A Guide to Traffic Signing

Ministry of Infrastructure Development
Safety and Environment Unit
United Republic of Tanzania
2009

Table of Contents

Foreword

FOREWORD

Traffic signs are all the road signs, road markings, traffic signals and other devices used by road authorities to regulate, warn and guide traffic. They have a key role in ensuring the safe, smooth movement of road traffic. It is very important to have a standard set of signs and to use them in a consistent manner, so that the travellers can become familiar with them. Tanzania has adopted the SADC system of traffic signs, which conforms to the international conventions on traffic signing. It is only a little different from what has been used on our road up to now.

This Guide provides an overview of the new sign system and gives advice on how to design and use the signs in a consistent way. I urge all road authorities to improve the standard of traffic signing in order to make travelling in Tanzania easier and safer.

Hon. Shukuru Kawambwa
Minister for Infrastructure Development

1. INTRODUCTION

This Guide provides an introduction to the use of traffic signs in Tanzania. It covers all kinds of signs, including road markings and traffic signals. It has been written primarily for road engineers who are preparing signing schemes and designing guidance signs.

Traffic signing is a complex subject. For more comprehensive and detailed advice refer to the latest edition of the SADC Road Traffic Signs Manual (SARTSM).

Section 64 of The Road Traffic Act [CAP 168, R.E. 2002] gives the Ministry and its road agencies the power to install prescribed traffic signs. Traffic Signs Regulations will prescribe the design and meaning of each sign.

This Guide will have to be amended and revised as the road traffic system develops, and the knowledge and experience of signing increases.

2. TRAFFIC SIGNING PRINCIPLES

Clear and efficient signing is an essential part of the road system, and a road with poor signing or with badly maintained signs is not functioning well. Road users depend on signing for information and guidance, and road authorities rely on signing for traffic control and regulation, and for road safety.

The key requirements for each traffic sign are that it should:

- meet a need
- command attention
- be legible
- convey a simple, clear meaning at a glance
- be placed so as to give road users time to respond
- command respect.

Signs must only be used where there is a clear need for them. The incorrect or unnecessary use of a sign annoys drivers, and when this happens frequently, drivers lose respect for the sign and it becomes ineffective in situations where it is really needed. For the same reason, avoid using signs which impose a restriction which will be very unpopular and difficult to enforce. Drivers will stop taking signs seriously when they see others ignoring them without being caught.

Using standard signs assists in their quick recognition, as does uniformity of shape, colour and lettering for each type. To obtain the full benefits of standardisation, the signs must be used in a consistent manner.

It is important that the message be presented in a simple way. The new signs make a great use of pictorial symbols, as these are much more effective than words and can be understood by those who cannot read. Signs with words are used only where there is no alternative.

Signs must have sufficient impact to be noticed by drivers. This has been taken into account in the design of the signs, but the size and siting of the sign are also relevant. For most signs there are several permitted sizes, and it is largely the speed of the traffic at the site that determines which size is appropriate.

The symbols and legends on signs must be easy to read. This has influenced the design of the symbols, lettering, letter spacing, colours, etc., but size is again of most importance, as drivers who are travelling fast need to be able to recognise a sign from a long distance away. This

means that the symbols and lettering need to be large enough to enable drivers to recognise them at the required distance.

Traffic signs must be visible at night. They must be reflectorised so that they show up clearly in vehicle headlights.

Traffic signs should be constructed and erected so that they will last for many years without any attention apart from regular cleaning.

Refer to the Ministry's Standard Specification for Road Works 2000 for details of how traffic signs shall be constructed and installed.

3. TRAFFIC SIGN CLASSIFICATION

Figure 1 shows the general classification of traffic signs. The term "road signs" is used to mean upright signs on poles.

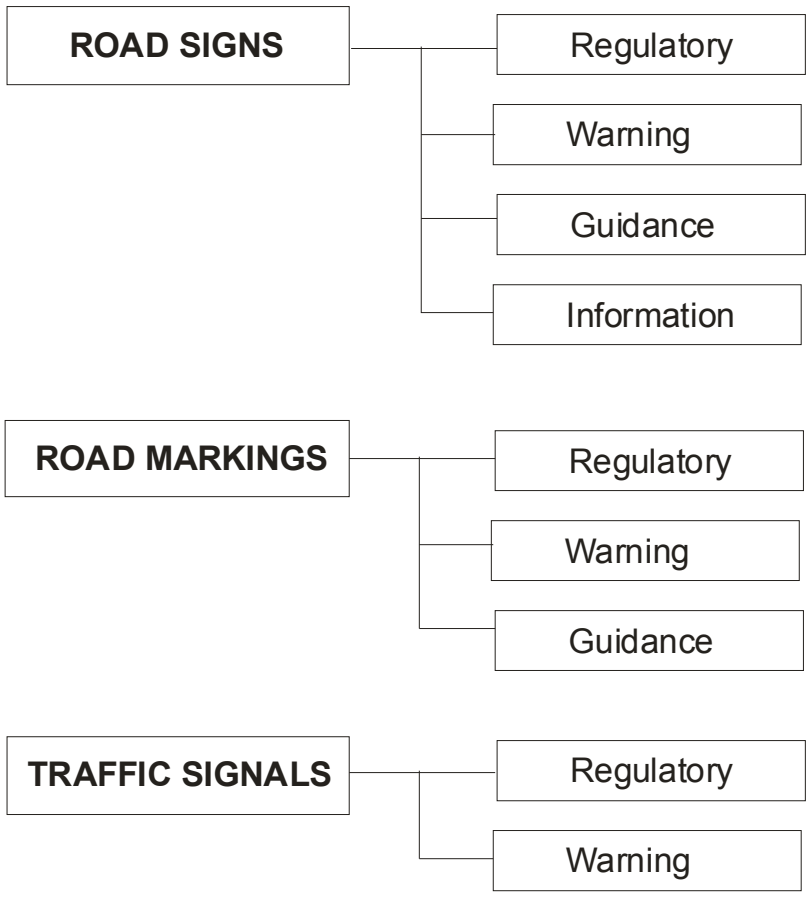


Figure 1. General Classification of Traffic Signs

4. ROAD SIGNS

4.1. Siting and Mounting of Road Signs

Introduction

General advice on sign mounting and positioning is given below, and there is more guidance in the sections of the Guide dealing with specific sign classes. It will not always be possible to follow this advice exactly, because of site constraints. Check that:

- the signs are clearly visible from the appropriate distance
- there is no confusion about which road the sign refers to
- the signs do not obstruct the view of drivers – especially at junctions
- the signs are not placed where they could be struck by vehicles.

If necessary, alter the siting or mounting to overcome the problem.

Siting

Signs should generally be sited on the left-hand side of the road. However, at sharp left-hand bends it may be better to put the sign on the right-hand side of the road where it will be more noticeable. On dual carriageway roads warning and regulatory signs should be installed in pairs – one on the left-hand side and another on the median.

Most warning signs, and some guidance signs, have to be placed in advance of the hazard or junction to which they relate. The distance depends on the speed at which traffic approaches the sign. Advice on siting distances is given in the sections of the Guide dealing with these sign classes. It is important to be consistent, so that drivers will become familiar with the rate at which they have to slow down. When signs have to be sited far away from their standard position, a supplementary plate may be used to give the distance to the site. It is better to increase the distance between a sign and the site to which it relates, rather than reduce it.

Approach speed (km/h)	Visibility distance to the sign (m)
≤ 60 km/h	60
80 km/h	80
≥ 100 km/h	100 - 150

Table 1 Visibility Distance Requirements

Regulatory signs are normally sited at or near the point where the instruction applies. Care must be taken to ensure that there is no confusion about which road they refer to.

Signs are designed to be read from a specific distance, so the sign must be sited where it can be clearly seen from this distance - see Table 1.

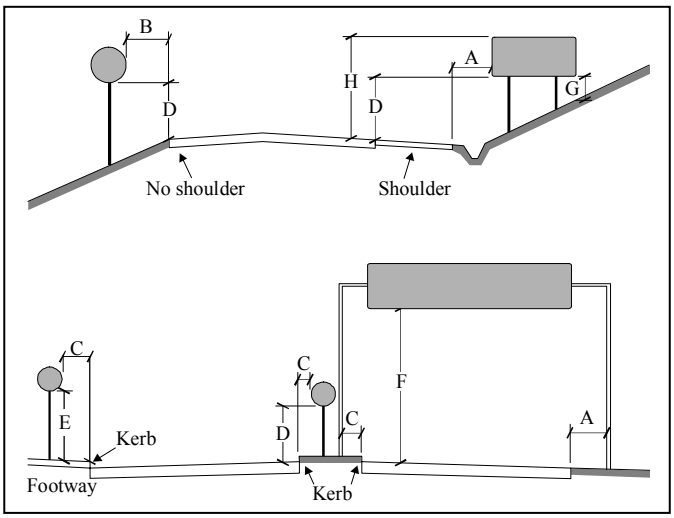
If it is necessary to use two signs at the same place, they should be spaced at least V metres apart (where V is the approach speed in km/h), so that the first one does not obscure the other. Alternatively, mount both signs on the same pole.

Avoid siting signs at places where vehicles pull off the road to park. If this cannot be avoided, consider installing guardposts around the sign to protect it from damage. Clear the area around the sign of trees, bushes and other vegetation, so as to reduce the risk of the sign being obscured or being damaged by a bush fire. When installing signs over footways try and position the supports so that they do not obstruct the movement of pedestrians.

Mounting

Heights and Side Clearances

Recommended mounting heights are given in Table 2 below. The standard mounting height is 2100mm from the lowest edge of the sign plate to the road surface.



	Minimum (mm)	Desirable (mm)	Maximum (mm)
A	600	1500	2000
B	1200	1500	2000
C	500	750	
D	600	2100	2500
E	2100	2100	3000
F	5200	5500	
G	750		
H			6000

Table 2 Heights and Clearances

Signs must be set back from the road to reduce the risk of them being hit by passing vehicles - see Table 2. Signs on traffic islands are especially vulnerable to being hit, and a small-size sign may have to be used to achieve the necessary clearance. Signs at the ends of traffic islands should be set back from the nose. Supports for overhead signs may need to be protected by safety barrier.

Multiple Signs

Where it is necessary to supplement the primary sign with a secondary sign providing additional information, it should be mounted beneath the primary sign to which it refers. Wherever possible the secondary sign should be made the same width as the primary sign - see Figure 2. The two signs can be put on separate sign plates, but it is simpler to mount them both on a single plate, and this produces a stronger sign that is less easily damaged or vandalised.

Figure 2

Two or more signs can be mounted on the same sign pole. When two warning signs are mounted together the sign at the top should refer to the nearest of the two hazards. When two signs are to be mounted on the same pole it looks neater if they are made the same width.

Backing Boards

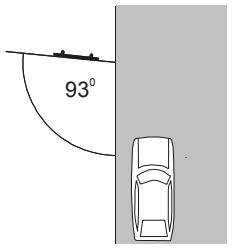
Mounting a sign on a backing board – see Figure 3 – makes it stand out against the background. However, this should only be done when it is an important sign that drivers might otherwise not notice. If backing boards are too widely used, drivers may stop noticing them. An alternative way of making a sign more visible is to make it larger than normal.

Figure 3

Angle of the Sign Plate

Sign plates are normally mounted so that they face the driver. The plate should be angled at approximately 93^0 to the direction of travel in order to avoid mirror-like glare when the sign is illuminated by vehicle headlights – see Figure 4. To obtain a 93° angle the sign should be offset by 52mm per metre of sign width. Where the sign is to be sited on the outside of a curve it should be mounted at 93^0 to the tangent to the curve from the expected point from which the sign will be read (normally about 100 - 150m from the sign).

Figure 4



4.2. Regulatory Signs

Use and Classification

Regulatory signs are used to control the actions of road users in the interests of safety and the efficient use of road space. Failure to obey regulatory signs is an offence.

There are four groups of regulatory signs – see Table 3.

Group	Sample sign	Function	Sign numbers
CONTROL		Exercise control over the right of way of traffic	R1 – R6
COMMAND		Instruct drivers what to do	R103 - R137
PROHIBITION		Instruct drivers what they must not do	R201 - R245
RESERVATION		Reserve road space for specific vehicle types	R301 - R360

Table 3 Classification of Regulatory Signs

The R1 Stop and R2 Give Way signs (Control Group) need to be much more widely used at junctions, so that drivers always know who has priority.

