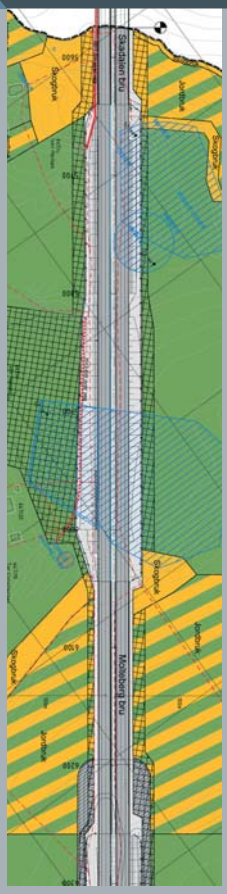
Statens vegvesen

Handbook 222

Road Safety Audits and Inspections

GUIDELINES

Handbook 222



Road Safety Audits and Inspections

October 2006

Road Safety Audits and Inspections

Statens vegvesen

Public Roads Administration Handbooks
This is a Level 1 handbook (Guide) in the Norwegian Public Roads Administration's handbook series, a collection of consecutively numbered books primarily written for use within the Administration.

The English version is a translation of the Norwegian one. In case of linguistic differences between the two versions, the Norwegian version is the valid one.

The books are for sale and may be ordered from the Directorate of Public Roads at prices given in the book-list – Handbook no. 222.

Preparing and updating the books is the responsibility of the Directorate of Public Roads.

The Graphics Division at the Administration is generally responsible for designing and printing the books.

The handbooks are issued on two levels:

Level 1: Yellow band on the cover indicates regulations, standards and guidelines approved by the authority responsible or the Directorate of Public Roads with authorization.

Level 2: Blue band on the cover indicates instructions, teaching manuals and road data approved by individual departments authorized by the Directorate of Public Roads.

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Foreword

Road safety audit and road safety inspection1) is a systematic work method contributing to safer roads and safer road traffic.

A road safety audit is defined as a systematic and independent traffic safety investigation relative to a road or traffic plan. Road safety inspection is similarly defined as a systematic review of a new road project or an existing road with the intention of uncovering conditions of potential hazard to road users.

The National Transport Plan and the National Action Plan for Road Traffic Safety contain directions on the use of road safety audits and road safety inspections in Norway.

The road safety audit concept came into being in Great Britain, where the method was developed and implemented towards the end of the 1980s. Denmark was one of the first Nordic countries to employ and develop the method further. Today, the method is being used in most Western countries.

Road safety auditing of plans were undertaken in Norway as trial projects in 1997/98. Handbook 222 was prepared in 1999 (as a precursor to the current version) and road safety audit of plans have since then been undertaken to a varying degree. A preliminary guide was issued in 2001 for road safety audit of existing roads. Since then a number of road sections have been audited. All countries that have undertaken road safety audits can point to positive experiences and results.

This handbook replaces Handbook 222 – "Road Safety Audit of Existing Roads and Traffic Systems" of October 1999 and "Preliminary Guide for Road Safety Audit of Existing Roads" of 2001.

The handbook is available on the Internet at the following address: www.vegvesen.no

Part 0 provides information on goals, responsibilities and description of the road safety auditing procedure and of road safety inspection of existing roads.
Part 1 presents more detailed information on the auditing procedure, while the inspection procedure is described in Part 2.
A description of methods associated with specific topics is found in separate handbooks (e.g. HB 046 – Sign Renewal, HB 249 – Bicycle Road Inspections etc.)

1)Road safety inspection of existing roads is a new concept that has been adopted because this term appears to be more appropriate when associated with existing roads.

The handbook was prepared by a working group consisting of:

Arve Kirkevold - Public Roads Administration, Directorate of Public Roads, Chair
Tommy Bones - Public Roads Administration, Central Region
Svein Ringen - Public Roads Administration, Western Region

Grethe Myrberg, Rambøll Norge AS, was a consultant during the work.

The handbook replaces the 1999 issue as of September 1st, 2005.

Department responsible: Roads and Traffic Department
Preparation: Traffic Safety Section

Part 0 General provisions

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1 Introduction

This handbook describes the basic principles, requirements, responsibilities, guidelines and methods for undertaking road safety audits and inspections at the Norwegian Public Roads Administration. Road safety audit of existing roads will, as mentioned in the foreword, hereafter be called road safety inspection. This is being done because it is considered to be a more appropriate designation of a method and process regarding existing road and is in line with terms used in other European countries.

It is important that both the Public Roads Administration and the municipalities consider road safety early in the planning process based on recognition of the principle that it is simpler and cheaper to prevent than to repair. When the damage has been done and a road has been constructed with serious safety deficiencies, or new insight has revealed other hazardous conditions, it is important that road safety inspections are undertaken promptly to prevent accidents from happening or to reduce the severity of a possible accident.

The handbook describes method and procedure for planning, undertaking and documenting road safety audits and road safety inspections at the Public Roads Administration, and is a guide to be used in this work.

The handbook is based on:

- Guidelines included in NS-ISO 10011, parts 1, 2 and 3.
- Handbook 222 – Road Safety Audits of Roads and Traffic Systems, October 1999.
- Preliminary Guide for Road Safety Audits of Existing Roads, TTS-report - 04 -2001.
- Evaluation of Road Safety Audit of Plans, TTS-report - 13 – 2002.
- Road Safety Audits of Existing Roads, Summary of Experiences, Report 08/2004.
- Road Safety Audits of Road and Traffic Project Plans 1999 - 2003, Report 04/2004.
- R&D project 2004/05, Developing Existing Road Safety Inspection Method.

Undertaking road safety audits and inspections is a central means in the Vision Zero effort. Experiences from completed road safety audits and other road safety studies in Norway show that all new road and traffic system plans have not been equally well prepared with consideration to safety. This is either due to inadequate standards or that current standards have not been followed. It is also caused by inadequate resources or traffic safety qualifications in the planning process, or that traffic safety had to yield to other considerations. It is therefore desirable to undertake road safety audits of new plans to ensure that roads are designed in a manner that will result in few accidents with low severity.

Road safety inspection experiences show that existing roads often have a number of design flaws that can result in serious accidents. It is therefore important to review existing roads.

A way to ensure that additional kilometres of existing road are being reviewed is to make the process simpler and less formal. A method has therefore been developed to speed up the process.

2 Vision Zero

The purpose of road safety audits and road safety inspections is to improve existing/ design new roads and traffic systems in a manner to avoid accidents resulting in fatalities or persons being permanently injured (Vision Zero).

Vision Zero means that work shall be undertaken to prevent serious accidents and to reduce the severity of accidents that still take place. Support was given to Vision Zero through Report to the Storting no. 46 (1999-2000) - NTP 2002-2011.

Vision Zero views accidents in a system perspective, where all elements affecting accidents and their consequences are considered: road user, vehicle, the road and its surroundings.

The elements within the road traffic system must interact and be mutually adapted for the system to be safe. Human qualifications - our abilities and tolerance - must be the basic prerequisite when forming the system. An accident is as a rule caused by failure in the interaction between the elements and is thus a system deficiency, and not only a personal mistake or a random incident. The road and traffic environment must be designed in a manner that promotes correct road user behaviour and protects them against serious consequences of erroneous actions.

Speeds selected by road users relative to road design and vehicle safety standard is a central element in the traffic interaction. The force the body is exposed to at the moment of impact is to a large extent determined by vehicle weight and speed.

Collision tests show that occupants of relatively new cars wearing seat belts, who collide head-on with a similar car or fixed object have a good chance of surviving at speeds up to 70 km/h. With increasing speed the chances of surviving decrease dramatically. Similarly, the critical limit for side impacts is 50 km/h, and for a pedestrian or cyclist struck by a car 30 km/h.

Shaping the road traffic system must be based on a recognition that it is human to err and on knowledge on the limit of the impact forces a human body can stand. In a safe traffic system there are factors that counteract erroneous actions and counteract erroneous actions from resulting in serious accidents.

It is important to keep such knowledge in mind when undertaking a road safety audit. Human abilities and tolerance form a basis for how to assess whether an existing road or a plan will adequately ensure traffic safety.

Roads must in particular be checked against conditions that can contribute to serious accidents. Head-on and off-the-road accidents are dominant accident types with many fatalities. Along with pedestrian accidents, these three accident types account for 81% of all fatalities, while they represent only 50% of all accidents.

Measures aimed directly against head-on accidents, off-the-road accidents and pedestrian accidents will therefore be of major importance.

3 Intention and Concepts

3.1 Intention

The purpose of road safety audits and road safety inspections is to design new and existing roads and traffic systems in a manner to avoid accidents resulting in fatalities or persons being permanently injured (Vision Zero).

A road safety audit is defined as a systematic and independent traffic safety investigation of a road or traffic plan. Road safety inspection is similarly defined as a systematic review of a new or existing road with the intention of uncovering conditions of potential hazard to road users.

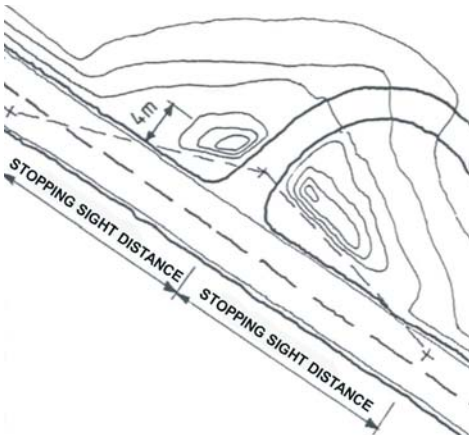

Figure 0.1: Road safety audit and inspection

Figure 0.2: Road safety inspection of existing road network

1. The purpose of road safety audits of road and traffic plans:

- To ensure that new roads and traffic systems are built in accordance with Vision Zero, knowledge of safe road design and requirements stated by current design standards and any other sets of rules.
- To weed out undesirable solutions, faults and deficiencies at various planning levels before construction.

2. The purpose of road safety inspections of existing roads:

To improve traffic safety standards on existing roads by identifying and weeding out hazardous conditions, faults and deficiencies along the road that can lead to serious accidents. This is done using well-established experience and knowledge of safe road design and traffic operation as well as knowledge about the effect of traffic safety measures.

3.2 Some definitions

Deviation:

Deviation means lack of fulfilment of specified user requirements such as lack of fulfilment of road standard requirements, or by other statutory or adopted requirements that might have significant bearing on traffic safety.

Deviation can be grouped into significant and minor deviation.

Significant deviation is meant to include conditions of such importance to traffic safety as to justify changes to the plan or project with the intent of eliminating or mitigating the problem. If this is not possible, measures must be implemented to safeguard road users or in a satisfactory manner warn them about the hazard. Non-compliance with certain standard requirements of importance to traffic safety is normally considered as essential deviation.

Minor deviation is meant to include conditions of lesser importance to traffic safety, but which still should be considered in the progression of the project. Lack of compliance with standard requirements of lesser importance to traffic safety is normally considered as lesser deviation.

Fault:

Fault means lack of compliance with an intended user requirement or a reasonable expectation, including those concerning safety. Fault is lack of conformity with intended usage. This implies for example that a road project in accordance with the road standards and therefore without deviation, still can have faults if it does not fully satisfy the users' needs. Choosing too low a standard relative to adjoining roads or inadequate adaptation to existing road network, are examples of faults that should be mitigated. Another example is pedestrian crossings unfavourably placed relative to pedestrian walking patterns and destinations.

Note/remark:

Note or remark are used as indication of conditions that can be documented as undesirable with regard to traffic safety, such as bad solutions or choices, but which are not in conflict with current standards and guidelines. New knowledge or experience acquired after the standards were written should be considered. Standard requirements or recommendations are, moreover, not necessarily optimal with regard to traffic safety.

