

1 INTRODUCTION

This section deals with the requirements for Road Safety Audits as contained in the South African Road Safety Audit Manual (SARSAM), May 2012, published by the Road Traffic Management Corporation. Furthermore, before safety audits are undertaken there must be budget provision to implement the recommendations as they are now compulsory for all road authorities.

Audits need to be undertaken in respect of roads planned or that are already built. In the latter case, the process leads to the instigation of some or other remedial action on the basis of a report compiled by the audit team. This is not to be confused with identification of red spots (high frequency accident locations, previously black spots). Red spots are indicators of the crash history of a stretch of road whereas the audit seeks to identify points at which crashes could occur. Red spots are a far superior and more accurate indicator of safety problems, but proper crash records are not always available.

The road safety audit applies practical safety experience to the project to ensure that:

- ☐ Unsafe features are not introduced; and
- ☐ Safety features are built in

The objectives of road safety audits are to:

- ☐ Ensure high levels of safety on new road projects;
- ☐ Reduce the whole life costs of projects;
- ☐ Minimise accident risk on the adjoining network;
- ☐ Promote the safety of all road users; and
- ☐ Promote road safety engineering

2 THE ELEMENTS OF A ROAD SAFETY AUDIT

A road safety audit is defined as a **formal examination** of an existing or future road project in which an **independent qualified examining team** reports on the project's crash potential and safety performance. It takes technical skills, mixes these with sound judgement and considers the safety of all road users and generates a written report.

The highlighted words in the definition demand further consideration.

- (a) Formal examination implies that the audit is not a rough and ready check. It follows a set procedure discussed further below.

- (b) In the same way that a writer cannot effectively edit his or her own work, the audit must be carried out by a team that is independent of the design team. It is important that “fresh eyes” view each project.
- (c) The examination team has to have appropriate experience and training. The reason for this is that the audit is not simply a design check against current design standards and procedures. If it were, anybody armed with the latest design manual would be able to carry out the audit. The team must have knowledge and experience beyond that reflected by current manuals. This requirement is confirmed by the SARSAM that states that the members of the audit team must have:
 - i) expert knowledge in road safety engineering with at least three years of experience;
 - ii) at least conducted at least five road safety audits under a Lead Road Safety Auditor
 - iii) conducted at least one road safety audit annually

A problem in South Africa is that accident investigations and road safety audits are still in their infancy with regards to the procedures set out in the SARSAM, particularly with regards to Lead Road Safety Auditors. In consequence, relatively few persons in South Africa ever get involved in road safety audits and the possibility of others ever gaining experience in road safety audits is restricted.

- (d) The road safety audit must report only on the accident potential and safety performance of the project. No other norms and criteria such as economic or social benefits are applicable, and comment may not be made on the desirability of the project on the basis of such considerations.

3 THE NEED FOR ROAD SAFETY AUDITS

To repeat: It is not the function of a road safety audit to check a project against compliance to standards. In fact, as stated in a previous lecture, a road can be designed to every standard in the book and still be a total disaster. If a road has a high crash potential, this can be attributed to one of only two things, being:

1. Insufficient attention being given to traffic safety during the design process; and
2. The use of design standards or combinations of standards that are inadequate and unsafe.

Many engineers firmly believe that complying with standards result in designs that are safe. Prof Ezra Hauer points out that safety is not an absolute. If it were an absolute, this would imply that it is not possible to ever have a crash or even a slight mishap on the road. A road can always be made more or less safe than it currently is; it cannot be made safe. According to Robin Morgan, the principal author of the Austroad RSA Guidelines, “standards do not necessarily equal safety”. He offers various reasons for this contention:

- ❑ Standards often reflect what is considered economically justifiable at the time they were established – they reflect value judgements that can, and often do, change with time;
- ❑ Standards reflect what we currently know and, as we learn more, standards can lag behind;
- ❑ Standards are developed for a variety of reasons that may have little to do with safety, e.g. cost or capacity;
- ❑ Standards usually cover simple or common situations and not all situations;
- ❑ A designer may inadvertently use an inappropriate or an outdated standard;
- ❑ Individual road elements, designed to standard may be quite safe in isolation but, when combined with other standard elements, may lead to a significant number of users making errors;
- ❑ Standards are often minima or maxima. Combining a series of limiting values leave no room for error (and reference has already been made to the fact that drivers are inclined to soak up any margin for error that there may be).

