.8 Location/Quantity of Administrative Telephones

Location	Q'ty	Remarks
Main Center		
Administrative Office	1+N	N: Except for the manager, one set per two staff is to be palnned.
Traffic Control Room	3	
Facility Control Room	3	
Communication Equipment Component Room	2	
Rest Area in Main Center	2	
Traffic Police Office	2	
Road Management Office		
Administrative Office	1+N	N: Except for the manager, one set per two staff is to be palnned.
Traffic Condition Monitoring Room	2	
Manager desk for patoroling staff and vehicles	1	
Traffic Police Office	1	
Rest Area in Road Management Office	2	
Toll Office		
Administrative Office	1+N	N: Except for the manager, one set per two staff is to be palnned.
Rest Area in Road Management Office	2	
Service Area		Assumption of future development condition
Administrative Office	2	To be installed one set for each direction.
Information Desk	2	To be installed one set for each direction
Rest Area for staff	2	To be installed one set for each direction

3) Emergency Telephone

Emergency telephone is to be installed as follows:

Table 9.9 Location/Quantity of Emergency Telephones

Location	Q'ty	Remarks
Road Management Office		
Receiving Telephone of Emergency Call (Operator Desk who monitor the traffic condition)	1	
Roadside	N	N: Basically one set for every 2km interval. It is the same condition for both sides.

9.8 Network Management Systems (NMS)

9.8.1 Outline of NMS

Operation condition of the communication network is to be monitored by introducing Network Management System (NMS).
The outline of NMS is summarized in the following table.

Table 9.10 Outilnes of NMS

Network Layer	Location of NMS Display	Supervision Framework	Responsible Organization of Operation and Maintenance
Integration Layer	Communication Equipment Components Room in Main Center	Round the Clock	Main Center
Road section and Terminal Layer	Monitoring Room in Road Management Office	Monitoring Alert	Road Management Office

9.8.2 Functions of NMS

NMS is required to equip the following functions:

(1) Monitoring Alert and Notification Function

Function for detection of origination and recovery of various types of alert and monitoring transmission system and route is required. Recording function of alert log is necessary, and displaying/printing out function is also required whenever required. Notification function to the operating staff by buzzer or flashing light is also required.

(2) Resource Management Function

Function of monitoring operation condition of equipment component and transmission system/route which are connected to the network are required. When system configuration is modified, the function of adding system, registration and modification of the equipment component should be also equipped. During the replacement of the equipment component, it should be distinguished “Operating Condition” and “under installation”.

(3) Performance Monitoring Function

The function to monitor the communication traffic on the network is required.

(4) Testing Function

Testing function of Communication line should be equipped.

(5) Switching Function to the Redundant Equipment Component

The switching function to the redundant equipment component should be automatically

basically when failure is detected, and it should be capable to distinguish operation conditions of equipment components such as “Normal” or “Trouble” for both in operation and standby equipment components. If it is not switched over to the redundant equipment component when required, NMS should be equipped to switch it over manually on mandatory basis.

9.8.3 Monitoring Targets of NMS

Monitoring target of NMS is shown below;

(1) Transmission equipment components

(2) Switching equipment components

(3) Electric power supply system for communication system

(4) Communication cables

(5) Other supporting facilities such as air conditioning facilities

Necessary monitoring items are required to select to detect fault location and faulty conditions.

9.8.4 Installation Location of NMS

Alert terminal of the NMS is recommended to install in the traffic control room in the Main Center so as to share such information with traffic information operator.

9.9 Emergency Telephone System

9.9.1 Outline of Emergency Telephone System

Emergency telephone system is utilized by the expressway users in case he or she has a traffic accident or witness it. When the handset of the telephone is picked up, it connects to the receiving telephone directly installed at related road management office.

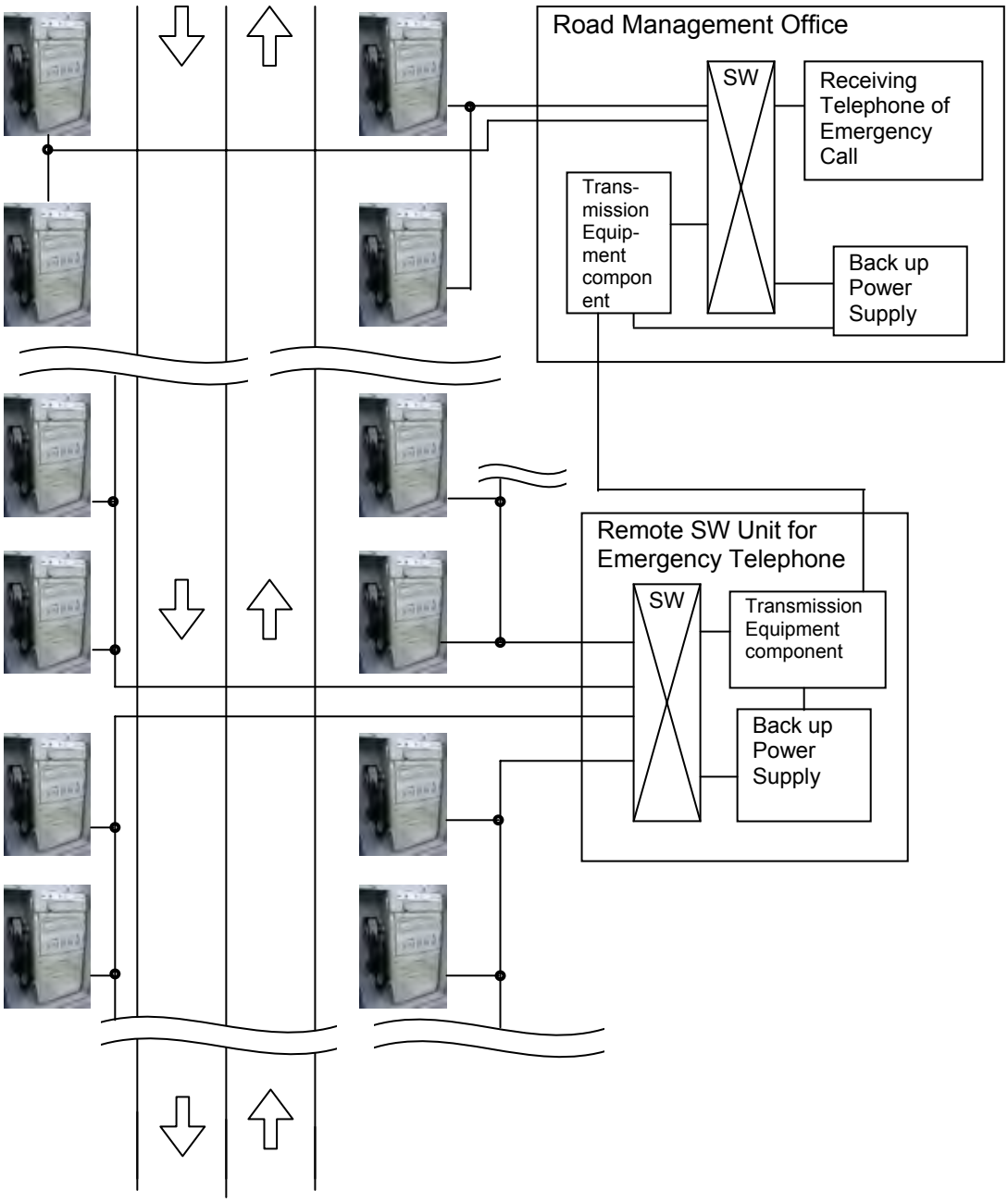
(1) Telephone call system: Simultaneous conversation system

(2) Receiving method: The road management office can receive the call from emergency telephone under jurisdiction of the office. The call can be received by the receiving telephone installed at road management office.

(3) Item to be displayed on the emergency telephone
   (a) Expressway name
   (b) Up line or down line
   (c) Kilo-meter of its location

Installation mage of the emergency telephone is shown below

Figure 9.6 Installation Image of Emergency Telephones



9.9.2 Installation Criteria of Emergency Telephone at Roadside

Emergency telephone is required to install taking following conditions into account.

(1) Emergency telephone is to be installed every 2km basically.

(2) It should be installed in appropriate height which meets standing use of adult.

(3) It should be installed in the dust and waterproof type box or cabinet.

(4) The emergency telephone installation direction and covering box or cabinet over opening direction should be considered that user of the telephone can see the coming vehicle during usage.

(5) Maximum metal cable installation length is shown in the following table. Emergency telephone installation position and remote switching equipment components location should be considered based on this and above conditions.

Table 9.11 Maximum Metal Cable Installation Length based on the Allowable Loss

Category	Allowable Loss (dB)	Transmittable Distance (km)	
		Wire Gauge 0.65mm	Wire Gauge 0.9 mm
Administrative Telephone & Receiving Telephone set	10.0 dB	7.5	10.7
Directive Telephone set	10.0 dB	7.5	10.7
Emergency Telephone set	8.0 dB	6.0	8.6

9.10 Mobile Radio Communication System

9.10.1 Outline of Mobile Radio Communication System

(1) Mobile radio communication system is absolutely required not only for normal operation and maintenance purpose such as patrol, but also for communication method between the site and road management office under emergency cases such as accident or disaster.

(2) Mobile radio communication system is able to actualize interactive voice communication between console in road management office and terminal equipment component holders, and among terminal equipment component holders.

(3) Mobile radio communication system means the facilities and equipment components from land mobile station such as terminal equipment components to the console in road management office through the base station.

(4) The interference should be considered to minimized as much as possible.

9.10.2 System Design Conditions

1) Coverage Area of mobile Radio Communication

The coverage area of mobile radio communication shall be capable to communicate on the expressway and related facility areas along the expressway such as outside area within the premises of road management office, interchanges, toll areas, rest areas, parking areas and other premises along the expressway. However it should not be caused interference due to unnecessarily expanded coverage areas.

2) Circuit Configuration

(1) Between base station and mobile terminal under one road management office area, circuit frequency is required two (2) waves.

(2) The circuit frequency for mobile terminal is needed three (3) waves for communication between console in road management office and terminal, and for receiving directives.

(3) The base station is able to be controlled from the console of the road management office. However if the coverage area of several consecutive base stations are limited due to several short tunnels, those base stations may be controlled as a group.

3) Location of Base Station

Base station location within the own road management section is selected in the following priority order. It is preferable to be determined by the characteristics of the radio wave propagation theoretically.

(1) Within the premises of road management office

(2) Within the premises of toll office

(3) Within the premises of inter change or toll gate area

(4) Within the premises of rest area, service area, or parking areas

(5) Other necessary locations

If the base station is required to be outside of the premises of road management office, the site ownership should be clarified or agreement related to land lease should be made in writing, prior to commencement of installation work at site.

4) Assignment of mobile terminal equipment component

In-vehicle mobile terminal equipment components are to be utilized for expressway patrol vehicles, maintenance vehicles, and vehicles for installation work on the expressway. The necessary number of terminals should be surveyed and determined.
The mobile terminals which are to be utilized not in-vehicle purpose, at least four (4) set are required for one road management office.

5) Standby of the Radio Equipment Component

Since the transceiver of the base station is core component of the station and it is required to avoided long time operation down due to the component failure, standby transceiver shall be equipped.

6) Leaky Coaxial Cable

Inside of the tunnel in which the minimum receiving power of the radio wave is not able to be obtained by antenna, leaky coaxial cable installation should be considered.

7) Backup Electric Power Supply Facility

In order to keep the radio communication functions during commercial power failure, the backup electric power supply facility such as UPS, battery and engine generator shall be equipped for the base station equipment component. The backup power supply facility shall be covered the capacity of the necessary power of the radio communication system and the conditions are shown below;

In case the base station equipped engine generator: ten (10) minutes

In case the base station not equipped engine generator: six (6) hours

The engine generator shall be kept the good conditions and amount of fuel for six (6) hours continuous operation shall be stocked within the same premises.

8) Functions related to Directive Communications

Directive communication console located in the road management office which is required to control the base stations shall be equipped the following functions;

(1) Selection function of base station to transmit the directive

(2) Displaying function (such as flashing light) of reception of directive

(3) Directive buzzer (twice of approx. 1 sec buzzer)

9.10.3 Communication System

1) Radio Frequency Band

Frequency band for expressway mobile radio communication system is recommended to be VHF or UHF, and it is required to be licensed by the Radio Frequency Directorate of Ministry of Information and Communication in Vietnam prior to the operation.

2) Communication Method

Full duplex communication method is to be applied for the mobile radio communication system for the following reasons;

(1) Simultaneous transmission and reception is available
(2) No proficiency is required for terminal usage

For information sharing purpose, the voice communication made by mobile radio communication system is preferable to be heard by the operator at console and other terminal holders within one road management office area as much as possible.

9.10.4 Speech Quality

1) Consideration of Speech Quality

The speech quality design and threshold should be considered as follows;

(1) The speech quality on the expressway should be within 25dB of S/N (Signal-to-Noise) ratio for normal modulation. It means that “the degree of clear voice can be head fully with some degree of noise”.

(2) During design stage, in order to secure the above S/N ratio, speech quality should be checked by the site survey taking necessary margins into consideration. For example, an obstacle margin of sound abatement shield along the expressway should be considered.

(3) The terminology of “normal modulation” in item (1) above means ±1.75KHz frequency modulation due to 1 KHz input signal.

(4) The specified S/N ratio in item (1) is the threshold for the measurement result specified in the item 13.4.2 (5) and taking necessary margins mentioned above item (2) into account.

2) Measurement method of input signal strength of receiver and noise intensity

Input signal strength of receiver and noise intensity are measured with the following procedure;

(1) Measurement of input signal strength of the receiver should be made under the condition of transmitting from base station and receiving of mobile terminal.

(2) Whole measurement result of input signal strength of receiver is required to record along each 100m interval of expressway, and data analysis should be made for lower 25% measured result. In addition, elevated section of expressway such as inter change, road management office area, toll office, rest area, and parking areas is also required to measure.

(3) Measurement of noise intensity should be made for 10 minutes duration in accordance with the CISPR standard for the above 25% lower signal strength points, and at the same time, number of passing vehicles also should be counted. The noise intensity measurement for base station should be made under the similar conditions of actual antenna installation conditions such as height and location. As for noise intensity measurement for mobile terminal is also made under the similar conditions of actual operation such as utilization of vehicle mounted antenna and parking shoulder part of the expressway.

If there is very few vehicle passage observed during measurement, it is able to refer to the measurement result of in-service expressway section's measurement record.

(4) Analysis of measurement result of noise intensity is made based on the recorded data, and required to obtain to calculate 50%-value (medium value) and 95%-value. As for 95% -value of noise intensity is obtained based on the condition that the 95% measured data is equal to or less than other measured data of one specific location.

(5) The S/N ratio is obtained for the location where the measured result of input signal strength of receiver is rather low mentioned above item (2), and the 95%-value of noise intensity explained above item (4) at the same location is utilized.

9.10.5 Radio Wave Propagation

After completion of installation of the radio communication equipment component, radio wave propagation from antenna and leaky coaxial cable shall be confirmed with the conditions specified in item 13.2.1 under the quality specified in the item 13.4 through the measuring method specified in the item 13.4.2.

9.10.6 Antenna Supporting Pole

Antenna supporting pole should be designed taking following conditions into account:

(1) Necessary antenna height is able to set

(2) Platform for maintenance work of the antenna is necessary to equip at the place where maintenance staff is able to reach the antenna easily

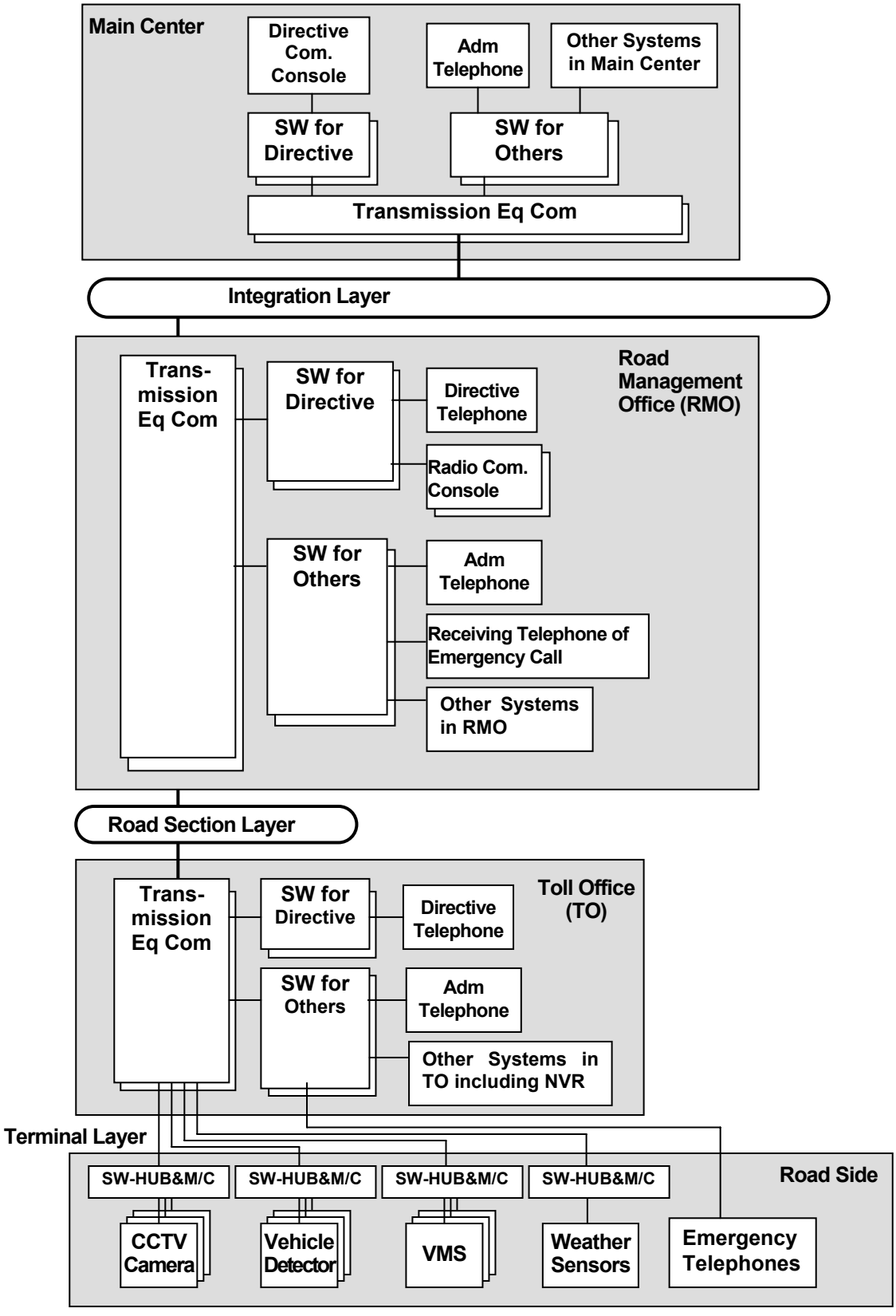
(3) Enough strength should be kept against the prospective load to the pole

(4) Counter measures shall be taken to the various environment conditions of Vietnam, such as lightning strike and surge, flood, and storm.

9.11 Location of Equipment Components

General equipment component location related to Communication system is shown below.

Figure 9.7 General equipment component location



9.11.1 Major equipment component of SW and Telephones

(1) SW for Directive Communication at Main Center

SW for directive communication is required redundancy; therefore two (2) switching systems for directive communication are required in the Main Center.

(2) SW for Others at Main Center

SW for others except for directive communications such as video images from roadside cameras, traffic data, weather data, administrative telephone, emergency telephone etc., is required redundancy, therefore two (2) switching systems are required in the Main Center.

(3) Directive Communication Console

Directive communication console is required redundancy; therefore two (2) sets of directive communication consoles are required in Main Center.

(4) Terminal for Administrative Telephone at Main Center

The number of terminal for administrative telephone in the Main Center is considered as per the number of telephone set specified in this document. The number of staff is assumed 60, and spare number is also considered. Then the quantity of fifty (50) sets for the Main Center is calculated.

(5) SW for Directive Communication at Road Management Office

SW for directive communication is required redundancy; therefore two (2) switching systems for directive communication are required in one (1) road management office.

(6) SW for Others at Road Management Office

SW for others except for directive communications such as video images from roadside cameras, traffic data, weather data, administrative telephone, emergency telephone etc., is required redundancy, therefore two (2) switching systems are required in one (1) road management office.

(7) Terminal for Directive Communication at Road Management Office

The number of terminal for directive communication in road management office is considered as per the number of telephone set specified in this document, and in addition to this, spare number is also considered. Then the quantity of six (6) sets per one (1) road management office is calculated.

(8) Terminal for Administrative Telephone at Road Management Office

The number of terminal for administrative telephone in road management office is considered as per the number of telephone set specified in this document. The number of staff is assumed 20, and spare number is also considered. Then the quantity of twenty (20) sets per one (1) road management office is calculated.

(9) Receiving Telephone of Emergency Call

The number of receiving telephone of emergency call is required two (2) sets per one (1) road management office.

(10) SW for Directive Communication at Toll Office

SW for directive communication is required redundancy; therefore two (2) switching systems for directive communication are required in toll office.

(11) SW for Others at Toll Office

SW for others except for directive communications such as video images from roadside cameras, traffic data, weather data, administrative telephone, emergency telephone etc., is required redundancy, therefore two (2) switching systems are required in toll office.

(12) Terminal for Directive Communication at Toll Office

The number of terminal for directive communication in toll office is considered as per the number of telephone set specified in this document, and in addition to this, spare number is also considered. Then the quantity of two (2) sets for toll office is obtained.

(13) Terminal for Administrative Telephone at Toll Office

The number of terminal for administrative telephone in toll office is considered as per the number of telephone set specified in this document. The number of staff is assumed 10, and spare number is also considered. Then the quantity of ten (10) sets per one (1) toll office is calculated.

(14) Emergency Telephone Set

The emergency telephone set is to be installed at both side of expressway with 2km intervals. The number of emergency telephone set is to be calculated based on this condition.

9.11.2 Major equipment component of Transmission

(1) Transmission Equipment Component at Main Center

Transmission equipment component for directive communication and others such as video image from roadside camera, traffic data, weather data, administrative telephone, emergency telephone etc., are required redundancy, therefore two (2) transmission systems are required in the Main Center.

(2) Transmission Equipment Component at Road Management Office

Transmission equipment component for directive communication and others such as video image from roadside camera, traffic data, weather data, administrative telephone, emergency telephone etc., are required redundancy, therefore two (2) transmission systems are required in road management office.

(3) Transmission Equipment Component at Node to be installed at Toll Office

Transmission equipment component for directive communication and others such as video image from roadside camera, traffic data, weather data, administrative telephone, emergency telephone etc., are required redundancy, therefore two (2) transmission systems are required in toll office. If separate component is required for directive communication and others to keep necessary performance of the equipment component, it is acceptable.

9.11.3 Major equipment component of Radio Communication

(1) Radio Communication Console at Road Management Office

Radio communication console equipment component is required redundancy, since it is used mainly for directive communication. Therefore two (2) sets of radio communication console are required in road management office.

(2) Base Station for Radio Communication

Base station should be located to cover whole expressway sections. It is depend on the conditions however, it is assumed that at least one (1) base station is needed fro 10km expressway section.
As for the transmitter and receiver of base station, it shall be required redundancy. The one set base station includes two (2) sets of transmitter and receiver.

(3) Terminal for Radio Communication

For one (1) road management organization, at least ten (10) sets of terminal are required as per the conditions specified in this document.

9.11.4 Major equipment component of Optical Fiber Cable

Some fiber cores of the optical fiber cable to be installed as the road section layer are utilized for the integration layer and the national layer also. In addition, cables for connecting base station for radio communication from road management office is also necessary to include in this layer. Therefore the number of core should be required to taking these conditions into account. The optical fiber cable for Road section Layer is installed in the conduit to be installed both side of the expressway basically. Detailed installation position of conduit is shown in the item of location of conduit installation in this document.

9.12 Conduit Design

9.12.1 General Information

Conduit design should be performed by selecting a rational and economical route as well as method of construction in consideration of various related facilities. Furthermore, “conduit, etc.” is the collective term for conduit, cable rack, hand hole, manhole, pull box. etc.

(1) As conduit design is mutually related to earthworks, pavement works, bridge elevated works, tunnel construction, etc., its designing should be performed with sufficient understanding of such related regulations and this document.

(2) Communication conduit means the conduit used for communication cables.

9.12.2 Notional System

Identical notations should be used commonly for design documents, contract documents and related technical documents to keep consistency for different projects.

Conduits installation are usually tendered, contracted and implemented together with preceding earthworks, bridge construction, tunnel construction and pavement works and embedded in respective structures normally. Relevant works are sometimes divided into several lots even within one interchange zone. Due to such circumstances, notational system is required to be unified to avoid inconsistency in later cable installation works.

9.12.3 Conduit Category

Conduit category shall be selected in consideration of mechanical load at time of construction and thereafter, electrical induction, economic efficiency, etc.

(1) Conduit type should be selected in accordance with type of cable, installation location conditions and other factors, but selection of conduit type should be referred to the criteria set forth in Table 9.12.

Table 9.12 Conduit Selection Criteria

Conduit material \ Place to be installed		Earthworks			Bridge elevated works			Tunnel works		Utility tunnel works
		General earthworks	Road crossing section	Longitudinal section within shoulder subgrade	Buried	Attached	Suspended	Buried	Attached	
Conduit	Thick steel conduit							○*6	○*1	
	Polyvinyl chloraide conduit	○	○*4	○	○			○		
	Corrugated hard resin conduit	○*2	○*4							
	Steel pipe	○*3	○	○*3	○*3	○	○	○*3	○*3	
	Bundle type plastic flexible conduit							○*5		
Cable rack							○		○	○

*1: Used as conduit excluding communication main cable (optical fiber and metallic cables)
*2: Use between hand holes to be less than 150m
*3: To be used at places indicated hereunder.
I) High voltage incoming lines and high voltage trunk lines
II) Where high pressure is applied
III) Where electrical induction exists
Note) Dependent on where used, exterior double layer polyethylene covered steel pipe for embedding in portions of earthworks, interior coated steel pipe for burying in concrete and exterior one layer polyethylene covered steel pipe used for attachment and suspension works. As for attachment works and when conduit bending is required for risers connecting to machinery, installation of thick steel conduit pipe shall be permissible.
*4: Used for road cross sections other than main express driving lanes (rest station car park, etc.)
*5: Bundled type plastic flexible conduits is applied for tunnel section.
*6: To be used as intra-tunnel transverse conduit (embedded in lining)

(2) The load which embedded conduit bears can be calculated by structural calculation or other means, but methods applied for excavation, backfill, characteristics of soil affect complicated influence. In general, conduit to be installed where the load of vehicles affect should keep covering depth of at least 30cm both during construction and after completion, and in case it is less than 30cm, steel pipes are required to be used or polyvinyl chloride conduit with concrete protection should be applied. As for the crossing portion of expressway main driving lanes, if covering depth is not able to keep more than 80 cm, steel pipe should be applied.

9.12.4 Conduit diameter and number of cables

Diameter of conduit and its number shall be determined by outside diameter of cable, its number, etc. The diameter of telecommunication conduit should be as follows:

Table 9.13 Standard diameter of conduit

Type of cable	Standard diameter of conduit
Main optical fiber cable	50 ㎜
Main metallic cable	50 ㎜

(1) Conditions from (a) through (c) hereunder shall be satisfied when determining the diameter of the conduit and number of cables to be installed.

(a) Telecommunication main line (optical fiber and metallic main line) shall be 1 cable for each conduit.
(b) Cables other than (a) above shall be maximum 3 per conduit.
(c) Control cables less than 60V and telecommunication cables shall not be installed together within same conduit.

When cables are to be installed into conduit, cable jacket might be damaged due to friction heat, or cable might be damaged due to excessive pulling force. In order to avoid such cases, and taking necessary number of cables to be installed into account, required number of conduits should be considered.

The number of conduit is composed of necessary number and spare number of conduits. The reference is made to the following table.

Table 9.14 Conduit number

Number	Breakdown	Criterion
Required	Initial stage	Initial number of conduits estimated/calculated based on required number of cables to be installed..
	Future	For sections uneconomical to construct conduits in future, such required number to be estimated and included in the required number of conduit.
Spare	Spare	One conduit is to be added for the location which needs to excavate pavement or break existing facilities such as longitudinal section within medial strip sub-grade, longitudinal section within shoulder pavement and longitudinal section within shoulder sub-grade and other similar places

(2) Necessary diameter of a conduit when cables are installed should be obtained by the following method

(a) One cable per conduit

$D \geqq d+15$ （In this case $d \geqq 30$）
$D \geqq 1.7d$ （In this case $d < 30$）

Note 1: D is inner diameter of conduit, d is outside diameter of cable
Note 2: Excluding telecommunication main line cable (optical fiber and metallic) Above-mentioned formula to be used when laying cable within conduit.

(b) Laying 2 cables within 1 conduit

$D \geqq 1.5(d_1 + d_2)$

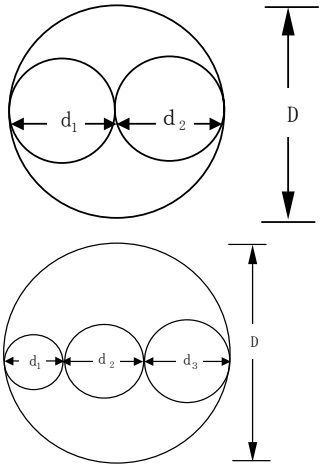
Note: D is inner diameter of conduit, d_1, d_2 are outside diameters of cables.

(c) Laying 3 cables within 1 conduit
Select inner diameter 2.85 times that of maximum diameter of cable to be inserted and make its numerical value 2.85 times as much as possible.

In case $d_3 \geqq d_2 \geqq d_1$
$D > 2.85 \times d_3$

Note: D is inner diameter of conduit, d_1, d_2 and d_3 are outside diameter of cables.

Figure 9.8 Diameter of Conduit



9.12.5 Linearity of Main Conduit

Conduit is recommended to install linearly as much as possible. When it is required to install curve section, radius of the conduit run should be as large as possible.

(1) Radius to be over 10m when curved sections are used for medial strip, main conduit within tunnel and other necessary cases. However, curved sections for which radius of more than 10m cannot be secured due to other underground facilities, radius may be reduced up to 2.5m within the range of one (to be two when curve for the another one is close to hand hole) for every span.

(2) Linear of longitudinal section shall eliminate slackness to prevent stagnant water from accumulating and the end of at least one span shall be at lowest level for such span. When slackness is unavoidable, lowest joint to be T shaped and draining undertaken by branch pipe. However, as possibility of slurry back streaming is there, such should be restricted to locations of good drainage (such as at embankments, etc.)

9.12.6 Electromagnetic induction countermeasure

When laying telecommunication lines near power lines (railways, extra-high voltage power transmission lines, etc.,) there is fear of dangerous voltage being created in telecommunication lines installed parallel nearby from high current flow to earth in case grounding fault occurred. Appropriate measures will have to be taken for such phenomenon.

9.12.7 Conduit in earthwork sections

1) Embedding location

Location of embedded conduits in earthwork sections should be where specified covering depth and linearity can be secured, difficulty of installation due to other existing underground utilities and structures is negligible and design is required to be performed in consideration of safety of conduit, work efficiency, economical efficiency, etc.

(1) Conduits are recommended to be buried within the same cross section of earthwork of expressway during road construction time simultaneously. The conduit is required to be installed at a depth and location to keep its strength, where it is not endangered during and after construction and considering the depth and location preventing damage from vehicle accident.

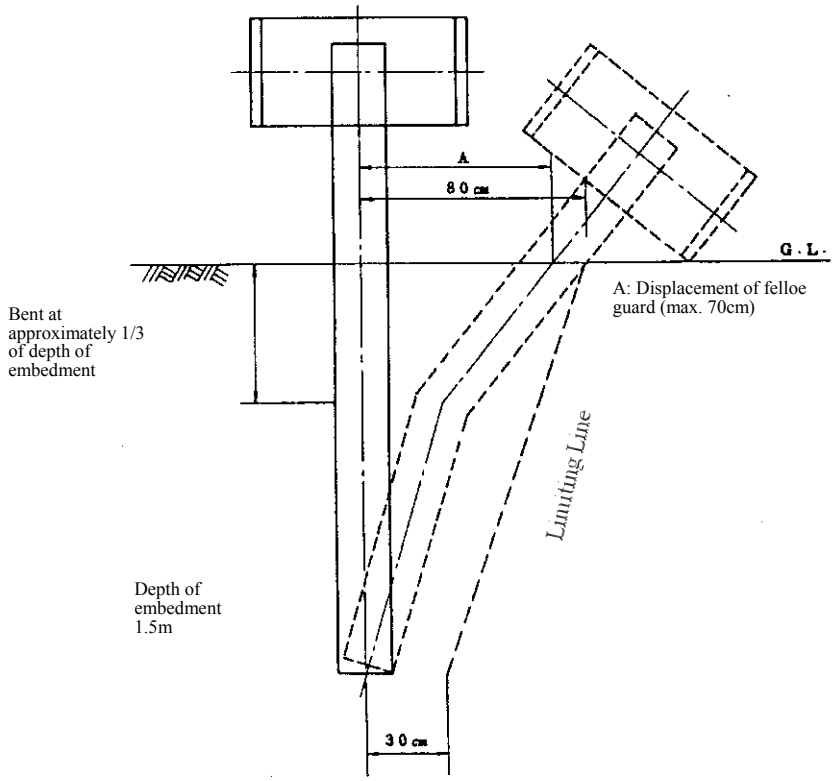
(2) In case conduit is installed in road shoulder part, clearance from ancillary structures such as drainage, etc. shall be kept by standardized means of construction wherever possible. Furthermore, installation of power cables and telecommunication cables together in same road shoulder part is avoided wherever possible. When parallel installation of those cables is inevitable, necessary clearance between those cables should be maintained.

(3) Location of installation of conduits should be considered to prevent damage accidents and alleviating burden caused by maintenance and improvement works at maintenance stage. In principle, the conduits should be installed in shoulder part of expressway road where the location will not affect the pavement, or be installed in the roadbed located at the bottom end of the slope of earthwork. As for the bridge and tunnel section, the conduits should be installed at shoulder part or center divider.

(4) To avoid danger caused by impact of drilling of guard-rail and impact of driving vehicles onto guard-rail posts, conduits should, in principle, be installed away from affection limit line as per Figure 9.9.

(5) Conduits crossing roads should be crossed at right angles to road center lines.

Figure 19.9 Deformed Guard-rail Post



2) Installation Depth of conduits and protection soil

Installation depth of conduits, protection soil and backfill material should be in accordance with the tables hereunder.

Table 9.15 Installation Depth of Conduits

Installation Location	Covering depth	Remarks
General Earthworks	More than 0,3m	Depth from the top of the sub-grade within sub-grade.
Road crossing	More than 0.3m	Depth from the top of the sub-grade. Includes parking area. (Minimum 0.6m to be secured from road surface.)
Medial strip within sub-grade	More than 0.3m	Depth from the top of the sub-grade
Longitudinal section out of shoulder pavement	More than 0.1m	Depth from surface
Longitudinal section at the bottom end of the slope of the earthwork	More than 0.3m	Depth from the top of the sub-grade

Table 9.16 Protective Soil

Embedding site	Vehicle load	Protective soil	Remarks
General earthworks	Nil	Not required	Backfill with excavated soil
	Exists	required	Protective soil is not required if steel pipe is installed in single layer.
Road crossing	Exists	required	
Medial strip・Longitudinal section within subgrade	Exists	required	
Longitudinal section out of shoulder pavement	Exists	Not required	Protective concrete
Longitudinal section at the bottom end of the slope of the earthwork	Exists	required	

Table 9.17 Backfilling Material

Location of backfill	Backfilling material	Remarks
Longitudinal section within pavement	Concrete	To be used on routes already in service

(1) In the event more than 0.3m covering depth of telecommunication conduits cannot be secured, either steel pipes or protective concrete is applied.

(2) Protective soil is used to protect conduit and as backfilling material. Its material properties should be good quality gravel, mountain sand or river sand which do not contain any boulder stones.

(3) Laying conduit for the longitudinal section out of pavements shall be applied when newly installing telecommunication conduit along the routes which is already in service, and not applied when expressway road is under construction.

(4) Soil volume to be excavated for conduit installation should be minimized during design stage.

3) Conduit installation indication

Conduit installation indication is required to identify the installed location of conduit with plant record drawings for the locations such as general earth work and road crossing part.

The interval of the indication is every 20 m for straight section and both starting and ending points of curved section or shifting part of installation position of ducts in cross-section of the road.

9.12.8 Bridge elevated segment conduit

1) Location to install conduit

Conduits to be installed on elevated segments of bridges are required to design proper location taking future cable installation work and maintenance/inspection work into account.

Conduit material for bridge part should, in principle, be steel.

(1) Conduit installation location should be selected considering easy cable installation work and maintenance /inspection work.

(2) For the protection of cables from fires from the lower part of bridge elevated segments or conduit due to aging deterioration, embedded ducts should, in principle, be located as per (1) and (4) in Figure 9.10 or (5) in Figure 9.11.

(3) Bridges on which wheel guard or wall type bridge railings were constructed in advance without installing conduit for communication cables, the conduit is required to be installed as attachment or suspension method.

(4) If conduit is located the position to be embedded, the concrete will be casted in the form surrounding the conduit. In order to protect conduit deformation from heat of the concrete solidification or vibrator during casting of concrete, the conduit type should be steel. On the other hand, if the conduit is attached to the bridge or suspended from the bridge, the steel duct is also applied to protect from deterioration due to sunlight exposure or fire from lower part of brides. The conduit installation location (5) in Figure 9.11 allows to be applied synthetic resin pipes.

Figure 9.10 Location of conduit installation (1)

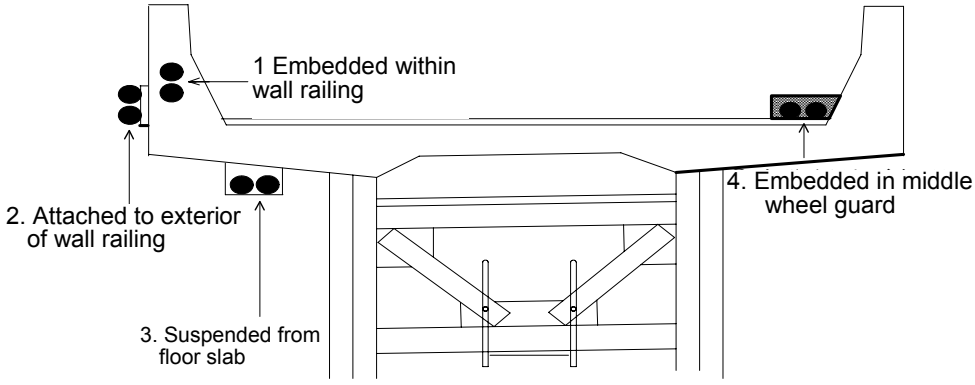
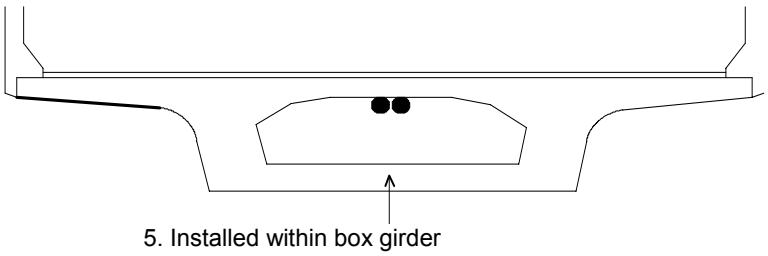


Figure 9.11 Location of conduit installation (2)



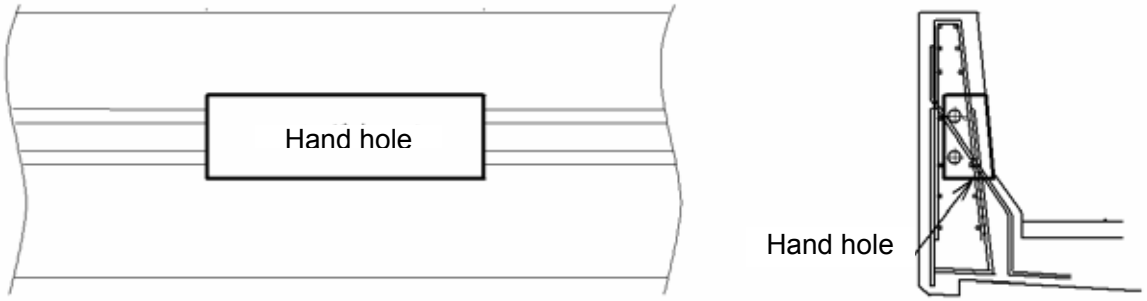
2) Embedded conduit

In case conduit is embedded in wheel guard concrete or concrete wall railing, it should be designed taking into account several factors such as influence of structural strength of wall, workability of concrete encasement, and available space for other facility such as vehicle noise barriers to be installed in future in concrete wall railing.

(1) Embedded conduit should be designed to prevent damage due to vibrator at time of casting of concrete (when vinyl conduit is used in particular,) lack of concrete filling, and deviation of conduit location.

(2) When embedding in wall railing, connections with other structures such as vehicle noise barriers should be considered in the design. As for sections at which noise barriers will initially not be installed, available space for noise barriers should be considered for future needs, and straightness of conduit is required to be secured as much as possible.

Figure 9.12 Piping embedded in concrete wall railing



3) Attached conduit

Conduit installed by attachment method should be executed so as not to impair the appearance of the structure, and it should be located for easy maintenance and inspection of conduit and cables.

Supports for attachment should not only sufficiently support its own load and vibration with margin of safety but also expansion and contraction of conduit will have to be taken into consideration.

(1) In order to avoid uncoupling of jointed conduit due to conduit extension or contraction, fixed support is required to install in specific intervals.

(2) The interval between supporting points to attach steel pipes is as per Table 9.18 and specific supporting point and supporting type should be determined taking following points into account;

(a) Fixed support points (for expansion joint side only) should be fixed 1m from bridge floor separation point or abutment.
(b) When box which accommodates equipment component exists, fixed support should be installed 1m away from the box.

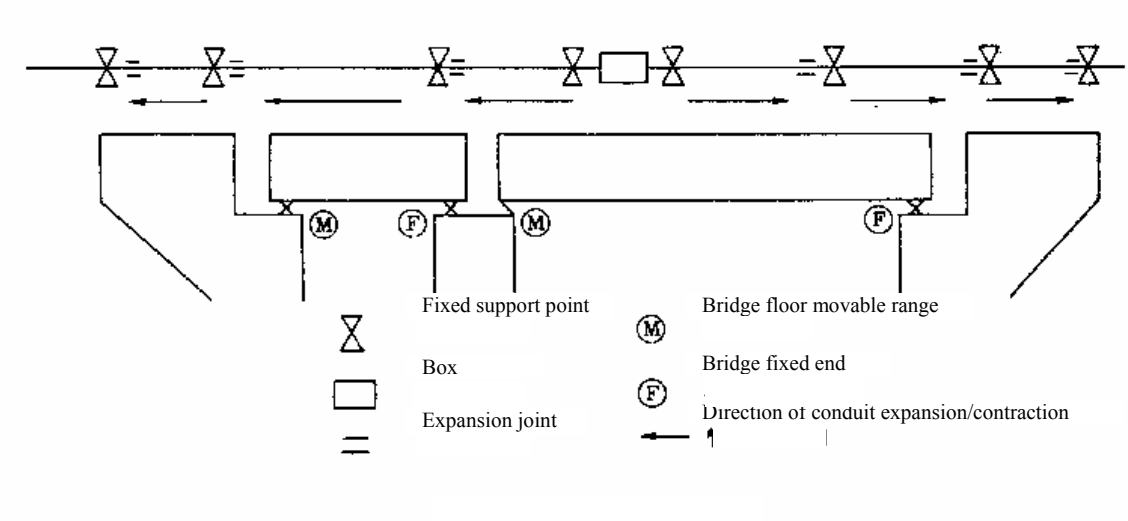
(c) When expansion joint is installed at bridge floor intermediate point, fixed support point is required 1m away from the intermediate expansion joint.

(d) General support points are required to be located between fixed support points within 4m intervals with equal distances as much as possible.

Table 9.18 Interval of supporting points in general

Supporting type	Supporting interval for steel pipe
General support	4m
Fixed support	50m

Figure 9.13 Supporting points in general



(3) When there is a possibility of fire below bridge elevated segment and attached conduits in the vicinity of abutment, required conduit protection measures against fire is required to be taken in consideration of importance of cable. zones at which measures are to be taken are as follows:

(a) Barrier to prevent entry does not exist, places whereby entry is easy (excluding road crossings,) shortest height to conduit is less than 5m and sections where risk of telecommunication cables being damamged by fire is high. (Figure 9.13)

(b) Regardless of whether a barrier exists or not, shortest height to conduit is less than 5m and slope is protected with grass. (Figure 9.14)

(c) Places where conduit is attached on wall of culvert (Figure 9.15). However, where slopes are of stone or concrete blocks, conduit protection against fire is not required.

Figure 9.14 Places of side attachment of conduit and less than 5m height

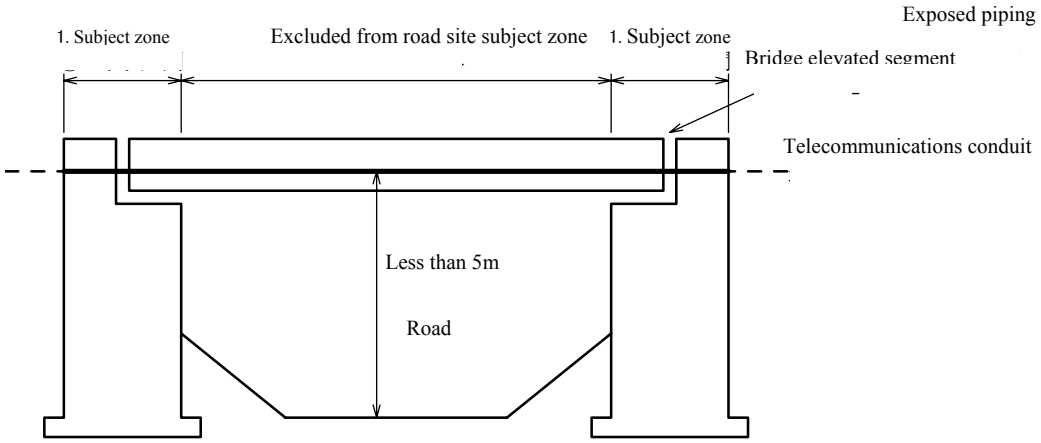


Figure 9.15 Less than 5m height to conduit and where slope with grass space outside road site could be exposed to spreading fire

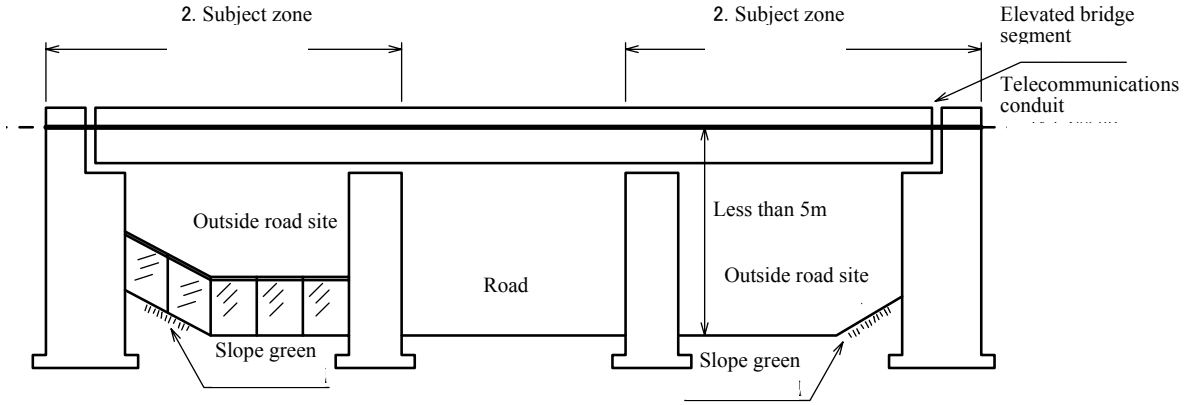
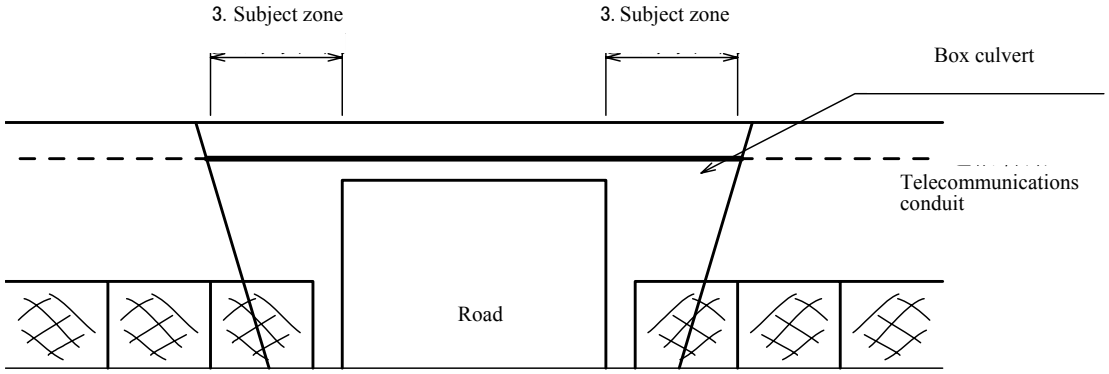


Figure 9.16 Box culvert where slope with grass could be exposed to spreading fire



4) Expansion joint

Expansion joints are required to be installed at points of bridge floor separation and at abutment connections.