Secondary Message Signs

Where it is necessary to qualify the message on a regulatory sign a secondary sign, called a secondary message sign, should be added – see Figure 5. Secondary message signs always have the same colour scheme as the primary sign with which they are used. They must never be used on their own. Secondary message signs should be mounted on the same sign plate as the primary sign.

Figure 5

Temporary Signs

When Command, Prohibition and Reservation Group signs are used for temporary restrictions, such as at roadworks, they should have yellow backgrounds – see Table 4. Sign numbers for these temporary versions start with 'T' (e.g. TR201 is the temporary version of the R201 Speed Limit sign). The colours of the Control Group signs (the STOP sign etc.) do not change when the sign is used on a temporary basis.

	Command Group	Prohibition Group	Reservation Group
Border	Black	Red	Black
Background	Yellow	Yellow	Yellow
Symbol	Black	Black	Black

Table 4 Colour Code for Temporary Regulatory Signs

End of a Restriction

Many regulatory signs impose some form of restriction on road users, and this remains in force until it is removed (de-restriction) or changed by another sign. De-restriction is achieved by installing a sign that shows four black diagonal bars superimposed on a grey version of the restriction sign - see R214-600 in the Schedule of Regulatory Signs.

Siting and Sizes

Regulatory signs are normally sited on the left-hand side at or near the point where the instruction applies. It is important to make sure that there is no confusion about which road they refer to. Drivers must be able to see the sign in time to read the message and act on it.

A second sign on the right-hand side may be used where extra emphasis is needed – examples include speed limit signs at the entrance to a village on a high-speed road, and the No Entry signs used to stop drivers going the wrong way along a one way street. On dual carriageway roads, signs should be installed in pairs – one on the left-hand side and another on the median.

Table 5 gives the recommended sizes for standard regulatory signs. Larger than normal signs may be used where extra emphasis is needed.

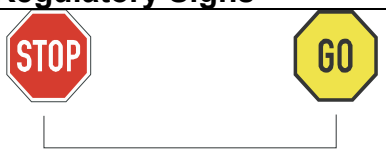
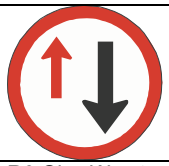
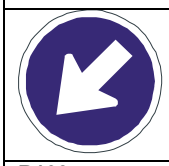
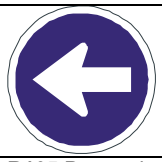
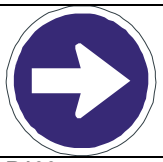
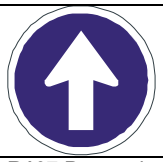
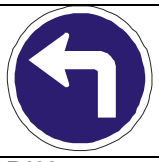
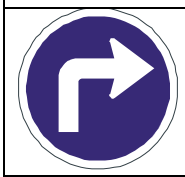
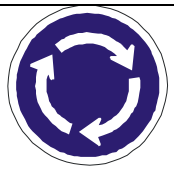
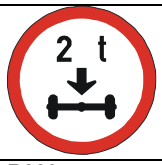
Approach speed	Circular sign (diameter) (mm)	Rectangular sign (H x W) (mm)
≤ 60 km/h	600 *(900 on 3-lane roads and dual carriageways)*	600 x 450
80 km/h	900	900 x 675
≥ 100 km/h	1200	1200 x 900
Overhead signs	*1600*	*1600 x 1200*

Table 5 Sizes of Standard Regulatory Signs

Reduced sizes are recommended for:

(a) Signs on traffic signal heads – 300mm diameter
(b) Keep Left signs on traffic bollards – 300mm diameter
(c) Parking signs – 450mm diameter and 450 x 340mm

Schedule of Regulatory Signs

					
R1 Stop	**R1.5** (Stop / Go Control)		**R2** Give Way	**R3** No Entry	**R4.1** One-Way (Left)
					
R4.2 One-Way (Right)	**R4.3** One-Way (Straight On)	**R6** Give Way to Oncoming Traffic			
					
R103 Keep Left	**R104** Keep Right	**R105** Proceed Left Only	**R106** Proceed Right Only	**R107** Proceed Straight Only	**R108** Turn Left Ahead
					
R109 Turn Right Ahead	**R110** Pedestrians Only	**R111** Cyclists Only	**R121** Buses Only	**R137** Roundabout	
					
R201 Speed Limit	**R202** Mass Limit	**R203** Axle Load Limit	**R204** Height Limit	**R205** Length Limit	**R206** No Excessive Noise
					
R209 No Left Turn Ahead	**R210** No Right Turn Ahead	**R211** No Left Turn	**R212** No Right Turn	**R213** No U-turn	**R214** No Overtaking
					
R216 No Parking	**R217** No Stopping	**R218** No Pedestrians	**R219** No Cyclists	**R220** No Cyclists and Pedestrians	**R222** No Motorcycles

					
R223 No Motor Cars	**R224** No Taxis	**R225** No Minibuses	**R227** No Buses	**R229** No Goods Vehicles	**R239** Width Limit
					
R242 No Motor Vehicles	**R245** Bogie Weight Limit	**R214-600** End of Restriction (example)			
					
R301 Area Reserved for Buses	**R301-P** Bus Parking Area	**R302** Bus Lane	**R303** Start of Bus Lane	**R304** Bicycle Lane	**R325** Bus Stop
					
R305-P Parking	**R306-P** Limited Duration Parking	**R308-P** Car Park	**R309-P** Parking Area for Taxis	**R310** Area Reserved for Minibuses	**R310-P** Parking Area for Minibuses
					
R312 Area Reserved for Use by Delivery Vehicles	**R313** Area Reserved for Use by Goods Vehicles	**R313-P** Goods Vehicle Parking	**R323-P** Disabled Persons Vehicle Parking	**R360** Pedestrian (zebra) crossing	

SECONDARY MESSAGE SIGNS FOR USE WITH REGULATORY SIGNS
Colours: border, background and text/symbol as for primary sign

					
(R)501 One Time Period	**(R)502** Two Time Periods	**(R)503** Two Time Periods	**(R)506** Max. Stay During One Time Period	**(R)520** Reserved Movement Left **(R)521** Right	**(R)522** Reserved Movement in Both Directions
					
(R)535 Distance over which the limit applies	**(R)560** Bus (message on primary sign applies to buses)	**(R)561** Bicycle	**(R)562** Motorcycle	**(R)563** Motor Car	**(R)564** Taxi

					
(R)565 Minibus	**(R)567** Delivery Vehicle	**(R)568** Goods Vehicle	**(R)569** Goods Vehicle Over Indicated Gross Vehicle Mass	**(R)570** Construction Vehicle	

4.3. Warning Signs

Use and Classification

Warning signs are used to alert drivers to danger or potential danger ahead. They indicate a need for extra caution by road users and may require a reduction in speed or other manoeuvre. Adequate warning signs can greatly assist road safety. To be most effective however, they should be used sparingly. Do not use warning signs in situations where the problem is obvious, or is so minor that no extra care is necessary. Side road junctions for example are not usually a danger when traffic speeds are low.

There are two groups of Warning Signs:

Group	Sample sign	Description	Sign numbers
Advance Warning Signs		Road Layout	W100 Series
		Movement	W200 Series
		Symbol	W300 Series
Hazard Marker Signs		Curve and object markers etc.	W400 Series

Table 6 Classification of Warning Signs

Hazard marker signs, including delineator posts, should be much more widely used in Tanzania, as they are of great help to drivers, especially at night.

Supplementary Plates

Supplementary plates that provide additional information may be used beneath the primary sign – these belong to the Information Signs Group. A typical example is the IN11.3 "Distance to" sign which can be used to tell drivers the distance to the hazard.

Temporary Signs

When warning signs are used for temporary situations they shall have yellow backgrounds instead of white backgrounds. Signs that are only used temporarily, such as the TW336 Roadworks sign, always have yellow backgrounds.

Siting and Sizes

It takes time for a driver to act on the message given by a warning sign and slow the vehicle down to a safe speed. Therefore signs must be sited sufficiently far ahead of the hazard to allow for this. Signs must also be large enough to be read clearly by drivers travelling at above average speeds. Table 7 gives the siting distances and sizes of standard warning signs for different traffic speeds. Where extra emphasis is required use the next larger size to that indicated in the Table, or mount the sign on a high visibility backing board. If it is necessary to site the sign a long way away from the standard position, the distance to the hazard should

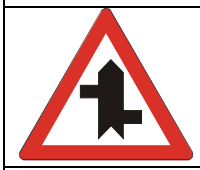
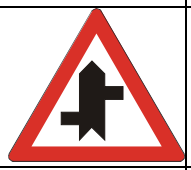
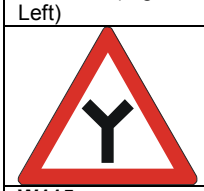
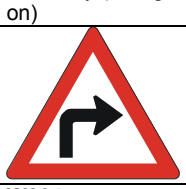
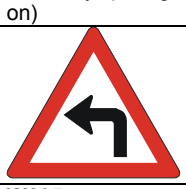
be indicated on a supplementary plate. Hazard marker warning signs should be located close to the hazard.

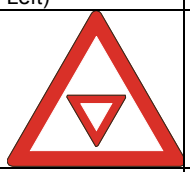
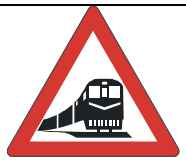
Approach speed	**Distance of sign from hazard (m)**[1]	**Advance warning signs - side length (mm)**	**Hazard marker signs** width height			
			W401 W402	W405 W406	W407 W408	W409[2] W410
≤ 60 km/h	100	900	200 800	400 400	1200 400	2400 400
80 km/h	160	1200	250 1000	600 600	1800 600	3600 600
≥ 100 km/h	240	1500	300 1200	800 800	2400 800	4800 800

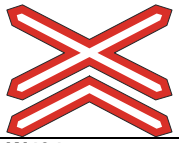
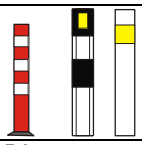
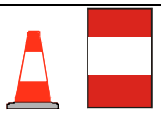
[1] *Does not apply to hazard markers* [2] *When used underneath a direction sign the sign shall be adjusted to equal the length of the direction sign*

Table 7 Siting and Sizing of Warning Signs

Schedule of Warning Signs

 **W102** Crossroads on Priority Road	 **W104** T-junction	 **W105** Skew T-junction (Right)	 **W106** Skew T-junction (Left)	 **W107** Side Road Junction (Left)	 **W108** Side Road Junction (Right)
 **W109** Staggered Junctions (Right-Left)	 **W110** Staggered Junctions (Left-Right)	 **W111** Sharp Junction (Half Left)	 **W112** Sharp Junction (Left)	 **W113** Sharp Junction (Half Right)	 **W114** Sharp Junction (Right)
 **W115** Y-junction	 **W116** End of Dual Roadway (To Right)	 **W117** End of Dual Roadway (Straight on)	 **W118** Start of Dual Roadway (Straight on)	 **W119** Start of Dual Roadway (To Left)	 **W201** Roundabout
 **W202** Gentle Curve (Right)	 **W203** Gentle Curve (Left)	 **W204** Sharp Curve (Right)	 **W205** Sharp Curve (Left)	 **W206** Hairpin Bend (Right)	 **W207** Hairpin Bend (Left)

					
W208 Winding Road (Right – Left)	**W209** Winding Road (Left – Right)	**W210** Combined Curves (Right – Left)	**W211** Combined Curves (Left – Right)	**W212** Two-Way Traffic	**W213** Two-Way Traffic Crossroads
					
W301 Traffic Signals Ahead	**W302** Traffic Control "Stop" Ahead	**W303** Traffic Control "Give Way" Ahead	**W306** Pedestrian Crossing	**W307** Pedestrians	**W308** Children
					
W309 Cyclists	**W310** Domestic Animals	**W313** Wild Animals	**W318** Railway Crossing	**W319** Tunnel	**W320** Height Restricted
					
W321 Length Restricted	**W322** Steep Descent	**W323** Steep Ascent	**W326** Narrow Bridge	**W327** One Vehicle Width Structure	**W328** Road Narrows Both Sides
					
