**VOLUME 6 ROAD GEOMETRY**
**SECTION 3 HIGHWAY FEATURES**

## PART 6

## TA 98/08

# THE LAYOUT OF TOLL PLAZAS


### SUMMARY

This Advice Note gives guidance on the layout of toll plazas and the factors that need considering during their design. It can be used for the design of new toll plazas and for modifying existing ones.


### INSTRUCTIONS FOR USE

1. Remove Contents pages from Volume 6 and insert new Contents pages dated February 2008.

2. Insert the new Advice Note TA 98/08 into Volume 6, Section 3.

3. Please archive this sheet as appropriate.

Note: A quarterly index with a full set of Volume Contents Pages is available separately from The Stationery Office Ltd.

DESIGN MANUAL FOR ROADS AND BRIDGES

TA 98/08
Volume 6, Section 3,
Part 6

THE HIGHWAYS AGENCY


TRANSPORT SCOTLAND


WELSH ASSEMBLY GOVERNMENT
LLYWODRAETH CYNULLIAD CYMRU


THE DEPARTMENT FOR REGIONAL DEVELOPMENT
NORTHERN IRELAND

# The Layout of Toll Plazas

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## REGISTRATION OF AMENDMENTS

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**VOLUME 6 ROAD GEOMETRY**
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# THE LAYOUT OF TOLL PLAZAS

**Contents**

Chapter

# 1. INTRODUCTION

**Scope**

1.1 This document gives guidance on the layout of toll plazas and the factors that need considering during their design. It is based on experience gained by operators of major existing toll facilities in the UK and also draws on experience of European and American operators.

1.2 This document is not intended to be a detailed design guide for the construction of toll plaza pavements or structures.

1.3 In projects where free-flow express lanes are to be incorporated there will be a requirement to separate the express traffic from the rest of the flow. The highway design requirements for this and the subsequent merge will be similar to the requirements of **TD 22 (DMRB 6.2.1)**. This guidance document relates to the traffic approaching the toll plaza.

1.4 An explanation of the terms used in this document is included in Chapter 4 'Toll Plaza Glossary of Terms'.

**Implementation**

1.5 This Advice Note should be used forthwith on all schemes for the construction, improvement and maintenance of toll plazas on trunk roads including motorways, currently being prepared, provided that, in the opinion of the Overseeing Organisation, this would not result in significant additional expense or delay progress. Design Organisations should confirm its application to particular schemes with the Overseeing Organisation. Where this is confirmed, the contract documents for the Works should be written to reference this Advice Note.

**Background**

1.6 There are many elements in a toll plaza facility that involve a number of interrelated design decisions. These elements need to be integrated with each other through balanced design to satisfy the numerous requirements of a toll plaza.

1.7 A holistic approach is required throughout the design process. The designer should ensure that the blend of the various elements within the available space balances considerations of safety, environmental impact, cost, buildability, operation and maintenance. The decision making process should include consideration of the often complex interaction between these factors and other design constraints. Proper consideration of the basic design requirements will help ensure that both the new facility and the highway fit harmoniously into their surroundings.

**Persons with Disabilities**

1.8 Legislation prohibits discrimination on the basis of disability. The designer should take into account the implications of such legislation when considering the design and operation of toll plaza features. The toll operator should therefore provide means for receiving the toll fee from all users at any time.

1.9 As part of the development of the toll plaza operations policy, the designer, in conjunction with the operator, should consult with disabled individuals and representative groups to identify and understand their requirements.

1.10 If necessary, a designated facility should be incorporated into the toll plaza which is designed specifically to meet the needs of disabled users based upon the information collected through the consultation exercise.

1.11 Designers should also seek to ensure that the working environment at the toll plaza is accessible to all employed persons, including those with disabilities.

1.12 Further advice on designing to meet the needs of persons with disabilities is found in guidance notes 'Reducing Mobility Handicaps', published by the Institution of Highways and Transportation, and 'Inclusive Mobility', published by the Department for Transport's Mobility and Inclusion Unit.

**Environmental Design**

1.13 Environmental design is an integral aspect of the design of any road and toll facility. Many features such as landscaping, air quality and noise can have a radical effect on the environment and its protected habitats and species. The 'Good Roads Guide' **HA 55, HA 63**

**(DMRB 10.1 to DMRB 10.3), HA 67 (DMRB 10.4)** and **DMRB Volume 11** provide further advice.

1.14 Toll Plaza sites tend to be large, open, brightly lit and obtrusive. Topographically hidden sites are best. Associated buildings within the toll plaza area should be considered as part of the overall design; input from a registered architect should be considered. Reference should be made to the Highways Agency sponsored publication 'The Appearance of Bridges and other Highway Structures' ISBN 0 11 551804 5 published by TSO.

**Health and Safety Responsibilities**

1.15 The designer is required to consider the operation and future maintenance of the toll facility when selecting the most appropriate configuration. It is a requirement of Health and Safety legislation that the designer considers the safety of maintenance activities during the plaza design. The designer should compile a checklist of all relevant health and safety issues to ensure that all planned and routine operational and maintenance activities are considered.

**Toll Plaza Location**

1.16 The location of a toll plaza can have a significant effect on both its operational performance and environmental impact. Therefore, consideration of the major contributory issues should be undertaken at the initial design phase to determine the optimum location.

1.17 Some major contributory issues are:

- visibility to approaching traffic;
- horizontal and vertical alignment of mainline;
- proximity to road junctions;
- safety and security;
- consistency with any other toll plazas in the area;
- environmental impact;
- land take and land suitability;
- capital cost;
- economic assessment;
- access to existing infrastructure.

1.18 For the purposes of visibility for the approaching driver the toll plaza should be treated as a 'junction' within the context of **TD 9 (DMRB 6.1.1)**. The "immediate approach to a junction" should be taken as that length of carriageway from a point 1.5 times the desirable minimum stopping sight distance upstream of the start of the Approach Zone to the end of the Departure Zone.

**Northern Ireland**

1.19 The legislation referred to in this document may, in some instances, have a Northern Ireland equivalent. For schemes in Northern Ireland the designer should refer to the Overseeing Organisation for advice.

# 2. TOLL PLAZA CARRIAGEWAY LAYOUT

**Toll Plaza Configurations, Elements and Layout**

2.1 Layouts for toll plazas should be developed in accordance with the guidance in this Advice Note and in conjunction with the Overseeing Organisation's requirements.

**Design Factors**

2.2 The simplest description of a toll plaza is a length of highway where the carriageway width increases to accommodate additional traffic lanes and their associated toll collection facilities; see Figure 2/1. The design of a toll plaza is influenced by a multitude of factors which will determine the number of toll collection facilities and hence the width and the resultant length of the toll plaza.

2.3 Different schemes will require different toll plaza arrangements. One-way tolling may be effective for structures such as major bridges or tunnels if there is no viable alternative route. Two-way tolling may require one-way toll plazas at each end of the structure to remove the risks associated with traffic queues forming within a tunnel or along one carriageway of a bridge.