When no expansion joints are installed over a span exceeding 50m of steel pipe installation,

an expansion joint is to be installed in the span next to the fixed support point.

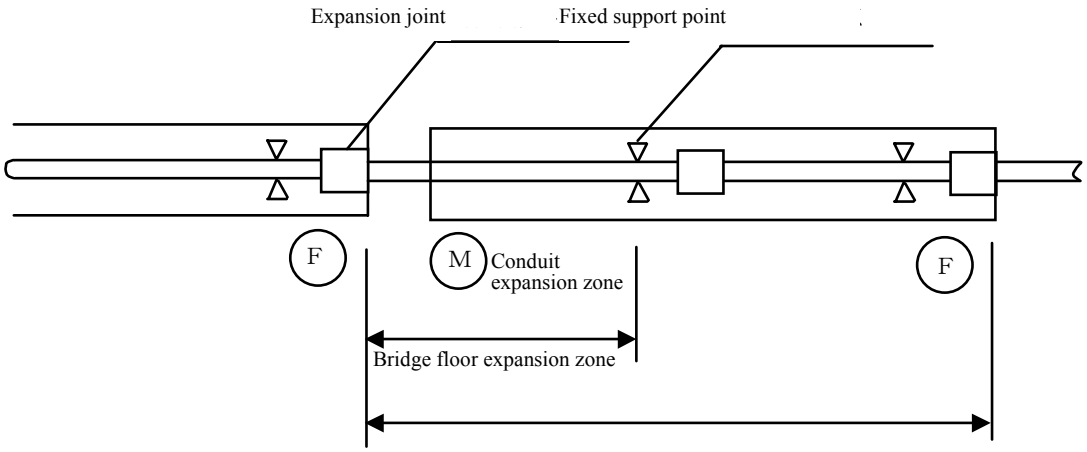
Appropriate and economical expansion joint is required to be selected taking into account the conditions such as movable length of expansion/contraction, and moveable direction of the joint.

In addition to the above, expansion/contraction due to thermal characteristics of steel pipe, and movable direction and length of expansion joint for road bridge is also need to be considered.

(1) For protection of pipe body and supports from pipe's thermal stress, expansion joints are required to install at bridge elevated part for embedded conduit and attached conduit.

(2) Expansion joint of the bridge attached conduit is to be applied at separation point of bridge floor and between abutment and bridge floor considering sufficient absorb length to cover total expansion/contraction for the section.

Figure 9.17 Expansion zone of attached conduit section



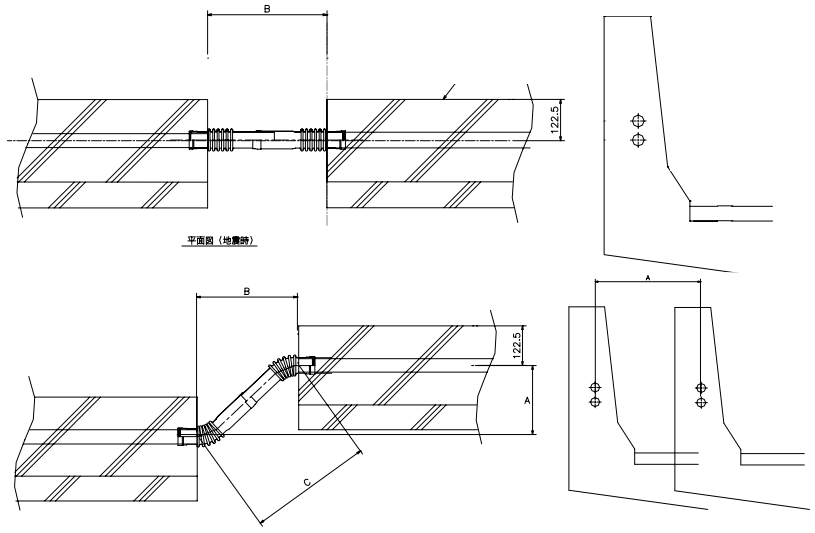
(3) Rust-proof expansion joints is needed to be used for attached conduits or corrosion protection applied at site.

(4) Expansion/contraction length of conduit is required to consider the bridge expansion/ contraction basically. In the bridge expansion/contraction is considered following factors mainly:

(a) Expansion/contraction due to thermal characteristics of bridge
(b) Displacement due to earthquake ground motion

The expansion joint is required to absorb the expansion/contraction due to above factors. The sample calculation method in item b) above is shown in Figure 9.17.

Figure 9.18 Horizontal displacement during an earthquake



A= Horizontal displacement
B=Normal expansion spacing width
C＝Maximum expansion/contraction ($C=\sqrt{A^2+B^2}$)

(5) Surplus length of cable to meet the expansion joint selected in accordance with above items is required to confirm in cable installation design.

9.12.9 Hand hole and manhole

1) General information

(1) Hand holes, manholes and boxes to be installed at locations/points where cables are connected or installed and where small radius bending is required.

(2) Size of a hand hole is considered necessary factors of cable and cable joint accommodation capacity and cable installation work space.

(3) Strength of hand holes and manholes is required to withstand cable pulling force, live load caused by earth pressure and traveling vehicles at time of construction and after commencement of service.

2) Required Dimensions of MH/HH

The dimensions of MH/HH are to be determined taking occupied space of cables and splicing points and cable installation working space into account.

3) Locations of installment and span

(1) Hand holes is to be installed where cables are joined, at road crossings, where small radius bends exist in roads, etc. Concerning its locations on elevated bridge part and within tunnels, decisions shall be made considering other supporting facilities location.

Moreover, they shall be installed at equal distances wherever possible.

(2) When connections are to be made with the room in building structures such as electric room, communication equipment component room, etc., the handhole should not be located close to the building foundation and installed exterior of the cat walk.

(3) HH is not considered to be located those places where it will be expressway driving lane, unequal external pressure being applied, and the location where there is a possibility of ground subsidence, however when installation of such location is unavoidably required, sufficient protection should be made to hand hole cover and its duct connection part.

(4) When pipe for power cables existing in the tight space within a tunnel, isolated structure or isolated installation of hand holes should be required. Optical fiber cables and telecommunication main lines should not installed in hand holes for power cable.

(5) Standard installation interval of hand holes for optical fiber cable and main line metallic cables should be as per Table 9.19.

Table 9.19 Installation Interval of Hand Holes

Location	Detailed location (Usage)	Type of cable to be installed	Hand hole Usage	Maximum span
Earthworks	Communi-cations	Optical fiber cable		Approx. 1000m(a)(b) (Note 1)
		Metallic cable		Approx. 333m (a)(Note 1)
Tunnel	Embedded (Communi-cations)		Cable joint	Approx 333m (Note 1)
			Expansion/contraction	150m(c)
			-ditto-	90m(c)
			-ditto-	60m(c)
Elevated bridge portion	Embedded in wall railing (Communi-cation)	Optical fiber cable	Cable joint	Approx 1000m (a)(b) (Note 1)
		Metallic cable		Approx 333m (a)(Note 1)
		Optical fiber cable	Cable joint	Approx. 500m(d)
		Metallic cable		Approx. 111m (d)
	Wheel guard embedded (Communi-Cation)		Cable joint	Approx. 333m(Note 1)
			Expansion/contraction	100m(d)
			Expansion/contraction	60m(d)
			Expansion/contraction	40m(d)
	Attached and suspended (Communi cation)	Optical fiber cable	Cable installation	Approx. 1000m(a)(b) (Note 1)
		Metallic cable	Cable joint	Approx. 333m(a)(Note 1)

Note 1:
(a) In general, the number of cable joint which can be accommodated in one hand hole is maximum two. If 3rd joint is required to be accommodated, further detailed check on remaining space is required.
(b) Indicating span between hand holes which accommodates cable joint.
(c) Span between hand holes accommodating cable joint should be half of this distance.
(d) As expansion/contraction of bridge floor affects expansion/contraction of cable in sections where floor slab expansion/contraction is equipped, designing span is carefully considered. Span between cable joint hand holes should be half of such distance. At the border of earthworks and bridge elevated portion, an expansion/contraction hand hole should not be installed.

Note 2:
It is desirable span for linear cable laying case, and when curved section is required, span is needed to be minimized. If necessary, installation tension calculation is required and span should be determined accordingly.

(1) Hand holes is required to be installed at locations in consideration of maintainability and safety working condition during maintenance and inspection time.

(2) Cable connection points is considered, in principle, not be located in bridge elevated portion and cable joint should be located in earthwork part away from bridge portion.

4) Number indication

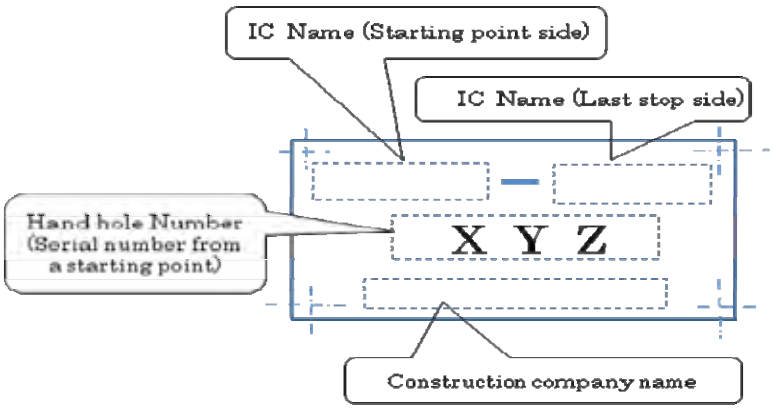
Number of main line conduit hand hole is required to be indicated inside of hand holes and hand hole nameplate is fixed inside of hand hole.

(1) The name plate is required to include the nearest interchange names, serial numbers starting from one side interchange, and others as shown below."

(2) In case hand hole, etc. are to be added between existing hand holes after completion of installation work, "supplementary number" to be added to serial number.

(3) Plant record for each hand hole is required to prepare and periodically needed to update for operation and maintenance. The plant record includes the information of hand hole number, connected ducts, installed cables, installed cable joint and other necessary information to manage cable facilities.

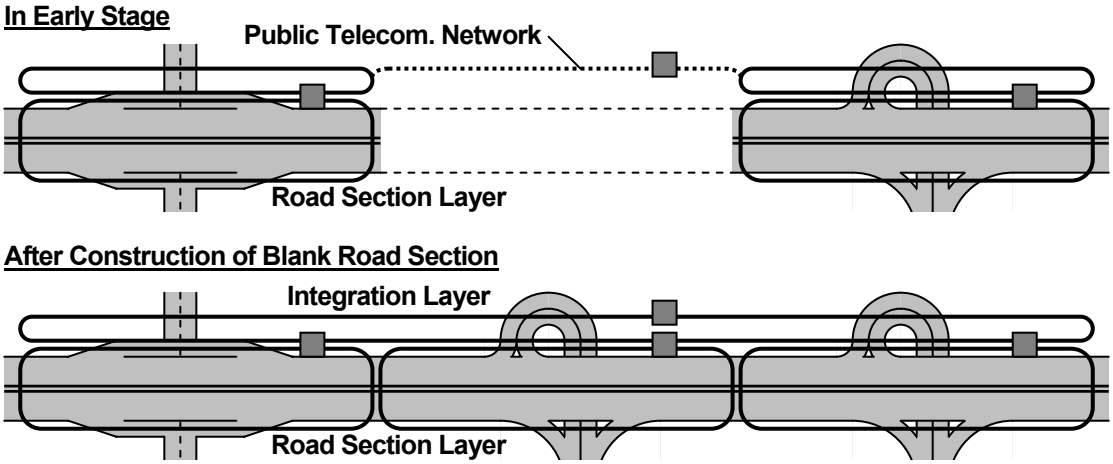
Figure 9.19 Hand hole Nameplate Example



9.13 Preparation for Stepwise Implementation

In addition, the fiber optic cable network is to be installed by sections of the road. For the missing section, the public telecommunication network is to be used as a complement in early stage as shown below; then, the fiber optic cable is to be installed to form the linked loops after construction of the blank road section.

Figure 11.17 Stepwise Installation of Fiber Optic Cable



APPENDIX 5: COMPARISON WITH ON-GOING EXPRESSWAY PROJECTS

Comparison on the requirements for functional packages is performed between the Draft ITS Standards and the following three On-going Expressway Projects.

- Cau Gie – Ninh Binh Expressway
- HCMC - Long Thanh – Dau Giay Expressway
- HCMC – Trung Luong Expressway.

Table A5.1 Comparison of Requirements with On-going Expressway Projects

No.	Functional Packages	Requirements of ITS Standards	Requirements of ongoing Projects		
			Cau Gie – Ninh Binh	HCMC - Long Thanh – Dau Giay	HCMC – Trung Luong (Ph 1)
1)	Telephone Exchange	• System shall be capable of receiving notification of incident occurrence promptly from road user and of identifying the user's location on the expressway.	• Emergency telephone using fiber optical cable and solar panel is proposed. • Capable of receiving notification of incident occurrence prompt from road user or operator in the control center • Capable of indicating hot line number by Hot Line Number Board at roadside at 1km interval	• All calls from the emergency telephone will be received at the reception desk at the Control Center • Call will be connected immediately by picking up the handset and no other action must be required for caller • The Location of calling emergency identified and the location will be shown telephone must be automatically on the monitor panel of receiving desk.	
		• System shall be capable of receiving report of current traffic conditions on the expressways and of incident occurred promptly from the operators in the toll management office and the rest area.			
		• System shall be capable of sending instructions to the units concerned at an instant for clearing incidents and enforcing traffic regulations.		• Emergency call can be transferred to other telephones of internal telephone system.	
				• Emergency call can be transferred to other telephones installed at police, ambulance service and other organizations connected with direct line.	

		• System shall be capable of receiving notification of incident occurrence generally within 20 minutes, and sending road operation vehicles to the incident site generally within 1 hour.	• Location interval: every 1km	• Location interval: basically every 1km, for emergency telephone will not be installed on the bridge having length less than 1km, and will be installed on the middle point of the bridge having length from 1km to less 2km, and 2 emergency telephones will be installed 500m far from the center point of bridge on both sides for brides longer than 2km and shorter than 3km.	
		• System shall be capable of functioning 24 hours a day, 365 days a year through sufficient durability and reliability of equipment components.			
2)	CCTV Monitoring	• System shall be capable of recognizing incident occurrences on the road and their types, such as traffic accidents, breakdown vehicles, left obstacles, vandalism, and natural disaster, by remote monitoring at the Main Center and road management office.	• CCTV Monitoring will be used for direct and timely observation of traffic conditions and incident sites on the expressway, providing latest information for respond action to emergency events.	• Two main objectives of CCTV system: - Observation of traffic flow - Observation of road condition	• CCTV system shall support traffic management center operators to check expressway traffic conditions such as flow, frequent congestion, and unexpected incidents (accidents, vehicle malfunctions)
		• System shall be capable of recognizing the severity of incidents through identifying types of vehicles involved (such as trucks, buses and sedans) by appearances.			• CCTV system should be able to ensure the full-time monitoring of the expressway as a whole. In particular, unforeseen incidents should be quickly checked and controlled
		• System shall be capable of identifying the place of incident occurrence at the Main Center and road management office.	• After the image data transmitted to road management office, these data will be analyzed for events and vehicle monitoring.		• Speedy camera rotation should be ensure for a quick shift from a up to down line or vice versa.

		• System shall be capable of minimizing the required number of monitoring devices.			• Structures, cabinets, and communication cables should be consolidated to maximize economic feasibility, taking in to account the location of other system facilities.
		• System shall be capable of installing roadside equipment adequately at bottleneck spots on the road where traffic can be stuck easily by incident and at tunnel sections.	• Monitor the whole route (At every 1 km along the expressway)	• Camera will be installed at the limited location where traffic flow is more susceptible to disturbance due to diversion and merging of flow on straight section where lane change is less often.	• The system should be sufficiently durable to withstand environmental changes such as weather, temperature, and humidity • CCTVs should be installed every 2km.
		• System shall be capable of controlling roadside equipment remotely at the Main Center and road management office	• Remote Control video cameras will be installed.		
		• System shall be capable of minimizing load caused by data transmission including video image on the communication system.			• Video signal should be compressed in order to provide reduced band-width, quicker file transfers, and reduced storage requirements.
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.		• CCTV camera system must be designed to operate 24h/day and 7day/ week without shutdown. Thus high reliability and availability are required.	• The system should be able to ensure seamless 24-hour monitoring
3)	Event Detection (by Image)	• System shall be capable of detecting incident occurrences and their types, such as traffic accidents, breakdown vehicles, left obstacles, vandalism and natural disaster, automatically and promptly by analyzing video image captured at roadside.	• Incident information is detected by image recognition • Following traffic events will be verified by image monitoring system for each lane and each vehicle; (fire, natural disaster, pedestrian, vehicle stopping but not congested, vehicle stopping by congested, illegal vehicle stopping, congestion preventing, congestion moving, small objects fallen from vehicles)	• Vehicle detection system shall be capable of identifying incident such as congestion based on the vehicle detector data.	

		• System shall be capable of notifying the detected results automatically and promptly to the Main Center road and management office.			
		• System shall be capable of monitoring original video image remotely at the Main Center and road management office.			
		• System shall be capable of identifying the time and place of incident occurrence at the Main Center and road management office.			
		• System shall be capable of installing roadside equipment adequately at bottleneck spots on the road where traffic can be stuck easily by incident and at tunnel sections.			
		• System shall be capable of minimizing load caused by data transmission including video image on the communication system.			
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside			
		• (congestion information and travel time is able to analyze by traffic analysis)	• Image recognition is applied to monitoring traffic conditions for incident information, congestion information, travel time, speed regulation and rescue service.		

4)	Vehicle Detection	• System shall be capable of measuring number of vehicles, vehicle speed and vehicle length at a specific point on the road.	• Vehicle Image detection equipment will be installed. • Detection data: Traffic volume of each lane, vehicle speed, crowdedness, etc.	• Vehicle detection station accommodates necessary number of vehicle detector units, must detect vehicles, measure traffic flow or calculate traffic flow parameters separately for each lane. (4 lanes) • Speed detection type vehicle detector is proposed for the usefulness of speed data. But vehicle classification will not be required as the current regulation does not classify vehicles type by physical dimensions.	• The system should be able to gather basic data such as traffic volume, speed, share, and vehicle length, based on which traffic flow and speed by zone are identified.
		• System shall be capable of notifying the measured results automatically and promptly to the Main Center and road management office.	• Capable of transmitting captured image to monitoring/control center for data processing, and the results is displayed on the computer.	• Data gathering processor at the Traffic Control Center will collect periodically traffic flow parameters from the vehicle detection station. • The pre-processor in vehicle detection station receives detection signal from the detector unit, processes them and produces the outputs such as the traffic volume, time occupancy rate, average speed, and sensor or unit maintenance information. • It must be possible to monitor in real-time traffic flow parameter data through monitor display and printed report at Control Center.	• Detectors are installed at around 2.0 km intervals. • On a crossing zone and junction/disjunction other than the main line, detectors are installed at around 1 km intervals.
		• System shall be capable of identifying the time and place of measured values at the Main Center road and management office.			• Detectors should be installed on a straight line (if possible) in order to enhance accuracy

		• System shall be capable of installing roadside equipment adequately at important points on the main line of expressways and the tollgates.	• Capable of installing image detectors both roadside of interchanges	• Vehicle detector will be installed at 2km interval.	• If VDS is installed every 1km, VDS can share the same structure, ground connection, power system with CCTV.
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.	• Capable of functioning 24h/day in any weather conditions		
5)	Traffic Analysis	• System shall be capable of calculating traffic volume and heavy vehicle ratio at a specific point on the road, average travel speed and congestion levels based on the measured results by vehicle detectors	• Capable of event analysis automatically and promptly informing to operator for countermeasure	• Vehicle detection system will be installed to measure traffic flow parameters at each section of the expressway. • The traffic parameters are traffic volume, time occupancy rate, average speed.	• A diversity of data such as traffic, share, average speed, average vehicle length, and individual vehicle information (if requested) should be collected.
		• System shall be capable of storing the calculated results and the measured results by vehicle detectors as the data for every 5 minutes in a database.		• Vehicle detector data are recorded and kept as statistical data for expressway management, maintenance operation and road planning. • Unit measurement duration will be five (5) minutes and be shortened to one (1) minute. • Data gathering processor, its software and other system components shall be capable of changing the different unit measurement duration.	• The data gathering cycle closely links to design speed, processing data by comparing traffic characteristics by spot. Data collected every 30 seconds, calculated and save to database for every 5 minutes.
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.			• In principle, data by lane are collected. Individual vehicle data are transmitted if requested by Traffic Management Center

6)	Weather Monitoring	• System shall be capable of measuring rainfall, wind speed, visibility, and temperature at a specific point on the road.	• Capable of measuring wind direction/ speed, visibility, air temperature & humidity, road surface water contain, chemical factor of road surface, and also forecast road surface slipperiness	• Measuring - Air temperature - wind velocity and wind direction - precipitation (rainfall) - Fog and heavy rain is monitored by CCTV camera	
		• System shall be capable of measurement with an accuracy for making decision of speed restrictions and closure in case that driving speed needs to be less than the maximum speed –70km/h.		• If weather condition is too dangerous for driving on expressway, the expressway may be closed.	
		• System shall be capable of sending the measured results automatically and promptly to the Main Center and road management office.		If hazardous weather condition is detected by the system, an alert will be issued to the operator in the traffic control center, then a warning message will be displayed on the variable message sign and traffic control center website.	
		• System shall be capable of identifying the time and place of measured values at the Main Center and road management office.			
		• System shall be capable of storing the measured results as the data for every 5 minutes in a database.		• All weather observation data will be recorded in the database. • Displayed data will be updated every minutes.	
				• Data retrieval software will be provided for easy access to the recorded data. The retrieved data can be displayed in both tabulation and graphic.	

		• System shall be capable of sending a warning automatically and promptly to the Main Center and road management office in case that a measured result is beyond the limit defined in advance.		• A warning system must be introduced in which an alarm is issued to the operator when the wind data or precipitation data exceeds the preset threshold. Several types and values of threshold must be provided.	
		• System shall be capable of installing sensors adequately at interchanges and important points on the expressways.			
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.			
7)	Traffic Event Data Management	• System shall be capable of categorizing the results of CCTV monitoring, event detection, traffic analysis and weather monitoring, information from the drivers and other input information into adequate types, such as traffic accidents, breakdown vehicles, left obstacles, congestion levels, driving in the reverse direction, vandalism, significant weather and natural disaster.	• Capable of inputting and categorizing the events into fire, traffic incidents, road works, storm/flood, etc. into computer system of control center by operator	• Incident management system will manage the information of all incidents related to the expressway operation. • Traffic condition at each detector is classified into three (3) states: normal or no congestion, lightly congested, heavily congested based on the traffic volume, occupancy rate, average speed or combination of their parameters detected by detector	
		• System shall be capable of inputting and categorizing the traffic regulations issued from the Main Center and road management office into adequate types such as speed restrictions, in-coming restrictions and closure.			• Traffic control in bad weather (ex. Maximum Speed in case of heavy fog: 30km/h)
		• System shall be capable of identifying the categorized events by time and place.			

		• System shall be capable of storing the categorized events as the data for every 5 minutes in a database.			
		• System shall be capable of functioning 24 hours a day, 365 days a year through sufficient durability and reliability of equipment components.			
8)	Traffic Supervision	• System shall be capable of inputting the data necessary for generating/ managing information for traffic control.		• A traffic control center will be established, having control room where the operation of the entire system as well as the road and traffic condition of the Expressway will be monitored, and a computer room where all the central equipment will be accommodated.	• System should be capable of transmitting and managing control data (PTZ) for remotely controlling CCTV Cameras from Traffic Management Center
		• System shall be capable of indicating the information categorized as traffic events, in the form with specific time and place of their occurrences, for the operators in the Main Center and road management office.			• System should be capable of receiving and managing video images sent from various cameras, and displaying those video images automatically or manually on a number of different display screens
		• System shall be capable of functioning 24 hours a day, 365 days a year through sufficient durability and reliability of equipment components.		• Non-stop and reliable operation of the system is ensured by uninterruptible power supply (UPS) system.	
9)	VMS Indication	• System shall be capable of disseminating the information categorized/stored by traffic event data management in the forms appropriate for their types, such as traffic accidents, breakdown vehicles, left obstacles, driving in the reverse direction, vandalism, significant weather and natural disaster, at the roadside.	• The Large size VMS is for important information dissemination of the monitoring/control system for expressway, the displayed information or message on VMS can be adjusted upon the traffic conditions, weather conditions, and instructions given by control room.	• Call road user's attention to the incident on the expressway such as accident, road works, adverse weather condition, and congestion by providing adequate information in advance in order for driver to be prepared for the incident and drive with care. • Suggest diversion to other roads in case of congestion	• System should be capable of disseminating congestion and unexpected incidents to the users of expressway, at the roadside.

		• System shall be capable of intervening in information dissemination by the operators based on their estimation.	• Capable of intervening in information dissemination by operator using 25 preset graphics		• System shall be capable of intervening in information dissemination by the operators in 3 modes (Automatic, Semi-Automatic, Manual)
		• System shall be capable of indicating text information for the drivers to read it visually on the vehicles with the maximum speed 120km/h.		• One message will be shown on the VMS for one incident. • Three methods for message input: manual, combination of preset words, selection of preset message. • Max speed: 120km/h	• Through Lane speed: max. 100km/h, min. 60km/h
		• System shall be capable of updating the indicated information every 5 minutes.			
		• System shall be capable of installing roadside equipment adequately at the place short of interchanges entrances, exits, tollgates, junctions and tunnels on the expressways.	• VMS: 2 locations (2 units) • CSS (Changeable Speed Limit Sign): 5 locations (10 units)	• VMS is installed on expressway upstream of interchange (4 locations) and on surface road (4 locations)	• System should be capable of installing roadside equipments at place short of interchanges entrances, exits, upper reaches of driveway to a tunnel, accident black-spots without interfering or conflicting with the functions of existing facilities.
			• Displaying Language: Vietnamese, Chinese and English	• Displaying language: Vietnamese	
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.		• Availability of each VMS must be 99% or better, although VMS is not intended to operate 24h/day and 365days/year.	
10)	Mobile Radio Communication	• System shall be capable of receiving report of current traffic conditions on the expressways and of incident occurred promptly from the operators in the toll management office and the rest area		• Wireless communication system is proposed for this project. (400MHz) • The system must cover the entire expressway • Capable of verbal communication between two points	

				• One-to-one, one-to-many, and many- to-many communication is possible.	
		• System shall be capable of sending instructions to the units concerned at an instant for clearing incidents and enforcing traffic regulations.			
		• System shall be capable of receiving notification of incident occurrence within 20 minutes, and sending road operation vehicles to the incident site within 1 hour.			
		• System shall be capable of functioning 24 hours a day, 365 days a year through sufficient durability and reliability of equipment components.			
11)	Traffic Information	• System shall be capable of disseminating the information categorized/stored by traffic event data management in the forms appropriate for their types, such as traffic accidents, breakdown vehicles, left obstacles, driving in the reverse direction, vandalism and natural disaster, through the Internet.		• Road and traffic condition information will be disseminated to the public through Internet.	• System should be capable of disseminating the traffic information from Traffic Management Center, through Internet
		• System shall be capable of intervening in information dissemination by the operators based on their estimation.			
		• System shall be capable of updating the disseminated information every 5 minutes.			
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.			

12)	Lane Monitoring	• System shall be capable of monitoring vehicles passing through a tollgate lane, in the toll booth and toll management office, and identifying their classes such as trucks, buses and sedans.		• The Vehicle Detector (VD) shall be used as a kind of traffic counter to calculate the number of vehicle passing through the toll lane.	• System should be capable of monitoring vehicles passing through a tollgate lane, in the toll booth in the Central Control Room.
		• System shall be capable of monitoring situation of toll payment/receipt between a driver and a toll collector in the toll management office.	• The financial loss caused by toll collection staff will be minimized in the most effective way.	• The Toll Lane Server (TLS) shall transmit the job and traffic data after summarizing all the toll transactions of the toll corrector's job.	• System should be capable of monitoring transactions between driver and a toll collector in the Central Control Room.
		• System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.		• Automatic License Plate Number Recognition Camera (ALPR-CAM) shall be located where it is the best position to take a shot the license plate number properly. • Lane Side Camera (LS-CAM) shall be located where it is possible to observe the vehicle fully while the driver stopped at the booth. • The Lane Side Display (LSD) shall be located where the driver can see it while he stopped at the tollbooth.	
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions of roadside.			
13)	Vehicle Identification	• System shall be capable of identifying the classes of vehicles passing through a tollgate lane, such as trucks, buses and sedans.	• Vehicle classification	• To be available for all vehicle classes • Vehicle classification for toll collection shall follow the requirements of Ministry of Finance (MOF), as stipulated in the latest circular, 90/2004/TT-BTC.	• System should be capable of classifying vehicle passing through a tollgate lane based on toll collector's selection. His selection would be captured for auditing at the Central Control Room.

		• System shall be capable of identifying the vehicles passing through a tollgate lane by their license number plate and storing the results.			
		• System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.			
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.			
14)	Lane Control	• System shall be capable of generating/ processing the data appropriate for collecting toll based on the data sent from IC-card and OBU, the results of vehicle class identification and the regulated toll rate system.	• The financial loss caused by road users will be minimized by modern monitoring/controlling method.	• The Toll Lane Server (TLS) shall form the integrated core equipment to ensure the all lane functions and procedures, and all data of transaction are controlled and retrieved independently by the TLS.	• System should be capable of carrying out toll collection, vehicle class verification, receipt insurance, creation and storage of operation unit data, number plate recognition, barcode scanning, receipt printing, and data transmission to Toll plaza main server.
		• System shall be capable of securing an average service-time by non-stop less than 4.5 sec/vehicle and by one-stop less than 6.0 sec/vehicle	• Service level is rather high with short service time minimizing the traffic congestion caused by toll collection activities	• It is necessary to adopt a new efficient payment method such as contact-less IC-card or ETC in order to reduce a transaction time.	
		• System shall be capable of processing the data for collecting toll putting the vehicle class judged by toll collector on a higher priority.			
		• System shall be capable of notifying a driver, in case of prepaid balance shortage for required toll amount, the necessity to recharge prepaid balance before next time of system usage including the amount of shortage.			
		• System shall be capable of notifying the data for collecting toll and the results of processing the data.			

		• System shall be capable of inhibiting the vehicles without normal completion of toll collection.			
		• System shall be capable of generating/ storing identification data of the vehicles without normal completion of toll collection.			
		• System shall be capable of rejecting in-coming of the vehicles beyond the legal limits of dimensions.			• The operators must comply with regulations on size limit of the road.
		• System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.			
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.			
15)	Road-to-Vehicl e Communication	• System shall be capable of notifying the data for collecting toll and the results of processing the data.	• DSRC 5.8GHz	• DSRC complied with the active method requirements on Annex1 on Recommendation ITU-R M.1453 Transport information and control systems – Dedicated short range communications at 5.8GHz	
		• System shall be capable of securing an average service-time by non-stop less than 4.5 sec/vehicle.	• Service level is rather high with short service time minimizing the traffic congestion caused by toll collection activities.		
		• System shall be capable of securing undisturbed conditions by disconcertion/ tapping from outside and restricting an error ratio less than 1%.	• The system should have data back up function so that the local errors can not influence other functions.		
		• System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.			

		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.			
16)	IC-Card Recording	• System shall be capable of notifying the data for collecting toll and the results of processing the data	• One stop collection using contact less IC card 13.56MHz, ISO/IEC 18092-2004	• Prepaid card is used for ETC (2-pieces OBU is recommended) • Contact less IC card is proposed (ID1 in ISO/IEC 7801) • Frequency 13,56MHz	
			• IC card management center is to be separately arranged		
		• System shall be capable of securing an average service-time by one-stop less than 6.0 sec/vehicle.		• IC-card shall provide high processing speed at minimum power consumption.	
		• System shall be capable of securing undisturbed conditions by disconcertion/ tapping from outside and restricting an error ratio less than 1%.		• Capable of stable communication without any affection by any surroundings • Capable of realizable communication for all OBU within a limited communication zone provided on the ETC lane. • Capable of authenticity of transaction which is processed into OBU, IC-Card and ETCC	
		• System shall be capable of prepayment and retaining prepaid balance in the IC-card.			
		• System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.			
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.			

17)	Toll Management			• Followings are recommended - Cash payment - Commutation ticket (seasonal ticket) - Prepaid value payment from contact less IC card - ETC • Requirements of the system design - capable as a common system for all toll road throughout Vietnam - capable to various toll policies such as vehicle classification or receipt issuance - available for all vehicle classes - capable for both open and closed system - capable to new payment methods such as ETC - high reliability and accuracy - enable secured data management - enable to apply the existing toll collection policy and systems	• System should be capable of - Identifying vehicle class by the toll collector's selection. - Automatically Issuing ticket at the entrance of tollgate lane with information of vehicle class, toll plaza number, insurance date/time, operation number, serial number, barcode. - Scanning and processing barcode information on the voucher. - Printing receipts for driver at the exit lane.
		• System shall be capable of storing all transaction data between OBU and roadside equipment for toll.	• Closed system is proposed • All toll collection data is recorded and stored in timely, accurately, and complete manner.	• The Toll Office System (TOS) shall have transaction data acquisition/ store from the Toll Lane System and provision of real time monitoring facilities via a visual display unit in the room of toll office. • The TOS shall have data processing and toll office management via visual display units, printer terminals, auxiliary memory media and data transfer facilities.	
		• System shall be capable of generating the data of forms for toll management and storing them in a database.			

		• System shall be capable of storing the identification data of suspended OBUs and IC-cards in a database and listing them as a negative list.		• The Toll Data Management System (TDMS) shall be a server to carry out real time functions, such as data communication with the Toll Lane Server and data archiving including captured image and a result of license plate number recognition to inspect and post-check the toll collection work.	
			• The system should allow future expansion and up grade with high integration possibility.		
		• System shall be capable of functioning 24 hours a day, 365 days a year through sufficient durability and reliability of equipment components.		• The system must continue to operate for 24h/day and 7day/week without stopping.	
18)	OBU Management	•			
19)	Axle Load Measurement	• System shall be capable of measuring the number of axles and axle loads of vehicles in motion and investigating overloading.	• In case overloading vehicle is detected during high speed driving time, and the driver does not follow the instructions shown on the VMS, the information of such vehicle go through the tollgate, the computer at tollgate will give the instruction to the staff to handle with that vehicle.	• Only WIM is proposed but not combining with static vehicle scale. • Capable of measuring weight of each axle, total vehicle weight, distance between two adjacent axles and vehicle speed • Measurement accuracy must be within the range of $\pm$10% for 95% of vehicles measured.	• Comply with the regulation of weight limit
		• System shall be capable of notifying the detection of overloaded vehicle to the operator.	•	• Data gathered at each weight station will be sent to the traffic control center	
		• System shall be capable of generating/ storing identification data of overloaded vehicles.		• Overloaded vehicle data collected by the system will be sent to the traffic control center for recording and video image must be kept permanently until deleted by the operator	

		• System shall be capable of installing roadside equipment adequately in a tollgate lane and a dedicated space.			
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.			
20)	Overloading Management	• System shall be capable of storing all data prepared for investigating overloading in a database.	• In case overloading vehicle is detected during high speed driving time, and the driver does not follow the instructions shown on the VMS, the exit tollgate is to be managed.	• Data gathered at each weight station will be sent to the Traffic Control Center together with equipment monitoring data for monitoring and recording.	• Comply with the regulation of weight limit.
		• System shall be capable of generating the data of forms for overloading regulation and storing them in a database.			
		• System shall be capable of listing the identification data of overloaded vehicles as a negative list.			
		• System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.			
21)	Center/ Roadside Communication	• System shall be capable of exchanging data including video image among roadside equipment on the expressways, the Main Center and road management offices.	• SDH (ITU-T G803, G703) • Optical Fiber Cable (ITU-T G652, G655) • Video Conference (ITU-T H320, 323)	• SDH (ITU-T G803, G703) • Optical Fiber Cable (ITU-T G652, G655) • Video Conference (ITU-T H320, 323)	• System shoud be capable of exchanging data, multimedia data between roadside equipment and Traffic Management Center.
		• System shall be capable of identifying location of problems that occurred on communication network and of recovering them by automatically switching network.			• System should be capable of remotely monitoring the operation of communication device to ensure the remote operation of video and data transmission equipment.
		• System shall be capable of functioning 24 hours a day, 365 days a year through sufficient durability and reliability of equipment components.		• Physically separate optical fiber cables will be used for a ring topology.	• System should be capable of automatically identifying location of failures that occurred on communication network.

APPENDIX 6: RELEVANT OFFICIAL DOCUMENTATIONS & INTERNATIONAL STANDARDS

The following relevant official documents and summaries of relevant international standards are compiled:

(1) Prime Minister's Decision 1734/QD-TTG/2008: Approval on Expressway Network (3) Development Plan in Vietnam
(2) National Standards TCVN 5729/Draft Revision: Expressway – Specifications for Design
(3) MOF Circular 90/2004/TT-BTC: Guiding the Regime on Collection, Payment, Management and Use of Road Toll
(4) Decree 34/2010/ND-CP: Government Stipulating on Penalization due to Administrative Violations on the Field of Road Traffic (Summary)
(5) MOT Circular 07/2010/TT-BGTVT: Regulating on Load, Road Clearance Limits, Oversized Vehicles, Caterpillar Vehicle; Heavy-haul Cargo Transport, Long-haul Cargo Transport; Allowable Package Sizes of In-route Vehicle (Summary)
(6) Summaries of Relevant International Standards.

PRIME MINISTER

SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom – Happiness

No.1734/QĐ-TTg

Hanoi, December 01, 2008

DECISION

Approving the Vietnam Expressway Network Development Master Plan toward 2020 and a vision beyond 2020

PRIME MINISTER

Pursuant to Law on Organization of the Government dated Dec 25, 2001

At the proposal of the Ministry of Transportation (Letter of Transmittal No. 7056/TTr-BGTVT dated 05/11/2007 on the Vietnam Expressway Network Development Master Plan toward 2020 and a vision beyond 2020)

DECIDES

Article 1. To approve the Vietnam Expressway Network Development Master Plan toward 2010 and a vision beyond 2020 with the main contents as follows:

1. Viewpoint:

The national expressway network is to be constructed completely, appropriately and adaptationally to the requirements for the long-term development of the country in need of industrializing the country in 2020. The expressway network includes trunk lines with traffic volume, connecting with the road system, other transportation infrastructures to simultaneously, actively and effectively operate the transportation services in the economic development. The master plan is the basis to determine the investment fund, land fund and implementation schedule of expressway projects from now up to 2020 and the following years:

2. Goals

- To promptly build up the national expressway network that ensures a connectivity to focal economic zones, main border gates and significant transport hubs where exist high traffic volume. In that network, the South - North expressway project should be a focus of interest with priorities given to sections connecting to large cities (such as Hanoi, HCMC, Danang) and to the large seaports.
- The expressway network should be able to link with other modern modes of transport and enhance the regional and international integration.
- The expressway is a separate project; however, it will be required to integrate with the existing road network and protect the environment, landscape.
- The expressway network will contribute to handle traffic congestion, particularly in Hanoi and Ho Chi Minh City.
- In the master plan, the expressways are planned in a completed scale; however, the construction of these routes can be implemented by phases in reference to traffic volume

and fund availability. On the hand, it is needed to manage the land fund to reduce land acquisition costs in the future.

3. Vietnam Expressway Network Development Master Plan

Based on the forecast demand, the socio-economic development orientation for 2020; the economic development orientation of three focal economic zones; the transport development strategy up to 2020 and vision beyond 2020; the master plan defines the expressway network of Vietnam to include 22 expressways with the total length of 5,873km.

a) The North- South Expressway

Including 02 routes and the total length is 3.262km

- The earthen North- South Expressway: 1.941km length
- The western North- South Expressway: 1.321km length

b) The expressway system in the northern region

Including 07 routes connecting with Hanoi Capital; total length of 1.099km, specify:

- Lang Son- Bac Giang- Bac Ninh, 130km in length;
- Ha Noi- Hai Phong, 105km;
- Ha Noi- Viet Tri- Lao Cai, 264km;
- Noi Bai- Ha Long- Mong Cai, 294km;
- Ha Noi- Thai Nguyen- Cho Moi (Bac Kan), 90km;
- Lang- Hoa Lac- Hoa Binh, 56km in length;
- Ninh Binh- Hai Phong- Quang Ninh, 160 km;

c) The expressway system in the Central region and Central Highland

Including 03 routes with the total length of 264km, specify:

- Hong Linh (Ha Tinh)- Huong Son (Ha Tinh), 34km;
- Cam Lo (Quang Tri)- Lao Bao (Quang Tri), 70km;
- Quy Nhon (Binh Dinh)- Pleiku (Gia Lai), 160km.

d) The expressway system in the Southern region

Including 07 routes with the total length of 984km, specify:

- Bien Hoa (Dong Nai)- Vung Tau (Ba Ria- Vung Tau), 76km;
- Dau Giay (Dong Nai)- Da Lat (Lam Dong), 209km;
- Ho Chi Minh City- Thu Dau Mot (Binh Duong)- Chon Thanh (Binh Phuoc), 69km;
- Ho Chi Minh City- Moc Bai (Tay Ninh), 55km;
- Chau Doc (An Giang)- Can Tho- Soc Trang, 200km;
- Ha Tien- Rach Gia (Kien Giang)- Bac Lieu, 225km;
- Can Tho- Ca Mau, 150km.

e) Ring-road expressway system in Hanoi and HCMC

In Ha Noi City:

- Ring Road 3: 56km;

- Ring Road 4: 125km;

Ho Chi Minh City:

- Ring Road 3: 83km.

(Ring Road 5 (Hanoi City) and Ring Road 4 (HCMC) function to connect urban satellites will be considered and revised during the implementation).

4. List, scope and construction schedule of expressways

The List, scope, total estimated investment and construction schedule are shown in the Appendix I.

5. Proposed land fund:

The total land fund for the planned expressways is about 41.104ha, in which, occupied area of completed and under-constructed expressways is about 2.916ha, additional area is required to be 38.188ha (in which, the area of agricultural land is estimated at about 24.167ha).

Please refer to the Appendix II for detail information of occupied land by route and locality

6. Mechanism and Policy:

a) Mechanism for Fund Creation

The fund for the construction of expressway network will be mobilized from the following sources:

- The state budget under the forms of Government loan or Loan Security and construction bond …;
- Funds mobilized by the investors under the forms of BOT, BTO, BT, Public-Private Partnership (PPP)…

Ministry of Transportation will oversee and coordinate with Ministry of Planning and Investment, Ministry of Finance to formulate a mechanism for fund creation to construct the expressway network toward motivating involvement of domestic and foreign economic bodies.

b) Application of Advance Sciences and Technologies

It is recommended to adopt new technologies, new materials in expressway construction. Applying advanced technologies in Managing- Building- Operating: traffic safety facilities, Information Technology in Operation and Management.

c) Organizing the management

Ministry of Transportation is the state agency of expressway construction, investment, management and operation in the nationwide.

d) Formulation of integrated policies for implementing the master plan

- To formulate a policy that creates a fair play ground for the investors and a policy of environment protection in the expressway development.
- To formulate a policy of human resource development: Extending methods for domestic and oversea training on expressway construction, management and operation.

Article 2. Organizing the implementation

1. Ministry of transportation:

To be responsible for monitoring and implementing the master plan;

The Ministry of Transport needs study on an appropriate organizational model for management of expressway investment, construction and operation; build up Vietnam

Expressway Cooperation (VEC) as the core enterprise in expressway investment and development of Vietnam.

2. Relevant Ministries and Agencies:

Subject to their function, responsibility, power, the relevant agencies have responsibility to cooperate with MOT, People Committees of Provinces, cities to realize the goals, ensuring a consistence and integration with the implementation of the Socio-Economic Development Plan of Vietnam toward 2020 and vision beyond 2020, the sectoral socio-economic development plans and the provincial socio-economic development plans..

3. Relevant People Committees of Provinces and Cities:

- To cooperate with MOT and Relevant Ministries, Agencies to organize the construction of expressways;
- To review and adjust the existing plans and projects in the provinces/ cities in order to match with this master plan;
- To approve, decide to change the purpose of land-use into expressway construction under the Land Law; strengthen the management of land fund for implementing the master plan.

Article 3. This decision take effects 15 days after the date of signing
Ministers, Leaders of Ministerial- level agencies, Leaders of Government Agencies, Chairmen of People committees of relevant provinces, cities shall take responsibilities to enforce this decision./.