Immediate measures:

Immediate measures mean minor measures not requiring right-of-way acquisition or formal process in accordance with the Plan and Building Act. Examples of immediate measures are signing and markings, improving sight distance, erecting and repairing guardrail, eliminating roadside obstacles, elevated pedestrian crossing, traffic island at pedestrian crossing, correcting faulty super elevation and intersection improvement within existing right-of-way. Financing measures on existing road is at present done jointly by budget item 23 ”Traffic surveillance, operation and maintenance of national roads” and budget item 30 ” National road investments”. Costs are dependent on type of measure and whether it is to be undertaken within or outside urban areas.

Minor investment measures:

These are measures that do not require major investments but which may require formal processing according to the Plan and Building Act. Examples of minor investment measures are intersection improvements, roundabouts, median barriers and curve straightening. The measures are at present financed by budget item 30 ”National road investments”.

Route investment measures /major investment measures:

These are measures requiring major investments. Examples include new road sections, pedestrian/bicycle roads, major intersection reconstruction etc. The measures are normally financed over budget item 30 ”National road investments”

3.3 Levels and timing

Road safety audits or road safety inspections can be carried out at:
- Levels 1 – 3, Road safety audit in the planning process
- Level 4, Road safety inspection of existing road

Previous level 4 (New road before opening) and level 6 (Existing road) are replaced by road safety inspection of existing road (henceforth level 4). This is being done because the levels are similar and the only distinction is the accident experiences being had on existing road. Previous level 5 (work zone signing, detours and major maintenance) will be replaced by a separate topics guide in conjunction with preparation of new handbook 051.

Level 1 ”Municipal Sector Plan”, level 2, ”Development Plan” and level 3 ”Construction plan” will retain their designation.

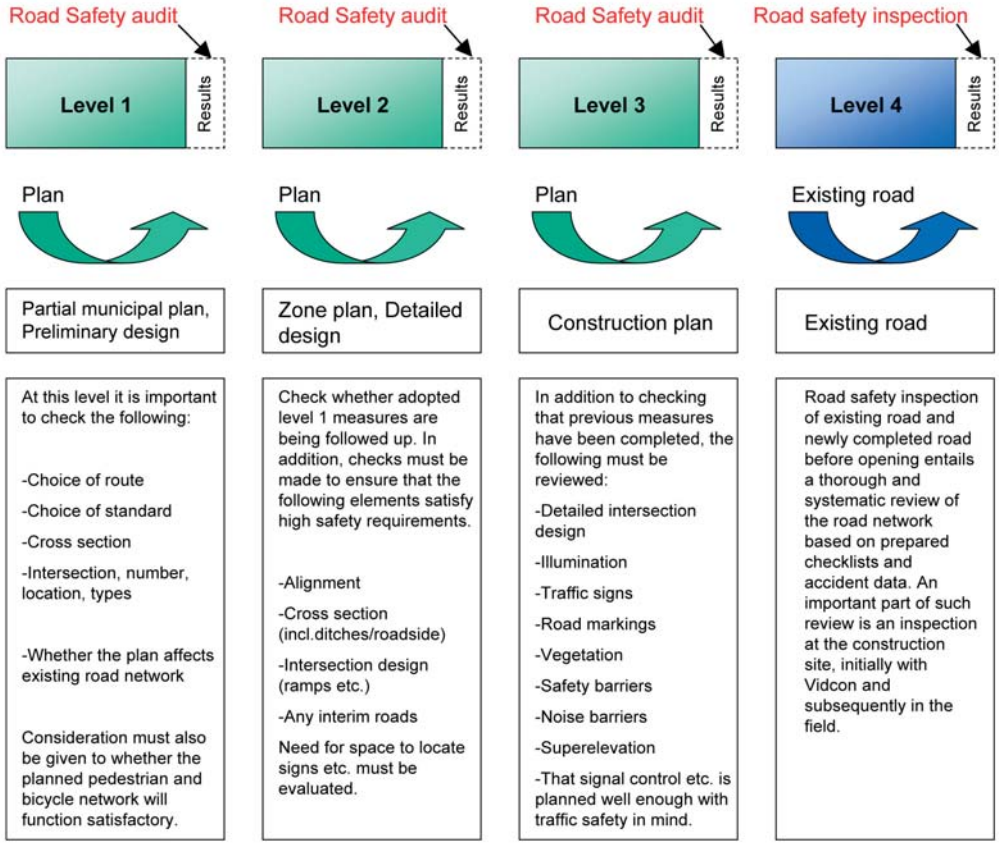

Figure 0.3: Road safety audit and road safety inspection levels

Figure 0.3 illustrates the four road safety audit and road safety inspection levels. With larger projects, audits should ideally be undertaken at all three planning levels and before the opening of the new road.

It is essential that road safety audits of plans be carried out at the appropriate time relative to the planning and construction process. This is the project holder's responsibility.

Part 1 and part 2 of this handbook contain procedures, checklists and other information on how to undertake road safety audits and road safety inspections.

Parts 1 and 2 contain the following:

Part 1 - common material on road safety audit of plans
- Municipal Sector Plan – level 1
- Development Plan – level 2
- construction plan – level 3

Part 2 - common material on road safety inspection on existing road
- existing road and new road before opening – level 4

4 Position in the safety system

The Public Roads Administration will base its activity on a system of safety management. It consists of gaining a formal foundation and precise description of which safety evaluations shall be made in all parts of its activity. Safety evaluation shall be included as primary requirements in the new safety management system being prepared by the Public Roads Administration.

A safety management handbook will describe which evaluations shall be undertaken when and by whom. This handbook will refer to separate guidelines describing how the various evaluations shall be carried out, for example road safety audits and inspections. The safety management handbook will also suggest scope of evaluations and measures to be implemented to achieve current safety objectives, including those stated by the National Transport Plan.

Figure 0.4. Road safety audits and inspections are two of several safety evaluation methods

5 Responsibility

5.1 Overall responsibility

The Public Roads Administration has an overall responsibility for the entire road traffic safety system and must ensure quality assurance and continual quality improvements. The Public Roads Administration initiated road safety audit as a supplement to the ordinary quality control of plans.

Vision Zero is the basis for all traffic safety work. Through Report to the Storting no. 46 (1999-2000) – NTP 2002-2011, support was given to a vision of a transportation system where no one is killed or permanently injured. Vision Zero means that we shall work both to prevent serious accidents and to reduce the severity of accidents that still happen. We must recognize that it is human to make mistakes and that accidents will occur also in the future, but a human mistake should not lead to death or permanent injury. Vision Zero is based on road users and authorities sharing a joint responsibility for safety. Road users must observe the rules of the road and pay attention, while the authorities must ensure that the traffic system is so safe that an unintended mistake will not lead to serious consequences.

Public Roads Administration guidelines on traffic safety and road safety audits are adopted by the National Transport Plan (NTP), the National Action Plan on Road Traffic Safety and the Public Roads Administration's action plan.

Based on Vision Zero and general plans, the Public Roads Administration has the responsibility for:

- Undertaking professional reviews of safety standards of road and traffic plans in progress.
- Undertaking professional reviews of existing road network and newly constructed roads before opening to identify and mitigate conditions that can cause serious accidents.

5.2 Basis in steering documents and recommendations

The following refers to NTP 2006 –2015 chapters dealing with road safety audits and road safety inspections. Moreover, recommendations are extracted from evaluations from past efforts. This reveals the scope of road safety audits and road safety inspections the Public Roads Administration should employ in its road safety endeavour.

Road safety audit of plans

NTP 2006 – 2015 contains a requirement concerning road safety audit of plans (page 79): "Road safety audits and risk assessments shall more actively be used as a prioritizing basis".

Page 27 in the Directorate of Public Roads' preliminary guidelines (May 2004) contains road safety audit requirements:
"Completed roads shall appear without faults and deficiencies with regard to traffic safety. Road safety audit shall be carried out on at least one planning level for all route investments for the period of 2006 – 2009. For most projects, road safety audits of construction plans will be of greatest importance. A risk assessment or road safety study is recommended undertaken at an early planning stage".

Evaluation of road safety audit of plans (TTS-report 13-2002) concludes that it is important to get involved at the development plan level, and in time – i.e. before a development plan is approved.

With route investments/major investment measures, a road safety audit shall be carried out on at least one planning level. Road safety audits should preferably be done at several levels. Both development plan (level 2) and construction plan (level 3) are important levels.

With minor investment measures, it is recommended that road safety audit be requested when giving the planning assignment. A road safety inspection should be undertaken before the opening of all new road projects to prevent new roads from having traffic safety deficiencies.

Road safety inspection of existing road

NTP 2006 – 2015 (page 105) has also set road safety inspection requirements for existing roads:

"The Public Roads Administration will during the planning period intensify its road safety audit effort on national roads with high injury severity density. The road safety audits are followed up with simple immediate measures such as erection of barriers, elimination of roadside obstacles and signing. Such measures are in the borderland between maintenance and investment and will be financed partly over budget item 23 and partly over budget item 30. In order to increase the activity in these areas within the established framework, certain savings on other operational tasks might be necessary. Tasks with potential effect on road safety shall not be affected by this".

As part of the NTP 2006 – 2015 effort, a classification of roads on the national network was made based on the accident and injury severity situation. This classification formed basis for prioritizing among existing road sections to be subject to road safety inspection:

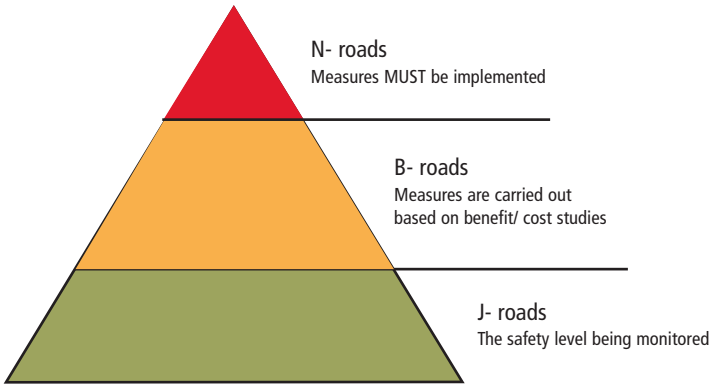

Figure 0.5 Classification of the national road network

- N-roads (no-roads, red roads) are roads where especially many and/or serious accidents occur and where measures MUST be undertaken. The N-roads make up about 10% of the national road network.
- B-roads (adequate roads, yellow roads) are roads where measures are carried out based on a benefit/cost assessment. These roads make up about 40% of the national road network.
- J-roads (yes-roads, green roads) are roads being monitored with regard to traffic safety. These roads make up about 50% of the national road network.

5.3 Planning and initiation

Leaders at the various levels are responsible for undertaking road safety audits and road safety inspections within their area of responsibility. Road safety audits and road safety inspections are clearly a line responsibility.

At the national level, the Directorate of Public Roads through the Director General, has the overall responsibility for road safety audits and road safety inspections. The Director General can initiate road safety audits and road safety inspections as system holder.

At the regional level, the Regional Director has the overall responsibility for road safety audits and road safety inspections. The Regional Director is responsible for having road safety audits and road safety inspections incorporated into the Action Plan (4-year plan) and the annual plans. The Regional Director can initiate all types of road safety audits and road safety inspections within his area of responsibility.

At the district level, the District Director is responsible for road safety audits and road safety inspections being undertaken.