2.4 Tolled highways may be provided with toll facilities at strategic locations or at all entry or exit points.

2.5 There are a number of basic parameters that the designer will need to establish prior to commencing the design.

- One-way or Two-way tolling.
- Plaza throughput requirements and anticipated traffic mix.
- Permitted methods of toll payment.
- Toll levels and vehicle categories.
- Possible plaza location(s) and available land area.
- Priority requirements, e.g. Buses or High Occupancy Vehicles.
- Operational requirements, e.g. requirements for emergency vehicles, wide-load facilities, classes of vehicles exempt from tolls, provision for left-hand-drive vehicles.
- Traffic Control – Use of traffic signals and/or rising-arm barriers.
- Shared facilities, i.e. will service areas or highway maintenance units be combined with the toll administration and associated welfare facilities?

**Width of the Toll Plaza**

2.6 The width of the toll plaza is principally established by the number of toll lanes necessary to deal with design level of traffic flow. The number of toll lanes required to process that traffic flow is dependant upon their combined throughput.

**Maximum vehicle demand**

2.7 The number of toll lanes required will depend on the maximum traffic demand that the facility is required to cope with. The maximum potential design flow may be taken as the hourly maximum traffic capacity of the approaching or departing highway. However, lower design flows may enable a more economical but equally efficient design to be achieved. The chosen design flow and traffic mix will be the major determinant of the number of toll lanes required. Where express lanes are to be incorporated the proportion of traffic expected to use the express lanes should be taken into account.

2.8 The design flow and traffic mix should take account of the plaza location. For example, a nearby major sports stadium may generate occasional but unusual peak traffic demands.

2.9 A strategy to deal with underestimated traffic demand should be considered at the outset of the design process. It is far easier to make advance provision for later alterations than to reduce standards or to seek to acquire more land at a later stage.

2.10 Once the design throughput requirement has been established, consideration should be given to the factors that influence the realistic achievable capacity of the toll lanes. These major factors are considered, in turn, below.

**Methods of Payment**

2.11 There is a range of payment methods that can be used for toll collection. The efficiency, and other benefits, of each method will vary with other factors such as toll prices and vehicle classification.

- Cash to toll collector – a necessary feature of any toll plaza to deal with motorists who are unable to use any of the other payment options. Not the most efficient method of toll collection but still the most versatile.
- Tickets/tokens – These may be beneficial where the toll level is not equivalent to a single coin, e.g. 80p or £4.70. Open to abuse, particularly where discounts are offered.
- Automatic Coin Machine (ACM) – best used with low toll levels and automatic classification. Throughput decreases if change is offered.
- Credit/debit/charge cards – best used with automatic classification, unaffected by toll levels. However, bank charges on transactions decrease net toll revenue. Vehicle throughput will reduce if driver is required to enter a PIN to verify the transaction.
- Electronic Toll Collection (ETC) – ETC encompasses a range of measures where modern technology is used to identify vehicles and automatically collect tolls from the users account. ETC systems are the most effective means of collecting tolls.
- 'Smart' cards – this is a form of ETC although these cards are carried by an individual and are not specific to a vehicle.

2.12 It is anticipated that ETC will, in due course, enable tolls and road user charges to be collected for any vehicle on the road network. Early forms of ETC have been introduced at major UK toll plazas, such as the Severn and Dartford Crossings, that require vehicles to carry transponders (which are also known as Tags). Vehicles so fitted need only be slowed, not stopped, for their Tag to be read by toll lane equipment.

2.13 The Tags currently used are specific to one location. European Directives seek to introduce greater interoperability across Europe. Designers should seek advice from the Overseeing Organisation regarding the currency of these directives if installation of a Tag system is considered.

2.14 The London 'congestion charge' scheme makes use of Automatic Number Plate Recognition (ANPR) cameras and does not require toll plazas. This system does require a considerable resource devoted to collecting unpaid charges so may not be suitable for discrete tolled facilities.

2.15 ETC systems will continually be developed for an increasing range of purposes. The need for toll plazas as a method of collecting payment from motorists on major elements of infrastructure will therefore reduce.

2.16 Although there are several available methods for toll collection, it may be decided not to adopt some of the methods. It is recommended that, in order to give optimum flexibility in operational configuration, each toll lane is equipped to be capable of receiving payment by all of the chosen methods; although for normal operations, operators may choose to restrict some lanes to, for example, ETC or card payment only.

**Toll Prices**

2.17 The level of toll charged to motorists will have an effect on the throughput at those toll lanes where cash is accepted. For example, a toll level equivalent to a single coin or note, will allow a greater throughput than a toll which requires change to be given.

2.18 The designer will need to take account of the consequences of future toll price increases when considering the above aspect.

2.19 Where legislation permits, toll prices can be used as a method of controlling demand, i.e. by varying toll prices between periods of high and low demand.

**Vehicle Categorisation**

2.20 It is normal practice for toll levels to vary between various categories of vehicles, e.g. passenger vehicles and goods vehicles. Although there are various formal classifications for vehicle types, no standard method of categorising vehicles for tolling purposes has been established in the UK.

2.21 Categorisation will either be prescriptive or descriptive. Prescriptive systems may be based on elements such as number of axles, weight, length, height or combinations of these elements. Descriptive systems may be based on the number of seats or the purpose for which the vehicle was constructed. A fully prescriptive system, which allows for the automatic

classification of vehicles into defined categories, will allow simpler operation and greater throughput.

2.22 Vehicles which are to be exempt from tolls will be defined within the legislation associated with right to toll. An exemption will either be confirmed by the toll operator or the exempt vehicle will be provided with a 'toll exempt' ETC transponder. There is no standard or common classification for exemptions and they may be applied either to vehicle types or to the use being made of a vehicle.

**Toll Plaza Operational Procedures**

2.23 It is essential that the designer fully understands the operational procedures which the plaza operator intends adopting.

2.24 Throughput will depend upon whether or not raising arm barriers are used. The absence of barriers will increase vehicle throughput but will require recording and enforcement systems to be in place to deal with violations.

2.25 The designer will need to establish whether specific facilities are required to be provided for left-hand-drive vehicles. Generally, this would not be expected unless the anticipated frequency of such vehicles justifies it. Detailed consideration should be given as to how to adequately sign any facility dedicated to such operation.

2.26 Particular consideration should be given to the management of motorists who are unable or unwilling to pay the toll. Procedures will need to be established so that such vehicles create the minimum of disruption to toll plaza throughput.

2.27 In order to cater for abnormal loads, a special, wide lane will be required. This may be combined with an 'Authorised Vehicles Only' route. Wide loads will be wider than the cab of the lorry and as such, the driver will not be able to reach a standard toll booth window. Alternative payment procedures will, therefore, be required. Such a lane could be set up so as to be also available to deal with left-hand-drive vehicles. This lane could also be designed to provide the toll plaza with a degree of reserve throughput capacity.

2.28 The designer should establish whether the operator is going to take an active or a passive role in dealing with traffic incidents in the toll plaza area. Such incidents may cause disruption to throughput. The period of disruption will be minimised if the operator is able to deal with minor incidents.