PRIME MINISTER

(signed and sealed)

Nguyen Tan Dung

Phụ lục I

DANH MỤC CÁC TUYẾN ĐƯỜNG BỘ CAO TỐC QUỐC GIA ĐẾN NĂM 2020 VÀ TẦM NHÌN NGOÀI NĂM 2020

(Ban hành kèm theo Quyết định số 1734/QĐ-TTg ngày 01 tháng 12 năm 2008 của Thủ tướng Chính phủ)

STT	Tuyến đường/ đoạn	Điểm đầu	Điểm cuối	Chiều dài (km)	Quy mô (làn xe)	Ước tính TMĐT (tỷ đồng)	Tiến trình đầu tư
	Trục cao tốc Bắc - Nam phía Đông						
1	Cầu Giẽ - Ninh Bình	Cầu Giẽ, Hà Tây	Thị xã Ninh Bình	50	6	9.300	Đang xây dựng, GĐ1: 4 làn xe
2	Ninh Bình - Thanh Hóa	Thị xã Ninh Bình	Huyện Quảng Xương, Thanh Hóa	75	6	12.380	Trước 2020
3	Thanh Hóa - Vinh	Thanh Hóa	Cầu Bến Thuỷ, thành phố Vinh	140	6	22.120	Trước 2020
4	Vinh - Hà Tĩnh	Vinh	Thị xã Hồng Lĩnh	20	4 - 6	2.580	Trước 2020
5	Hà Tĩnh - Quảng Trị	Ngã ba Bãi Vọt	Cam Lộ - Quảng Trị	277	4	21.610	
6	Quảng Trị - Đà Nẵng	Cam Lộ, Quảng Trị	Túy Loan, Đà Nẵng	178	4	18.160	Trước 2020
7	Đà Nẵng - Quảng Ngãi	Thành phố Đà Nẵng	Thị xã Quảng Ngãi	131	4	17.820	Trước 2020
8	Quảng Ngãi - Quy Nhơn	Thị xã Quảng Ngãi	An Nhơn, Bình Định	150	4	23.700	Trước 2020
9	Quy Nhơn - Nha Trang	An Nhơn, Bình Định	Thành phố Nha Trang	240	4	24.960	
10	Nha Trang - Dầu Giây	Thành phố Nha Trang	Dầu Giây, Đồng Nai	378	4 - 6	55.940	
11	Thành phố Hồ Chí Minh - Long Thành - Dầu Giây	Thành phố Hồ Chí Minh	Dầu Giây, Đồng Nai	55	6 - 8	18.880	Trước 2020
12	Long Thành - Nhơn Trạch - Bến Lức	Long Thành, Đồng Nai	Bến Lức, Long An	45	6 - 8	12.340	Trước 2020
13	Thành phố Hồ Chí Minh - Trung Lương	Chợ Đệm, thành phố Hồ Chí Minh	Trung Lương	40	8	13.200	Đang xây dựng, GĐ1: 4 làn xe
14	Trung Lương - Mỹ Thuận - Cần Thơ	Thành phố Hồ Chí Minh	Cần Thơ	92	6	26.250	Trước 2020

STT	Tuyến đường/ đoạn	Điểm đầu	Điểm cuối	Chiều dài (km)	Quy mô (làn xe)	Ước tính TMĐT (tỷ đồng)	Tiến trình đầu tư
	Trục cao tốc Bắc - Nam phía Tây						
15	Đoan Hùng - Hoà Lạc - Phố Châu	Đoan Hùng, Phú Thọ	Phố Châu, Hà Tĩnh	457	4 - 6	53.930	
16	Ngọc Hồi - Chơn Thành - Rạch Giá	Ngọc Hồi, Kon Tum	Thị xã Rạch Giá, Kiên Giang	864	4 - 6	96.770	
	Khu vực phía Bắc						
1	Lạng Sơn - Bắc Giang - Bắc Ninh	Cửa khẩu Hữu Nghị	Cầu Như Nguyệt, QL1A mới, Bắc Ninh	130	4 - 6	12.220	Trước 2020
2	Hà Nội - Hải Phòng	Hà Nội	Hải Phòng	105	4 - 6	16.800	Trước 2020
3	Hà Nội - Lào Cai	Nội Bài, Hà Nội	Thành phố Lào Cai	264	4 - 6	15.580	Trước 2020
4	Hà Nội - Thái Nguyên	Hà Nội	Thành phố Thái Nguyên	62	4 - 6	4.220	Trước 2020
5	Thái Nguyên - Chợ Mới	Thành phố Thái Nguyên	Chợ mới	28	4 - 6	2.940	
6	Láng - Hoà Lạc	Láng	Hoà Lạc	30	6	7.650	Đang xây dựng
7	Hoà Lạc - Hoà Bình	Nút giao Hoà Lạc	Thành phố Hoà Bình	26	4 - 6	2.550	
8	Bắc Ninh - Hạ Long	Thành phố Bắc Ninh	Thành phố Hạ Long	136	6	19.040	Trước 2020
9	Hạ Long - Móng Cái	Thành phố Hạ Long	Thị xã Móng Cái	128	4 - 6	13.820	Trước 2020
10	Ninh Bình - Hải Phòng - Quảng Ninh	Thị xã Ninh Bình	Hạ Long	160	4	13.760	
	Khu vực miền Trung						
1	Hồng Lĩnh - Hương Sơn	Thị xã Hồng Lĩnh	Thị trấn Hương Sơn	34	4	2.450	
2	Cam Lộ - Lao Bảo	Thị trấn Cam Lộ, Quảng Trị	Cửa khẩu Lao Bảo	70	4	4.900	
3	Quy Nhơn - PLeiKu	An Nhơn, Bình Định	Thành phố PLeiKu	160	4	12.000	
	Khu vực phía Nam						
1	Dầu Giây - Đà Lạt	Dầu Giây	Thành phố Đà Lạt	189	4	19.280	Trước 2020
2	Biên Hoà - Vũng Tàu	Thành phố Biên Hoà	Thành phố Vũng Tàu	76	6	12.160	Trước 2020

STT	Tuyến đường/ đoạn	Điểm đầu	Điểm cuối	Chiều dài (km)	Quy mô (làn xe)	Ước tính TMĐT (tỷ đồng)	Tiến trình đầu tư
3	Thành phố Hồ Chí Minh - Thủ Dầu Một - Chơn Thành	Ngã tư Bình Phước	Chơn Thành	69	6 - 8	20.010	
4	Thành phố Hồ Chí Minh - Mộc Bài	VĐ3 thành phố Hồ Chí Minh	Cửa khẩu Mộc Bài	55	4 - 6	7.480	
5	Sóc Trăng - Cần Thơ - Châu Đốc	Thị xã Sóc Trăng	Thị xã Châu Đốc	200	4	24.200	
6	Hà Tiên - Rạch Giá - Bạc Liêu	Cửa khẩu Xà Xía, thị xã Hà Tiên	Thị xã Bạc Liêu	225	4	27.230	
7	Cần Thơ - Cà Mau	Thành phố Cần Thơ	Thành phố Cà Mau	150	4	24.750	
	Hệ thống đường vành đai thành phố Hà Nội						
1	Vành đai 3	Nội Bài, Hà Nội	Trùng với điểm đầu	56	4 - 6	17.990	Trước 2020
2	Vành đai 4	Sóc Sơn, Hà Nội	Trùng với điểm đầu	125	6 - 8	34.500	
	Hệ thống đường vành đai thành phố Hồ Chí Minh						
1	Vành đai 3	Nhơn Trạch, Đồng Nai	Bình Chánh, thành phố Hồ Chí Minh	83	6 - 8	20.750	Trước 2020
	Cộng			**5.753**		**766.220**	

Ghi chú: bảng trên chưa kể các đoạn Bắc Ninh - Pháp Vân (40 km), Pháp Vân - Cầu Giẽ (30 km), Nội Bài - Bắc Ninh (30 km), Liên Khương - Đà Lạt (20 km).

Phụ lục II
BẢNG TỔNG HỢP DIỆN TÍCH ĐẤT ĐAI CHIẾM DỤNG CỦA QUY HOẠCH

(Ban hành kèm theo Quyết định số 1734/QĐ-TTg ngày 01 tháng 12 năm 2008 của Thủ tướng Chính phủ)

STT	Tên tỉnh	Các tuyến cao tốc đi qua	Diện tích chiếm dụng (ha)		Cộng (ha)		Diện tích đất nông nghiệp (ha)
			Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	
I	Đồng bằng sông Hồng						
1	Hà Nội	Bắc - Nam phía Đông	166,80	0,00	457,20	2.620,49	2.620,49
		Hà Nội - Hải Phòng		68,03			
		Nội Bài - Hạ Long - Móng Cái	64,00	11,20			
		Hà Nội - Thái Nguyên		129,60			
		Hà Nội - Việt Trì - Lào Cai		177,16			
		Láng - Hoà Lạc - Hoà Bình	107,00				
		Vành đai 3 thành phố Hà Nội	119,40	134,50			
		Vành đai 4 thành phố Hà Nội		2.100,00			
2	Vĩnh Phúc	Vành đai 4 thành phố Hà Nội		1.300,00	0,00	1.618,88	1.618,88
		Hà Nội - Việt Trì - Lào Cai		318,88			
3	Bắc Ninh	Bắc - Nam phía Đông	122,40		190,40	1.776,90	1.776,90
		Nội Bài - Hạ Long - Móng Cái	68,00	152,90			
		Vành đai 4 thành phố Hà Nội		1.600,00			
		Hà Nội - Thái Nguyên		24,00			
4	Hà Tây	Bắc - Nam phía Đông	92,40	25,50	513,71	4.568,50	4.568,50
		Bắc - Nam phía Tây	53,31	143,00			
		Vành đai 4 thành phố Hà Nội		4.400,00			
		Láng - Hoà Lạc - Hoà Bình	368,00				

STT	Tên tỉnh	Các tuyến cao tốc đi qua	Diện tích chiếm dụng (ha)		Cộng (ha)		Diện tích đất nông nghiệp (ha)
			Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	
5	Hải Dương	Hà Nội - Hải Phòng		434,82	0,00	528,82	528,82
		Nội Bài - Hạ Long - Móng Cái		94,00			
6	Hải Phòng	Hà Nội - Hải Phòng		309,86	0,00	569,32	569,32
		Ninh Bình - Hải Phòng - Quảng Ninh		259,46			
7	Hưng Yên	Vành đai 4 thành phố Hà Nội		1.800,00	0,00	2.028,16	2.028,16
		Hà Nội - Hải Phòng		228,16			
8	Thái Bình	Ninh Bình - Hải Phòng - Quảng Ninh		194,59	0,00	194,59	194,59
9	Hà Nam	Bắc - Nam phía Đông		122,40	0,00	122,40	122,40
10	Nam Định	Bắc - Nam phía Đông		102,00	0,00	274,97	274,97
		Ninh Bình - Hải Phòng - Quảng Ninh		172,97			
11	Ninh Bình	Bắc - Nam phía Đông		93,30	0,00	201,41	201,41
		Ninh Bình - Hải Phòng - Quảng Ninh		108,11			
II	**Đông Bắc**						
12	Bắc Kạn	Thái Nguyên - Chợ Mới		33,60		33,60	8,40
13	Lào Cai	Hà Nội - Việt Trì - Lào Cai		399,22	0,00	399,22	119,77
14	Yên Bái	Hà Nội - Việt Trì - Lào Cai		463,84	0,00	463,84	139,15
15	Thái Nguyên	Hà Nội - Thái Nguyên		114,00	0,00	198,00	66,60
		Thái Nguyên - Chợ Mới		84,00			
16	Lạng Sơn	Bắc - Nam phía Đông	144,97	346,85	144,97	346,85	138,74
17	Quảng Ninh	Nội Bài - Hạ Long - Móng Cái		1.077,80	0,00	1.142,66	349,29
		Ninh Bình - Hải Phòng - Quảng Ninh		64,86			
18	Bắc Giang	Vành đai 4 Tp. Hà Nội		1.300,00	64,40	1.439,61	705,84
		Bắc - Nam phía Đông	64,40	139,61			

STT	Tên tỉnh	Các tuyến cao tốc đi qua	Diện tích chiếm dụng (ha)		Cộng (ha)		Diện tích đất nông nghiệp (ha)
			Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	
19	Phú Thọ	Hà Nội - Việt Trì - Lào Cai		228,90	49,92	328,75	164,37
		Bắc - Nam phía Tây	49,92	99,85			
III	**Tây Bắc**						
20	Hoà Bình	Bắc - Nam phía Tây	80,85	242,54	95,93	589,33	176,80
		Láng - Hoà Lạc - Hoà Bình	15,08	346,79			
IV	**Bắc Trung Bộ**						
21	Thanh Hoá	Bắc - Nam phía Đông		605,00	168,01	1,109,02	514,21
		Bắc - Nam phía Tây	168,01	504,02			
22	Nghệ An	Bắc - Nam phía Đông		506,00	166,74	908,96	333,59
		Bắc - Nam phía Tây	166,74	402,96			
23	Hà Tĩnh	Bắc - Nam phía Đông		588,50	7,58	780,46	273,79
		Bắc - Nam phía Tây	7,58	15,16			
		Hồng Lĩnh - Hương Sơn		176,80			
24	Quảng Bình	Bắc - Nam phía Đông		637,00	0,00	637,00	127,40
25	Quảng Trị	Bắc - Nam phía Đông		332,00	0,00	682,00	136,40
		Cam Lộ - Lao Bảo		350,00			
26	Thừa Thiên - Huế	Bắc - Nam phía Đông		360,00	0,00	360,00	108,00
V	**Duyên hải Nam Trung Bộ**						
27	Đà Nẵng	Bắc - Nam phía Đông	29,74	217,88	29,74	217,88	65,36
28	Quảng Nam	Bắc - Nam phía Đông		386,40	0,00	386,40	115,92
29	Quảng Ngãi	Bắc - Nam phía Đông		469,20	0,00	469,20	140,76
30	Bình Định	Bắc - Nam phía Đông		583,30	0,00	813,30	220,99
		Quy Nhơn - Pleiku		230,00			

STT	Tên tỉnh	Các tuyến cao tốc đi qua	Diện tích chiếm dụng (ha)		Cộng (ha)		Diện tích đất nông nghiệp (ha)
			Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	
31	Phú Yên	Bắc - Nam phía Đông		510,00	0,00	510,00	102,00
32	Khánh Hoà	Bắc - Nam phía Đông		892,50	0,00	892,50	178,50
VI	**Tây Nguyên**						
33	Kon Tum	Bắc - Nam phía Tây	37,90	113,69	37,90	113,69	11,37
34	Gia Lai	Bắc - Nam phía Tây	156,64	469,91	156,64	1,019,91	101,99
		Quy Nhơn - Pleiku		550,00			
35	Đắk Lắk	Bắc - Nam phía Tây	138,95	416,86	138,95	416,86	41,69
36	Đắk Nông	Bắc - Nam phía Tây	123,79	371,38	123,79	371,38	37,14
37	Lâm Đồng	Dầu Giây - Đà Lạt	100,00	475,00	100,00	475,00	47,50
VII	**Đông Nam Bộ**						
38	Ninh Thuận	Bắc - Nam phía Đông		316,20	0,00	316,20	63,24
39	Bình Thuận	Bắc - Nam phía Đông		984,30	0,00	984,30	295,29
40	Bình Phước	Bắc - Nam phía Tây	198,32	612,04	198,32	946,84	222,85
		Thành phố Hồ Chí Minh - Thủ Dầu Một - Chơn Thành		334,80			
41	Tây Ninh	Bắc - Nam phía Tây		65,83	0,00	192,73	35,25
		Thành phố Hồ Chí Minh - Mộc Bài		126,90			
42	Bình Dương	Bắc - Nam phía Tây		151,15	0,00	188,95	34,01
		Thành phố Hồ Chí Minh - Thủ Dầu Một - Chơn Thành		37,80			
43	Đồng Nai	Bắc - Nam phía Đông		550,80	0,00	1,220,10	248,91
		Thành phố Hồ Chí Minh - Long Thành - Dầu Giây		35,70			
		Biên Hoà - Vũng Tàu		220,00			
		Dầu Giây - Đà Lạt		413,60			
44	Bà Rịa - Vũng Tàu	Biên Hoà - Vũng Tàu		198,00	0,00	198,00	59,40

STT	Tên tỉnh	Các tuyến cao tốc đi qua	Diện tích chiếm dụng (ha)		Cộng (ha)		Diện tích đất nông nghiệp (ha)
			Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	
45	Tp. Hồ Chí Minh	Bắc - Nam phía Đông	21,00	110,25	125,00	704,65	704,65
		Thành phố Hồ Chí Minh - Long Thành - Dầu Giây		102,00			
		Thành phố Hồ Chí Minh - Mộc Bài		131,60			
		Vành đai 3 thành phố Hồ Chí Minh	104,00	360,80			
VIII	**Đồng bằng sông Cửu Long**						
46	Long An	Bắc - Nam phía Đông	105,00	41,25	105,00	297,24	220,44
		Bắc - Nam phía Tây		255,99			
47	Tiền Giang	Bắc - Nam phía Đông	42,00	322,50	42,00	322,50	322,50
48	Vĩnh Long	Bắc - Nam phía Đông		102,00	0,00	102,00	102,00
49	Đồng Tháp	Bắc - Nam phía Đông		61,20	0,00	278,18	278,18
		Bắc - Nam phía Tây		216,98			
50	An Giang	Bắc - Nam phía Tây		48,76	0,00	400,76	400,76
		Sóc Trăng - Cần Thơ - Châu Đốc		352,00			
51	Kiên Giang	Bắc - Nam phía Tây		63,39	0,00	877,39	701,91
		Hà Tiên - Rạch Giá - Bạc Liêu		814,00			
52	Cần Thơ	Bắc - Nam phía Đông		92,00	0,00	377,94	377,94
		Bắc - Nam phía Tây		21,94			
		Sóc Trăng - Cần Thơ - Châu Đốc		264,00			
53	Hậu Giang	Bắc - Nam phía Đông		322,00	0,00	564,00	564,00
		Hà Tiên - Rạch Giá - Bạc Liêu		88,00			
		Sóc Trăng - Cần Thơ - Châu Đốc		154,00			

STT	Tên tỉnh	Các tuyến cao tốc đi qua	Diện tích chiếm dụng (ha)		Cộng (ha)		Diện tích đất nông nghiệp (ha)
			Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	Diện tích đã chiếm dụng	Diện tích cần bổ sung thêm	
54	Sóc Trăng	Hà Tiên - Rạch Giá - Bạc Liêu		44,00	0,00	154,00	154,00
		Sóc Trăng - Cần Thơ - Châu Đốc		110,00			
55	Bạc Liêu	Bắc - Nam phía Đông		184,00	0,00	360,00	360,00
		Hà Tiên - Rạch Giá - Bạc Liêu		176,00			
56	Cà Mau	Bắc - Nam phía Đông		92,00	0,00	92,00	92,00
	Tổng cộng				**2.916,20**	**38.187,62**	**24.167,34**
					41.103,82		

TCVN 5729/2007: EXPRESSWAY STANDARD FOR DESIGN

TABLE OF CONTENTS

1. Applications

This specification is applied for designing new freeway/expressway outside the urban areas (abbreviated as expressway).

In some special cases, some other standards can be applied but it must be technically and economically analyzed and approved by the Authorities.

2. Standards and reference documents

Regulations for traffic road, No 26/2001/QH10;

Decree 186/NĐ-CP dated November 05 2004 regarding the Regulations in management and protection of road transport infrastructure.

- TCVN4054	Highway - Design Specification
−TCXDVN 104	Urban Road - Design Specification;
− TCVN 2737 :1990	Loading Capacity and Effect - Design Standards;
−TCVN 4527 :1988	Tunnel for Railway and Road - Design Standards;
− 22 TCN 272	Bridge Design Standards;
− 22 TCN 221	Transportation Structure in Earthquake Area - Design Standards;
− 22 TCN 211	Flexible Pavement - Technical Specification for Design;
− 22 TCN 223	Procedure for Rigid Pavement Design;
− 22 TCN 237	Road Signal Regulation;
− 22 TCN 278	Pilot Procedure for Determining Roughness Index by Sand spreading method;
− 22 TCN 345	Thin Asphalt Concrete with High Roughness Index – Technical procedure for construction and commissioning;
− 22 TCN 277	Standard for Inspecting and Appraising Road Surface based on International Roughness Index (IRI);
− 22 TCN 242	Procedure of assessing Environment impact during Feasible Study and Design Stage;
− 22 TCN 262	Procedure of Survey and Design fill road pavement on Soft Soil Area;
− 22 TCN 171	Procedure of Geology Survey and Method of pavement stabilization in the area of sliding, erosion.

Note: For the reference documents showing published year, apply that edition. In the case published year is not shown, apply the currently effected version.

3. General regulations

3.1. Definition:

The term “expressway” in this standard should be understood as follows:

The expressway is specially used by cars with the following specifications: separating two directions (each direction requires a minimum of two lanes; each direction needs the emergency lane). There should be no level crossing with other traffic flows. The expressway shall have appropriate equipment and service to ensure smooth and comfortable traffic flow. The

expressway only allows car to enter and exit at the regulated locations (besides these entry/exit locations, the expressway is fully separated from the residential areas and other means of transport).

Regarding its function, the expressway is the mean of transport that has high flexibility with the priority to shorten the travel time and ensure traffic safety for cars (predominantly to provide high efficiency for long-distance car travelling).

3.2. Expressway grades

Expressway is divided into 4 grades:

- Grade 60 with the design speed of 60 km/h
- Grade 80 with the design speed of 80 km/h
- Grade 100 with the design speed of 100 km/h
- Grade 120 with the design speed of 120 km/h

Grade 60, 80 are applied for the difficult topography such as mountainous, rolling terrain and areas with other restrictions, the grades 100,120 are for flat topography.

3.3. In the case of improving the old road into expressway, the regulations in this specification must be complied although it is encouraged to maximize the utilization of existing works.

Note: If the quality of the old road is too bad, highly populated residential developments on both sides, the expressway should be newly designed (separately from the old route).

3.4. Expressway should be cooperated well with the urban planning and suitable with the economical centers in the future. During design, it is necessary to provide the measures to ensure the transport connection between the urban areas and expressway (including the measure of gathering traffic in the entry/exit points located on the expressway). Besides, on the basis of comprehensive investigation and evaluation of the environmental impact, it is necessary to mention the solutions to protect natural and social environment, to prevent the impact resident liveliness along the expressway, to pay particular attention to the solutions to ensure the normal transportation for the residential areas, which are separated by the expressway.

3.5. In the preparation stage of the expressway construction project (basic design stage), it is necessary to undertake studies to clarify the following contents:

3.5.1. Study to confirm the necessity of expressway construction, to define the control points for establishing alignment options, to compare and select the options and to evaluate the economic and financial effectiveness of the selected route.

3.5.2. Study to confirm the number of lanes (if more than two lanes for each direction are required) based on the evaluation of traffic capacity, study to confirm the necessity and effectiveness of constructing the uphill lane for slow cars (see item 5).

3.5.3. Study to confirm the necessity of arranging the traffic lanes for each direction at different elevation to reduce the quantity of expressway pavement earthworks (if the expressway runs along the mountain/hill slopes or it is possible to rehabilitate the existing two-lane road to form part of the new expressway).

3.5.4. Study to confirm the entry/exit locations on the expressway, study to select and compare the types and arrangement options of intersections on the expressway.

3.5.5. Study the options of longitudinal sections to be above or under the residential road crossing, especially the sections in soft ground areas.

3.5.6. Compare the options and study to confirm location of toll stations.

3.6. Expressway shall be designed based on the traffic volume forecast for 20 years from the commissioning year and the planning of railway, waterway, road, aerial, pipelines network at present and in the future so that the designed expressway can maximize its efficiency in the overall network. Besides, there should be no negative impacts to the activities of other short-distance and local transportation. It is also necessary to be aware of reserve land for the widening of traffic lane, intersection areas in the far future.

3.7. Although having to consider for the far future, since the expressway construction investment scope is large, the stage investment options must be considered in preparation of freeway/expressway project.

In the case of considering the stage investments, it is necessary to prepare a comprehensive general design for the future to ensure the inheritance of previously constructed works in the previous stages, also to ensure the staged design can provide advantageous condition to the construction works in the next stages.

3.8. It is necessary to pay attention to the space coordination of alignment elements to ensure safe, comfortable, steady, continuous feeling, clearly clarify the alignment visually and psycho-physiologically to users, and to ensure the well combination between the expressway and the scenery, the environment along the route by arranging the trees or equipment, structures on both sides of the road, also to supplement or minimize the cause of damaging natural landscaping due to the expressway construction.

To verify and evaluate the combination options, it is essential to prepare perspective presentation or 3D model of the sections with the above requirements during the design.

3.9. Design of freeway/expressway at earthquake area which is forecasted level 7 or above (following MSK64 scale) must be obeyed standard 22 TCN 221.

4. Basis for expressway design

4.1. The vehicles use on expressways are cars which are allowed to run on public road network and motorbikes which has appropriate power regulated by the Authorities (recommended to be over 175cm^3). The size of cars on expressway is the size regulated in TCVN 4054 Highway - Design standards and it is the basis to determine the technical standards for geometrical elements and navigation clearance limit on the expressway.

Besides the above-mentioned cars and motorbikes with appropriate power, the people and other vehicles, that wish to use the expressway, should obtain permits from the Authorities.

4.2. Traffic regulations on freeway/expressway

4.2.1. The vehicles must run on the correct lane; overtaking is only allowed in the left lane; if there is auxiliary lane, it must used by slow and heavy vehicles; if the car exits from expressway, it must run on the auxiliary/split lane and reduce speed; if it enters the expressway, it must run on the accelerating lane, waiting for merging into the expressway.

4.2.2. The vehicles are allowed to stop on the expressway (except for the emergency case, it can stop on the emergency lane)

4.2.3. The vehicles is only allowed to turn its direction (U-turn) at the next intersection or at the regulated locations in item 7.4.3 (the break between medians are for reservation only)

In geometric design, guiding and warning elements must follow and ensure the compliance with the above regulations.

4.3. Normally, the construction of expressway should be considered if the forecasted traffic volume is approximately 25.000 units /day. It must not be understood that we have enough basis to make decision for the expressway construction investment project if the traffic volume is over the mentioned number. This figure is for guidance only. In any expressway construction project (irrespective of how large the traffic volume is), it is necessary to prepare economical and financial evaluation report with the consideration of political, national defense, cultural and social requirements and international relation and exchange to make decision on the expressway construction.

The calculated traffic volume is understood as the average daily traffic volume per year of the vehicles which are allowed to run on the expressway. The volume is converted to equivalent car in the calculated year correlative with the calculate time as mentioned in 3.8. The converted ratio into car is applied according to TCVN 4054.

4.4. In the expressway, there may be some sections with various grades, but these sections must be at least 15km long and the design speeds variation at two continuous sections cannot be more than 20km/h. If there is over one grade (20km/h) difference, it is necessary to have one transition section with the minimum length of 2km according to the standard of the road grade of the transition section.

4.5. Define the required number of lane for the expressway.

4.5.1. The required number of lanes for each direction of the expressway is determined based on the estimated traffic volume of each direction N_k at the k^{th} hour of the evaluated year (car/hour) and the design traffic capacity N_{tk} of each lane (car/hour.lane) as follows

$$N_{lx} = \frac{N_k}{N_{tk}}$$

N_k and N_{tk} are calculated in PCUs. The required number of lanes for each direction of the expressway shall be an integer, not less than two.

4.5.2. Determine the value of N_k

The meaning of N_k: in the calculated year (refer 3.8), there are only k hours with similar or larger traffic volume than N_k; k is stipulated as 30 hours or 50 hours (usually the 30th peak hour of the year).

If there is no basis for estimating N_k, the designer is allowed to apply the following correlation to define N_k:

$$N_k = K.N_{avg\ year}$$

of which:

$$K = 0.13 \div 0.15$$

N_{tbnam} is the average daily traffic volume per year for each direction in the calculated year (car/day).

For each direction of expressway, there may be different N_{tbnam}

4.5.3 Determine the value of N_{tk}

Design traffic capacity of one lane N_{tk} is defined as follow:

$$N_{tk} = Z.N_{ttmax}$$

of which:

N_{ttmax} is the largest actual traffic capacity of one lane in the standard condition (travel in straight and flat section) (PCU/hour-lane); as for expressway, apply N_{ttmax} = 2,000 PCU/hour.lane.

Z is the level of service coefficient, defined as follows:

For expressway in flat and hilly terrain, apply Z = 0.55; for mountainous area, apply Z = 0.77.

4.6. Navigation clearance on expressway is showed in figure 1.

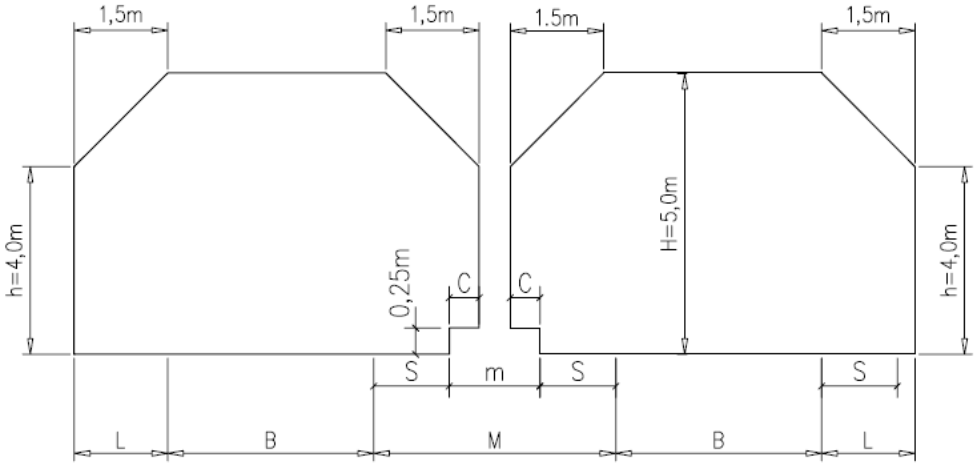


Figure 1 – Navigation clearance on expressway

of which:
m - the width of separating strip
M - the width of median strip
S - the width of the emergency strip
B - the width of the carriageway (road surface), measured in meter.
L - the width of hard shoulder (excluding the grass shoulder)

The values m, M, S, B, L are determined in accordance with regulations in 5.1 depending on the grade of expressway and the structure of separating strip.

The coefficient c is stipulated as 0.3m for grade 120; 0.25m for grades 100, 80 and 60.

H = 5.00m is the height of navigation clearance, measured from the highest point on the carriageway B (H should be increased by 0.1-0.2m to allow for raising of road pavement level in

the tunnel under repair).

h = 4.0m is the height, measured from the edge of hard shoulder.

4.7. The navigation clearance of the expressway tunnel is specified in Figure 1 with the following notes:

4.7.1. For the tunnel less than 1000m long, since there is no need for emergency lane, the width of hard shoulder L in Figure 1 can be reduced to 1.50m for grade 60 and 80 expressways and 1.25m for grade 100 and 120 expressway to ensure the arrangement of 1.0m wide footpath with sufficient clearance from carriageway edge for the pedestrians. For this scope of L, the coefficient h is defined as follows:

$$h = \Delta h + 2.5$$

of which

Δh is the difference between the height of footpath pavement and safety lane surface S (normally, $\Delta h = 0.40m$)

2.5 is the navigation clearance for pedestrians, measured in meter.

4.7.2. For the expressway tunnel longer than 1000m, at the widened area for the emergency lane regulated in 5.13.1, the navigation clearance is maintained as Figure 1, depending on the expressway grade.

4.8. Navigation clearance required underneath the expressway

When the expressway flies over the railways, roads, waterways with ship navigation…, it is necessary to ensure that the navigation clearance under the expressway shall be correlative with the standard, specification of railway, road, waterway to ensure the comfortable transport on those routes. If the residential road under the expressway is for pedestrians, bicycles and non-motorised vehicles only, the clearance height at this location is specified as 2.50m with the minimum width of 4.0m.

5. Cross section arrangement of expressway

5.1. The elements of expressway cross section are shown in Figure 2.

The standard width of the elements on the cross-sectional for each direction of two-lanes expressway is stipulated in Table 1.

5.2. The crossfall of the road surface on the straight section shall be 2% slope to the outer-edge. For the curve section, it requires the crossfall i_{sc}% as stipulated in Figure 3, where the safety lane on the shoulder of the curve must be designed with the crossfall of 2% towards the outer-edge.

5.3. The safety lane shall be arranged to allow vehicles to run at the high speed. Besides, the safety lane next to the road outer-edge is also used for emergency vehicles if necessary (also called the emergency stopping lane).

5.3.1. In area of 0.25m adjacent to the edge of carriageway, the safety lanes on either side must have the same road pavement structure (assume widening 0.25m to both sides). Beyond this

area, the remaining portion of the safety lane can have thinner pavement structure, but for the safety land on the shoulder (the reinforced shoulder side), it must ensure the durability for emergency stopping vehicles (not very often). The structure and design of safety lane must follow the guidance in 22 TCN 211.

5.3.2. In the area of the 0.25m widening referred above, use the paint of regulated color to draw a 0.2m wide direction-guiding line adjacent to the edge of road surface. This line must be visible at night (using road marking reflection painting).

5.3.3. The crossfall of the safety lane located in the median area must be the same as the crossfall of road pavement for both straight and curve sections as referred in 5.2 (Figures 2 & 3).

5.3.4. On straight sections, the crossfall of the safety lane in the area of hard shoulder is 4% (Figure 2). On curve alignment which i_{sc}, the crossfall shall be the same with i_{sc} of the emergency stopping lane at the inner side of the curve, for the outer side of the curve, the crossfall is towards outside with the gradient of 2% (Figure 3).

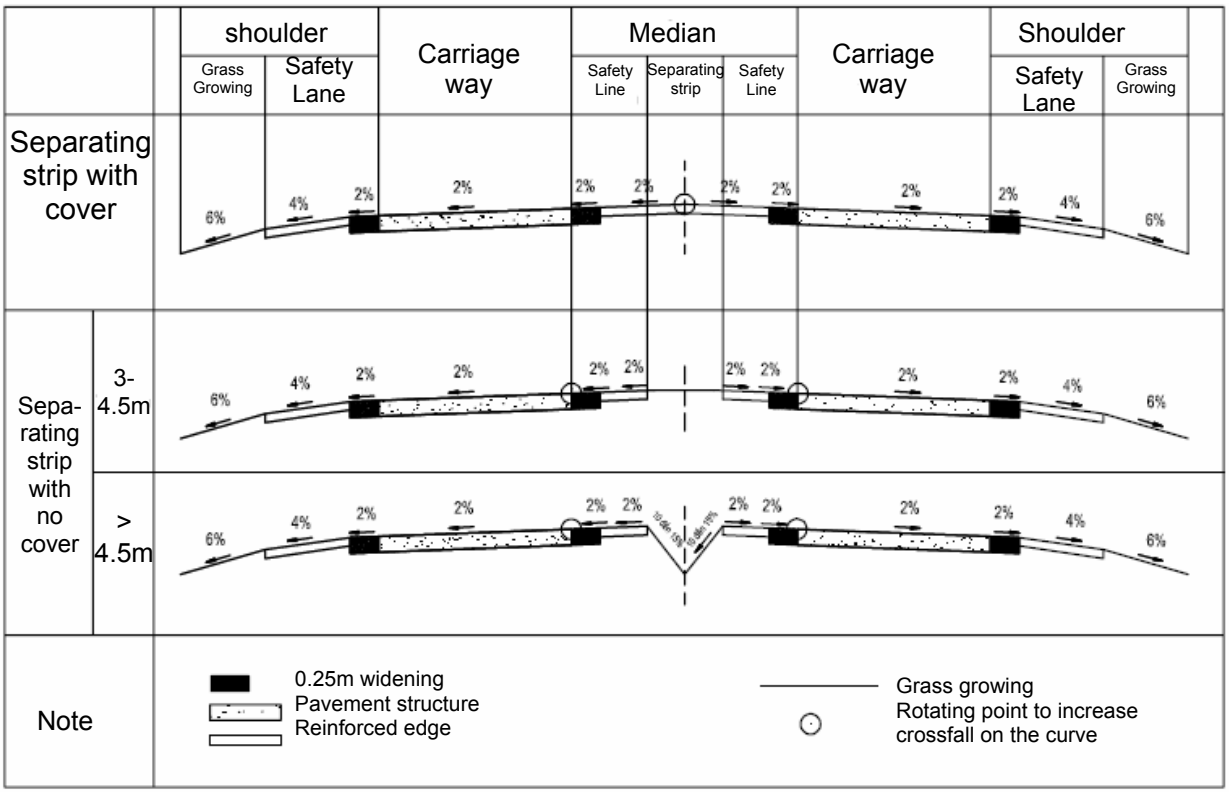


Figure 2 – Elements on expressway cross Section

5.4. The grass-growing shoulder must be graded away from the carriageway with the cross fall of 6% (see Figures 2 & 3).

5.5. The median includes two safety lanes on both sides and one separating strip (Table 1) to divide two traffic directions, to reserve spaces for support of flyover structure, signal pedestal, protective equipment, trees, anti-glaring devices (due to headlight of opposite vehicles) and putting line, pipeline or drainage system. The width of separating line can be bigger than stipulation in Table I so that there is sufficient land for the mentioned works or widening the road in future if necessary.

unit: meter

Structure of separating strip	Express-way grades	Shoulder		Carriage-way	Median			Carriage-way	Shoulder		Road width
		Grass-growing	Safety lane (reinforced shoulder)		Safety lane	Separa-ting strip	Safety lane		Safety lane	Grass-growing	
1. with cover without column	60	0.75	2.5	7.0	0.50	0.5	0.50	7.0	2.5	0.75	22.0
	80	0.75	2.5	7.5	0.50	0.5	0.50	7.5	2,5	0.75	23.0
	100	035	3.0	7.5	0.75	0.5	0.75	7.5	3.0	0.75	24.5
	120	1.00	3 0	7.5	0.75	1.0	0.75	7.5	3.0	1.00	25.5
2. with cover and column	60	0.75	2 5	7.0	0.50	1.5	0.50	7.0	2.5	0.75	23.0
	80	0.75	2.5	7.5	0.50	1.5	0.50	7.5	2.5	0.75	24.0
	100	0,75	3.0	7.5	075	1.5	0.75	7.5	3.0	0.75	25.5
	120	1.00	3.0	7.5	0.75	1.5	0.75	7.5	3.0	1.00	26.0
3. without cover	60	0.75	2.5	7.0	0.50	3.0	0.50	7.0	2.5	0.75	24.5
	80	0.75	2.5	7.5	0.50	3.0	0.50	7.5	2.5	0.75	25.5
	100	0.75.	3.0	7.5.	0.75	3.0	0,75	7.5	3.0	0.75	27.0
	120	1.00	3.0	7.5	0.75	3.0	0.75	7.5	3.0	1.00	27.5

Table 1-The standard width of cross section elements on expressway

Note:

1) The columns in the table are arranged correlative with the elements on cross section from left to right in case two traffic directions are on the same road pavement. In difficult topographic area, each traffic direction can be arranged on separate pavement, the road width will then consist of the width of one-direction carriageway plus two shoulder widths (for the right shoulder, the width is the same as in Table 1, for the left shoulder, the safety lane (reinforced shoulder) is decreased to 1.00 for road grades 120 and 100, and 0.75 for the grades 80 and 60.

2) If each direction has 3 lanes, the pavement width should have additional 3.50m (grade 60) or 3.75 (grade 80, 100, 120) and the width of freeway/expressway base must be plus 7.0m (grade 60) or 7.5m (grade 80, 100, 120).

3) In any case the width of separating line is considered as the minimum.

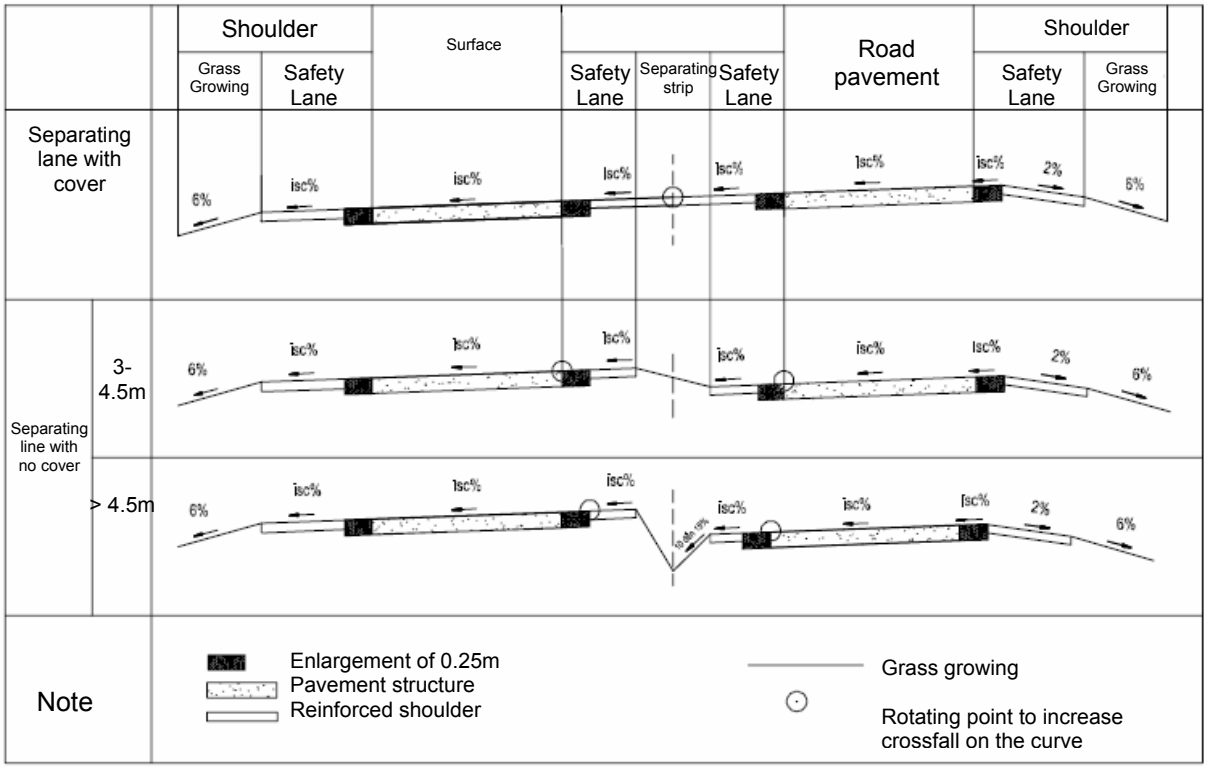


Figure 3 - Freeway/expressway Cross Section

5.5.1. If the width of the median is less than 3.0m there shall be a surfacing layer and the crossfall of this layer from its centerline must be equal to the crossfall of the road pavement in item 5.2 (see Figure 2). For the median with curb and 1.5m - 3.0m width, the surfacing layer is not required but it requires the solution to prevent dirt and unclean water from the median flowing to road pavement (the land in the median between two curbs must be lower than the top of curb) and to preventing surface water infiltrated from the median to the expressway pavement (install waterproofing layer of well compacted clay underneath).

5.5.2. If the width of the median is between 3.0m and 4.5m, there is no need for cover layer; grass planting is required with the cross fall of 0% for the straight section (Figure 2). For the curve section, we can connect the outside of one safety lane to the inside of the other safety lane after two parts of road pavement of two directions are super-elevated separately (Figure 3).

In this case, no matter if the median is curbed or not, there must be longitudinal drainage system along the median (install open trench, trench with grated cover, underground drainage pipe, infiltration trench etc.)

5.5.3. If the width of the median is more than 4.50m, its cross section must be designed into V shape with the crossfall from the two safety lanes on both sides to centerline between 10% and 15% (see figure 2 & 3). There should be some measures to guide the direction at night or in bad weather condition (to clearly identify the carriageway edge and the safety lane) to prevent vehicles from running into the median.

5.5.4. Along the median, at every 2 - 4km interval, in front of major structures (bridge, tunnel), a median break of 25-30m long is required to allow vehicles to turn its direction if necessary (the

management and barrier are arranged here, it is only open for U-turn in urgent case). The location of median break sections must be selected on the straight section or curve sections if the curve section is well ventilated and visible with a minimum radius of 600m.

The end of the median strip at the break shall be filleted with semi-circle.

5.5.5. In the design case with the median strip with curb, the curb must be at least 15cm higher than the road surface, the face of curb shall be sloped towards the carriageway (vertical face shall be avoided) and the top face of kerb must be filleted.

In this case, there must be drainage measures to drain water along the curb channel in on the curve sections with super-elevation towards one end (drainage pipe or underground trench with grated inlet).

5.6. In difficult topography or for purpose of reducing the size of flyover or road crossing structures on the expressway, the width of the cross section elements in Table 1 can be reduced as follows if approved by the investment Authorities:

- The width of expressway pavement is reduced to 7.0m. The width of the median strip cannot be reduced.

- The width of the safety lane must not be reduced below 0.5m. The width of the emergency lane must not be less than 2.0m or the emergency lane is arranged with 30m length for every 500m interval.

- The grass-growing shoulder must not be less than 0.75. For the Grade 60 expressway, it must not be less than 0.5m.

The length of the narrowed sections in the cross sections as mentioned above must not be between 0.5km - 1km or more than 2km. The transitional section from the standard section to narrowed section must be 1° slope maximum compared with the centerline. The ends of the transitional section are connected with the curve sections with the radius larger than the correlative radius with the grade of i_{sc} = + 2% (Table 4).

5.7. If the traffic directions are on separate pavements, the standard cross section of the expressway is stipulated in item 1 of the Notes of Table 1.

5.8. If each direction has more than two lanes, the arrangement of the cross section shall still comply with the regulations for shoulder and median of Table 1. For the width of road pavement, it is necessary to add 3.50m for each additional lane (Grade 60 and 80) and 3.75m for each additional lane (Grade 100 and 120) (refer note 2 of table 1).

5.9. Up-hill auxiliary lane

5.9.1. Consideration shall be given to the construction of uphill auxiliary lane on 4-lane expressway in the following cases:

- The section with the longitudinal gradient of 3% or more and the length of the slope of 800m or more for the expressway of grade 100 and 120.

- The slope section with the vehicle speed of truck is below the permissible value in table 2, and the calculated traffic volume on the upside direction (2 lanes) exceeds the design traffic capacity in item 4.5.3 (N_{ttmax} is determined correlative with the specific gradient of the design slope section; in preliminary calculation, the value N_{ttmax} of the uphill section is average of 1600 units /hour/lane).

Measured by km/h

The grade of expressway	120	100	80	60
The minimum acceptable speed for vehicles going up the slope	60	55	50	40

Table 2 - The minimum permissible speed for vehicles going up the slope on freeway/expressway

- In the slope section which the uphill speed of truck is less than the permissible value in table 2 and the length of the slope is more than 1000m, the speed of uphill truck must be evaluated based on the type of vehicle, the grade and the length of the slope

- No consideration is given to the construction of uphill auxiliary lane for the 6-lane expressway (each direction has 3 lanes or more) and the 4-lane expressway with high bridge, tunnel, and pavement with deep cut.

Note: In the cases with above conditions, the decision whether to construct auxiliary lane for uphill truck shall depend on specific economic and financial study for each particular case. The study must calculate the time savings when light vehicles are going up the slope, when another lane is dedicated for the trucks.

5.9.2. Structure and arrangement of auxiliary lane of going up slope

- The width of auxiliary lane for uphill slope must be 3.50m; it can be reduced to 3.25m for the difficult mountainous and hilly topography.

- The auxiliary lane shall be located next to the outer lane of the carriageway with the lane separating line of 0.20m width (this line is in the area of the auxiliary lane).

- The transitional section with triangular style from the outer main lane to auxiliary lane is minimum 45m long and located in front of the point of changing longitudinal grade; the outer side of transition section must be connected with the curve line.

- At the end of slope, the transition section must be provided so that the trucks accelerate to merge into the main lane; the length of this section from top of the slope (the grade changing location on the convex curve in the longitudinal section) is stipulated in table 3.