4 THE PHASING OF ROAD SAFETY AUDITS

Audits are ideally undertaken during the design phase. Five stages of the design process are identified as being times when audits should be carried out. A sixth stage relates to existing roads. Most road safety audits currently being carried out in South Africa concern existing roads. This is not unlike closing the stable door after the horse has bolted. These stages are:

- Stage 1 - Feasibility (Planning, Route Determination - call it what you will)
- Stage 2 - Layout. Horizontal alignment, vertical alignment, intersections etc
- Stage 3 - Detailed design. Road signs and markings, drainage details, lighting, clearance to roadside obstacles etc. This Stage is normally immediately prior to the preparation of contract documentation and drawings.
- Stage 4 – Road Construction. During this stage only those aspects applicable to construction activities are checked. These include temporary facilities provided during the construction phase as well as the utilisation of permanent facilities.
- Stage 5 - Pre-opening. Immediately before the road is opened to traffic. By this time mistakes are already set in concrete but, at least, they have as yet to kill someone.
- Stage 6 - Existing roads.

The whole thrust of the road safety audit is that prevention is better than cure. Furthermore, it is easier and cheaper to rectify a mistake while it is still on paper than when it is represented by several cubic metres of 25 MPa concrete. Part of the output of the road safety audit is to determine precisely where what safety appurtenances should be provided, assuming that the need for them cannot be eliminated.

When applied to an existing road, the audit process is sometimes given a different name to emphasise its difference from the design stage audits. Terms such as “road network review” and “road safety assessment” are used. The term “road safety review” is used in the Austroads Manual.

In South Africa, there is also a differentiation between “road safety assessments” and “road safety audits”. A road safety assessment is aimed at the entire road network under the jurisdiction of the authority initiating it and is intended to determine which road segments and intersections take the highest priority for the implementation of audits. Furthermore, it is intended to assist the authority concerned in identifying any existing deficiencies of design, layout and road furniture that are not consistent with the road’s function and use. A road safety audit is focussed on a single road or road section or road construction project and considers its safety shortcomings in depth.

On existing roads, therefore, a road safety audit would often be initiated on the basis of the findings of a road safety assessment.

5 THE ROAD SAFETY AUDIT METHODOLOGY

As pointed out earlier, there is a significant difference between identification of red spots and road safety audits. Red spot identification is concerned with historical absences of safety whereas audits look to potential or future absences of safety. In the BC (Before Computers) era, we would stick coloured pins into a strip map with blue pins representing property-damage-only crashes, red pins representing injury and black indicating fatal crashes.

In previous versions, it was considered advisable to undertake an audit without the audit team being aware of the previous history of the road as this prior information may inadvertently cause the findings ultimately reported to be skewed towards explanations of why the reported crashes occurred.

The SARSAM confirms that the auditors are not tasked to develop or plan remedial measures after completion of the audit. They make findings based on their audit and it is up to the designer to consider these findings and to take appropriate action. This could include changes to the design or just leaving it as it is. In either case it is imperative that the designer formally document his reasoning for whatever decisions he makes regarding the responses to the audit findings.

Once an audit team has been selected and appointed, the steps to be followed are:

- ❑ Commencement meeting where the audit team meets the designer team. If the design team is not the road authority, the road authority should also be present.
- ❑ Background information is provided, normally at this meeting, by the design team to the audit team in addition to the drawings appropriate to the stage in design at which the audit is being

undertaken. Background information may include locality sketches, detail survey plans design standards, traffic counts or projections and anything considered relevant.

- ❑ Assessment of information provided enables the audit team to familiarise itself with the project and also to check the information for completeness. Further information may be required, and this would be compiled by the design team rather than the audit team.

The site inspection is an essential step in the audit process. In the case of an existing road, it should be visited during day and night-time and also during peak and off-peak periods. This site inspection should take all possible users of the facility into account including public transport, heavy vehicles, pedestrians, and disabled persons. It should also take operating conditions such as dry and wet conditions into account.

The audit report contains the findings of the audit team and lists all deficiencies identified. It is not obligatory to do so but the report may include recommendations regarding possible remedial measures for the consideration of the design team. It is to be noted that these recommendations are not enforceable and the decision to accept them or not is exclusively that of the design team with whom the final responsibility for the design rests. It is important also to note that the audit report is a FINAL report. At most, expansions in support of clarity may be requested.

A completion meeting is held with the purpose of presenting the findings of the audit team.

6 THE CHECKLIST

Having pointed out that the audit is a formal process with set procedures, to be undertaken by an independent, experienced audit team, and that the process is not a check against a specific set of standards, it follows that that the use of a checklist is not the process to be followed by the audit team.

For the designer however, a checklist becomes a very useful tool to at least jog the memory as to what features or design aspects need to be considered with respect to road safety during the design process. In the pages that follow, a checklist has graciously been made available by Dr S C van As for inclusion in these course notes. These checklists are a great tool for the designer to work through most aspects of the design that Road Safety Auditors would typically look at.

7 SOME PRACTICAL HINTS ON CONDUCTING A SITE INSPECTION

The process described below has been developed based on experience and a number of site investigations.