W329 Road Narrows From Right Side	**W330** Road Narrows From Left Side	**W331** Uneven Roadway	**W332** Road Humps	**W333** Slippery Road	**W334** Falling Rocks (From Right)
					
W335 Falling Rocks (From Left)	**TW336** Roadworks	**TW338** Loose Stones	**W339** General Warning	**TW340** Edge Drop	**TW343** "Stop/Go" Control Ahead
					
W348 Jetty Edge or River Bank	**W349** Crosswinds	**W350** Drift	**W351** Low Flying Aircraft	**W352** Agricultural Vehicles	**TW353** Road Crash

					
W355 Traffic Queue	**W360** Width Restriction	**W365** Opening Bridge			
					
W401 Danger Plate / Delineator Plate (Left)	**W402** Danger Plate / Delineator Plate (Right)	**W403** Railway Crossing	**W404** Railway Crossing (more than one track)	**W405** Sharp Curve Chevron (Single) (To the Right)	**W406** Sharp Curve Chevron (Single) (To the Left)
					
W407 Sharp Curve Chevron (Triple) (To the Right)	**W408** Sharp Curve Chevron (Triple) (To the Left)	**W409** T-junction Chevron		**W410** Road Closed Chevron	
					
TW411 Barricade	**W413** Pass Either Side	**W415** Overhead Danger Plate	**D3** Delineators	**TD4** Traffic Cones and Drums	

4.4. Guidance Signs

Use and Classification

Guidance signs give road users information on how to find their way to their destination. They also help to reduce delay and keep traffic flowing smoothly and safely through junctions. Guidance signs belong to one of five groups:

Group	Sample sign[1]	Description	Sign number prefix
LOCATION		Place names, river names	GL
DIRECTION		Direction signs before and at junctions	GD
TOURISM		Directions to tourist attractions, services and facilities	GF
LOCAL DIRECTION		Direction signs for minor, local destinations in urban areas	GDL
DIAGRAMMATIC		Signs warning of a change in road layout ahead (e.g. start and finish of climbing lane)	GS

[1] *Temporary signs will normally have black letters on a yellow background and a black border*

Table 8 Classification of Guidance Signs

Direction Signs - Types and Siting

Direction Signs are one of the most important groups of Guidance Signs. They include:

- Advance direction signs (GD1, GD5, GD8) - these give route information to drivers approaching a junction, and are normally sited as follows:

Approach speed	Distance of sign from junction (m)
≤ 60 km/h	50 - 90
80 km/h	90 - 150
≥ 100 km/h	150 - 220

- Direction signs (GD2, GD4) - these give route information at the junction and often point along the route referred to
- Confirmation signs (GD3) - these list the destinations ahead, and are placed about 100m after important junctions, and at intervals along the road.

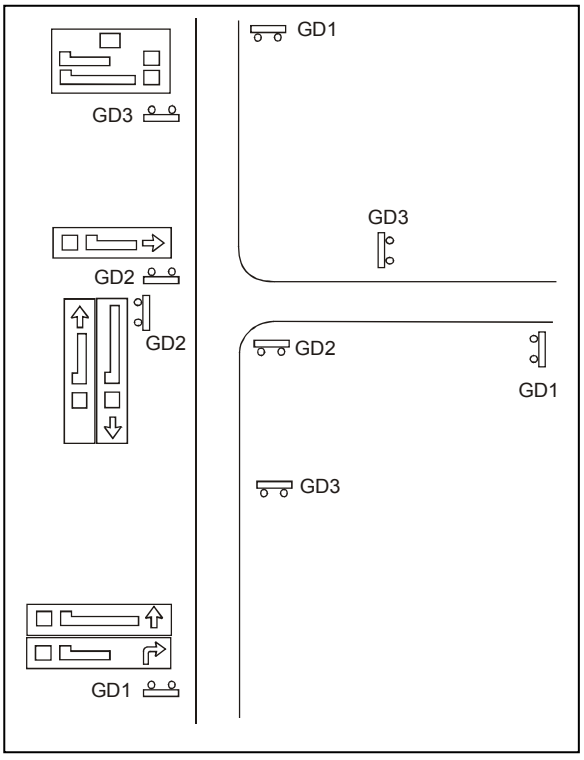


Figure 6 Typical Layout of Direction Signs at a Major Junction in a Rural Area

Notes:
1. At less important junctions, or on minor road approaches to junctions, the GD1 signs may be replaced by a warning sign (W104, W107, W108 or other appropriate to the junction layout)
2. At junctions with minor, local roads, the GD1 sign may be replaced by the appropriate warning sign, and the GD2 sign may be replaced by the GD4 Fingerboard sign
3. Where the junction is a roundabout or has a complex layout the appropriate map-type sign (e.g. GD8) should be used instead of GD1
4. A W409 chevron sign may be added below the GD2 sign that faces the traffic approaching along the stem of the T-junction
5. GD3 Confirmation signs are normally used only at major junctions.

Sizes and Design Principles

There are no standard sizes for text-based guidance signs. The size depends on the amount of text, and the size of the lettering.

General guidance on lettering size is given in Table 9, but refer to Section 4.4, Chapter 4, Volume 1, SARTSM for more detailed recommendations.

Approach speed	Typical situation	Capital letter height (mm)	Lower case letter height (mm)
< 50 km/h	Very minor roads	112	80
50 km/h	Local urban and rural roads	140	100
60 km/h	Urban and rural 2-lane roads and urban dual carriageways	175	125
80 km/h	Good standard rural main roads	210	150
≥ 100 km/h	High standard rural main roads, and all signs mounted overhead	280	200

Table 9 General Guidance on Lettering Size

Once the lettering size has been chosen, the design should proceed according to the layout rules set out in Section 4.3, Volume 1, SARTSM. Most Direction and Local Direction signs take the form of a stack of panels, each one with an arrow and associated destination(s) - these are called "stack-type signs." Section 4.3, SARTSM provides two alternative sets of layout rules for these signs. The "recommended rules" produce large signs with optimum readability, whereas the "intermediate rules" result in smaller signs that are not quite as easy to read. Given that sign materials are very expensive it is advisable to use the "intermediate rules."

Ideally, no more than four destinations should appear on one sign - and no more than two destinations should be given for any one direction (except on GD3 Confirmatory signs). Where two or more destinations are shown for one direction the nearest destination will be at the top. Signs should display the route number of trunk roads - in yellow.

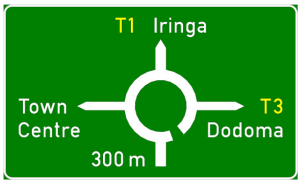
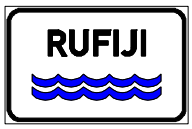
Signs depicting a map of the junction (e.g. GD5, GD8) should always be used in preference to stack-type signs for roundabouts or other complex layouts. They are generally larger than stack-type, and thus more expensive, but they give drivers a better understanding of how the junction is laid out.

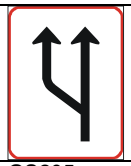
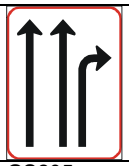
Where a junction has advance direction signs as well as direction signs, the direction signs can have lettering that is one size class below that of the advance direction signs - because the advance directions signs will have had the effect of slowing down those drivers that are turning at the junction.

Symbols for Facilities and Tourist Attractions

Symbols are an efficient way to show directions to facilities and attractions. Priority should be given to signing major traffic generators, (bus termini, airports, etc.) and emergency services (major hospitals and police stations). Tourism signs (brown background) should be used to sign general services for travellers (rest areas, petrol stations, refreshments) and all kinds of tourist attractions. A few examples of symbols are shown in the Schedule of Guidance Signs, but refer to Chapter 4, Volume 1, SARTSM for details of the full range.

Schedule of Guidance Signs

		
GD1 Stack-Type Advance Direction Sign	**GD1** Stack-Type Advance Direction Sign with one cross street name	**GD2** Stack-Type Direction Sign with Tourist Destination Panel
		
GD2 Stack-Type Direction Sign	**GD2** Stack-Type Direction Sign with Chevron (for use at T-junctions)	**GD2** Stack-Type Direction Sign with street name
		
GDL2 Stack-Type Direction Sign – Local Roads	**GD3** Confirmation Sign	**GD4** Fingerboard - minor destinations **GDL3** Fingerboard - minor, local destinations
		
GD5 Map-Type Advance Direction Sign - Crossroads	**GD8** Map-Type Advance Direction Sign - Roundabout	**GF2** Stack-Type Direction Sign – Tourist Attractions, Services and Facilities
		
GF3 Final Turn Sign – Tourist Attractions, Services and Facilities	**GL3** Town or Village Name	**GL4** River Name

					
GS101 Left-hand lane ends	**GS205** Lane added on left hand side	**GS805** Lane pre-selection sign (example)	**GFS B1-2** Police symbol	**GFS B1-3** Hospital symbol (with name)	**GFS B1-4** First Aid Post

					
GFS B2-1 Filling station and workshop	**GFS B3-1** Truck rest and service area	**GFS B4-1** Restaurant	**GFS B4-2** Refreshments	**GFS B4-3** Take-away	**GFS B4-4** Rural shop / cafe
					
GFS B5-1 Parking	**GFS B5-2** Toilets	**GFS B5-7** Picnic area	**GFS B5-8** Tourist information	**GFS B5-9** Facility for the handicapped	**GFS B6-3** Rest and service area

4.5. Information Signs

Use and Classification

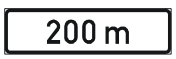
The most common type of information sign is the supplementary plate that provides additional information to that given on the primary sign. A typical example is the IN11.3 "Distance to" sign which is sometimes used with warning signs to tell drivers the distance to the hazard. Other information signs indicate the presence of an information centre or other facility.

Sizes and Design Principles

Supplementary plates have black lettering, symbol and border on a white background. The width of supplementary plates should normally match that of the primary sign, but make sure that the text on a supplementary plate is large enough to be read by drivers. The standard text size is a capital letter height of 140mm and a lower case letter height of 100mm. There should normally be no more than two lines of text. When the supplementary plate is to be used with a small sign, such as a 600mm diameter regulatory sign, it is permissible to reduce the text size to 112mm / 80mm and condense the lettering slightly.

Other information signs, such as the cul-de-sac signs, are normally 600mm (h) by 450mm (w) and have white symbols and border on a green background. If additional information signs are needed they should follow the design of IN12 and IN16. Symbols shall be used instead of text wherever possible.

Schedule of Information Signs

					
IN4 Cul-de-sac	**IN5** Cul-de-sac	**IN6** Cul-de-sac	**IN12** Information Centre	**IN16** Bus Stop Ahead	**IN20** Oncoming vehicles are required to give way
					
IN11.1 Supplementary. Plate-Advisory speed	**IN11.2** Supplementary. Plate-Distance "For"	**IN11.3** Supplementary. Plate-Distance "To"	**IN11.4** Supplementary. Plate-Text Message (example)	**IN11.568** Supplementary Plate-Vehicle Class (example)	**IN11.502** Arrow left **IN11.503** Arrow right

4.6. Road Sign Materials and Manufacture

Sign Specifications

Section 5500 of the Ministry's Standard Specifications for Road Works, 2000 sets out detailed standards for the manufacture and installation of road signs. Strict adherence to these standards will ensure that the signs are of good quality and will have an acceptable working life. This section of the Traffic Signs Guide contains general advice on sign materials and manufacture, but in all cases the Standard Specifications take precedence. The components of a traffic sign are:

- sign face
- sign plate
- sign support frame
- sign post.

Sign Face Materials

It is recommended that all traffic signs, permanent and temporary, be fully reflectorised by making the sign face from retroreflective sheeting. This is a special type of reflective material that reflects light back to the light source, which in this case is the vehicle headlight. For simplicity the sheeting will be referred to hereafter as reflective sheeting. All parts of the sign face except those coloured black should normally be made of reflective sheeting, so that the sign looks the same in both day and night. Map-type direction signs can be very large, and, if it is too costly to make these fully reflective, it is permissible to reflectorise only the text, symbols and border.

There are various grades of reflective sheeting available, each providing different levels of retroreflectivity when viewed under standard conditions. The Standard Specifications require that High Intensity Grade be used, and this is defined by reference to standards used in the United States. The contractor must submit sign specifications, test certificates, and warranties, as required in the Standard Specifications. The warranty must say that, if the retroreflective performance of the sign falls below a specified minimum during the warranty period (normally 10 years), the sheeting manufacturer will replace the sign or restore it to its original performance. This is the best way of ensuring that the signs will be of proper quality.