Longitudinal slope after going up the slope, %	Down-hill	Flat (0%)	Uphill			
			0.5	1.0	1.5	2.0
The length of the transition section after the slope, m	150	200	250	300	350	400

Table 3 - The length of transition section following the slope of auxiliary lane for vehicles going uphill

There must be connection of triangular style of 75m at the end of transitory section.

5.9.3. Cross section of expressway at the section with uphill auxiliary lane.

- At the slope section with the auxiliary lane without the emergency lane, the outside of the auxiliary lane only needs the safety lane of 0.50m (with lane separation line marking of 0.20m), followed by the grass shoulder of 0.75m.

- On the straight expressway section, the crossfalls of auxiliary lane, of the safety lane and of the shoulder are the same as the crossfall of the section without auxiliary lane.

- When the expressway is on the curve, the super-elevation in the area of auxiliary lane is maximum 4% (correlative with the super-elevation specified for the main lanes from 4% to 8%); if the super-elevation of the main lane is less than 4%, the super-elevation of auxiliary lane shall be the same as main lane's.

5.10. The cross section of freeway/ expressway at the section of parallel speed-changing lane

- The width of speed-changing lane is 3.50m for one lane and 7.00m for two lanes. This lane is separated from the main lane by a pavement marking of 0.20m width (this marking is in the area of speed-changing lane).

- The speed-changing lane should be located on the cross section of expressway similarly to uphill auxiliary lane in item 5.9.3; for the curve the super-elevation in the area of speed-changing lane should be linearly changed according the increase or decrease of speed in the scale of super-high gradient of main traffic and the one of the out/in-coming section to freeway/expressway.

5.11. Protective corridor for expressway

5.11.1. Protective corridor for expressway begins from the outer edge of the table drain on both sides of the fill embankment (from the batter toe or toe of the supporting structure if there is no table drain), or from the outer edge of the gutter on top of cut batter (if there is no top gutter, then calculate from the top of batter) to the outside according to the Regulations on Road Management issued with the Decree 186/2004/NĐ-CP.

5.11.2. For the section of high embankment or deep excavation, embankment on soft ground, the determination of protective corridor must be based on the protection works such as counter berm, retaining wall etc.

5.11.3. It is necessary to rely on the practical requirement and detailed design to define the land corridor for the arrangement of equipment along the alignment, rest areas, service areas and toll stations on expressway on the principle of saving land and using uncultivated land.

5.11.4. In the area of land corridor stipulated in item 5.11.1, plants are only allowed to grow according to the current regulation, the non-road works such as channel excavation, buring of pipeline, cable and electricity pole and other equipment are not allowed to be constructed. For BOT expressway projects, the use of this corridor is regulated in the permit documents and investment agreements.

5.12. The cross section of the bridge on expressway

5.12.1 The bridge cross section is arranged and applied the standards of the road cross section of the correlative grade in item 5.1 (fully including the shoulder, pavement, median with the dimension stipulated in table 1). The grass shoulder is replaced by the auxiliary strip for operation service and parapet wall as shown in figure 4. It means that the width of the bridge (from the outside edge of this bridge parapet to the outside face of the other one) is equal to the width of road pavement at the correlative grade.

5.12.2 In difficult cases, the cross section of bridges with more than 100m length can be narrowed as shown item 5.6 (including the stipulation of arrangement of the transitional section from the standard cross-section to narrowed cross section) if it was approved by the investor.

For the bridge with 100m length or less, the cross section cannot be narrowed (the length includes two abutment lengths).

5.12.3 The cross section on Expressway Bridge shall be kept unchanged along to the length of bridge, including the length of two abutments. The structure of cross fall direction and crossfall grade of bridge on the straight or curve section are the same as the road (item 5.2).

5.12.4 On the cross section, the bridge on the expressway is often divided into two separate bridges for two traffic directions (figure 4), therefore there may be a gap with the same width the median taking into account the two parapets. This gap can be used for lightening the underpass below the expressway or covered by light material which is able to resist pedestrian loading if narrow (for repair and maintenance purpose).

5.12.5 For the bridge on expressway, arrange each traffic direction on separate pavement. For the section with auxiliary lane (uphill or speed-changing), the cross section shall be arranged so that the width (between outside edges of two parapets as shown in figure 4) shall be equal to the width of road pavement as stipulated for cases in items 5.7, 5.8, 5.9.3, 5.10.

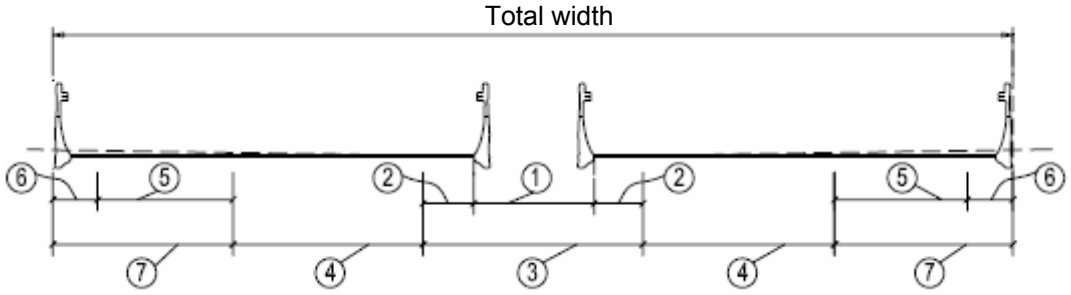


Figure 4-The cross section of bridge on freeway/expressway

Note:

1) The same as the width of separating strip,
2) The same as the width of safety lane inside.
3) The same as the width of the median
4) Expressway pavement surface (carriageway)
5) The same as the width of safe line on the right
6) The grass shoulder is replaced by the area of parapet and walkway for expressway operation staff.
7) Correlative with the width of the right pavement.

5.13. The cross section of expressway tunnel

5.13.1. On expressway tunnel with length less than 1000m, the emergency lane may not be essential; only the pedestrian walkway is required as stipulated in item 4.7.1. If the length of expressway tunnel is greater than 1000m, the emergency lane is to be arranged with 30m long sections at the interval of 500m.

5.13.2. On the expressway, there should be separate expressway tunnel for each traffic direction. In cross section, these two separate tunnels should have a minimum distance between two outer edges of tunnels wall equal or larger than 10m - 15m.

5.13.3. The dimension of the elements on the cross section of one tunnel for one direction of expressway is stipulated in item 4.7:

- The width of carriageway in tunnel B is correlative with the grades of expressway in table 1;
- The width of safety lane (S in figure 1) depends on expressway grade (table 1);
- The width of hard shoulder L (figure 1) is stipulated in 4.7.1 or 4.7.2;
- The pedestrian walkway of 1.0m width shall be 0.4m higher than the hard shoulder surface;
- The grass shoulder is not to be constructed;
- The clearance height of the expressway tunnel is stipulated in item 4.7

5.13.4. If the different direction of lanes is designed in one tunnel, the cross section of the expressway in tunnel is stipulated in figure 1, i.e. including 2 symmetric cross sections as stipulated in 5.13.2 with a medium at m width (refer Figure 1)

5.14. The cross section of the expressway exit/entry ramp from the right and the branch road at the interchange consist of one-way and two-way ramps.

5.14.1. The width of the one-way ramp pavement on the straight section is minimum of 4.0m, 7.0m for the two-way; at the curve sections, widening as stipulated in table 16 is required. In case of heavy traffic, the pavement width can be calculated by the number of necessary lanes as for usual road (see TCVN 4054)

5.14.2 The cross section of the one-way ramp consists of road pavement (as above), the safety lane of 2.0m wide on the right and the grass shoulder of 1.0m wide on both sides.

5.14.3 The cross section of the two-way extension road consists of road surface (as above), one safety lane of 1.0m for each side and the grass shoulder of 0.75m wide for both sides.

6. Design of expressway alignment on plan, longitudinal section and coordinated design of geometric alignment elements.

6.1. Main technical standard of geometric alignment elements of expressway grades on plan and longitudinal section is stipulated in table 4.

Items	Unit	The grade of freeway/ expressway			
1. Calculated speed Vtt Km/h	%	60 ~	80	100	120
2. Super-elevation slope (or one-way crossfall) isc % not more than	M	8	8	8	8
3. The minimum radius Rmin correlative with isc = +8%,m	M	140	240	450	650
4. The minimum normal radius correlative with isc, = + 5%	M	250	450	650	1000
5. The radius correlative with isc =+ 2%	M	700	1300	2000	3000
6. The radius without the structure of one-way crossfall isc = -2%	M	1500	2500	4000	5000
7- The length of the transition curve correlative with Rmin,	M	150	170	210	210
8. The length of transition curve correlative with the minimum radius,	M	90	140	150	150
9. The length of transition curve correlative with the radius with the parameter in the bracket,	M	50 (450)	75 (675)	100 (900)	125 (1125)
10. The length of braking section and the eyeshot of stopping vehicles,	M	75	100	160	230
11. Maximum longitudinal gradient of going uphill,	%	6	6	5	4
12. Maximum longitudinal gradient of going downhill,	%	6	6	5.5	5.5
13. The minimum radius of convex vertical curve radius,	m	1500	3000	6000	12000
14. The minimum radius of concave vertical curve radius,	m	1000	1 2000	3000	5000

Table 4 - Main technical standard for expressway alignments

Note: The evaluated speed V_{tt} is understood as the speed for evaluating and defining limited standards of the geometrical elements at some special locations on the expressway.

6.2. Requirements for straight sections in alignment plans of expressway

- The length of straight alignment section shall not exceed 4km.
- The straight alignment section (measured by meter) shall be designed no more than 20-25 times of the evaluated speed (measured by km/h).
- The very long straight section shall be replaced by the curve with the small angle of turning direction and large radius (5000m to 15000m) to avoid monotony and glaring due to headlight at night.

6.3. Select the curve radius on expressway alignment

6.3.1. As usually, the curve with the radius less than the minimum normal radius in row 4 of table 4 shall not be used.

6.3.2. When using the minimum radius R_{min} in row 3 of table 4, the approval from the investor must be obtained.

6.3.3. The selection of the radius of the curve R should be based on the length of the straight section *l* following it as follows:

- If *l* ≤ 500m, then R ≥ *l*
- If *l* > 500m, then R ≥ 500m

6.3.4. Select of the radius of the curve so that the length of the curve is larger than the minimum length K_{min}:

- K_{min}„ shall ensure that the driver does not need to turn direction of steering-wheel in 6 seconds, i.e.

$$K_{min} = 1.67 \times V_{tt}$$

of which

- V_{tt} is the calculated speed, measured by km/h.
- K_{min} is equal to two times of the minimum length or the connected curve L (L value in item 6.5), measured by m.

6.3.5. When deviation angle is less than 7^0, the radius of the curve must be selected so that distance p and the curve length K is large enough, in particular, p shall be greater than or equal 2.0m; 1.75m; 1.50m; 1.0m and K must be greater than 1,400/α; 1,200/α ; 1,000/α; 700/α (α is the angle of deviation, measured by degree; $\alpha \leq 2°$ is measured by 2^0) correlative with evaluation of 120, 100, 80 and 60km/h.

6.4. Super-elevation on the curve

6.4.1. The crossfall of road pavement on the curve shall be designed to be inclined towards the inner of the curve for all curves with the radius less than the parameter in 5 of table 4. Depending on the location of R(m) between the rows 3,4; 4,5 and 5,6 of Table 4, the value of the gradient i_{sc} is defined by linearly interpolation of the values of correlative gradients at that line according to the invert of the radius (1/R) and rounded to 0.5%.

6.4.2. Super-elevation (Figure 3) can be applied to two sides of the road pavement (from the safety lane of this side to the safety lane of that the other side with the same gradient) if the median has a cover. For the median without the top cover, the two carriageway pavements of two-way road surface shall have separate crossfall increase as shown in figure 3 (in this case, the drainage system must be located at the median) or it is possible to select other super-elevation method so that the level of pavement edge is suitable to the actual topography and to reduce the volume of embankment.

6.4.3. The super-elevation transition shall be applied on the whole transitional curve as stipulated in 6.5.2.

6.5. The transition curve

6.5.1. The transitional curve of the clothoid shape with $A = \sqrt{R.L}$ must be located between the straight alignment and the round curve with the radius less than the minimum radius without the one-way crossfall stipulated in row 6 of Table 4, with the following conditions:

- R is the radius of the round curve at the end of the transitional curve, measured by meter.
- L is the length of transitional curve, measured by meter.

6.5.2. Correlatively with the different radius R, the minimum length of the transitional curve L is

defined as row 7, 8, 9 of table 4. If the designed radius of curve R is within the values given in brackets (row 7, 8, 9 of table 4), the length of the transitional curve is defined by linearly interpolation according to the radius R and the length L correlative with among the respective lines (the less the radius R is, the larger L is).

If the design radius R is greater than the value in bracket in row 9 of table 4, the length of the design transitional curve L shall be larger to ensure the harmony coordination with the plan elements with optical design perspective.

6.5.3. The parameter of the transitional curve with the clothoid shape A shall be selected as follows:

$$R \geq A \geq \frac{R}{2}$$

If the curve radius of is very large we should select A as follows:

$$R \geq A \geq \frac{R}{3}$$

6.6. Connection between the curve sections

6.6.1. Two curve sections with the same direction or consecutive opposite direction will be directly connected to each other (the connected straight section is not required) if each curve has the transitional curve of the clothoid shape meeting the standard in item 6.5.2. This stipulation allows direct connection between the transitional curve of the clothoid shape on alignment. In this case the curve radius at the direct connecting point should be greater than 100m.

6.6.2. If due to restrictive topography, there must be a straight connecting section between the consecutive curves, the minimum length (measured by meter) of this straight section between two same direction curves is defined as 6 times of calculated speed (measured by km/h), between the curves of opposite direction is defined as 2 times of calculated speed (measured by km/h)

6.6.3. When connecting the opposite curve of the S shape we should use two transitory curves having the same parameter A (or not more than 1.5 times difference with parameter A) and R_1, R_2 are not more than 3 times difference (R_1, R_2 are the curve radius at the end of the transition curve of the curves 1 and 2).

When connecting two curves of the same direction, the parameter A should be as follows: $0.5R_1 < A < R_2$.

6.7. Ensuring the sight distance on the curve

6.7.1. The obstacles in the inside of the curve on the plan must be removed to ensure the sight distance equal to the length of the stopping distance stipulated in row 10 of table 4 and the height of the driver eye-level of 1.20m and the removal section is 0.30 lower than this eye-level.

6.7.2. In defining the area of removing obstacles, the position of the driver's eyes on the cross section is located at 1.50m from the inside edge of the safety lane at the inside of the curve towards the carriage-way.

6.8. To increase the safety at the sections close to intersection point, the service station center or

the toll station, it is necessary to ensure the minimum sight distance of 200m, 270m, 350m and 400m correlative with the expressway of grades 60, 80, 100 and 120. Ensuring the sight distance on the horizontal and vertical curves must be checked to satisfy the above minimum sight distance.

6.9. The position of finished grade on the vertical alignment.

The finished grade on longitudinal section shall be designed along the edge of road surface if the median has no cover or along the centerline (centerline of median) if the median has cover (through the turning point super-elevation gradient on the curve in figure 2 and 3).

6.10. Regulations on vertical alignment

6.10.1. The maximum longitudinal gradient for the expressway grades is stipulated in row 11 and 12 of table 4. Because the expressway is one-way, in the case of separate pavement for different traffic directions with separate vertical grade, the maximum vertical grade when going down-hill is permitted to be larger than the uphill's vertical grade.

6.10.2. The value of longitudinal gradient is only used in the specially difficult case, the vertical grade of 3% or less (to avoid uphill auxiliary lane) is to be widely used. Particularly at the expressway sections before and after the intersections, a gradual slope should be designed (refer item 7.6 and 7.8). The vertical grade on the bridge, which span is 30m or above, and the approach bridge should not exceed 4%, the vertical grade through the tunnel of over 50m long should not exceed 3%.

6.10.3. The minimum vertical grade

- On the long excavated sections, the minimum longitudinal gradient must be 0.5%.
- On the transitional sections with crossfall of less than 1%, the minimum vertical grade shall be 0.5%.
- In tunnel the minimum longitudinal grade must be 0.3%

6.11. The length of vertical slope

6.11.1. The minimum slope length of the freeway/expressway is 300m, 250m, 200m, 150m, correlatively with the grades of 120, 100, 80, 60 and sufficient for the arrangement of vertical curve.

6.11.2. The maximum slope length for the different grades on the freeway/expressway grade should be as Table 5 below:

unit: meter

The longitudinal gradient %	Grade 120	Grade 100	Grade 80	Grade 60
4	600	800	900	1000
5	-	600	700	800
6	-	-	500	600

Table 5 - The maximum slope length for the different grades on the freeway/expressway

Note:

1) The slope length is calculated as the total of ¼ the first vertical curve and the straight line between 2 curves and ¼ the following vertical curve.
2) If the slope is continuous by combining various slope section with different gradient, us the average slope gradient calculating method to restrict the slope length in that section.

6.12. The vertical curve

6.12.1. On expressway, at the changing point of vertical curve, the vertical curve of the arc, parabolic or clothoid shape is required.

6.12.2. The radius of the vertical curve at different grades and its minimum length is shown in Table 6 below:

unit: meter

Item		Grade 120	Grade 100	Grade 80	Grade 60
The radius of the crest vertical curve	Minimum	12,000	6,000	3,000	1,500
	Minimum normally	17,000 (20,000)	1,000 (16,000)	4,500 (12,000)	2,000 (9,000)
The radius of the sag vertical curve	Minimum	5,000	3,000	2,000	1,000
	Minimum normally	6,000 (12,000)	4,500 (10,000)	3,000 (8,000)	1,500 (6,000)
The minimum length of vertical curve		100	85	70	50

Table 6 - The radius and the minimum length of the vertical curve on expressway

The radius of greater than minimum value should be applied; the minimum value is used in the specially difficult case. If the angle of changing slope is less, select the larger radius.

The values in brackets in table 6 are the radius of the vertical curve meet with the requirements of vision and we should design the vertical curve of those radius if favorable.

6.12.3. Avoid the short slope section between the vertical curves of the same direction (especially the same concave direction curves).

6.13. Designing co-ordination of alignment elements

6.13.1. To ensure safe and economic traffic on expressway, the expressway alignment must be designed harmoniously to the topography, landscaping, assisting the driver to have good vision and recognize the alignment clearly. Therefore, verification and evaluation of the alignment coordination in space must be carried out by perspective photograph, firstly at the section with the simultaneously change of plan and vertical grade, then the sections at the intersections or the section with special topography and geophysics on both sides.

6.13.2. To make alignments continuous, smooth and clear in space, the regulations and instructions of designing the elements of plan and vertical grade shown in 6.2, 6.3, 6.5, 6.6, 6.7, 6.12 shall be obeyed. The high levels should be applied to these elements so as to provide good guidance of direction to drivers naturally.

6.13.3. Coordination of vertical and horizontal curve

- The vertical and horizontal curve must be located coincidently with the length of horizontal curve greater than the length of the vertical curve and the deviation of their peaks is not larger than 1/4 of the shorter curve length.

- The radius of the vertical curve should be 6-time greater than the radius of the horizontal curve.

- Avoid connecting the end of the horizontal curve with the beginning of the convex or concave vertical curve (the vertical curve on the straight section).

- The vertical curve with the small radius must not be located in the transition curve.

6.13.4. Avoid locating many slope-changing sections on one long straight section. Avoid locating the concave vertical curve with shoe length and convex vertical curve with small radius on a straight line. Avoid locating the turning location at the steep slope area.

6.13.5. Co-ordination of expressway alignment and bridge and tunnel

- The location and the shape of the bridge is in attempt to satisfy the requirements of the coordination of alignment elements. The curve bridge, slope bridge, skew bridge are to be used, if necessary, to ensure the continuity and smoothness of expressway alignment on bridge.

- Design the straight alignment in tunnel; if the alignment in tunnel is on curve, the radius without one-way crossfall must be used and this radius must meet with the requirement of stopping distance on the curve (row 10 of table 4).

- The elements on plan and longitudinal section at the two ends of bridge or tunnel need the minimum section of 10m with the same arrangement as that on the bridge or in tunnel.

6.14. The expressway design is to be coordinated with landscaping

6.14.1. When selecting expressway alignment, use natural scenery such as hills, mountains, lakes, plants and architectural works (dike, rural housing etc.) to avoid the monotonous feeling.

6.14.2. Avoid destroying the topography, natural geomorphology and landscape: using alignment to emphasize the natural curvature of natural topography; growing plants to minimize the impact of excavation or embankment on the both sides of the road.

6.14.3. Avoid growing the same plants on both sides of the road: using tall trees to emphasize and guide directions, short trees to cover; single large trees or group of plants for landscaping purpose etc.

6.14.4. If expressway goes through the forest, avoid straight alignment to minimize the effect of inflexibly separating the forest. Start with the curve from the outside of the forest and arrange group of plants with the increasing density on the transition sections to the forest.

6.14.5. Through hills, expressway alignment should have the curve with the large radius and the

large bending of topography. Should not rely too much on the local small curvature. Restrict high embankment, deep excavation. The best way is to use the whole clothoid alignment to avoid break on longitudinal grade and plan which is caused by hilly topography.

For the topography of bald hills, we should grow plants at two sides of road.

6.14.6. For the plain topography, the selection of alignment must follow item 5.2

6.14.7. Expressway alignment on mountain should have retaining walls, road of balcony style, viaduct, type of crossfall and reinforcement measures that have decorative effects to make alignment continuous, smooth and clear.

Besides, the method of separating alignment of two carriage-way directions shall be applied to mountainous topography to suit the topography and reduce high embankment and deep excavation.

7. Design of intersection on expressway and entry/exit point to expressway

7.1. Classification of intersection on expressway

Functionally, the intersections on expressway are divided into three types:

- The intersection without in-coming/out-going point at freeway/expressway (called grade-separated junction). These are the intersections between expressway with railway, pipeline, pedestrian walkway (underpass or overpass the expressway) or other public roads which entry/exit to the expressway is not permitted.

- The intersection with in-coming/out-going point at expressway - (called level crossing). These are the intersections between expressway and highway of different grade which we can entry/exit the expressway and intersections between expressway and roads to airports, ports, railway station, cities, political and economical centers, industrial zones, mines, scenery, resorts, service centers along the expressway.

The connecting intersections on expressway should only be located at the junction of maximum 4 road branches, i.e. only T-junction, or crossing are accepted for the ease of concentrated toll station installation.

- The intersections on freeway/expressway is only the entry/exit point on the right side.

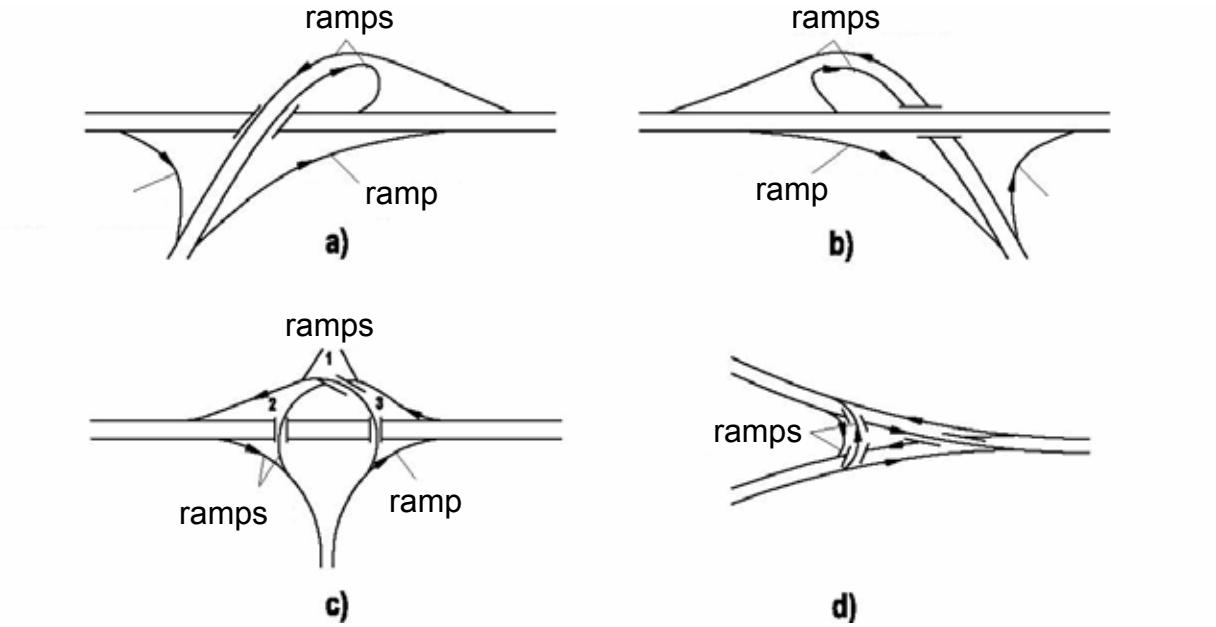
7.2. Expressways of both types of intersection (grade-separated junction and connecting intersection) in item 7.1 require intersection in principle of no at-grade intersection point on the whole freeway/expressway. However, in the area of intersection, depending on economical and technical study, the level crossing with other roads (two lane road and grade III or below) can be permitted.

If intersection is only an entry/exit ramp on the right, the design shall follow the requirements as for the ramps on the connecting grade-separated interchanges *refer to 7.7).

7.3. Selection of connected interchange types

7.3.1. At three-branch intersections (T-intersection location), the types of grade-separated

interchange can be chosen in figure 5.



Note: a, b - Trumpet interchange, c - T shape interchange, d - Y shape interchange

Figure 5 - Basic types of three-branch interchange

The trumpet interchange in figure 5a and 5b have advantage as follows: only one flyover is needed to ensure there is no crossing and mixing of traffic in the area of interchange (only have split and merge traffic), nice topology, driver can recognize direction easily. But the disadvantage of this type is the existence of indirect and semi-direct left turn stream has to travel a long distance which needs a large area to ensure the vertical slope for all ramps. This type of interchange is suitable for crossing between two expressways or between expressway and highway of 4 lane of grade I-III (i.e. crossing between the roads does not permit any crossing between the traffic flows).

The T and Y shape interchanges (figure 5s and 5d) have advantage as follows: the route to go through the intersection is shorter than trumpet one (especially Y shape); thanks to good ramp aspects, high traffic capacity and speed can be achieved; there is no indirect turn and land acquisition is reduced. The disadvantage of this type is that the construction cost is high due to the construction of 3 flyovers. However in case the expressway crosses over low grade roads (Fig 7.2), the number of flyovers can be reduced and crossing with exit/entry ramp to low grade roads can be permitted (Fig 5c). If the North-South is low grade auxiliary road, it is possible to combine Bridge 2 and 3 into one and remove Bridge 1; accept the crossing at 1 or in Figure 5d, it is possible to remove 1 certain bridge on the low grade auxiliary road.

7.3.2. In three-way intersection area, it is always possible to arrange closed toll collection system with only one toll plaza located at the lower grade road (if all crossings are expressways, locate the toll stations on the branches with lower traffic flow).

7.3.3. At four-way intersection, if toll plaza is not necessary, the types of grade-separated interchange can be chosen in figure 6. In figure 6a, 6b and 6e, if freeway/expressway crossing over a highway of 2 lanes (of which grade is lower than III), only two flyovers are necessary (level crossing with low grade road is acceptable). The remaining types are suitable for crossing over

between two expressways, each one has at least 4 lanes and grade I-III.

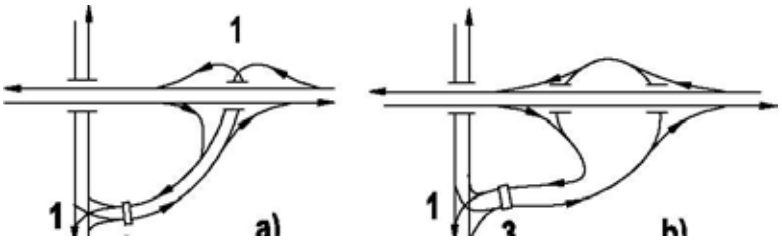
The advantage of each type of interchange can be seen by total number of flyovers to be constructed, the total road length through interchange and the ability in assisting the driver to recognize the traffic direction.

(this figure is not enough in VN version)

a- Lozenge interchange, b- half-asterisk interchange, c- spiral interchange, d: asterisk interchange, e- bracelet interchange, d- half-spiral interchange

Figure 6 - Basic types of four arm intersection interchange in which toll plaza is not constructed

7.3.4. At four-way arm intersection, if closed tolling system is in use, only one toll plaza shall be constructed. In this case, grade-separated connected interchange types in figure 7 can be applied; whereas Figures 7a, 7b, 7c and 7d (intersection with lower grade highway), is suitable for connected intersections between the expressway and with highway of 2 lanes or less (grade I-III). Figures 7e, 7f, 7g and 7h is suitable for connected interchanges between two expressways, expressway with highway with at least 4 lanes and grade I-III.



Note:

1- at-grade intersection on ramp; 2- three layer interchange; 3- location of toll plaza. (this figure is not enough in VN version)

Figure 7 - Basic types of four-way intersection with toll plaza

7.3.5. Not restricted to the above basic types, the suggestion of grade-separated connected interchange is the creativity of the designer based on the traffic scope of the branches with consideration the conditions of site topography and geophysics. In proposal phase, the type of interchange shall be considered with the below analysis:

- Consider turn direction in priority order: direct turn left for heavy traffic stream, semi-direct, or indirect left turn for medium or small traffic stream. Similarly, priority is given to the short turn length for heavy traffic.

- Three-level grade-separated intersection may be considered for the traffic of more than 6.000 PCU/day to reduce the travel length and time or to overcome the difficult topography.

- In all case, before any comparison, the traffic capacity should be audited to ensure the traffic capacity of branch road (by using the usage ratio of traffic capacity in item 4.2.2 of TCVN 4054),

the mix traffic section, the level crossing in the area of grade-separated connected interchange and ensure that they meet the technical requirement on geometrical elements as mention in item 7.7 of this standard and in chapter 11 of TCVN 4054.

7.3.6. The design of grade-separated connected interchange should be based on the comparison study of general technique and economy of each option by the following criteria:

1. Technical specification:

- Land area for right of way (ha);
- Total length (converted to one lane) of all branches in interchange area (km);
- Total length (converted to one lane) of main road in interchange area (km);
- Total surface area of all branches (m^2);
- Total surface area of main road in the area of the interchange (m^2);
- Total length (convert to one lane) of flyover and underpass in interchange area (m);
- Total quantity of earthwork(m^3).

2. Operating specification

- Travel time for left and right turn at design speed (second). (travel time is the time for travelling between two fixed points in the through road for comparison of various options)

- Total time for passing through interchanges in all direction per day (PCU hour/day). This criterion is calculated by the product of travel time on straight direction, left turn, right turn and number of PCU on straight direction, left turn, right turn, correlatively with each trip which is fixed by the same locations for all the comparison options.

3. Economy specification:

- Total construction cost (VND);
- Average maintenance cost in 1 year (VND)
- Average operation cost in 1 year (average in the entire operation period) (VND)

From the above criteria, it is possible to calculate the capital recovery duration of a high cost construction project but the maintenance and operation cost is small with a contrary option.

7.4. Stipulation of the distance among grade-separated connected interchanges

7.4.1. The minimum distance between grade-separated connected interchange and the entry/exit ramps from the right-hand side is 4 km. However, it is necessary to consider the solution of mixing the very close intersections into 1 such as 7.4.2.

7.4.2. The distance between grade-separated connected interchanges (the distance between entry and exit points of expressway) should be from 15km to 25km by constructing auxiliary road to combine the very close intersections into one point; for expressway sections around major cities or important industrial zones, this distance can be from 5km to 10km.

7.4.3. If the distance between grade-separated connected interchanges is more than 30km, we must locate the turning point at the break of the median at the special positions. At that location, signage or management personnel is required to instruct the wrong-direction vehicles, maintenance and emergency to U-turn.

7.4.4. The minimum distance between grade-separated connected interchange and rest, servicing areas along the expressway must be from 3km to 5km with the minimum tunnel opening of 1.5km-4km.

7.5. The requirements for other highways connecting with grade-separated connected interchange on expressway:

These highways must ensure sufficient traffic capacity to avoid negative impacts to the through traffic of connected alignments. Besides, it can gather and distribute traffic to the neighbor road network or directly connect with the heavy traffic locations.

7.6. In the area of grade-separated connected interchange, apply the technical standards in table 7 for expressway (especially for the expressway running underneath); usually use the radius larger than or equal to the normal value and the vertical grade smaller than or equal to the normal value in Table 7.

The grades of expressway			120	100	80	60
The minimum radius of the horizontal curve		Normally	2,000	1,500	1,100	500
		Limited	1,500	1,000	700	350
The minimum radius of the vertical curve	Convex	Normally	45,000	25,000	12,000	6,000
		Limited	23,000	15,000	6,000	3,000
	Concave	Normally	16,000	12,000	8,000	4,000
		Limited	12,000	8,000	4,000	2,000
The largest longitudinal gradient, %		Normally	2	2	3	4.5
		Limited	2	2	4	5.5

Table 7 - Technical standards for freeway/expressway at the connecting elevated

7.7. Design requirements for the ramp in the area of the grade-separated connected interchange and the entry/exit ramp on right side of expressway.

7.7.1. The cross section of these ramps must be arranged as item 5.14

7.7.2. Calculated speed on the ramps in the area of grade-separated connected interchange is stipulated in Table 8.

Measured by km/h

Characteristic of grade-separated connected interchange	Grade of expressway			
	120	100	80	60
Transport connection between expressway and highway of grade I, II	80÷50	70÷40	60÷35	50÷35
Transport connection between expressway and other road	60÷35	50÷35	40÷30	35÷30

Table 8 - Evaluated speed on the extension road

Note:

1) For the right or left turning branch road, use the factor of calculated speed between the parameters in Table 8 or above.

2) For the branch roads of asterisk or spiral type, the low parameter in table should be used.

3) For the branch road with heavy turning traffic and outgoing roads, select high evaluated speed.

7.7.3. The calculated speed on the entry/exit ramp from the right side of the expressway should follow its design grade and the geometrical specification of this ramp should be applied in accordance with its design grade (comply with TCVN 4054). If design speed is similar to table 8, the geometry specification is applied as for branch road located within the area of grade-separated connected interchange (7.7.5).

7.7.4. The above-mentioned value of calculated speed is used to define the geometrical elements of branch road alignments on plan and vertical alignment according to TCVN 4054 and current traffic interchange design standards (the minimum radius, the length of transition curve, the widening of curve, super-elevation, the maximum longitudinal grade, reduction of slope on curve etc.). During the design, avoid applying the minimum and maximum factors to those elements and pay attention to the fact that traffic speed often change gradually on branch road.

7.7.5. Depending on the calculated speed of table 8, the geometrical elements of ramp on grade-separated connected interchange should obey the specification in table 9 (regarding curve radius); table 10 (regarding parameters of clothoid transition curve); table 11 (regarding vertical slope); table 12 (regarding vertical curve elements); table 13 (super-elevation); table 14, 15 (regarding transition of super-elevation); table 16 (regarding widening on curve); table 17 (regarding stopping sight distance).

Evaluated speed on ramps in the area of interchange (km/h)		80	60	50	40	35	30
Minimum radius of curve (m)	Normal value	280	150	100	60	40	30
	Low limited value	230	120	80	45	35	25
Note: the normal value shall be used except when the interchange is located in difficult topography.							

Table 9- Minimum curve radius of branch road in grade-separated connected interchange

Calculated speed on branch road in the interchange (km/h)	80	60	50	40	35	30
Parameter A (m)	140	70	50	35	30	20
Note: 1) The length of clothoid transition section should follow the requirements of super-elevation connection; 2) Parameter A shall be chosen as $A \geq 1.5R$ (R - radius of designed curve); 3) Two curves in opposite direction should have the same parameter A or their ratio shall be less than 1.5.						

Figure 10- Clothoid parameters on branch road (for calculating the length of transitional clothoid)

Calculated speed on ramp at the intersection (km/h)	Maximum vertical slope (%)
80	4.0
60	5.0
50	5.5
≤ 40	6.0

Table 11- Maximum vertical slope in interchange

Calculated speed on ramp in the interchange (km/h)			80	60	50	40	35	30
Minimum radius of vertical curve (m)	crest	normal	4500	2000	1600	900	700	500
		low limit	3000	1400	800	450	350	250
	sag	normal	3000	1500	1400	900	700	400
		low limit	2000	1000	700	450	350	300
Minimum length of vertical curve (m)		normal	100	70	60	40	35	30
		low limit	70	50	40	35	30	25
Note: Except for specially difficult case, the normal value or above shall be used.								

Table 12- Minimum radius and length of vertical curve in interchange

Evaluated speed on branch road (km/h)	80	60	50	40	35	30	super-elevation (%)
	230 ~ 330	120 ~ 180	80 ~ 120	45 ~ 70	35 ~ 50	< 30	8
	330 ~ 380	180 ~ 220	120 ~ 160	70 ~ 90	50 ~ 60	30 ~ 40	7 ~ 8
	380 ~ 450	220 ~ 270	160 ~ 200	90 ~ 130	90 ~ 110	40 ~ 60	6 ~ 7
	450 ~ 540	270 ~ 330	200 ~ 240	130 ~ 160	90 ~ 110	60 ~ 80	5 ~ 6
	540 ~ 670	330 ~ 420	240 ~ 310	160 ~ 210	110 ~ 140	80 ~ 110	4 ~ 5
	670 ~ 870	420 ~ 560	310 ~ 410	210 ~ 280	140 ~ 220	110 ~ 150	4
	870 ~ 1240	560 ~ 800	410 ~ 590	280 ~ 400	220 ~ 280	150 ~ 220	3
	> 1240	> 800	> 500	> 400	> 280	> 220	2
Radius without super-elevation	2500	1500	1000	600	500	350	No change

Table 13- Super-elevation on curve branch road

Pavement type and location of super-elevation axis	One-way single lane		One-way double lanes and two-way double lanes (not separate pavement type)	
Calculated speed on branch road (km/h)	Pavement edge	Centerline	Pavement edge	Centerline
80	1/200	1/250	1/150	1/200
60	1/200	1/225	1/125	1/175
50	1/200	1/200	1/100	1/175
≤ 40	1/100	1/150	1/100	1/150
Note: the location of super-elevation connection should overlap the clothoid transitional section. The length shall be chosen as the large value from the results calculated from table 10 and table 14.				

Table 14- The changing rate of super-elevation on branch road of interchange (for determining the transitional length)

Type of branch road cross section		One-way single lane	One-way double lanes and two-way double lanes
Location of super-elevation axis	Centerline	1/800	1/500
	Shoulder	1/500	1/300

Table 15- The minimum changing rate of super-elevation to determine the super-elevation length of branch road of which the crossfall is 0%

Branch road of one-way single lane		Branch road of one-way double lane or two-way double lanes	
Radius of curve (m)	Extension parameter (m)	Radius of curve (m))	Extension parameter (m)
25 ~ < 27	2,00	25 ~ < 26	2,25
27 ~ < 29	1,75	26 ~ < 27	2,00
29 ~ < 32	1,50	27 ~ < 29	1,75
32 ~ < 36	1,25	29 ~ < 31	1,50
36 ~ < 42	1,00	31 ~ < 33	1,25
42 ~ < 48	0,75	33 ~ < 36	1,00
48 ~ < 58	0,50	36 ~ < 39	0,75
58 ~ < 72	0,25	39 ~ < 43	0,50
≥ 72	0	43 ~ < 47	0,25
-	-	≥ 47	0,00
Note: The extension of main branch road is not including the extension of safety lane as mention in 5.14.2 and 5.14.3			

Table 16- Extension parameter of curve branch road

Evaluated speed on branch road (km/h)	80	60	50	40	35	30
Sight distance (m)	110	75	65	45	35	30

Table 17- Sight distance on branch road

When applying the parameters in tables 9-17 above, the linear interpolation between the ranges of calculated speed is acceptable.

7.7.6. In asterisk interchange (figure 6e), the minimum radius should be 55-60m, 40-50m, 30-35m for correlative calculated speed on ramp of 40km/h, 35km/h, 30km/h.

7.8. Locate the connection between the ramp and expressway (the entry/exit point to expressway) in the area of grade-separated connected interchange and the entry/exit from the right-hand side.

7.8.1. Locate this connection from the right side of traffic direction. The exit ramp from expressway must be visible, often located in the front of man-made works (such as crossing bridge etc.). If it must be located after the manmade works, it should be more than 150m away from the bridge. Besides, the exit location on the uphill section of the expressway should be provided to assist the deceleration.

7.8.2. The location from the auxiliary lane to the expressway should be located on the section of downhill slope (to assist the acceleration) and it is necessary to ensure a clear space of triangle shape between two roads to allow vehicles on expressway and ramps can recognize each other. This triangle has its peak as the intersection between the edge of the right pavement edge of the expressway and left pavement edge of the ramp. The side of the triangle along the right pavement edge of the expressway is 100m and the side along the left pavement edge of the ramp is 60m (figure 8).

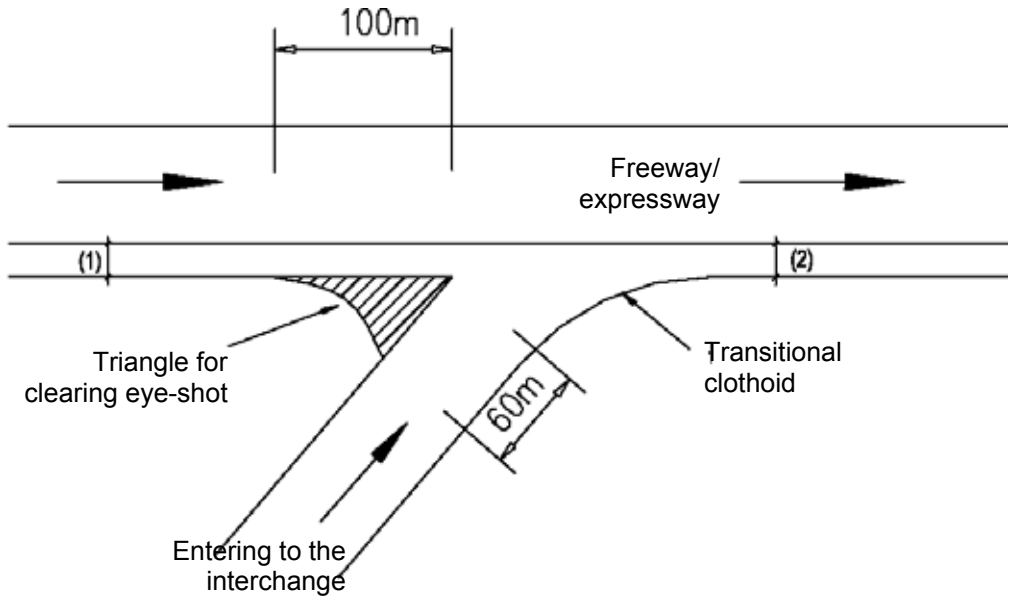


Figure 8 - The triangle for eye-shot at entry/exit point of interchange

7.8.3. Ensure the sight distance on the expressway at the section before the lane-split section at the exit ramp is more than 1.25 times of the stopping-sight distance in table 4 and follow the required stopping-sight distance in item 6.8 if possible.

7.8.4. The out-going section from freeway/expressway can be arranged according to two parallel ways or connecting directly as figures 9.

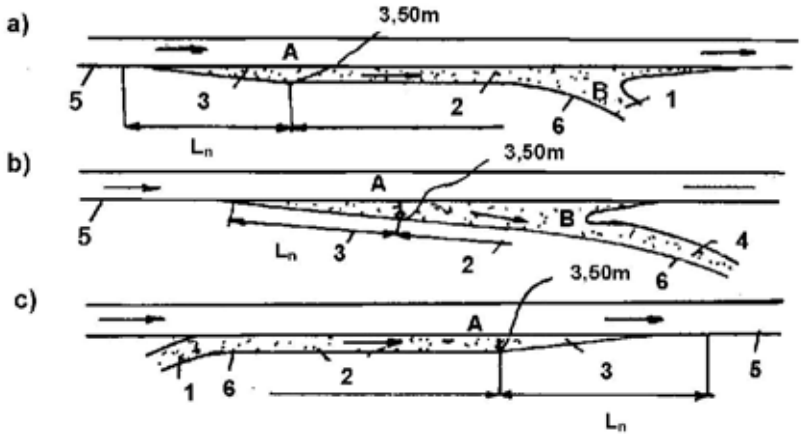


Figure 9 - The ways of locating out-going and in-coming section

a) The exit section with the parallel type
b) The exit section with the direct connection type
c) The entry section with the parallel type

Curve radius at B: r = 0.60m – 1.00m

1 . The branch road
2. The speed-changing section (deceleration in figure a and b; acceleration in figure c).
3. The triangle lane-changing section (refer definition in 7.8.6)
4. The branch road with the function of changing lane and speed.
5. Edge of carriageway (excluding shoulder) of the expressway.
6. Clothoid transition section, as 7.8.1

L_n : lane-changing section in triangle shape.

7.8.5. For the entry to expressway (merging location), follow the parallel style (figure 9c) with the whole length of the acceleration section to be located next to the carriage-way on expressway (widen the shoulder); if the acceleration section is too long, at least 100m of the section must be located next to the carriage-way of the expressway. In the case there is two traffic lanes in the entry road, it is possible to have the entry of direct connection type.

7.8.6. The width of a speed-changing lane in all cases is stipulated as 3.50m. The length of triangle lane-changing section in all cases includes the widened carriage-way of 3.50m (if the speed-changing section has 1 lane) and 7.0m (if 2 lanes). 2-lane speed-changing section occurs when the expressway has 6 traffic lanes.

7.8.7. The minimum length of the triangle lane-changing section (including the case of entry/exit to the expressway) is defined in accordance with the grades of expressway as shown in table 18; in case the lane-changing section has two lanes, the value of L_n in Table 18 should be multiplied by 1.3 – 1.4 times

Grades of freeway/ expressway	120	100	80	60
L_n	75	60	50	40

Table 18 - the minimum length of the triangle lane-changing section (current separating or joining)

7.8.8. The acceleration/deceleration section is calculated from the point A (beginning or end of triangle section) in figure 9 and its length S (measured by meter) is defined according to the formula below:

$$S = \frac{V_A^2 - V_B^2}{26.a}$$

of which

- V_A is the vehicle speed at the point A (end of the lane-changing section with triangular type) in figure 9, measured by km/h; the value A is based on the grades of expressway in table 19.

Unit: km/h

Grades of freeway/expressway	120	100	80	60
V_A	130	170	160	150

Table 19 - The value of the speed V_A at the beginning of the deceleration section or the end of the acceleration section.

- a is the acceleration of increasing or reducing speed, measured by m/sec'

When defining the length of the deceleration, use a = 2.5m/sec^2, for the length of the acceleration, a= 1.0 m

- V_B is the speed at the end of the deceleration section or the beginning of acceleration section, measured by km/h.

The value V_B is based on the calculated speed of branch road (item 7.7.2 and 7.7.3) or based on the actual geometrical elements applied to branch roads in specific design after the deceleration section or before the acceleration section.