Diagrammatic layout maps are used for making notes as the inspection progresses. When detail design drawings are available, the maps can be developed from these drawings. If such drawings

were not available, it would be advisable to prepare the maps prior to commencement of the inspection - on a separate visit if need be. Maps do not have to be exactly to scale but an approximation of true scale would be useful. The following information should be shown on the maps:

- ☐ Road and street names, including those of intersecting roads;
- ☐ Road reserve boundaries;
- ☐ Road and lane layout of road links, intersections including the angle of intersection of the intersecting roads, accesses and pedestrian crossings;
- ☐ The start and end of horizontal and vertical curves;
- ☐ Pedestrian sidewalks and lanes, including cycle lanes;
- ☐ Developments adjacent to the road; and
- ☐ Kilometre markings along the road

No additional information should be shown on the maps leaving them as clear as possible for notations during the inspection.

The maps should preferably be produced on A4 sheets but nothing larger than A3 sheets should be used. Handling large sheets of paper out of doors can be difficult, especially under windy or wet conditions.

The site inspection should be completed for each section covered by one sheet before moving onto the next section. During the inspection, deficiencies observed are indicated on the map.

If a shoulder is available, the inspection can be conducted by means of a vehicle travelling slowly along the shoulder in each direction. Where necessary, the team can stop and undertake a detailed inspection on foot. If a shoulder isn't available, the entire inspection must be undertaken on foot. (This is often impractical but is the current requirement).

The inspection process is as follows:

- ☐ The team first travels up and down the road without taking notes in order to familiarise themselves with the road section.
- ☐ The team then travels up and down the road with the purpose of identifying deficiencies. This inspection is done WITHOUT reference to the checklist.
- ☐ Deficiencies are marked on the map. A photograph is taken of each deficiency recorded and the photograph number and position is noted on the map.
- ☐ The checklist is then consulted and, if items are found that have not been inspected, the inspection is repeated until all items have been checked.

This process is repeated for each section of the road.

ROAD SAFETY AUDIT CHECKLIST FOR DESIGNERS

Stage 1: Preliminary Design
Stage 2: Draft Design
Stage 3: Detailed Design
Stage 4: Road construction
Stage 5: Road pre-opening
Stage 6: Existing Roads

Note: The following checklist can be used by designers for all Road Safety Audit Stages. Some items may not be applicable to all stages.

During the construction stage, only those items applicable to construction activities are checked. These include temporary facilities provided during the construction as well as the utilisation of permanent facilities. No check, however, is made for safety deficiencies that may result after construction has been completed.

1) NETWORK IMPACT AND PROJECT STAGES

The following items are only checked during the various design stages of the project:

Network impact

- 1 Will traffic volume and mix on other roads in the network change as a result of the project, and would such change create safety problems? This includes the possibility of traffic intrusion through sensitive areas (residential neighbourhoods)?

Project phases

- 2 Will road safety be affected by planned project stages and phases?
- 3 If provided, are transitions between different stages or phases of the project safe? Has advance warning been provided? Do transitions occur near to hazards?

2) DESIGN STANDARDS

The following items are only checked during the various design stages of the project:

Road classification

- 1 Is the road classification selected for the road appropriate?
- 2 Are there excessive changes in the road classification on the network or on the same road that may be unsafe? Are transitions between different road classes in the network or on the same road safe? Has advance warning been provided? Do transitions occur near to hazards?

Geometric design standard

- 3 Is the current or selected design standard (as opposed to the design itself) appropriate for the class of road, expected volume and mix of traffic, pedestrians and cyclists, environment, driver expectancy?
- 4 Is the design standard flexible enough to accommodate unforeseen changes?
- 5 Are there excessive changes in design standards on the network on the same road that may be unsafe? Are transition zones between different design standards on the network and on the same road safe? Has advance warning been provided? Do transitions occur near to hazards?

Design speed

- 6 Is the current or selected design speed appropriate for the class of road, expected volume and mix of traffic, pedestrians and cyclists, environment, driver expectancy?
- 7 Are there excessive changes in design speed on the network or on the same road that may be unsafe? Are transition zones between different design standards on the network and on the same road safe? Has advance warning been provided? Do transitions occur near to hazards?
- 8 Have a design/operating speed profile been developed for the project? Should one be developed?

Design vehicle

- 9 Have the appropriate design vehicles been selected for the project?
- 10 Can unforeseen future changes in design vehicle mix be accommodated?

3) SIGHT DISTANCE

Attention should be given to all possible obstructions to sight distances, including the following:

Permanent obstructions

- 1 Natural features, cuts and fills
- 2 Bridge abutments and traffic barriers.
- 3 Overhead structures, such as bridges on sag vertical curves.
- 4 Street furniture, fencing, services, road signs.
- 5 Landscaping, plants or expected future plant growth.

Temporary obstructions

- 6 Parked or loading vehicles, public transport vehicles.
- 7 Queues of vehicles (including right-turn queues).
- 8 Construction equipment, vehicles and material.

