Reference-3

Design standards for toll gate booths

I. Definition of Terms

1. The meanings of the terms Toll Gate and Toll Office used in this standard are defined in the following Articles.

(i) Toll Gate : A facility established on a toll road to collect the prescribed toll charges directly from the vehicles (passengers) which use the Toll road. There are two types of Toll Gates, namely the Barrier Gates which are established on the main route and the Interchange Gates which are established within the Interchanges.

(ii) Toll Office : An Office established on Toll roads to carry out the official work related to the road management and collection of toll charges.

II. Toll Gates

1. Standards for the setting up of barious Toll Tage facilities.

(i) Standard Target Year for the determination of the scale or the number of facilities.

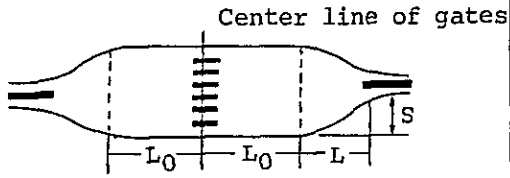
The number of facilities and the scale are determined according to the traffic volume in the standard target Year shown in the following table. However, in the case of roads opened for service in stages, the when the whole road is opened for service is taken as the starting year.

Road classification / Facility	Type 1	Type 3
Toll Plaza (Land)	15 (years after opening to traffic)	20 (years after opening to traffic)
Toll Plaza (Earthworks)	10 (years after opening to traffic)	20 (years after opening to traffic)
Underpass	10 (years after opening to traffic)	20 (years after opening to traffic)
Toll island (Road Pavement)	8 (years after opening to traffic)	10 (years after opening to traffic)
Toll gate buildings or Roof Passage	8 (years after opening to traffic)	10 (years after opening to traffic)
Toll Booth	5 (years after opening to traffic)	5 (years after opening to traffic)
Toll collection Machine (Including the vehicle detector)	5 (years after opening to traffic)	5 (years after opening to traffic)

(Note) Classification of Type 1 & Type 3 are in accordance with the Code of Road Structures.

(ii) Standard for the setting up of various facilities.

Item	Standard
Toll Plaza (Toll Gate Square)	
a. Horizontal Alignment	In case of Barrier gate the horizontal alignment of the section where Toll Plaza is to be established shall be in accordance with the standard (stated elsewhere) and in the case of Interchange gates minimum radius is taken as zoom.
b. Radius of Vertical Curve	The Radius of Vertical Curve of the section where Toll Plaza is to be established shall be in accordance with the stnadard for the main route where interchange is planned in the case of Barrier gates and in the case of interchange gates it shall be over 1,000 m as a , and shall be over 700 m even in a extraordinary case.

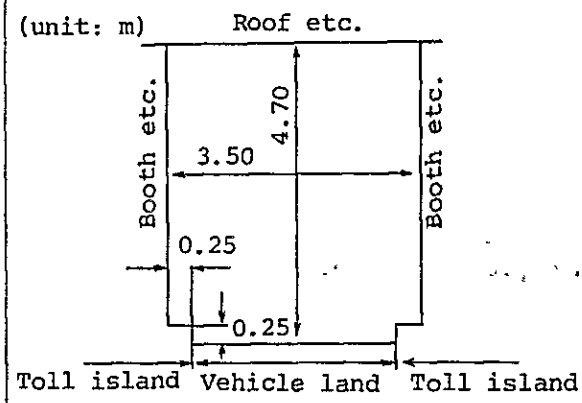
<table>
<tr><th>Item</th><th>Standard</th></tr>
<tr><td>c. Gradient</td><td>The gradient at the gate shall be less than 20% as a rule and shall be less than 3% even in extraordinary cases. The range of the slope shall extend to a minimum distance of 50 m from the Central line of the gate in both directions, and specially in the case of barrier gates where design velocity is over 80 km/hr, this range shall extend to a minimum distance of 100 m in both directions from the centre lines of the Gate.</td></tr>
<tr><td>d. Cross Slope</td><td>The gross slope of the gate shall be 1.5% as the standard shall be 2% as the maximum.</td></tr>
<tr><td>The range of Pavement</td><td>Pavement at the toll gate shall be near and it shall extend to a length L_0 from the centre line of the gate when as the value of L_0 is given in the following table.
<table>
<tr><th></th><th>Interchange gate</th><th>Barrier gate</th></tr>
<tr><td>Type I</td><td>25 m</td><td>50 m</td></tr>
<tr><td>Type II</td><td>20 m</td><td>40 m</td></tr>
</table>


The width of the wearing resistant pavement as a rule, shall be equal to the required width at the centre line of the gate. The connection from both ends of the over resistant pavement to the normal width shall be smoothy either be two circular arcs or by a clothoid; specially taking care on the The runoff ratio S/L is the above figure is desired to be kept below 1/3.

Note: Even in the case of Lane pavement at the gates where vehicle</td></tr>
</table>

Item	Standard
	detectors are not installed either due to temporary service or due to the excess installation according to Standard target year, the design shall be done in such a ways to accomodate the installation of loop coils or in the future.
f. Distance	In the case of Barrier gates, the distance from the centre line of the gate to the strip shall be taken in such a way that vehicles could travel with case, taking into consideration the reversible lanes. In the case of interchange gates the distance from the centre line of gates to the ramp junction shall be over 75 m.
g. Others	Land for future expansion where only earthworks are constructed shall be made a green belt installed with kurb stones aand no permanant structure shall be constructed within this area.
Lane Width at the Gate	Lane width at the gate shall be 3.0 m. However the lane to the utmost left shall be 3.5 m.
Toll Island (Safety belt installed between the lanes at the gate)	As a rule length 22.4 m, width 2.2 m and length 0.15 m. However, in cold areas or when self supported type toll collection machines are installed the width shall be 2.7 m.
Guard post	Guard posts shall be installed on the toll stand in front of the booth to serve as regular posts. Those which cannot be used also as regular posts shall be installed at places where considered specially dangerous.
Gate shed (Roof)	The gate shed shall be ofreinforced concrete, precast concrete of steel framed structure and a roof shall be provided for the toll island even if a toll booth is not installed.

Item	Standard
Underpass or roof passage (Safety passage connecting each island):	One of these types of passages shall be provided, as a rule, for gates with 6 lanes or more. However, for the purpose of crossing over to the toll booths on the opposite lanes, a passage shall be provided when the traffic volume is large or when there is no space for seperation, even if the number of lanes is less than 6.
Wind protection and Snow protection facilities	When the toll gate is installed in a coastal sandy area where wind is extraordinarily strong, or in an area with very severe snowstrom, appropriate wind protection facilities and snow protection facilities shall be taken in to consideration at necessary spots around the gates.
Too collection machines	A footboard, when factors of vehicle axle are contained in the toll system or loop coils, when factors of vehicle axle are not contained in the toll system shall be installed as vehicle detectors in between the lanes at the gate.
Toll both (Boxes installed on the toll island for the purpose of collecting toll charges)	One booth per lane in one direction shall be installed on the toll island, on the right hand side of each traffic lane (one booth-one lane system). The structure shall be of reinforced concrete and the type shall be either (one lane booth) to collect toll charges only from one direction, or (reverse booth) to collect toll charges from both directions. When there is only one lane each in up and down directions, a reverse booth shall be installed as a rule, and in other cases, one lane - booths shall be installed as a rule.
Clearance at the gate (in the case of 3.5 m lanes)	The clearance shall be in accordance with the following figure.

Item	Standard
	

(3) Detailed Standards of the Safety Facilities for Toll Gates

Detailed standards of structures, standards, quality of materials etc., of the safety facilities etc., for toll islands, toll booths, guard posts, etc., shall be refered to the Guide for the Design of Safety Facilities for Toll Gates, specially established for this purpose.

2. Standard for the Determination of the Number of Lanes Required at Toll Gates

The number of lanes required in one direction shall be determined after comparing the value of DHV obtained from the formula DHV - ADT x K x D according to the classification given in the following table, and the value of DHV given in table 2.