Road safety audits and road safety inspections at the Public Roads Administration shall be planned and determined by plans. A 4-year action plan and annual plans are prepared for this purpose. The Public Roads Administration will continuously prepare and present plans of the following types where road safety audits and road safety inspections are a natural and integral part:

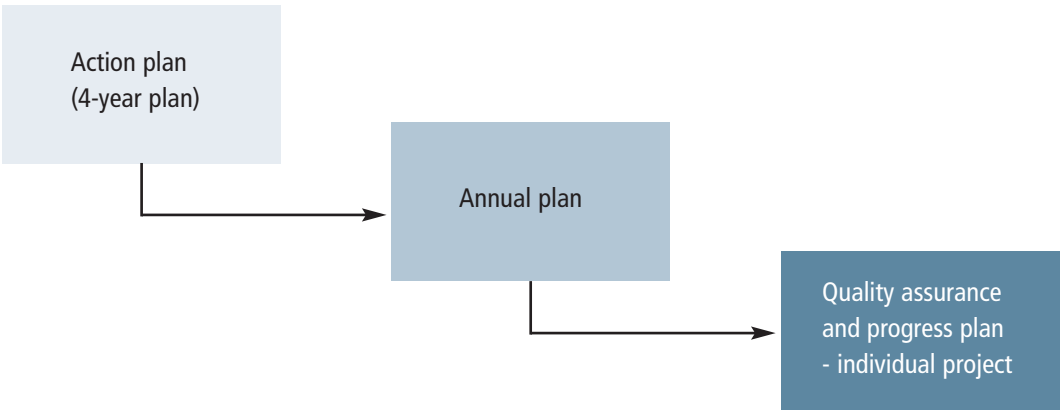

Figure 0.6 Planning levels

Road safety audit:
The 4-year road action plan for road safety audits shall show which road and traffic plans shall be subjected to road safety audits and at which planning level such audits shall be undertaken.
The annual plan shall list which plans shall be subjected to road safety audits.
The quality/progress plan shall state which individual construction project shall be subjected to road safety audits and the timing of these. (REMEMBER: Timing is essential to ensure that whatever has been pointed out by the audit will be considered).

Road safety inspection:
The 4-year action plan and the annual plan shall list which road sections shall be subjected to road safety audits. Priorities are determined based on the classification given the various sections (accident situation) – see Chapter 4.2.

Individual audits and inspections beyond those determined by 4-year plans and annual plans can be initiated by an employer if there is a need.

6 The Process

6.1 Plans

Road safety audit of plans involves three parties:

1. Project owner. This is the initiator of the project, which can be the regional Road Development Department or the district Contracting Section/Road Development Section.

2. Road safety auditor. Consists of a group of auditors headed by an auditor in charge who must be an approved road safety auditor.

3. Designer. This is the design unit that might include district office planners, the regional resource unit or consultants.

A road safety audit of a plan shall be a joint effort involving the three previously mentioned parties. The role played by each of these during the progress of the road safety audit is defined as follows.

		Responsibility:
Initiation	• Quality/progress plan for each individual project	Project owner
Planning/ preparation	• Select audit leader • Establish audit team safety auditor • Make agreement • Submit plans and other basic material • Hold initial meeting	Project owner Project owner/road Project owner Designer Project owner
Implemen-tation	• Plan and carry out the audit – use checklists found in Part 1 of the handbook • Prepare preliminary report and clarifying round (through concluding meeting or by mail) • Prepare final audit report • Give written response to audit report • Fill out audit form • Clarify need for additional audits	Road safety auditor Road safety auditor Road safety auditor Project owner Project owner Project owner
Follow-up	• Adjust plans in accordance with project owner directives • Handle deviations in the plan and ensure changes in the planning process • Send audit form with attachment for each project to the region • File audit report and form at O:	Designer Project owner Project owner Project owner
Experience transfer	• Spread knowledge about typical faults to the design profession (meetings, mini-seminars etc.)	Designer

Project owner is responsible for:
- making sure that road safety audits are being included in quality/progress plan for each project to ensure that time will be set aside on the project,
- establishing the audit team with audit leader – ensuring adequate competence and training of inexperienced road safety auditors,
- ensuring adequate resources to undertake road safety audits,
- selecting lead auditor,
- make sure agreement is made,
- reviewing preliminary report – have concluding/clarifying meeting with auditor and designer,
- receiving final audit report and deciding which changes/measures shall be implemented,
- giving written response to lead auditor on final audit report – which of the report recommendations will be followed up,
- filling out audit form (specified by auditor) – referring to final audit report and written response,
- handling deviations and ensuring changes in the planning process,
- filing audit report and form at O:.

Road safety auditor (lead auditor) is responsible for:
- establishing the audit team with project owner,
- planning and carrying out the audit,
- representing the audit team,
- preparing preliminary audit report,
- having clarifying/concluding meeting with project owner and designer and undertaking any relevant corrections/modifications to the report,
- handing over final audit report,
- filling out audit form (draft) and sending to project owner,
- handling information confidentially.

Audit leader should put forward proposed improvement measures.

Auditor shall have an objective and independent role and should therefore not be employed in the region where the project belongs. This is dependent on the size and involvement in the project. As a minimum the auditor shall be from a different district.

The designer is responsible for:
- supporting the implementation of the audit including the provision of plans and necessary basic data,
- undertaking adjustments/corrective measures of plans determined by project owner,
- passing on audit results in the design unit and spreading knowledge within the profession.

6.2 Existing road

Road safety inspection of existing roads involves two parties:

1. Project owner. This is the initiator of the project. The district can also play such a role by delegated authority or in cooperation with the region. This will depend on how each region organizes such work. The district will, by delegated authority from the region, be involved in implementing the actual measures.

2. Road safety inspector. Consists of an inspection team headed by an approved inspection leader.

The following provides an overview of the progression of a road safety inspection of existing road and what responsibilities the two involved parties have.

		Responsibility:
Planning/ preparation	• Plan the inspection • Select inspection leader • Establish inspection team • Make agreement/contract • Send various data material (maps, accident data, AADT, speed limits....) • Arrange initial meeting	Project owner Project owner Project owner/ Road safety inspector Project owner Project owner Project owner
Implementation	• Plan and carry out the inspection – use checklists found in Part 2 of the handbook • Prepare preliminary inspection report and arrange possible clarifying round • Prepare final inspection report	Road safety inspector Road safety inspector Road safety inspector
Follow-up	• Evaluate inspection report and determine which measures to be implemented • File inspection report at O: • Undertake measures on existing road	Project owner Project owner Project owner
Experience transfer	• Spread knowledge within the profession on typical faults... (meetings, mini-seminars etc.)	Project owner

Project owner is responsible for:
- selecting inspection leader, and establishing inspection team together with inspection leader – ensuring adequate competence and inspection resources (vehicles, equipment etc.),
- ensuring that agreement/contract is made with road safety inspector
- providing necessary data material (maps, accident data etc.),
- holding initial meeting,
- evaluating the inspection report and determining which measures shall be implemented,
- filing inspection report at O:,
- implementing measures that have been determined.

Road safety inspector (inspection leader) is responsible for:
- establishing the inspection team together with project owner,
- planning and carrying out the inspection,
- representing the inspection team,
- preparing and handing over the inspection report,
- handling information confidentially.

6.3 Confidentiality

The audit and inspection reports are basically internal documents and shall be treated and kept in accordance with the Confidentiality Act. The project owner determines whether the audit and inspection reports shall be made public.

6.4 Qualifications and training

6.4.1 Approval requirements of audit/inspection leader

The qualifications of the person leading a road safety audit or a road safety inspection are the same. To be an audit or inspection leader means having the responsibility of carrying out road safety audits and road safety inspections.

Approval as a road safety auditor requires:

- having passed the exam at the Directorate of Public Roads'/The Norwegian University of Science and Technology's course in road safety audit or equivalent training,
- having been approved as road safety auditor by the Directorate of Public Roads,
- having 5 years relevant experience.

To practice as an audit/inspection leader, requires in addition to having been approved as a road safety auditor:
- having participated in at least one audit or inspection during the last 24 months.

Courses in quality auditing/quality assurance, safety management and risk management etc. are recommended as supplements.

6.4.2 Training through practice

Today there are about 100 approved road safety auditors in Norway. Not all have the foundation to lead an audit/inspection because they lack practical experience – a number of road safety auditors have not undertaken an audit/inspection or it is a long time since they have done so.

It is important to include inexperienced road safety auditors in the audit and inspection teams. Additional persons will in this manner be given a natural training in the audit and inspection role and be able to the take responsibility for leading an audit/inspection next time. The secretarial task, i.e. writing the report is the best way of being introduced to the work.

The responsibility of arriving at such arrangements lies primarily with the Public Roads Administration itself. The person responsible for road safety audit in each region should ensure a distribution and composition of the teams to facilitate the use of a broader spectre of today's road safety auditors. This applies to audits/inspections undertaken by own staff, but also when receiving offers from consultants with approved road safety auditors. The consultant, for his part, should take responsibility by ensuring that several road safety approved co-workers are involved in the projects.

6.5 Reporting

Completed road safety audits and road safety inspections shall be reported to the Directorate of Public Roads on an annual basis. The regions are responsible for such reporting.

The following shall be reported:

1. Which plans or sections have been audited/inspected and by whom.
   - For plans this means: Lists/tables with plans that have been audited (Name of plan, type road(s), level, audit leader).

- For existing road this means: List/table with sections that have been inspected (Route number, road section, kilometre-post and location from-to, inspection leader).

2. What are typical findings with the audited plans and inspected sections.
   - This is described jointly for all plans having been audited and for all sections having been inspected.

3. What are total costs (rough estimates) for the proposed improvements by section – applies only to inspection of existing road sections.
   - List/table of sections having been inspected (Route number, road section, kilometre-post and location from-to, rough cost estimate for proposed improvements by section).

Filing of reports

Project owner is responsible for filing the reports digitally at O: in each region. Sub catalogues should be established each year separately for audits and inspections.

Road Safety Audits

Part 1

Contents

Attachments

1 Introduction

Experience from completed road safety audits and other road safety studies in Norway shows that not all new road and traffic plans have been equally well designed with traffic safety in mind. It is therefore desirable to undertake road safety audits of new plans in a manner that will promote a design that will result in few accidents, and low injury severity for those that still occur. Undertaking road safety audits will be a central measure in the Vision Zero effort.

A road safety audit is defined as a systematic and independent investigation of traffic safety conditions of a road or traffic plan (levels 1, 2 and 3). The aim is to have all unfavourable solutions, faults and deficiencies weeded out at the various planning levels before start of construction.

This part (part 1) of Handbook 222 contains procedures, checklists and other information on how to carry out road safety audit of plans.

Part 1 contains the following:

Common material for road safety audit of plans

1	Municipal sector plan	level 1
2	Development plan	level 2
3	Construction plan	level 3

This handbook, with all attachments, is found on the Internet at www.vegvesen.no under the path ”Professions and projects/handbooks”.

2 Vision Zero

The aim of road safety audits is to ensure that new road and traffic systems are designed to prevent fatal or permanent injury accidents from occurring (Vision Zero).

Vision Zero means that work shall be undertaken to prevent serious accidents and to reduce the severity of accidents that still take place. Support was given to Vision Zero through Report to the Storting no. 46 (1999-2000) - NTP 2002-2011.

Vision Zero views accidents in a system perspective, where all elements affecting accidents and their consequences are considered: the road user, the vehicle, the road and its surroundings.

The elements within the road traffic system must interact and mutually adapt for the system to be safe. Human qualifications - our capabilities and tolerance - must be the basic prerequisite when forming the system. An accident is as a rule caused by failure in the interaction between the elements and is thus a system deficiency, and not a personal error or a random incident. The road and traffic environment must be designed in a manner that encourages correct road user behaviour and provides protection against serious consequences of erroneous actions.

Speeds selected by road users relative to road design and vehicle safety standard is a central element in the traffic interaction. The forces the body is exposed to at the moment of impact are to a large extent determined by the weight and speed of the vehicle.

Collision tests show that occupants of relatively new cars wearing seat belts who collide head-on with a similar car or a fixed object have a good chance of surviving at speeds up to 70 km/h. With increasing speed the chances of surviving decreases dramatically. Similarly, the critical limit for side impacts is 50 km/h, and for a pedestrian or cyclist struck by a car 30 km/h.