(SSD) Stopping sight distance

- 9 Is stopping sight distance adequate for light and heavy vehicles over the full length of the road (every single meter of the road)?
- 10 Will the sight distance be affected by permanent or temporary obstructions.

(DSD) Decision sight distance

- 11 Is decision sight distance adequate for light and heavy vehicles at each intersection, access or decision point on the road?
- 12 Are there any possible locations in future where decision sight distance may become required and where it would be inadequate?
- 13 Will the sight distance be affected by permanent or temporary obstructions.

(GSD) Gap acceptance sight distance – Motorised vehicles(All stages)

- 14 Is gap acceptance sight distance adequate for vehicles at each intersection and access on the road (all turning movements, including right-turning vehicles)?
- 15 Are there any possible locations in future where gap acceptance sight distance may become required and where it would be inadequate?
- 16 Will the gap acceptance sight distance be affected by permanent or temporary obstructions (including queues of vehicles opposite right-turn movements)?

(PSD) Gap acceptance sight distance - Pedestrians and cyclists

- 17 Is gap acceptance sight distance adequate for pedestrians and cyclists at each possible location where they may cross the road?
- 18 Will the gap acceptance sight distance be affected by permanent or temporary obstructions?

(XSD) Overtaking sight distance

- 19 Is adequate overtaking sight distance adequate wherever overtaking is permitted?
- 20 Will the sight distance be affected by permanent or temporary obstructions.

4) ROAD ALIGNMENT

Element co-ordination

- 1 Is the interaction of horizontal and vertical alignments safe (i.e. roller coaster alignments, sequencing of horizontal and vertical curves, etc.)?
- 2 Are there any tree, pole or other lines that do not follow the road alignment or will there be any lights at night, include vehicle headlights, that do not follow the road alignment and which could create driver confusion?

Horizontal alignment

Horizontal curves

- 3 Are there an excessive number of horizontal curves on the road that contributes to safety problems?
- 4 Are there any curves that are excessively long?
- 5 Are there any curves that would require an excessive change in operating speed? Are there excessive curve radii that would cause skidding in adverse weather conditions? Have advance warning been given?
- 6 Are horizontal curves visible and readable by drivers?

Transition curves

- 7 Will transition curves lead to drivers underestimating the radius of a curve? Have advance warning been given?

Chevrons

- 8 Are chevrons provided along curves at adequate spacing?

Tangents

- 9 Are there any tangents that are excessively long and which could result in boredom and safety problems?

Vertical alignment

Vertical curves

- 10 Are there an excessive number of vertical curves on the road that contribute to road safety problems?

Gradients

- 11 Are there excessive gradients on the road that could be unsafe, particularly for heavy vehicles? Has advance warning been given?
- 12 Are there any excessive speed changes required on such gradients, such as at intersections and accesses?

Passing opportunities

Overtaking areas

- 13 Is there adequate provision for passing opportunities?
- 14 Are the overtaking areas safe? Are they visible and readable by drivers?

Climbing and passing lanes

- 15 Have climbing and passing lanes been provided and are they required? Is the number and spacing of the climbing and passing lanes adequate?
- 16 Is the design of the climbing and passing lanes safe? Are the end treatments safe? Has adequate warning been given? Are they readable by drivers?

5) CROSS SECTION

Number of carriageways

- 1 Is the number of carriageways appropriate for the road?
- 2 Is future expansion possible and may it affect future safety?
- 3 Are transitions safe where the number of carriageways change? Is there no opportunity for driver error (both day and night)? Has advance warning been given? Do transitions occur near to hazards?

Number of lanes

- 4 Is the number of lanes appropriate for the road and volume of traffic?
- 5 Is future expansion possible and may it affect future safety?
- 6 Are transitions safe where the number of lanes change? Is the lane drop given on the slow or fast lane, and is there sufficient provision for driver error (both day and night)? Has advance warning been given? Do transitions occur near to hazards?

Lane width

- 7 Is the lane width appropriate for the class of road, design speed, traffic volume and mix of traffic?
- 8 Has lane widening provided on sharp curves to accommodate vehicle off-tracking?
- 9 Has lane widening provided at intersection to accommodate turning vehicles?

Disused pavement

- 10 Is there any disused road pavement that can cause driver confusion?

Crossfall and superelevation

- 11 Has sufficient crossfall been provided? Is crossfall adequate for drainage?
- 12 Has adequate superelevation been provided? Will superelevation result in water running across the road?

Median

- 13 If a median has not been provided, is there an increased safety risk because of this?
- 14 Is the width of the median adequate for road signs and pedestrians?
- 15 Is the design of the median safe? Are slopes on the median safe?
- 16 Is there a risk for vehicles crossing the median into the path of opposing vehicles?
- 17 Have median barriers been provided or should they be provided?
- 18 Have median openings been provided for emergency vehicles?