Table 2

Classification of road / Item		Type I				Type 3	
		Multi-interval highway		Ordinary highway		Ordinary highway	
Peak hour coefficient (K)		0.12		0.12		0.12	
One side coefficient (D)	Standard	0.60		0.60		0.60	
	Terminal	0.70		0.70		0.70	
	Tourist spots	0.75		0.75		0.75	
Applicable range		Table 4-5(1)		Table 4-5(1)		Table 4-5(2)	
Average number of vehicles waiting per lane		1 vehicle(s)		1 vehicle (s)		1 vehicle(s)	
Service time		En-trance	Exit	Up	Down	Up	Down
		6 sec.	14 sec.	8 sec.	8 sec.	8 sec.	8 sec.

(Note) 1. DVH : Traffic volume in one side during the peak hours.

2. ADT : Daily mean traffic volume.

3. K : Peak hour coefficient

4. D : One side coefficeint

5. Multi-interval highway : A highway where the interchang system is adopted and the toll charges are collected at the exit by issuing entrance tickets at the entrance using a punch cards type or a token plate type toll collection machine.

As a rule, the number of lanes shall be determined for ADT x K x D seperately with respect to the entrance, exit or up, down directions. When it becomes necessary to use the centre lane at the toll gate of either up or down direction at the entrance or exit, as a reversible lane, due to unavoidable circumstances, the total number of lanes shall be determined by adding up the number of exit (up) lanes with respect to ADT x k x D, and the number of entrance (down) lanes with respect to ADT x K x (1-D), and out of which the diference between the number of entrance (down) lanes with respect to ADT x K x D and the number of entrance (down) lanes with respect to ADT x K x (1-D), shall be taken as the number of reversible lanes.

Further, in the case of type 1 highways, even if the number of lanes required per direction is determined as 1, two lanes shall be provided with the left hand side lane (width 3.5 m) as an auxiliary lane. However, when the exit and entrance or up and down toll gates are seperated, booths shall be installed on the island between the two lanes and in this case, the left hand side lane shall be for normal use.

Moreover, the peak hour coefficient for widened or extended highways is determined by using the following fomula based on actual records.

$$\text{Peak hour coefficient} = \text{Seasonal variation ratio} \times \text{Hourly variation ratio}$$

$$= \frac{\text{Monthly maximum traffic volume}}{\text{Monthly mean traffic volume}} \times \frac{\text{Peak hour traffic volume}}{\text{Daily traffic volume}}$$

Reference-4

Design manual for bus stops

1. Planning of the Lay out of Bus Stops

1-1 Investigations

In planning the layout of bus stops, investigations shall be performed for the following items with respect to each prospective site.

(1) Alignment of main route
(2) Distance from the adjoining facilities
(3) Relevant population
(4) Number of trips of the buses
(5) Present status and future plans of the connecting roads and relevant roads.
(6) Tourist area development plans
(7) Structure of the main route and topographical conditions

2. Design of Bus Stops

2-1 Independent Bus Stops

2-1-1 Layout Planning

Planning of the layout of independent bus stops shall be done after thorough consideration is given to the traffic safety, convenience in use and economy.

(1) Alignment of Main Route

The standard minimum values of the alignment for the section of main route where the independent bus stop is to be installed are given in table 2-1. However, it is desired to select a section where the slope is within 2%.

Table 2-1. Standard Minimum Values for the Alignment of Main Route

Design speed of the main route (km/h)		120	100	80	60	50
Radius of horizontal curve (m)		1,000	700	400	200	150
Gradient (%)		2	3	4	5	6
Radius of Vertical curve	Convex	17,000	10,000	4,500	2,000	1,200
	Concave	6,000	4,500	3,000	1,500	1,000

2-1-2. Types and Applications

Independent bus stops are divided into the following two categories.

Type 1. Bus stops separated from the main lanes by an outer separator.

Type 2. Bus separated from the main lanes by road markings or chatter bars.

Application of each type is determined according to the traffic volume of the main route and the usage frequency of the route bus.

Table 2-2. Length of Speed Change Lanes, Secondary Speed Change Lanes and Stationary Lanes

Design speed of the main route			120 Km/h		100 Km/h		80 Km/h		60 Km/h		50 Km/h	
Types			Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2
Length of decralarion lane l_1	Taper length l_1 "		1/20	1/20	1/20	1/20	1/20	1/20	1/20	1/20	1/20	1/20
	(Direct type) l_1 ' (m)		110	110	100	100	90	90	60	60	35	35
Length of secondary deceleration lane		l_2 (m)	50 (40)	40	50 (40)	40	50 (40)	40	40 (30)	30	30	20
Length of bus stop lane		l_3 (m)	30	20	30	20	30	20	20	15	20	15
Length of secondary acceleration lane		l_4 (m)	40 (30)	30	40 (30)	30	40 (30)	30	30 (25)	25	25	20
Length of acceleration lane l_5"(m)	l_5'(m)		150	150	130	130	110	110	70	70	30	30
	Taper length l_5 " (m)	Parallel type,	70	-	60	-	50	-	45	-	40	-
		Direct type	1/30	1/30	1/30	1/30	1/30	1/30	1/20	1/20	1/20	1/20

(Taper length of direct type is given as a ratio).

Table 2-3. Correction Factors

Gradient of main route i (%)		0<i≦2	2<i≦3	3<i≦4	4<i
Factors	Deceleration lanes with descending slope	1.0	1.1	1.2	1.3
	Acceleration lanes with ascending slope	1.0	1.0	1.3	1.4

Table 2-4. Component of Cross Section

Design speed of Main route		120 Km/h		100 Km/h		80 Km/h		60 Km/h		50 Km/h	
Types		Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2
Width of speed change lane	(m)	3.5	3.5	3.5	3.5	3.5	3.5	3.25	3.25	3.25	3.25
Width of Stationary lane	(m)	5.5	3.5	5.5	3.5	5.5	3.5	5.5"	3.25	5.5	3.25
Width of side blet	(m)	0.5	0.5	0.5	0.5	0.5	0.5	0.5"	0.5	0.5	0.5
Width of Shoulder	(m)	1.0	1.0	1.0	1.0	0.75	0.75	0.75	0.75	0.75	0.75
With of outer separator	(m)	2.0 or more	1.0 or more	2.0 or more	1.0 or more	2.0 or more	1.0 or more	2.0" or more	1.0 or more	2.0 or more	1.0 or more
Width of bus stop	(m)	3.0	2.25	3.0	2.25	3.0	3.0	3.0"	2.25	3.0	2.25

When a shed is installed for the bus stand in the case of type 2, the width of the bus stand, where the shed is installed shall be widened to 3.00 m. Moreover, following run off shall be done in the section of secondary speed change lanes.

(a) Run off between the speed change lanes and the stationary lane.

(b) Run off is done so that the width of shoulder becomes 0.25 m at the connection with bus stand.

(c) Run off for the outer separator is done so that the nose becomes 1.2 m in type 1 and 0.5 m in type 2 respectively.

(1) Types of Speed Change Lanes

In type 1, direct type deceleration lanes shall be used. The acceleration lanes shall be either of direct type or parallel type. In type 2, both deceleration and acceleration lanes shall be of direct type.

Table 2-5. Various Dimensions of Platforms

Types		Type 1		Type 2	
Design speed of main route (km/h)		120, 100, 80	60, 50	120, 100, 80	60, 50
Platform	Length	30 m	20 m	20 m	15 m
	Width	3.0 m		2.25 m	
	Height	20 cm		20 cm	
Steps		1.5 m		1.5 m	

The cross slope at the bus stand shall be less than 1.5% and shall be one-way grade.

(2) Sheds, public telephones etc., may be installed at the bus stands as the necessity arises.

2-2. Bus Stops at Interchanges

2-2-1. Layout Planning

The layout of bus stops installed at the interchanges be done at a suitable site after carefully considering the convenience of passengers, traffic safety economy and the social and geographical conditions of the region.

The bus stops, as a rule, shall be places in such a way that the route bus of the expressway doesnot have to pass through the toll gate.