Coloured areas should preferably be made from sheeting of the appropriate colour or by applying coloured overlay film onto white sheeting. They can also be created by applying coloured ink to white sheeting. Symbols or letters coloured black shall preferably be made from black non-reflective overlay film. Film, ink and sheeting shall come from the same manufacturer and be applied in accordance with their instructions.

It is important to use standard colours on traffic signs, though the small variations that occur between sheeting from different manufacturers are permissible.

Sign Plate

Aluminium alloy sheet is the preferred material, because of its resistance to corrosion. However, it is expensive. Cheaper alternatives are galvanised steel, plastic-coated steel, or steel treated with primer. The cleaning and preparation of steel plates needs to be of a very high standard, but even then there will always be a risk that the plate will corrode around the bolt holes or places where the coating has been damaged. With all materials, proper cleaning and degreasing is essential to ensure good adhesion of the sheeting. The back of the sign plate shall be painted grey, and the sign manufacturer’s name and the date of manufacture shall be permanently marked on it.

Sign Support Frame and Fastenings

All sign plates, with the exception of very small ones, need to be stiffened so as to prevent them from being deformed by wind pressure, minor collisions, or attack by vandals. This is normally done by riveting the sign plate to a back support frame made of angle iron or aluminium sections. It is essential that all frames, brackets, clips, rivets, nuts, bolts and washers be corrosion-proofed if not made of aluminium or stainless steel. The frames and brackets shall then be painted grey. The method of fixing to the post shall be as shown on the scheme drawings or be as approved by the engineer in charge of the scheme.

Sign Post

Sign posts will normally be made of galvanised steel tube set in concrete foundations.

Anti-theft Precautions

Theft of signs and posts is a problem in some parts of Tanzania. It may help to mount the sign plate high up out of easy reach, spot-weld the nuts onto the fixing bolts, and fill the posts with concrete. Drilling many holes in the sign plate in order to reduce its usefulness as a roofing sheet should only be done if all other measures fail.

Checklist of Sign Supply Requirements

It is recommended that contractors be asked to provide the following information and items before manufacturing and supplying signs:

- name of sign manufacturer and sheeting manufacturer
- retroreflective performance of the sheeting, as determined by a reputable laboratory
- letter of warranty, endorsed by the sheeting manufacturer, specifying the minimum retroreflective performance at the end of the warranty period (the warranty should be specific to the contract)
- a sample of the reflective sheeting for each colour to be used
- a sample sign
- details of the sign plate stiffening and fastenings (unless included in the drawings)
- a written declaration that the signs to be supplied will meet all the requirements of the specifications.

5. ROAD MARKINGS

5.1. Purpose and Classification

Road markings can be used to control, warn, or guide road users. Regulatory markings have legal backing, so a driver who disobeys the instruction is committing an offence. Other markings are for guidance only. Markings comprise longitudinal lines (centre lines, edge lines, etc.) transverse lines (stop lines, and give way lines, etc.) and other types, such as arrows, symbols, patterns and words. Longitudinal lines are good for giving a continuing message to the driver - for example they can be used to guide drivers in the correct positioning of their vehicles so that the traffic flows more smoothly and safely. Roadstuds can be used to make longitudinal lines more effective.

Road markings have the limitation that they get covered up by dirt, and they wear away quite quickly on heavily-trafficked roads. Nevertheless, they serve a very important function in conveying to drivers information and requirements which might not otherwise be possible by post-mounted signs - and there is little risk of them being vandalised or stolen.

Where traffic congestion occurs, extensive use of road markings is essential to ensure that full use is made of the available road space. In particular, widespread use of lane markings is desirable; by enhancing lane discipline they add to the safety of traffic, besides improving traffic flows. And at junctions transverse road markings can be very useful in showing drivers exactly where to stop or give way. Improving the road markings is often one of the most cost-effective ways of treating sites with traffic and safety problems.

It is strongly recommended that road markings be considered in detail at the design stage of new or improved junctions.

5.2. Sizes and Design Principles

Key requirements for road markings include:

- good visibility by day and night
- good skid resistance
- durability
- clarity of message
- symbols and words should be elongated in the direction of traffic (usually by a factor of three times whilst retaining the original width).

The design principles for line markings are:

- broken longitudinal lines are permissive in character
- continuous solid longitudinal lines are restrictive in character
- double continuous solid longitudinal lines indicate maximum levels of restriction
- the width of the line is an indication of the degree of emphasis attached to the marking.

General guidance on the size of markings is given in Table 10, but refer to Chapter 7, Volume 1 and Chapter 12, Volume 4, SARTSM for more comprehensive coverage.

Marking Number	Colour	Description	Dimension (mm)			
			Rural (speed > 60 km/h)		Urban (speed ≤ 60 km/h)	
			Width	Line-Gap	Width	Line-Gap
RTM1	White	Stop Line	500		300	
RTM2	White	Give Way Line	300	600-300	200	600-300
RTM4	White	Pedestrian (Zebra) Crossing	3000 4000	600-600	3000 4000	600-600
RM1	White	No Overtaking Line	150 100		150 100	
RM2	White	No Crossing Lines	2 x 150 (170 apart) 2 x 100 (120 apart)		2x150 (170 apart) 2x100 (120 apart)	
RM3	White	Channelizing Line	200 150 100		200 150 100	
RM4.1	Yellow	Left Edge Line	150 100		100	
RM4.2	White	Right Edge Line	150 100		100	
RM5	Line: White Bar: Yellow	Painted Island	edge line:150 100 bar:300 200	bar width to space: 1:2	edge line: 150 100 bar:200 150	bar width to space: 1:2
RM6	White	Parking Bays	100		100	
RM9	Yellow	Exclusive Use Lane Line	N/A		150	750-750
RM10	Yellow	Box Junction	N/A		border:200 diagonals: 150	
RM11	White	Zig Zag Zone Line	100	2000-150	100	2000-150
RM13	Yellow	No Parking Line (24hr) No Parking Line (selective times)	100 100	 4000-2000	100 100	 4000-2000
WM2	White	Continuity Line	300 200	2000-2000 2000-4000	200	1500-1500 1500-3000
WM3	White	Dividing Line	150 100	4000-8000	150 100	3000-6000
WM12	Yellow	Rumble Strip	4 x 150 (400 apart)		4 x 150 (400 apart)	
GM1	White	Lane Line	150 100	2000-4000	150 100	1500-3000
GM2	White	Guide Line	100	500-1500	100	500-1500
GM8	Black/white	Kerbface Marking	Black: 600 1000 White: 600 1000		Black: 600 1000 White: 600 1000	
			Length		**Length**	
RM8	Yellow	Mandatory Direction Arrows	4000		4000 2500	
RM17	Yellow	Exclusive use lane symbol	N/A		1600 (cycle) 4000 (bus)	
WM1	White	Railway Crossing Ahead	7500 line width:400		4000 line width:200	
WM5	White	Give Way Control Ahead	4000		2500	
WM6	White	Lane Reduction Arrow	6000		4000	
WM7	White	Lane Direction Arrow	4000		4000 2500	
WM8	White	No Overtaking Line Ahead	4000		3000	
WM10	White	Road Hump	1500 square: 500x500		1500 square: 500x500	
WM11	White	End of Exclusive Use Lane Arrow	N/A		WM11.1: 7200 WM11.2: 6000	
GM3	White	Bifurcation Arrow	5000		4000	
GM6	White	Cycle Facility	N/A		1600	
GM7	White	Word Marking	4000		4000 2500	
GM9	White	Speed Limit	7500 symbol width: 1500		4300 symbol width: 1500	

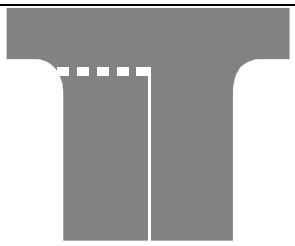
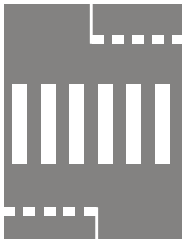
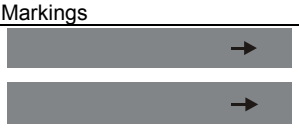
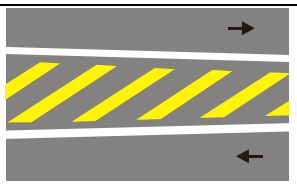
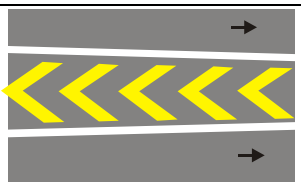
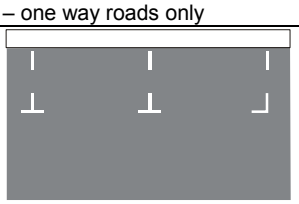
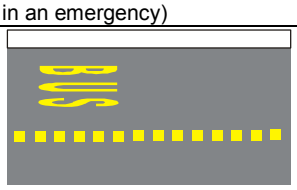
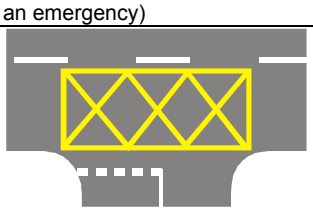
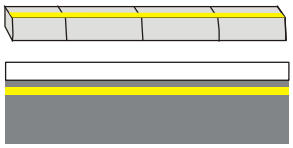
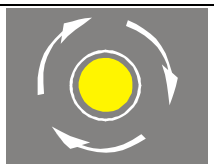
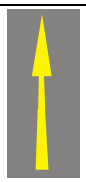
Table 10 General Guidance on Size of Markings

A Dividing Line should be marked on the centreline of all two-way surfaced roads with a surface width of 5.5m or more. See Section 5.4 for details of centreline markings to control overtaking.

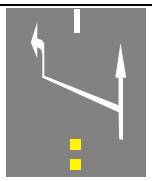
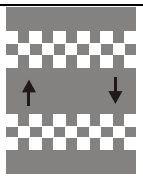
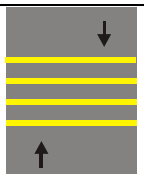
When longitudinal lines need to be re-aligned, such as when lanes are added or dropped, or traffic needs to be diverted around a traffic island, the preferred taper rate is 1 in 35 (or 1 metre of lateral shift for every 35 metres longitudinal distance). The minimum taper rate is 1 in 25, and this should only be used on roads with speeds less than 80 km/h.

5.3. Schedule of Road Markings

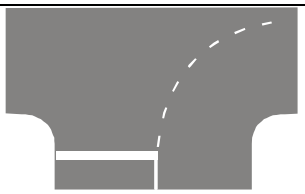
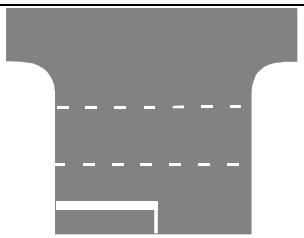
Regulatory markings

			
RTM1 Stop Line	**RTM2** Give Way Line	**RTM4** Pedestrian Crossing (zebra) Markings	
			
RM1 No Overtaking Line	**RM2** No Crossing Lines	**RM3** Channelizing Line (do not cross)	**RM4.1** Left Edge Line **RM4.2** Right Edge Line (white) – one way roads only
			
RM5.1 Channelizing Island (do not drive over the marking except in an emergency)	**RM5.2** Channelizing Island (do not drive over the marking except in an emergency)	**RM5.3** Channelizing Island (do not drive over the marking except in an emergency)	**RM6** Parking Bays
			
RM9 Exclusive Use Lane Line Plus Word Marking **RM17.2**	**RM10** Box Junction (do not enter the box unless your exit is clear)	**RM11** Zig Zag Zone Line on approach to zebra crossing (do not stop except to allow pedestrians to cross)	**RM13** No Parking Line (no parking at any time)
		 	 
RM13 No Parking Line (selective times – as shown on secondary message sign to R216)	**RM15** Roundabout Mandatory Direction Arrows	**RM8.1** Mandatory Direction Arrow (left) **RM8.5** (right)	**RM8.2** Mandatory Direction Arrow (ahead and left) **RM8.4**(ahead and right)	**RM8.3** Mandatory Direction Arrow (ahead)	**RM17.1** Exclusive Use Lane Symbol - Bicycle **RM17.2** - Bus

Warning markings

							
WM1 Railway Crossing Ahead		**WM2** Continuity Line – between through lanes and turning lanes/lay-bys/junction mouths		**WM3** Dividing Line – between traffic moving in opposite directions		**WM5** Give Way Control Ahead	
							
WM6.4 Lane Reduction Arrow (right) **WM6.5** (left)	**WM7.1** Lane Direction Arrow (left) **WM7.5** (right)	**WM7.2** Lane Direction Arrow (ahead and left) **WM7.4**(ahead and right)	**WM7.3** Lane Direction Arrow (ahead)	**WM8.1** No Overtaking Line Ahead	**WM11.1** End Of Exclusive Use Lane (left turn) **WM11.2** (ahead)	**WM10** Speed Hump	**WM12** Rumble Strip

Guidance markings

			
GM1 Lane Line	**GM2.1** Turning Guide Line	**GM2.2** Pedestrian Guide Line	**GM3.1** Bifurcation Arrow (left) **GM3.3** (right)
			
GM6.1 Cycle Facility	**GM7** Word Marking	**GM8** Kerbface Marking	**GM9** Speed Limit Marking (example)

5.4. No Overtaking Lines

One of the markings with special importance for safety is the RM1 No Overtaking Line, which is a continuous white line. This imposes a mandatory requirement that drivers keep to the left of the line unless they are turning into or out of a side access. These lines shall be provided at places where overtaking must be prohibited because of dangerously restricted sight distances or other hazardous conditions. In the case of vertical and horizontal curves the RM1 line should be used where the sight distance is less than the value given in Table 11.