Median ends

- 19 Are median ends/transitions safe? Has advance warning been given? Do median ends occur near to hazards? Are they visible and readable by drivers?

Kerbs

- 20 Is the type of kerb used appropriate to requirements and speeds? Have barrier or semi-mountable kerb been used when the speed limit exceeds 80 km/h?
- 21 Are there any unsafe abrupt changes in the kerblines?
- 22 Are the kerbs in an acceptable condition? Have any loose kerbs been provided?

Road shoulders

- 23 Have paved shoulders been provided or are they required?
- 24 If wide paved shoulders have been provided, can the shoulders safely be used by slow-moving vehicles?
- 25 Is the shoulder adequate for broken down vehicles?
- 26 Are the shoulders adequate for use by road maintenance vehicles?
- 27 Are the shoulders adequate for use by emergency vehicles?
- 28 Are the paved shoulders adequate for use by pedestrians and cyclists? Should they be using the shoulders?
- 29 Is the shoulder crossfall adequate for drainage?
- 30 Are transitions safe where the shoulder width and construction changes (such as over bridges)? Is there sufficient provision for driver error (both day and night)? Has advance warning been given? Do transitions occur near to hazards?

Road verge, cut and fill

- 31 Is the road located in an area in which the topography is of such a nature that it does affect road safety? Can the road be realigned to avoid the area?
- 32 Is the road verge adequate to provide safe recovery. Is it of sufficient width and are batter slopes too steep? Are there any embankments on the road verge that are unsafe?
- 33 Are cuts stable, or is there a possibility of loose material falling onto the road?

6) INTERSECTIONS AND ACCESSES

Intersection/Access management (Intersection and access location and spacing)

- 1 Does the location of intersections and accesses serve the need of the community and thus contribute to road safety?
- 2 Is the intersection and access spacing (degree of access) appropriate for the class of road (as well as the intersecting road)? Are there an excessive number of intersections and access that affects road safety? Are all the intersections and accesses really necessary or essential?
- 3 Is road safety not adversely affected by excessive access management?
- 4 During construction, have all intersections and accesses been located at well-defined positions? Are any accesses provided over long undefined distances?

Intersection consistency

- 5 Is the intersection control type, layout and other features consistent with other intersections, on the road and on the intersecting road?

Intersection control

- 6 Will intersections and accesses be able to cope with traffic demand? Will congestion result in traffic safety problems?
- 7 Is the intersection and access control appropriate for the class of road and design speed (as well as that of the intersecting road)? Traffic signals may not be used on roads with a speed limit higher than 80 km/h.

Intersection layout

- 8 Are there any features that may affect safety, such as parking, signs, etc?
- 9 Is the angle of intersection nearly 90 degrees, or at least not less than 70 degrees?
- 10 Can intersections accommodate all design vehicle types, including swept paths?
- 11 If two stage gap acceptance is necessary, is there adequate median width?
- 12 Are intersections visible and readable by drivers?

Intersection gradient

- 13 Are approach gradients too steep on approaches to intersections or accesses?

Auxiliary lanes

- 14 Have left-turn and right-turn auxiliary lanes been provided and are they required?
- 15 Are they of adequate length? Can right-turn auxiliary lanes accommodate right-turn queues?
- 16 Are their designs safe? Has adequate warning been given?
- 17 Are there any trap lanes? These are basic lanes that do not continue through an intersection and where only turning movements are allowed.

Slipways

- 18 Is the design of slipways safe for vehicular traffic? Are angles near to 90 degrees?
- 19 Is the design of slipways safe for pedestrians?
- 20 Is the island size and offset adequate?

Traffic circles

- 21 Has adequate deflection provided to reduce approach speeds?
- 22 Have splitter islands been provided or are they needed? Is their design safe?

- 23 Is the central island prominent. Is the design of the island safe? Is the circle visible and readable by drivers?
- 24 Are traffic circles visible and readable by drivers?

Railroad crossings and bridges

- 25 Would rail bridges be justified?
- 26 At level crossings, have adequate sight distances for approaching trains been provided? Have adequate warning been given?
- 27 Are there any hazardous features at the crossing or bridge?

7) INTERCHANGES

Interchange location and spacing

- 1 Does the location of interchanges serve the need of the community and thus contribute to road safety?
- 2 Is the interchange spacing adequate and is there adequate distance for weaving?

Interchange type

- 3 Is the interchange type appropriate in respect to topographical and operational requirements?
- 4 Is the interchange type consistent with other interchanges on the road?

Interchange design and layout

- 5 Does the design of the interchange meet design requirements?
- 6 Is lane balance and continuity maintained at all locations?
- 7 Have provision been made for access by maintenance and emergency vehicles?