2-2-2. Types and Applications:

The bus stops installed in interchanges can be largely divided in to the following five types.

(a) Bus stops installed in between the exit and entrance gates which separates them.

(b) Bus stops installed between the main route and the toll gates.

(c) Bus stops installed on the main route using the acceleration lane in common with the interchange.

(d) Bus stops either on one side or both sides installed on the main route and separating from the interchange.

(e) Bus stops installed outside the toll gates.

In applying these types, the type most suitable for the interchange shall be selected after carefully considering the advantages, disadvantages, benefits and losses in each type.

(a) Bus stops installed in between the exit and entrance gates which separate them.

Application : This type is suitable for bus stops installed at interchanges which has the functions of a terminal connecting cities and main tourist centres, and where a large number of passengers could be expected. When connecting with large cities

which become the terminal for route buses, it is necessary to install a ramp where one full turn could be made.

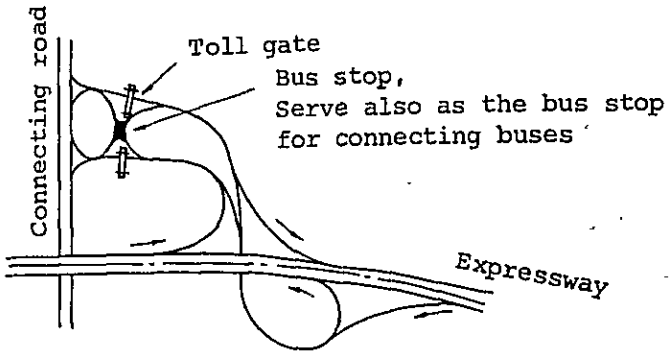


Figure 2-1. Type (a)

(b) Bus stops installed inside toll gates.

Application : This type is suitable for bus stops installed at interchanges where the traffic inflow and outflow through the interchange is small (less than 2,000 vehicles/day in the initial year). Platforms may be installed on the side of the exit. However, considering the passengers crossing the traffic lanes, it is desirable to install them on the side of the entrance.

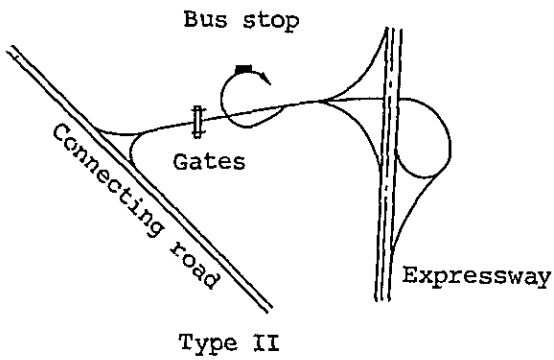


Figure 2-2. Type (b)

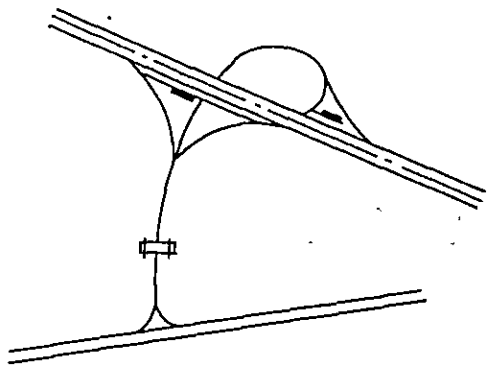


Figure 2-2. Type (c)

(c) Bus stops installed on main route using the acceleration lane in common with the interchange.

Application : This type is used when types (a) and (b) are not applicable, and specially when only a few passengers use the busses.

It is desirable to keep the walking distance from the platform to the connecting road within 300 m. In this case, the distance between the noses (length of secondary speed change lanes, length of parking lane etc.,) shall be greater than the values shown in Fig. 2-4. When it is difficult to use type (a) for bus stops installed in the interchanges connecting large cities which become terminals for route buses, this type may be used. Further, installation of a bus stop on the connecting road for route buses which use this interchange may also be considered.

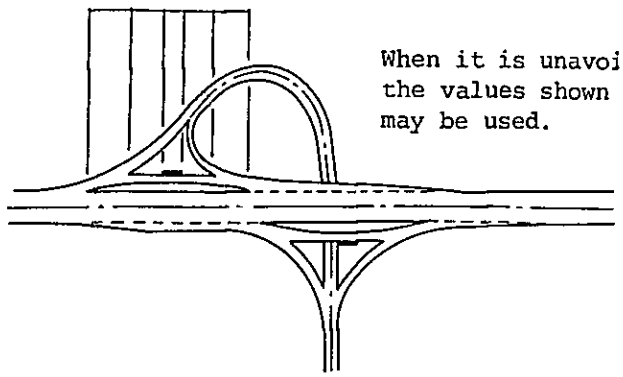


Figure 2-4. Distance between the Noises in Type (c) Bus Stops

(d) Bus stops either on one side or on both sides installed on the main route by seperating the interchange.

Application : When type (c) is used, the walking distance increases, and difficulties arise in the design of interchange. This type becomes advantageous when there are problems such as extremely high cost of construction when other types are adopted. Moreover, since problems of viewing, layout of road signs etc., may arise in this case

when the bus stop is close to the interchange, the distance between their tapered ends shall be kept above 300 m.

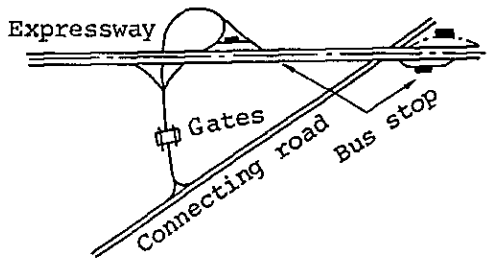


Figure 2-5. Type (d)

(e) Bus stops installed outside the toll gates.

Application : this type is used when types (a), (b), (c) and (d) are found difficult to be adopted due to various reasons. This type shall be avoided as far as possible since it is not desirable due to large time loss of the route buses.

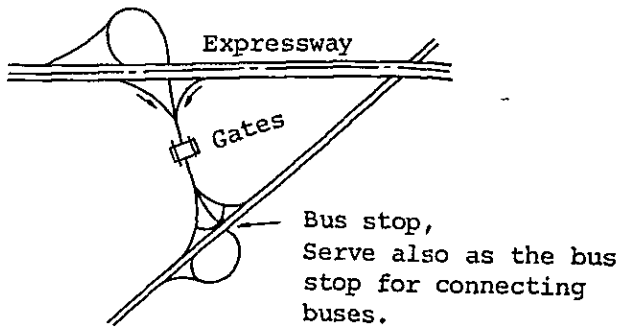


Figure 2-6. Type (e)

2-2-3. Geometric Design

In designing bus stops installed in the interchanges, values larger than those shown in table 2-6 shall be used. Moreover, the application of type 1 or type 2 shall be determined according to the usage frequency of the buses.

Table 2-6. Geometric Design of Juxtaposed Bus Stops

Item \ Types		Type 1	Type 2
Stationary lane	Length	30 m (20 m)	20 m (15 m)
	Width	5.5 m	3.5 m
	Minimum radius of curve	30 m	
	Maximum gradient	However, when it is unavoidable to maintain due to topographical conditions etc., a gradient up to 3% may be used.	
	Cross slope	Asphalt pavement 2.0% Concrete pavement 1.5%	
Bus lane	Minimum radius of curve	15 m	
	Width composition	Same as the width composition of one lane ramp in one direction of the interchange concerned.	

The values shown in ( ) are when the design speed of the main route is 60 km/h, 50 km/h.

With regards to the speed change lanes, type (d) is in accordance with design standards for independant bus stops discussed in chapter 3-1. And in the other types, bus lane shall be smoothly run off to the ramp of the interchange.