2.29 Special consideration should be given to the procedures required for dealing with vehicles which may be classed as exempt from tolls. These may be considered in various ways:

a) Frequent use vehicles, such as maintenance vehicles, Public Service Vehicles and local police vehicles. These may be provided with an exempt ETC account (Tag or similar) or they may use an 'Authorised Vehicles Only' route.

b) Occasional use vehicles, such as those carrying disabled persons. These may be required to request exemption via a manned toll lane.

c) Specific vehicle types, such as motorcycles. These may be required to request exemption via a manned toll lane or a dedicated lane may be provided.

2.30 Consideration should also be given for emergency vehicles to negotiate the toll plaza without being delayed. This may be achieved by providing an 'Authorised Vehicles Only' route from one end of the toll plaza to the other. This route would also assist with the recovery of broken down vehicles and for aspects of winter service.

**Toll Plaza Customers**

2.31 When considering the design of a toll plaza, account should be taken of the profile of the customer. An assessment should be made, not only of traffic mix but also of customer mix. If there is an anticipated high level of users that may be unfamiliar with toll plazas then throughput will be impaired. This effect will certainly be noticed in the initial period after the introduction of tolling but will decrease as users become familiar with the systems in place. Customer mix may vary on an hourly as well as a daily or seasonal basis.

2.32 Where each toll lane has been equipped to be capable of receiving payment by each of the permitted methods, the operational configuration of the toll plaza can be adjusted to address varying customer mixes. The operational configuration should aim to achieve an even use of all lanes and to avoid a situation where a queue at one lane has the effect of preventing access to other lanes.

2.33 The designer should not assume that a significant proportion of customers will choose to use ETC as a method of toll payment unless the operator is prepared to offer an incentive to such customers.

**Toll Plaza Throughput**

2.34 From the above it can be seen that several factors influence the achievable throughput.

2.35 A high level of throughput would be expected by the following example:

- toll level of, for example, £1, (i.e. single coin transaction);
- categories are prescribed;
- rising-arm barriers are not in place;
- automatic categorisation of vehicles;
- several dedicated lanes available for frequent users;
- low proportion of HGV traffic;
- exempt traffic is 'blue light' vehicles only;
- a high take-up of ETC is achieved because of incentives offered to users.

2.36 Conversely, the following would reduce the potential throughput:

- toll level would need change to be given, e.g. £1.80;
- categories are descriptive;
- rising-arm barriers in use;
- automatic categorisation is not available;
- no dedicated lanes provided;
- high proportion of HGV and non-frequent users;
- several categories of exempt vehicles;
- a low take-up of ETC because no incentives are offered to users.

**Number of Lanes Required**

2.37 The number of toll lanes will be determined by the capacity of the toll methods chosen. Table 2/1 gives ranges of throughputs that should be achievable for a variety of methods based on the experience of a number of UK toll plaza operators. The throughputs given below are stated for toll lanes dealing with either only 'Cars' or only 'HGVs'.

| Method | Explanation | Car Throughput vph | HGV Throughput vph |
|---|---|---|---|
| Electronic Toll Collection (ETC) | Transponders, contact-less reading of bar code stickers/ proximity cards, Tags(Low speed automatic – vehicles reduce speed, barrier lifts when transponder/card/tag is read) | 450 - 900 | 300 - 500 |
| Card Payment | Credit, Debit or Charge Cards(Vehicles stop – barrier lifts when card is passed through reader and has been verified – receipt may be given)<br>Note: Throughput will reduce if driver is required to enter a PIN to verify the transaction | 200 - 350 | 150 - 250 |
| Coin Bin | Cash machines/coin baskets<br>(Vehicles stop – barrier lifts when cash has been verified – change and receipts may be given) | 300 - 500 | 200 - 350 |
| Manual | Card/cash/voucher/token<br>(Vehicles stop – barrier operated by attendant; change and receipts may be given) | 250 - 550 | 200 - 300 |
| | Note: 900 vph = 4 seconds per transaction<br>450 vph = 8 seconds per transaction<br>300 vph = 12 seconds per transaction<br>200 vph = 18 seconds per transaction | | |

**Table 2/1 Toll Lane Throughput**

2.38 When determining the number of toll lanes, the designer should take account of the need for routine and non-routine maintenance within the toll plaza.

**Methods for Dealing with Underestimated Traffic Demand**

2.39 It should be anticipated that at times there will be a build-up of traffic at the toll plaza. This may be due to various reasons, e.g. peak traffic demand exceeding the design provision, equipment failure or maintenance making one or more lanes unavailable, vehicle breakdown or accidents within the toll plaza area. Consideration should be given at the design stage as to how such situations could be addressed and, if necessary, provision made within the design.

2.40 There are various ways in which a toll plaza operator can deal with congestion at the toll booths. The designer should be aware of them in order to allow their potential use in the overall design (where applicable), e.g:

- regular peak hour delays could be addressed by introducing higher toll charges during peak periods with the aim of spreading the peak demand over a longer period;
- overall throughput could be increased by encouraging drivers to adopt ETC methods of toll collection. Discounts to the normal toll level could be used for ETC users;
- for occasional (or regular) periods of high demand, a wide load facility could be used for all vehicles;
- the use of a Host Toll Lane, feeding two or more additional toll booths via Branch Lanes, could be implemented. See Figure 2/2. This potential solution for increasing overall throughput, will require additional signing and traffic management measures and should be modelled, assessed and allowed for in the original design;
- rising-arm barriers could be removed to increase throughput but this should be expected to result in a greater number of violations which will need to be actioned. In extreme circumstances, tolls could be suspended for a period of time to relieve the build-up.

**Toll Lane Width**

2.41 For the normal road network, road lane widths are prescribed by **TD 27 (DMRB 6.1.2)**.

2.42 The distance between kerb faces is between 3.0 and 3.3 metres within the toll lanes of major existing UK toll plazas. Toll lane widths within this range help to slow traffic and guide the driver closer to the toll collector or ACM bucket.

2.43 A greater width should be considered at the height of HGV and PSV exterior mirrors to avoid these impacting the toll booths and other toll lane equipment.

2.44 All normal toll lanes should be a uniform width for maximum operational flexibility. Abnormal wide loads should be directed to a separate wide load facility.

**Toll Island Width**

2.45 The overall width of toll islands is determined by the size of the toll booth and the established lateral clearance between the face of the island kerb and the booth face. The toll island width at existing facilities varies between 1.2m and 3.0m, although most islands are 1.8 to 2.1 metres wide. 2m is a good starting point for outline design purposes but this measurement will be affected by the operator's collection equipment and safety requirements.

2.46 Toll Island dimensions are further discussed in paragraph 3.69.

**Toll Plaza Width**

2.47 The overall plaza width is calculated after establishing the number of lanes required, the island widths and the toll lane widths. The plaza length may now be addressed.