Traffic speed	Sight distance (m)[1]
50 km/h	150
60 km/h	180
80 km/h	250
100 km/h	300
120 km/h	400

Table 11 Warrants for RM1 No Overtaking Line

[1] Measured between a point 1.05m high (equivalent to eye height) and a point 1.3m high (equivalent to vehicle height)

The minimum length of RM1 line on vertical and horizontal curves is 150m, and the absolute minimum distance between successive RM1 lines is 120m. When the RM1 line is used on the approach to junctions a minimum length of 24m is recommended, but at higher traffic speeds this should be increased to 60m or more.

Except at junctions, the RM1 line will normally be used in a double line system - see Figure 7. When two RM1 lines are needed (one for each direction) the combined marking is termed an RM2 No Crossing Line.

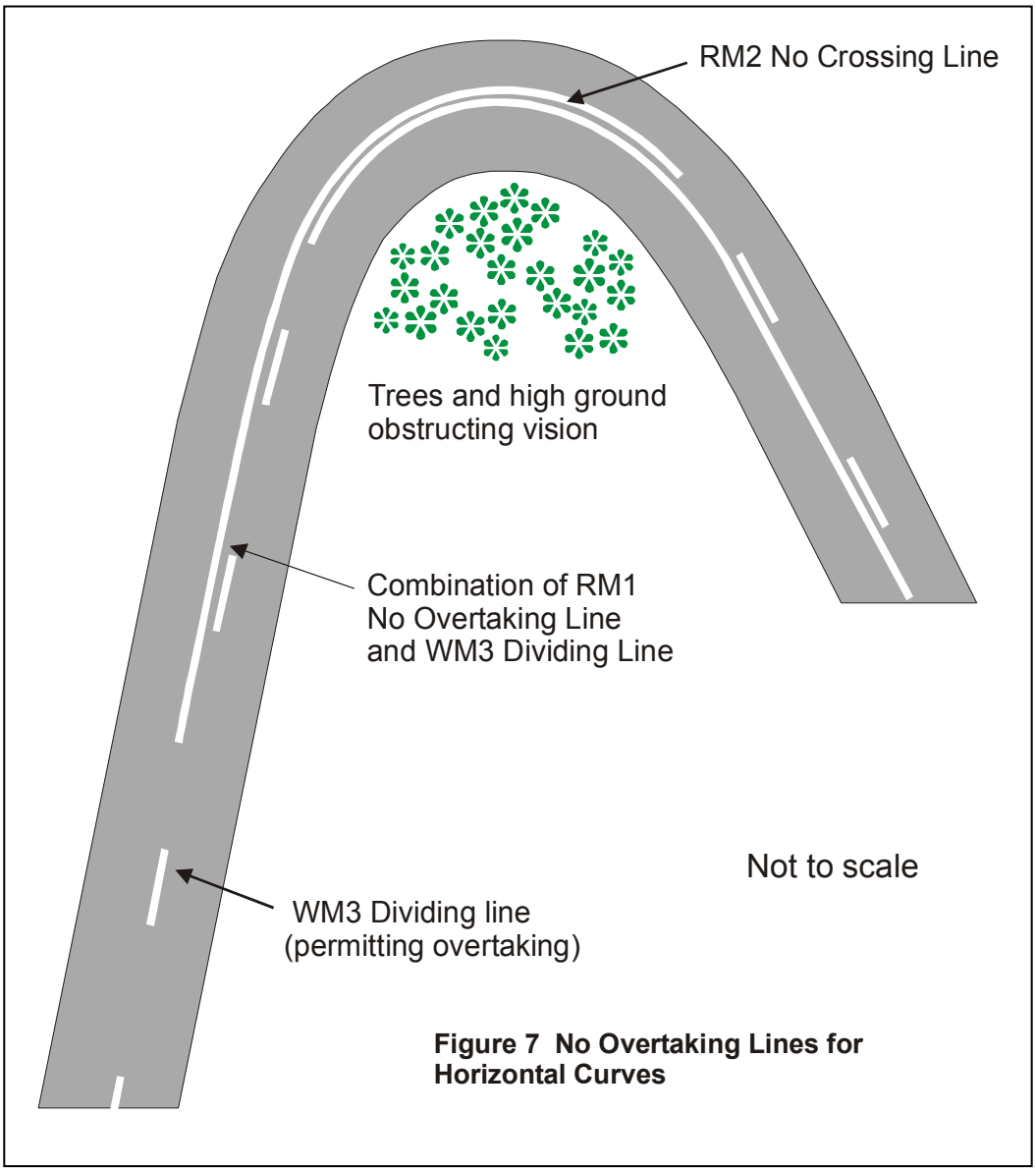


Figure 7 No Overtaking Lines for Horizontal Curves

5.5. Markings at Junctions

The basic layout principles for road markings at junctions are illustrated in Figure 8 (a simple rural T-junction) and Figure 9 (a signalised cross-roads in an urban area). For further information refer to Chapter 7, Volume 3 SARTSM.