8) PEDESTRIAN AND CYCLIST FACILITIES

Pedestrian crossings

Intersections

- 1 Have proper provision been made at the intersection for pedestrians?
Midblock crossings
- 2 Have midblock pedestrian crossings been provided or are they required? Are midblock crossings appropriate for the class of road?
Crossing design
- 3 Have sufficient provision been made for the volume and queues of pedestrians?
- 4 Have pedestrian refuge islands or a median been provided on wide crossings? Are these islands of sufficient size?
- 5 Have kerb ramps been provided? Are transitions smooth without lips that can create a danger for persons in wheelchairs, or pedestrians with clutches?
- 6 Are crossings visible for and readable by drivers?

Bridges/subways

- 8 Would pedestrian bridges/subways be justified? Are these bridges/subways on desire lines and will they be used?
- 9 Are the bridges/subways safe? Have security been taken into account?

Sidewalks and walkways

- 10 Have a paved sidewalks been provided for pedestrians, or is one required? If provided, are such sidewalks suitable for the class of roads?
- 11 Are sidewalks discontinued at any location, including bridges and high fills?
- 12 Are sidewalks continued through the work zone during construction?
- 13 Are the sidewalks or footpaths in a useable condition? Do objects (such as plants) obstruct the sidewalks and result in pedestrians having to use the road or street?
- 14 Do the sidewalks or footpaths have an adequate hard vibration free surface. Vibration free surfaces are required for persons in wheelchairs.
- 15 Have a buffer strip been provided between the sidewalks and the roadway?

Bicycle roads and lanes

- 16 Have bicycle road or lanes been provided, or would they be required? If provided, are such roads or lanes suitable for the class of road?
- 17 Are the facilities discontinued at any location, including bridges and high fills?
- 18 Are facilities continued through the work zone during construction?
- 19 Are the facilities in a useable condition? Do objects (such as plants) obstruct the facilities and result in cyclists having to use the road or street?
- 20 Are the treatment of bicycle roads and lanes at intersections safe?

9) BRIDGES, DRAINAGE AND ENGINEERING SERVICES

Bridges

Bridge width and clearance

- 1 Is the road cross section continued over the bridge. If not, have safe transitions with adequate warning been provided?
- 2 Are pedestrian walkways continued over the bridge?
- 3 Are sufficient horizontal and vertical clearance distances provided?
- 4 Are bridges visible for and readable by drivers?

Bridge railings

- 5 Is the design of bridge railings adequate and safe? Does the railing pose a safety hazard for vehicles and pedestrians?
- 6 Is transition between different types of barriers safe?
- 7 Are bridge ends properly treated and anchored? Have proper energy attenuators been provided?
- 8 Have reflectors been installed on railings?

Road drainage

- 9 Have sufficient drainage structures been provided? For all road users, including pedestrians and cyclists?
- 10 Is there a possibility of surface flooding or can ponding occur? Is the crossfall on the road surface and shoulder adequate for drainage?
- 11 Is there a possibility that pedestrians will be sprayed by water from the road surface?
- 12 Are there factors that could lead to blocking of drains (e.g. vegetation)?
- 13 Are the drainage structures safe? Are there any unprotected walls, channels, etc?

Engineering services

- 14 Is the recovery zone clear of engineering services or have safety devices been provided. Hazardous objects may include electricity and telephone poles, electricity substations, etc.

10) ROAD SURFACE

Skid resistance

- 1 Is the skid resistance of the road surface adequate, particularly at intersections, steep grades and on curves?
- 2 Have skid resistance tests been undertaken?

Loose material

- 3 Is there any loose construction and other material, or excessive bleeding on the road surface that may affect road safety?

Pavement defects

- 4 Are there any defects of the road surface, such as potholes, rutting, bleeding, etc, and are these unsafe?
- 5 Are there any unsafe drop-offs on the road edge?
- 6 Are there any manholes and other features that are unsafe?

Headlight glare

- 7 Will headlight glare have an impact on nighttime operations?

11) SAFETY BARRIERS

Temporary safety barriers

- 1 Is the type of safety barrier appropriate to its use?
- 2 Is the design of safety barriers adequate and will they function as intended? Have they been installed correctly? Are all segments fixed to each other? Have sufficient deflection distance been provided behind the barrier?
- 3 Is transition between different types of barriers safe?
- 4 Are the ends of the safety barriers safe? Have proper energy attenuators been provided?
- 5 Have reflectors been installed on barriers?
- 6 Does the barrier pose a safety hazard for vehicles, pedestrians and other users?

Safety barriers (hazardous object protection)

- 7 Is the type of safety barrier appropriate to its use?
- 8 Is the design of safety barriers adequate and will they function as intended? Have they been installed correctly? Are all segments fixed to each other? Have sufficient deflection distance been provided behind the barrier?
- 9 Is transition between different types of barriers safe?
- 10 Are the ends of the safety barriers safe? Have proper energy attenuators been provided?
- 11 Have reflectors been installed on barriers?
- 12 Does the barrier pose a safety hazard for vehicles, pedestrians and other users?