**Toll Plaza Length**

2.48 Descriptions of the elements of the toll plaza are shown in Figure 2/1. The entrance to the plaza is located at the commencement of the Approach Zone which widens over its full length to the plaza design width. Traffic speed reduces through the Approach Zone as drivers choose a toll lane based on their tolling method preference or on traffic classification where tolling is segregated. At the end of the Approach Zone traffic enters the Queue Zone. Vehicles should now be in the correct lane and minimal lane changing will

occur. The length of the Queue Zone should be sufficient to accommodate the design flow. A traffic simulation exercise should be undertaken to assess the extent of queues at the maximum annual peak hour flow to ensure that they do not extend back to the approach carriageway.

2.49 On exiting the toll lane, traffic enters the Recovery Zone where vehicles accelerate to regain speed. Beyond the Recovery Zone is the Departure Zone which reduces in width to funnel the traffic back down to the departure carriageway cross section.

2.50 The taper at which the Approach Zone and Departure Zone is developed depends on the approach speed. The approach speed need not be the free flow design speed of the highway leading to the plaza area (for example 120kph). The plaza speed, which may be restricted, (see paragraph 3.55), would permit a lesser approach speed to be used. 85kph may as a result be considered the maximum plaza speed for use in design. The taper design should follow the principles set out in **TD 22 (DMRB 6.2.1)**. The layout chosen should be modelled using an appropriate micro simulation program to give confidence in the designed layout.

**Toll Island Length**

2.51 The length of the toll islands largely depends on the configuration of the toll category classification equipment, toll payment facilities and protection devices for the booths, the equipment and vehicles.

2.52 Early UK toll plazas required cash payment to a toll collector in a booth. As such, toll islands required little more than enough length for the booth and some form of protective nosing. The length of toll islands has tended to increase due to the development of electronic vehicle identification and recording methods, and a greater emphasis on the protection of tolling staff.

2.53 Toll Island dimensions are further discussed in paragraph 3.69.

**Toll Plaza Carriageway Footprint**

2.54 The toll plaza carriageway footprint may be considered as the carriageway area necessary to accommodate the required toll plaza width and length. In addition to this, the design of the toll facility should take account of the ‘off-carriageway’ infrastructure requirements.

# 3. FURTHER ASPECTS TO CONSIDER

**Additional Infrastructure Requirements**

3.1 Each plaza will require a toll administration building with traffic monitoring and secure cash handling capabilities as well as staff welfare facilities.

3.2 In situations where the available land plot is limited, consideration may be given to incorporating administration facilities as part of the toll plaza canopy design.

3.3 The highway facility that is being tolled, e.g. a bridge or tunnel, may also require 'off-carriageway' infrastructure for maintenance and operation of that facility. The designer should establish whether such facilities can be combined or whether the toll administration facilities are to be kept separate.

3.4 The highway facility being tolled may require control over the movements of abnormal and dangerous loads. Provision may be required, within the toll plaza area, for such vehicles to be able to park whilst awaiting an escort or permission to proceed.

3.5 A section of tolled highway may include a service area. In such circumstances, consideration should be given to incorporating the toll plaza with the service area.

3.6 Consideration should be given to providing alternative access arrangements from the toll administration buildings to the existing local road network.

**Canopy**

3.7 The canopy is a roof structure built over the toll booths and toll lanes. The benefits of a canopy are that:

- it defines the location of the toll plaza for motorists;
- it serves as a mounting frame for signs, variable message signs (VMS), lighting, lane signals and ETC antenna;
- it provides support for overhead signs and for security and safety devices;
- it provides a route for a variety of services;
- it provides the motorists and toll attendants with shelter from the elements whilst paying.

The canopy and its attached signs and equipment should be of adequate height to comply with the headroom standard set out in **TD 27 (DMRB 6.1.2)**.

3.8 On highways which are designated high load routes, at least one lane may need to be sited without the benefit of canopy cover.

3.9 A canopy should be designed as a structure over a highway and will be subject to technical approval in accordance with **BD 2 (DMRB 1.1.1)**. The designer should establish and agree with the Technical Approval Authority (TAA) the appropriate design parameters for the form, location and use of the proposed canopy and its supporting structure. The design will require an independent check in accordance with the requirements in **BD 2 (DMRB 1.1.1)**. This will usually be undertaken by an independent team within the design organisation or, for complex structures, by a checking team from an independent organisation agreed with the TAA. Primary design considerations to observe include:

- determining the functions to be fulfilled by the canopy;
- aesthetic consideration and architectural requirements;
- canopy and all attached signs and equipment to be of adequate height to comply with the headroom standard set out in **TD 27 (DMRB 6.1.2)**;
- prevailing wind direction and path of the sun;
- canopy support structure impact design loading;
- canopy impact design loading.

**Toll Lane Access Tunnel**

3.10 Toll booth access tunnels should be given consideration as they are able to provide several operational benefits as well as increased safety for toll staff. The benefits of a tunnel are that it provides:

- staff access to the toll booths via a stairwell. (This may be limited to every second or third toll island);
- a route for toll booth services with access for maintenance;
- a location for ACM coin vaults where they can be safely handled;
- a secure route for toll revenue from the booth to the administration building.

**Pavement**

3.11 Pavements do not usually fail suddenly but gradually deteriorate in service. In the case of the surface course, loss of skid resistance can be equivalent to failure.

3.12 **HD 28 (DMRB 7.3.1)** describes how the appropriate levels of skid resistance on in-service UK Trunk Roads will be managed. **HD 36 (DMRB 7.5.1)** sets out advice on surfacing material characteristics necessary to deliver the required skid resistance properties. **HD 28 (DMRB 7.3.1)** does not specifically consider toll plazas within the Site Category and Definitions section in respect to setting Investigation Levels. The Designer, in conjunction with the Overseeing Organisation, should determine the appropriate Site Category and Investigation Level; the Operator should ensure that the Investigation Level is reviewed on a regular basis.

3.13 The permitted surfacing materials for roads in the UK are given in **HD 36 (DMRB 7.5.1)**. In England, rigid concrete construction of any type is not a permitted option for trunk roads unless it has an asphalt surface course. However, concrete should be considered as the pavement material for the length of the toll island for reasons stated below:

- to prevent pavement rutting caused by high flows of slow, heavy goods vehicle (HGV) movements using the same, narrowly defined wheel track through a toll lane constraint;
- to reduce damage caused by the possible discharge of oils, fuel, and grease;
- to prevent surface layer undulation created by vehicle braking and acceleration impact, particularly that of HGVs and public service vehicles (PSVs);
- to ensure the integrity of in-lane toll equipment such as loops; and
- to facilitate a simpler and effective maintenance regime (washing).

3.14 Run-on concrete slabs should also be considered for areas constructed on either side of the toll lane and toll island slab. A run-on slab acts as a structural element seated on the island slab at one end and the adjacent pavement construction at the other end to provide a transition between the approach and departure zone pavements.

**Drainage**

3.15 Advice on drainage is given in **DMRB Volume 4**. The standard minimum crossfall is 2.5%.and the minimum longitudinal gradient recommended is 0.5% to allow for water flow along the roadside edge channel.