Shaping the road traffic system must be based on the recognition that it is human to err and on knowledge of the strength of the impact forces a human body can stand. In a safe traffic system there are factors that both counteract erroneous actions, and counteract erroneous actions from resulting in serious accidents.

It is important to keep such knowledge in mind with all road safety audit levels involved. Human capabilities and tolerance form a basis for how to assess whether a plan will adequately ensure traffic safety.

The plans must in particular be checked against conditions that can contribute to serious accidents. Head-on and off-the-road accidents are dominant accident types with many fatalities. Along with pedestrian accidents, these three accident types account for 81% of all fatalities, while they represent only 50% of all accidents.

Measures aimed directly against head-on accidents, off-the-road accidents and pedestrian accidents will therefore be of major importance.

3 Preparations

3.1 Agreement

An agreement shall be established for road safety audit. Builder/employer orders auditor and is responsible for the agreement being made with audit leader. The agreement must state what shall be audited and at which level this shall be done. Moreover, it must be stated which documentation shall be presented as basis for the audit. Deadline for submitting final audit report and any costs incurred by the audit should also be included. Any limitations (extent of audit) must be specified.

Audit form shown in ATTACHMENT 1.1 is recommended used.

3.2 Basic material

Basic material is here meant to include documents and planning material necessary to carry out the audit.

Examples of basic material include:

- Necessary planning basis for the project.
- Reports from revisions previously undertaken on the same project.
- Other relevant documentation.
- Road data
  - Available road data such as: road class, road profile, expected AADT, planned speed limit.
- Relevant laws, regulations, handbooks and guidelines such as:
  - Handbook 017 Road and street design
  - Handbook 021 Road tunnels
  - Handbook 062 Traffic safety equipment
  - Handbook 231 Road barrier standards
  - Handbook 235 Trunk road design
  - NA circular 27/1, Yielding pylon design requirements.

A complete list of the roads administration's handbook series is found at www.vegvesen.no

3.3 Commencement meeting

The audit always starts with a commencement meeting where all parties involved participate. Project owner in cooperation with audit leader invites to the meeting. As much as possible of the base material should be obtained and handed over to audit leader before the commencement meeting.

The purpose of the commencement meeting is to:

1 Present the project and clarify any ambiguities.
2 Obtain verification that the audit basis, equipment and resources needed by the audit team are made available.
3 Establish communication lines between the audit team and the designer.
4 Give a brief presentation of the audit process.
5 Undertake inspection if necessary.
6 Determine timing of any concluding meeting and who should participate.

It is important that the project owner has prepared a review of the project beforehand. It is important that the project owner conveys which evaluations have been made throughout the project as well as background and basis for the chosen solutions. The designer is responsible for obtaining and handing over documentation requested by the audit team beyond what has already been handed over.

4 Implementation

It is important that road safety audit of plans is undertaken at the right time relative to the planning and construction process to ensure that audit suggestions will be considered. This is the project owner's responsibility.

The road safety audit approach is relatively similar at all planning levels. A general approach used at all planning levels is described below. The following chapters (4.1, 4.2 and 4.3) give more specific advice on how to proceed depending on the planning level in question.

Initially an overview is obtained of the entire project. Available road data is used as basis for the work such as: road class, road profile, anticipated AADT, planned speed limit and available planning basis. The planning basis will be more comprehensive the further down in the planning hierarchy one operates. Construction plans will involve a comprehensive set of planning material to be reviewed.

After having obtained an overview, the situation is looked at from the viewpoint of individual user groups (motorist, cyclist and pedestrian) "moving through" the planned facility. This will more easily reveal factors unfavourable to the plan, but which cannot positively be pointed out when only checking individual elements (road section, intersection, bicycle/pedestrian road, bridge or tunnel). The elements are part of a larger plan, and even when each element satisfies road safety requirements, it is not certain that the combined composition of the elements is favourable. There might be factors associated with the plan that will make the road users behave differently from what was planned. The distance between the elements and geometric design in general must be checked.

When the big picture has been evaluated and important factors noted, it is advantageous to divide the plan into physical elements and systematically analyze each of these elements individually. The following chapters include checklists prepared for this purpose. The checklists are divided by element: Road section, intersection, pedestrian/bicycle facilities, bridges and tunnels. It is recommended that the plans be checked using these checklists for each of the elements. Checklists have been prepared for each of the planning levels, municipal sector plan, development plan and construction plan. More detailed checklists referred to and included as an attachment should be used for development plans and in particular construction plans.

4.1 Municipal sector plan - level 1

4.1.1 Approach – use of checklists

Various checklists are presented below. These are intended for guidance and are not by any means exhaustive. It is therefore important to check with relevant standards, handbooks, guidelines and circulars.

Road sections

Road sections are checked against conditions that can lead to serious head-on accidents and serious off-the-road accidents.

Route alignment	• Will the chosen alignment cause major barrier effects that can lead to unintended crossing of roadway? - Assess residential sites relative to important destinations - Assess whether the chosen alignment will cause problems for crossing of wild game - Assess access to farm properties • Is it possible to position the road differently in order to reduce the number of intersections and access drives? • Has the chosen alignment been assessed with regard to snow, slides, wind and floods? • Does relevant accident data from adjacent areas indicate any special conditions that can be a problem such as traffic composition, glare, light conditions, driving conditions?
Posted speed	• Are proposed posted speeds appropriate for road type and area?
Road class and road profile	Here an assessment should be made whether the chosen road class and road profile is correct considering the road's transportation function, anticipated AADT and proposed posted speeds: • Will the road have a standard that corresponds to adjoining sections? - Is there a jump in the standard between new and old road? - Have connections to existing road been given special attention? - Can old road cause erroneous driving because of optical guidance? • Has the right road class been selected? • Has the right number of lanes been chosen in each direction? • Is there a need for a central reserve based on the proposed posted speed limit and expected AADT? • Is road width and profile the right ones with regard to traffic safety?
Alignment/ curvature	• Are horizontal and vertical curves in accordance with road class selected? • Are there any sudden and unexpected alignment changes such as curves, crests, sags?
	• Have needs for passing been attended to?
Safety zone	• Have adequate areas been set aside for the safety zone?
Service installations etc	• Has the need for service installations, rest areas and control areas been considered?

Intersections

The intersections are checked against conditions that can cause serious intersection accidents, particularly side impact collisions.

Uniform design	• Is there a uniform structure with regard to geometry and intersection type along the road section?
Placement	• Are intersections well placed relative to surrounding roads? For example by relieving adjoining roads • Are intersections placed correctly relative to road alignment? For example by avoiding being placed on a crest. • Are intersections placed correctly relative to horizontal and vertical alignment? • Does the intersection design ensure that traffic to proposed new residential, industrial and similar areas is safely taken care of?
Numbers and spacing	• Can the number of intersections be reduced? • Is there an adequate distance between intersections? Relative to signing, markings, lane change etc.
Intersection type	• Is the intersection type used the appropriate one with regard to traffic safety? Here, AADT, turning movements, speeds and area type will play a role. Four-legged intersections should be avoided. • Is adequate area set aside? (are for example interchange ramps sufficiently long, number of lanes, sight distances etc.?)

Pedestrian and bicycle facilities

Pedestrian and bicycle facilities shall be checked against conditions that can lead to serious accidents involving vulnerable road users.

Entirety in the pedestrian and bicycle road network	• Are planned pedestrian/bicycle facilities adequate and safe? - Any links missing? Both present and future needs must be met. - Are there main bicycle routes included in the plan? - Are there any school routes in need of special attention? • Will new road result in detours for pedestrian/bicycle traffic?
Road crossing	• Are chosen crossings located properly relative to pedestrian and bicycle movements? • Are planned crossings sufficiently secured considering traffic volumes, pedestrian and bicycle traffic, speeds etc.? • Should crossings be made at grade or grade separated?

Alignment/ Curvature	• Are the horizontal and vertical curves of the pedestrian/bicycle facilities well chosen? - Were the most logical and favourable solutions chosen for vulnerable road users? - Is alignment in accordance with standards?
Distance to road	• Are pedestrian and bicycle facilities given sufficient separation from the roadway?

Bridges

Bridges must be checked against conditions that can lead to serious accidents

Alignment/ Curvature	• Are the bridge alignment and the road alignment on both sides satisfactory relative to posted speed? • Has visibility been checked at possible crests? Assess potential for congestion or stops at crests
Intersections	• Are there intersections or ramps at bridge ends? - Visibility and alignment must be checked against posted speed limits (road guardrails or bridge railings can reduce visibility)
Pedestrian/ bicycle traffic	• Is pedestrian/bicycle traffic across the bridge adequately handled?
Wind, driving conditions	• Is there a risk of strong side-wind? • Is there a risk of difficult driving conditions such as at transition from fill to bridge slab and with bridge on a curve?

Tunnels

Tunnels must be checked against conditions that can lead to serious accidents.

Profile	• Was correct tunnel class selected? • Are adequate emergency escapes included in single tube tunnels? • Are auxiliary lanes used on up and down grade sections in single tube tunnels? • Are there adequate possibilities of emergency escape?

Curvature	• Are horizontal and vertical curves in accordance with standards? • Is there sufficient visibility through curves? • Does the alignment outside the tunnel provide a natural guidance towards the tunnel? Both horizontal and vertical curves are checked against such risks as hitting tunnel portal and blinding.
Emergency stops	• Are sufficient emergency stops and turning possibilities planned and designed correctly? (location, visibility, length)
Intersections, ramps	• Are there intersections or ramps within the tunnel or the entrance zone? - Visibility and alignment must be checked against speeds. - Check risk of head-on accidents with two-way ramp traffic. - Check risk of wrong way traffic with dual tube tunnels. - Distance to intersections outside tunnel must be checked (is there sufficient distance for signing, markings, lane change and queuing?).
Pedestrian/ bicycle traffic	• Has handling of pedestrian/bicycle traffic been considered?

4.1.2 Examples of typical findings in municipal sector plans

With regard to level 1, Municipal sector plan, the most prevalent situation being pointed out is unfavourable choice of road standard and design speed relative to road type and function, along with unfavourable choice of intersection type relative to traffic volumes and turning movements.

4.2 Development plan – level 2

4.2.1 Approach – use of checklists

Various checklists are presented below. These are intended as guidance and are not by any means exhaustive. It is therefore important to check against relevant standards, handbooks, guidelines and circulars.

Relationship to municipal sector plan	• Is the plan audited at municipal sector plan level 1? If so, have the recommendations from this audit been followed up?

Road sections

Road sections are checked against conditions that can lead to serious head-on accidents and serious off-the-road accidents.

Posted speeds	• Is the proposed posted speed the right one considering road type and area?
Road class and road profile	Here, attention should be given to whether the correct choice of road class and road profile has been made, considering the road's transportation function, expected AADT and proposed posted speed: • Will the road have a standard in accordance with adjoining sections? - Are there jumps in the standard between new and old road? - Have connections to existing road been given special attention? - Can old road contribute to faulty driving because of optical guidance? • Was the correct road class chosen? • Was the correct number of lanes chosen in each direction? • Is there a need of a central reserve with the proposed posted speed and expected AADT? • Is the chosen road width and profile the right ones with regard to traffic safety?
Alignment/ curvature	• Are horizontal and vertical curves in accordance with road class selected? • Are there any sudden and unexpected alignment changes such as curves, crests, sags? • Have needs for passing been attended to?
Safety zone	• Have adequate areas been set aside for the safety zone? Are there elements within the safety zone that must be removed or secured with safety barrier? • Are clearances under bridges adequate within the safety zone?
Barriers	• Is the use of barriers in accordance with the barrier standards? • Can the use of barriers be reduced using gentle slopes and yielding posts and pylons in the safety zone?
Signing and markings	• Is there sufficient distance between intersection, tunnel, toll plaza etc to facilitate signing, marking and lane change?
Illumination	• Has illumination been considered? (on the entire section, in the intersection areas and relative to adjoining road network) Does chosen solution provide favourable safety?
Intersections/ Access drives	• Is it possible to reduce the number of intersections and access drives? • Has restructuring of access drives been suggested? • Can crossing the road with farm machinery create a problem? • Does the section have crossings for wild game?