7.8.9. If the triangle lane-changing section with the deceleration section are located on the downhill section and the triangle lane-changing section with the acceleration section are on the uphill section, their length as defined in table 18 and item 7.8.8 must be multiplied by an adjustment factor in table 20:

The average grade of the speed-changing lane, %	≤ 2	>2÷3	> 3÷4	> 4÷6
The factor for the downhill speed-changing lane Down	1.0	1.1	1.2	1.3
The factor for the uphill speed-changing lane slope	1.0	1.2	1.3	1.4

Table 20 - Adjustment factor of the speed-changing lane length on the slope

7.8.10. In all cases, depending on the expressway grade, the total length of the lane-changing (triangle type) plus the length of the speed-changing section (reducing or increasing speed) should be larger than the value in table 21 multiple with adjustment factor in table 20.

Grades of expressway	120	100	80	60
The minimum length at exit point (reducing speed) of one lane, m	100 (150)	90 (130)	80 (110)	70 (90)
The minimum length at entry point (increasing speed) of one lane, m	200 (300)	180 (260)	160 (220)	120 (160)
Note: the value in brackets is correlative with 2-lane speed-changing section				

Table 21 - The minimum value applied to the total length of the lane-changing section plus the speed-changing section.

7.8.11. On the direct connected deceleration section (section 2 and 6 in Figure 9b) or at the location where the deceleration begins to be far away from the expressway (section 6 on Figure 9a) and at the merging location to acceleration section running parallel with the expressway (section 6 in Figure 9c), apply all the geometric design standards in 7.7.5, correlatively with the speed V_A depending on the expressway grade as shown in Table 19 for all cases without depending on the calculated speed of the branch road. Arrange the transitional connection by clothoid curve as mentioned in figure 9.

7.8.12. Crossfall and Super-elevation arrangement at entry/exit of expressway

1. If the entry/exit point is on the straight section of expressway and the lane-changing section is also on straight section (figure 10a), the crossfall on the entire section (1) and (2) is still one-way as the usual slope of the expressway. From point ZH, the branch road is designed and connected with super-elevation in accordance with branch road design standard (table 14, 15).

2. If the entry/exit point is parallel with expressway straight section (figure 10b), the section from (1) and (2) to point A (the branch road begins to be away from the expressway) have normal super-elevation value of expressway. From point A, the super-elevation will comply with the branch road standard.

3. If the entry/exit point is of parallel type, located on the curve which has same direction with the expressway (figure 10c, 10d), the super-elevation on section (1) and (2) is design with normal super-elevation value of expressway carriageway.

4. If the entry/exit point is directly connected on the curve which has opposite direction with expressway (figure 10e), the super-elevation value on section (1) is the same as the super-elevation value of expressway. The super-elevation on section (2) is gradually transitioned to the super-elevation value of less than 2% and have opposite direction with expressway super-elevation so that the difference in crossfall value at point A is not larger than 5% and then the super-elevation of section (3) is transitory to the design super-elevation of branch road.

5. If the entry/exit point is parallel connected on the curve which has opposite direction with the expressway curve (figure 10g), the super-elevation from section (1) and a part of section (2) to the point ZH is same value and direction with expressway super-elevation. The super-elevation at point A is transitory to the value of less than 2% (opposite direction with the expressway super-elevation) so that the difference in crossfall value at point A is not larger than 5%. The super-elevation on section (3) is transitory to the super-elevation of branch roach.

When design the transition for super-elevation, the requirements in Table 14 and 15 should be

complied.

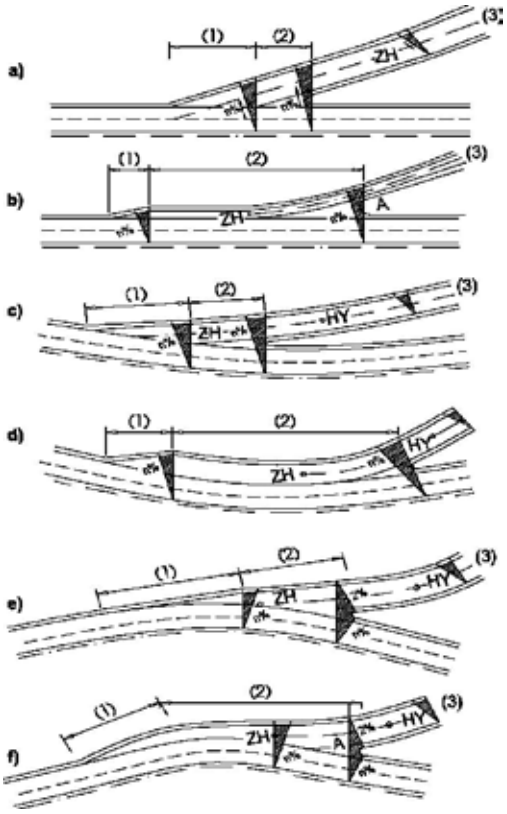


Figure 10 - Super-elevation at out-going, in-coming point

Note:
1. Triangle lane-changing; ZH: beginning point of curve;
2. Speed-changing lane; HY: ending point of curve;
3. Curve branch; A: start point of far away from freeway/expressway

7.8.13. Balancing the number of lanes and arranging auxiliary lane at entry/exit point of expressway

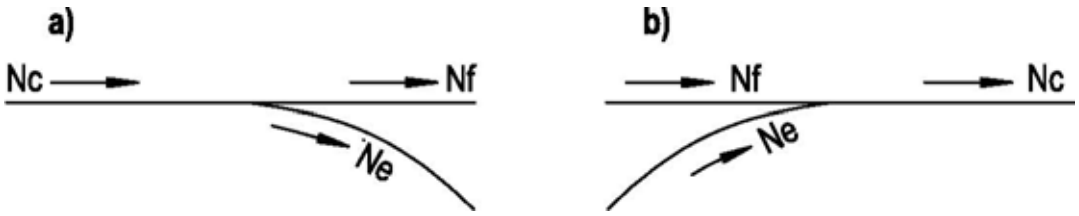
1. On the whole length or section length of expressway, the number of basic lanes should be ensured.

The increasing or decreasing of basic lanes of 2 consecutive road sections in the same direction should not be more than 1 lane, the changing number of lane should be in the location of no less than 0.5-1.0km from the grade-separated connected intersection and arrange the transition section with the gradually changing factor of no more than 1/50.

The location for lane splitting/merging must be calculated based on the below balancing formula to experiment the balancing of number of lanes

$$N_c \geq N_f + N_e - 1$$

in which:
N_c: Number of lanes on main roads before splitting lane or after merging lane;
N_f: Number of lanes on main roads after splitting lane or before merging lane;
N_e: Lane number of branch road

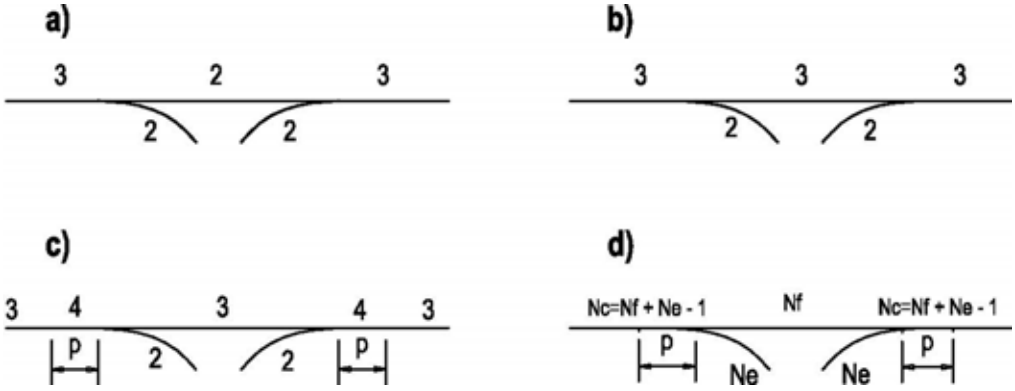


Note: a) Lane-split to exit from expressway, b) lane-merging to enter expressway;

Figure 11 - Balancing lanes checking scheme

2. Arranging auxiliary lane

When arranging the lane split/merge for 2-lane branch road, the continuity of basic lanes should be kept; keep the balancing of number of lanes; increase the number of auxiliary lane when neccesary as shown in figure 12



Note:
a) Balancing the number of lanes but the continuity of number of basic lanes is not ensured;
b) The number of basic lanes is continuous but not balancing the number of lanes;
c) Balancing number of lanes and ensuring the continuous number of basic lanes
d) Conditions for continuous number of basic lanes;
p: Section needs additional auxiliary lane to ensure the balancing and continuity

Figure 12 - Checking diagram on balancing lanes and continuity of basic lanes

For smooth traffic, the length of auxiliary lane p at the beginning of lane-split section shall be 1000m (minimum 600m); at lane-merging section shall be 600m.

When the distance between the end of acceleration lane of grade-separated connected interchange at the front and the beginning of deceleration lane of the grade-separated connected at the back is less than 500m, the auxiliary lane must be added to connect them together. If the traffic volume is relatively high, the flow mixing rate is quite high, the auxiliary lane is required even the above distance is larger than 2000m. Therefore, if there are two connected interchanges with distance less than 2000m, the auxiliary lanes shall be constructed to connect them together. The arrangement of auxiliary lane on cross section is mentioned in item 5.9.

7.9. Design of landscape, trees and drainage system in the area of grade-separated interchange

7.9.1. At the grade-separated connected interchange, Inundated water should not be allowed within the area of curved branch roads.

7.9.2. Landscaping designing at the batter

The fill batter on branch road should have gradually gentle slope to the existing surface.

7.9.3. In the area of grade-separated connected interchange, various types of trees should be grown: at the entry/exit sections, grow the direction-guiding trees. On one side of lane-split location, grow shrubs to restrict sight-distance to indirectly make the drivers reduce speed.

In the triangle area of the turning location of branch road, grow flowers, grass. When growing the shrubs in the inner side of curve section, the sight distance should meet the requirements of sight distance and have the effect of direction guidance as shown in figure 13.

7.9.4. The drainage system in the area of grade-separated connected interchange should be consistent with the expressway drainage system to create a comprehensive drainage system.

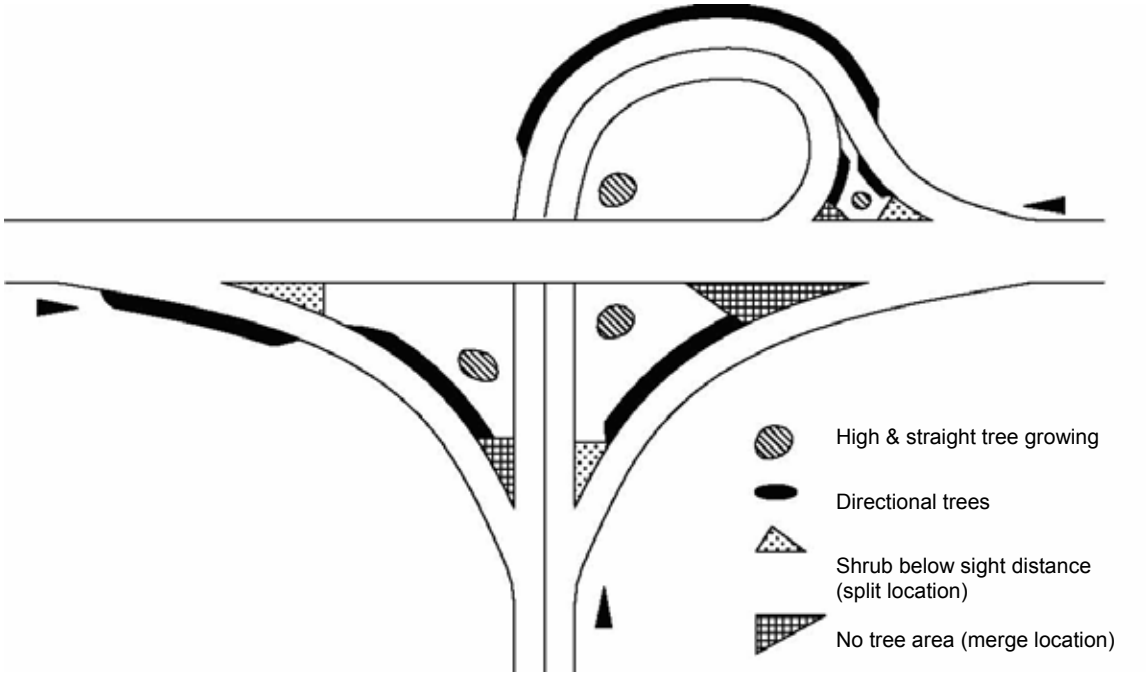


Figure 13 – Tree planting

7.10. Design requirements for at-grade intersection on low grade road (refer in 7.2) within the area of grade-separated connected interchange.

This design should comply with requirements for at-grade interchange mentioned in chapter 11 of TCVN 4054 and other related standards, for selecting intersection type, design speed, geometric elements arrangement and ensuring the arrangement of sight-distance, island, speed-change lanes and traffic sign.

7.11. Arrangement of grade-separated intersection

7.11.1. The design of grade-separated non-connected intersection as mentioned in item 7.1, 7.2 must follow the stipulation of overhead clearance over and under the expressway in item 4.7 and 4.9. If the expressway crosses over the residential roads without any grade, the determination of

clearance height will be based on the actual traffic condition. If there is not much car traffic, clearance height of the residential roads can be reduced to 3.20m. If the road is just for tractors, the overhead space limit can be reduced to 2.70 and only 1 lane is required.

7.11.2. It is necessary to have comparison study of expressway options for flyover or underpass. In every case, the arrangement of bridge span and length (including the location of abutment and pier) must ensure the sight distance of the traffic on the road underneath. Should not construct concave vertical curve on the expressway at the location with a flyover.

7.11.3. The drainage system and the lighting at the underpass should be sufficient.

7.11.4. The angle between the flyover and road underneath should be larger than 45^0.

7.11.5. It is not permitted to have grade-separated junction between the expressway and railway in the area of railway station or switch location.

7.12. The intersection between expressway and pipeline, other lines (power, communication etc.) and the reciprocal position among them outside or inside the area of intersection should follow TCVN 4054 and other requirements from the Authorities.

8. Design of expressway pavement and drainage system

8.1. General requirements

8.1.1. In order to ensure the continuous traffic performance, safety of traffic, the pavement of expressway must be strong and stable to avoid the negative effect of environment (especially from underground and surface water). The surface of expressway must be flat and have sufficient roughness with good drainage system.

8.1.2. Regarding pavement and drainage, besides the requirements in this standard, it is necessary to meet the basic requirements and design principles and other requirements in TCVN 4054.

8.1.3. Regarding road pavement, besides the compliance with TCVN 4054, it is also necessary to meet the requirements and guidance of 22TCN 211 (flexible pavement) and 22TCN 233 (rigid pavement).

8.1.4. For the section in soft ground area, the remaining permissible settlement at the road centerline after the construction should follow 22TCN 211 and the design survey follow 22TCN 262.

8.1.5. The structure of pavement should not be implemented in staged investment. In special case, when the expressway embankment is located in soft soil area which have high settlement rate, the staged investment shall be considered through economic study to lay the cover layers depending on settlement time to reduce investment cost. This proposal must be approved by the investor.

8.2. Design of pavement

8.2.1. The design of expressway pavement should be based on the sufficient and trustful investigation of geology, hydrology to ensure the stability of road pavement in the below cases:

- High embankment and deep excavation with batter height of over 12.0m;

- Excavation in the rock area, erosion area, rock rolling area, and the area of difficult geology and hydrology (hillside, weathered soil condition, swamp, soft ground with underground water, hillside with steep crossfall)

- Pavement close to river, creek with high possibility of erosion.

8.2.2. The design of batter

1. To ensure the requirements of safety for hi-speed vehicles, avoid erosion and rock rolling and landscaping requirements, the pavement of expressway should be designed with the batter slope in accordance with Table 22. If land area is limited, the retaining wall or rock filling can be use to replace fill batter. The design of batter on the mountain areas which have high slope angle, difficult topography and steep rock embankment, the batter slope can follow TCVN 4054.

Embankment height or excavation depth	Fill embankment slope	Cut embankment slope
to 1.2m	1 : 4 (1 : 3)	1 : 3.0
≥1.2m ÷ 3.0m	1 : 3 (1 : 2)	1 : 2.5 (1 : 2)
≥ 3.0m ÷ 4.5m	1 : 2.5 (1 : 1.75)	1 : 2.0 (1 : 1.5)
≥ 4.5m ÷ 6.0m	1 : 2 (1 : 1.5)	1 : 1.75 (1 : 1.5)
over 6.0 m	1 : 2 (1 : 1.5)	1 : 1.5
Note: - The value in bracket is correlative with the case of difficult topography or limited land area; - the design batter slope varies within the embankment height values in Table 22 (the type of embankment that is gentle slope at toe, steep slope on top)		

Table 22 - Slope angle of expressway embankment (soil batter)

2. The top of batter slope is filleted with the radius of R = 2.5m, the toe of fill batter R = 8.0m; the top edge of cut shoulder R = 2.5m, the top of cut embankment R = 2H (H is the height of cut batter, measured in meter).

3. For the coordination between the shape of embankment and landscape, at the changing between cut section and fill section, batter slope of cut section should be gradually gentle from the middle of the section to the transition section (change to fill batter) (for example, the slope 1 : 2 in the middle is changed into 1 : 3 then 1: 5).

8.2.3. Compaction and loading capacity requirements of pavement foundation

1. The compaction index of 30cm for the top layer under the pavement bottom layer must be K = 1.0 (standard compaction of 22TCN 332) or improved compaction K=0.98. All the soil layers under the This requirement must be applied to fill embankment, earthwork-balanced embankment and cut embankment (if natural soil does not have the same compaction index as above).

2. The soil section of fill embankment underneath 30cm mentioned above must be compacted with K = 0.98 (standard compaction) or improved compaction K = 0.95. The soil section of cut

embankment underneath 30cm up to 1.0m depth must be compacted with K = 0.95 (standard compaction).

3. The pavement of expressway must be designed to meet the pavement structure standard Grade I in Annex B of 22TCN 221, and correlatively meet the elastic module of 400daN/cm^2 or more.

4. The surface of cut batter on expressway must be reinforced by appropriate measures with the geotechnical and hydrological condition on site, to avoid the weathered condition creating soil, rock sliding and erosion in the batter.

8.2.4. Soil for expressway fill embankment shall be taken from borrow-pit. Do not take soil from excavation on the road sides because it cannot ensure the consistency, creating water inundation and destroying scenery. If fine sand is used for filling, select cohesive soil with capability of avoiding erosion on surface, simultaneously select the method of filling that ensures the quality of compression, especially batter surface compression quality. The top layer of sand filling should be covered by 30 cm thickness of clayish sand or clay mixed with gravel with the compaction level stipulated in item 8.2.3.

8.2.5. Use the requirements in item 7.4 of TCVN 4054 to select the appropriate soil and request the compression level to be K=1.0 for embankment behind bridge abutment, on both side of residential and drainage culverts.

8.2.6. Design requirements for expressway pavement on soft soil or peaty soil.

1. There must be the measures during the filling so that when reaching the design height and in use, the fill embankment ensure the stability of the entire embankment.

2. Before constructing the finished pavement structure, apply the measures to ensure the settlement of embankment meet the requirements of item 1.3.5 in 22TCN 211.

3. The size of fill embankment on soft soil must be designed correlatively with the value of settlement allowance and it should be noted that due to the large width of expressway, the settlement at centerline must be paid attention to avoid the inundated water.

4. For the fill embankment section on the soft soil at the end of bridge, culvert, underpass, to avoid the unpredicted damage of abutment base, wing wall, etc. by the negative friction between embankment and abutment when base is subsiding, the base must be designed with settlement reaching 90% of consolidation index before constructing foundations of above structures. If these requirements are not met, the foundation and their other parts must be designed with consideration of negative friction and forces from behind the abutment when the foundation keeps settling. Filling the embankment through these sections should be carried out as soon as possible to allow for pre-settlement. At the residential and drainage culverts with small opening, it is possible to have pre-surcharged over the culvert location; when the settlement reaches the consolidation level as required above, excavate to construct the foundation and culvert. The minimum time for surcharge is 6 month and the longer the better if the construction time is permitted. The construction of embankment on soft soil area shall be commenced as soon as possible and a good construction management is very important to avoid the deviation due to settlement at the expressway exit/entry to bridge and over the culvert.

5. For the general fill embankment sections of the expressway through soft soil areas and the section mentioned in Item 4 in particular, the settlement survey and lateral movement of the soil

during the filling and waiting periods prior to the construction of road pavement is essential. It must be carried out in accordance with the appropriate survey quality to ensure the accuracy. The consolidation level of soft soil under fill loading (including the surcharge) can be evaluated through the settlement curve through actual survey if the survey result is trustable (it is possible to compare with the settlement forecasting result based on time)

6. If the expressway project has many soft soil sections, the owner shall hire the consultant and contractor to experiment some embankment section before constructing the embankment on the whole project. On the experiment embankment section, it is necessary to have sufficient equipment for settlement survey and lateral movement of the soil (at the top layers of soft soil and perhaps at different depth level in soft soil and survey equipment for porous water pressure at various depth in the soft soil). The observation time for this experimental embankment is at least 12-18 months. From the results of experiment filling, it is possible to confirm the treatment method or adjust the methods to suit the actual condition to have the most beneficial economical and technical results.

8.3. Design of drainage system

8.3.1. Drainage system on expressway must drain water from road surface quickly to avoid infiltration of water to road structure and avoid the erosion of embankment at shoulder or batter. Due to the expressway has many lanes and median, the drainage design not only follow TCVN 4054 and item 2.6 of 22TCN 211 but also refer to item 15 “Surface water drainage planning for roads and height planning for drainage design” of TCXDVN104 (Urban Road - Design Specification).

8.3.2. In any case, at the expressway entry/exit section, curve section on plan and section with vertical slope less than 1%, in order to have good drainage system, the designer should have the height planning (vertical planning) in the entire width of road pavement.

8.3.3. In the low filling and cutting pavement, it is possible to use narrow side ditch of 0.50m with covers, or table drain of 0.4m-0.5m depth and 2m - 2.5m width, the batter slope and bottom of table drain is gently sloped or curved, and reinforced by thick grass.

8.3.4. On the curve section with one-way crossfall, design the water collection system next to the median by covered trench or pipeline and arrange the pipeline to convey water out of the pavement area; if using covered trench, it can encroach the safety lane and its cover can bear traffic loading capacity.

8.3.5. Locate the side trench in the grass shoulder on the top of fill batter and trench on the top of cut batter to hold and collect surface water, preventing water to cause damage to the batter. It is also possible to have a asphalt concrete barrier at the edge of the hard shoulder (the emergency lane) so that the hard shoulder can hold and collect water, preventing water from directly running to the batter but running to the flow opening then getting out of the pavement area. The distance between the flow stream and flow area must be determined based on the catchment area of each flow.

8.3.6. Every trench must be reinforced. The underground pipeline must be located on a reliable foundation to avoid water infiltration causing settlement and must be covered fully on top.

8.3.7. The drainage outfall from the pavement area or from the top trench, stopping trench to batter toe should have steps, flows and downstream reinforcement.

8.3.8. The calculated frequency of hydrology for the drainage trench is 4%, for bridge and culvert is 1%.

8.3.9. It is necessary to have a comprehensive treatment method for the underground water section and exposures of underground water that have the capability of causing negative impacts to the stability of the whole pavement.

8.4. Pavement design

8.4.1. The expressway pavement must be designed with the structure of asphalt concrete or continuous steel-reinforced cement concrete or whole block cement concrete (cannot use assembled cement concrete) and ensure the requirements of intensity, durability, especially the roughness and smoothness index as mentioned in item 1.3.3 and 1.3.4 of 22TCN 211. For this purpose, the structural design and intensity calculation must follow the principles and guidance in current procedures of pavement design; in which for the flexible pavement, it is necessary to study and design the rough-making layer suitable for the climate conditions and construction technique. Use the material with organic or inorganic binder for the subgrade of the asphalt concrete pavement. Use soil, rock, sand with inorganic binder for the cement road pavement.

8.4.2. The pavement structure of reinforced shoulders, central median cover layer, safety lanes, auxiliary lanes, toll gate of the expressway should comply with 22TCN 211.

8.4.3. At bridge abutment area, the expressway pavement should be located on strength transition slab to ensure good connection between road and bridge. The expansion join is also chosen appropriately for smooth movement of vehicles from road to bridge.

9. Designing and locating toll stations on expressway

9.1. The location of toll stations depends on the toll collection method:

- If applying "the close system", the toll gate must be located on all the exit/entry ramps and toll is collected according to the length of real journey on expressway (refer 7.3.2, 7.3.2 and Figure 7 of this standard).

- If applying "the open system", the toll gate is located at some certain locations on the expressway; toll is collected based on the acceptable average distance for every vehicle.

- If applying "the lump sum collection", the toll gate must be located at the ends of each expressway. Depending on the actual condition, the design consultant will select the toll collection method and study the location of toll gate, especially for "the open system" to avoid too many toll stations that may cause negative effects to the social activities (in particular with BOT project). The distance between toll gate of "the open system" is stipulated in the Circular “Guidance to the collection, management and using road tolls” No 90/204/TT-BTC dated Sept 07-2004.

9.2. The area of the toll gate requires the following works:

- The island of separating lane and classifying vehicles.

- Control booth, toll booth, ticket booth.

- Car parking for police work.

- Toll plaza (management, accounting, data storage, money box, transport control, electrical and communication system).

9.3. Alignment of the section having toll gate.

9.3.1. If toll gate is located on expressway, the alignment requirements of this section is the same as other sections on expressway. If it is on the branch road, the radius of the curve at that location must not be less than 200m.

9.3.2. Vertical grade in the area of toll gate should be less than 2.0%.

9.3.3. Crossfall at toll gate area is 2%.

9.4. The number of traffic lanes is defined in formula in 4.5.1; in which N_k is defined as shown in item 4.5.2 but the calculated duration is 10 years, then N_{tk} is defined as follows:

- For toll gate on entry ramp, no collection of money, only collect the number: from 500 units/hour-lane to 650 units/hour-lane.

- For toll gate on exit ramp, collection of money: from 300 units/hour-lane to 350 units/hour-lane.

It is necessary to rely on the traffic component forecast to define the number of lanes and required waiting length for every vehicle class with the same toll amount. Besides, one lane for over-sized vehicles should be located on the outer right-hand side on either side.

The number of traffic lanes at toll gate should be 1.5 - 2 times more than the number of traffic lanes on the expressway.

9.5. The width of one lane at toll gate is from 3.0m to 3.2m. The width of lanes for over-sized vehicle is from 3.5m to 4.0m.

9.6. The clearance in the area of one lane at toll gate is stipulated as figure 14.

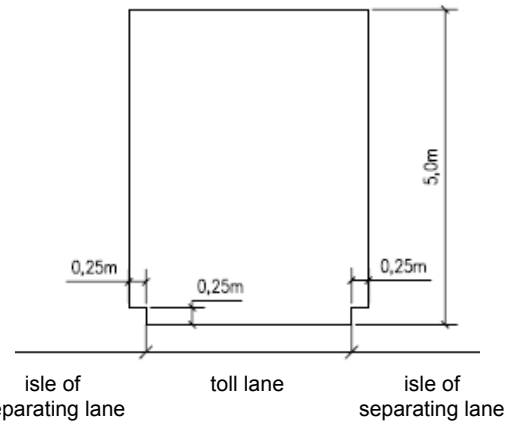


Figure 14 - the overhead space limit for one toll gate

9.7. The structure of lane-separating island at toll gate.

The width of island is from 1.50m to 2.20m (depending on the toll collection method); the surface of island is 0.25m higher than carriage-way (figure 14); the length of island along the road is from 25m to 30m if toll gate is located on branch road and from 30m to 45m if it is on freeway/expressway. On the island, outside the clearance limit in Figure 14, can arrange the toll booths. On the surface, two ends of toll gate island have one narrowed section as boat shape which is away from the island end with the length of 1/5 - 1/6 of island and it is filleted, increasing elevation and having line marking.

The roof of toll booth is 5 - 6m large every side from the center of toll booth and over the height of overhead space limit in figure 14.

9.8. Cross sections at the center of toll gate (this center is in the middle of toll island according the along the alignment).

These cross sections consist of toll lanes (the number of lanes is determined in accordance with 9.4), the lane-separating islands, the normal shoulder to the right side of the over-sized vehicle lane (do not arrange island for hard shoulder and over-sized lane). The total width of pavement at toll gate (B_{tr}) is the total width of all mentioned elements.

9.9. The width transition from outside of toll stations area to the center of toll station.

9.9.1. The width B_{tr} determined in item 9.8 must remain the same in the area of the lane-separating island length and extend a minimum of 20m - 25m from each end of the land-separating island (if toll gate is on expressway) and 10m -15m (if toll gate is on the entry/exit ramp to expressway).

9.9.2. Outside of the above mentioned width (B_{tr}), the width of pavement is gradually narrowed to the pavement width outside of the toll stations with the reduction factor of 1/3 (every 3m of the length, 1m of the width is reduced), symmetrical with road centerline. At the beginning point to reduce the width, arrange a curve connecting the edge of shoulder with the radius of 5m - 15m.

9.9.3. The length of toll station consists of the total length of constant width (B_{tr}) and the length of reduced width sections (as mentioned in 9.9.2). This length should be audited to ensure the queue length on both ends of toll stations (the queuing length is recommended not longer than 500m).

9.10. In area defined in item 9.9.1 and 9.9.2, cement concrete road pavement must be (recommended to be constructed (preferably, continuous steel reinforced cement concrete pavement)

9.11. In front of each toll lane, the barrier must be placed to stop vehicles if necessary (except the lane for over-size vehicle). Around toll booth, protective balcony is required. The toll booth requires sufficient equipment for toll staff, installing communicative system and necessary devices for tolling purpose. For toll station with heavy traffic which have many gates and large traffic flows, use underpass for staff accessing the toll booths.

10. Safety measures, facilities and environmental protection on expressway

10.1. Safety measures, transport safety must follow the below stipulations:

10.1.1. On the median there must be two safety barriers (made of steel or cable) with back to each other (figure 15) or double protective barriers of shaped steel in these cases:

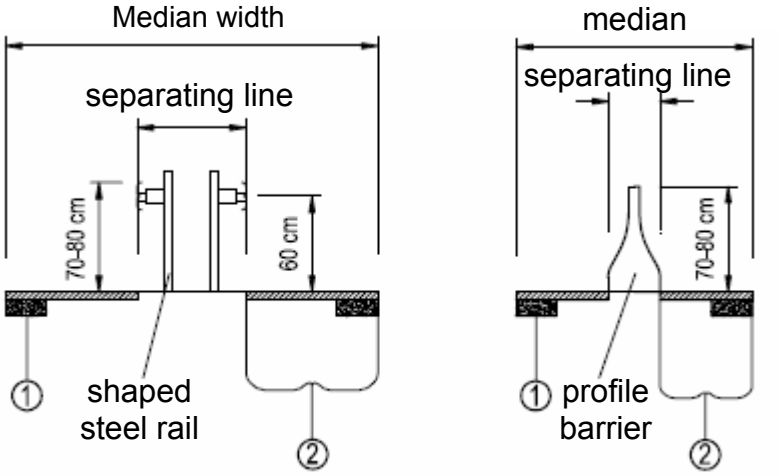
- The width of median is less than 4.50m.

- The width of median is from 4.5m to 10.0m but anticipated traffic after 5 years (from the time of opening traffic) will reach 4,000 unit/day/lane. If the width of median is over 10.0m, protective barrier is not needed.

- At the curve with the radius less than the normal smallest radius along the length of curve.

- On the right hand side and entire length of the signal pole or abutment foundation of the road crossing structure.

- At median break, the mobile barrier should be installed (can be opened for car turning back in emergency cases).



1) Widening section of 0.25m

2) The minimum distance to the edge of expressway pavement is at least equal to the width of safety lane (table 1)

Figure 15 - Protective balconies of shaped steel or barrier wall at the median

10.1.2. On the median there is a cover of 0.5÷0.75m width and barrier wall should be made of concrete (figure 15), the wall must be foot-buried or connected with steel pin with 20mm diameter to stick into cover layer.

10.1.3. On the grass shoulder, there must be a row of protective barriers of shaped steel or cable in these cases:

- Along the length of curve with the radius less than the normal smallest radius, excluding the

case that this curve is on the low cut and fill embankment with the gentle batter slope and the table-drain having cover;

- The fill embankment height is more than 2.0m;

- The fill embankment height is over 1.0m without batter slope but replaced with retaining wall or abutment;

- In the area of signal panel pole or abutment for crossing bridge;

- Within 1.0m from the batter toe in the area river, pond;

- When using bridge, entry/exit the tunnel, overpass bridge at the grade-separated non-connected intersections;

- At entry/exit ramp of expressway, speed-changing lane, width-changing pavement sections.

- In the section that has railway or other highway running parallel with the expressway.

10.1.4. Install protective wall (concrete) along the length of high embankment section or sections having elevation higher than existing ground level over 5.0m. The structure of protective wall must follow 22TCN 237.

10.1.5. In cases of item 10.1.1 to 10.1.4, the edge side of balcony or protective wall should have at least the same width with safety lane (table 1), 1.0m from the pillar surface or the column of signal panels, 0.30m from the edge of road pavement, their height is 0.75m - 0.8m (the height of cable-stayed balcony is 1.05m).

In case using the hard protective wall with glaring resistance for median, the elevation above road surface is 1.2m and hence the safety lane must be a minimum of 1.0m.

Steel for barrier must be 4mm thick and galvanized, its section of cogwheel type (2 teeth) is 300mm - 350mm high. Shaped steel balcony is fixed to the supporting column through wedging block. The steel supporting column with the diameter of 110mm - 150mm or U shape steel of 100-125mm is buried of 70-120mm depth. The beginning sections of protective balcony must ensure the longitudinal anchoring capacity of the whole row by gradually lowering the beginning section to the ground level in the area of 12m long. The distance between the balcony columns is from 2m to 4m (or less on the curve section).

The cable-stayed barrier type requires cable diameter of 16÷20mm, connected to supporting column by 4-5 cables, the upper string is 10-25cm from the top of column, the lower string is 45cm above existing ground level. The structure of column, the distance among columns and the longitudinally anchoring method are the same as shaped steel balcony.

10.1.6. Install the barrier of steel net (or other materials) rigidly with a minimum height of 1.50m at the section where people or animals can suddenly cross the road. This barrier is placed at the edge and within the expressway ROW. The detailed specification and material requirements of these protective equipment should follow 22TCN 237.

10.2. Direction-guidance design

Besides the line marking a direction guidance at the edge of road surface as mentioned in item 5.3.2, it is necessary to install some guide pole (to show direction at night or under rainy condition when direction-guidance line is hardly visible), coordinated with safety barriers and plants.

10.2.1. Guide post can be made of round, square, triangle section with the diameter or side of 12-15cm which placed on both sides of the road, 25cm away from the road shoulder, 1.05m higher than road shoulder and 35-40cm buried underground.

Guide post must be placed on the entire alignment (including ramps at interchanges), excluding the section with safety barriers and safety walls. The distance between guide posts depend on the horizontal curve radius (table 23).

Curve radius(m)	<30	30÷89	90÷179	180÷274	275÷374	375÷999	1000÷1999	≥2000 and on low embankment
Guide post distance(m)	4	8	12	16	20	30	40	50

Table 23 - Guide post distance (also applying to branch road)

On the curve section, there are at least 5 guide posts each side.

At the section with protective balconies, guide posts can be coordinated with supporting column at the same height (higher than balcony) or connecting one part of guide post on the top of supporting column,

In any case, guide post must be painted luminously (usually use yellow reflective paint of 4cm width, 18cm height at the body of guide post facing towards the traffic direction on black background by a distance of 25cm far from the top of column). The remaining column (both on top and bottom) is painted white.

10.2.2. Growing plants to show directions

Grow the high plants with straight trunk, straight and long root at median or in the area of safety corridor so that drivers can recognize direction from far distance (detailed design and verification by 3D image is required).

10.3. Signals panels on expressway

10.3.1. Design of signal panels must aim for these purposes:

- Contributing to stipulations of vehicle class allowed to run (item 4.1) and transport regulations on expressway (see 4.2).

- Provide information to road users regarding the related road network, journey (km, distance), travel directions at intersections, accident precautions, service system along the expressway.

To fulfill the above requirements, it is necessary to repeat the information by combining the sign boards (both sign board on post and gantry) with the line marking, signs and writings on pavement. The combination must be consistent, and not conflict with each other.

10.3.2. The position, structure (material, size, font, color etc.) of signal panels, drawing lines (horizontal, vertical, font, signs) must follow stipulations in "Regulations of highway signal" 22TCN 237.

10.3.3. In any cases, signal works must not encroach safety lane including encroaching in vertical direction. If signage is placed on gantry, the overhead clearance is at least 5.2m.

10.3.4. The signal panels on expressway must be made of reflective glass or reflective materials.

10.3.5. For grade-separated connected interchange, signal panel is installed so that driver can see it before 10 seconds of reaching the intersection (the sign should show travelling directions of the interchange).

10.4. Preventing glaring due to opposite headlight at night

10.4.1. If the express way has sufficiently wide median (with land preserve) so that the distance between two opposite traffic directions is more than 12m, anti-glaring measure is not required.

10.4.2. Anti-glaring measures must be arranged on the sections of heavy traffic (especially heavy truck) at night time; at the section with curve radius less than the normal radius value, vertical curve section, long straight section, mountain area with continuous level variations, long bridge, flyover without lighting, connected interchange, entry/exit to rest area and service areas on the expressway.

10.4.3. Anti-glaring method for opposite traffic direction headlights must be arranged on median of expressway or by growing shrubs or placing light-stopping panel of 1.60m height.

If choosing the shrub growing method, the shrubs should have green leaf all the year round. Each herb width is 0.4-0.6m and the distance between them is 2.0÷3.0m.

If using light-stopping panel, it consists of steel or general plastic plates of 1.5-4.0cm thick, 8.0-10.0cm width (at normal sections) or 8.0-25.0cm (at horizontal or vertical curve sections). The height of panel is 80.0cm. Each panel is mounted to the square shaped steel frame (section size is 40x40mm or 65x65mm) and connected to the top of straight-standing pole to directly bury at the middle of the median or at the top of cement concrete protective wall as mentioned in item 10.1.2 (the height from the top of this wall to median is 1.6m). In all cases, this panel is buried and anchored for 45^0 rotation to the traffic direction and located at every 50cm interval along the anti-glared section. The panel must be painted in dark color and securely buried to prevent the falling into the carriageway even during the storm event.

10.4.4. The sight-stopping distance must be checked at the curve section when using anti-glaring methods.

10.5. Lighting on expressway

10.5.1. Lighting must be placed at the following sections:

- At toll gate area;

- In tunnel.

Besides, there should be lighting at:

- The area of connected intersection on expressway;

- The section where the vehicle just exit from expressway and approach one lit road section connected to the expressway or in the area of a lit zone (such as industrial zone, airport).

- On the right side of technical service center.

- At the important signal panels (when it is not possible to install signs with automatic lighting).

10.5.2. Light index which is measured by the average light on expressway pavement is from 1cd/m^2 to 2cd/m^2 (candela/m^2).

The equally spread light level on carriage-way is shown by the luminous ratio between the darkest place and brightest place shall not be more than 1:1.3 along the alignment and 1:2.5 across the carriage-way.

10.5.3. The transition from the light section to the non-light section must be gradually carried out by decreasing the average illumination index from 2cd/m^2 to 0cd/m^2 in the minimum section area of 250m. If the section requiring light is less than 250m from each other, the light should be continuously kept at the section between them.

10.5.4. The light is placed on pole with the pole height of 12-15m and arranged in the line at the median or on the expressway shoulder or on both the meidan and the pavement (horizontally straight or staggered). The distance between the light poles must be computed in accordance with item 10.5.2 and 10.5.3.

10.6. The service works on expressway

10.6.1. Along the expressway there should be the following service works:

- For every 50km - 60km, there should be a technical service center (capable of supplying petrol, oil, minor repair and facilities such as motel, restaurant, toilet).

- Every 120km to 200km there should a large service center (capable of repairing vehicles, supplying petrol, and receiving tourists with restaurants, hotels, tour information office, transit guide, etc.) based on the class of majority guests. It also requires a long-term parking area.

10.6.2. Coordinate with the towns along expressway to construct the service works. The entry/exit section to parking stations or service works must follow the requirements in item 7.8.

10.6.3. The parking stations along the expressway should be at the good scenery at different scope:

- Short-term parking: space for 1 - 3 units of vehicle with a relaxing hut and tourist map.

- Long term parking: space for many vehicles and perhaps with restaurant and telephone booths etc.

10.6.4. The service works must be located at the favorable place for entry/exit, must not block the sight distance at the steep and curve sections and far away from the intersections; the entry/exit must be more than 6m width and have the maximum speed of 40km/h.

These service works (especially petrol stations) should be located regularly and symmetrically (nearly opposite, it can see each other if not opposite) and have the same service capability. The restaurants, hotels can be arranged on the same side but flyover/underpass must be constructed for passengers. Parking lots can be located on both sides of the expressway.

The scale of service stations must be based on traffic flow, traffic components, number of passengers for each service type at the station.

10.6.5. The emergency telephone booths (to urgently noticed to road management centre, traffic

police, car repairing centre, emergency service…) should be installed along the expressway with the distance of 2-3km and at two ends of major structures (bridge, tunnel).

They are located on the grass shoulder, behind balconies or protective walls and symmetrically with each other on both sides of the road. Only 1 telephone booth at the median is not permitted. The phone booth must be painted for easy recognition and consistent in the entire expressway.

10.7. The design contents must consider the environment protection on both sides of the expressway in accordance with 22TCN 242, especially:

- Protective measures to agriculture, forestry, and water source.

- Improving the drainage condition, do not change the flood level on both sides of the expressway compared with the pre-construction condition

- Preventing noise, dust and wast by traffic activities.

- Method to resolve the traveling issues of residents on both sides of the expressway that require daily crossing of the expressway.

10.7.1. To protect agriculture, forestry, and water source, there must be measures of restoring excavated land for cultivation purpose; consideration of the effects of expressway operation and service works to surrounding water sources; restriction method of deforestation around the expressway and anti-erosive measures. For the large bridge, it is necessary to undertake comparison study for using approach bridge instead of high embankment to save cultivated land and avoid flow blocking.

10.7.2. The method of flooding prevention on the upstream end is basically to provide sufficient bridge navigation, drainage capacity and when necessary, lower the height of design road level as referred Clause 7.3.2 of standard TCVN 4054.

10.7.3. To improve environmental pollution by dust and sewer the following measures must be paid attention to:

- The main solution is to design the expressway without traffic congestion (the slower the vehicles run, the more dust and air pollution they emit), therefore calculation of traffic capacity must be considered properly (item 4.5); it is necessary to consider the design of uphill auxiliary lane near residential area and focus on traffic management measures.

- At the branch road to expressway, there should be the section to wash vehicles or the transitory section with the minimum length of 30m of the high grade pavement to restrict dirty vehicles entering the expressway.

10.7.4. The acceptable noise index for the residential area along the expressway is from 45 dB/A to 55 dB/A (A: the value of the maximum noise index measured at 2.0m from the wall, outside the house facing towards the expressway.

At the edge of expressway pavement, the noise index due to traffic is defined as follows:

$$L_0 = 24 + 20 \log N \quad (1)$$

of which:
- L_0 is the noise index, measured by dB

- N is the traffic volume in one hour, measured by unit/hour.

The noise factor L_n is far from noise-causing position (centerline of expressway) with the horizontal distance, R_n, measured by meter, is defined by the formula:

$$L_n = L_0 - 25 \log \frac{R_n}{R_0} \quad . (2)$$

of which:
- L_0 is the noise index at the edge of expressway pavement, measured by dB.
- R_0 is the distance from the centerline to the edge of expressway pavement, measured by meter.

After coordinating formula (1) and (2), we can anticipate the noise factor for the residential area R_n, measured by meter.

10.7.5. If the residential area is too close to the expressway and does not satisfy the noise requirements, the following anti-noise measures can be applied:

- Construct the noise-stopping wall of 3-3.5m tall, close to the edge of the expressway pavement (pavement widening), the wall is made of sound-stopping cement or assembly steel reinforced concrete slab

- Sound-stopping embankment with the top width of 2.0m, tall enough to create the sound-stopping area (from the center of carriage-way to the inner edge of the embankment top).

- Growing grove of plants outside the area of the expressway usage.

10.7.6. To ensure traveling of local residents on both sides of the expressway, the investment report preparation stage should suggest the service road options, underpass/flyover so that it is both favorable and economical. Besides, the designer must pay attention to planning, construction management for residential areas on both sides of the expressway.

10.7.7. The alignment location and technical standard of service roads must be determined based on actual traffic requirement at present and in future of 5-10 years (type of vehicles, traffic volume, etc.) predominantly for residential use. It is not obliged to design the road on any certain road grade (including the overpass width on the expressway). For the residential culvert under the expressway, there should be at least 1 traffic lane with 3.5m width (see 7.11.1).

To ensure the function of freeway/expressway, the service road must be completely separated from the expressway (if it is in the area of the expressway as mentioned in item 5.11, there must be barrier as shown in item 10.1.6).

10.8. The arrangement and construction of maintenance and service works for the expressway must be included in the expressway design project as other road routes and follow the regulations of Vietnam Road Authority (VRA).

MINISTRY OF FINANCE

No.: 90/2004/TT-BTC

SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom – Happiness
===== * =====**

Hanoi, dated 7 September 2004

CIRCULAR
GUIDING THE REGIME ON COLLECTION, PAYMENT, MANAGEMENT AND USE OF ROAD TOLL

Pursuant to Ordinance No. 38/2001/PL-UBTVQH10 of August 28, 2001 on Charges and Fees and the Government's Decree No. 57/2002/ND-CP of June 3, 2002 detailing the implementation of the Ordinance on Charges and Fees;

Pursuant to the Government's Decree No. 77/2003/ND-CP of July 1, 2003 defining the functions, obligations and competence and organizational structure of the Finance Ministry;

The Finance Ministry hereby guides the regime of road toll collection, payment, management and use as follows:

Part I
GENERAL PROVISIONS

I. INTERPRETATION OF TERMS AND PHRASES

In this Circular, the terms and phrases below shall be construed as follows:

1. Roads shall include land roads, land road bridges and land road tunnels.

2. The toll roads are those for which tolls shall be collected under decisions of competent state bodies within effective durations.

3. Road toll booths shall each comprise the control house, the ticket-selling house, the toll gates, toll collection control equipment, the electric lighting system and other support facilities in service of toll collection.

4. Land road motorized vehicles shall include automobiles (including lambrettas, rudimentary trucks), tractors, two-wheelers, three-wheelers, mopeds and the like, including motorized vehicles for the disabled.

5. Specialized vehicular machinery shall include construction vehicular machines, vehicular agricultural or forestry machines, which participate in land road traffic.

II. CONDITIONS FOR APPLICATION OF ROAD TOLL COLLECTION

Roads prescribed for toll collection and toll-collecting organizations must satisfy the following conditions:

1. The construction, repair or upgrading thereof has been completed under projects approved by competent authorities, ensuring that the traffic service quality is better than before toll collection.

2. They belong to road toll collection network planning decided by competent agencies after the Finance Minister gives his/her opinions, specifically:

- For national highways, they must be included in the national highway toll collection network planning and the setting up of toll booths therefor has been decided by the Transport Minister;

- For local roads, they must be included in the local road toll collection network plannings decided by provincial-level People's Councils. Documents promulgating the local road toll collection network plannings and decisions on setting up of toll booths of provincial-level People's Committees must be concurrently sent to the Finance Ministry and the Transport Ministry within 15 days after the promulgation thereof.