3.16 For wide carriageways the most direct drainage flow paths are realised when the longitudinal gradient is zero. Therefore, low longitudinal gradients can be acceptable, provided that standard crossfalls are maintained and a continuous edge drainage system is provided.

3.17 In setting the vertical and horizontal geometry of a plaza, water should not be allowed to accumulate in the expanses of the approach and departure zones nor in the toll lanes.

3.18 Within the transition zones of the toll plaza, the use of high performance and heavy duty longitudinal linear drainage channel systems, in combination with transverse drains need to be considered. It is likely that these drains will require more regular maintenance but they are likely to provide the most suitable system.

3.19 Where a longitudinal drainage system is to be used, the line of the system should coincide with the line of an actual, or theoretical, lane divider, i.e. the line of the drainage channel will appear, to the motorist, as a lane marking. (See Figure 3/1). The designer should also take into account the effect of longitudinal drainage systems on powered two wheel vehicles.

3.20 Maintenance of the drainage system may, at times, render certain toll lanes unavailable. Care should be taken in determining the layout so that maintenance can be carried out without significantly affecting off-peak capacity.

**Lighting**

3.21 The provision of road lighting at toll plazas should be considered in accordance with **DMRB 8.3**.

**Environment Issues**

3.22 The general principles of environmental assessment including the techniques and reporting are given in **DMRB Volume 11**.

**Air Quality**

3.23 The impact of a toll plaza on air quality is one of many factors to be considered in the choice of location and design, and conflicts can occur. Any mitigation measures should perform to an acceptable level in road safety and economic terms. Both environmental and health and safety legislation require consideration of air quality. The potential for exposure of the toll collectors to exhaust emissions should be considered in the design process.

3.24 Studies of typical air quality patterns in and around toll booths show that exhaust emissions tend to concentrate in toll lanes as a result of vehicle acceleration and idling. To prevent such contaminants from being drawn into the toll booths, a positive (overpressure) ventilation system should be provided. This draws fresh air from a source located away from the plaza and conditions the air before diffusing it into the toll booths, creating an outward pressure that blocks contaminated air from entering the booth.

3.25 If individual air conditioning units are installed, their mounting locations should be selected carefully in order to ensure that exhaust fumes are not drawn into the booth. The air conditioning units should have filters that are easily accessible for maintenance.

3.26 Consideration should be given to installing Carbon Monoxide (CO) monitors and Hydrocarbon analysers in the toll booths to monitor emission levels. These can be used to help regulate ventilation and alert the plaza supervisor to possible problems.

3.27 Air quality modelling of proposed toll plaza configurations should be undertaken to ensure compliance with European Air Quality framework directives which specify concentration limits for certain air pollutants. For schemes with two-way tolling, a design that creates an overlap in the high-emission departure zones is the least desirable configuration. A toll plaza where the approach zones overlap is preferable.

3.28 It should be noted that the use of ETC systems, which allow vehicles to retain a reasonable speed as they pass through the toll plaza, will result in lower levels of emissions.

**Highway Noise**

3.29 Highway noise is a sensitive environmental issue that requires analysis and, quite often, mitigation. It is a function of many variables, including traffic volume, vehicle mix, speed, tyre composition, pavement surface, grade and topography. An individual's perception of highway noise will be influenced by factors including wind direction, atmospheric conditions, ambient noise levels and relative location. Toll plaza areas should be considered as a greater source of highway noise than an equivalent length of a normal highway. Environmental barriers, depressed carriageway profiles, noise retaining walls and the planting of trees and shrubs can all contribute to a reduction in perceived noise to acceptable levels. The use of ETC systems, which allow vehicles to retain a reasonable speed as they pass through the toll plaza, will contribute to a reduction in noise levels.

**Water Quality**

3.30 Water quality requirements at toll plazas will be the same as for the adjacent lengths of highway; Overseeing Organisations have a duty under pollution protection legislation to ensure that highway runoff does not pollute adjacent areas. However, given the large expanse of pavement within a toll plaza, a potential exists for a large amount of contaminated runoff to find its way into a plaza drainage system. By considering traffic volume, the percentage of commercial vehicles and the size of the plaza, the amount of oil, salt, and other contaminants can be estimated. A further source of contaminants results from the periodic cleaning of the toll lanes, booth exteriors and canopy. The wash and rinse water becomes laden with contaminants from vehicle exhaust, brakes, and tyres, as well as dirt, sand, and salt that vehicles track into the lanes. Balancing ponds and oil/water separators and interceptors are some of the treatment processes available. Further advice is given in **HA 103 (DMRB 4.2.1)** and **DMRB 11.3: Water Quality and Drainage**.

**Winter Service**

3.31 In toll plaza areas, special consideration should be given to the development of effective winter service procedures and the potential effect of such procedures on the operation of the tolling facility.

3.32 Adequate levels of surface treatments for winter maintenance within the approach and departure zones will require a greater number of passes than required on the approach and departure roads. The provision of an 'Authorised Vehicle Only' route from one end of the toll plaza to the other, (see paragraph 2.27), will allow the spreading vehicle to undertake the required number of passes.

3.33 Snow clearance within the toll plaza area will often result in toll lane availability being reduced as the snow is cleared from some lanes but piled up in others. In locations where frequent snow fall is anticipated, the landscaping alongside the plaza could incorporate snow dumping areas where the piled up snow could be moved from the plaza carriageway.

3.34 Consideration should be given to ensuring that winter maintenance vehicles fitted with snow plough blades can pass through the toll lanes.

**Traffic Signals**

3.35 Traffic signals should be considered for use in each toll lane to instruct drivers to stop, so as to pay the toll, and to allow them to proceed once payment has been verified. In such cases, Type approved signal-heads that carry only red and green signals should be used.

3.36 In addition to traffic signals, rising-arm barriers may also be used to prevent vehicles from proceeding before payment has been verified.

3.37 If both traffic signals and barriers are used, control of the two systems should be linked so that they cannot give conflicting messages to drivers. Each system should also be capable of operating independently, but only at times when the other system is out of use.

3.38 The optimum position and height of the traffic signals should be determined in conjunction with the other toll island equipment and vehicle types using the lane, when categorisation is used. Where necessary, approval should be sought for proposed departures from regulations.

3.39 Hazard warning beacons should be provided on the approach end on toll islands for use during periods of poor visibility, particularly when traffic volumes are low. The use, frequency, intensity and optical characteristics of such lights should take account of the potential impact such lights may have on queuing drivers. Examples of hazard warning beacons are given in Figure 3/4.

**Signing**

3.40 Toll plazas and their approaches require a greater density of signing than usual. The density of signing increases where the toll plaza incorporates dedicated lanes for specific vehicle types, e.g. Left-hand drive, Motorcycles or Abnormal loads. Signs are required to give advice, information and instructions to motorists. There are no standard signs available for several of the specific requirements of toll plazas.