Service installations etc	• Has the need for service installations, rest areas and control areas been considered?
Bus stops	• Are bus bays and stops placed in a correct and safe manner? Is visibility adequate when exiting and are pedestrian crossings satisfactory?
City and urban related problems	• Are there enough parking spaces on the properties? On-street parking should as far as possible be avoided • Have loading and unloading areas on own property been secured? • Can vehicles turn around on own lot? Also large vehicles? • Can emergency vehicles reach the properties?
Others	• Can the design of any elements represent a risk when unfavourable combinations are being used? Such as use of maximum grade combined with minimum radii.

Intersections

The intersections are checked against conditions that can cause serious intersection accidents, particularly side impact collisions.

Uniform design	Is there a uniform structure with regard to geometry and intersection type along the road section?
Placement	• Are intersections well placed relative to surrounding roads? For example by relieving adjoining roads • Does the intersection design ensure that traffic to proposed new residential and industrial areas etc is safely taken care of? • Are the intersections perceptible and clearly visible to road users? Alignment, width, traffic islands and use of curb towards the intersection is considered. • Does the users' path through the intersection appear natural and functional for all directions and movements?
Numbers and spacing	• Can the number of intersections be reduced? • Is there an adequate distance between intersections? Relative to signing, markings, lane change etc.

Intersection type, design	• Is the intersection type used the appropriate one with regard to traffic safety? Here, AADT, turning movements, speeds and area type will play a role. • Are sufficient consideration given to space requirements for the various types of vehicle? Is there sufficient area within the curb line for the vehicle overhang? Are intersection leg angles, radii and widths satisfactory? • Is super elevation adequate to prevent skidding/sliding or overturning of heavy vehicles? • Has illumination of the intersection area been considered?
Visibility	• Is visibility adequate at intersections? Check horizontal and vertical curvature in the direction towards the intersections and any sight reducing elements such as noise barriers, vegetation etc. • Are intersection and access drive sight triangles marked on the plans?

Pedestrian and bicycle facilities

Pedestrian and bicycle facilities shall be checked against conditions that can lead to serious accidents involving vulnerable road users.

Entirety in the pedestrian and bicycle road network	• Are planned pedestrian/bicycle facilities adequate and safe? - Are any links missing? Both present and future needs must be met. Side change is inadvisable for pedestrian/bicycle roads. - Are there main bicycle routes included in the plan? - Is the correct type of installation selected for the type of area? Are bicycle lanes proposed in urban areas? - Are there any school routes in need of special attention? - Has the mobility of the disabled been considered? • Will new road result in detours for pedestrian/bicycle traffic?

Road crossing	• Are chosen crossings properly located relative to pedestrian and bicycle movements? • Are planned crossings sufficiently secured considering traffic volumes, pedestrian and bicycle traffic, speeds etc.? - Should crossings be made at grade or grade separated? - Is the planned at grade crossing in accordance with the bicycle handbook (HB 233)? - Is visibility adequate at crossings and where pedestrian/bicycle roads cross? Check relative to vegetation, parked cars, noise barriers, safety barriers etc. - Is illumination of crossings satisfactory? (dual-side illumination of pedestrian crossings is recommended).
Alignment/ Curvature	• Are the horizontal and vertical curves of the pedestrian/bicycle facilities well chosen? - Were the most logical and favourable solutions chosen for vulnerable road users? - Is alignment in accordance with standards? Check grades especially.
Visibility	• Are visibility requirements at intersection/access drives and between pedestrian/bicycle roads attended to? Pay special attention to underpasses.
Separation	• Is the pedestrian/bicycle road sufficiently separated from the roadway? Are guide fences and barriers erected where necessary? • Is the pedestrian/bicycle traffic sufficient to warrant separate pavement?

To check additional details with regard to pedestrian/bicycle design, reference is made to relevant detailed checklists in Handbook 249, Bicycle road inspections. There you will find checklists for:

- section with cycling in mixed traffic,
- section with bicycle lane,
- section with pedestrian/bicycle road,
- system change between various types of installations,
- bicycle parking.

Bridges

Bridges must be checked against conditions that can lead to serious accidents

Alignment/ Curvature	• Are the bridge alignment and the road alignment on both sides satisfactory relative to speed levels? • Has visibility been checked at possible crests? Assess potential for congestion or stops at crests
Intersection	• Are there intersections or ramps at bridge ends? - Visibility and alignment must be checked against posted speed limits (road guardrails or bridge railings can reduce visibility)
Pedestrian/ bicycle traffic	• Is pedestrian /bicycle traffic across the bridge adequately handled?
Bridge pillars	• Are these secured against collisions? (example with road under bridge)
Wind, driving conditions	• Is there a risk of strong side-wind? • Is there a risk of difficult driving conditions such as at transition from fill to bridge slab and with bridge on a curve?
Illumination	• Should the bridge be illuminated, or should preparations for that be made? (assessed with consideration to conditions on either side of bridge)
Railing	• Is railing designed in accordance with barrier standards? • Is the transition between bridge railing and adjoining road guardrail satisfactorily executed? Is the guardrail adequately anchored and grounded/deflected?

Tunnel

Tunnels must be checked against conditions that can lead to serious accidents.

Profile	• Was correct tunnel class selected? • Are adequate emergency escapes included in single tube tunnels? • Are auxiliary lanes used on up and down grade sections in single tube tunnels? • Are there adequate possibilities of emergency escape? • Is there set aside sufficient room for road equipment, signs etc.?

Curvature	• Are horizontal and vertical curves in accordance with standards? • Is there sufficient visibility through curves? • Does the alignment outside the tunnel provide a natural guidance towards the tunnel? Both horizontal and vertical curves are being checked against such as hitting tunnel portal and glare.
Emergency stops	• Are sufficient emergency stops and turning possibilities planned and designed correctly? (location, visibility, length)
Intersections, ramps	• Are there intersections or ramps within the tunnel or the entrance zone? - Visibility and alignment must be checked against speed level. - Check risk of head-on accidents with two-way ramp traffic - Check risk of wrong way traffic with dual tube tunnels. - Distance to intersections outside tunnel must be checked (is there sufficient distance for signing, markings, lane change and queuing)
Pedestrian/ bicycle traffic	• Has handling of pedestrian/bicycle traffic been considered?
Equipment, signs	• Is there a need of signing within the tunnel and in case is there sufficient room? • Is the tunnel equipped with safety equipment in accordance with the tunnel class and satisfactorily placed and secured?
ATC	• Is use of automatic traffic control (ATC) being planned? Take position on such usage.

For check of additional details regarding tunnel design, reference is made to checklist for tunnels in the chapter on construction plans. In addition to checklist points regarding equipment, this chapter deals with signs, illumination and barriers/impact attenuation devices.

4.2.2 Examples of typical findings in development plans

It was through the road safety audit of development plans (derived from TTS-04/2004) that shortcomings were found most frequently within the following topics:

- Visibility at intersections and access drives – inadequate visibility.
- Intersections, especially roundabouts – unfavourable geometric design, poor deflection.
- Various types of lanes, ramps, pockets, bus bays and bus stops – unfavourable design.
- Design speed and alignment – incorrect choice.
- Horizontal/vertical alignment and cross section – unfavourable design.
- Pedestrian/bicycle traffic – unsatisfactory layout and intersections.

4.3 Construction plan – level 3

4.3.1 Approach – use of checklists

Various checklists are presented below. These lists are intended as guidance and are not by any means exhaustive. It is therefore important to check with relevant standards, handbooks, guidelines and circulars.

Relationship to development plan	• Is the plan audited at development plan level 2? If so, were recommendations from the audit followed up? • If the plan was not audited at development plan level, it is recommended to first go through the checklists (road sections and intersections) for the development plans. Here, checkpoints are found concerning overall conditions that are recommended reviewed first. For pedestrian/bicycle facilities, bridges and tunnels, checklists for development plans are included in this chapter.

Road sections

Road sections are checked against conditions that can lead to serious head-on accidents and serious off-the-road accidents.

Cross-section	• Is ditch design safe? Check the ditch profile
Guardrails and impact attenuation devices	• Are all exposed areas protected? Are there elements within the safety zone that must be removed, or possibly secured with guardrail? Such as rock cuts, steep side-slopes, trees, posts, pillars and protruding manholes and cabinets. • Can guardrail usage be reduced using gentler side-slopes, eliminating hazardous objects or using yielding posts or pylons within the safety zone? s the use of guardrail in accordance with guardrail standards? Is the correct and approved type guardrail/impact attenuation device selected? • Is there sufficient deformation space behind the guardrail relative to speed level and guardrail type? • Has closer pole spacing been chosen for guardrails near the edge at top of embankment, on curves with radius below 150 m and at transitions to solid obstructions? • Is the guardrail securely anchored? • Is guardrail terminal design and position satisfactory? • Does the guardrail reduce visibility?
Noise barriers	• Does the noise barrier reduce visibility? • Is the noise barrier designed in a safe manner when located within the safety zone? Is there a risk of hitting guardrail terminal?

Illumination	• Are all intersection areas/road sections in need of lighting, illuminated? Will any remaining unlit areas represent a hazard? • May illumination of side-roads or side-areas cause misunderstanding? • Was the correct illumination level chosen and does the illumination level satisfy standard requirements? • May lighting pylons give rise to misinterpretation of the road system? Alignment must be checked • Have yielding pylons been chosen within the safety zone? • Are lighting pylons, traffic signals and sign placement in mutual conflict? • Are the pedestrian/bicycle roads satisfactorily illuminated and are crosswalks particularly well illuminated (dual side illumination is recommended)?
Signing and markings	• Is there sufficient distance between intersections, tunnel, toll plaza etc. with regard to signing, markings and lane change? Do road users have time to perceive the message? • Is there potential for confusion; that road users misunderstand or are misled? • Is the signing perceptible considering the number of signs? • Are the signs properly placed, without obstructing the view? • Are there curves in need of signing? • Are any no-passing zones properly signed and marked? • Are signs of correct size and retro-reflective? • Are markings adequate and correct? Should profiled lane marking be used?
Vegetation	• Will sight lines be obstructed by vegetation or adjacent terrain features? Has the potential of vegetation growth been considered? Particularly important for the visibility to pedestrians and bicyclists • Is there a risk of trees being hit? Will there in the future be trees with a trunk diameter exceeding 10 cm within the safety zone of road with a speed limit of 60 km/h or more? • Can side areas safely be maintained?

Intersections

The intersections are checked against conditions that can cause serious intersection accidents, particularly side impact collisions.

Intersection type, design	• Is the type of intersection used the right one with regard to traffic safety? Here AADT, speed and area type plays a role. • Has space requirements for the various types of vehicle been considered? Is there sufficient area within the curb-line for typical vehicle overhang? Are intersection leg angles, radii and widths satisfactory? • Is the super elevation sufficient to prevent skidding/sliding or overturning of heavy vehicles? • Has intersection illumination been considered?

Visibility	• Is there sufficient visibility at all intersections and access drives? Sight triangles shall be depicted. Examples of conditions that can obstruct visibility include road curvature, vegetation, noise barriers, guardrail and other road equipment.
Signs	• Is there a need for uniform and correct signing and are sign locations good with regard to visibility? Check directional signing in particular. • Have signs of right size, right retro-reflectivity foil and right erection equipment been used?
Markings	• Are the intersection markings used correct and are they adequate?