In cases where the toll roads are not included in the local road toll collection network plannings promulgated by competent agencies under the above regulations, the managing agencies or investors, before building toll booths, must send documents to the Finance Ministry clearly stating: The length of the entire road, the number of booths and their locations on such roads (the number of projected or existing booths); the length of the road section where a toll booth is to be placed and the reason for the placement of a toll booth at such location. The Finance Ministry shall study and give its written comments within thirty (30) days after the receipt of the documents.

3. Completion of support facilities in service of toll collection, such as toll booths (ticket-selling locations, ticket control location,...), lighting systems, assorted toll tickets, toll-collecting and ticket-controlling apparatus, etc.

4. The Finance Ministry has issued decisions specifying toll rates for national highways or the provincial-level People's Councils have issued resolutions or decisions specifying the toll rates for local roads, suitable to the grades of roads expected for toll collection.

III. SUBJECTS OF APPLICATION

1. Objects liable to road tolls shall be land road motorized vehicles and specialized vehicular machines participating in road traffic (hereinafter referred collectively to as means participating in road traffic).

2. Organizations and individuals (Vietnamese and foreign) having means participating in traffic on toll roads must pay charges for using the roads (hereinafter referred collectively to as road toll) provided for in this Circular.

3. Persons (Vietnamese and foreign) who directly operate means participating in traffic on toll roads must pay road tolls in form of tickets (specified by the Finance Ministry) for each travel on such roads at toll booths according to regulations (except for the cases defined at Point 4 of this section).

4. Road tolls shall be exempt for the following cases:

a) Ambulances, including automobiles of other types carrying accident victims to emergency places.

b) Fire engines.

c) Agricultural or forestry vehicular machines, including mechanical ploughs, harrows, raking machines, weeding machines, rice threshers.

d) Dike patrol cars, vehicles performing urgent tasks against storms and floods.

e) Specialized vehicles in service of defense, security, including tanks, armored vehicles, artillery haulers, troop-carrying vehicles on march.

Besides, specialized vehicles in service of defense shall also include land motorized vehicles bearing the number plates: red background, white stamped letters and figures (hereinafter referred to as red number plates, which are mounted with specialized defense equipment (other than trucks) such as vehicular facilities, lifts, sterns, eclectric generators... Particularly troop-carrying vehicles being on march shall be understood as cars of 12 seats or more, trucks with roofs and benches in trunks, which bear red number plates (regardless of whether they carry troops or not).

Specialized vehicles in service of security (hereinafter referred collectively to as motorbikes, automobiles) of police forces (of the Ministry of Public Security, provincial/municipal Police Departments; district-level Police Sections, etc.), including:

- Traffic police patrol and control motorbikes, cars with the following characteristics: The roofs are fixed with rotating light and the two sides of the motorbikes or cars are printed with "CANH SAT GIAO THONG" (TRAFFIC POLICE).

- Motorbikes, automobiles of Police 113 force, with the line "CANH SAT 113" (POLICE 113) printed on their both sides.

- Motorbikes, automobiles of the mobile police force with the line "CANH SAT CO DONG" (MOBILE POLICE) printed on their both sides.

- Police motorbikes and automobiles performing public duties shall use one of the priority signals specified by law in case of performing urgent tasks.

- Trucks with roofs and installed with benches in trunks for carrying policemen for performance of tasks.

- Specialized automobiles carrying defendants, rescue and salvage cars.

Other land motorized vehicles (other than the above- mentioned specialized vehicles in service of defense and security) shall all be liable to road toll and have to pay tolls according to the provisions of Point 4, Section I, Part III of this Circular.

g) Funeral procession convoy.

h) Convoys with escort motorcades.

5. For toll booths where traffic congestion has not yet been settled, road tolls shall temporarily not be collected from two-wheelers, three-wheelers, mopeds, tripeds (hereinafter referred collectively to as motorbikes).

Based on the traffic situation at each toll booth, units tasked to organize toll collection shall have to report to the Transport Ministry and the Finance Ministry (for national highways) or the provincial-level People's Councils (for local roads) on the situation of traffic congestion in the localities, make specific proposals on temporary non-collection of road tolls for motorbikes at such locations.

On the basis of the proposals of the units tasked to organize toll collection, the opinions of the Transport Ministry and actual investigations as well as surveys, the Finance Ministry shall consider and decide on temporary non-collection of national highway tolls and the provincial-level People's Councils shall consider and decide on temporary non-collection of local road tolls from motorbikes at each toll booth. Pending the decisions of competent agencies, the toll booths shall still have to collect tolls from motorbikes according to regulations.

Part II
COLLECTION LEVEL AND TOLL MANAGEMENT AND USE APPLICABLE TO EACH KIND OF ROAD

I. ROADS INVESTED WITH STATE BUDGET CAPITAL

1. The state budget-invested roads prescribed in this Circular shall include:

a) Roads invested with state budget capital (central budget and local budgets).

b) Roads invested with capital originating from the state budget, such as charges left for units, non-refundable aids, financial supports contributed by organizations and individuals,...

c) Roads invested with loan capital and the debts will be repaid by the state budget, regardless of whether the state budget fully repays the debts (including both the principals and interests) or only the principals while the interests are paid with toll money (including capital borrowed by the state budget and capital borrowed by investors).

d) Other roads managed by the State, such as roads invested for business purpose, which shall be transferred to the State for management after the end of commercial operation period; roads invested in form of BT (the State repays capital for investing organizations or individuals and investing organizations or individuals shall transfer the roads to the State for management); roads built in form of exchange of land for works (the State assigns land and organizations or individuals shall transfer road works), etc.

2. The toll rates for roads invested with state budget capital shall uniformly apply to all booths according to the toll rate table promulgated together with this Circular.

3. In the course of implementation, the Transport Ministry and the provincial/municipal People's Committees should study, arrange and reduce improper toll booths, then proceed to

ensure that the minimum distance between two toll booths on successive roads must be 70 km or longer.

For road sections where toll collection begins (as from the date this Circular takes effect), apart from the conditions specified in Section II, Part I of this Circular, the minimum distance between two toll booths on the same road must be 70 km.

For specific cases where road sections fail to ensure the minimum distance of 70 km between two toll booths, the Transport Ministry or the provincial-level People's Councils shall send documents to the Finance Ministry, clearly stating the reasons for the proposals on toll collection, enclosed with toll collection schemes (including investment mode, time limit for construction, completion and transfer, time limit for putting the works to use, the road length and quality, the construction of toll booths and conditions to ensure the organization of toll collection, the time expected to begin the toll collection, the expected traffic flow, the projected toll rates and grounds for determination of toll rates, estimated toll revenues and toll collection efficiency) for the Finance Ministry to consider and decide.

4. Units organizing the collection of toll on roads invested with the state budget capital must open road toll accounts at the State Treasuries of their respective transactions.

Road tolls collected daily must be deposited immediately into the accounts opened at the State Treasuries and shall be managed and used as follows:

4.1. Road toll-collecting units shall be entitled to deduct part of the collected toll amounts in percentages before remitting them into the state budget, concretely:

a) The local road toll- collecting units may deduct toll in percentages to be decided by provincial-level People's Committee presidents.

b) The national highway toll-collecting units may deduct 20% of the total collected toll amounts.

Of the deducted 20%, 5% (equal to 25% of the total deducted amount) shall be used for formation of investment capital for modernization of toll-collecting technology, which must be remitted by the toll-collecting units to Vietnam Road Administration for focal and concentrated investment under approved projects and the remaining 15% (equal to 75% of the total deducted amount) shall be used to cover expenses for toll collection according to estimates approved by competent authorities, specified in the following corresponding Items b.1, b.2, b.3:

b.1. Expenses for organization of regular toll collection activities:

- Salaries, wages, salary allowances, salary-based contributions (social insurance, medical insurance, trade union fund);
- Management expenses: for working trips, conferences, communications and information, public services (lighting electricity, office water for toll booths), office supplies, meetings,...
- Expenses for mid-shift meals for laborers with the maximum spending level per head not exceeding the minimum salary level set by the State;
- Expenses for labor protection or working uniforms according to the prescribed regimes (if any);
- Expenses for regular repairs of houses, office equipment, toll booths;
- Expenses for hiring security agents to protect toll booths (if any);
- Expenses for tickets, prints in service of toll collection;
- Expenses for purchase of spare parts, equipment of small value and other labor tools in direct service of toll collection;
- Indirect expenses of enterprises in service of toll collection (for state enterprises tasked to collect tolls);
- Other expenses (if any).

b.2. Deductions for reward funds, welfare funds for officials and employees directly engaged in toll collection. The average per-head annual deduction level for these two funds shall not exceed three months' paid salaries if the collected amount is higher than that of the preceding year or two months' paid salaries if the collected amount is lower than, or equal to, the preceding year's.

b3. Expenses for investment in modernization of toll-collecting technology: procurement and installation of toll-collecting equipment (automatic, semi-automatic equipment), procurement of

vehicle-counting equipment according to estimates approved by competent authorities. The investment in procurement of equipment for modernization of toll-collecting technology shall be opened to bidding under the current regulations of the State.

Particularly irregular expenditures and peculiar spendings under separate regulations of designers, such as expense for overhaul of control houses, toll booths, expenses for maintenance of road bridges, lighting systems on bridges (for road sections with bridges), expenses for protection of bridges, purchase of money- transportation vans and overhaul thereof shall be covered by state budget funding sources according to approved annual estimates (the central budget for national highways, local budgets for local roads).

4.2. For roads invested with loan capital, with principal debts repaid by the state budget and loan interests paid by toll money, apart from the amounts deducted in percentages specified in Item 4.1 above, the toll-collecting units may also retain other amounts according to the actual expenses for loan interest payment under loan contracts.

All the expenses specified in Items 4.1 and 4.2 of this Point must not be reflected into the state budget, but must be balanced in the annual financial estimates of toll-collecting units, which are approved by competent agencies. They must be used for the right purposes, in accordance with the right contents, be evidenced with lawful vouchers and settled annually.

The toll-collecting units shall base on the deducted amounts to make spendings in service of the toll collection (15%) and the spendings according to approved estimates (annual estimate divided for each month, each quarter); if the deducted amount in service of toll collection is greater than the spending amount, the difference must be paid into the account of Vietnam Road Administration for it to regulate for attached units having not enough sources to ensure the minimum salary funds for toll-collecting officials and employees according to the prescribed regimes.

Vietnam Road Administration shall open its separate account at the State Treasury of its transactions for monitoring the revenues and expenditures of the investment funds for modernization of toll-collecting technology (5%) remitted by toll-collecting units and the fund amounts regulated in service of the toll collection, remitted by toll-collecting units with surplus differences for transfer to units with deficits. At the same time it must also open books for separate accounting of each fund; if the amounts are not used up by the year-end, they shall be carried forward to the following year for continued use and must annually settled with the Finance Ministry. In cases where the regulation funds in service of toll collection are not used up for three consecutive years, the surplus amounts must be transferred to the investment funds for modernization of the toll-collecting technology.

4.3. The total collected toll amount, after subtracting the temporarily deducted amounts specified at Points 4.1 and 4.2 above, shall be remitted into the state budget by the toll-collecting units according to the following regulations:

a) The toll-collecting units shall declare the toll amounts collected monthly and submit the declarations to the directly managing tax agencies within the first 5 days of the following month. The road toll declarations must clearly state the number and types of tickets already used and the collected toll amount, the deducted toll amount, the toll amount paid into the state budget in the preceding month, made according form No. 2 promulgated together with the Finance Ministry's Circular No. 63/2002/TT-BTC of July 24, 2002 guiding the legislation on charges and fees.

Based on the declared amounts, the toll-collecting units shall carry out procedures for remittance into the state budget. The deadline for toll remittance into the state budget shall be no later than the 15th day of the following month (corresponding chapter, category and item, Section 036, sub-section 01 of the prescribed state budget contents (the centrally-managed road tolls shall be remitted into the central budget, locally-managed road tolls shall be remitted into the local budgets).

b) The directly managing tax agencies are tasked to check the declarations, compare each type of ticket already issued and used in order to determine accurately the toll amounts already collected, the amounts to be remitted into the state budget and notify the toll-collecting units to settle the toll amount to be monthly remitted into the state budget.

The toll-collecting units shall settle the amounts to be remitted monthly into the state budget according to notices of tax agencies; the overpaid amounts, if any, shall be deducted from the toll amounts to be remitted into the state budget in the following period; if they have underpaid, they must remit the outstanding toll amounts into the state budget within 10 days after the receipt of the tax agencies' notices.

c) The finance bodies shall reallocate the total road toll amounts actually remitted into the state budget for arrangement of capital for management and maintenance of the road systems in accordance with the current provisions of the Law on State Budget and finance for road management and maintenance.

5. Road toll revenue-expenditure estimation:

Annually, units having toll booths shall base on the tolled objects, toll rates for each kind of means, the number of means participating in traffic in the plan year, the standard norms, the current financial expenditure regime to make road toll revenue-expenditure estimates under the Finance Ministry's guidance on state budget decentralization, estimation, implementation and settlement. Concretely as follows:

a) For units having national highway toll booths:

- The road - managing and - repairing companies under the road - managing regions where exist toll booths shall make toll revenue-expenditure estimates of the plan year and send them to the road-managing regions for consideration and sum-up to be sent to Vietnam Road Administration.

- Units (road public-utility enterprises or non-business units) under the provincial/municipal Transport Services, which are entrusted by the Transport Ministry to manage national highways with toll booths, shall make road toll revenue-expenditure estimates and send them to the provincial/municipal Transport Services for consideration and sum-up to be sent to Vietnam Road Administration.

- Vietnam Road Administration shall consider and sum up the toll revenue-expenditure estimates for sending them to the Transport Ministry. The Transport Ministry shall sum them up together with its annual budget estimate and send them to the Finance Ministry according to regulations.

b) For local road toll-collecting units:

Units (road public-utility enterprises or non-business units) with toll booths shall make toll revenue-expenditure estimates to be sent to the provincial/municipal Transport Services which shall sum them up together with their annual budget estimates and send them to local Finance Services according to regulations.

c) The road toll revenue-expenditure estimates made by units shall include:

- Revenue estimate, including revenue amount to be remitted into the state budget and the revenue amount to be retained according to regulations.

- Expenditure estimate made according to assigned percentages, ensuring the compatibility with spending contents specified at Point 4.1, Section I of this Part.

The toll revenue-expenditure estimates shall be made by units for every toll booth, with explanation of the bases for detailed calculation according to revenue and expenditure contents.

6. Assignment of toll revenue-expenditure estimates:

a) For national highway toll- collecting units:

- For units under road-managing regions: Based on the road toll revenue-expenditure estimates assigned by competent authorities, the road-managing regions' toll revenue- expenditure estimates detailed to every toll booth, the standard norms and the current financial expenditure regimes, Vietnam Road Administration shall assign the revenue estimates and expenditure percentages on the total collected amounts to road-managing regions, detailed to each toll booth; the road-managing regions shall assign revenue estimates and regular expenditure percentages on the total collected amount to road-managing and- repairing companies, detailed to each toll booth.

- For units attached to the provincial/municipal Transport Services entrusted by the Transport Ministry to manage national highways with toll booths: Vietnam Road Administration shall assign road and bridge toll revenue estimates and regular expenditure percentages on the

total collected amounts to provincial/municipal Transport Services, detailed to each toll booth. The provincial/municipal Transport Services shall assign estimates to units, detailed to each toll booth.

b) For local road toll- collecting units:

Based on road toll revenue-expenditure estimates assigned by competent authorities, the toll revenue-expenditure estimates made by units with toll booths, the standard norms and current financial expenditure regimes, the provincial/municipal Transport Services shall assign road toll revenue estimates and regular expenditure percentages on the total collected amounts to units, detailed to each toll booth.

The assignment of road toll revenue estimates and percentages left for regular expenditures on the total collected amounts by the Transport Ministry, Vietnam Road Administration and provincial/municipal Transport Services to their respective attached units with toll booths must ensure the principles: The revenue must not be lower and the regular expenditure percentage must not be higher than the level assigned by competent authorities, detailed according to revenue-expenditure contents in Item b.1. Item b.2, Point 4.1, Section I of this Part.

The road toll revenue estimates, the regular expenditure percentage on the total collected amounts, which are assigned to units (detailed to each toll booth) of Vietnam Road Administration and provincial/municipal Transport Services must be sent to finance bodies of the same level and tax agencies, the State Treasuries where units having toll booths register their transactions.

Based on the revenue estimates, regular expenditure percentage on the total collected amounts, units shall make quarterly revenue-expenditure estimates (divided to each month) and send them to the tax agencies, the State Treasuries where the units register their transactions, and concurrently to the superior managing agencies.

7. Observance of road toll revenue-expenditure estimates:

a) Based on expenditure estimates notified by competent authorities, the collected amounts actually remitted into the State Treasuries, the expenditure-approving orders of the unit heads and lawful vouchers, the State Treasuries shall control expenditures, allocate advances or make payments to units under the provisions of the Finance Ministry's Circular No. 79/2003/TT-BTC of August 13, 2003 guiding the regime of management, allocation and payment of state budget expenditures through the State Treasuries.

b) Annually and quarterly, based on the toll amounts actually remitted into the state budget, Vietnam Road Administration shall sum up the national highway toll amounts and the provincial/municipal Transport Services shall sum up local road toll amounts, certified by the State Treasuries. Based on the toll amounts actually remitted into the state budget, finance bodies shall transfer the sources to the State Treasuries for allocation and payment. Based on the toll sources reallocated by finance bodies, Vietnam Road Administration and provincial/municipal Transport Services shall assign estimates to their respective units after reaching agreement with finance bodies and send them to the State Treasuries for control and payment in form of estimated expenditures from the State Treasuries.

8. Accounting and settlement of road toll revenues and expenditures:

a) Toll-collecting units must account and settle toll revenues and expenditures strictly according to current accounting and statistical regimes. At quarter-end and year-end, the toll-collecting units must make reports on settlement of toll revenues and expenditures after completing the settlement with tax agencies of the collected toll amounts, the payable amounts and the amounts already remitted into the budget, the amounts retained and the amounts actually spent according to the provisions of this Circular.

b) The superior managing agencies of toll-collecting units shall have to examine and notify the consideration and approval of toll revenue-expenditure settlements of their attached units and send sum-up settlement reports to finance bodies of the same level for appraisal and notify the approval of settlements together with annual settlements of the managing agencies.

II. ROADS INVESTED BY THE STATE WITH LOAN CAPITAL AND SUBJECT TO TOLL COLLECTION FOR CAPITAL RECOVERY

1. Roads invested by the State with loan capital and subject to toll collection as mentioned in this section are roads whose investors (State management agencies in charge of land roads) are permitted by the State to borrow capital for investment, then to collect tolls for repayment of loan capital under investment projects approved by competent state bodies (excluding roads invested with loan capital for business purpose).

2. The toll rates applicable to roads invested by the State with loan capital and subject to toll collection for capital recovery shall comply with the toll rates applicable to roads invested with state budget capital specified at Point 2, Section I of this Part. In cases where the application of toll rates for roads invested with state budget capital fails to ensure the capital recovery under the approved investment projects, the investors must request in writing the competent agencies (the Finance Ministry for national highways; provincial-level People's Councils for local roads) to decide on appropriate toll rates, which, however, shall not exceed twice the toll rates applicable to roads invested with state budget capital. The procedures and order for issuing decisions providing for the toll rates mentioned in this section shall be as follows:

a) Within 60 days before the date of starting the toll collection, investors must send to the Finance Ministry (for national highways) or the provincial-level People's Councils (for local roads) the official letters requesting the latter to specify the toll rates, enclosed with the following dossiers:

- Road investment projects approved by competent authorities (clearly stating the road grade and the length of the toll sections, the toll rates approved under projects), the time limit for completion of construction and putting of the works to use.

- The toll collection scheme, covering: toll booths (automatic, semi-automatic, manual, conditions on lighting electricity...), the estimated collection amounts (if different from the collection amounts inscribed in the projects approved by competent agencies, the reasons therefor must be stated clearly), the projected revenue sources, toll collection efficiency and the time for capital recovery.

b) Within 30 days before starting the toll collection, the Finance Ministry or the provincial-level People's Councils must consider and decide on the toll rates and notify them in time to investors for deployment of toll collection. Where the provincial-level People's Councils issue decisions on toll rates for locally-managed roads, such decisions must also be sent to the Finance Ministry and the Transport Ministry for monitoring the implementation.

3. Toll-collecting units must open toll collection accounts at the State Treasuries of their respective transactions. The toll amounts collected daily must be deposited into the accounts opened at the State Treasuries and shall be used as follows:

a) Making deductions in percentage for toll-collecting units to cover expenses for toll collection and expenditures specified at Point 4.1, Section I of this Part (roads invested with state budget capital).

b) The remainder (the total collected toll amount minus the amount retained in percentage as provided for in Item a of this Point) shall, at the end of a month, be transferred into the accounts opened by investors or units entrusted to accept and repay debts on behalf of investors at the State Treasuries. When debts turn due, these units shall carry out procedures for payment to the lending units strictly according to the provisions of Joint Circular No. 90/2001/TTLT-BTC-BGTVT of November 9, 2001 of the Finance Ministry and the Transport Ministry guiding the management and settlement of state budget capital and road tolls for repayment of development investment credit loan capital of the State for traffic projects.

4. The entire toll amounts used for debt repayments stated at Item b, Point 3 of this Section must be recorded for mutual ceasing via the state budget according to the following procedures and order:

- Annually, once every six months (the first half and the second half of the year), the toll-collecting units must sum up toll revenue-expenditure settlements in the period, clearly stating the toll amounts collected, the toll amount used for each spending item with detail on the spending item

of deductions payable to the investing agencies and send such settlement summary to the directly managing tax agencies.

- The tax agencies shall examine the toll revenue-expenditure settlement of each unit, determining the amount actually collected, the amount actually spent, including amounts deducted for creation of sources for repayment of loan capital, send documents together with revenue-expenditure settlements to the Finance Ministry (General Department of Taxation, for national highways) or the provincial/municipal Finance Services (for local roads). The General Department of Taxation shall examine, sum up and transfer them to the Administrative and Non-Business Department for submission to the Finance Ministry for consideration and decision on mutual ceasing for national highways; the provincial/municipal Finance Services shall decide on mutual ceasing for each locality (the mutual ceasing of the state budget must not be later than the time for adjustment of the preceding year's settlement).

- Based on toll collection vouchers made in form of mutual ceasing, the General Department of Taxation shall announce the budget revenue amount at each national highway toll booth and the provincial/municipal Finance Services shall announce the budget revenue amount at each local toll booth to provincial/municipal Tax Departments for sum up of the state budget revenue amounts in the localities.

- Investors or units entrusted to accept and repay debts on behalf of investors shall have to strictly monitor the repayment of debts and capital amounts borrowed by the State for investment in upgrading roads with toll collection for capital recovery. For roads with loan capital fully recovery under the approved projects, there must be reports thereon to the Finance Ministry, the Transport Ministry (for national highways) or the provincial-level People's Councils (for local roads) so that the latter stop the toll deduction for capital recovery and at the same time issue decisions on toll collection, remittance and use management according to the regimes prescribed for roads invested with state budget capital as mentioned above.

5. Units organizing the collection of tolls on roads invested by the State with loan capital and collection of tolls for capital recovery shall have to make estimates, observe the estimates and toll revenue-expenditure settlements according to regulations applicable to roads invested with the state budget capital mentioned at Points 5, 6, 7 and 8, Section I of this Part. Besides, they must also explain in detail the payable debts (principals and interests), amounts already repaid by the reporting year, amounts payable in the estimating year and payment source of the estimating year.

6. For roads invested by the State with loan capital for upgrading mentioned in this Section, after the full repayment of loan capital (including both principals and interests), tolls must be collected, remitted, managed and used according to the regime prescribed for roads invested with state budget capital mentioned above.

III. ROADS INVESTED WITH JOINT- VENTURE CAPITAL

1. Roads invested with joint-venture capital mentioned in this Section shall include:

- Roads invested with capital of joint venture between state budget capital and other partners' capital.

- Roads invested partially by the State (a bridge in the entire toll road section or a part of the entire toll road section) and the rest invested by other partners. In this cases, the joint-venture parties must reach agreement on the assessment of the actual value of the road sections invested by each party in order to determine the capital amount contributed by each joint-venture party.

2. The toll rates for roads invested with joint-venture capital shall be considered road-using charge inclusive of value added tax (VAT) set by the Finance Ministry (for national highways) or provincial-level People's Councils (for local roads) suitable to the road grades and the length of the toll road sections under the approved investment projects, which, however, shall not exceed twice the toll rates for roads invested with state budget capital. The toll rate-setting procedures and order shall comply with the provisions of Point 2, Section II of this Part.

3. Tolls collected from roads invested with joint-venture capital shall be used as follows:

3.1. Payment of value added tax and business income tax according to current regulations.

3.2. Payment of expenses for organization of toll collection.

3.3. Payment of expenses for management, maintenance and regular repair of toll road sections.

3.4. The total collected toll amount, after subtracting expenses made according to the above spending contents (3.1, 3.2, 3.3), shall be left 100% for the joint-venture partners (in order to shorten the toll collection duration, for roads invested with joint-venture capital) or divided to joint-venture parties according to their capital contribution percentages stated in the investment projects approved by competent authorities according to the following regulations:

a) The collected toll amount divided according to percentages of state budget capital contribution must be fully remitted into the state budget (if the investment capital comes from the central budget, such amount shall be remitted into the central budget; if the investment capital comes from local budgets, such amount shall be remitted into local budgets. In cases where the capital is contributed by both the central budget and the local budget, such amount shall be divided to each budget level according to its capital contribution percentage in the total capital amount contributed to a joint venture).

b) The collected toll amounts divided according to percentages of contributed capital of other joint-venture parties shall be accounted into their incomes which shall not be liable to business income tax.

4. For roads invested with joint-venture capital mentioned in this section, after the full recovery of capital and payment of relevant arising expenses as stipulated above (including permitted profits) under the approved investment projects, tolls must be collected, remitted and used according to the regime prescribed for roads invested with state budget capital as mentioned above.

IV. ROADS INVESTED FOR BUSINESS

1. The toll rates for roads invested for business (including BOT and other forms of business) are road-using charges inclusive of VAT for use of roads, which are set by the Finance Ministry (for national highways) or provincial-level People's Councils (for local roads), suitable to the road grade and the length of the toll road sections under the approved investment projects and investors' proposal, which, however, shall not exceed twice the toll rates for roads invested with state budget capital. The toll-setting procedures and order shall comply with the provisions of Point 2, Section II of this Part.

2. The road toll amounts invested for business are business revenues of units. Toll-collecting units shall have to declare and pay value added tax and business income tax, and account business results as provided for by law.

3. At the end of the business duration under contracts or decisions of competent state bodies, investors must transfer such roads to the State for management and the toll-collecting units must collect, remit, manage and use road tolls according to the regime prescribed for roads invested with state budget capital as mentioned above.

Part III
TOLL COLLECTION VOUCHERS AND RESPONSIBILITIES OF ROAD TOLL-COLLECTING ORGANIZATIONS

I. TOLL COLLECTION VOUCHERS

1. The toll collection vouchers are referred collectively to as tickets. The toll tickets are provided differently:

a) The toll tickets for roads invested with the state budget capital and the State's loan capital for upgrading, subject to toll collection for capital redemption (Section I, Section II, Part II of this Circular) are titled "Phi duong bo" (Road tolls). The road toll vouchers are receipt of tolls belonging to the state budget.

b) The toll tickets for roads invested for business (section III, section IV, Part II of this Circular), are titled “Cuoc duong bo” (Road-using charge). The road-using charge vouchers are specific invoices used upon the provision of road-using services.

2. Types of toll ticket:

2.1. The toll tickets at each toll booth shall include single trip ticket, monthly ticket, quarterly ticket.

a) The booth toll tickets bear the following common characteristics:

- Booth toll tickets are used for collection of tolls from means participating in traffic through a toll booth where tickets are issued. The toll tickets issued for any toll booth shall be valid for use only at such toll booth (not valid at other toll booths).

- Tickets are printed according to set forms of the Finance Ministry (General Department of Taxation) with uniform sizes and common norms (excluding types of toll tickets at automatic and semi-automatic toll booths).

- Tickets are issued annually according to the calendar year. Single trip tickets shall be used continuously through years. The monthly tickets and quarterly tickets shall be valid only within the duration inscribed in the tickets. The sold tickets must not be changed or returned (including damaged tickets and expired tickets).

- Single trip tickets are sold according to traffic means corresponding to the par values pre-printed on the tickets, not inscribed with plate numbers of traffic means. Monthly tickets and quarterly tickets are sold according to traffic means corresponding to the par values pre-printed on the tickets, which are, however, must be inscribed clearly with the use duration and plate numbers of traffic means.

- Single trip tickets, monthly tickets and quarterly tickets at each toll booth shall be widely sold to all subjects that have demands therefor. Organizations and individuals may buy one or many tickets at a time for use.

b) Specific characteristics of each type of toll ticket:

- Single trip tickets: Used for collection of tolls on traffic means passing through toll booths where tickets are issued. Single trip tickets are pre-printed with par values according to toll rate prescribed for each type of traffic means.

- Monthly tickets: Used for collection of tolls on traffic means passing through toll booths where tickets are issued within a month starting from the first day to the last day of the month inscribed in the tickets.

Monthly tickets are pre-printed with par value corresponding to each type of traffic means. The par value of a monthly ticket shall be 30 times the par value of a single trip ticket. Particularly, the par value of monthly tickets for two wheelers, three wheelers, mopeds and the like shall be ten times the par value of the single trip ticket.

- Quarterly tickets: Issued according to quarter (I, II, III, IV) in the calendar year, used for collection of tolls on traffic means passing through toll booths where tickets are issued within a quarter starting from the first day of the first month of such quarter to the last day of the quarter inscribed in the tickets.

Quarterly tickets are pre-printed with par values corresponding to each type of traffic means. The par value of a quarterly ticket shall be three times the par value of a monthly ticket, with 10% discount (to encourage the purchase of quarterly tickets).

2.2. Highway 5 toll tickets:

To experimentally use Highway 5 toll tickets at two toll booths with monthly tickets and quarterly tickets (single trip tickets shall not be used, which, however, can be bought at each toll booth, if needed).

a) The Highway 5 toll tickets bear the following common characteristics:

- Highway 5 toll tickets are titled “Phi duong bo tuyen Quoc lo 5” (Highway 5 toll”, clearly inscribed with: The use duration, type of traffic means, plate numbers, toll rates.

- Highway 5 toll tickets shall be used for means (excluding two-wheelers, three-wheelers, mopeds and the like) joining in traffic on Highway 5. The Highway 5 toll tickets shall not be valid for use on other roads.

- The par value of a Highway 5 toll ticket is equal to a booth toll ticket par value multiplied by 2.

- The Highway 5 toll tickets shall be uniformly prescribed by the Finance Ministry in terms of sizes, colors and norm contents.

- The Highway 5 toll tickets shall be sold widely to all subjects, without restrictions on quantity. The means operators using Highway 5 toll tickets shall put up the tickets inside the front wind shields for ticket check upon each time the means pass through the toll booth.

b) Specific characteristics of each type of Highway 5 toll ticket shall be as follows:

- Monthly tickets: Used for the collection of tolls on means participating in traffic on Highway 5 within a month duration inscribed in the tickets.

A monthly Highway 5 toll ticket par value = a monthly booth toll ticket par value x 2

- Quarterly tickets: Used for the collection of tolls on means participating in traffic on Highway 5 within a quarter duration inscribed in the tickets.

A quarterly Highway 5 toll ticket par value = a quarterly booth toll ticket par value x 2

c) The par values of assorted booth toll tickets and Highway 5 toll tickets are specified in the Appendix to this Circular.

2.3. “Phi quoc lo luot” (National highway single trip) tickets:

- A “Phi quoc lo luot” ticket has the par value of VND 10,000/ticket/trip, applicable to cars of under 12 seats and valid for toll booths managed by the State (including national highway toll booths assigned to localities for toll collection). The “phi quoc lo luot” tickets shall not apply to toll booths invested for business (BOT or other business form), regardless of national highways or local roads; toll booths managed by localities (local roads) and toll booths with toll collection rights already transferred for a definite term.

- A “phi quoc lo luot” ticket shall be valid only for one trip through a national highway toll booth. Organizations and individuals using cars of under 12 seats can buy “phi quoc lo luot” tickets as requested (without restriction on quantity) at any national highway toll booth most convenient and each time passing through a national highway toll booth, the means operators shall produce one ticket.

- The Finance Ministry (General Department of Taxation) shall print and issue “phi quoc lo luot” tickets according to a set form. A ticket is composed of three parts: The counterfoil, the part kept by ticket control gates and the part kept by toll payers (for use as payment voucher), which are made with the contents, colors and sizes as prescribed.

- Toll booths shall have to sell “phi quoc lo luot” tickets to all subjects in need; settle tickets and toll money according to current regulations.

- The toll-collecting units shall collect, remit (into the state budget or into sources created for capital recovery) and manage the use of proceeds from the sale of “phi quoc lo luot” tickets according to current regulations.

2.4. The “phi duong bo toan quoc” (nationwide road toll) tickets:

- Tickets used exclusively for defense and police vehicles bear the title “phi duong bo toan quoc” (nationwide road toll). The possession of “phi duong bo toan quoc” tickets by defense or police agencies or units means they have already paid the road tolls for all toll booths nationwide (regardless of whether the roads are invested by the State or invested in BOT or other business forms) at the par values promulgated together with this Circular.

- The “phi duong bo toan quoc” tickets applicable to defense vehicles shall include the following contents: The issuing agency (The Finance Ministry -General Department of Taxation), type of vehicle with two types of ticket used separately for military cars and military trucks (without details on tonnage and plate numbers of each means), the expiry year (not inscribed with par values). A ticket sizes 12 cm in length x 8 cm in width and has the colors: red for the background, white for letters and numerals. The “phi duong bo toan quoc” tickets applicable to the Defense Ministry’s vehicles bearing red number plates shall not be used for means bearing other number

plates (including the Defense Ministry's means which do not bear red number plates). Ticket controllers at toll booths shall recognize types of the Defense Ministry's means for which road tolls have been already paid through two basic characteristics: the red number plates and "phi duong bo toan quoc" (nationwide road toll) tickets; in cases where traffic means lack either of these two characteristics, they shall be considered as having not paid the road tolls.

- A "phi duong bo toan quoc" ticket applicable to the Public Security Ministry's vehicles shall include the following contents: The issuing agency (the Finance Ministry - General Department of Taxation), type of vehicle (with 5 types prescribed in the toll rate table issued together with this Circular). Such a ticket sizes 12 cm in length x 8 cm in width and has the colors: yellow for the background with red stripes along the ticket body at the position of 1/3 from left to right, and black for letters and numerals.

- The "phi duong bo toan quoc" tickets shall not be used as payment vouchers (including payment covered by the state budget and production, business and service expenses).

3. Printing, issuance and use management of road toll tickets:

3.1. Ticket forms:

Road toll ticket forms are used to distinguish between two types of ticket:

- Magnetic tickets used for automatic or semi-automatic toll collection and printed in forms suitable to different types of machine manufactured by different firms.

- Non-magnetic tickets used for manual toll collection and printed according to set forms uniformly designed by the Finance Ministry (General Department of Taxation) in cooperation with the Transport Ministry in terms of sizes and norm contents.

Based on the ticket forms prescribed by the Finance Ministry, the provincial/municipal Tax Departments shall assume the prime responsibility for, and coordinate with units tasked to organize the toll collection in, determining specific norms applicable at toll booths and the color of each type of ticket shall be provided for by localities. The principles for determining the ticket forms shall be as follows:

a) Ticket size (excluding magnetic tickets):

- Single-trip ticket, composed of three parts: The counterfoil, the part to be kept at ticket control gates, the part to be kept by toll payers (for ticket control and use as payment vouchers), with the ticket size of 19 x 7 cm (excluding section for the back of the receipt volumes).

- Toll booth monthly or quarterly ticket, composed of two parts: The counterfoil and the part to be kept by toll payers (for ticket control and use as payment vouchers), with the ticket size of 9 x 6 cm (excluding section for the back of the receipt volumes).

- Highway 5 monthly, quarterly ticket, composed of two parts: The counterfoil and the part to be kept by toll payers (for ticket control and use as payment vouchers), with the ticket size of 28 x 12 cm (excluding section for the back of the receipt volumes). Particularly, the monthly toll tickets for motorbikes have the same sizes as the booth monthly tickets for motorbikes (mentioned in the above part).

b) Ticket color:

- The booth single-trip, monthly, quarterly toll tickets are printed in 7 different colors corresponding to 7 par values (each color for each par value), which are determined properly by Provincial/Municipal Tax Departments in cooperation with units tasked to organize the toll collection.

- The highway 5 monthly, quarterly toll ticket is divided into two parts: The upper part is in light bright color and the lower part is in dark color (each color for each par value).

c) Details to be inscribed on tickets:

Details to be inscribed on tickets shall be provided uniformly, containing such basic norms as the issuing unit, type of ticket, type of traffic means, use duration, ticket par value.

3.2. Ticket printing and issuance

a) The General Department of Taxation shall print and issue Highway 5 monthly and quarterly tickets, national highway single-trip tickets and tickets for traffic means of the Defense Ministry and the Public Security Ministry, specifically:

- Annually or extraordinarily, the General Department of Taxation must sum up the use demands of units for adequate printing and issuance of assorted necessary tickets to

provincial/municipal Tax Departments for timely delivery to toll-collecting units for sale to users according to regulations.

- To sell "phi duong bo toan quoc" (nationwide road toll) tickets at the request of the Defense Ministry and the Public Security Ministry and send notices on road toll payment by the Defense Ministry, the Public Security Ministry to Vietnam Road Administration for sum-up of, and report on, toll collection results.

b) The provincial/municipal Tax Departments shall print and issue single-trip tickets, monthly tickets and quarterly tickets for toll collection by toll booths based in the localities (national highways, local roads, BOT roads and other roads), receive Highway 5 toll tickets and national highway single-trip tickets, which are printed by the General Department of Taxation, for supply to toll booths for sale to users.

Annually, quarterly or extraordinarily, the provincial/municipal Tax Departments shall make sum-up reports on demands for each type of ticket, forwarded by units tasked to organize the toll collection, compare them with the volume of stock tickets which can be continually used (if any), determine the quantity of assorted tickets to be printed in the period so as to print them adequately and timely, satisfying the use demands, not letting the situation of ticket shortage occur while saving expenditures. For tickets to be printed and issued by the General Department of Tax, the provincial/municipal Tax Departments must sum up reports on estimation of the necessary ticket volume and propose the General Department of Taxation to print them in accordance with the practical requirements.

c) Units tasked to organize toll collection must:

- Annually, before the 15th day of the first month of the last quarter of the current year, or extraordinarily (due to ticket shortage or change in demands...), estimate the ticket volumes (detailed to each type of ticket) needed for use in the following year or period (for extraordinary cases) and send report to the superior road- managing companies (for toll booths), and the direct managing Tax Departments for timely printing of tickets to satisfy the use demand in the period.

- Receive assorted tickets at Provincial/Municipal Tax Departments for sale to users according to regulations (excluding the "phi duong bo toan quoc" (nationwide road toll) tickets).

- Regularly monitor opinions of units on the use demand for each type of ticket, the detailed norms on the tickets; if they are inappropriate, report them in time to the superior managing agencies and the direct managing tax agencies for appropriate adjustment.

3.3. Ticket management and use:

a) The "phi duong bo" (road toll) tickets for roads invested with the state budget capital or loan capital for capital recovery as provided for in Section I, Section II, Part II of this Circular shall be managed and used according to the Finance Ministry's regulations on management of charge and fee collection receipts. Organizations and individuals having "phi duong bo" (excluding the "phi duong bo toan quoc" (nationwide road toll) tickets may account the toll money amounts (printed on the tickets) into business expenditures (for production, business and/or service units) or into non-business expenditures.

b) The "cuoc duong bo" (road-using charge) tickets for roads invested for business as provided for in Section III, Section IV of this Circular shall be managed and used according to the Finance Ministry's regulations on management of invoices and vouchers. Organizations and individuals having "cuoc duong bo" tickets may account them into business expenditures or non-business expenditures. Production and/or business establishments paying value added tax by tax credit method may account into their business expenditures the VAT-exclusive charge amounts and credited input VAT according to the Law on Value Added Tax. Production and/or business establishments paying value added tax by method of direct calculation on the added value may account into their business expenditures the total payable road charges inclusive of VAT amounts.

c) The road toll booths shall have to:

- Settle the ticket volumes and toll amounts collected in each working shift in the day, clearly define the personal responsibility of each working shift on the principle that those who cause the loss of tickets must compensate for the toll money at the corresponding toll rates inscribed on each type of ticket, that those ticket controllers who let vehicles without tickets or with invalid tickets

pass through toll booths must compesentate for toll money according to regulations. Besides, these persons shall also be fined correspondingly to the seriousness and nature of acts of violation.

- Monthly, quarterly and annually, compare and settle the tickets and settle the collected toll amounts, the amounts remitted into the state budget with the direct managing tax agencies.

3.4. Liquidation and destruction of toll tickets:

a) The parts of the toll tickets already sold to users, which are kept at the ticket control gates shall be liquidated and destroyed daily according to working shifts after comparing them with vehicle-counting machines or the ticket-selling sections, and the records thereon shall be signed by the ticket-selling section, the ticket-controlling section and the head of the toll booth.

b) The single-trip ticket counterfoils kept at units assigned to organize the toll collection shall be liquidated and destroyed after three months from the month the tickets are sold to users.

c) The monthly ticket counterfoils shall be liquidated and destroyed after six months from the month the tickets are used.

d) The quarterly ticket counterfoils shall be liquidated and destroyed after one year from the year the tickets are issued, which is inscribed on the tickets.

The liquidation and destruction of assorted ticket counterfoils as mentioned in Items b, c and d above must be decided in writing by directors of the toll road management companies and the liquidation and destruction must be recorded in writing with the participation of the direct managing tax agencies in strict accordance with the procedures prescribed for liquidation and destruction of tax receipts and prints.

Particularly, the ticket parts kept at the ticket control gates shall be liquidated and destroyed daily according to working shifts after making comparison with the ticket-selling section (with records signed between the two sections); the toll booth heads shall decide on the liquidation and destruction and bear responsibility therefor.

4. For motorized vehicles of the Defense Ministry and the police forces, which participate in road traffic:

The Defense Ministry's vehicles bearing red number plates, which are liable to road tolls and a number of traffic means of the police forces, when performing urgent and/or special tasks or operations, shall pay road tolls according to the following regulations:

a) Annually, simultaneously with the budget estimation, the Defense Ministry and the Public Security Ministry shall estimate the volumes and types of ticket needed and the funding amounts for ticket purchase for the plan year and send them to the Finance Ministry (General Department of Taxation and Department I).

b) The General Department of Taxation shall print and issue the nationwide road toll tickets exclusively for defense and police vehicles.

c) The Defense Ministry and the Public Security Ministry shall purchase "phi duong bo toan quoc" (nationwide road toll) tickets at the Finance Ministry (General Department of Taxation) according to the following procedures:

- When the time for ticket purchase comes, ticket purchasers shall bring introduction papers of the Defense Ministry or the Public Security Ministry, which are clearly inscribed with their full names and positions; the volumes and types of ticket to be purchased, together with their identify cards to the General Department of Taxation for ticket purchase.

- The General Department of Taxation shall supply tickets to the purchasers with volumes and types of the "phi duong bo toan quoc" tickets as requested. On the basis of the supplied ticket volumes, the calculation of the payable toll amounts, it shall send notices to the Defense Ministry, the Public Security Ministry on the payable toll amounts, the time and place of payment into the state budget. The notices must be signed and sealed by the head of the General Department of Taxation and certified by the ticket recipients as having fully received the tickets, who must also sign and inscribe their full names thereon. A toll payment notice must be made in five copies: one copy is sent to the Defense Ministry or the Public Security Ministry, one to the Central State Treasury, one to Department I of the Finance Ministry and two copies are kept at the General Department of Taxation.

- Based on the toll payment notices of the General Department of Taxation, the Defense Ministry and the Public Security Ministry shall carry out the procedures for money remittance into

the state budget according to regulations. After receiving the money payment receipts of the Defense Ministry or the Public Security Ministry, the Central State Treasury shall carry out procedures for collection of money and account them as follows:

+ Deducting 20% into the account of Vietnam Road Administration, of which 15% (equal to 75% of the total deducted amount) for reward to persons who have detected fake tickets (the reward to persons who have detected fake tickets shall comply with the separate guidance of the Finance Ministry). At year-end, if such amount is not used up, the remainder shall be transferred to the following year for further use and must be annually settled with the Finance Ministry. In cases where such amount is not used up for three consecutive years, the remainder must be transferred into the investment funds for modernization of toll-collecting technology; 5% (equal to 25% of the total deducted amount) shall be added to the investment fund for modernization of toll-collecting technology;

+ The remaining 80% shall be accounted into the state budget at the Central State Treasury according to corresponding chapter, category, clauses, section 036, subsection 01 of the current state budget contents.

- The Central State Treasury shall, after receiving the money payment vouchers and the toll amounts already paid into the state budget by the Defense Ministry or the Public Security Ministry, make certification of having already collected the road tolls in the payment vouchers of the Defense Ministry or the Public Security Ministry and issue notice on state budget credit according to the prescribed procedures.

The toll payment papers with the Central State Treasury's certification of having already collected road tolls shall be used as vouchers for settlement of defense or public security budget.

- Periodically, the Defense Ministry and the Public Security Ministry shall compare with the General Department of Taxation the payable toll amounts, the toll amounts already paid into the state budget and the toll amounts to be further paid or overpaid in order to settle them according to actual payment.

d) The funding sources for payment of tolls on traffic means in service of the tasks of commanding, training and/or combat readiness of the Defense Ministry and the Public Security Ministry shall be allocated by the state budget according to the approved annual estimates.

II. RESPONSIBILITIES OF TOLL-COLLECTING ORGANIZATIONS AND INDIVIDUALS

Road toll-collecting organizations and individuals (hereinafter referred collectively to as road toll-collecting units) shall have the responsibilities:

1. To publicize announcements (including the posting up at ticket-selling places) on subjects liable to pay tolls, subjects entitled to toll exemption, the toll rates and procedures for toll collection and remittance.

2. To organize convenient ticket-selling locations according to regulations:

a) To organize ticket-selling spots at toll booths, which are convenient for traffic means operators and free from traffic congestion. Besides, the toll-collecting units should expand networks and forms of ticket sale, which are convenient for ticket buyers while ensuring the strict management and avoidance of toll loss.

b) To sell assorted tickets in time and adequately at the request of buyers, without any restriction on the subjects and volumes of tickets. For single-trip tickets sold at the ticket par values corresponding to tonnage of traffic means, not to specify the number plates of traffic means and the use duration. For monthly and quarterly tickets, to sell them according to the following regulations:

- Organizations and individuals buying tickets must produce to ticket sellers the registration certificates of traffic means for purchase of tickets at the toll rates corresponding to types of traffic means and their designed load.

- Ticket sellers must fully inscribe on the tickets: the number plates, the use duration.

c) Organizations and individuals buying toll tickets shall base on their practical conditions to select the mode of payment in cash, cheque, account transfer or accreditative expenditure by deducting money from buyers' accounts for transfer into toll-collecting units' accounts.

- The sold tickets (including booth tickets, Highway 5 toll tickets, national highway single-trip tickets and nationwide road toll ticket) must not be changed or returned, including cases where tickets expired, and damaged or become non-magnetic and invalid for passage through ticket control gates.

- Road toll tickets serve as vouchers for control of traffic means when passing through toll booths and also as vouchers for payment (excluding "phi duong bo toan quoc" tickets).