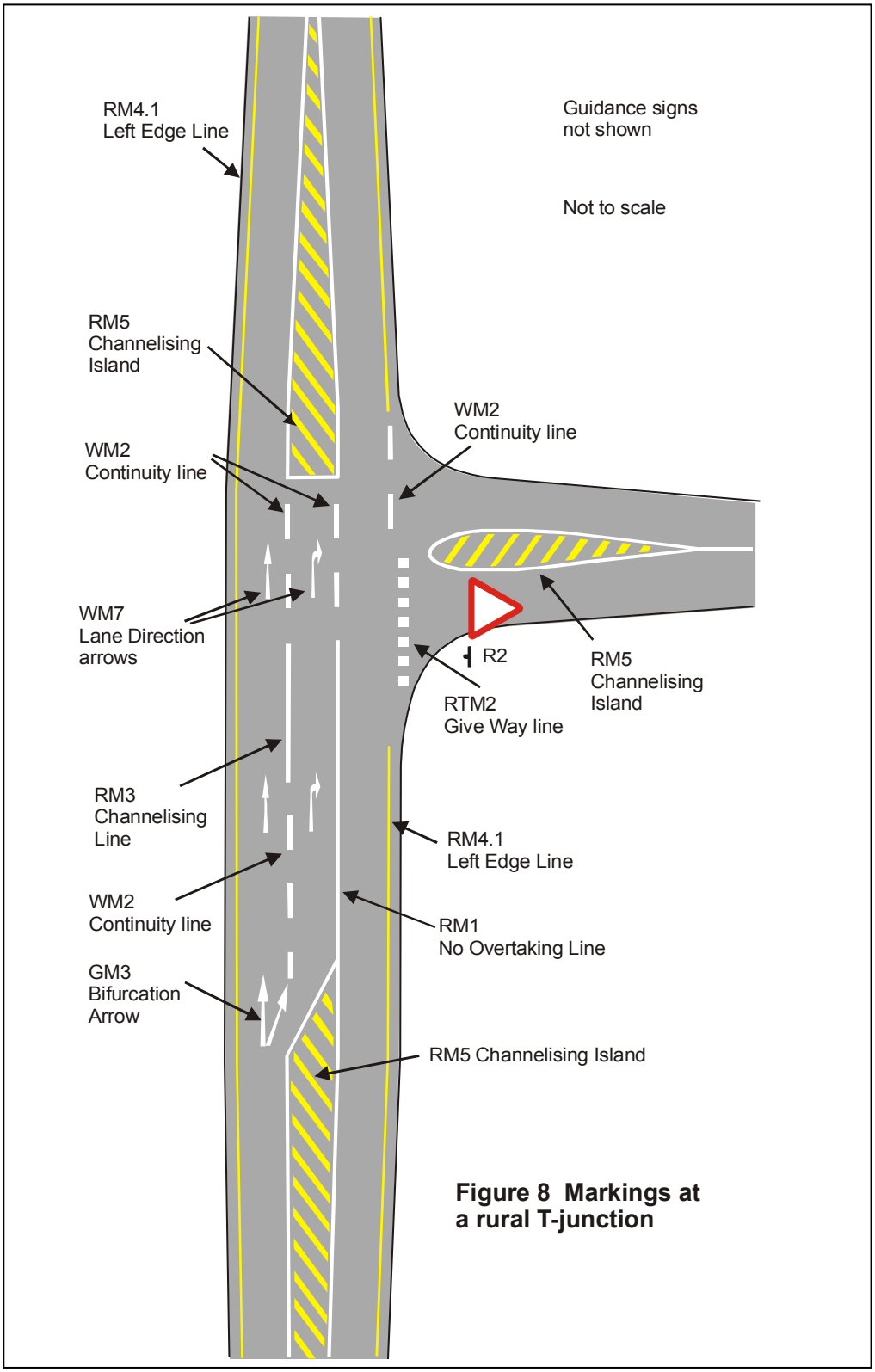


Figure 8 Markings at a rural T-junction

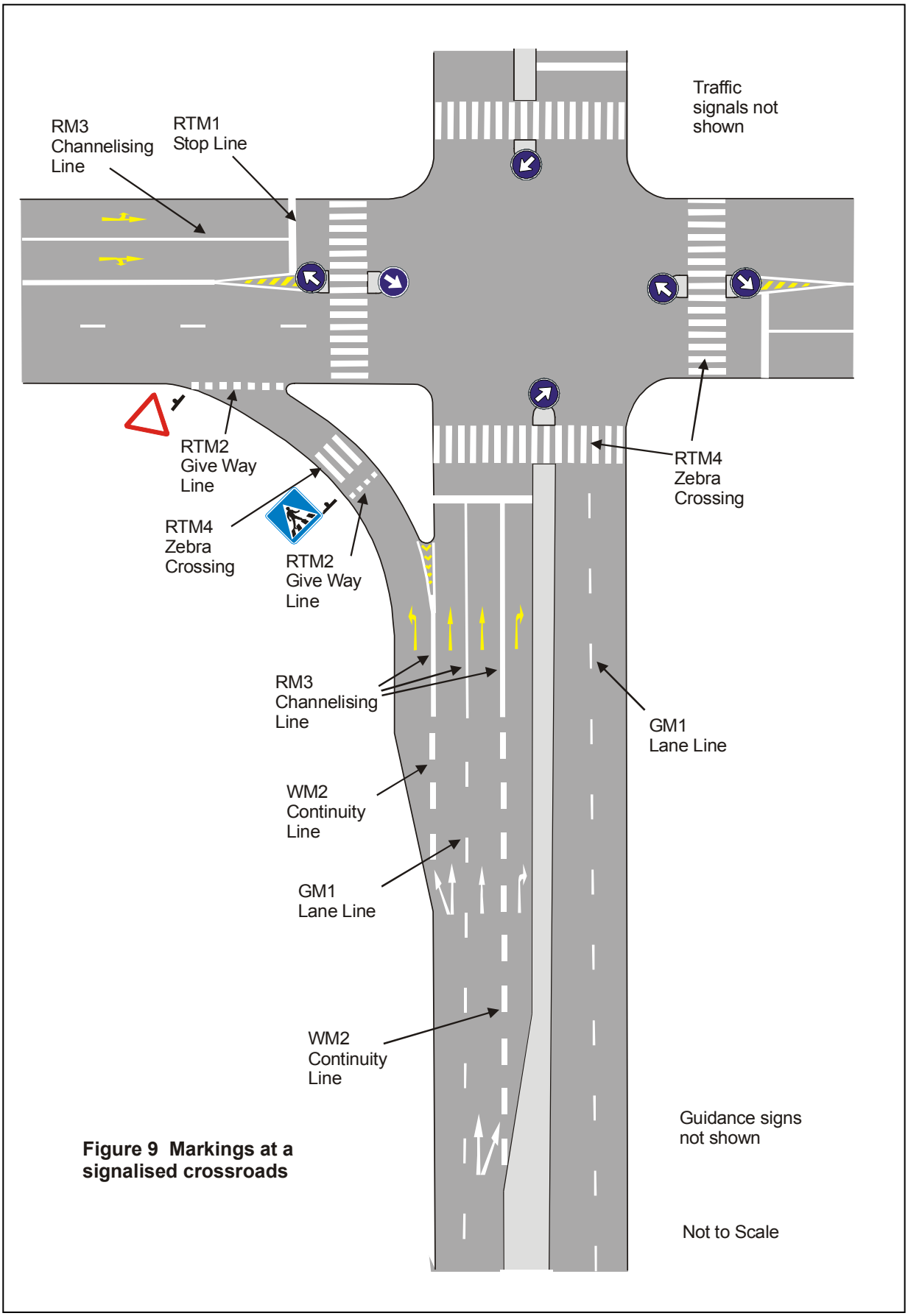


Figure 9 Markings at a signalised crossroads

5.6. Road Marking Materials

Specifications

Section 5500 of the Ministry's Standard Specifications for Road Works, 2000 sets out detailed standards for the manufacture and application of road markings. Strict adherence to these standards will help ensure that the marking performs well for an acceptable period. This section of the Guide contains general advice on road marking materials and application, but in all cases the Standard Specifications take precedence.

Road marking requires special equipment and skills, and is best done by a contractor who specialises in this activity. The quality of the road marking will be very dependent on the skill and experience of the contractor's staff.

It is important with all road marking work to give careful attention to surface preparation, setting out, and testing of the equipment. Templates should be used for arrows, symbols, words and other complicated shapes.

Road Paint

The paint used for road markings should be manufactured specially for this purpose. It should be quick-drying, durable and have good skid resistance. The paint is normally applied by a spray machine, but some markings are easier to do with a brush. When ordering road paint the proposed method of application must be specified to ensure that the correct type of paint is supplied.

Thermoplastic

Hot-applied thermoplastic is the preferred marking material. The initial cost is higher than for paint, but it is far more durable, so it will usually be the more cost-effective option. It can be sprayed or screeded onto the road surface. Transverse lines, arrows, symbols, and words are most easily created by screeding. A high standard of materials, equipment and workmanship is needed to produce good-quality markings.

Reflectorisation

Road markings should be reflectorised by the addition of reflecting glass beads. It is important to ensure that the glass beads meet the specifications. With thermoplastic the beads will normally be mixed into the material and more will be sprayed onto the top of the marking whilst it is still molten. In the case of paint, the beads will be sprayed onto the paint before it is dry.

5.7. Roadstuds

Use of Roadstuds

Roadstuds can be very effective at night, but they are costly, and so are likely to be used only where clear guidance at night is critical for safety or smooth traffic flow. Conditions that may justify the use of roadstuds include:

- frequent mist, fog or rain (making it difficult to see the road markings)
- poor visibility due to glare from the headlights of oncoming vehicles
- difficult alignment (e.g. roads with many bends, some of which may be hard to see)
- roadside hazards (e.g. reduced carriageway width or limited clearance to obstacles)
- other hazardous sites.

Colour and Spacing

Roadstuds are usually bidirectional, meaning that they have two reflectors, each facing opposite directions. The three permissible colours for the reflectors are:

RED - which means PROHIBITION
YELLOW - which means WARNING
WHITE - which provides GUIDANCE

Figure 10 shows typical roadstud use on a two-way roadway. Note that the studs on the WM3 Dividing Line are placed in every second gap, and this rule applies also to other broken lines, such as the WM2 Continuity Line and the GM1 Lane Line. The recommended spacing of roadstuds on continuous lines, such as the RM1 No Overtaking Line and the RM4 Edge Lines, is 24m in rural areas and 18m in urban areas; these spacings may be halved where it is necessary to provide extra emphasis.

Roadstuds are normally aligned with the road marking, but where there are parallel lines, such as the RM2 No Crossing Line, the roadstud should be placed between the lines. Roadstuds for RM4 Edge Lines should be placed on the shoulder side of the line about 50mm away from the line.

On a one-way roadway the roadstuds may be unidirectional, i.e. they only have one reflector, which faces the approaching traffic. Roadstuds should not normally be used on transverse markings, as they could interfere with a vehicle's stopping ability, and be hazardous to two-wheeled vehicles.

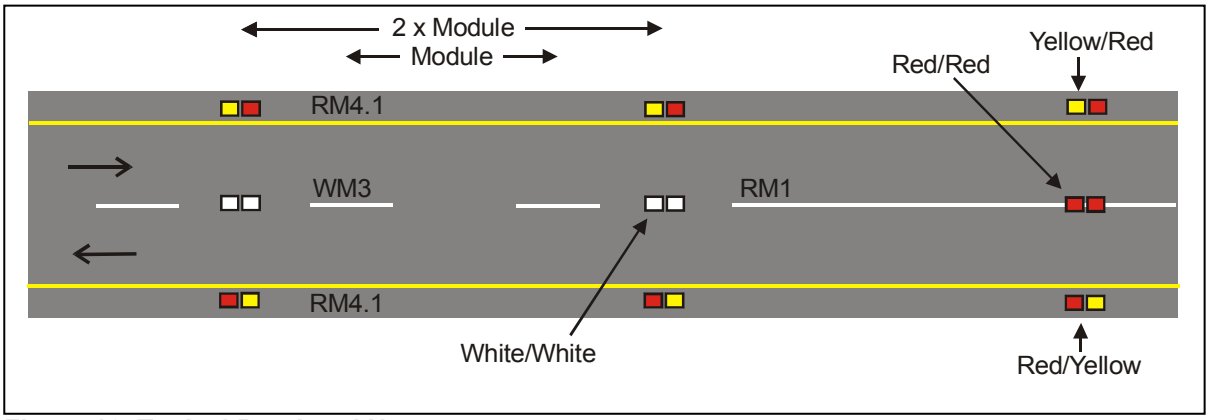


Figure 10 Typical Roadstud Use

Specifications

Section 5500 of the Ministry's Standard Specifications for Road Works, 2000 contains a requirement that roadstuds conform to South African Bureau of Standards 1442 or equivalent. Modern roadstuds are made of high-strength plastic and incorporate corner cube retroreflectors protected by an abrasion-resistant glass or plastic lens. They are bonded to the road surface using epoxy resin or other adhesive. Do not install them on top of road markings, as this could affect the bond.

6. TRAFFIC SIGNALS

6.1. Purpose and Use

Traffic signals are used for the control and direction of vehicles and pedestrians at:

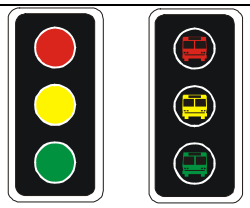
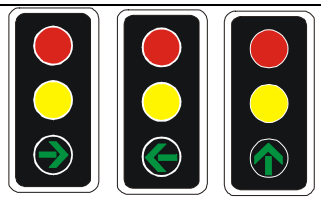
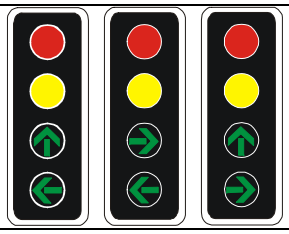
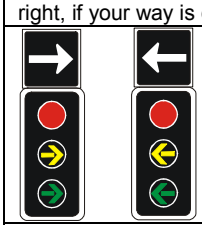
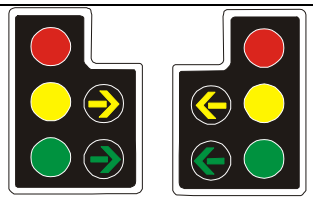
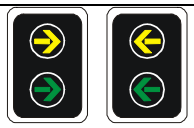
- Road junctions
- Pedestrian crossings
- Railway crossings.

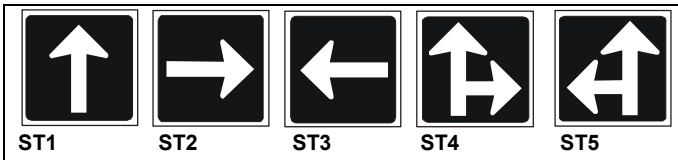
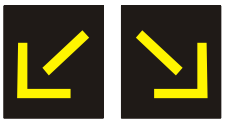
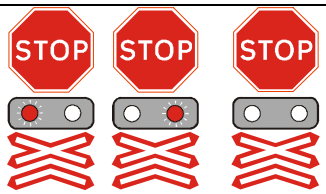
This section gives a general outline of what the signals practice should be, together with advice on the siting and mounting of signal heads. The proposed system is based on SADC standards, except for a few features where we have preferred to retain existing Tanzanian practice to avoid confusion. Volume 3 of SARTSM 3rd Edition sets out comprehensive and detailed requirements for the design and installation of traffic signals and their methods of control. These requirements shall apply here, subject to the amendments referred to in the footnote to section 6.2 below. The design, installation and operation of traffic signals should only be undertaken by professionals with skills and experience in this area.

Traffic signals other than rail crossing signals should normally be used only on streets and roads with a speed limit of 50 km/h or lower. They can, exceptionally, be used on roads with speed limits between 50 km/h and 70 km/h, provided the visibility is good, warning signs are used, the right turns are fully-controlled (no conflicting traffic movements) and at least one signal on each high-speed approach is mounted overhead.

6.2. Schedule of Traffic Signals

The main signals and their meanings are shown below.

<table>
<tr>
<td> 
S1B is for exclusive bus lanes</td>
<td>  </td>
<td>  </td>
</tr>
<tr>
<td>S1 - Standard signal face
Red means ‘stop’: yellow means ‘stop unless you are so close to the stop line that you cannot stop safely’; green means ‘you may proceed straight ahead or turn left or right, if your way is clear'</td>
<td>S2 – Green arrow right
S3 – Green arrow left
S4 - Green arrow up (straight on)
When the green arrow is lit you may proceed in the direction indicated by the arrow</td>
<td>S5 – Green arrows up and left
S6 – Green arrows right and left
S7 – Green arrows up and right
When the green arrows are lit you may proceed in either of the directions indicated by the arrows</td>
</tr>
<tr>
<td>  </td>
<td>  </td>
<td>  </td>
</tr>
<tr>
<td>S1R + ST2 & S1L + ST3 – Signal face that provides for a fully-controlled (protected) right-turn (left-turn) phase.
When the green arrow is lit it means that right (left) turning traffic has right of way (no conflicting traffic movements)</td>
<td>S8 & S9 – Signal face that provides for a permissive-protected right-turn (left-turn) phase.
When the green arrow is lit it means that right (left) turning traffic has right of way (no conflicting traffic movements).</td>
<td>S10R & S10L These signals may be used as far-side repeaters for the S8 and S9 signals</td>
</tr>
</table>

<table>
<tr><td colspan="3"> 
</td><td>  </td></tr>
<tr><td colspan="3">ST1 - ST5 Traffic signal arrow signs (non-illuminated) - attached to signal heads to indicate which movement (s) the signals refer to</td><td>S11 – Pedestrian signal
Red man means ‘do not cross’; green man means ‘cross with care’; flashing green man means ‘do not start to cross’</td></tr>
<tr><td>  </td><td>  </td><td>  </td><td> 
</td></tr>
<tr><td>S16 Lane direction control signal meaning 'you may drive in this lane.' Mounted above the lane.</td><td>S17 Lane direction control signal meaning 'you shall not drive in this lane.' Mounted above the lane.</td><td>S18 & S19 Lane direction control signal meaning 'the lane ahead is closed, and you must leave the lane in the direction shown by the arrow'</td><td>FRD – Flashing red disc – at rail crossings – in conjunction with signs R1 and W403 or W404</td></tr>
</table>

Note on differences from the SARTSM: a) in signals S1R, S1L, S8, S9, S10L and S10R the green arrow signal does not flash, and b) in signal S11 the red man signal does not flash to indicate that the pedestrian phase is coming to an end.