Reference-5

Design manual for rest facilities

1. Types and Definitions

1-1. Types and Definitions

Types of rest areas and their definitions are as follows:

1. Parking Area : A rest area including a parking lot, a garden, and as a rule, the lavotories.
2. Service Area : A rest area which includes refuelling facilities. They can be divided in to two types according to the type of business.
   (a) Service Area Types 1 : In addition to the parking lot, garden, lavotories and free rest house, gasoline stations, repair work-shops, restaurants and shops etc., are installed.
   (b) Service Area Type 2 : A service area smaller in scale than type 1, but with a gasoline station as the main business facility.

2. Appropriate Interval

The standard for the layout intervals of rest areas is shown in table 2-1.

Table 2-1. Layout Intervals of Rest Areas (Unit: Km)

	Minimum interval	Standard interval	Maximum interval
Between all rest areas	-	15	25
Between all service areas	30	50	60
Between only type 1 service areas	-	50	100

The above standard is illustrated in figure 2-1 with an example.

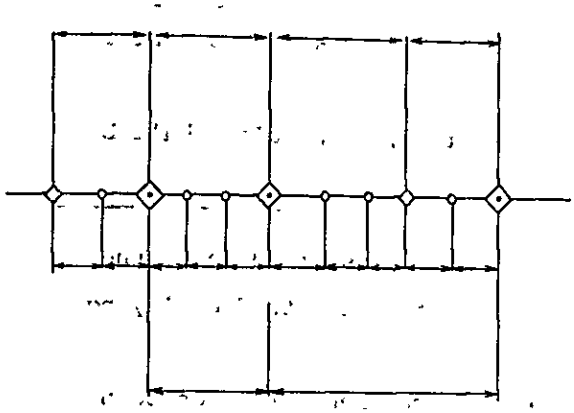


Figure 2-1. Example of Lay out Intervals

Table 2-2. Intervals of Facilities in Foreign Countries

Country	Type of facility	Interval (km)	Remarks
USA	Parking area	16 ∿ 24	In sections with high traffic volume
		32 ∿ 48	In sections with low traffic volume
England	Service area	16 ∿ 27 (average 19)	
Germany	Parking area	5 ∿ 10	
	Service area	50	
France	Parking area A	8 ∿ 10	For short time parking
	Parking area B	25 ∿ 30	Equipped with lavotaries, benches etc.
	Filling station	40 ∿ 50	
	Service area	100	
Holland	Filling station	20 ∿ 30	
Hungary	Parking area	20 ∿ 30	
Recommendation at the 8th Conference of PIARC	Parking area	5	
	Service area	50	

From papers submitted by various countries for the 7th and 8th Conferences of PIARC and "A policy on Safety Rest Areas for the National System of Interstate and Defense Highways" (AASHO), USA.

3. Types and Composition

3-1. Fundamental Type of Service Area

(1) The type of service area, as a rule, shall be separated outbound type.
(2) The location of the gasoline stand, as a rule, shall be centre type.

The types of service areas can be classified in to the following three categories according to the method of laying out the facilities.

(1) The parking lots are located either separately on both sides of the main route, or collectively on one side of the main route or at the centre of both traffic lanes, and classified respectively as (1) separated type and (b) collective type.

(2) According to whether the restaurant is located outside or inside the passing-through road, service areas are classified respectively as (a) outbound type and (b) inbound type.

(3) According to the location of gasoline stand within the service area, it can be classified as (a) entrance type, (b) centre type and (c) exit type.

In reality there can be so many combinations and variations of the above types and their characteristics are discussed in the relevant chapters. In this design guide, based on the experience gained so far, the separated outbound type was adopted as the fundamental type of service area, (figure 3-1).

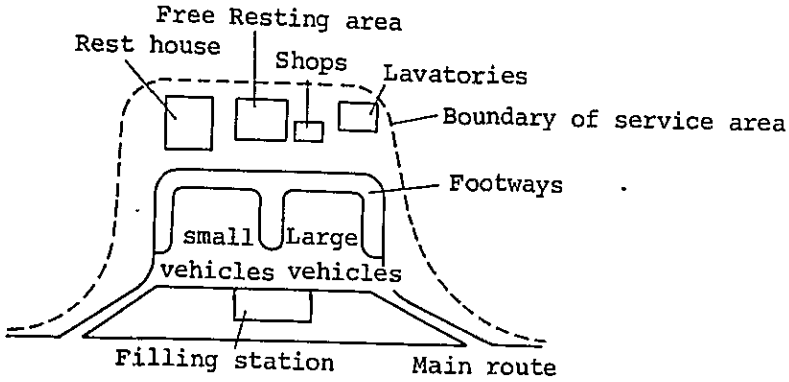


Figure 3-1. Fundamental Type of Service Area

Although some difficulties could be faced with the fundamental type according to the topographical and land conditions, economy of construction and management, and further according to conditions of service, etc., the most suitable type must be selected by making a comparison study of various types. The types of service areas and their features are discussed below.

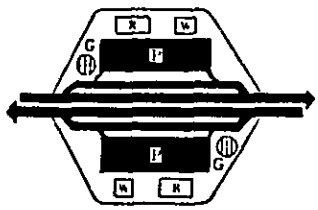
(1) Separated Type (see figure 3-2)

This is the most fundamental type in which the up an down lanes of the main route are seperated and parking lots are planned for each vehicle lane. Since the rest areas are planned, as a rule, separately and independantly for the up and down directions, there is flexibility against the topographical conditions etc., and as a result, the application range is wide. This type can be further classified in to outbound type and inbound type, according to the direction of vision of the users.

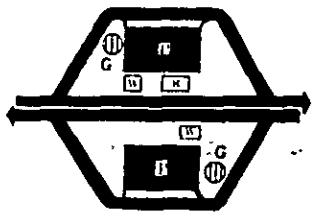
(a) Outbound Type (see figure 3-2 (a))

This is the most general type, and the facilities of main route, through passage, roads within the area, parking lots, refuelling facilities, restaurants, shops, and public lavotories, rest gardens etc., or in other words, the facilities for the vehicles and the facilities for the passengers are arranged in that order from the main route

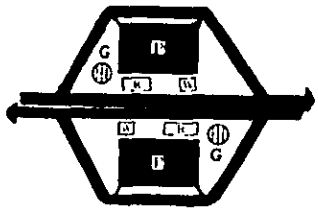
outwards. Therefore, as moving away outwards from the main route, the direction of vision too develops. Therefore, although this type is suitable for a hill from where a good vision of an environment suitable for relaxing is available outside the rest area, it is not suitable for a closed environment, for example, where the sorrounding area is urbanized.



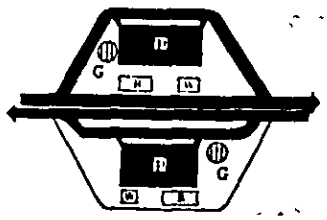
(a) Outbound type



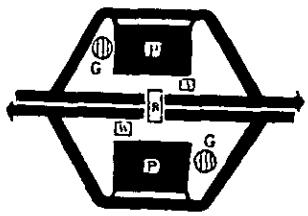
(d) Single sided Collective type



(b) Inbound Type



(e) Outbound and inbound combined type



(c) Overbridge type

P : Parking lots
G : Filling station and Repair workshops
W : Public lavotories (including shops)
R : Restaurants

Figure 3-2. Several Types of Separated Type Service Areas

(b) Inbound Type (see figure 3-2 (b))

In contrast to the outbound type, the facilities are arranged in the reverse order. In other words, the through passage with the highest speed next to that of the main route is arranged along the periphery of the rest area,

and then the roads within area, parking lots, restaurants etc., are arranged in that order towards the main route. In this case, since the roads of the main route and the restaurant become adjoined in the same plane and make it not not suitable for resting, this problem is solved very often by creating a feeling of a three dimensional space by using different elevations. This type is adopted when the outside view is not opened due to urbanization of the sorround area or due to deep cutting etc. In this case it is necessary to make efforts to let the drivers feel relaxed after the tiresome driving and to keep the users of the rest area happy by providing a good perspective above the adjoining facilities such as main route and parking lots by maintaining the line of vision over these facilities.