Pedestrian and bicycle facilities

Pedestrian and bicycle facilities shall be checked against conditions that can lead to serious accidents involving vulnerable road users.

Entirety in the pedestrian and bicycle road network	• Will new road result in detours for pedestrian/bicycle traffic? • Are planned pedestrian/bicycle facilities adequate and safe? - Are any links missing? Both present and future needs must be met. Side change is inadvisable for pedestrian/bicycle roads. - Are there main bicycle routes included in the plan? - Is the correct type of installation selected for the type of area? Are bicycle lanes proposed in urban areas? - Are there any important school routes in need of special attention? - Is the mobility of the disabled been considered?
Road crossing	• Are chosen crossings located properly relative to pedestrian and bicycle movements? • Are planned crossings sufficiently secured considering traffic volumes, pedestrian and bicycle traffic, speeds etc.? - Should crossing be made at grade or grade separated? - Is the planned at grade crossing in accordance with the bicycle handbook (HB 233)? - Is visibility adequate at crossings? Check relative to vegetation, parked cars, noise barriers, safety barriers etc. - Is illumination of crossings satisfactory? (dual-side illumination of pedestrian crossings is recommended) - Is there a need for traffic calming? - Have lowered curbs been used at crossings?

Alignment/ Curvature	• Are the horizontal and vertical curves of the pedestrian/bicycle facilities well chosen? • Were the most logical and favourable solutions chosen for vulnerable road users? • Is alignment in accordance with standards? Check grades especially.
Visibility	• Are visibility requirements at intersection/access drives and between pedestrian/bicycle roads attended to? Pay special attention to underpasses.
Signing and marking	• Are directions clear so cyclists can find their way? Check directional signing/ destinations indicated and signing/markings through intersections. • Are yield requirements clear? Check signing/markings at intersections
Separation	• Is the pedestrian/bicycle road sufficiently separated from the roadway? Are guide fences and barriers erected where necessary and are they properly designed? • Is the pedestrian/bicycle traffic sufficient to warrant separate pavement?

To check additional details with regard to pedestrian/bicycle design, reference is made to relevant detailed checklist in Handbook 249, Bicycle road inspections. There you will find checklists for:

- Section with cycling in mixed traffic.
- Section with bicycle lane.
- Section with pedestrian/bicycle road.
- System change between various types installation.
- Bicycle parking.

Bridges

Bridges must be checked against conditions that can lead to serious accidents

Alignment/ Curvature	• Are the bridge alignment and the road alignment on both sides satisfactory relative to speed levels? • Has visibility been checked at possible crests? Assess potential for congestion or stops at crests
Intersections	• Are there intersections or ramps at bridge ends? - Visibility and alignment must be checked against posted speed limits (road guardrails or bridge railings can reduce visibility)

Pedestrian /bicycle traffic	• Is pedestrian /bicycle traffic across the bridge adequately handled?
Bridge pillars	• Are these secured against collisions? (example with road under bridge)
Wind, driving conditions	• Is there a risk of strong side-wind? • Is there a risk of difficult driving conditions such as at transition from fill to • bridge slab and with bridge on a curve?
Illumination	• Should the bridge be illuminated, or should preparations for that be made? (to be assessed with consideration to conditions on either side of the bridge)
Railing	• Is railing designed in accordance with barrier standards? • Is the transition between bridge railing and adjoining road guardrail satisfactorily executed? • Is the guardrail adequately anchored and grounded/deflected?

Tunnels

Tunnels must be checked against conditions that can lead to serious accidents.

Profile	• Was correct tunnel class selected? • Are auxiliary lanes used on up and down grade sections in single tube tunnels? • Is there set aside sufficient room for road equipment, signs etc.?
Curvature	• Are horizontal and vertical curves in accordance with standards? • Is there adequate visibility through curves? • Does the alignment outside the tunnel provide a natural guidance towards the tunnel? Both horizontal and vertical curves are being checked against such as hitting tunnel portal and glare.
Intersections, ramps	• Are there intersections or ramps within the tunnel or the entrance zone? - Visibility and alignment must be checked against speed level. - Check risk of head-on accidents with two-way ramp traffic - Check risk of wrong way traffic with dual tube tunnels. - Distance to intersections outside tunnel must be checked (is there sufficient distance for signing, markings, lane change and queuing?) • Are rocky features between lanes, lanes/ramps, properly secured? Check need for guardrail or impact attenuation devices

Pedestrian/ bicycle traffic	• Has handling of pedestrian/bicycle traffic been considered?
ATC	• Is use of automatic traffic control (ATC) being planned? Take position on such usage. • Is there a risk of ATC equipment being hit? Are there in such cases breakaway mountings?
Tunnel portal	• Does the tunnel portal have a safe design for all vehicle types? Funnel shape and gradual height reduction is recommended • Is there a risk of heavy vehicles hitting the tunnel ceiling or walls? • Is there a need for guardrail in the portal zone? And is the guardrail in case well anchored and extended back both outside and inside the tunnel?
Emergency stops	• Are sufficient emergency stops and turning possibilities planned and designed correctly? (location, visibility, length)
Equipment, signs	• Is there a need of signing within the tunnel and in case is there sufficient room? • Is the tunnel equipped with the safety equipment in accordance with the tunnel class and satisfactorily placed and secured? Such as signals, bars, fire extinguishing equipment, telephone, height restrictions • Are signs in the tunnel placed correctly? Ref. handbook 021 and 050 • Can the equipment represent a hazard for road users when hit? Check if there is equipment in need of being protected with guardrail, such as telephone cabinets etc.
Markings	• Are profiled road markings being used? • Is LED light used?
Illumination	• Are light walls being planned? • Is the entrance zone designed to provide as low adaptation luminance as possible? • Is the right illumination level chosen at the entrance zone, transition zone and within the tunnel? Does the illumination level satisfy all lanes and has the illumination calculations in HB 021 been followed? • Has the illumination level in low traffic volume tunnels with pedestrians and bicyclists been increased? • Has it been considered to increase the illumination level in low traffic volume tunnels because of high adaptation luminance? • Has the flickering effect been considered when selecting armature spacing in tunnels with driving time of more than 2 minutes?
Drainage	• Is drainage at the entrance zone satisfactory, especially with downgrade tunnels?

A more detailed checklist for tunnels has not been prepared.

4.3.2 Examples of typical findings in development plans

Some of the typical findings made during road safety audit were (derived among others from TTS-04/2004 and from top ten in the magazine "Vegen og vi"):

1 Guardrail and guardrail terminals – too short, lacking, too much, faultily executed.
2 Signs and road markings – unfavourably/wrongly placed, signs lacking.
3 Ditches and side-areas – unfavourable/hazardous design.
4 Noise barriers, vegetation and other objects within the safety zone.
5 Mounting equipment signs/lighting - wrong design, often yielding posts are not used.
6 Intersections – unfortunate placement, poor visibility, insufficient deflection (roundabouts).
7 Crossings for vulnerable road users – unsafe.
8 Cross-section, resulting super elevation – unfavourable/faulty.
9 Ramps - unfavourable/wrong length, radius and grade.
10 Crest/sag - radius too small.

5 Supplementary work

5.1 Report

After the road safety audit has been completed, an audit report is written in accordance with the chapter structure given below:

The following structure is recommended:

1. **Introduction.**
   Prepare a simple project description and state if the project has been audited at an earlier level.

2. **Auditors and auditing process**
   State who has been involved in the audit and their function. Here, name, employer, title and participation in the project should appear. Moreover, date of meetings and inspections must be given.

3. **Basic material for the audit**
   Here should be listed which planning documents and basic data from the project were made available to auditor and which documented requirements auditor used in the audit. For examples of such documents see Chapter 3.2

4. **Audit results and recommendations**
   State discrepancies, faults and remarks with possible suggested measures. With many finds, it is recommended that the findings be numbered with reference to drawings where the numbering can be found.
   If possible, estimate the anticipated accident reduction effect from the suggested changes (Effect catalogue, TSEFFEKT).

5. **Audit summary**
   Here typical findings are described and should auditor have any priorities this is stated. Recommendations made to the next audit level should also be stated.

6. **Concluding remarks**
   If auditor has comments regarding challenges in conjunction with the audit or other comments these should be described here.

Attachment
Here agreement form and audit form are found

5.2 Concluding work

When a draft report is completed it is sent/mailed to employer for comments. Employer/project owner gives written response (by mail) to the report. In some cases concluding meeting with designer can be undertaken. Final report is prepared and sent employer with attachments. Employer/project owner files the report at O:\.

5.3 Audit form

When the audit report has been sent and accepted, the initiator fills out the audit form as a conclusion/closure of the audit. This form states which mitigating measures the project owner will carry out. When the audit form is signed by project owner and audit leader the audit is considered completed. Employer/project owner sends audit form to region and files it at O:\.

Template for audit form and completed example is found in ATTACHMENT 1.2

Agreement form

ROAD SAFETY AUDIT AGREEMENT

Project:

Parties:

Contracting agency/project owner:

Designer:

Road safety auditor (Audit leader and others):

Project description:

Audit level – and scope:

(State audit level and what shall be audited. Limitations might be necessary)

Remarks/comments to the agreement:

Deadlines etc:

Date and signatures:

Contracting agent/project owner *Designer* *Audit leader*

Audit form

AUDIT FORM FOR ROAD SAFETY AUDITS
Project, name and level:

Parties:
Contracting agency/project owner:
Designer:
Road safety auditor (Audit leader or others):

Agreement date:

Audit report date:

Basic material for the audit (see possible attachments) and any remarks:

Date and signature (audit leader):

Dates for meetings and inspections:

Meetings:

Inspections:

Audit results (filled out by designer),
(project modifications are enclosed as attachments when necessary):

Date and signature (designer):

Concluding statement (filled out by audit leader):

Date and signature (audit leader):

Road Safety Inspections

Part 2

Contents

1 Introduction

Experience from completed road safety inspections in Norway shows that many roads have design faults that can lead to serious accidents. Undertaking road safety audits that can reveal such faults will be a central measure in the Vision Zero effort.

A road safety inspection is defined as a systematic review of a new road project or an existing road with the intent of identifying hazardous conditions, faults and deficiencies that can lead to serious accidents. This is done using well-established experience and knowledge of safe road design and traffic control as well as knowledge about the effect of various traffic safety measures.

In this part, part 2, of handbook 222 there are procedures, checklists and other information on how road safety inspections of existing road shall be carried out.

Parts of the material are taken from previously published "Preliminary guide for road safety audit of existing road and traffic projects", TTS report –04-2001. Additional material has been taken from R&D project 75/2004 – Development of road safety inspection methods for existing roads.

This handbook with all attachments is found electronically at www.vegvesen.no under the path "Professions and projects/handbooks".

2 Vision Zero

The aim of road safety audits is to ensure that new road and traffic systems are designed to prevent fatal or permanent injury accidents from occurring (Vision Zero).

Vision Zero means that work shall be undertaken to prevent serious accidents and to reduce the severity of accidents that still take place. Support was given to Vision Zero through Report to the Storting no. 46 (1999-2000) - NTP 2002-2011.

Vision Zero views accidents in a system perspective, where all elements affecting accidents and their consequences are considered: the road user, the vehicle, the road and its surroundings.

The elements within the road traffic system must interact and mutually adapt for the system to be safe. Human qualifications - our capabilities and tolerance - must be the basic prerequisite when forming the system. An accident is as a rule caused by failure in the interaction between the elements and is thus a system deficiency, and not a personal error or a random incident. The road and traffic environment must be designed in a manner that encourages correct road user behavior and protect them against serious consequences of erroneous actions.

Speeds selected by road users relative to road design and vehicle safety standards is a central element in the traffic interaction. The forces the body is exposed to at the moment of impact is to a large extent determined by vehicle weight and speed.