Guardrails (hazardous object protection)

- 13 Are guardrails used where appropriate?
- 14 Have guardrails properly been installed? Have sufficient deflection distance been provided behind the guardrails? Is post spacing and post depth adequate? Are rail overlaps correct?
- 15 Is transition between different types of barriers safe?
- 16 Are guardrail ends properly treated and anchored? Have proper energy attenuators been provided?
- 17 Have reflectors been installed on guardrails?
- 18 Does the guardrail pose a safety hazard for vehicles, pedestrians and other users?

Pedestrian barriers

- 19 Is the separation of vulnerable road users and vehicles required?
- 20 Is such separation appropriate to the class of road?
- 21 Will/are the barriers be effective?
- 22 Will/are the barriers be safe?

Fences

- 23 Are road reserve fences provided and are they required?
- 24 Are the fences effective?
- 25 Are fences safe? Do they contain dangerous horizontal elements?

12) TRAFFIC CALMING

Traffic intrusion

- 1 Is traffic calming required to reduce or prevent traffic intrusion?
- 2 Is such traffic calming appropriate for the class of road?
- 3 Will/are the traffic calming measures be effective?
- 4 Will/are the traffic calming measures be safe? Are they visible and readable?

Speed calming

- 5 Is the road used by significant numbers of pedestrians or cyclists and are operating speeds too high?
Are speed calming measures required?
- 6 Are speed calming measures appropriate to the class of road?
- 7 Will/are the speed calming measures be effective?
- 8 Will/are the speed calming measures be safe? Are they visible and readable?

13) ROADSIDE FACILITIES

Parking and loading

- 1 Has on-street parking or loading been provided? Are they safe? Are they suitable for the class of road and operating speeds?
- 2 Does illegal parking or loading occur? Is it safe?
- 3 Has provision been made for safe access to the parking and loading by pedestrians?

Bus stops (Public transport stops)

- 4 Have adequate public transport stops been provided or are they required?
- 5 Does illegal activities occur that are unsafe?
- 6 Can or has provision been made for safe access to the stops by pedestrians?

Refuse collection

- 7 Can refuse safely be loaded at properties along the road?

Law enforcement

- 8 Is there space available along the road for law enforcement activities?

Truck stops and escape ramps

- 9 Have truck stops been provided or required? Have adequate warning been given?
- 10 Have escape ramps been provided or required? Have adequate warning been given?

Rest areas

- 11 Are rest areas desirable on the road? Is the number of rest areas adequate?
- 12 Are the rest areas placed at appropriate locations?
- 13 Do the rest areas have safe access? Have adequate warning been given?

14) ROAD SIGNS, MARKINGS, TRAFFIC SIGNALS AND LIGHTING

Traffic accommodation plan

- 1 Is a traffic accommodation plan available for use during construction?
- 2 Does the plan comply with the requirements of the Road Traffic Signs Manual?

Road signs

- 3 Have road signs been provided in accordance to the requirements of the RTSM?
- 4 Have sufficient road signs been provided? Are there any signs that are redundant? Are there any road signs missing or have any been removed?
- 5 Are all road signs located properly?
- 6 Have sufficient vertical and horizontal clearance distances been provided? A minimum clearance height of 2,1m must be provided where there are pedestrians.
- 7 Are all road sign and letter sizes adequate?
- 8 Are all road signs visible and readable? Have the visibility been obscured by other signs, structures, vehicles or vegetation?
- 9 Is the condition of the road signs adequate? Are they faded or damaged?
- 10 Are all important road signs retroreflective at night? Are some signs not too reflective?
- 11 Are road sign supports safe? Have they been located outside of the clear zone? Have signs been mounted using safe methods (not in sand-filled drums). Have frangible or slip-base poles been used on large signs? Have they been protected by safety barriers?
- 12 Are there any advertising and other signs located near to the road signs that would confuse drivers?

Pavement markings

- 13 Have road markings been provided in accordance to the requirements of the RTSM?
- 14 Have sufficient road markings been provided? Are there any markings that are redundant?
- 15 Are all road markings located properly?
- 16 Are all road markings visible? Under all adverse weather conditions? At night? Is the condition of the road markings adequate? Are they faded?
- 17 Are all important road markings retroreflective at night? Are some markings not too reflective?
- 18 Have unused and old pavement markings been adequately removed? Do such markings create a safety hazard?

Road studs

- 19 Are road studs provided or will they be required?
- 20 Are the road studs in acceptable condition?

Speed limits and advisory speeds

- 21 Are speed limits appropriate for the road?
- 22 Would speed limits result in a large reduction in speeds? Is such reduction reasonable and safe?
- 23 Have transitions in speed limits been posted in intervals?
- 24 Are signs placed at the correct location and not ahead of where they are needed?
- 25 Have speed limit signs been posted at each intersection on the road?
- 26 Are there considerable variation in speed limits that may create confusion? Is adequate warning given for speed limits?
- 27 During construction, are speed limits properly being managed? Are speed limits removed or covered when not required?
- 28 Have advisory speeds been provided where required? Are the advisory speeds suitable? Is sufficient distance provided to react to the warning signs?