(c) Overbridge Type (see figure 3-2 (c))

This type may be considered as a variation of the inbound type and is a peculiar type where the facilities such as restaurants etc., are placed facing each other sandwitching the main route. Since the space above main route is used there is an advantage that the whole area could be managed in a small site, and therefore this type is applicable to service areas planned in the suburbs of urbanized areas or in hilly landscapes. This type is most suitable specially when the main route is constructed as a cut section. There is the further advantage in business operation as the two buildings are arranged together. However, the biggest advantage to the users of the expressway is that it serves as a landmark when driving, in addition to that it is extremely effective in giving an accent in the case of flat land scape. Recently, this type has started to appear widely in countries such as England and Italy, with examples also in the United States. Further, this type is under planning and construction in West Germany. However, in Japan, this type could be applied only in the height districts where the minimum limit of the height of buildings

is specified by the regulations of the Building Standards Act, and as a result, this type is not still adopted.

(d) Single Sided Collective Type (see figure 3-2 (d))

This type too could be considered as another variation of the inbound type. Although the facilities like parking lots and public lavotories etc., are located on both sides of the vehicle lanes of the main route, the restaurant, which is the main facility, is located in either of the two sides. This type is suitable when the site available on one of the two sides is too narrow or when it is inevitable to adopt a system to construct the facilities in stages, when management of two restaurants on both sides of the main route is found to be uneconomical due to scarecity of users at the initial stages. In this case, it is inevitable that the location of the restaurant has to be selected adjoining to the main route, in order to reduce the distance the users have to travel when they cross over the main route by the connecting road.

(e) Outbound and Inbound Combined Type (see figure 3-2 (e))

This type is a combination of the above mentioned outbound and inbound types. With regards to the location of the restaurant, arrangement is done on one side according to inbound type. This type is applied specially when there are sceneries, which attract the eys of users of the service area, are on one side, when there are restrictions to topographical conditions etc., or when the view is concentrated in one direction.

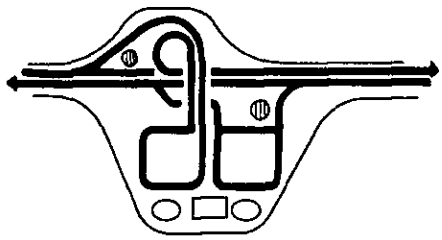
(2) Collective Type

(a) Single-sided Collective System (see figure 3-3 (a))

In this system, parking lots are provided on one side of the main route for both up and down lanes. Therefore, all the other facilties are also collectively arranged on one side. Sometimes, only the gasoline stand is left on the opposite side for the vehicles concerned. This type is applicable when it is possible to collectively arrange

facilities considering the conditions of the site, specially when there are beautiful scenes or spots of interest on one side of the main route which attract the eyes of the users. Vehicles from the opposite side, where facilities are not available, are introduced to the side, where rest area is provided, after crossing the main route by a graded crossing through an out flow ramp. The layout of facilities for the passengers, such as restaurants, is of course, arranged in the outbound type. In this case, although the parking lots for up and down lanes are very often arranged close to one another, it is necessary to seperate them in the case of toll roads. Although, the service areas at Fujikawa, Hamanako etc., were planned based on the conventional concept that it is not necessarily required to seperate the facilities used by the passengers, several problems were faced in the management of toll road, and therefore, the facilities used by passengers will also be seperated completely according to up and down lanes.

(a) Single-sided Collective System



(b) Centre Collective System

P : Parking lots

G : Filling station and Repair shops

W : Public lavotories (including shops)

R : Restaurants

Figure 3-3. Several Types of Collective Type Service Areas

(b) Centre Collective System (see figure 3-3.(b))

In this system the facilities are collected in between the up and down vehicle lanes. Although this type is very often seen on the regional expressways in the United States, where a wide median could be maintained, it is not an exageration to say that it is almost impossible to apply this system in Japan where land is scarce. Further, since the entry to and exit from the main route is done using the innermost lanes for high speed vehicles, safety becomes a problem.

3-2. Fundamental Type of Parking area

The type of Parking area, as a rule, should be seperated out bound type; It is desired to have the lay out of facilities as shown in figure 3-4.

(1) For considerably small scale (2) For considerably large scale

Figure 3-4. Fundamental Types of Parking Area

4. Scale

4-1. Scale of the whole area

1. The scale of the rest area as a whole is determined intergrating the scale of each constituent elements, and these constituent elements are determined with the number of parking lots as the basis.
2. As a standard, the scale of rest area should meet traffic volume after 10 years of service and construction in stages is considered according to the constituent elements.

4-2. Scale of Parking Lot

1. The number of parking places is determined from the traffic volume of main route and the utility ratio of facilities.
2. The number of parking places are determined as a rule, according to the type of vehicles (motor cars, Large buses, heavy trucks) and classified as parking places for motor cars and those for heavy vehicles.

The number of parking places becomes the basis for the determination of the scale of other facilities, and as a result it is a factor which affects the scale of the whole rest area The nu,be of parking places is determined from the traffic volume on the main route and the coefficient of utilization of the facilitaties, using the following formula.

$$\text{Number of parking places (one side)} = \text{Design traffic volume} \times \text{Drop in factor} \times \frac{\text{Rush factor}}{\text{Turning factor}}$$

Design traffic volume (one side) : The traffic volume at the 10% th position (or about the 35th position) from the highest for the 365 days of the tenth year after opening is considered.

= (Holiday service coefficent) x (projected daily traffic volume per one side ten years after opening)

Holiday service coefficient = 1.30 : standard
1.40 : when close to large cities and located in a scenic spot.

Drop in factor : Number of vehicles drop in (vehicles/day)/ Traffic volume on main route (vehicles/day)

Rush factor : Number of vehicles drop in during rush hours (vehicles/hour)/Number of vehicles drop in (vehicles/day)

Turning factor : One hour/A verage parking duration (hours)

In the past, the averate daily traffic volume (ADT), ten years after opening of the highway was taken, as it is, as the design traffic volume, and traffic that exceed the AD^T was covered by considering an increase (of about 1.7 times) in the tenth year after opening. However theoritically, ten years after the opening, it becomes impossible to serve a traffic volume greater than AD^T (in case of Tomei Expressway there are about 100 to 150 days per year, for which the traffic volume exceed this).

Therefore the coefficients are considered so as to maintain services for 330 days or 90% of the 365 days of the year. The holiday service coefficient may be taken as 1.30 in general, and though it is desired to estimate this factor for case when the rest area is situated in a scenic spot and close to large cities where concentration of traffic can be expected, a value of 1.40 may be used in this case.

These factors of, drop in coefficient, rush factor, turning factor etc., vary largely with the type of rest area, the location of rest area and also the type of vehicles.

Therefore, when it is possible to estimate the composition of vehicle types in the traffic, the required number of parking places can be calculated using drop in factor, rush factor, turning factor etc., seperately for each vehicle type, and added together classifying them into small vehicles and large vehicles.

Moreover, when the composition of vehicle types is not clearly known or when the scale of rest area is small, the number of parking places may be calculated based on the total traffic volume and this total number may be distributed between large vehicles and small vehicles in the ratio of 1:3.

The required number of parking places is determined using the drop in factor, rush factor and the average parking duration shown in table 4-1. The values shown in this table are determined empirically based on the results of survey done on rest areas in Meishin Expressway and Tomei Expressway.