Collision tests show that occupants of relatively new cars wearing seat belts that collide head on with a similar car or fixed object have a good chance of surviving at speeds up to 70 km/h. With increasing speed the chances of surviving decreases dramatically. Similarly, the critical limit for side impacts is 50 km/h and 30 km/h when a pedestrian or cyclist is struck by a car.

Shaping the road traffic system must be based on the recognition that it is human to err and on knowledge about the strength of the impact forces a human body can stand. In a safe traffic system there are factors that both counteract erroneous actions and counteract erroneous actions from resulting in serious accidents.

It is important to keep such knowledge in mind with all road safety audit levels involved. Human capabilities and tolerance form a basis for how to assess whether a plan will adequately ensure traffic safety.

The plans must in particular be checked against conditions that can contribute to serious accidents. Head-on and off-the-road accidents are dominant accident types with many fatalities. Along with pedestrian accidents, these three accident types account for 81% of all fatalities, while they represent only 50% of all accidents.

Measures aimed directly against head-on accidents, off-the-road accidents and pedestrian accidents will therefore be of major importance.

3 New standardized method

It is stated in the Action Program for 2006 – 2015 that the Public Roads Administration will intensify its work on road safety inspections on national roads with high injury severity density. Such intensification means that road safety inspections will be carried out on very many kilometers of road.

Much of this part of the handbook is based on material from R&D project 75/2004, which involved the development of a method to make road safety inspections simpler, more rational and more secure.

The most important change with this method is the more extensive use of Vidkon than previously (Vidkon inspection). Experience reveals that field inspections can be undertaken much more swiftly when a Vidkon inspection was carried out beforehand. The field inspection will then require less inspection on foot. On straight road sections much can be checked by driving slowly along the roadside. When completed forms with pictures and comments are being used, the inspection is less time-consuming (less need to take several pictures and notes and the discussion proceeds more swiftly).

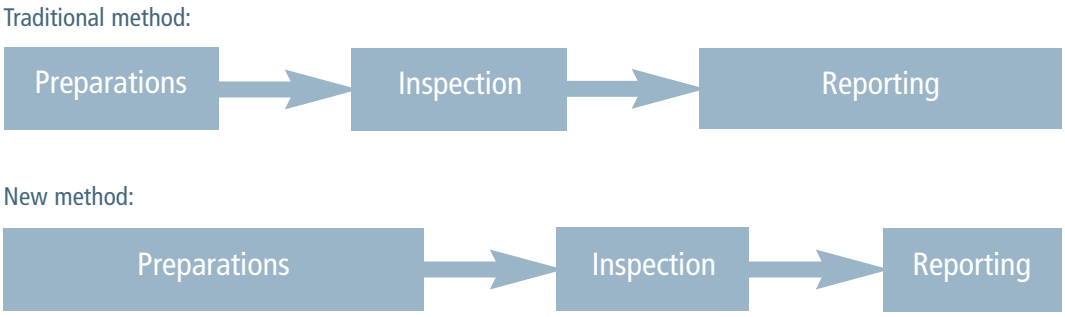

Figure 2.1. Axis that indicate time distribution of the process

With the traditional method little time was used on preparations, while inspection and supplementary work have taken the longest time. When actively using Vidkon and filling out standard forms as part of the preparation, the time required for the inspection itself, field discussions and supplementary work will be reduced. See more about the method in Chapter 5: Implementation.

In summary, the method suggested in this handbook is meant to provide the following advantages:

- Less time spent in traffic (increased safety).
- Simpler and standardized report form.
- Vidkon inspection possible throughout the year – the winter season can be used for preparations.
- Quality on level with or better than traditional method.
- A better basis for prioritizing among hazardous conditions being identified.
- With experience – a quicker method.

4 Preparations

4.1 Agreement and inspection team

Agreement must be made between road safety inspector (inspection leader) and project owner. Such agreement should contain description of inspection sections, what shall be included in the inspection (point out traffic safety deficiencies, proposed measures, cost estimates of measures etc.), deadline for delivering inspection report (preliminary and final), how expenses are covered and extent of district contributions.

The inspection team is established after a clarification between inspector and project owner. Project owner clarifies the extent of internal manpower available for inspector in an inspection team and inspection leader clarifies his manpower needs.

The inspection team should contain:
- Inspection leader.
- Local knowledge.
- Traffic safety know-how.
- Contracting competence.

but it can also be correct to involve:
- Special know-how within
  - tunnel,
  - bridge,
  - signs and markings,
  - operation and maintenance,
  - road user.
- Municipality.
- Police.

One person can obviously play several roles. The composition and number of persons on the team can vary depending on complexity, area type and length of road section.

4.2 Commencement meeting

The inspection always starts with a commencement meeting where all parties involved participate. Project owner in cooperation with audit leader invites to meeting. To be as well prepared as possible for the meeting, the base material should be sent audit leader beforehand.

The purpose of the commencement meeting is to:

- Present the project and clarify any ambiguities (also see the points on Vidkon inspection)
- Clarify which road type(s) the section belongs to, i.e. which requirements apply for the section in question (H1, H2, H3, S1…)

- Confirm that basic material, aids and resources needed by the inspection team are available
- Give a brief presentation of the audit process
- Carry out a Vidkon inspection of the road section – review and discuss overall principles and solutions
- Determine timing of inspection
- Determine timing of any concluding meeting and who should participate

The project owner is responsible for obtaining and handing over documentation requested by the audit team beyond what has already been requested.

4.3 Basic material

Basic material is here meant to include documents and data necessary to carry out the inspection. Examples of such material include:

- Relevant material:
  - map of road section, including parcel and kilometer post,
  - map in sosi format suitable for making copies to scale 1:5000 (overview maps) and 1:500 (for sketches),
  - vidkon images,
  - existing road plans,
  - URF profile for the road section.

- Relevant basic data:
  - data on AADT,
  - data on speed limits, speed measurements,
  - data on possible plans/developments in progress,
  - data on turning movements at intersections,
  - data on pedestrian traffic,
  - Accident data – STRAKS data for the last 4-8 year period.
  - tables for undertaking a simple analysis.

- Relevant laws, regulations, handbooks and guidelines such as:
  - Handbook 017 Road and street design,
  - Handbook 021 Road tunnels,
  - Handbook 062 Traffic safety equipment,
  - Handbook 231 Barrier standards,
  - Handbook 235 Trunk road design,
  - NA circular 27/1, Requirements regarding yielding masts.

A complete list of handbooks in the administration's handbook series is found at www.vegvesen.no

4.4 Important standard requirements

Below can be found some important standard requirements that can be used as a basis for road safety inspections. So far only safety requirements are included. Other requirements such as passing sight distance and visibility at intersections and access drives will be included later when the new HB 017, Road and street design and HB 263, Geometric design of road and street intersections have been approved.

Safety separation and safety zone

No hazards should be found within the safety zone (S) such as hazardous obstacles or hazardous slopes. Areas adjacent to the road shall be given a safe design within the safety zone.
The width of the safety zone is measured from the edge of lane and is determined based on the road's safety separation (A), with addition for steep slop and reduction for deep and steep cut.
For more detailed description, see Handbook 231, Safety barrier.

Safety separation (A) is determined based on speed limit and AADT of the road:

	Speed limit (km/h)			
AADT	50 and lower*	60 *	70 og 80	90 and higher
< 1500	2 m	3 m	5 m	6 m
1500 - 5000	3 m	4 m	6 m	7 m
> 5000	4 m	5 m	7 m	8 m

Safety separation (A) requirements with various speed limits and AADT

*For urban streets and roads with a speed limit of 60 km/h or less, the table applies only in conjunction with the following conditions (from HB 231):

- *Where there is a need for guardrail on embankment/sloping terrain and drop-off in accordance with Figure 2.8 and 2.9.*
- *Tunnel opening and interior tunnel arch extending out from the tunnel.*
- *Road or pedestrian or bicycle road underpass.*
- *Railway or subway crossing under or paralleling roadway.*
- *Play areas, kindergartens and school yards.*
- *Special installations such as fuel installations or water reservoir.*

In addition, yielding road equipment, such as sign posts and luminaries, shall be used within the safety separation/safety zone on roads with a speed level of 60 km/h when approved road equipment exist for this type of road. Yielding road installations should also be used on important roads with a speed level of 50 km/h.

It is recommended to use the safety separation shown in the table above as a basis with road safety inspections. Where there is a particularly hazardous element outside the safety zone that can cause serious person injury when hit, such hazardous element should be considered eliminated or protected against with guardrail.´´

4.5 Simple accident study

When considering the accident situation on a road section, it is important to think proactively, i.e. not focusing on what has happened, but more on anticipating what can happen in the future. One never knows where the next accident will occur.

One should not be too focused on previous accidents on the road section, but rather gain a rough overview of the accident situation along the section. The reason for this is that it is easy to focus too much on past occurrences and overlook other hazardous conditions.

It is the general accident picture of the section that should be focused on and not the locations where the individual accidents have occurred. This is achieved through a simple accident study. Which accident types dominated on the section and which have resulted in serious injury should be revealed. Moreover, it would be appropriate to check if there are other factors that typify the accident picture (time of year, time of day etc.).

It is recommended to carry out the simple accident study after the inspection is completed and check whether something has been overlooked relative to the accident picture that appears. When there are many accidents at one location, the inspection report should recommend that a black-spot study should be undertaken at these locations.

5 Implementation

Below follows a brief presentation in chronological order of the implementation of a road safety inspection. The next chapter elaborates on what is behind the various procedural points. A corresponding overview is found in part 0 of the handbook, where it is also stated who is in charge of each point.

Before road safety inspection commences, some preparations must be made. Traffic data and other data must be reviewed (AADT, speed limits, road widths, road standards, plans….).

The road safety inspection itself consists of the following stages (see also Chapter 5.1 and 5.2):

- Vidkon ”inspection”, the section is “driven” through several times using Vidkon
  - First to obtain an overview of the road section and an overall check (the road safety inspection team)
  - Then check for uniform and continuous design along the section (the road safety inspection team)
  - Finally, Vidkon inspection is undertaken to point out each individual find (inspection leader or the road safety inspection team)

- Reporting – starts through Vidkon inspection. Problem description and description of measures are discussed, commented and entered onto standard report forms during the Vidkon inspection.

- Inspection – check dubious conditions along the road and supplement/elaborate on conditions not seen via Vidkon.

5.1 Vidkon ”inspection”

The road section should be ”driven” in the office using Vidkon. Firstly, to obtain an overview over the section and to check overall factors such as:

- Area type - does the road go through different area types? (concerns speed limits)
- Speed limit – does this vary and could there be occasion for changing the speed limit after the road safety inspection?
- Possible standard jumps – are there any pronounced jumps in the standard and in such case, should upgrading of parts of the section be considered?
- Curvature and visibility – is the section and adjoining areas such that stopping sight distance and passing sight distance requirements to a large extent remain unfulfilled?

Then the various elements are checked for correct, uniform and continuous design along the length of the section. Examples of conditions that should be checked include:

- **Intersection types** – are intersection types appropriate with regard to traffic safety? Are the intersections of a uniform design?
- Pedestrian crossings – are they located correctly? Are crossings secured well enough? Are they given a uniform design along the section?
- Guardrail – are guardrails used extensively along the section? Can this be reduced? Are there many elements within the safety zone in need of protection? Are there rock cuts that must be safeguarded against and can this be done using guardrail?
- Signing – is directional signing uniform and continuous ? (check intersection signing)
- Road markings – are profiled road markings being used? (should be considered)
- Illumination – are all sections and intersection areas in need of lighting illuminated?
- Poles/pylons – which pylon and pole types are used along the section? Are there large variations and should wooden poles be considered replaced or cables buried?

It will make sense to discuss these principles before tackling individual findings. When certain design principles have been arrived at beforehand, suggested solutions for individual findings will be as uniform and continuous as possible.