3.41 Those traffic signs that may be erected on a public highway are prescribed in the Traffic Signs Regulations and General Directions (TSRGD), in Northern Ireland the Traffic Signs Regulations (Northern Ireland) (TSR). Guidance on the design and use of traffic signs is contained in the Traffic Signs Manual and in Local Transport Note 1/94, 'The Design and Use of Directional Informatory Signs'.

3.42 When no suitable fixed or variable message sign is prescribed in TSRGD, in Northern Ireland the TSR, for a particular purpose, non-prescribed signs may be specially authorised by the Secretary of State. Requests for such authorisation should be submitted to the Overseeing Organisation.

3.43 Non-prescribed variable message signs will be required above each toll lane to indicate the payment options that are permitted in each open toll lane and to indicate which lanes are open to traffic. These signs will need to be authorised (see paragraph 3.42).

3.44 Signs may be considered in two categories: advance signs and toll plaza signs. The advance signs should be located so as to allow motorists who are unable or unwilling to pay the toll the opportunity to avoid the tolled facility and to take an alternative route. It may be necessary to provide advance signs on other nearby routes as well as on the main route approaches.

3.45 Toll plazas require high levels of driver concentration. Advance signing is needed to prepare drivers and provide them with tolling information. This may include some of the following: peak period and

off-peak period start and finish times, vehicle category, the applicable toll level and the accepted payment methods.

3.46 Advance signing is necessary to indicate the accepted methods of toll payment. Drivers entering the toll plaza area should be prepared to approach a correct toll lane at a reasonable speed. Clear, consistent and distinctive signing, using a combination of symbols, colours and legends should be used on the advance signs and repeated over the toll lanes with the aim of avoiding late or excessive lane-changing by vehicles.

3.47 From the downstream end of the Departure Zone, for the distance along the route in the direction of travel, as shown in Table 3/1, there should be no signs on the nearside verge and central reserve or on portal or cantilever gantries. Any proposal to install a sign within the distance in Table 3/1 should be referred to the Overseeing Organisation for advice.

| Number of lanes on mainline | Distance m |
|---|---|
| 2 | 380 |
| 3 | 580 |
| 4 | 580 |

**Table 3/1 Distance From End of Departure Zone for Which There Should be no Signs**

3.48 For further guidance and advice on the correct use of traffic signs and traffic signals and control equipment and their maintenance see:

- The Traffic Signs Manual, Chapters 1, 3, 4, 6 and 7;
- Local Transport Note 1/94;
- **TA 16, TD 24, TD 7, TA 82 (DMRB 8.1)**;
- **TA 61, TD 25, TD 33, TA 60 (DMRB 8.2)**;
- **TD 46 (DMRB 9.1)**.

**Road Markings, Studs and Traffic Cones**

3.49 Lane lines help to ensure that available carriageway space is used to its maximum capacity. In helping vehicles to maintain a consistent lateral position, they also offer safety benefits and should be used wherever practicable. In the approach zone, lane lines are used to assist drivers in lining themselves up with their chosen booth: see Figure 3/1.

3.50 Chevron markings should be used at the approach to and departure from toll booth islands. They are intended to aid the separation, and merging, of streams of traffic.

3.51 'Keep Clear' markings may be considered for use in areas approaching the toll booth in order to ensure that vehicles only enter the area when the vehicle in front has been processed.

3.52 Markings should minimize the effects of late lane changes in advance of the toll plaza. Cones may be used temporarily to assist traffic flows, e.g. if one lane becomes blocked or inoperable.

3.53 Further measures may also be considered within, and in advance of, the toll plaza area to improve driver awareness and to promote appropriate behaviour.

3.54 For further guidance and advice on the correct use of road markings and studs and their maintenance, see:

- The Traffic Signs Manual Chapter 5;
- **TA 87 (DMRB 6.3), TA 61, TD 26 (DMRB 8.2)**.

**Control of Vehicle Speed**

3.55 The control of vehicle speed is essential for the safe operation of a toll plaza. All vehicles should expect, and be prepared, to stop at a toll plaza; this may be within the toll lane or at a queue in advance of the toll lane. The mechanism for achieving this will depend upon the speed of traffic on the approach road.

3.56 A risk assessment should be undertaken to establish whether the maximum permissible speed of vehicles within the Approach Zone should be restricted to a level below the permitted speed on the approach road.

3.57 The designer should seek to ensure that traffic is required to decelerate steadily as it approaches the toll lanes. On high speed roads, e.g. motorways, consideration may be given to the introduction of a 'buffer zone' speed limit (i.e. an intermediate speed limit) on a suitable length of the approach road. In such instances, specific authorisation should be sought from the Overseeing Organisation.

**Protection Devices**

3.58 Provisions for protective safety devices on the approach to toll islands need careful consideration. Such devices need to be sufficiently robust to ensure that an errant vehicle is prevented from impacting the toll booth and the canopy supporting structure but also need to effectively absorb and cushion the impact. An effective speed limit will contribute towards the protection of the Toll Attendant and the vehicle occupants. The safety device on each toll island should have retro-reflective end panels which will need to be authorised (see paragraph 3.42).

**Protection of the Toll Attendant**

3.59 Protection of the toll attendant is improved by ensuring that vehicles are lined-up and channelled through the toll lane. High kerbs and lateral barriers along the toll islands should ensure that vehicles are kept on-line. The approach end of the toll island should include a substantial concrete or steel bollard capable of stopping an errant vehicle or deflecting such a vehicle along the toll lane. Protection measures for such bollards may be required, see paragraph 3.63 below.

3.60 Further measures should be provided on the approach to the toll booth to protect it from any load that may be protruding from the side of a vehicle. Such measures may also be used to protect vulnerable elements of the toll lane equipment.

3.61 Examples of the above forms of protection are given in Figures 3/2, 3/3 and 3/4.

3.62 A safe method of access should be provided for toll collection staff to get to and from the toll booths. The Designer may consider providing a designated at-grade walk route to the toll booths. This would be expected to be located at the traffic exit side of the booths and may incorporate walkway signals linked to the barrier position for the lane being crossed. Paragraph 3.10 refers to tunnel access, which would reduce the number of lanes to be crossed.

**Protection of Vehicle Occupants**

3.63 Devices used to protect toll attendants will be a hazard to the occupants of any vehicle that hits them head-on. They should be designed to minimise this hazard.

3.64 Signs and road markings should give clear and adequate warning to drivers of which toll lane they need to use before they arrive at the toll booths.

3.65 Impact absorbing barriers should be placed in front of any significant concrete or steel bollards on the approach to a toll island unless a specific risk assessment supports their omission.

3.66 Examples of toll plazas with and without the above forms of protection are given in Figure 3/3.

3.67 For further advice on road restraint systems, reference should be made to **TD 19 (DMRB 2.2.8)**.

**Toll Islands**

3.68 Toll Islands are raised platforms similar to traffic splitter islands and are usually of concrete construction. The toll booth or toll collection equipment is situated on the island and should be within easy reach of the driver. Signing on toll islands should be consistent with advance toll information signing and toll plaza signing.