Table 4-1. Drop in Factor, Rush Factor, and Average Parking Time According to Vehicle Type

Type of rest area			Drop in factor	Rush factor	Average parking time (min)
Service area	Strong in tourism aspects	Small size Vehicles	0.20	0.10	35
		Large buses	0.30	0.10	20
		Large commercial trucks	0.10	0.10	20
	Ordinary	Small size Vehicles	0.15	0.10	15
		Large buses	0.20	0.10	15
		Large commercial trucks	0.10	0.10	20
Parking area		All vehicle types	0.75	0.10	15

Table 4-2. Standard Scale of the Number of Parking Places

Type of rest area	Number of parking places (one side)		
	Maximum	Standard	Minimum
Service area Type 1	250 (Small size vehicles 200; Large size vehicles 50)	100 ~ 200 (Small size vehicles 70; Large size vehicles 30) / (Small size vehicles 150; Large size vehicles 50)	70 (Small size vehicles 50; Large size vehicles 20)
Service area Type 2	100 (Small size vehicles 70; Large size vehicles 30)	50 ~ 80 (Small size vehicles 35; Large size vehicles 15) / (Small size vehicles 55; Large size vehicles 25)	30 (Small size vehicles 20; Large size vehicles 10)
Parking area	60 (Small size vehicles 40; Large size vehicles 20)	25 ~ 40 (Small size vehicles 20; Large size vehicles 5) / (Small size vehicles 30; Large size vehicles 10)	15 (Small size vehicles 10; Large size vehicles 5)

Moreover, the figures shown in table 4-2 are considered as the standard scale of the number of parking places in rest areas.

5. Design of Ramps

5-1. Fundamental Rules in the Design of Ramps

> In proceeding with the design of ramps and speed change lanes, design shall be done so as to assure the safety moving of vehicles accomodating the changes in speed of vehicles on the ramps and speed change lanes.

In order to accomplish a natural and perfect design to accomodate the vehicle movement within the rest area full of variation, it is necessary to seriously consider the following points.

1. Geometric design of the rest area should guarantee the safe movement of vehicles, and guide the vehicles from the main route to the parking area and from parking area to the main route quite naturally. Therefore, the alignment should be designed so as to avoid the necessity for the drivers to make two or more decisions at the same time by suddenly changing the speed and controlling the steering operation. As the vehicle move from the ramp terminal to the ramp and then to the parking area, the vehicle speed varies from high speed to low speed and ultimately to a stand still position, and since the range of variation of speed is very large in doing so, it is necessary to design the alignment so that the change in speed can be done smoothly.
2. Between the ramp terminal and the passing out lane, it is necessary to establish an alignment without any obstruction to the vision, so that the location of parking lots and other facilities could be easily recognized. Care must be taken not to do a design which will create a condition where the whole rest area become remarkably unrecognizable due to a particular facility set up at least on the above section, or a situation where the leading to various facilities by means of road signs cannot be done in time.
3. Although the speed of vehicles near the parking lots is low, sufficient care should be taken in the method of guiding people as turning and reversing of vehicles is done for parking, while

people and vehicles cross each other in this area.

4. Serious considerations shall be given also on the maintenance and management. The structure should not allow the ordinary vehicles easily enter illeagally in to the area from the ordinary roads and service roads. Special care should be taken on drainage and large areas where drainage gradient could not be achieved must not be allowed.

5. The design shall be based on standards given in this chapter. However, for items which are not specified here, reference shall be made to The Standards for Interchanges in the case of designing service areas and to The Standards for Bus stops in the case of designing parking areas.

5-2. Alignment of Main Route

(1) The alignment of main route near the ramp terminal of service areas shall satisfy the standard values shown in table 5-1, according to the design speed of the main route.

Table 5-1. Alignment of Main Route Near the Ramp Terminal of Service Areas

Alignment factors \ Design speed of main route (km/h)		120	100	80	60	50
Radius of horizontal curve (m)	Standard	2,000	1,500	1,000	500	300
	Exceptions	1,500	1,000	700	400	200
Minimum radius of vertical curve, Convex (m)	Standard	45,000	25,000	12,000	6,000	4,000
	Exceptions	23,000	15,000	6,000	3,000	2,000
Minimum radius of vertical curve, Concave (m)	Standard	16,000	12,000	8,000	4,000	3,000
	Exceptions	12,000	8,000	4,000	2,000	1,500
Maximum gradient (%)	Standard	2	2	3	5	6
	Exceptions	2	3	4	6	7

However, when it is difficult to satisfy the standards of the general alignment elements due to unavoidable reasons of topographical, land or economical conditions etc., or due to special technical reasons, exceptions may be allowed after the safety aspects are specially considered.

(2) The alignment of main route near the ramp terminal of parking areas shall satisfy the standard values shown in table 5-2 according to the design speed of the main route.

Table 5-2. Alingment of Main Route Near the Ramp Terminal of Parking Areas

Alignment factors \ Design speed of main route (km/h)		120	100	80	60	50
Radius of horizontal curve (m)	Standard	1,500	1,000	700	400	250
	Exceptions	1,200	850	600	400	200
Minimum radius of vertical curve, Convex (m)	Standard	45,000	25,000	12,000	6,000	4,000
	Exceptions	23,000	15,000	6,000	3,000	2,000
Minimum radius of vertical curve, Concave (m)	Standard	16,000	12,000	8,000	4,000	3,000
	Exceptions	12,000	8,000	4,000	2,000	1,500
Maximum gradient (%)	Standard	2	3	4	5	6
	Exceptions	3	4	5	6	7

However, when it is difficult to satisfy the standards of the general slignment elements due to unavoidable reasons of topographical, land or economical conditions etc., or due to special technical reasons, exceptions may be allowed after the safety aspects are specially considered.

For the alignment of main route near the ramp terminal of service areas, same standard values as for the interchanges are used. In the case of alignment of main road near parking areas, allowance is made to use much smaller values than those used in the case of service areas. This is because, parking areas do not require wider area as in the case of service areas and therefore they are very often located in steep topography and the adoption of strict standards is not desirable on the other hand, as it becomes a barrier to the effective use of suitable spots and beautiful sceneries etc.

5-3. Design Speed of Ramp

(1) The design speed of ramps, as a rule, is taken as 40 km/h.

(2) However, when it is necessary to reduce the design speed of ramps due to unavoidable reasons when there are limitations to the topographical conditions etc., as an exceptional case, the designspeeds shown in table 5-3 may be used according to the design speed of the main route.

Table 5-3. Design Speed of Ramps in Exceptional Cases

Design speed of main route (km/h)	Service areas		Parking area
	Service area of type 1	Service area Type 2	
120	40 km/h	40 km/h	40 km/h
100	40	35	35
80	35	30	30
60	30	30	30
50	30	30	30

In the design of rest areas, the design speed of 40 km/h shall be applicable for the range between the diverging nose of decelerating lane and the diverging nose of rest area and, between the merging nose of rest area and the merging nose of accelerating lane.

6. Design of Parking Areas

6-1. Concept of the Design of Parking Areas

> The lay out of parking places and the roads shall be determined making it possible for the design vehicles to park and move away without any difficulty while using the land available most effectively.

Parking area can be divided in to the parking places and the roads according to their functions. Parking place is a place for parking and the alighting and boarding of passengers, while the roads guide the vehicles from the ramp to the passing through roads and to the parking places and provide space for the vehicles to make the movements of turning and reversing etc.

The items which should be considered in the design of parking areas are;

(1) When the parking lots are set up scattered within the area, they will not be utilized evenly bringing down the efficiency. Therefore scattering of small parking lots should be avoided by bringing all parking lots together to one place.

(2) It is desirable that parking lots for small vehicles and those for large vehicles are seperated completely. From the point of view of visibility, it is desirable to have the parking lots for small vehicles arranged closer to the entry from main route, while the parking lots for large vehicles are arranged behind them. However, in the case of small scale rest areas, considerably strict seperation of the parking lots by traffic islands may become a hindrance to smooth parking, and sometimes it is much advantageous to use parking lots common to the small vehicles and large vehicles. Therefore, it is desirable to provide traffic islands within the minimum limits of requirement.

(3) Considering the utilization condition, the parking lots for small vehicles should be planned at a location that provides convenience in using the rest house.

6-2. Slope of Parking lots

The slope within parking lots shall be less than 2% in the longitudinal direction and less than 3% in the transverse direction with due consideration given to drainage.

The slope within the parking area shall be kept within the specified values after considering the lay out of parking places so that the parked vehicle does not move. Further, Design shall be done giving sufficient consideration to the drainage design within the parking area.