6.3. Signals at Junctions

Design Principles

The main objective when installing signals at junctions is to reduce delays to traffic by eliminating or reducing the number of conflicts. There are often safety benefits, but not always, and signals can rarely be justified on safety grounds alone. The type of traffic signal control and its method of operation must be designed to control the traffic movements in the most efficient and safe manner at all times of day – it should not be necessary for the Police to take over control of the junction when the signals are working.

Signal Mounting

The standard arrangement is to mount the signal head (the box in which the signal lenses are housed) on a post at the side of the road, and 3m (2.3m minimum) above the road surface (measured to the centre of the lowest (green) lens). No part of the signal head should be within 500mm of the kerb face. The signals shall be mounted vertically with the red signal at the top, and the lenses shall be protected from direct sunlight by hoods. The nominal diameter of the signal lens will normally be 200mm. The signal head shall be painted black, and shall incorporate a black backing board with a white reflective border, so as to make the signals stand out against the background.

Where drivers could have difficulty seeing the signals a duplicate signal head can be installed above the main one. Another option is to mount the signal head on an overhead arm, but this should be restricted to signals that are placed on the far side of the junction. Overhead signals must be mounted so that the clearance from the road surface is not less than 5.2m. The signal lenses must be arranged vertically, not horizontally.

Signal Positioning

At least two signal heads shall be provided for the main traffic movement through the junction from each approach – and the same applies to any turning movement that has its own phase. One signal is placed on the near side of the junction (at the stop line) and another on

the far side. On wide or multi-lane roads additional signals will be needed, and these may be on the far side or the near side of the junction - see Figure 11.

The signals must be visible from at least 80 metres away (or 110 metres if the traffic speed exceeds 50 km/h). Warning sign W301 "Traffic Signals Ahead" must always be used where the visibility is poor, but do not install signals where the visibility on any approach is well below these limits. Make sure that the driver's view of the signals is not blocked by trees, lighting columns, bus shelters, parked vehicles, or other obstructions.

A driver in a hurry at the stop line may start off early if he can see that the signals on the other approaches are changing to red. This can be dangerous. To avoid this, site the signals where they cannot be seen from other approaches, or fit long hoods over the signal lenses.

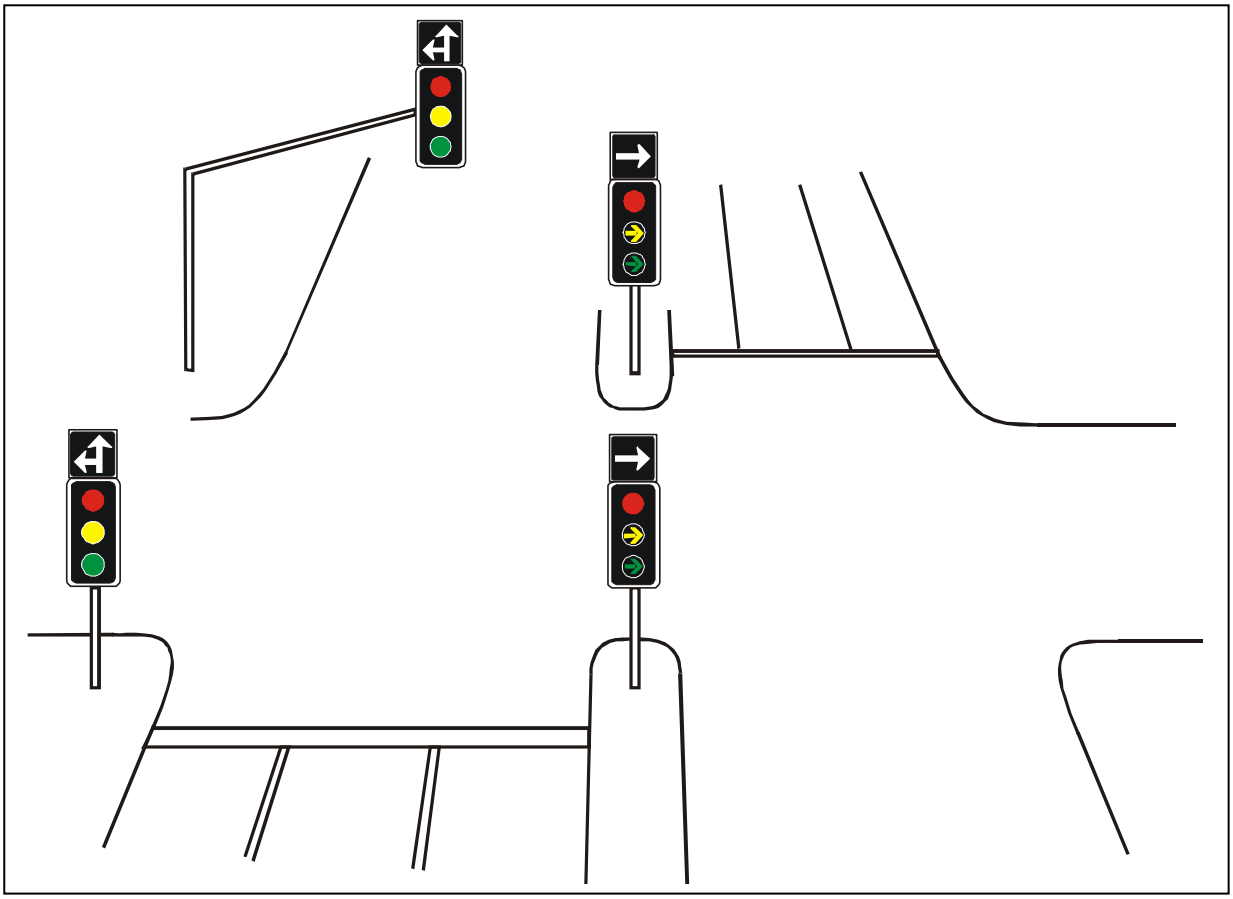


Figure 11. Signals at a crossroads - with fully-controlled right turn

Signal Control Methods and Timings

The aim in designing signal installations is to maximise capacity (minimise overall delay) while maintaining a high degree of safety. It is important to keep as much traffic moving as practicable at the same time. Detailed advice on signal timing is given in Volume 3 of the SARTSM 3rd Edition, but key recommendations include:

- Use the lowest practicable number of stages (changes) in the signal cycle (complete sequence of stages)
- The signal cycle should not exceed 100 seconds (absolute maximum: 120 seconds)

- Ensure that the time allocated to each stage is appropriate to the actual traffic flow (a control system that can automatically vary the duration of the green signal according to actual traffic flow is highly desirable on both efficiency and safety grounds)
- The minimum duration of green signals (including green arrows) shall be 7 seconds
- The duration of the yellow signal shall be 3 seconds
- The intergreen period (the period between the end of the green signal for one approach and the start of the green signal for a conflicting approach) must be sufficient to enable vehicles to clear the junction safely – the minimum duration is 5 seconds (3 seconds of yellow plus 2 seconds all-red), but it must be longer at large junctions or where traffic approaches the junction at high-speed – note however that excessively long intergreen periods are wasteful and may be abused by drivers
- It is preferable for right-turn movements to be fully-controlled (also called a "protected-only right turn") whereby drivers are only permitted to turn right when signalled to do so, and there are no conflicting traffic movements - this method should always be used on high-speed and multi-lane roads
- Right-turn phases shall normally appear after or during the final part of the main phase (also called a "lagging right-turn phase")
- When green arrow signals are lit drivers shall be able to proceed in the direction of the arrow without having to merge or give way to conflicting traffic streams
- When drivers can turn left without conflicting with another traffic movement they should be permitted to do so by means of a green arrow signal - otherwise drivers are not permitted to turn left when the main signal is on red.

The optimisation of signal timing is a complex task that requires a high degree of expertise. Although it can be done manually, it is more common to use computer software. Detailed traffic counts and forecasts are always necessary.

6.4. Pedestrian Signals

General

Pedestrian signals are used in combination with traffic signals at pedestrian crossings within junctions or at separate pedestrian crossings. They should be used where large numbers of pedestrians are crossing the road, or crossing the road is hazardous on account of high speeds or multi-lane traffic. SARTSM Vol. 3 Chapter 4 gives further advice. The signals may be activated automatically by the junction signal controller, or by the pedestrian pushing a button to indicate to the controller his wish to cross. When the "green man signal" is lit pedestrians may cross, but they need to take care, because at some junctions turning traffic will be cutting across their path. The RTM4 zebra crossing marking shall be used in these situations, so as to give the pedestrian the right of way. A pedestrian who starts to cross as the "green man signal" ends must be given sufficient time to complete the crossing before the vehicle traffic is allowed to move again.

Standard Design

The signals shall be arranged vertically with the red standing man signal at the top and the green walking man at the bottom. The signal lens shall normally have a diameter of 200mm. It is desirable for pedestrian signals to be fitted with an audible signal that sounds when the green signal is lit - for the benefit of blind and partially-sighted pedestrians.

Positioning and Mounting

A pedestrian signal is normally mounted on the same post as the traffic signal. The signals must face across the road so that the signal can be clearly seen by pedestrians. Minimum vertical clearances from the footway surface shall not be less than 2.1m and not more than 2.6m. It is preferable to arrange for the pedestrian to cross the full width of the road in one movement, but where this is not possible and the pedestrian has to cross the road in several controlled stages, position each signal so that there is no confusion as to which section of the crossing they control.

6.5. Traffic Signals at Railway Crossings

General

It is recommended that this signal, together with gates or barriers, be used at all rail crossings. The diameter of the signal lamps must be at least 200 mm. The flashing red lights may be supplemented by a sound signal. A stop line must be marked on the road to indicate to drivers where to stop when the red lights are flashing.

Positioning and Mounting

The signal will be positioned within 5 - 10 metres of the nearest rail line and where it can easily be seen by drivers halted at the stop line. It can be at the left hand side of the road, but it may be more visible if it is mounted above the carriageway.

6.6. Technical Specifications

Traffic signals are not covered by the Ministry's Standard Specification for Roadworks 2000, so the choice of specifications will normally be left to the organisation that designs the signal installation. It is essential that all signals equipment be designed and manufactured so as to provide:

- adequate optical performance - the use of quality LED light sources is strongly recommended because of their low energy consumption and their long life
- long-term durability and operational reliability - in an environment of poor-quality power supply - the use of solar power is recommended
- ease of maintenance, e.g. modular construction, 'plug and play' capability, spares are easily available and reasonably priced, fault monitoring, etc.
- adequate capacity for signal phases, signal plans, detector inputs, etc.
- ease of changing timings, signal plans, etc.
- ability to operate in various modes, including manual control, part-time, fixed-time, vehicle-actuated, cableless linking, and centrally-controlled (UTC)
- ability to work with different types of vehicle and pedestrian detectors
- ease of upgrading
- safe operation, e.g. green conflict monitoring with safety shutdown.

7. SIGNING AT ROADWORKS

7.1. General Principles

All road authorities, utility agencies, and others working in the road have a duty to manage their operations so that road users can pass safely and disruption is kept to a minimum. Good, clear signing is essential, and on busy roads it may be necessary to have a system of temporary traffic control. This section of the Guide is intended to provide basic advice on how to sign and manage roadworks. It is important that everyone working in the road follows this advice in order that road users are presented with a clear, consistent system of signing and control. This will help to reduce the number of crashes that occur at roadworks.

Plan ahead - Think what signs and equipment you will need before you leave for the site. This Section will help you decide what is required. If it is a road scheme where the Ministry's Standard Specifications for Road Works 2000 applies, you must prepare a *Programme for Passing of Traffic* which details the arrangements to be made for traffic management and the protection of the public. This *Programme* must be approved by the supervising Engineer before work commences, and no changes should be made without his prior agreement. Get advice and assistance from the Police in difficult or dangerous situations. You must always have the permission of the road authority before you carry out works on their road. Consult railway management if the works will extend over a rail crossing.