3.69 The footprint of the island depends largely on the toll lane equipment, its location, size of booth, presence of tunnel stairwell and extent of HGV traffic and plaza configuration. The minimum width is determined by the size of the toll booth and the established lateral clearance between the face of the island kerb and the booth face. The overall length of the island largely depends on the configuration of the safety protection devices and the location of any pre-classifying toll equipment. This dimension could range between 6m and 40m.

3.70 A clearance of 0.5m should be allowed between the toll island kerb face and the nearest obstruction. This will avoid exterior mirror impact and allow for a slight projection for the toll booth payment window. The kerb height can range between 150 mm and 350 mm but it should be reduced in the payment area to allow the driver's door to be opened if required. (e.g. if payment is dropped).

3.71 Toll islands should be provided with water and power for maintenance and cleaning activities.

**Toll Booths**

3.72 In order to provide an efficient, comfortable and safe working environment for staff in toll booths, the design of the internal layout of the booth should be based on sound ergonomic principles.

3.73 A health and safety evaluation of the proposed facilities should be undertaken to ensure compliance with the necessary legislation and workplace regulations.

3.74 Toll booths should be equipped to deal with minor vehicle fires.

3.75 General points to consider are noted below:

- size;
- construction;
- access;
- lighting;
- heating, (particularly at floor level);
- staff welfare;
- ventilation;
- air quality monitors;
- safety;
- security;
- signing;
- uninterrupted power supply;
- other amenities; and
- environmental issues

Proprietary booths are available that address many of the above issues. Particular care should be taken if a bespoke design is to be developed.

**Toll Collection and Toll Lane Equipment**

3.76 The equipment is installed either in or adjacent to the toll booth. The type of toll lane equipment will depend on the facility's configuration and chosen methods of payment. Many, or all, of the following will be included:

- computer equipment;
- attendant's terminal;
- receipt printer;
- CCTV monitor;
- intercom/loudspeakers;
- magnetic card reader;
- bar code reader;
- automatic coin machine (coin basket);
- change machine;
- cash transfer equipment;
- vehicle detector loops;
- treadle/axle counter;
- entrance and/or exit automatic toll barriers;
- height sensor;
- weight in motion detector;
- traffic signals (usually only red and green aspects);
- CCTV cameras;
- variable message signs.

**Exceptional Vehicles**

3.77 The provisions for exceptional vehicles, particularly wide vehicles and those carrying dangerous goods, should be allowed for in the configuration of the toll plaza facility. Further guidance should be sought from the Overseeing Organisation on the type and frequency of exceptional vehicles and whether the toll plaza will be on a designated high load route. Traffic surveys carried out in the area previously may give an indication of the classification of traffic expected and the maximum vehicle width to be catered for.

3.78 It should be noted that drivers of wide loads will need to leave a greater lateral clearance to the toll booth or toll collection machinery than is usually required. It should therefore be expected that either the driver will need to get out of his vehicle to pay the toll or that the toll collector will need to go to the driver. Consideration should be given to the provision of a special wide-load lane. (See also paragraph 2.27).

3.79 The Designer should agree with the operator a procedure for dealing with the movement of exceptional vehicles through the toll plaza and also along the length of highway to which the toll applies, e.g. a bridge or tunnel. The operator may choose to escort such loads or may seek to prohibit such movements at peak times. A 'wide load bay' or holding point may be required within the toll plaza area or on an adjacent section of highway.

# 4. TOLL PLAZA GLOSSARY OF TERMS

**Toll Plaza Glossary**

Particular terms used in this document (see also Figure 2/1 in Chapter 5 below) are defined as:

**Approach Zone:** The tapered area on the approach to the toll booths which connects the approach carriageway to the queue zone.

**Automatic Coin Machine (ACM):** An electronic coin processor that collects, counts, evaluates and stores various denominations of coins or tokens.

**Branch Toll Lane:** A route to or from additional toll booths constructed, either in front of or beyond the toll islands, as a means to increase plaza throughput. Access to or egress from a branch lane is via a toll lane in the main plaza which is in use as a host lane.
(See Figure 2/2).

**Canopy:** A structure built over the toll booths and toll lanes.

**Coin Vault:** A steel box with an integral locking cover mounted at the bottom of an ACM or drop tube mechanism that serves as the depository for coins and tokens used for toll payments. Each vault can store several thousand coins and tokens.

**Departure Zone:** The tapered area downstream of the toll booths which connects the recovery zone to the departure carriageway,

**Electronic Toll Collection (ETC):** A system that automatically identifies a vehicle equipped with an encoded data tag or transponder. The system debits the cost of the toll from, or charges the toll to, a motorist's account without the motorist having to stop.

**Host Lane:** A lane in the main toll plaza used to feed traffic to or from branch toll lanes.

**Lane Configuration:** The arrangement of lanes at a toll plaza sorted according to the methods of toll collection available. The configuration may vary by time of day and day of week.

**Manual Toll Collection:** The method of toll collection that employs attendants to collect tolls and give change and receipts if required.

**One-Way Toll:** A toll arrangement in which tolls covering the cost of both outward and return journeys are collected in one direction of travel only.

**Positive Ventilation System:** A system that feeds the toll booths with fresh air from a remote source and thus prevents exhaust fumes from entering the booth.

**Queue Zone:** The arrangement of parallel toll lanes directly upstream of the toll booths.

**Recovery Zone:** The area immediately beyond the toll booths where traffic can accelerate before beginning the merge in the departure zone.

**Toll Attendant or Toll Collector:** A designated person authorised to collect toll payments from motorists.

**Toll Barrier:** A rising-arm or similar barrier across a toll lane which is raised once toll payment has been confirmed.

**Toll Plaza:** The arrangement of toll booths and other toll collection points.

**Toll Plaza Area:** The length of highway between the start of the approach zone and the end of the departure zone. See Figure 2/1.

**Toll Plaza Facility:** The toll plaza area plus the adjacent associated off-carriageway infrastructure requirements.

**Transponder or TAG:** A radio or radar device that identifies vehicles equipped for the purpose, and allows the user to be billed electronically.