6-3. Lay out of parking places and width of roads

(1) As a rule, the parking procedure for small vehicles is either by perpendicular forward parking and backward departure or by perpendicular backward parking and forward departure, while the parking procedure for large vehicles is by forward parking and forward departure at an angle of 60° to the right side.
However, when it is difficult to satisfy the above due to unavoidable reasons of prevailing site conditions etc., other methods discussed here may be applied.

(2) The width of roads for the above mentioned standard lay out shall be as shown in figure 6-1.

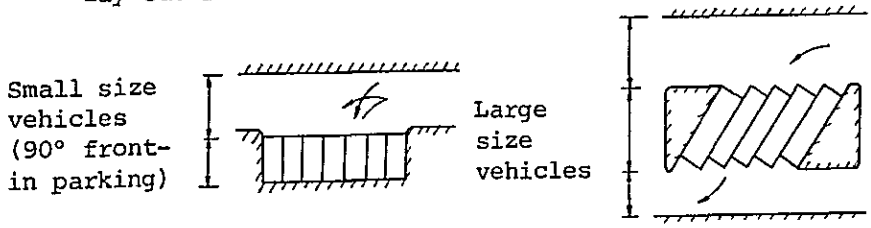


Figure 6-1. Standard Layout of Parking Places

There are two methods of parking namely, forward parking (front-in) and backward parking (back-in). In front-in parking,

the running vehicle gets in to the parking place as it is and comes to stop, and in the case of small vehicles, as a rule, the vehilce leaves after it is reversed on to the road. Therefore, although parking is easy, considerable time is needed in the departure and on roads where visibility is not very good, there is a certain amount of danger. In the back-in parking, the running vehicle first comes to a stop on the raod. The it is reversed to the parking position gradually while operating the steering wheel, to be parked with its front facing the road. In leaving the parking place, the vehicle can be moved as it is. Therefore, although considerable time is taken for parking, leaving is easy. In this case, width of road could be managed slightly smaller than in the front-in parking. In the case of large vehicles, reversing is avoided in both parking and leaving, and as a rule, forward parking- forward leaving system is adopted. Moreover, parking method of large vehicles adopts rightside because, entrances and exits of buses through which a large number of passengers get in and off are generally on the left hand side of the vehicle and consideration is given so that this this part of the vehicle does not get sandwitched by the adjoining vehicles.

7. Appurtenant Facilities

In order to make the various facilities build in the rest area display their functions sufficiently, following appurtenant facilities and their survey becomes necessary.

(1) Water supply
(2) Drainage facilities
(3) Elevated water towers
(4) Storehouse
(5) Fuel storage facilities
(6) Solid wasted incinerator
(7) Power substation

Refecence-6

Manual for installation of variable message sign.

1. Comparison of Message Signs

Location of Installation of the variable Message Signs and the Method of Installation.

Table 3-1. Comparison Chart of Variable Message Sings

System / Conditions	(Jimaku) Florescent projecting System	(Toko) Incandescent projecting	Electric Sign System
Structure	° In this system a title made by printing letters and other symbols on a film is projected using built in florescent lamps. The changing of items is done by winding the film manually or by a motor.	° In this system, the principle is somewhat similar to that of the (Jimaku) type. Background except for the letters and symbols are printed on a film in black and the transparent parts of letters and symbols are projected on to the sign board using a built in incandescent electric light the changing of itemsis done similarly as in (Jimaku) Type.	° In this system, the letters and symbols are constructed of a larger number of small incandescent lamps, and the notice is given by illuminating these lamps. Changing of items is done by varying the combination of illuminated lamps.
Visibility	° Clearness varies widely during day time and night time. Specially during day time visibility is very poor due to back light of the sun. Colours can be used in the sign design.	° Functions equally well as the electric sign system.	° Clearness during day time and night time does not vary so much, and superior in visibility. Although slightly difficult to see at close distances as they are point syllables, It has a very strong power in calling attention.
Applicability	° There is limit to the sign patterns. Corrections and additions are difficult. Considerably large scale signs are difficult to make.	° Has the same features as the the (Jimaku) system.	° There is almost no limit to the sign patterns. ° Corrections and additions can be done comparatively easily. ° Large scale signs are also easy.

Maintenance	° Though little maintenance required mechanically, maintenance is simple electrically.	° Has the same features as the (Jimaku) system.	° Though mechanically simple, laborious electrically.
Economy (Manufacturing cost)	° Somewhat cheap	° Moderate	° Somewhat cheap

1-1. Variable Message Signs on Main Route

(1) Variable Message Signs at the Exit of Interchanges.

> On roads of the Expressway Standards, as a rule, F type variable message signs shall be installed at a point about 200 m before the taper end of speed change lanes of the interchanges.

What it is necessary to close a certain section of the road for traffic due to accidents etc., a control system is adopted by which the vehicles already on the main road are immediately informed of the situation and made to go out through the interchange concerned. For this purpose, a variable message sign is installed at the exit of the interchange.

Considering the location of informatory sign, the variable message sign is installed as a rule 200 m before the end of the taper of speed change lanes of the interchange.

(2) Variable Message Signs at Intermediate Points

> On roads of the Expressway Standards, variable message signs shall be installed at intermediate points as may be required, so as to provide the road users information on the condition of road ahead, weather condition, traffic condition etc.,
>
> Installation, as a rule shall be of the F type, however, for main routes with routes with six lanes, overhead type shall be used as a rule.

The variable message signs are installed on expressways in order to provide the drivers on the expressway with information of condition of the road ahead, weather etc., requesting them to drive accordingly, and to control traffic accidents and to guide exits and detours. In deciding where to install these signs, a location before the interchange which provides connections to a major highway necessary for the detouring of traffic is selected. It is deciding where to install these signs, a location before the interchange which provides connections to

a major highway necessary for the detouring of traffic is selected. It is desired that the location thus selected is about 2.5 km before the interchange.

Moreover, since the location of the installation of these signs can be moved within a considerable range, the use of overbridges shall be positively considered when such overbridges exist close by.

(3) Variable Message Signs for Meteorological Information

In areas, where there is a danger of the occurence of road weather conditions which are obstruction to the traffic flow, variable message signs shall be installed in order to maintain the traffic safety.

Installation shall be either F type or Road Side type.

(4) Variable Message Signs at the Entrance of Tunnels.

Variable message signs shall be installed before the entrace to tunnels. However, when the length of the tunnel is less than 150 m, when both horizontal alignment and vertical alignment are good and when the obstructions within the tunnel could be easily recognized, the installation of variable message signs may be omitted.

The installation, as a rule, shall be of the F type.

(5) Variable Message Signs at the Entrance of Service Areas

Variable message signs may be installed at the entrance of service areas with a high utilization ratio during peak hours, to inform when the parking area is full.

Installation shall be done in parallel with the informatory sign for the service area installed at the begining point of taper.

1-2. Variable Message Signs on Ordinary Connecting Roads

Installation of variable message signs on ordinary connecting roads shall be done after deciding the location with careful consideration given to the toll collecting system of the road concerned and the raod environment etc., of the ordinary roads.

The purpose of installing variable message signas on ordinary connecting roads is to provide the drivers who are about to use the road now onwards, with prior information of road condition, traffic condition and weather condition on the main route and to let the users themselves decide on the possibilities of using the highway or changing route etc., Since they are installed with the above purpose, location of installation shall be selected after specially considering the road environment, and further, it is necessary to increase the visibility by adopting F type structures etc.

1-3. Variable Message Signs at the Entrance Booths

- In installing variable message signs in front of the entrance booths of toll gates, one variable message sign shall be installed for every two entrance booths as a rule.

The variable message signs installed in front of the entrance booths are for the purpose of providing prior information of road condition, traffic condition etc., on the main route to the drivers who are about to use the main route.

Reference-7

Manual for installation of delineator

1. Definition

Delineators and safety posts are facilities installed along the vehicle lanes to guide the vision of the drivers by indicating the edges and the alignment of road during day and night.