3. To strictly control traffic means passing through toll booths according to regulations:

a) To control traffic means passing through toll booths around the clock and handle as follows:

- For traffic means liable to pay road tolls, the means operators must produce tickets according to regulations. In case of producing tickets in contravention of regulations or using fake tickets, they are not allowed to pass through the toll booths and shall also be handled for violations according to the provisions of law.

The ticket controllers who detect acts of ticket fraudulence (having no tickets, using fake tickets or tickets not corresponding to tonnage, type of traffic means...) shall have to transfer the subjects to competent sections for handling without delay which may cause traffic jam.

- For traffic means entitled to toll exemption as provided for at Point 4, Section II, Part I of this Circular, the ticket controllers shall base on the identification characteristics of each corresponding vehicle (specialized defense vehicles, fire engines, ambulances, motorcade, vehicles carrying accident victims...), to handle specifically the right objects, avoiding negative phenomena, abusing situation or causing difficulties to means operators.

b) To unexpectedly check traffic means using tickets in order to discover fake tickets, ticket frauds and handle them according to competence or transfer the cases to competent agencies for handling according to the provisions of law. The checks must comply with law, avoid bad consequences for strict observers of law and traffic jams.

c) To strictly prohibit all cases of receiving road tolls from means operators without giving them tickets, or permitting traffic means liable to pay tolls but having no toll tickets to pass through toll booths, colluding in toll evasion, toll embezzlement, causing toll loss.

4. To handle administrative violations of subjects that commit acts of toll fraudulance according to competence or transfer to competent agencies for handling cases of violating legislation on toll payment and toll ticket use according to the provisions of law.

5. Within 30 days before commencing the toll collection, the toll-collecting units must register the road toll collection with the Provincial/Municipal Tax Departments of the localities where toll booths are located in terms of toll booth locations, types and quantity of toll tickets needed.

Monthly, they must declare the collected toll amounts, the amounts payable to the state budget (toll or tax money) and submit the declarations to the direct managing Provincial/Municipal Tax Departments within the first five days of the following month. The declaration must be made in full and according to a set form and declares must bear responsibility for the accuracy of the declared data as provided for by law.

6. To remit the road toll amounts (for roads invested with state budget capital) or payable taxes into the state budget (for roads invested for business) within the time limit provided for by law.

7. To follow the regimes of accounting and settling road tolls according to regulations:

- To open accounting books for monitoring the collected and remitted toll amounts and the management of toll use according to the State's current accounting regimes.

- To manage and use road toll tickets and relevant vouchers according to the Finance Ministry's regulations on management of invoices and vouchers.

- To settle road tolls according to calendar year. The time limit for toll-collecting units to submit the settlements to tax agencies shall be 60 days as from December 31 of the toll - settlement year. The toll settlement must fully reflect the entire collected toll amount, the payable toll or tax amounts, the amounts already remitted into the state budget, the amount retained for expenditures, the amounts to be additionally remitted into the state budget or over remitted up to the time of toll settlement.

The toll-collecting units shall have to fully remit the outstanding toll or tax amounts into the state budget within 10 days as from the date of submitting the toll settlement reports; in case of

overpayment, the overpaid amounts shall be deducted from the amount payable in the following period and they must bear responsibility for the truthfulness of the data in the toll settlement; if units give false reports to evade toll payment or commit fraudulence related to state budget money, they shall be sanctioned according to the provisions of law.

- To fully supply documents, books, invoices and accounting vouchers related to management of tolls and/or taxes at the request of tax agencies.

III. RESPONSIBILITIES OF TAX AGENCIES

Tax agencies shall have the responsibilities:

1. To guide and urge the toll-collecting units to declare, collect, remit, open books and accounting vouchers on, and to settle road tolls according to the provisions of law on charges and fees and the specific provisions of this Circular.

2. The General Department of Taxation shall coordinate with Vietnam Road Administration, the provincial/municipal Tax Departments shall coordinate with the provincial/municipal Transport Services as well as toll-collecting units in localities in studying and designing forms of vouchers and prints in service of toll collection; organize the printing, issuance and management of toll collection vouchers strictly according to the Finance Ministry's regulations on management of prints, ensuring the timely and adequate supply of toll collection vouchers to toll-collecting units for sale to users at their requests. Besides, the General Department of Taxation shall also have to bear responsibility for selling the "phi duong bo toan quoc" (nationwide road toll) tickets applicable to motorized vehicles of the Defense Ministry and the Public Security Ministry, open books to monitor and urge the road toll payment by the Defense Ministry and the Public Security Ministry into the state budget according to regulations.

3. To examine and inspect the declaration, collection, remittance and settlement of road tolls; to handle administrative violations in the observance of the regime of registration, declaration and remittance of tolls into the state budget, the regime of opening accounting books, managing the use and archive of toll collection vouchers.

Part IV
HANDLING OF VIOLATIONS

1. If traffic means operators, when passing through toll booths, commit acts of toll fraudulence (failing to buy toll tickets, using fake tickets, falsifying tickets or agreeing on toll fraud...), they shall, apart from fully paying toll amounts at the toll rates provided for in this Circular, be sanctioned for administrative violations according to current provisions of law.

The handling of violations must comply with the procedural order provided for by law. In cases where fines are collected, fine receipts inscribed with the collected amount (the receipt of the type issued by the Finance Ministry) must be issued to fine payers.

2. Toll-collecting units and individuals that violate the regimes of toll and fine collection and remittance; the regime of toll declaration and remittance into the state budget; the toll accounting and settling regimes, shall be handled according to the provisions of law on charges and fees and the relevant provisions of law.

Part V
ORGANIZATION OF IMPLEMENTATION

1. This Circular shall take effect 15 days after its publication in "CONG BAO."

This Circular shall replace: Circular No. 109/2002/TT-BTC of December 6, 2002 of the Finance Ministry providing the regime of road toll collection, remittance and use management; Circular No. 01/2003/TT-BTC of January 7, 2003 of the Finance Ministry amending the charge rates for use of roads by military vehicles of the Defense Ministry; Circular No. 12/2003/TT-BTC of

February 18, 2003 of the Finance Ministry guiding the supplementation of Circular No. 109/2002/TT-BTC of December 6, 2002 of the Finance Ministry providing the regime of collection, remittance and management of road-using charges; Circular No. 52/2003/TT-BTC of May 30, 2003 of the Finance Ministry amending and supplementing Circular No. 109/2002/TT-BTC on road-using charges, and official Letter No. 4269-TC/TCT of April 28, 2003 on the issuance of road tool tickets.

The Finance Ministry's previous regulations on road-using charges, which are contrary to those of this Circular, shall all cease to be effective.

2. Based on the toll rates specified in this Circular, the Transport Ministry and the provincial/municipal People's Councils shall, according to their respective competence, notify, direct the toll-collecting units under their management to collect road tolls according to the provisions of this Circular.

If any problems arise in the course of implementation, organizations and individuals are requested to report them in time to the Finance Ministry for study and additional guidance.

For the Finance Minister
Vice Minister
TRUONG CHI TRUNG

TOLL RATES FOR ROADS INVESTED WITH STATE BUDGET CAPITAL

(Promulgated together with the Finance Ministry's Circular No. 90/2004/TT-BTC of September 7, 2004)

Ordinal number	Road toll-liable means	Par value		
		Single-trip ticket (VND/ticket/ trip)	Monthly ticket (VND/ticket/ month)	Quarterly ticket (VND/ticket/ quarter)
1	Two wheelers, three wheelers, mopeds and the like	1,000	10,000	
2	Lambretta, rudimentary trucks, tractors	4,000	120,000	300,000
3	Cars of under 12 seats, trucks of a tonnage of under 2 tons and mass transit buses	10,000	300,000	800,000
4	Cars of between 12 and 30 seats, trucks of a tonnage of between 2 tons and under 4 tons	15,000	450,000	1,200,000
5	Cars of 31 seats or more; trucks of a tonnage of between 4 and under 10 tons	22,000	660,000	1,800,000
6	Trucks of a tonnage of between 10 and under 18 tons and 20ft-container lorries	40,000	1,200,000	3,200,000
7	Trucks of a tonnage of 18 tons or over and 40 ft-container lorries	80,000	2,400,000	6,500,000

Notes:

- The tonnage of each type of traffic means subject to the above toll rates shall be the designed tonnage.

- For the application of toll rates to container lorries (including specialized trailer haulers): They shall be subject to the application of toll rates based on their designed tonnage, regardless of whether they are loaded with cargoes or not, including cases of carrying goods by containers with a tonnage lower than the designed tonnage.

HIGHWAY 5 TOLL RATES

(Promulgated together with the Finance Ministry's Circular No. 90/2004/TT-BTC of September 7, 2004)

Ordinal number	Road toll-liable means	Par value of Highway 5 Toll tickets	
		Month (VND/ticket/month)	Quarter (VND/ticket/quarter)
1	Two wheelers, three wheelers, mopeds and the like	20,000	
2	Lambretta, rudimentary trucks, tractors	240,000	600,000
3	Cars of under 12 seats; trucks of tonnage of under 2 tons; mass transit buses	600,000	1,600,000
4	Cars of between 12 and 30 seats; trucks of between 2 and 4 tons	900,000	2,400,000
5	Cars of 31 seats or more; trucks of between 4 and under 10 tons	1,320,000	3,600,000
6	Trucks of between 10 and under 18 tons; 20 ft-container lorries	2,400,000	6,400,000
7	Trucks of 18 tons or over; 40 ft-container lorries	4,800,000	13,000,000

Notes:

- The tonnage of each type of means liable to the application of the above toll rates shall be the designed tonnage.

- For the application of toll rates to container lorries (including specialized trailer haulers):The toll rates are based on designed tonnage, regardless of whether the lorries are loaded with cargoes or not, including cases of carrying containers with a tonnage lower than the designed tonnage.

NATIONWIDE TOLL RATES APPLICABLE TO THE DEFENSE MINISTRY'S VEHICLES BEARING NUMBER PLATES WITH RED BACKGROUND AND WHITE STAMPED LETTERS AND NUMERALS

(Promulgated together with the Finance Ministry's Circular No. 90/2004/TT-BTC of September 7, 2004)

Ordinal number	Types of means	Yearly ticket par value (VND/ticket/year)
1	Military cars	
	- Rate 1:	2,000,000
	- Rate 2:	1,000,000
2	Military trucks	
	- Rate 1	3,000,000
	- Rate 2	1,500,000

NATIONWIDE TOLL RATES APPLICABLE TO VEHICLES OF THE POLICE FORCES

(Promulgated together with the Finance Ministry's Circular No. 90/2004/TT-BTC of September 7, 2004)

Ordinal number	Type of means	Yearly ticket par value (VND/ticket/year)
1	Cars of under 7 seats	1,000,000
2	Cars of 7 seats or more	1,500,000
3	Specialized authomobiles, including scene-inspection vehicles, communication vehicles, specialized mobile communications vehicles	2,000,000
4	Trucks	3,000,000
5	Two wheelers, three wheelers	200,000

THE GOVERMENT

SOCIALIST REPUBLIC OF VIETNAM
Independence - Freedom - Happiness

No. **34**/2010/NĐ-CP

Ha Noi April 02, 2010

DECREE
ON SACTIONING OF ADMINISTRATIVE VIOLATIONS IN THE FIELD OF TRANSPORT

THE GOVERMENT

Pursuant to the December 25, 2001 Law on Organization of the Government;

Pursuant to the November 13, 2008 Law on Road Transport;

Pursuant to the July 2, 2002 Ordinance on Handling of Administrative Violations and the April 02, 2008 Ordinance Amending and Supplementing a Number of Articles of the Ordinance on Handling of Administrative Violations;

At the proposal of the minister of Ministry of Transport,

DECREES:
(Summary)

CHAPTER I. GENERAL PROVISIONS

Article 1. Scope of regulations

1. This Decree provides administrative violations, sanctioning forms and levels, competence and procedures, and remedies for administrative violations of road transport.

2. Administrative violations in road traffic is the behavior of individuals and organizations that violate the provisions of law in the field of road traffic intentionally or unintentionally, that are not crimes and, under provisions of law they must be sanctioned for administrative violations, including:

a) The violations of road traffic rules;
b) The violations of regulations on road infrastructure ;
c) The violations of regulations on means of transport participating in road traffic;
d) The violations of regulations on vehicle drivers;
đ) The violations of regulations on road transport;
e) The other violations related to road traffic.

Article 2. Subjects of application

1. Individuals and organizations that have acts of administrative violations in road traffic in the territory of the Republic of Vietnam Socialist shall be sanctioned under the provisions of this Decree.

2. Minors who have acts of administrative violations in road traffic, the application of sanctions under the provisions of Article 7 of the Ordinance on handling of administrative violations.

Article 3. Terms and definitions

Article 4. Principles for sanctioning administrative violations

2. The sanctioning of administrative violations in the field of road traffic must be conducted by the authorities specified in Articles 47, 48, 49 and Article 50 of this Decree.

CHAPTER II. ADMINISTRATIVE VIOLATIONS, FORMS AND LEVELS OF SANCTION

Article 27. Sactioning of drivers who driving truck, tractors, and similar vechiles for cargo transportation.

1. A fine from VND 200 000 to VND 300 000 for one of the following violations:

b) Loading of cargo exceeds the design payload stated in the vehicle registration certificate but does not reach to the violation level specified in Point a, Clause 2, Point a Clause 3 of this Article.

2. A fine from VND 500,000 to VND 1,000,000 for one of the following violations:

a) Loading of cargo exceeds the design payload stated in the vehicle registration certificate from 10% to 40% for vehicles with a payload of under 5 tons and from 5% to 30% for vehicles with a payload of 5 tons or above (including trailers and semi-trailers);

3. A fine of between VND 2,000,000 and VND 3,000,000 for one of the following violations:

a) Loading of cargo exceeds the design payload stated in the vehicle registration certificate over 40% for vehicles with a payload of under 5 tons and over 30% for vehicles with a payload of 5 tons and above (including trailers and semi- trailers);

4. In addition to fines, the violator can be subjected to additional sanctions and measures to overcome consequences as following:

a) Violating points a, b, c, Clause 2, Point a, Clause 3 of this Article was forced to unload the overloaded cargo part, unloading the cargo exceeding the size limit;

b) Violating point a, Clause 2 of this Article, driving license will be confiscated for 30 (thirty) days;

c) Violating point a, Clause 3 of this Article, driving license will be confiscated for 60 (sixty) days; .

Article 28. Sanctioning drivers who have violations against regulations on transporting super-sized and super-weighted cargoes.

1. A fine of VND 1,000,000 to VND 2,000,000 for one of the following violations:

a) Loading of super-sized and super-weighted cargoes without notifying the cargoes size in accordance with the law;

b) Failing to comply with provisions in the vehicle circulation license, except for violations prescribed at Point b, Clause 2 of this Article.

2. A fine of 3,000,000 to 5,000,000 for one of the following violations:

a) Loading of super-sized, super-weighted cargoes without having the vehicle circulation license which is still valid in accordance with the law.

b) Loading of super-sized, super-weighted cargoes with the vehicle circulation license but the total weight, external dimensions of the vehicle (after uploading cargo) exceeding the provisions in the vehicle circulation license.

3. In addition to fines, the violator can be subjected to the additional sanctions and required to have measures to overcome consequences as the following:

a) Violating Clause 1, Clause 2 of this Article, the vehicle circulation license will be suspended until implementing regulations; if damaged bridges, roads, it must be restored the original state that has been changed due to administrative violations.

b) Violating Clause 1 of this Article, the vehicle circulation shall be expropriated for 30 (thirty) days; violating Clause 2 of this Article, it shall be expropriated for 60 (thirty) days.

Article 36. Sanctioning driver who drives tracked vehicle, overloaded truck exceeding bridge size limits, and road size limits (including passenger vehicle)

1. A fine of VND 1,000,000 to VND 2,000,000 for one of the following violations:

a) Total weight of the vehicle or axle load (including cargo and passengers) exceeds the allowable bridge and road load limits from 10% to 20%, except the valid circulation license;

b) Failing to comply the provisions in the vehicle circulation license, except violations specified at Point b, Point d, Point đ of Clause 3 of this Article.

2. A fine of VND 2,000,000 to VND 3,000,000 for failing to comply with the vehicle load inspection when there was a signal requesting for vehicle load inspection.

3. A fine of VND 3,000,000 to VND 5,000,000 for one of the following violations:

a) Unloading cargoes or using other tricks to evade the detection of overloaded, oversized;

b) Driving vehicle with valid circulation license but the total weight of the vehicle or axle load (including loaded cargo if any) exceeding the provisions specified in the vehicle circulation license.

c) the total weight or axle load (including cargo and passengers) exceeding the allowable bridge, road load limits above 20% except having the valid vehicle circulation license;

d) Loaded cargo exceeds the bridge and road size limits, stated in the vehicle circulation license.

đ) Driving tracked vehicle on the road without having the valid vehicle circulation license

4. In addition to fines, the violator can be subjected to the additional sanctions and required to have measures to overcome consequences as the following:

a) Violation of the provisions of Clause 1, Clause 3 of this Article, it shall be suspended until implementing regulations or be forced to immediately download the overload, the oversize discharge; if damaged bridge, road, it must be restored the original state that has been changed due to administrative violations.

b) Violation of Clause 1 of this Article, the driving license is going to be expropriated (when driving car, as automobile drivers, tractors and other vehicles similar to cars), thirty days training for certificates of knowledge of the law on road traffic;

c) Violation of Clause 3 of this Article, the driving license is going to be expropriated (when driving car, as automobile drivers, tractors and other vehicles similar to cars), sixty days training for certificates of knowledge of the law on road traffic;

CHAPTER III.

COMPETENCE AND PROCEDURES FOR SANCTIONING OF ADMINISTRATIVE VIOLATIONS

ITEM 1. SANCTIONING COMPETENCE

Article 47. Determination of competence to administrative sanctions in the field of road traffic.

Article 48. The sanctioning competence of the President of the People's Committees at all levels

Article 49. The sanctioning competence of the People's Police

Article 50. The sanctioning competence of the transport inspectorate

ITEM2. SANCTIONING PROCEDURES

MINISTRY OF TRANSPORT

SOCIALIST REPUBLIC OF VIETNAM
Independence - Freedom - Happiness

No. **07**/2010/TT-BGTVT

Ha Noi February 11, 2010

CIRCULAR

Regulations on load, clearance, circulation of overloaded, over-sized, caterpillar vehicles; transporting super-sized and super-weighted cargoes; limits on cargo load of vehicle (Summary)

Pursuant to the road transport dated on November 13, 2008;

Pursuant to Decree 51/2008/ND-CP of April 22, 2008 of the Government regulating functions, tasks, powers and organizational structure of the Ministry of Transport;

Minister of Transportation regulates on load, clearance, circulation of overloaded, over-sized, caterpillar vehicles; transporting super-sized and super-weighted cargoes; limits on cargo load of vehicle; as following:

CHAPTER I. GENERAL PROVISIONS

CHAPTER II. REGULATIONS ON LOAD, CLEARANCE; LOAD DISCLOSURE, HIGHWAY ROAD CLEARANCE

Article 4. Road load

1. Road load of the load is the exploitatative bearing capacity of bridges to ensure the longevity of construction by the design.

Article 5. The clearance of road

1. The clearance of road is a space with size limits of height, width of road, bridge, ferry, tunnel so that vehicle, including vehicle with loaded cargoes can safety pass through.

2. The clearance of road height is 4,75 meters for expressway, road types I, II, III; 4,5 meters for road type IV and below.

3. The clearance of road width is width limits of lane, depending on the level of road engineering and construction of the road terrain.

CHAPER III. REGULATIONS ON OVERLOADING VEHICLE, OVERSIZED VEHICLE, CATERPILLARS.

CHAPTER IV. TRANSPORTING SUPER-SIZED, SUPER-WEIGHTED CARGOES

Article 12. Regulations on super-sized, super-weighted cargoes

Super-sized cargoes are those packed in bales, which cannot be knocked down when being loaded onto land-road transport means and each have:

a) the length of over 20 meters.

b) The width of over 2.5 meters;

c) the height of over 4.2 meters from the ground;

2. Super-weighted cargoes are those packed in bales, which cannot be knocked down, and weight over 32 tons each.

Article 13. Super-sized and super-weighted cargo transport means

CHAPTER V. CARGOES LOADING LIMITS

Article 16. Axle load and gross weight of vehicle

1. Limits of the axle load

a) Single axle: axle load ≤ 10 tons/axle

b) Dual-axle group:(two axles), depending on the distance (d) of two axle centers:

- In case of d<1.0 m, axle group load ≤ 11 tons;

- In case of 1.0 m ≤ d < 1.3 m, axle group load ≤ 16 tons;

- In case of d ≥ 1.3 m, axle group load ≤ 18 tons;

c) Triple-axle group (three axles): Depending on the distance (d) of two adjacent axle centers :

- In case of d ≤ 1.3 m, axle group load ≤ 21 tons;

- In case of d > 1,3 m, axle group load ≤ 24 tons

2. Gross weight of vehicle

a) For single-unit truck that has:

- Two axles, total weight of the truck ≤ 16 tons;

- Three axles, total weight of the truck ≤ 24 tons;

- Four axles, total weight of the truck ≤ 30 tons;

- Five axles or more, total weight of the truck ≤ 34 tons.

b) For trailer or semi-trailer truck that has:

- Three axles, total weight of the truck ≤ 26 tons;

- Four axles, total weight of truck ≤ 34 tons;

- Five axles or more, total weight of the truck ≤ 40 tấn;

c) For single unit trailer truck or semi-trailer truck: Total weight of the truck including total weight of single-unit truck (corresponding to the total weight specified in a) and total axle loads of pulled trailer or semi-trailer (corresponding to the axle loads specified in Item 1 of this Article, but not heavier than 45 tons.

Article 17. Height limits for cargo loading on vehicle

Article 18. Weight and Length of cargo loading on vehicle

CHAPTER VI. LICENSING THE VEHICLE CIRCULATION LICENSE FOR OVER LIMITED SIZE VEHICLE, CATERPILLARS, AND VEHICLE FOR TRANSPORTING OVER-SIZED AND OVER-WEIGHTED CARGOES.

Article 23. Vehicle weight inspection

1. Equipment used for inspecting the weight of truck must be checked, for periodical inspection and certification as prescribed by law for measurement. The testing weight equipment shall have a valid inspection certificate.

2. Only checking axle load when there are not enough facilities for inspecting the gross weight of truck (weight station). In case a truck has many axle groups, select the axle which has the heaviest axle load for testing. The gross weight of the truck is determined by the total weight of the axles

3. Truck is considered to exceed the permitted maximum weight limit if it violates one of the two conditions as following:

a) The total weight of the truck exceeds the permitted maximum weight of truck specified in Item 2 of Article 16;

b) The total weight of the vehicle is smaller than the permitted maximum weight, but the axle load exceeds 1.1 times the permitted maximum axle load specified in Item 1 of Article 16.

Summary of Relevant International Standards

Summaries of the following international standards are presented in this appendix.

- ISO/CD 14813: Reference model architecture for the ITS sector
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ITU-R M.1453: DSRC at 5.8GHz (physical layer)
- ISO 15628: DSRC application layer
- ISO 14906: Application interface definition for DSRC
- ISO/CD 22837: Configuration of vehicle probe for wide area communication
- ISO/CD 24533: Data dictionary and message set for tracking of freight and It's inter-modal transfer
- ISO 14443: Contactless IC-Card
- ISO/IEC 18092: Information technology – telecommunications and information exchange between systems – near field communication – interface and protocol (NFCIP-1).

1) ISO/CD 14813: Reference Model Architecture for the ITS Sector

System architecture is a conceptual design of a whole system. In establishing ITS, a large-scale and long-term system, system architecture is important to make all the people concerned share a picture of the whole system and to ensure interoperability, compatibility and expandability of the system. The ITS reference architecture has been established to serve s reference materials for architectural development in various countries, and as a reference model for comparison of different architecture, such as the OSI layer model.

ISO/CD 14813 consists of six parts as follows:

- Part1: Fundamental services
- Part2: Core reference architecture
- Part3: Example elaboration
- Part4: Reference model tutorial
- Part5: Requirements for architecture description
- Part6: Data presentation in ASN.1.

2) ISO/IEC 11179: Information Technology – Specification and Standardization of Data Elements

International standard ISO/IEC 11179 was prepared by joint technical committee ISO/IEC JTC 1, information technology, SC 14, data element principles. ISO/IEC 11179 consists of the following parts, under the general title Information technology - specification and standardization of data elements:

- Part1: Framework for the generation and standardization of data elements
- Part2: Classification of concepts for the identification of domains
- Part3: Basic attributes of data elements

- Part4: Rules and guidelines for the formulation of data definitions
- Part5: Naming and identification principles for data elements
- Part6: Registration of data elements.

3) ISO/DIS 14817: Transport Information and Control Systems – Requirements for an ITS/TICS Central Data Registry and ITS/TICS Data Dictionaries

This international standard specifies the framework, formats and procedures used to define information exchange within Intelligent Transport System / Transport Information and Control Systems (ITS/TICS) sector. It defines the content of the ITS/TICS central Data Registry and data dictionaries, the registration to enter data concepts into the Data Registry. Throughout the text, the Data Registry should be taken to mean the ITS/TICS central Data Registry.

Specifically, this International Standards specifies:

- Framework used to identify and define all information exchanges
- Framework used to extend standardized information exchanges to support local customizations and combinations
- Information modeling method for defining ITS/TICS data concepts, when used
- the meta attributes used to describe, standardize and manage each of data concepts defined within this framework
- Requirements used to record these definitions
- Formal procedures used to register these definitions within the Data Registry.

The Data Registry described herein supports, and is designed to include, data concepts using alternative International, Regional or National System Architecture methodologies or techniques. A common Data Registry will ease migration and interoperability between such approaches.

4) ITU-R M.1453: DSRC at 5.8GHz (Physical Layer)

This Recommendation outlines the technologies and characteristic for DSRC in the 5.8GHz band. This Recommendation includes both the active (transceiver) method and the backscatter (transponder) method as DSRC technologies available for ITS. The technical and operational characteristics of both are described. DSRC application include ETC (Electronics Toll Collection), parking payment, gas (fuel) payment, traffic information, management pf public transportation and commercial vehicle, fleet management, probe data collection, border crossing and electronic clearance of freight.

- **Active (transceiver) method:** For the active method, on-board units are equipped with the same function as roadside units for radio communication. More specifically, both roadside units and OBU incorporate 5.8GHz band carrier frequency oscillator and have the same functionality for radio transmission.
- **Passive (transponder) method:** In contrast to the active method, OBU for the Passive method does not have an internal oscillator for generating 5.8GHz band radio carrier signal, so it relies on the 5.8GHz oscillator of the roadside unit with which it communicates.

5) ISO 15628: DSRC Application Layer

This standard defines DSRC (Dedicated Short Range Communication) Application Layer equivalent to communication protocol Layer 7. Standardization of the radio communication method equipment to the Physical Layer has been handled by ITU-R, and recommendations on methods, including those of Japan and Europe, have been approved.

Under DSRC, Layers 3-6 are usually omitted so that a vehicle running at a high speed can carry out direct communication with roadside equipment within a limited communication area. Functions necessary in theses layers are included in the application Layer. Various applications are available in DSRC, and as application identifier (AID) identifying application is stipulated in the Application Layer. Roadside or On-Board application processes designate this AID, and carry out communication with the other (on-board or roadside) application processes by way of the Application Layer and lower layer. Communication functions are performed mainly by transfer kernel. The functions include encoding and decoding of information, division and assembly of given frames and multiplexing of application information.

6) ISO 14906: Application Interface Definition for DSRC

This standard specifies the application interface in the context of EFC using DSRC. The EFC application interface is the EFC application process interface to the SARD Application Layer. The scope of this standard comprises specifications of following items.

- EFC attributes (i.e. EFC application information)
- Addressing procedures of EFC attributes and components (e.g. ICC and MMI)
- EFC application functions
- EFC transaction model
- Behavior of the interface

This standard provides security-specific functionality as place holders (data and function) to enable the implementation of secure EFC transaction.

7) ISO/CD 22837: Configuration of Vehicle Probe for Wide Area Communication

A system that consists of a grope of vehicles that collect and transit various types of data using medium and wide area radio communication, and center functions for statistical processing of the received data to acquire information concerning traffic, road and environment is called a “probe vehicle system”. Probe data is the data sent from on-board systems in the vehicle to the centers and other external systems. The sped and other basic data in the probe data are called “probe data element”, and a compilation of multiple data elements is called probe message”. Probe message always contains the position and the time stamps.

For probe data, standardization of the following is in progress:

- Basic work frame
- Reference architecture
- Core data element
- Initial set of probe messages.

8) ISO/CD 24533: Data Dictionary and Message Set for Tracking of Freight and It's Inter-modal Transfer

Subject to this standardization are the data dictionary and message sets to be exchanged between a shipper and several transport organizations in door-to-door transport. Specifically, it involves standardization of data elements used for electronic data interchange (EDI) and message necessary in supply chains.

Door-to-door transport requires international integrated transport involving trucks, railways, ships and airplanes. A different EDI is used for each transport organization. It will take a great deal of time and effort to unify data standardization that differs according to each country and organization, and to introduce rules for standard information exchange.

9) ISO 14443: Contactless IC-Card

Contactless IC card generally means the IC card capable of radio communication within 10 centimeter. The standard ISO 14443 for contactless IC card comprises 5 parts.

- ISO 14443-1: Physical characteristics
- ISO 14443-2: RF power and signal interface
- ISO 14443-3: Initialization and anti-collision
- ISO 14443-4: Transaction protocol
- ISO 14443-5: Test methods

Contact IC card includes Type-A, Type-B and Type-C. Specifications for Type-A and Type-B are in the foregoing ISO 14443-2.

10) ISO/IEC 18092: Information technology – telecommunications and information exchange between systems – near field communication – interface and protocol (NFCIP-1)

"Type-A" and "Felica" are according to this standard. ISO/IEC18092 is standardization of "Communication protocol", "Anti-collision" and "Radio spec". It is not included "Physical characteristics".

ISO/IEC 18092:2004 defines communication modes for Near Field Communication Interface and Protocol (NFCIP-1) using inductive coupled devices operating at the centre frequency of 13,56 MHz for interconnection of computer peripherals. It also defines both the Active and the Passive communication modes of NFCIP-1 to realize a communication network using Near Field Communication devices for networked products and also for consumer equipment. This International Standard specifies, in particular, modulation schemes, codings, transfer speeds and frame format of the RF interface, as well as initialization schemes and conditions required for data collision control during initialization. Furthermore, this International Standard defines a transport protocol including protocol activation and data exchange methods.

Information interchange between systems also requires, at a minimum, agreement between the interchange parties upon the interchange codes and the data structure.

APPENDIX 7: RECORDS OF WORKING GROUP & WORKSHOP

Records of the 1st to 7th Working-Group and the Workshop are presented by the minutes and pictures.

Time Schedule of Working Group & Workshop

Meetings of the Working Group (WG) and the Workshop were held according to the time schedule below. Minutes of each meeting is shown in the following pages.

Table A7.1 Time Schedule of Working Group (WG) & Workshop

Name	Date	Discussion Items
1st WG	May 25	• Minimal Service Requirements (other than 4 minimal services, security should be added in accordance with Permanent Vice Minister Ngo Thinh Duc mentioned) • Goals of ITS
2nd WG	June 15	• Study Procedure. • WG discussion approach: Study team present their findings and provisional recommendations and WG members discuss over such finding and recommendations • Discussion over requirements of 3 priority ITS user services (such as, emergency telephone or other means for incident notification, time allowance for incident notification; time interval for information dissemination on VMS, Traffic Analysis (2nd requirements), CCTV monitoring (surveillance range), Vehicle detector arrangement, Communication traffic, etc.
3rd WG	July 8	• Draft General Specifications for Telephone Exchange (recording of emergency call is not allowed, using emergency telephone or mobile phone – following Official Application Letter from MPI to JICA) • Draft General Specifications for Traffic Analysis (time allowance for data calculating and updating – every 5 minutes, and vehicle detection shall be on real time basis) • Draft General Specifications for Traffic Event Data Management (Chinese language should be excluded from VMS indication) • Draft General Specifications for Traffic Supervision • Draft General Specifications for Center/Roadside Communication (single mode optical fibre cable, separate communication network from PSTN, giving highest security level, IC-card security, security requirements should not clearly mentioned in the documents because it is security) • Needed Framework for Traffic Information/Control • Demerits of Emergency Telephone System
4th WG	July 29	• Draft Design Standards for Traffic Information/Control • Draft Design Standards for Communication System • Draft General Specifications for CCTV camera (surveillance range, PTZ functions, installation interval in accordance with monitoring goals • Draft General Specifications for Traffic Event Data Management (data collection and transmission, integration of different road operators by Main Center) • Draft General Specifications for VMS Indication (traffic regulation, weather conditions, letter height and width on VMS, etc.)

		• Draft General Specifications for IC-Card Recording (IC-Card shared use) • Draft General Specifications for Toll Management (average service time for none stop or touch&go toll collection, toll collection accuracy) • Needed Framework for Expressway Operation using ITS (Incident Notification fr Emergency Telephone or fr Traffic Police, or information sharing by administrative telephone, by mobile radio communication, by internet) • Comparison on Operation/Arrangement Policy of CCTV camera for Incident Information (video switcher for reducing image traffic volume, incident detection by patrol crews or by cameras, camera installation interval, monitoring goals – i.e. monitoring traffic conditions on the whole expressway including expressway and its facilities, monitoring screen size)
5th WG	September 17	• Interim Report (Draft) • Draft General Specifications for Mobile Radio Communication • Draft General Specifications for Lane Monitoring • Draft General Specifications for Vehicle Identification • Draft General Specifications for Lane Control • Draft General Specifications for Toll Management (inter-bank toll settlement, IC-card issuing banks, equipment compatibility, vehicle classification • Draft Design Standards for Communication System
6th WG	October 11	• Draft General Specifications for Event Detection • Draft General Specifications for Vehicle Detection • Draft General Specifications for Traffic Analysis • Draft General Specifications for Road-to-Vehicle Communication • Draft General Specifications for OBU Management (RF tag) • Draft General Specifications for Axle Load Measurement • Draft General Specifications for Overloading Management • Design Standards for Heavy Truck Control • Draft Message/Data Standards
7th WG	October 29	• Summary of Draft ITS Standards • Selected Key Policies on System • Draft Design Standards for Weather Monitoring • Draft General Specifications for Traffic Analysis • Draft General Specifications for Weather Monitoring • Draft General Specifications for Traffic Event Data Management • Draft General Specifications for Traffic Supervision • Draft Message/Data Standards
Workshop	November 19	• Opening Remarks by Mr. Ngo Thinh Duc, Permanent Vice Minister of MOT • Speech by JICA Representative • Presentations by Study Team on Study Results • Conclusion Remarks by Mr. Ngo Thinh Duc, Permanent Vice Minister of MOT

STUDY FOR SUPPORTING ITS STANDARDS &OPERATION PLAN DEVELOPMENT IN VIETNAM Minutes of 1st Working Group

1) **Date** : May 25, 2010

2) **Venue** : Information Technology Centre, MOT

3) **Attendance** :

- Working Group Members: Refer to the attendance list hereinafter presented.
- Study Team: Ishiguro, Iwata, Satoh, Tam

4) **Presentations and Discussions**

- Study Team : Presentation was made upon materials prepared for Working Group
- Study Team : We would like to get your discussion/opinion particularly on Minimal Service Requirements in the materials of Working Group today.
- Directorate for Roads of Vietnam: We suppose that Goals of ITS are not fixed, that can be modified. The importance is given for Safety from aspect of countermeasures for incidents, and Security from aspect of countermeasures for terrorism. MOT's Vice Minister insisted that the monitoring cameras should be installed along the expressway so as they can cover every 1m of expressway for antiterrorism. In addition, we think that improvement of Traffic measurement & control is also very important. ITS will be the tool for traffic conditions analysis. General objective of ITS is minimizing traffic accidents and congestions.
- Study Team: We shall consider the Security as recommended. As for the Safety, it is unable to eliminate incident and traffic congestion only introduction of ITS. First, it is important to design the road taking safety into consideration as a road structure, and secondly, it is important to educate road users. The ITS is to be utilized as a supporting tool of these conditions in addition to execute them adequately. The goals of ITS shown in the material are prepared based on the goals of USA, not showing Japanese ones as they are.
- ITC : It is hard to discuss because it is 1st WG. We think that it is better to clarify the tasks of the study team and WG members.
- CADPRO : In fact, the ITS has been introduced without discussion of its standards. Why ITS standards are required? We consider that important point is how to connect the different systems, which are to be introduced by different investors/contractors under the different expressway development projects financed by different sources. It means that the Standards are required to realize Centre-to-Centre functions. In the other hand, it is not so important on the accuracy (specifications) of the equipment component. The accuracy (specifications) will be improved along with the technology improvement. Therefore we think it is unnecessary to determine such accuracy as the standard.
- CADPRO : We would like to point out that there was no discussion about Toll Clearing System under VITTRANS2. The discussion of contactless IC card had not also made. As for the DSRC,

the discussion of 1 piece or 2 pieces of OBU had made, however the comparison of Active or Passive had not made in detail. It seems VITTRANS 2.2 will be necessary.

- ITC : We think that we need to discuss the Specifications for expediting the progress of the Study Team.
- Study Team: We explained Inception Report of the Study to ITC and DOST, and we understood that it was approved including the procedure of WG. As it is explained in the Inception Report, requirements are prerequisites of formulation of ITS standards. When the requirements become clear, the individual ITS standard is to be drawn theoretically. The Minimal Service Requirements shown today is the first step to determine the requirements. It will be necessary to discuss the requirements of 20 draft general specifications in the next WG. Please give us more clear comments and suggestions.
- DOST：We issued 6 Requirements to JICA through the Ministry of Planning and Investment. In order to expedite the discussions, it is better to adopt top-down approach.
- Study Team: We are proceeding with both top-down approach and bottom-up approach. The former approach is starting from Goals, then considering roadmap and ITS user services, and drawing requirements. The latter approach is starting Minimal Service Requirements based on the knowledge and experience, and then drawing the requirements. It is essentially needed to obtain the opinions or endorsements to our proposed draft requirements.
- VEC: We are implementing 3 expressway construction projects with ITS components. However, they are open toll collection system, and there are some issues and the connection is not good.
- ITC: Is there any good idea about speed up method as the Study team?
- Study Team: It is difficult to speed up more by ourselves because the discussion material of 2nd WG is almost completed. The best way to expedite the study is to involve Decision Makers from individual organizations to the WG because they may give quick comments and suggestions at the WGs.
- ITC: We need to consider the roles and duties of the WG members and Study Team. We shall hold separate meeting with Study Team on May 26 (Wednesday), 2010 14:00.

The meeting was closed.

Figure 7.1 Scenes in the Meeting of the 1st Working Group






Table A7.2 Attendance List of Working Group

No.	Name	Đơn vị công tác
1	TS Vũ Văn Chung	Trung tâm CNTT- Bộ GTVT
2	Lê Thanh Tùng	Trung tâm CNTT- Bộ GTVT
3	Nguyễn Mạnh Thắng	Vụ Khoa học công nghệ - Bộ GTVT
4	Nguyễn Tuấn Anh	Vụ Khoa học công nghệ - Bộ GTVT
5	Chu Văn Tuân	Vụ Kết cấu hạ tầng giao thông - Bộ GTVT
6	PGS.TS Lê Hùng Lân	Đại học Giao thông vận tải.
7	GS. Le Hong Ngan	Đại học Giao thông vận tải.
8	Nguyễn Vĩnh Thuận	P.GĐ Cty CP Công nghệ ITD
9	Ngô Phương Thanh	TP Cty CP Công nghệ ITD
10	Nguyễn Việt Phương	P.GĐ TT CNTT - VietinBank
11	Phạm Văn Khoa	P.GĐ TT Thẻ - VietinBank
12	Đặng Công Chiến	Phó vụ trưởng, Tổng cục Đường bộ VN
13	Phạm Hồng Quang	TP, Công ty đầu tư phát triển đường cao tốc
14	Phạm Quang Minh	Tổng công ty tư vấn thiết kế GTVT
15	TS. Phạm Hồng Quang	Công ty phần mềm tự động hóa điều khiển
16	TS. Tạ Tuấn Anh	Công ty phần mềm tự động hóa điều khiển
17	Nguyễn Đình Khoa	Viện Khoa học và Công nghệ GTVT
18	Phùng Văn Trọng	Trung tâm CNTT- Bộ GTVT

STUDY FOR SUPPORTING ITS STANDARDS &OPERATION PLAN DEVELOPMENT IN VIETNAM Minutes of 2nd Working Group

1) Date : June 15, 2010

2) Venue : Information Technology Centre, MOT

3) Attendance :

- Working Group Members: Refer to the attendance list hereinafter presented.
- Study Team: Mr. Ishiguro, Mr. Iwata, Mr. Kurita, Mr. Thanh, Ms. Ha, Ms. Tam

4) Presentations and Discussions

- Study Team(=ST) : Made presentation upon materials prepared for Working Group
- ST : We would like to draw your discussion/opinion particularly on Minimal Service Requirements of 20 functional packages in the main document, i.e. Draft General Specifications.
- ITC :

  There was some troubles during sending the WG materials through email causing some of the members could receive the documents before WG. Please use the latest documents in front of you that were delivered by ST. And we suggest the ST to send documents in doc file not pdf., it will be more convenient for WG members to put their comments on documents.

  With the mutual agreement among JICA, ST and us, the outline document_dispatch 8735 will be used as basic for Working Groups. Based on that ST prepares documents and also we discuss on. We should be back to the outline document if any member has his opinion out of the outline. The issues come to agreement or not, we propose to note down into the minute.

  According to ST, today we will discuss about the Requirements.
- DOST: We would like to have example for 20 minutes for incident notification on the express way.
- ST: 20 minutes is maximum time allowance. In many cases, people don't only contact directly to road operators, but traffic police or others.
  ⇨ Ok, agree.
- WG: Will emergency telephone also be used for emergency call or normal call? Is it really necessary or not? Is it free of charge? What will happen when there is no signal in mountainous area or tunnel?
- ST: Emergency telephone is dedicated telephone, connecting directly to road operator. In the 3rd WG, we will discuss in more details about Telephone Exchange: using emergency telephone or mobile phone. In fact, we haven't decided which one to use.

  The telephone service provider will get benefits from the service, they need to provide the through network service.

- VRGD: As far as we know, that in some European countries Emergency telephone is still used. We think it is vital, not only used by who cope with accidents.

  Vice Minister Duc seems to agree for the telecommunication service provider to invest in it, for example EVN , and extra part will be for rent.

- ST: It will be costly and cannot be supported by toll revenue.
- ITC (Chairman): We think that idea relates to the policy, we should discuss others Requirements.

  We found that in the materials, there are many blank items.

- ST: Next time we will make the documents much more thickly, this time the blank ones are not so important items, we need to discuss about Requirements.

  Firstly we would like to know your ideas about the Requirement No. 5 of Weather Monitoring.

- ITC: “Capable of..” means automatically or with the assistance of human? Its for Standards, so it need to be clear.
- ST: We write down “ automatically” already, without that word, mean not automatic.
  ⇨ Agree.
- DOST: In 2.3 and other, TCVN 4054:2005 is about Highway, not Express way.
  ⇨ This is only the problem of translation from English into Vietnamese.

  For Event Detection, how about speed, volume, road quality, density?

- ST: Such issues belong to Vehicle Detection.
  ⇨ Ok.
- ITC: About Vehicle Detection, need to be capable of notifying vehicle driving direction also.
- ST: We will add into Event Detection. We would like to discuss Requirement No. 4. In Japan, they install detectors at every 300m in urban area and at 2km in rural area.
- WG: For example in 6km Hai Van tunnel, every 200m is necessary. Interchange, tunnel, bridge,…Anyway, bridge is not so important. Purpose is to detect congestion, rain,…
- ST: Please disscuss Requirement No. 2 of Traffic Analysis, time allowance for calculated data storing. We are considering every 15 minutes.
  ⇨ WG needs to consider to do like Japan, storing every minute.
  But ST think that its costly, not simple to do.
- VRGD: No one stores the calculated results, only measured ones are enough.
- ST: we need to consider to send the message for VMS indication every 15 minutes.
- ST summarizing the other materials.

The meeting was closed with some results. Suggestion on others Requirement please send by email. There are the idea about creating a forum about ITS.

STUDY FOR SUPPORTING ITS STANDARDS &OPERATION PLAN DEVELOPMENT IN VIETNAM Minutes of 3rd Working Group

1) **Date :** July 8, 2010

2) **Venue :** Information Technology Centre, MOT

3) **Attendance:**

- Working Group Members: Refer to the attendance list hereinafter presented.
- Study Team: Ishiguro, Iwata, Kurita, Kondo, Thanh, Ha, Tam

4) **Explanations and Discussions:**

- ITC (Chairman): We are sorry that Mr Chien, Mr Mai Tuan Anh are absent today because of busy schedule. However some members who couldn't come to 2nd WG are already here today like Mr Le Hung Lan from University of Transport.
- Study Team (=ST) : made presentation upon materials prepared for Working Group , i.e. 9 materials as distributed to all the members; focusing on the Draft General Specifications (Version 0.25)
- ITC (Chairman): Asked about the main points of discussion today. We will discuss about Requirements of documents number 1, 5, 7, 8, 21? WG should discuss one by one.
- ST: Its necessary to explain to make the members fully understand the indicated contents. We will skip the same ones if they are mentioned in next Requirements.
  ⇨ Explanation on important points.
- ITC: (Mr Tung): Why ST mentioned about rest area in Requirement but there is no in the System Architecture? Which facilities are installed there?
  ⇨ We will add into System Architecture. RMO should be put there with its facilities.
- ITC (Chairman): ST states that " System shall be capable of…" but we think that system shall not be itself without human.
  ⇨ "20 minutes" for incident notification doesn't comply to the requirement.

  Allowing to sending directives to all or one by one?
  ⇨ To all at once.
- ITD: We should record the emergency calls in case someone does vandalism?
  ⇨ It belongs to Basic International Human Right. For vandalism call, we need considere other countermeasures but not Recording.
- WG: All the others ITS projects like Cau Gie – Ninh Binh and Ho Chi Minh – Trung Luong; HCM – Long Thanh_Dau Giay all have agreed to add to the Standards " Emergency Telephone"; We require to add it into our Standards also.

  ⇨ Its very costly, while road operator like VEC will receive very little toll revenue. Anyway, we

understand and consider your ideas. We would like to refer to road operators like VEC about this issue before coming to further discussion and decision.

- ITC : The outline written in officicial application letter No. 8735 also mentions Emergency Telephone. This letter is the only legal document that WG need to follow. If we want to cross out anything from the outline we need to do official procedures to submit for agreement from not only MOT but also JICA. Moreover, based on our experience, ST shouldn't follow the road operators because it may be difficult in developing standards based on only road operator opinions.
  ⇨ From our experience in many countries, Emergency Telephone is not necessary, costly, …Some can never be used forever. Anyway, later we will continue discuss more.
- WG: Others projects also separate Emergency Telephone and Administrative Telephone. We suggest ST also make it the same.
  ⇨ Ok
- WG: Storing data every 5 minutes, why not 1 minute like in Japan?
  ⇨ In Japan we set up Detectors in every 500m, that makes its possible. But in VN, we are considering to install them at every 2km. 2km means all lane Detector.
  ⇨ Ok, understand & agree.
- ITC: We suggest that in 5.7.1 (Traffic analysis) Necessary statistical data should be yearly, monthly, daily, hourly, minutely, secondly; with priority.
  ⇨ We mentioned about priority already.
  ⇨ Ok. How to define the priority, maybe due to the management policy. We discuss and understand already.
- ST: Explanations are made on No. 21, especially about Node.
- ITD: We need to add Security in transmission line in Requirement.
  ⇨ Ok, We know its necessary but, the standard of security shouldn't be written down because it is security.
- ITC (Mr Tung): Why ST lists single-mode, but there is no information about it. Do you imply to use it?
- WG agrees to use single-mode.
  ⇨ We will add.