# 5. ILLUSTRATIONS REFERRED TO IN THE TEXT

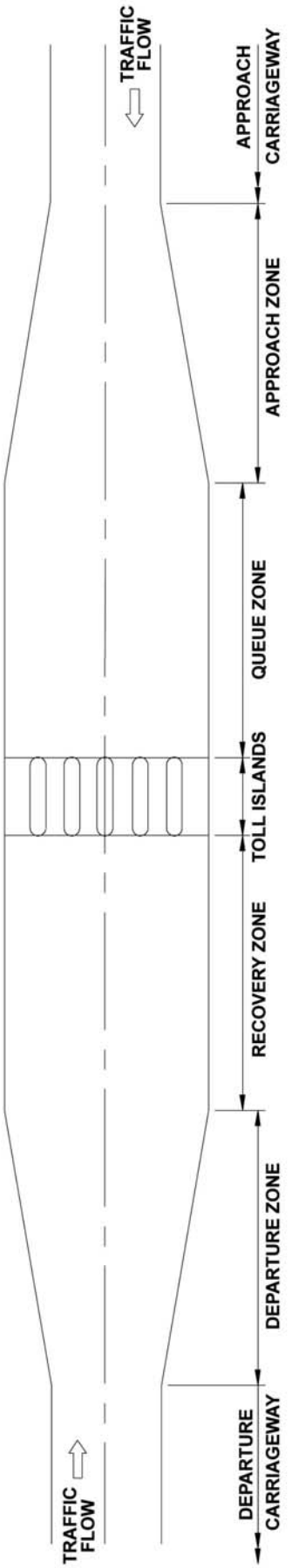


**Figure 2/1 Toll Plaza – Layout and Terminology**

**Note: The above terminology applies to traffic travelling from right to left.**

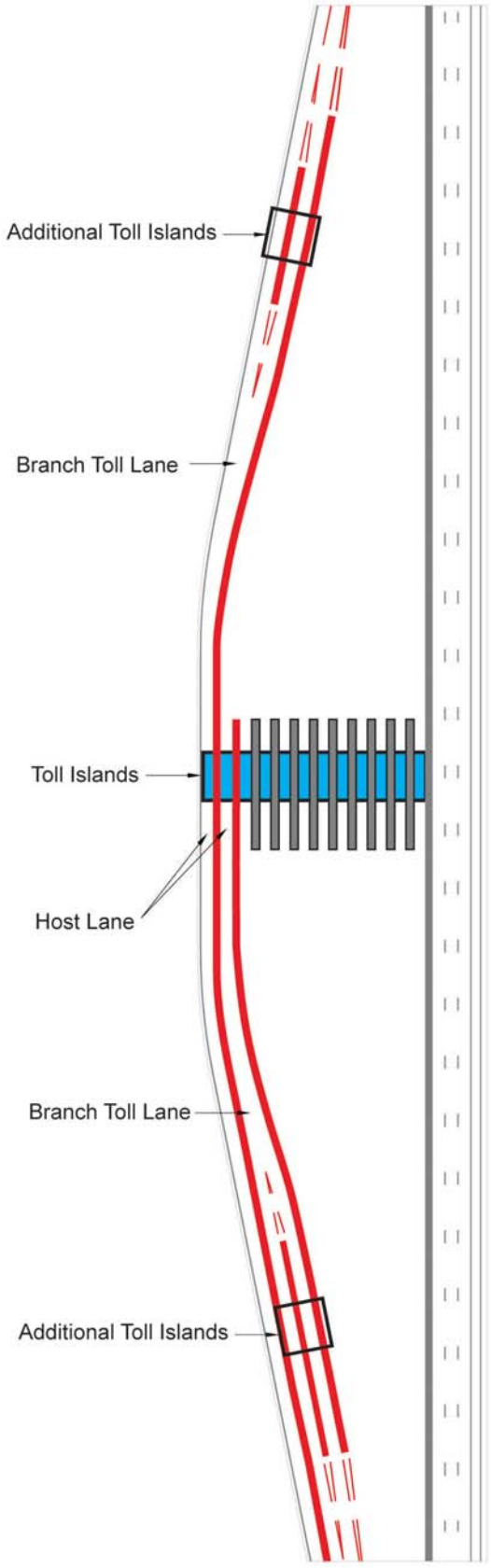


**Figure 2/2 Host Lanes and Branch Lanes – Diagrammatic**

**Figure 3/1 Lane Markings Within Approach Zone**

**Note: Lines of longitudinal drainage systems**


**Figure 3/2 Protection of Toll Attendant**

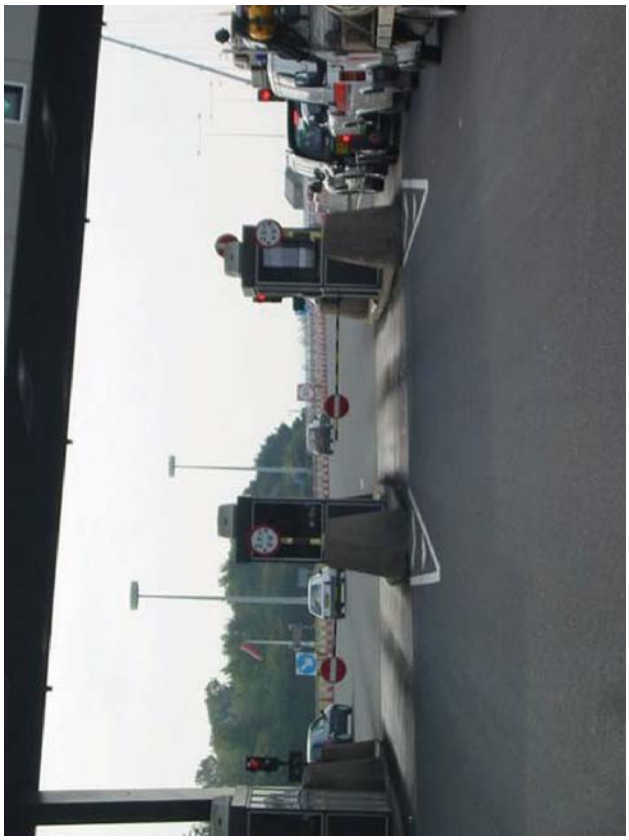

Figure 3/3 Protection Measures at Toll Plazas


**Figure 3/4 Hazard Warning Beacons Fixed to Concrete Bollard**

**Note: Measures to give protection from protruding loads**

# 6. REFERENCES

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BD 2: Technical Approval of Highway Structures (DMRB 1.1.1)

HA 55: New Roads Landform and Alignment (DMRB 10.1.1)

HA 63: Improving Existing Roads Improvement Techniques (DMRB 10.2.2)

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HD 28: Skidding Resistance (DMRB 7.3.1)

HD 36: Surfacing Materials for New and Maintenance Construction (DMRB 7.5.1)

TA 61: Currency of Traffic Signs Manual (DMRB 8.2.2)

TA 87: Trunk Road Traffic Calming (DMRB 6.3.5)

TD 9: Highway Link Design (DMRB 6.1.1)

TD 19: Requirement for Road Restraint Systems (DMRB 2.2.8)

TD 22: Layout of Grade Separated Junctions (DMRB 6.2.1)

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**2. Traffic Signs Regulations: The Stationery Office**

The Traffic Signs Regulations and General Directions (TSRGD)

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**3. Local Transport Notes: The Stationery Office**

Local Transport Note 1/94 – The Design and Use of Directional Informatory Signs

**4. Other Publications**

'Reducing Mobility Handicaps', published by the Institution of Highways and Transportation

'Inclusive Mobility' published by the Department for Transport's Mobility and Inclusion Unit

'Toll Plaza Design – A Synthesis of Highway Practice' published by the Transportation Research Board (USA), National Co-operative Highway Research Program – Synthesis 240

'The Appearance of Bridges and other Highway Structures' ISBN 0 11 551804 5 published by The Stationery Office

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