Traffic signals

- 29 Have traffic signals been provided in accordance to the requirements of the RTSM?
- 30 Have all primary and secondary signal faces been provided and properly positioned?
- 31 Have overhead signals been provided and are they necessary?
- 32 Is the design of the traffic signals consistent at all intersections along a route?
- 33 Are there any signal faces that are not in accordance to the RTSM?
- 34 Are slipways properly controlled? Have signals been provided on such slipways and have care been taken to prevent conflicting greens?
- 35 Are the intergreen (yellow and all-red) periods adequate?
- 36 Have adequate turning phases been provided?
- 37 Is the timing of the traffic signals satisfactory?
- 38 Are the signals visible and readable by drivers?
- 39 Have warning signs been provided where visibility is poor?
- 40 Will traffic signals be affected by a setting or rising sun?
- 41 Have adequate provision been made for pedestrians, also in the timing of the traffic signals? Are all pedestrian buttons working?
- 42 Are traffic signals located outside clear zone? Are they safe?

Lighting

- 43 Has lighting been provided or is it necessary? This include the following:
 - a) Intersections or pedestrian crossings (particularly traffic signals).
 - b) Sidewalks and footpaths, crossings (also required for security reasons).
 - c) Areas where there is a sudden transition from light to dark conditions.
 - d) Gores at diverging areas. Merging areas.
 - e) Construction areas.
- 44 Is the road lighting effective? What is the effect of features like trees, bridges, etc? Are there any lighting black patches?
- 45 Can luminaires create glare for road users? Have lighting black spots been created?
- 46 Is the transition in lighting safe? Will the lighting not create vision problems?
- 47 Are the light poles in the clear zone? Have frangible or slip-base poles been used or have other safety measures been implemented?

15) LAND USE AND DEVELOPMENT

Traffic generators

- 1 Is the road located adjacent to developments that would generate traffic that could cause congestion and safety problems on the road?
- 2 Will the development generate unusual types of vehicles, such as agriculture, abnormal loads, etc?

Pedestrians and cyclists at developments

- 3 Will the project result in the division of a community, or will it cut the community off from basic commodities such as water, firewood and retail facilities, so that pedestrians will have to cross the road?
- 4 Is the road located adjacent to developments (e.g. schools) that generate large volume of pedestrians and cyclists? Can such pedestrians and cyclists be accommodated safely? Should barriers and fences be erected?

Development access control

- 5 Will access control measures result in queue spill back onto the street system.
- 6 Are throat lengths of adequate length to accommodate queues?

Off-street parking and loading areas

- 7 Have adequate off-street parking and loading areas been provided?
- 8 Are such parking and loading areas visible from the street?

Distractions at developments

- 9 Is the roadside visually cluttered to the extent that it would distract drivers?
- 10 Is there a need to provide glare protection from lighting of adjacent developments?
- 11 Are there any other aspects that may distract drivers? These may include advertisements, low-flying aircraft, etc.
- 12 Will there be any special events that may distract drivers?

Hawkers

- 13 Are there any hawkers adjacent to the road that create safety problems?
- 14 Do these hawkers attract pedestrians that could cause safety problems?

16) ENVIRONMENT

Day/night and weather

- 1 Will traffic safety be affected at night?
- 2 Will traffic safety be affected by a setting or rising sun?
- 3 Have the effect of weather (wind, mist, fog, etc) adequately been taken into account?

Landscaping and plants

- 4 Do existing landscaping and plants affect clearances and sight distances?
- 5 Will future plant growth affect clearances and sight distances?
- 6 Can landscaping obscure pedestrians, cyclists, vehicles and animals?
- 7 Will plants result in shade which obscure road signs and other features?
- 8 Will plants result in leaves and litter on the road that may affect safety?
- 9 Are trees located within the clear zone? If so, have adequate provision been made for safety measures?

Animals and stock

- 10 Are there any known animal travel/migration routes which could affect the road?
- 11 Have fencing and animal underpasses been provided where required?
- 12 Have proper signage been provided?

17) CONSTRUCTION AND MAINTENANCE

Construction

- 1 Will road safety be affected by construction? Can construction be undertaken with an acceptable degree of safety?
- 2 Will road safety during construction be affected by the planning and design of the project?

Maintenance

- 3 Can all elements of the road be maintained (including medians and intersections)?
- 4 Have median openings been provided for road maintenance vehicles to turn?

Construction and maintenance activities

- 5 Is there adequate clear zone between construction activities and roadway?
- 6 Are there any hazardous objects near to the roadway?