The meeting was closed with some results. Suggestions on others Requirements please send by email. In this meeting we haven't receive all the documents before to study on it, and we don't know the main content of working also. Next time we suggest ST to send documents sooner with figuring out the main points for discussing.

ST expects the presentation of Mr Mai Tuan Anh for specific opinions as a road operator for us to focus on. ST and Jica will try our best to invite Mr Tuan Anh. If possible ST hope that our members can be flexible to follow Mr Tuan Anh's schedule.

However, every members know that as a deputy director of VEC he is too busy, perhaps he can't never come.

STUDY FOR SUPPORTING
ITS STANDARDS &OPERATION PLAN DEVELOPMENT IN VIETNAM
Minutes of 4th ITS-WG

1) Date : July 29, 2010

2) Venue : Information Technology Centre, MOT

3) Attendance

- Working Group Members: Refer to the attendance list hereinafter presented.
- Study Team: Ishiguro, Iwata, Kurita, Sato, Thanh, Ha, Tam

4) Explanations and Discussions

- ITC (Chairman_Mr Tung): Mr Chung can't take part in this meeting; so, on behalf of him, I will be chairman in this WG. Discussion procedure is similar to that of last time. Firstly, Mr Ishiguro will present about the documents.
- Study Team (=ST) : Presentation was made upon materials prepared for Working Group, i.e. 17 documents of this WG as delivered to all the members, the main is Draft Design Standards.
- VEC (Mr Quang): In the Reference ST shown 3 policies. There are 3 on-going projects that we manage 2 of them: Cau Gie – Ninh Binh and Ho Chi Minh – Long Thanh – Dau Giay. Although Ho Chi Minh – Long Thanh – Dau Giay hasn't defined the policy on Camera but, in general, all 3 projects are condering the policy to install cameras for monitoring the whole expressway (100%).
- ST: For example, cameras are installted at the interval of 200m for about 1563 km. The vehicle displayed size will be 5mm and be difficult to recognize on monitor screen. At that time, camera zooming will be necessary. But, even with zooming fuction, the operator need to monitor manually to detect traffic condition and incident. Our calculation also included camera zooming fuction. In Korea, patrol car detect the incident then camera is for checking. We can't detect the incident by camera except for the case that it luckily happens in front of the camera. Therefore, camera is not useful for detecting incident. Also, camera is not useful for monitoring at hill section or curve sections,…
- VEC: We are mentioning about the possibility to whole-section monitoring not every time. For example, in case of overloading, many drivers make use of black points to avoid being paid much of overloading fine. Thus, we want to mention about: how we can monitor any place we want, not 100% of time to monitor.
- ITD: Patrol can cause road bribery like on the highway.
- ST: Why we want to check some places? Someone informs us, then we need to do that?
- VEC: Give out a detail example of overloading case, that is necessary to be monitor by camera.
- DRVN (Mr Chien): Answer for the example of VEC: not so proper. At interchanges or junctions there are camera as ST shown. Patrol car can find out that case.

- VEC: Patrol car is put at road operator centre, or else, not toll gates. But not every time, they send the patrol car to monitor.
- DRVN: The road operator need to generally operate the car. People can also use other camera facilities to record video like mobile phone.
- VEC: We've implementing Noi Bai_Lao Cai package on facility purchasing and calculating for operator of toll management.
- ST: Notice that this package is for incidents monitoring not for overloading which will be for the next WG.
- ITD: We need to manage all events. If that is incident, if the vehicle stops at black point, how can camera monitor?
- ITC (Mr Thanh): In the early stage, we should be economic in using camera, then, we can change in the later stage.
- ST: If we want to monitor 100 %, what is your intended interval?
- VEC: We, as investor, haven't calculate the interval, but still require to monitor any place that we want.
- ITD: Interval also depends on the camera quality.
- ST: Patrol can be much easier, having strongest power to detect incident, camera is just for checking. Vietnamese may recognize incident by 5mm image, but Japanese can't. Mobile phone have its important role here.
- DOST(Mr Tuan Anh): That's is the general policy, useful for both active and passive traffic. The issue is that we need to consider the traffic situation, infrastructure, etc… to find out the suitable method. ST recommended the 3rd policy: camera are at interchange, entrance, exit,… only in the document. But for that policy, there are many black points that we cant have the image to monitor. Patrol car can't appear regularly; if there are 2 incidents at the same time, patrol car can't detect and give out solutions fully and timely.
- The Study mention about using 50-inch monitor. But, as in Cau Gia – Ninh Binh project, they intend to use 100-inch one. At that time interval can be 1km. Camera can also help to find out vandalism and other. So camera is necessary at the early stage of implementing expressway.
- ST: Every camera need to be monitored. 50 or 100-inch cant do that. Only 1 monitor is also not enough, we need how many monitor to monitor 50 cameras? Anyway, opinions about camera need to be checked, reviewed by calculation, analysing. Only taking is impossible to make Standards. Standard is based on actual calculations. We have just given the first stage calculations, not all. Moreover, we should discuss about the 1st case: camera for detecting incident, traffic information. We are not manufacturer, we don't recommend huge monitor, a large number of cameras to earn our benefit. We want to be neutral, so in each stage we will introduce the most suitable selection for Vietnam.
- DRVN: We should mention about specification, not camera should be set up or not.
- ITC: ST provided much information, time for discussing is not so much. We suggest ST to consider about camera, Deputy Minister Duc emphasised that: don't interrupt whole section

monitoring. We hand ST 2 decisions of Long Thanh – Dau Giay và Ho Chi Minh – Trung Luong projects to refer to.

- ST: Emphasis that its large different between the purpose of using camera to initially detect the incident and for checking; its an important point.
- ITD: For long time using, patrol car is more expensive because petrol is expensive, and human power is necessary.
- DOST: Its not save also.
  ⇨ Decide to prepare the document about camera.
- ITC: We should give out the maximum/minimum temperature for facilities. Why ST introduce one-stop toll collecting <6s, error rate is <1%. 1% money is a big problem.
- DRVN, ITD: Time depends also on operator action, diver, barrier opening/closing. Error rate depend on which method we use: human or facility?
- ST: We refer to the experience of Asian countries.
- ITC: ST should reduce the rate 1% to make it more precisely.
  ⇨ Ok.
- WG: GMS for Expressway need 2 language like in Highway? (TC 2231-05)

The WG 4th end with some results. The members require St to consider all the ideas, suggestions and will have clear explanation or revision.

STUDY FOR SUPPORTING
ITS STANDARDS &OPERATION PLAN DEVELOPMENT IN VIETNAM
Minutes of 5th ITS-WG

1) Date : September 17, 2010

2) Venue : Information Technology Centre, MOT

3) Attendance :

- Working Group Members: Refer to the attendance list hereinafter presented.
- Study Team: Ishiguro, Iwata, Kurita, Sato, Thanh, Ha, Tam

4) Explanations and Discussions:

- Study Team (=ST) : Present about documents (8 volumes, including the 4th WG minute) for this meeting, focusing on Interim report (Draft)
- ITC: In the Interim report we have some comments as follows:

  We are developing standards, establishing framework for ITS system. We should notice that we are behind of on-going projects.

  - "Communication management is to be conducted by an integrated organization" is suitable for organization but not for the actual fact short and long term. If it's the precondition to develop standard for transmission method, we're afraid that it cause problem in feasibility.
  - For the issue of Traffic information/control, same comment.
  - In precondition to develop standard for Toll management centre, each Road operator controls its own Toll collection. In current reality of Vietnam , its still an open issue, we haven't have the policy for that.
  - Traffic police is proper but now we haven't got expressway police bureau.
  - ST have not develop Framework for Overloading, that should be introduced.
    ⇨ ST: Next WG
  - In Japan, do you apply many advanced technologies in communication management on expressway and how about the management organization for management? In finalizing, we think that it will not be thoroughly.

  There are many documents for the meeting, some parts are repeated. We've just shown our comments above, then the other members will contribute there opinion, I hope ST will explain.

- DRVN:
  - In page 25, Interim report, where ST recommend FW-5, we think that ST should include (a), (b) together with (d) because overloading is related to Toll collection. (c) and (e) can be separated or together.
    ⇨ ST: Overloading should be done by inspectors, not related to normal toll collection.

It will be more convenient to set up weigh station at tollgates. We can allow overloading but have specific solutions (economic not administrative) to punish the overloading truck drivers with much more money that they can get.

⇨ ST: According to current regulation, overloading is unlawful (Decree 34:2010)

That is for nomal highway, expressway is trade road, investment is for benefit, has its own exploiting regulations.

- ST mentioned too much about settlement among banks. Each OBU is like an micro of ATM. One card type can withdraw from many banks from 2006 (information from VietinBank). As for me, settlement among banks is not so important to mention, which bank, and the settlement between road operator and bank is more important. We should consider which type of OBU, how to count the charge for the driver in some cases in case the car will be rent,…

  ⇨ ST: We are using magnet card, only PG Bank has been applying contact-less one. Standards for contact-less card have just been developed in Vietnam. If we want to apply this type, all banks need to accept it. OBU is just a transmission facility like a reader&writer. Most of the data is in the card. Each card is registered in a separate bank, so revenue need to be shared. That's is problem, so a settlement house/centre is necessary.

- That will be simple, not so difficult.

- VietinBank: We totally agree about IC-Card settlement for ETC and Touch&Go with ST's choice of Type 1' and Type 1. In the first stage when we start developing the network, one bank have to be the settlement centre; the later stage, when 2 or more banks take part in, its necessary for an organization which may be a bank or an organization like Banknet or Smartlink to be responsible for settlement. Currently VietinBank is developing this model in accordance exactly with the road map given by ST. DRVN's opinion is okay, connection among banks exits in Vietnam already but we need general standards for OBU, IC-Card. In the future investor A want to follow technology A, investor B want to follow technology B, etc…Technology A, B,…are difficult to be connected, adjusted in the later stage. We need the connection, integration among banks, MOT, bureaus,...to easily manage generally and manage information technology in particular. This is the issue for ministries, branches in coming time.

- ST(Mr Thanh): Ho Chi Minh – Trung Luong uses BIDV, is there any settlement connection between VietinBank and BIDV?

  ⇨ VietinBank: The connection is for the benefit of customers. Each bank can take up itself, but to get more customers and charged money, banks need to cooperate with each other. Or else, user have to buy many facilities, causing waste for the society, burden for our "Non-stop". Administrators should give out directions for banks to apply the same technology or standards to be easily cooperate later. Now VietinBank and BIDV cooperated already in ATM, not yet OBU.

- DRVN: The 3rd issue is for Toll management. MOT need to decide about OBU. How to integrate OBU contact with IC-card?

  ⇨ ST: That's no problem, OBU can contact with all types of card.

Study of ST seems to base on the old system, when technology is still complex. For example in document number (17), page 8, toll collection server seems to base on the old technology, when each toll system was like a local station. Now, it's not important that what the server does, but we need to know its database server or applying server. How to find out cheating or something like that depends on application, all server/computer use that application. Client-Server was used before, however now we are using Web-based. We haven't had expressway, but we need to predict technology development. Otherwise, when its born, it will become out of date.

- ST: We are preparing necessary descriptions to share information. We've just come to basic frameworks, not specific.
- VietinBank: Now we can look up for account information through a lot of channels: sms, website,…Transmission line doesn't cause any difficulty, also it can contain 2, 3 lines. We think Section 7.4: Communication System shouldn't be introduced into standards.
- ST: We think your communication network is still not so good.

The meeting ends with some results.

ITC and other organizations have had their own comments and contributions, we hope that ST takes more study, explanation, and addition properly with your reports. Time for discussion is still short. We propose that presentation should be 1 hour, then 2 hours is for discussion.

ST: Expect that next WG will be held on October 11.

STUDY FOR SUPPORTING
ITS STANDARDS &OPERATION PLAN DEVELOPMENT IN VIETNAM
Minutes of 6th ITS-WG

1) Date : October 11, 2010

2) Venue : Information Technology Centre, MOT

3) Attendance :

Please refer to the attached attendance list.
Study Team: Ishiguro, Iwata, Kurita, Sato, Thanh, Ha, Tam

4) Presentation and Discussions:

- Study Team (=ST) : Present about documents (11 volumes, including the 5th WG minute) for this meeting, focusing on Final Report (Draft).
- ITC: Page 64. Section 7.4: In Vietnam (VN) we are discussing with two debates, having not come to a decision. One of them is using RF-Tag (Passive)

  In both cases, it's easy to occur incidents. For Balance-in-card, it happens in-site incidents, affecting the traffic through ETC. Balance-in-card can't avoid all incident. How can we solve?

  Page 67, table 7.8: We emphasize again that we are behind the on-going projects with high feasibility; so, its necessary to refer to the their results. There is/are the project(s) that is/are going to realize(s) RF-Tag. If we don't consider that, we will be out of date. Cost of its OBU is very low, why it's not suitable.

  ⇨ ST: RF-Tag has the big advantage is that's it has no experience in shared use by difference operators. Just one company. Is that good? "Share" is an important issue.

  ⇨ ITC: For us OBU can not be shared.

  ⇨ ST: Manufacturer like in Japan maybe very friendly to partner but very competitive with each other. We always want to be neutral in consulting. As we know, government also high evaluates "share" and competitiveness.

  Page 13 in document (3) Heavy Truck Control: why ST state 2 inspectors? Inspector play the role of inspecting, checking, administrative punishment but not operating, managing. They should be operators or equivalent .

  We hope the presence of inspectors to provide proper information and rightly judge the situation. We will take note on this issue to be suitable with VN's administration.
- DRVN: Overloading truck is allowable to continue the trip or not? If its unallowable, we need to build specific road and area for overloading vehicles. With current design, we can't do enforcement. If it's allowable, fee will be high, ST's design is already suitable: no need inspector, collect fee/punishment according to load.

  ⇨ An example of HCM – Trung Luong road structure has been destroyed seriously by overloading trucks; cost for repairing is much more than benefit from those vehicles. VN's law require to remove from overloading vehicles, not our policy. We understand and will consider more about the design for this.
- ITC: ST has just said that to finalize the data dictionary need several years (3-4 years). In this urgent situation, how can it be? ST should consider this.
- DRVN: For Road-to-Vehicle communication: If nothing may change, there will be a decision

that: on 1st July, 2011 all the bus with the trip of more than 300 km, containers have to install trip control facility, which applies GPS/GSM. So, should we make OBU to follow that direction in order to all the vehicles/in one vehicle to apply the 1 type of facility?

⇨ We survey last year at HCMC one private company applied this. Very expensive. The system need to be based also on DSRC or IR. If there is no DSRC or IR, the sensor can't recognize the vehicle is on expressway or highway. So the title of the category from us is GPS/GSM/IR. We will consider.

- ITC: "defroster" is not so suitable

  ⇨ Ok.

- DOST: ST need to compare in one more category: VN's weather/geography: many places in VN are very hot and high humid. High temperature and humidity affect much to the durability of facilities. For example, in-car temperature may reach 60-70 Degree C. In cool stable weather like many States of America, Thailand or Saigon VN the situation may different. But in many place of VN the weather need to be considered.

  Agree that wording related to administrative is not suitable.

  Road-to-Vehicle communication: Checking for the account is still forced, because there are many other ways now. ST should put your attention on it.

- DRVN: OBU is just like a checking machine in supermarket. Mechanism of it belong to banks.
- ST: RF-Tag is used by only India, but now they stopped it already. We also need to update with the world. In addition, it is 900 MHz.
- ITC: How is the rate of ETC in Japan?

  ⇨ About 20% of 80 millions vehicles. However Japanese doesn't drive their vehicle into expressway all the time.

  The meeting ended.

STUDY FOR SUPPORTING
ITS STANDARDS &OPERATION PLAN DEVELOPMENT IN VIETNAM
Minutes of 7th ITS-WG

1) Date : Nov 3, 2010

2) Venue : Information Technology Centre, MOT

3) Attendance :

Please refer to the attached attendance list.
Study Team: Ishiguro, Iwata, Kurita, Thanh, Ha, Tam

4) Explanations and Discussions:

Study Team (=ST) : Present on documents (8 volumes, including the minute of WG 6th) of this meeting as delivered to all members.

- Capro (Mr Quang):

Firstly, I wonder what source that you refer to for some of your information?

⇨ We refer to standards from Europe for the examples.

According to me, bank need to send information back to tollgates only when account in bank is short, not every passage. Capacity is not big only some byte and there will be no problem for sending information, its very fast.

=> We think balance account is necessary to check.

Every 1000 passage, there are only about 10 vehicle being in short of balance status. So, information to be sent is very light.

Secondly, I found that you haven't mentioned about Resolution of Sensor. As for me, it's very important information.

=> We've calculated and later we will make it clear and show you the answer.

As I know, 2 months ago, we only had 2 Mpx Camera. But at the end of last month, we had 5 Mpx. At the beginning of next years we will have 10 Mpx camera. Therefore, 1 camera can replace 4 ones. Technology is improving very fast, high resolution camera is important. Please consider about it.

=> We want to mention here is only about arrangement of camera. And we identify incident after receiving information from telephone or else, not initially by camera.

In my idea, in your result, resolution is still very low. Moreover, we need standards for technical terms.

=> To identify image, many software is necessary, so we want to separate into some categories. As the information we received from HCM _Trung Luong, their policy is also separating manual monitoring and event detection, image recognition.

The case of big monitor and poor input is just very rare, we should mention normal situation. And how to use is different from how to arrange.

Thirdly, have you refer to Circular 36 of Ministry of Information and Communications?

I think we don't need to make it to be channel.

In Singapore, they don't use DSRC 5.8 but use 2.4.

=> We believe that heavy rain and hot pavement affect a lot on Resolution. At that time, resolution seems to have no meaning.

In many part of the world like Brazil, Mexico, Canada, they already used Passive. And Georgia state of USA, India, they've been being implementing. Georgia state and Thailand are testing EVR _ electronic vehicle registration with eGo Plus Sticker Tag.

According to me, we should use Balance-in-bank because balance-in-card can't assure security.

=> The important thing is that how to update the balance table.

The last meeting ended with some results. Other members hope ST to take note and consider more about the suggestions to prepare for the coming workshop and for a good result of the Study.

STUDY FOR SUPPORTING ITS STANDARDS & OPERATION PLAN DEVELOPMENT IN VIETNAM
Minutes of WORKSHOP

1) Date : November 19, 2010

2) Venue : Melia Hotel

3) Attendance :

- Ministry of Transport
- Embassy of Japan
- JICA
- JICA Study Team
- Working Group Members
- Related and Concerned Foreign and Local Organizations including related Ministries and Agencies, Universities and Firms.

4) Opening Remarks by Mr. Ngo Thinh Duc, Permanent Vice Minister of MOT

5) Presentations by JICA Study Team on Study Results and Recommendations

6) Questions and Answers

- Directorate for Roads of Vietnam

- For toll collection, the equipment for toll collection, such as lane equipment, monitoring equipment and toll collection equipment are concerned, but not the bank involvement in toll settlement. The Study Report should not refer to banking activities for toll settlement because they closely relates to the banking technology and are too much complicated.
- Communication System: the Study Team didn't give the conclusion that which technology shall be applied, i.e. conventional technology (SDH) or new technology (G-Ethernet). Technology should be adopted in consideration with future development. Now, Vietnam has started to adopt ITS while many other countries already introduce ITS much earlier, i.e. about 20 years, so Vietnam would better learn the experiences from such countries to find out from which points Vietnam can start ITS introduction in expressway network.

  ⇨ **ST**:

- Toll settlement should be performed by the Banks: it is presiquition for the Study, not Study output. How to process toll collecction data depending on IC-card.
- Transmission Method: Mr. Kurita already explained about this issue.
- Technology selection should be selected in consideration with future development: fully agreed. Example: free flow toll collection system is not future technology for Vietnam, free flow toll collection with heavy penalty system and cost cutting may not be accepted in Asian countries, to select toll collection system (free flow or not) is depending on the sociaty and culture. In Europe, 100% higher penalty sytem is accepted, so none-stop toll collection can be applied. In India, RF tag is accepted.

- Transport Infrastructure Dept. MOT

- It is highly evaluated that the recommendations made by JICA Study Team are systematic and useful. However, data dictionary is core item for communication network, the detailed data dictionary is required.
- Study Team has proposed 5 frameworks for expressway O&M, it is suggested to pay attention to heavy truck control and enforcement for road users in general since observation of traffic laws and regulations of Vietnamese road users is poor.
- Regarding minimum services, it should be understood that ETC/ITS will help to mitigate the traffic congestion, but can not completely eliminate it. Up to certain increase in vehicle volume, congestion may still occur especially in case of mixed toll collection method. It is suggested to give information up to which volume, congestion may still occur and what is solution for that. In some European countries, they have changed to toll collection per vehicle (how much for one vehicle in one year). Should Vietnam change to this method in future? If not, what is the solution for long-run.
- ITS is one of tool that help to reduce It is suggested to provide open frameworks so that each road operator can select the ones suitable with them.

⇨ **ST:**

- Data dictionary: Agreed that data dictionary is important however, it is first step for data dictionary prepared , I was the member for data dictionary preparation under MLIT, it needed much time and efforts. However, under this Study what we can prepare only very basic data dictionary.
- How to integrate 3 main centers: communication network connecting 3 main centers will connect each other by public communication network because the distance between them is too large. In our report, we deal with the communication between road management offices within one main center and between toll offices within one road management office. Mr. Kuria already gave some explaination on this issue.
- Overloading regulation: not only by ITS but transport infrastructure system. For example, if only one tollgate has weighing system, the driver may find other road to avoid weighting system. Reducing the overloading regulation system cost and reducing land acquisition are very important issue. However, in our recommendation penalty regulation will be applied at each tollgate, the weighing system shall be located closely back from exit tollgate. higher penalty system will be adopted to retrain the overloading trucks. So, for overloading regulation will be realized not only by communication network but also transport infrastructrure system and institutional system.
- Minimal Service Requirements: We fully agree, we alreay preapred preconditions and outputs for our study, others will be prepared in other Study. However, minimal service requirements are important prequisitions for ITS.

- Transport Infrastructure Dept. of MOT

- Study Team has proposed 3 vehicle axles weighing location alternatives: 1) before entering the expressway; 2) right after entering the expressway; and 3) upon exiting the expressway

and recommended alternative 3. It means heavy trucks are allowed to run on expressways. In that case, whether or not revenue from toll and penalty is sufficient for expressway maintenance, and what about safety issue?

⇨ **ST**: as I explained before, in our recommendation higher rate of penalty is necessary to reducting overloading trucks.

- Institute for Transportation Science and Technology

- It is suggested by the Study Team to adopt vehicle classification method according to MOF's circular together with image recognition. However, vehicle classification method according to MOF's circular is not suitable for ITS. Pls give more explanation on how to adopt this method efficiently.
- Regarding roadside-vehicle communication, Study Team has proposed DSRC (Passive and Active) and RF-Tag (to be followed-up). It is suggested to Study Team to make comparison with the proposal for HCMC-Trung Luong Expressway. It is concluded by Study Team that RF-Tag has low accuracy. What is the basis for such conclusion by Study Team?

⇨ **ST:**

- The Study's recommendations are made based on existing laws and regulations of Vietnam, i.e. for vehicle classification we depend on the regulation of MOF. However, some improvement need to be applied for the present vehicle classification, for example, by number of vehicle axles, however, to automatically detect vehicle class is not so easy, in some cases, facility cost for for toll collection is smaller than vehicle classification system, so vehicle classification or detectors need to be simplified, that is main point to improve vehicle classification for ETC introduction.
- Reability of Radio Frequency for Toll Collection: the answer will be rather complicated, we shall prepare the answer in paper and send to you. Main point is that reability will be established by communication and reply, during very short time when the vehicle is passing though the tollgate, usually communication for toll collection between road and roadside equipment retry many times, and reability become higher, more communcation will help higher reability can be obtained. Frequency 700MHz MHz or 5,8 GHz are quire different, that is one important factor to reply, we shall prepare the answer later for you.

- Hanoi Polytechnic University

- "Balance-in-card" is recommended by the Study Team. It means we should care about the security of the card. And there is big possibility that we have to depend on the technologies of the card manufacturers while recently some card manufacturers have had big problems.
- If "balance-in-card" is adopted, it means that we should use Active DSRC while there is limited number of countries using this (mostly Japan...). It means this will limit the supply market.

⇨ **ST**:

- Security of IC-card: We already described this matter in our report. IC-card TYPE A prepared the answer for their problem, and TYPE A and Mifare Plus prepared the answer to make higher security for their IC cards.

- CadPro

- "Balance-in-card" and 2-pieced type OBU is recommended by the Study Team. Many other countries including Mexico, Brazil... are now using "balance-in-bank". Together with

development of telecommunication, it has become easier and more convenient to check balance even by hand phone.

- Also, many countries have changed to RFID since it is cheaper and more popular. What is the opinion of Study Team?

  ⇨ **ST**:

- The number of expressway users will drastically increase after coming 10 years, so the communication traffic will be very hug, so prepaid balance-in-bank is not so easy.
- Prepaid balace in IC-card: prepaid balance in IC card is one thing for toll collection and the price of OBU is other thing. Of course RF tag is far cheaper than DSRC, however, the price and security or reability are different matter, we need to think separately. Firstly, European and US are supported by high penalty system and credit card, in that case checking the balance is not important, card users can pay much higher than toll amount. However, in many Asian countries, in tollgate there should be barrier for stopping unlawful vehicles. We, Asian peoples prefere fareness for users. We learn that in Can Tho bridge the prepaid balance card can be checked at OBU. We believe that our recommendation is suitable for Vietnam.

- University of Transport

- It is suggested to Study Team to specify the sources of data and information provided in the study reports.
- Vietnam should take initiatives in ITS study and application. For example, University of Transport already took up some researches on ITS related issues and has starting to educate ITS engineers with understanding and awareness about the importance and urgentness of ITS in expressway operation and management.

  ⇨ **ST**:

- Thank you for the suggestion. Study team shall try to show the data sources, however, many data were taken from Internet or from unofficially sources, that are difficult to clearly shown.

- VIDIFI (investor of Hanoi- Hai Phong Expressway)

- Results/standards of this study will be considered obligatory or only recommendable to expressway investors?

  ⇨ **ST**:

- The title of Study Results are Draft ITS Standards. Of course it is understood that such Draft ITS Standards will be further discussed and improved by Vietnam.

- Traffic Police Dept. of Ministry of Public Security

- Traffic police also involves in expressway O&M. It is suggested to the Study Team explain in the study report what results will be used for traffic police.
- About external equipment, Study Team has proposed fixed camera system while traffic police often use mobile camera system. How to connect?
- Detection device proposed by the Study Team has 4 objectives, it seems not enough. It is suggested to the Study Team to give more functions for external equipment since traffic police will use recorded images for violation treatment. Also, it is suggested to Study Team to give more detailed explanation on incident clearance by images.

- Close coordination between expressway management center and traffic police center is required for violation treatment. What is suggestion from Study Team?
  ⇨ **ST**:

- The Study Results just recommend the involvement of Expressway Traffic Police to collaborate with Road Operators, however, within the scope of Study, how far they can collaborate is not identified, what we can do that only prepare pre-quisition on expressway traffic police is necessary.
- Integration of mobile camera of traffic police: objectives of monitoring camera of road operation is mobile camera of traffic police are different, so under this Study, we dealt with monitoring camera for traffic monitoring only.
- Accident clearance: we understand that how to use the capture image for accident treatment need to be cooperated by road operator and traffic police, however, under this Study the details are not given, because much discussions among Vietnamese authorities are required.
- For camera arrangement, we discussed with many projects, firstly we considered camera will initially detect incidents, however, we found and agreed with Hochiminh – Trung Luong project, that incidents will be detected by emergency call and later camera will be used for identifying the severity of incidents.
- Cooperation between expressway traffic police and road operator should be based on this matter that camera will be used to check severity of incident but not detect them.

7) Closing Remarks by Mr. Ngo Thinh Duc, Permanent Vice Minister of MOT

- ITS introduction is very urgent in Vietnam. Vietnam is receiving assistance from various international donors and consultants, one of them is Study for Supporting ITS Standards and Operation Plan Development granted by Japanese Government through JICA.
- However, how to finalize ITS Standards and which roadmap for ITS implementation should be decided by Vietnam considering the local conditions. JICA Study Team just recommend Vietnam based on their experiences, researching and findings.
- Existing legal framework and institutional schemes may not fully appropriate for ITS realization in Vietnam. MOT would soon propose to Government to make this project become national program requiring concentrated participation from various ministries (Ministry of Police for violation treatment, Ministry of Information and Communication for communication network, Ministry of Science and Technology for standardization, State bank and Commercial Banks for toll collection/payment...).
- MOT is thinking to elaborate some kind of joint circular for expressway O&M and violation treatment. MOT will also get involvement of IT, electronic experts in this work since their expertise is essential.
- The participation, suggestions and ideas from organizations and individuals are expected because ITS introduction is urgent and closely related to each individual Vietnamese when they travel on expressway network.

WORKSHOP ON THE STUDY FOR SUPPORTING ITS STANDARDS AND OPERATION PLAN DEVELOPMENT IN VIETNAM

LIST OF PARTICIPANTS

Order No.	Full name	Organization/Company	Note
1.MOT			
1.1 Head office			
1.1.1 Deputy Minister & Secretary			
1	Mr. Ngo Thinh Duc	Permanent Deputy Minister of MOT	
2	Mr. Nguyen Tuan Anh	Secretary of Permanent Deputy Minister of MOT	
1.1.2 Secretariat			
3	Mr. Bui Nguyen Long	Deputy Chief Secretariat	
1.1.3 Dept. of Science and Technology_DOST			
4	Dr. Hoang Ha	Director General of DOST	
5	Mr. Nguyen Van Ich	Deputy Director of DOST	
6	Mr. Nguyen Tuan Anh	Specialist, DOST	
1.1.4 Dept. of Transport Infrastructure			
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27	Mr. Nguyen Tien Ha	PMU 85	
28	Mr. Le Trong Do	PMU 85	
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31	Mr. Le Anh Tu	VR	
32	Mr. Nguyen Dong Phong	VR	
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34	Mr. Nguyen Dinh Khoa	Deputy director of Traffic Safety Center	
34	Ms. Vu Phuong Anh	ITST	
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1.6 Transport Journal			
37	Ms. Vu Thi Minh Huong	Transport Journal	
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39	Mr. Pham Van Cong	Deputy Manager of Division No. 15	
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Information Technology Dept.			
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47	Mr. Mai Tuan Anh	Deputy General Director of VEC	
48	Mr. Pham Hong Quang	Manager, VEC	
49	Mr. Le Quang Hao	VEC	
50	Mr. Nguyen Hoang Ha	VEC	
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51	Ms. Tran Thi Thanh Xuan	VSQI	
7. Transport Engineering Design Incorporated _TEDI			
52	Mr. Pham Duc Thang	TEDI	
53	Mr. Nguyen Van Nghia	TEDI	
8. University of Transport and communication _UTC			
54	Dr. Le Hung Lan	Professor of Electronic Faculty	
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60	Mr. Ngo Phuong Thanh	Manager, ITD	
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67	Mr. Ken Furudoi	First Secretary	

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69	Mr. Shiro Oda	Representative, JICA	
70	Mr. Phan Le Binh	Senior Program Officer, JICA	
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80	Mr. Luu Thuc Sinh	GTRI	
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84	Mr. Tomoo Hirayama	Chief Representative for Vietnam, MHI	
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87	Mr. Tomoo Kikuchi	NEC	
88	Mr. Hirotatsu Yamauchi	NEC	
89	Yoshihiko Tatsugami	NEC	
90	Mr. Do Dinh Thang	NEC	
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91	Mr. Takahashi Shoichi	Chief Representative of Hanoi Office	
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93	Mr. Ichizuru Ishimoto	Nippon Kouei	
94	Mr. Le Tung Lam	Nippon Kouei	
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108	Mr. Thai Son	Vinaconex2	
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110	Mr. Nguyen Minh Duc	VTC8	
111	Mr. Pham Thanh Hai	Vietnam News	
112	Mr. Dam Minh	VTC	
113	Ms. Ngo Bich Quyen	Saigon Giai Phong Newspapers	
114	Ms. Nguyen Quynh	VOV News	
115	Mr. Pham Dinh Hiep	Hanoi Moi Newspapers	
116	Ms. Le Ngan Giang	VOV 1	
117	Ms. Doan Loan	VnExpress	
118	Mr. Tran Lan	Info TV	
119	Ms. Nguyen Hong Loan	VOV	
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Figure 7.2 Scenes in Workshop

APPENDIX 8:
TABLE OF KEY WORDS

Key words for the Draft ITS Standards are enumerated in English, Vietnamese and Japanese.

TABLE OF KEY WORDS

- **Administrative telephone:** Telephones between the persons in charge of road operation for routine work.
- **Axle Load Measurement:** This functional package allows the road operators to detect/ regulate overloaded heavy trucks on the expressways by using axle load scale installed in the exit tollgate lane exclusive for large-size vehicles.
- **Axle Load Scale:** a scale permanently installed in a fixed location, having a load receiving element specially adapted to determine the combined load of all wheels (1) on a single axle or (2) on a tandem axle of a expressway vehicle.
- **Bandwidth:** A data transmission rate; the maximum amount of information (bits/second) that can be transmitted along a channel.
- **Barrier Tollgate:** A tollgate located on the through lanes.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.
- **CCTV Monitoring:** This functional package allows the road operators to capture current situation of traffic accidents, broken-down vehicles, left obstacles, driving in the reverse direction, vandalism, natural disaster and traffic conditions on the expressways and to monitor the captured video image at the Main Centers and road management offices by using cameras installed at road sections where traffic can be stuck easily by incidents and at long tunnel sections.
- **Center/Roadside Communication (Including Ducts):** This functional package allows the road operators to exchange data for ITS among the main centers, the road management offices and pieces of roadside equipment by using the backbone network among the centers, which comprises fibre optic cables installed in the shoulder along the expressways and communication nodes, and access network between communication nodes and roadside terminals.
- **Closed System:** A toll road system completely enclosed by tollgates. Judgment of allowing a vehicle to enter the toll road network is conducted at incoming tollgates, and the incoming/outgoing vehicles of the closed road network are fully controlled by the tollgates.
- **Collaboration Diagram:** A diagram to be indicated by the combination of subsystems and interfaces necessary for realizing the implementation package to share understanding of the system.
- **Conduit:** A piping system used for protection and routing of network cables. Conduit may be made of metal, plastic, fiber, or fired clay. Flexible conduit is available for special

purposes.

- **Data Dictionary:** A document that specifies the definition, identification, representation and permissible values of data elements by means of a set of attributes for each data element.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Data Logger**: A device for receiving and storing measurement data from weather sensors
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Directive Telephone:** Telephones between a officer commanding and the persons in charge of road operation when an incident occur or a traffic restriction is needed.
- **Distance Proportional Tariff System:** A toll rate system in which a tariff rate is calculated depending on the distance between an incoming interchange and an outgoing interchange. This provides a toll rate fairly responding to the amount of benefit to be gained by road users, and is suitable an inter-city toll road network with a long driving distance.
- **Draft Communication System Plan:** The Draft Communication System Plan provides the General Plan and the Draft Design Standards of communication system in order to establish connectability of communication network.
- **Draft Design Standards:** One of the document of the Draft ITS Standards, which defines basic concept, general architecture and actualization method as a unified form for designing the system.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **Draft Message/Data Standards:** The Draft Message/Data Standards defines message list and data dictionary in order to establish inter-operability of message and data.
- **DSRC:** Dedicated Short Range Communications (DSRC), which allows high-speed communications between vehicles and the roadside, or between vehicles, for ITS.
- **DWDM:** Dense Wavelength Division Multiplexing - an optical technology used to increase bandwidth over existing fiber optic backbone
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **ETC:** Electronic Toll Collection (ETC), which is a toll collection method that eliminates the need for cash, tokens or credit cards to be used at tollbooths. Vehicles are equipped with small electronic devices that transmit both vehicle and account details through a reader located in the toll lane. The appropriate toll is then debited from the driver's prepaid account.
- **Event Detection (by Image):** This functional package allows the road operators to automatically recognize occurrence of traffic accidents, broken-down vehicles and left

obstacles on the expressways and to send notification to the Main Centers and road management offices by analyzing video images from cameras installed at bottleneck spots where traffic can be easily stuck and at long tunnel sections.

- **Event Detector:** A software application that uses computer algorithms to uses computer algorithms to intelligently monitor real-time video for automatically detecting incident occurrences and their types, such as traffic accidents, breakdown vehicles, left obstacles, driving in the reverse direction, vandalism and natural disasters.
- **Fixed Camera:** The traditional camera type where the camera and the direction in which it is pointing are clearly visible. This camera may come with a fixed or varifocal lens so that it has a fixed field of view (normal/telephoto/wide-angle) once it is mounted.
- **Flat Tariff System:** A toll rate system in which fixed rates by vehicle class are applied to each vehicle passage through a road section independently of distance. This is the most simple toll rate system and is suitable for the toll collection on a particular road section or an urban toll road network in which route selection is to be required.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **G-Ethernet:** Gigabit Ethernet (GbE or 1 GigE) is a term describing various technologies for transmitting Ethernet frames at a rate of a gigabit per second, as defined by the IEEE 802.3-2008 standard.
- **Heavy Truck Control:** An ITS user service for eliminating overloading of heavy trucks by automatic weighing at interchanges, restraining damage to the road structure, improving safety of the freight trans-port and restraining congestion caused by heavy trucks.
- **IC-card:** Integrated Circuit card, which is any pocket-sized card with embedded integrated circuits. There are two broad categories of IC-Cards. Memory cards contain only non-volatile memory storage components. Microprocessor cards contain volatile memory and microprocessor components. The card is used for identification or financial transaction.
- **IC-Card Recording:** This functional package allows the road operators to deduct prepaid balance of IC-cards for collecting toll by using equipment installed at tollgates on the expressways.
- **Image Recognition:** Software technology that uses computer algorithms to intelligently monitor real-time video for automatically recognizing license plate number of vehicle, vehicle speed, the occurrence of traffic accidents, broken-down vehicles, and left obstacles.
- **Incident:** An unusual and unplanned event that affects or impedes the normal flow of traffic, such as traffic accidents, broken-down vehicles, left obstacles, reversing vehicles, vandalism and natural disaster on the road.
- **Integration Layer:** Communication network among one Main Center and its related road management offices
- **Interchange:** A junction connecting an expressway network and an arterial road network.

That comprises grade separation and ramps to permit traffic on the expressway to pass through the junction without directly crossing other traffic on the arterial road.

- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **ITS User Service:** A service to be provided by an ITS application to the users directly or indirectly.
- **ITU:** The International Telecommunication Union is an agency of the United Nations which regulates information and communication technology issues. ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world and establishes worldwide standards.
- **Junction:** A location on an expressway network where traffic can change between different travelling routes or directions. That comprises grade separation and ramps to permit traffic on the expressways to pass through the junction without directly crossing any other traffic stream.
- **Lane Control:** This functional package allows the road operators to eliminate the vehicle passages without adequate toll collection by using a computer, vehicle detectors, signs and a barrier installed in a separated tollgate lane of the expressway.
- **Lane Monitoring:** This functional package allows the road operators to monitor current conditions of vehicle passage and operations by workers by using cameras installed in a separated lane such as a tollgate lane of the expressway.
- **Leaky Coaxial Cable:** The cable is leaky in that it has gaps or slots in its outer conductor to allow signal to leak into or out of the cable along its entire length.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Media Converter:** A device that converts signals from one media type to that of another
- **Message:** A set of data to be exchanged between subsystems for transferring information.
- **Message Sequence Diagram:** A diagram to be indicated by a set of messages/activities and their contents necessary for realizing the implementation package to discuss interoperability of the data.
- **Mobile Radio Communication:** Wireless communication systems and devices which are based on radio frequencies, and where the path of communications is movable on either

end

- **Mobile Radio Communication:** This functional package allows the road operators to exchange information between road operation vehicles/workers on the expressway and the road management office by using radio communication.
- **NMS:** A central set of software programs providing network-based control of disparate hardware elements; also, the software and hardware used in bridging, routing and other network functions.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **Non-stop Toll Collection:** An ITS user service for enabling toll payment without the need to stop the vehicle at the tollgates, allowing smooth incoming and outgoing of vehicles at the interchanges, increasing the vehicle processing capacity of the tollgate and reducing the number of tollbooths and land acquisition.
- **NVR:** A completed hardware box or software only that receives digital video streams and images from network cameras and records them onto a data storage device. Recording, playback, and panning, tilting, zooming for PTZ cameras is controlled remotely via a network computer.
- **OBU:** On-Board Unit. The in-vehicle device component of an ETC system. A receiver or transceiver permitting the Operator's Roadside Unit (RSU) to communicate with, identify, and conduct an electronic toll transaction; also called a 'transponder' or 'tag.'
- **OBU Management:** This functional package allows to register on-board units by using equipment installed in OBU issue offices, and allows to generate/manage the registration list and the invalidation list of on-board units by using computers and software installed in the OBU registration center.
- **Open System:** A toll road system not completely enclosed by tollgates arranged either on through lanes or on ramps. As a result, there are no closed sections whose incomings and outgoings are fully controlled by the tollgates.
- **Overloading Management:** This functional package allows the road operators to store/retrieve data of the heavy trucks overloaded on the expressways by using computers and software installed in the road management office.
- **PTZ Camera:** A closed-circuit television camera with remote directional and zoom control.
- **RF-Tag:** A microchip attached to an antenna in a package. An RF-tag contains a unique serial number at a minimum, but commonly contain other information about a product. RFID tags can be passive, semi-passive or active.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring

equipment for surveillance.

- **Road Section Layer:** Communication network among one road management office and its related nodes
- **Road-to-Vehicle Communication:** This functional package allows the road operators to exchange data for toll collection and other services on the expressways by using radio communication between antennas installed at roadside and on-board units installed in the vehicles.
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Subsystem:** An element of the system architecture defined by considering function, location and envisioned operating body, which can be broken down to the lower-levels.
- **Telephone Exchange:** This functional package allows to send an emergency call and a request for help to the Main Centers and road management offices at an incident occurrence by telephones installed at roadsides, rest areas and tunnel sections and by administrative telephones installed at the toll offices, and allows to send directives to the units concerned at an instant for clearing incidents and enforcing traffic regulations.
- **Terminal Layer:** Communication network between one node and its related SW-HUB which is connected with roadside equipment components and weather sensors.
- **Toll Management:** This functional package allows the road operators to keep all data of toll collection, to manage the invalidation list on the usage of on-board units and IC-cards, and to manage toll revenue of the expressways with a high reliability by using computers and software installed in the road management office.
- **Toll Office:** A toll office is located at a tollgate, which includes two or more tollbooths, and is in charge of toll collection.
- **Touch&Go:** A toll payment method using a prepaid balance in IC-Card. Information contain in this card can be read and written via magnetic induction using specified radio frequency and IC-Card software. Each time passing through a tollgate, road user uses the IC-Card, the electronic card reader will deduct the exact fare from the value stored inside the card. User can top-up or reload the card with a pre-defined amount to continue using it.
- **Traffic Analysis:** This functional package allows the road operators to keep track of traffic conditions on the expressways, such as crowdedness and vehicle velocity, by processing and analyzing the data captured by vehicle detectors.
- **Traffic Event:** An unusual event that affects or impedes the normal flow of traffic, which can be categorized to incident, traffic congestion, significant weather, construction work and traffic

regulation.

- **Traffic Event Data Management:** This functional package allows the road operators to conduct traffic control, regulation and information dissemination on the expressway, in the unified/integrated form, by categorizing the results acquired through emergency telephones, mobile radio communication, event detection, traffic analysis and weather monitoring and by organizing them as the data of traffic events corresponding to the place/time of occurrence and the priority.
- **Traffic Information:** This functional package allows the road operators to provide other organizations with the information organized as traffic events on the expressways by using the Internet.
- **Traffic Information/Control:** An ITS user service for providing accurate surveillance of traffic conditions on the roads, assisting prompt action of the road operator and emergency vehicles by notifying occurrences of traffic accidents, significant weathers and traffic congestions, allowing the road operator to control road traffic and the drivers to avoid the influence of the incidents by providing accurately updated information.
- **Traffic Restriction:** A limitation on the road transport, such as closure, lane restriction, speed restriction and warning information.
- **Traffic Supervision:** This functional package allows the road operators at the Main Center and road management office to supervise totally and visually the current traffic conditions on the expressways and the information organized as traffic events
- **Transmission Method:** The method of sending, propagating and receiving an analogue or digital information signal over a physical point-to-point or point-to-multipoint transmission medium, either wired, optical fiber or wireless. Transmission technologies and schemes typically refer to physical layer protocol duties such as modulation, demodulation, line coding, equalization, error control, bit synchronization and multiplexing.
- **UHF:** Ultra high frequency (UHF) designates a range of electromagnetic waves with frequencies between 300 MHz and 3 GHz (3,000 MHz), also known as the decimetre band or decimetre wave as the wavelengths range from one to ten decimetres (10 cm to 1 metre)
- **Vehicle Class:** A set of categories of vehicles for toll collection, traffic data or overloading regulation with definition of unique name/identifier to be applied to each category.
- **Vehicle Detection:** This functional package allows the road operators to measure actual traffic volume, heavy vehicle ratio and vehicle velocity on the expressways for developing road operation/ improvement plans by using vehicle detectors installed at important points on the throughway and the tollgates.
- **Vehicle Detector:** A sensor either embedded in the pavement or mounted above the expressway to provide vehicle volume, speed, counts, headway, queue lengths, and vehicle classifications.
- **Vehicle Identification:** This functional package allows the road operators to identify individual vehicle by using a license plate scanner and other equipment installed in a separated lane such as a tollgate lane of the expressway.

- **VHF:** VHF (Very high frequency) is the radio frequency range from 30 MHz to 300 MHz
- **Video Controller**: A video card, video adapter, graphics-accelerator card, display adapter or graphics card is an expansion card whose function is to generate and output images to a display.
- **VMS:** Variable Message Sign, which is an electronic sign installed along or above expressway and other highways that provide dynamic messages to alert the motoring public of incidents, congestion, construction, or other information. VMS is also known-as Changeable Message Sign and Dynamic Message Sign.
- **VMS Indication:** This functional package allows the road operators to provide road users on the expressways with the information organized as traffic events by using VMS (Variable Message Sign) installed at the place short of entrances, exits, tollgates, junctions and tunnels.
- **Weather Monitoring:** This functional package allows the road operators to estimate dangerous conditions for road traffic on the expressways by using data acquired by the sensors installed at the interchanges and at the road sections where undesired weather conditions for traffic safety frequently take place.
- **Weather Sensor:** A sensor installed at a specific point on the road for measuring rainfall, wind speed, visibility, air temperature and road surface temperature.
- **WDM:** Wavelength-Division Multiplexing (WDM) is a technology which multiplexes a number of optical carrier signals onto a single optical fiber by using different wavelengths (colours) of laser light. This technique enables bidirectional communications over one strand of fiber, as well as multiplication of capacity.