Put the TW336 *Roadworks* warning sign out first

Figure 12 - TW336

Channelise the traffic past the work areas using cones or drums - Plastic or rubber *traffic cones* are the best channelising devices, but metal drums painted red and white may be used instead. Drums shall be kept in place by being partly filled with sand or soil, but not stones. Where space is very limited you can fence off the area using metal or bamboo poles and red and white striped plastic tape. All channelising devices must have pieces of reflective sheeting on them if used at night. On busy roads or difficult sites you may need to use flashing lamps to make the works more visible at night.

Make sure that all excavations and other hazards are properly protected with barriers (barricades) - these may need to be illuminated at night.

Figure 13 - TR201

Control the speed of traffic – Traffic speeds through the site need to be kept at a safe level, generally 50 km/h or less. This can best be achieved by narrowing down the traffic lanes and making minor diversions - using traffic cones or drums. On roads with speeds in excess of 50 km/h you should consider imposing a temporary speed limit using TR201 *Speed Limit* signs. The new limit should be at least 30 km/h less than the permanent speed limit, and should extend over a distance of at least 300 metres. Remember though that temporary speed limits may not be effective unless you can get the Police to do some enforcement. Always ensure that the layout of the site encourages vehicles to move smoothly at safe speeds.

Check the signs carefully - Ask yourself this question: "Will someone coming along the road in either direction understand exactly what is happening and what is expected of them?" As the works proceed, alter the signing so that it is always consistent with the work that is going on. Cover up any permanent signs that give conflicting or confusing messages.

Fix the signs properly - The signs must be mounted off the ground, either on poles or frames. They must be fixed so that they cannot be blown over or dislodged by moving traffic. Check the signs regularly to see if they are all still in place, and clean them if they get dirty. If the signs get damaged or stolen they must be repaired or replaced promptly.

Ensure the signs are visible at night - Make every effort to finish the work before dark. If this is not possible check that the works and any diversions or other traffic control arrangements are clearly visible before you leave the site for the night. All signs must be fully reflective, and all cones, drums or other channelising devices must be fitted with reflectors. On busy roads or difficult sites install flashing yellow / orange warning lamps. You may need to employ a watchman.

Remove unnecessary signs - Never leave signs on the road once they are no longer needed. This annoys drivers and leads to distrust of roadworks signing.

Always use the standard signs - Do not design your own signs, as these will be unfamiliar to road users, and will not be legal. Refer to other sections of this Guide for advice on sign sizes. Sign faces should preferably be made from the same high intensity grade reflective sheeting as used on permanent signs, though the Standard Specifications for Road Works 2000 does permit the use of engineering grade reflective sheeting. All signs used at roadworks, other than the Control Group of regulatory signs (e.g. the GIVE WAY and STOP signs) shall have yellow backgrounds.

Be seen - Workers must wear high-visibility safety waistcoats made in bright orange or yellow material with reflective strips on them. Plant and equipment should be painted yellow, and be fitted with flashing yellow or orange beacons. It is recommended that all heavy vehicles, especially road rollers, be fitted with alarms that sound when they are reversing.

Make sure that the workers have been trained – All road workers should have had safety training and be properly equipped with shoes, gloves, etc. Children must never be employed. A first-aid kit must be kept on-site.

Provide a safety zone – Set out the traffic cones or drums so that there is at least a few metres of space between the working area and the traffic. This space is a safety zone that helps protect workers from being hit by out-of-control vehicles, and is particularly important if traffic speeds cannot be reduced to 50 km/h or less. In such cases extra protection can be provided by parking a truck in the safety zone, or building a wall of sand-filled drums. Do not use the safety zone as a working area or a place for storing materials.

Arrange proper access for works vehicles – Make sure that works vehicles can enter and leave the site safely through clearly-marked accesses. Works vehicles must be parked where they will not cause an obstruction or be a hazard to passing traffic.

Provide for pedestrians – Where the works will obstruct a pavement (footway) provide a safe, clearly-marked alternative route. Pedestrian barriers with handrails should be used to mark out the temporary footway. These should be designed to be easily detected by a visually-handicapped person using a stick. Stronger barriers should be put up around any excavations deeper than 1.2 metres.

Consider local residents and businesses – Inform people living and working alongside the road what will be happening. Ensure that access to business premises is maintained. Try and minimise disruption, and noise and dust nuisance. Re-site bus stops if necessary.

Keep the site tidy - Take up as little road space as possible, and store construction materials and equipment off the road if you can.

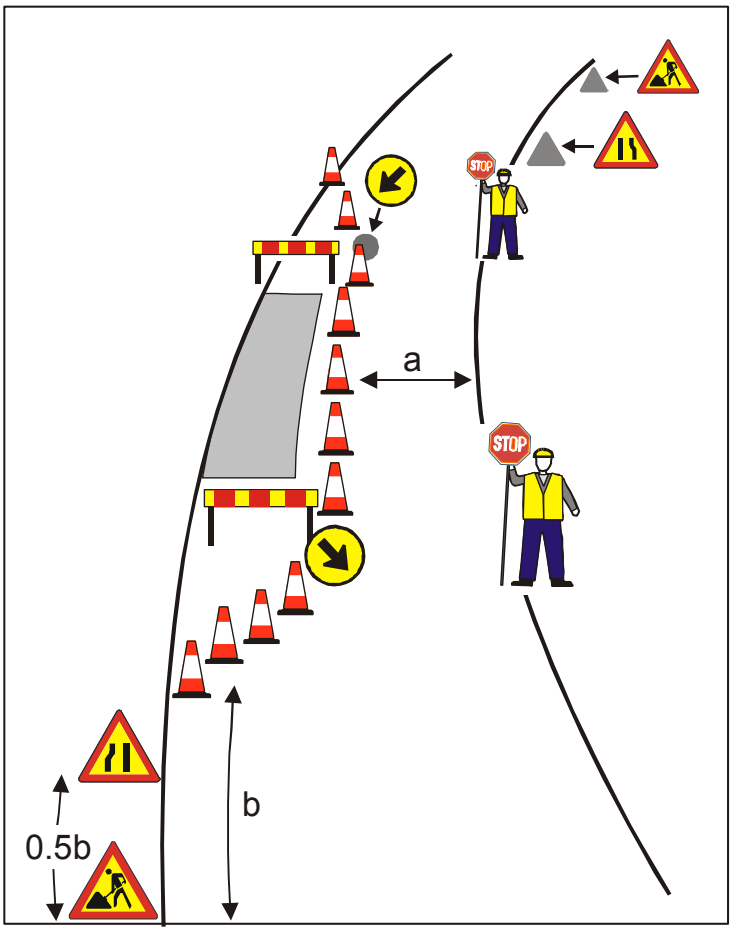
Install a project information sign – At major roadworks put up a sign giving the name of the project, the road authority, the contractor, and the donor, if any. Give contact phone numbers for the road authority and the contractor.

Leave the site in a safe condition - When you have finished make sure that the road surface has been properly reinstated and that there are no dangerous holes, or trenches. All holes and trenches must be backfilled with sufficient compaction to prevent the material slumping under the weight of traffic. Clean away any mud or gravel. Small changes in level, such as occur when road surfaces are removed prior to resurfacing, can be very dangerous to cyclists and motorcyclists. In these situations a ramp must be constructed and it should be signed using the TW331 *Uneven Road* warning sign.

Figure 14 - TW331

7.2. General Layout

The recommended layout of signs, channelising devices and traffic control at a typical works site is shown below:



Notes:

a = min. 3.25m max. 3.7m
for one-way traffic

b = 50m (≤ 50 km/h)
100m (60 km/h)
160m (80 km/h)
240 - 500m (≥ 100 km/h)

Place cones / drums 8m apart on straight sections, but reduce spacing to 2 - 4m at bends or tapers.

One-way working with traffic control must be used where the width of road left open to traffic is less than 6.5m. Traffic controllers should be responsible adults who have received training. They should use STOP / GO boards (sign R1.5). Using flags is discouraged because they can be confusing and they have no legal standing. Portable traffic light signals are an alternative. The single lane section should have no junctions within it and should not be longer than about 250m.

Figure 15 - Standard Signing and Traffic Control at Roadworks

Where it is not possible or desirable to pass traffic through the works a deviation (diversion road) will be constructed. It is important that the deviation be designed, constructed and

maintained to an adequate standard. It may be advisable to impose a temporary speed limit and prohibit overtaking. Typical signing for the start of a deviation is shown below.

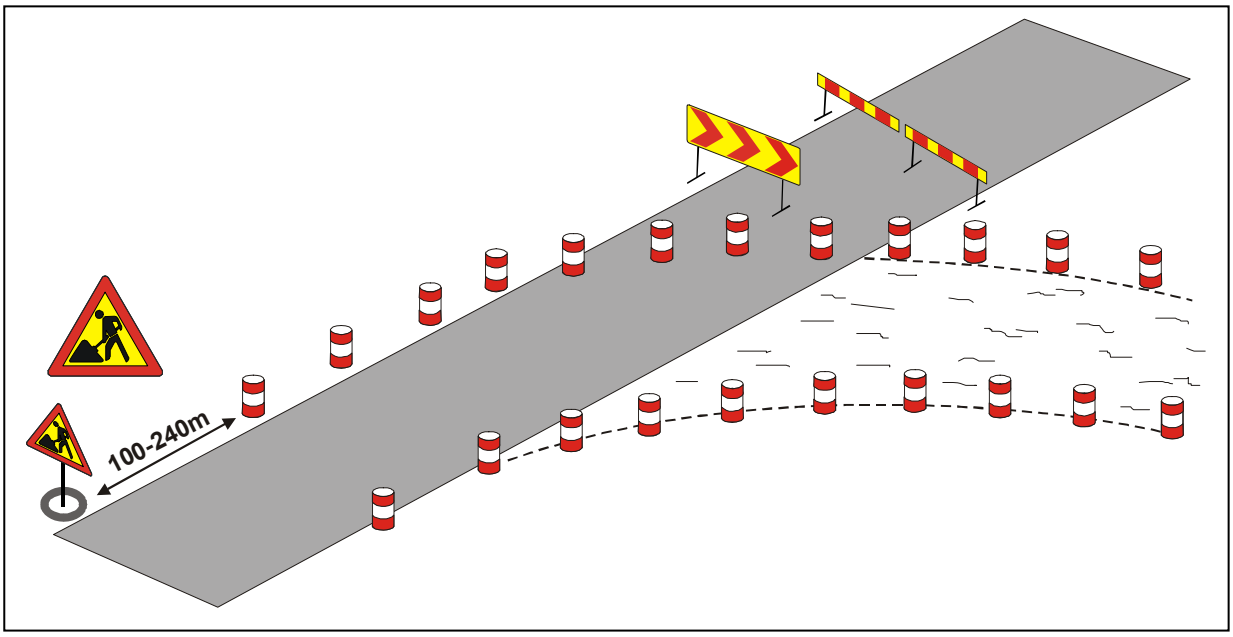


Figure 16 - Standard Signing for the Start of a Deviation

7.3. Implementation

Where contractors are employed to do work in the road it must be made clear in the contract that they are responsible for providing signing, traffic management and the construction and maintenance of any deviations. For anything other than very minor works it is strongly recommended that contractors be required to submit for approval a *Programme for the Passing of Traffic* as per the Ministry's Standard Specifications for Road Works 2000. The Supervising Engineer must check the signing and control arrangements at regular intervals, including at night, and must promptly draw the attention of the contractor to any deficiencies. The contractor is responsible for all maintenance, including cleaning of signs, and replacement of signs and other equipment that has been stolen or damaged.

Supervising Engineers have a duty to ensure that contractors meet their obligations, and must be prepared to impose such penalties as are provided under the contract, if the contractor fails to maintain an acceptable standard of signing and traffic management. Experience has shown that the contractor will be more likely to provide adequate signing and control if it is an item in the list of works to be done. It should be made clear to the contractor that payment will only be made if the entire signing and traffic control at the site is satisfactory. The failure or refusal of the contractor to provide an acceptable standard of signing and marking is sufficient grounds to close down all the work on the contract until all the requirements have been met.