Although necessary sight distance required for safe movement of vehicles is considered in the roads, delineators are installed so that, the driver can grasp easily the condition of road in making the travelling comfortable and preventing traffic accidents. They are effective specially when the visibility is poor during night, during snow fall or in mist.

2. The Range of Installation

1. On the main route, the delineators shall be installed continuously on both left and right sides of the road.
2. On the rampways of interchanges, service areas and parking areas, delineators shall be installed continuously on either left or right side of the road, excluding the toll gate area and parking lots.

(1) In addition to the delineators installed on both left and right hand sides of the main route, delineators shall be installed also on the median when such median exists.

3. Types

The types of delineators and where they should be installed are given in the following table.

Location of installation	Colour	Number	Remarks
Left hand side shoulder of main route	White	1	
Median of main route	Orange	1	
Rampways of Interchanges and service areas etc.	Orange	1	
Speed change lanes	Orange	2	Longitudinal arrangement
Marging nose and the end of acceleration lanes	Orange	3	Longitudinal arrangement
Diverging noses and beginning of deceleration lanes	Orange	3	Transverse arrangement

Since the delineators are installed continuously, as far as possible, they should of the same colour except for special sections. When the colour changes or when that is clearly understood, in other words, in interchanges, service areas etc., or where the number of lanes vary, colour was used.

The standard reflectors shall be circular in shape and shall be over 70 mm in diameter. Moreover, on roads with high design speed, it is desirable to use reflectors with wider reflecting area.

4. Location of Installation

As the standard installation of reflectors, reflectors shall be installed on the left hand side of the road at a height of 120 cm from the pavement surface of the shoulder and 50 cm away from the line of clearence.

A height of 120 cm was taken to match with the drivers eye level. A clearence of 50 cm from the line of clearence was adopted so as to prevent the danger of vehicles touching the delineators and to prevent vehicles from getting on to the right hand side of the lane more than necessary to avoid the delineators if they are placed too close to the traffic, and further to avoid damages to the delineators by the overhanging parts of the vehicles. However, under unavoidable circumstances, such as on bridges etc., the delineators may be installed on the guard rails, hand rails etc., Further, since the left hand side shoulder of the expressways is considered too wide, delineators may be installed using safety fences such as guard rails, when the width of shoulder exceeds 2.5 m.

In installing the delineators on the median side of the main route and rampways of interchanges etc., they shall be directly installed on the fron face of the guard rails, when guard rails are available, and if guard rails are not available, they shall be installed at a distance of 60 cm away from the line of side belt and at a height of 60 cm from the road surface as the standard height. However, when the medians are of construction, it is better to install them at a height greater than the standard height considering from the point of view of maintenance and management etc.

In tunnels, the height and intervals of installation need not to be restricted to the standard values, but shall be installed at appropriate positions, sufficiently considering the relationship with the installations such as linning plates of the tunnel and other affiliate facilities.

5. Angle of Installation

Delineators shall be installed so that their reflecting surfaces are perpendicular to the direction of traffic flow.

When the effect of delineators is found to be not sufficient due to weak reflection when they are installed perpendicular to

the road, as in sections where the radius of curvature is small, the angle shall be altered based on running tests. Therefore, when installing the delineators, they shall be first fixed so that the reflecting surfaces are perpendicular to the road direction and then shall be adjusted to the correct angle after conducting running tests in the night.

6. Intervals of Installation

The delineators shall be installed at the standard intervals given in the following table according to the corresponding radius of curvature of the road. However, the maximum interval shall be 50 m.

Table 6-1. Standard Intervals of Installation

Radius of curvature of the road R (m)	Interval of Delineators S (m)
∿ 50	5
51 ∿ 80	7.5
81 ∿ 125	10
126 ∿ 180	12.5
181 ∿ 245	15
246 ∿ 320	17.5
321 ∿ 405	20
406 ∿ 500	22.5
501 ∿ 650	25
651 ∿ 900	30
901 ∿ 1,200	35
1,201 ∿ 1,550	40
1,551 ∿ 1,950	45
1,951 ∿	50

(1) These standard intervals are determined based on examples abroad, according to the formula; $s=1.1\ R-15$.

(2) the maximum intervals of delineators in rampways of interchanges etc., speed change lanes and tunnels etc., shall be 25 m.

Appendix

Appendix

List of materials collected.

I. Plans

I-1. Proyek Jalan Jakarta- Bogor- Ciawi. (1/25,000)
(Plans of Jakarta- Bogor- Ciawi Highway Project (1/25,000)).

I-2. Jagorawi Highway General Map (1/300,000)

I-3. Pata Jaringan Jalan Kota. DKI Jakarta. (1/100,000)
(Jakarta Special City Road Map)

I-4. Original Plan of Jagorawi Expressway
(Back cover of "Introducing Toll road in Indonesia" mentioned later)

II. General Out Line

II-1. Introducing Toll road in Indonesia
Background, what is a toll road, conditions of Toll road, advantages of Toll road, Proposed location of Toll road, Jakarta-West Java Toll road network, Toll rates.

II-2. Jalan Raya Jagorawi (in Indonesian Language)
Jagorawi Main Road
Background of the construction of Jagorawi Main road.
Background of the adoption of Toll road system.
Progress Outline of Jagorawi Management of Jagorawi Toll road.

II-3. Laporan Perkembangan Balan Ke Satu Maret/April 1978 (in Indonesian Language). (Development report for first month March/April 1978).

II-4. Development Report First Month March/April 1978.
(English Translation of II-3).

II-5. Pengembangan Jaringan Jalan-Tol Rencana Jangka Panjang (1978 - 1985) (In Indonesian Language)
(Schedule for the Long Term Toll Road Network Development Plan)

II-6. Jagorawi Highway as Tollway (in English)
(Study report for the conversion of Jagorawi Highway as a Tollway)

III. On Legislative Matters

III-1. Out line of Indonesian Highway Corporation Law/Regulations and Other Highway Related Law and Ordinances May, 1978.

A.I. Government Regulation. No. 4 of 1978.

A.II. Presidentail Decree No. 3 of 1978.

A.III. Establishment of the P.T. Jasa Marga on March 1, 1978 with Notarial Act No. 1

B.I. Law No. 3 1965

B.II. Government Regulation on Road Traffic

B.III. Managing Board of P.T. Jasa Marga's Regulation

III-2. Perataran Pemerintah Republik Indonesia Nomor 4 Tahun 1978. (Indonesian Language Original of III-1, A-I)

III-3. Keputusan Presiden Republik Indonesia Nomor 3 Tahun 1978 (Indonesian Language Original of III-1, A-II)

III-4. Pendirian Perusahaan Perseroan (PERSERO) P.T. Jasa Marga pada tanggal 1 Maret 1978 dengan Akte Notaris Nomor 1. (Indonesian Language original of III-1 A III)

IV. On Organization

IV-1. Organisation Chart P.T. Jasa Marga

IV-2. Dafer Nama-Nama Pejabat & Karayawan "P.T. Jasa Marga" (Member List of P.T. Jasa Marga)

V. Finance

V-1. Anggaran Kas (Cash Flow 1978) Types of cash (contents- II-2, 3, 4)

VI. Toll Collection

VI-1. Organization Structure of Tollsection

VI-2. Principal Duties

VI-3. Toll Collection System

VI-4. Toll Collector & Supervisor Work Statement

VI-5. Work Schedule

VI-6. Schematic Diagram of Toll Section of Daily Work

VI-7. Reporting Form

VI-8. Traffic Tickets and Pamphlets for the users

VII. Maintenance and Repairs

VII-1. Reporting forms for maintenance works

VII-2. Machines Manual

VII-3. Working Diagrams.

, Operators of Electric power generators

Electric Engineers.

VII-4 Induk Patroli Jalan Raya "Jagorawi"

(Patrol Diagram)

VIII. Traffic Control

VIII-1. Traffic Volume Charts for March, April, May 1978.

VIII-2. Diagram of Communication System

Conceptual diagram for the attitude taken during occurrence of accidents.

IX. Others

Paper cutting on Opening Ceremony.