Where such overall conditions are reviewed and discussed, it is recommended that Vidkon inspection be undertaken by the entire road safety inspection team established for the project. This is suggested done as part of the commencement meeting. Sufficient time must be made available at the commencement meeting for this (an entire day).

Finally, the section is ”driven through” in order to pinpoint each traffic safety deficiency find. To ensure that all such finds are brought up, it may make sense to use the groupings and points listed below:

o **Safety zone /side area**
  - Ditch profile (design).
  - Manholes – protruding?
  - Poles and pylons – type, breakaway design lacking?
  - Trees – is trunk diameter more than 10 cm?
  - Walls and noise barriers – hazardous guardrail terminals?
  - Pillars– impact hazards?
  - Guardrail (unnecessary/lacking, wrong (height, post spacing.), wrong guardrail terminals).

o **Remaining sections (in addition to the side area)**
  - Passing – passing opportunities and visibility.
  - Stopping sight distance – check curves and adjacent terrain/vegetation.
  - Signing – are there any superfluous or lacking signs?
  - Markings – are profiled markings used?
  - Illumination – lacking, adequate illumination level?

- **Intersections and access drives**
  - Sight zones at intersections and access drives – satisfactory?
  - Intersections – location, design.
  - Signing – directional signing, yield signing.
  - Markings – correct, satisfactory?
  - Pedestrian crossings – location, design, visibility.

- **Bridges**
  - Alignment of bridge approach – is it good?
  - Visibility at crests – is it satisfactory?
  - Intersections, ramps at bridge end – is visibility and alignment satisfactory considering speed level?
  - Bridge railing – dimensioning, transition between road guardrail and bridge railing, visibility obstruction.
  - Pedestrian and bicycle traffic – is this attended to?

- **Tunnels**
  - Alignment towards tunnel – is it satisfactory?
  - Tunnel portals – do they have a safe design?
  - ATC – is there a need?
  - Road markings – are profiled markings used? Is there a need for LED lighting?
  - Equipment – is there sufficient equipment and is it placed correctly?

When reviewing individual finds, it can be advantageous to use the more **detailed checklists found in part 1 of the handbook: Construction plan.** These provide a good overview of what needs to be checked with the individual elements.

Pictures of findings are copied into the report form (see T-ess, Chapter 6.1) to supplement the problem description. Use of Vidkon pictures reduces the need for photos.

The problem description and measures being discussed are commented and filled in the form during the Vidkon inspection (see Chapter 6.1, standard texts are filled in the T-ess as a guide). As much information and assessments as possible will then be available before the field inspection is undertaken. This will make the inspection simpler and quicker. Gathering everyone involved in the inspection around a table will provide an opportunity to discuss the problem description and proposed measures. This will more easily facilitate a concerted and efficient discussion than during a field inspection, when several participants easily split into separate groups and are not gathered together.

With Vidkon inspection and completion of forms, much of the reporting has already been done.

5.2 Field inspection

The field inspection itself concentrates on checking conditions that are doubtful and supplement/elaborate on conditions picked up using Vidkon.

Further, choices and description of measures can be elaborated on during the field inspection

Map segments of spots/sections can be taken out to sketch solutions, measure lengths etc.. This can conveniently be done by the secretary between the Vidkon inspection and the field inspection.

Places that from experience are not easily discerned at the Vidkon inspection and that always have to be checked during the field inspection include:

- Ditch areas (ditch depths, any protruding manholes/foundations, culverts)
- Side slopes – if they are too steep (guardrail extension)
- If there are breakaway poles and pylons
- Intersection and access drive sight zones
- Side road signing
- Conditions on pedestrian and bicycle facilities

Signing and work zone signing before inspection.
Reference is made to Handbook 051 "Work zone signing" that states requirements in conjunction with work activities on the roadway. The following safety requirements are set for undertaking the inspection to make the inspection as safe as possible:

- Warning plan is prepared and approved by proper authority.
- Inspection must in some cases be arranged during periods with low traffic volumes. Road closure and nighttime inspection may be called for.
- Approved protective gear must be used (retro-reflective vests).
- It is recommended to walk along the edge of the road, preferably outside, where this is possible and to avoid crossing the road.

5.3 Typical faults on existing road

In 2003 the Directorate of Public Roads made an evaluation of results and experiences with undertaking road safety audits of a total of 56 road sections (41 outside urban area and 14 in urban area). This is presented in Report 08/2003 prepared by the Traffic Safety Section.
"Outside urban areas it is the problem of running off the road that has been in focus. Two types of safety problem have dominated. Firstly, conditions connected with roadside areas, sunlight, rock cuts and rocky outcrops, ditches, embankments, cuts etc.; secondly poor and hazardous guardrails. Naturally, proposed measures focus mainly on securing the roadside and on guardrail and bridge railing.
In urban areas, intersection problems and conditions for pedestrians and cyclists have been most in focus. Traffic safety problems are mainly associated with faulty design of intersections and access drives. But a typical problem that has been revealed is also conditions connected to the roadside and lack of pedestrian and bicycle facilities. Suggested measures primarily focus on improving and reconstructing intersections and access drives as well as erecting and improving guardrails".

Hazardous conditions frequently pointed out:

1. Hazardous roadside obstacles (poles, pylons, portals, manholes, abutments, walls etc.).
2. Unfavourable or faulty guardrail terminal design.
3. Hazardous rock cuts, rocky outcrops, large rocks.
4. Deep and hazardous ditches.
5. Too short guardrails in front of hazardous roadside obstacles, embankments etc.
6. High and steep down-slopes.
7. Hazardous trees.
8. Deficiencies with existing guardrails, too low, not to standard.
9. Faults at intersections and access drives (including pedestrian crossings).
10. Lacking pedestrian/bicycle facilities.

6 Supplementary work

The supplementary work consists of completion of the road safety inspection report (road safety auditor), reporting that the inspection is completed (project owner) and the follow-up of measures (project owner).

Work on the inspection report, started during the preliminary stage, is completed. Preliminary report is sent/mailed employer for comments. Employer/project owner make written response by mail to the report. In some cases a concluding meeting with the road safety auditor may be held. How many copies and if the report is preferred on paper, electronically or both, is agreed on in each case.

Funding will determine how many of the measures will be implemented and when.

The project owner is responsible for the reports being filed at O: in each region. The region is responsible for reporting to the Directorate of Public Roads through an annual reporting of completed road safety inspections.

7 Report standardization (T-ess)

A standard report form has been prepared as part of a new standardized work method. The form has been prepared in Excel (spreadsheet). The form has been designed based on forms already in use. Excel is used to simplify filling out common information required on the various forms and to be able to use macros capable of retrieving standard texts. The program is named T-ess.

It is recommended to establish several T-ess files with report forms for the section in question. Due to the size of the files, there should be no more than 40 report forms in each file (photos entered onto the forms will make the file cumbersome). The files can be labelled with kilometer post direction, such as: RV4 with 1.xls, RV4 with 2.xls, RV4 against 1.xls, RV4 against 2.xls.

Common information entered the form once for each file (at the very start when opening T-ess) includes:
- route number,
- name of the section, such as from name and to name,
- main road section (hp),
- kilometer post and direction.

The specific information entered onto each form contains:
- km identification of spot/find or km from-to for a section with multiple finds
- a problem description for the find,
- tick off for deviations, faults or remarks,
- tick off for finds considered to be an immediate measure or an investment measure,
- photo of the find (from Vidkon and/or from inspection),
- description of proposed measures,
- point number – or form number is filled in continuously to the very end when its is known for sure that all points/forms are filled out.

Standard texts are in the file as an aid for filling in the forms. These are retrieved and pasted in. The standard texts describe a number of typical situations. Standard texts have been prepared for the following:

Problem description
A number of standard problems/finds are described. Examples include: “Faulty/hazardous guardrail terminals”, “Trees within the safety zone”, “Poor visibility at intersection/access drives”.

Description of measure
The most common measures are described. The descriptions consist of a brief text. Typical examples are: “Remove trees”, “Install impact absorbing guardrail terminal”, “Remove visibility reducing vegetation”, “Replace with yielding sign posts”. A supplementary description might be necessary – which is done by supplementing the standard text or writing a separate description directly into the form.

Handbooks
List of relevant handbooks, numbers and names that the deviation/fault refers to.

The report form has a box at the bottom (a risk matrix) that can be filled out to derive what are the most serious remarks relative to risk (a probability assessment of an undesirable occurrence happening at the location and what will be the anticipated consequences considering the design of the place/point). Filling out the risk matrix can be of help in prioritizing possible measures. How probabilities and consequences are assessed will be up to individual judgment. This will most likely vary from section to section and from inspector to inspector.

The most important aspect with filling out the risk matrix is to clarify what are the most serious conditions along the section in question.

T-ess contains a **statistics sheet** for all completed forms in the same file. From that can be retrieved a summary of the total number of deviations/faults/remarks, number of immediate measures/investment measures and number of checks in the various risk matrix cells. This statistic will be of help summing up the finds and measures. As long as multiple files are required to store all report forms, several statistics sheets will be needed to provide the total picture for the entire section.

A sheet of totals is also included in T-ess where all points recorded (one for each form) are listed consecutively. This sheet can be used to enter cost estimates for the points.

A unit cost "data bank" has been established to assist in making rough cost estimates for the more typical road safety measures proposed in connection with road safety inspections. The cost data bank has been established based on collection and reviewing of costs from various sources. The contractor side has been drawn into the effort. Costs are based on average bid/contract costs for 2004.

8 Road safety inspection report content

The road safety inspection report shall contain the following chapters:

1. **Introduction.**
   What is the background for the inspection.
   Prepare a simple description of the section to be safety inspected.
   The following information should be stated:
   - o County and municipality
   - o Route number and name, Hp and km
   - o Area type
   - o Road type
   - o AADT
   - o Speed limit
   - o Overview map

2. **Inspectors and inspection process**
   State who have been involved in the inspection and their function! This should include name, employer, title and participation in the project. Moreover, date of meetings and inspections should be given.

3. **Basic inspection documents**
   Here should be listed which basic documents were made available to inspector from project owner and which requirement documents were used during the inspection. Examples of such documents can be found in Chapter 4.3.
   If important basic data could not be made available, this should be noted.

4. **Accident study and important data**
   Here is given a summary of the accident situation on the section. It is important to ascertain what dominant accident types on the section are and what the overall serious accident picture is. It is the general accident picture of the section that should be focused on and not the locations of individual accidents. See Chapter 4.5.

Important data used extensively throughout the inspection are placed in a table. Given the AADT and speed limit, the safety zone, stop sight distance required, passing sight distance required etc. can be derived, to be shown in a table:

Important data	Km x - xx	Km xx - xxx
Speed limit		
AADT		
Safety zone		
Stop sight distance		
Passing sight distance		
Free sight intersection		
Free sight access drive		

Also see Chapter 4.4 and example of enclosed road safety inspection report.

5. Inspection summary
What typical finds were made on the section inspected, and what were the most serious finds. What are road safety auditor's priorities. Which measures are recommended.

6. Anticipated accident reduction effect of proposed changes
If possible, undertake an estimate of the effect of proposed changes. TSEFFEKT can be a useful tool for this purpose.

Attachment:
Completed report forms showing all finds (the noted hazardous conditions)
This makes up the majority of the report and consists of all filled out report forms from T-ess. Here finds can be found on forms with information on direction of kilometer posting, km, problem description, photo(s), deviation/faults/remarks, proposed measures and completed risk matrix. There can be one or more finds on each form. When there are several finds at the same point/limited section, it is practical to include these in the same form. See Chapter 7.

Cost estimate
In addition, rough cost estimates of inspection measures are prepared. It is prepared as a separate document because it is undesirable to have cost estimates sent contractors to obtain offers. Enclosed cost bank can be used as an aid.

Statens vegvesen

The Handbooks may be ordered from:

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