BEST PRACTICE GUIDELINES ON ROAD SAFETY INSPECTION

C. STEFAN
Unit - Road Safety Economics, Austrian Road Safety Board (KfV), Austria
CHRISTIAN.STEFAN@KFV.AT
R. ELVIK
Institute of Transport Economics, Norwegian Centre for Transport Research, Norway
Re@toi.no

1. INTRODUCTION

The European Commission announced to take concrete action on road infrastructure safety in the White Paper on Future European Transport Policy for 2010 [European Commission 2001] and again in its Communication on an European Road Safety Action Programme on the 2nd June 2003 [European Commission 2003]. In order to reach the self imposed objective of halving the number of fatalities on European roads by 2010 (from more than 50,000 in 2001 to 25,000), several instruments concerning road infrastructure safety were proposed: Road Safety Impact Assessment (RIA), Road Safety Audit (RSA), Network Safety Management (Black Spot Treatment and Network Safety Analysis) and Road Safety Inspection (RSI) make sure that safety is integrated in all phases of road planning, design and operation of road infrastructure. The following paper deals with RSI only and gives examples and experiences (Best Practice) with this instrument in European states where Road Safety Inspections have been introduced for several years.

In the countries investigated, Road Safety Inspection is considered an instrument to improve the infrastructure safety on the already existing road network. Although definitions (what RSI actually is or ought to be) and methodology quite differ, this approach forms a mutual basis for further work on an international level.

In Task 5.2 of the Specific Targeted Research Project (STREP) RIPCORD-ISEREST, a common understanding between the participating states was developed according to which, RSI inspects and remedies safety deficits in locations without a past record of high accident numbers and should to be carried out periodically on the whole road network. The purpose of Road Safety Inspection is to improve traffic safety standards on existing roads by identifying and weeding out hazardous conditions, faults and deficiencies along roads that can lead to fatal and/or serious accidents. This is mainly done using well-established experience and knowledge of safe road design, road environment and traffic operation as well as knowledge about the effect of traffic safety measures. As mentioned above, the current practice of RSI differs in many respects between different European countries. Hence, there is a need for identifying best practice, or at least good practice with respect to road safety inspections.

2. THE SPATIAL PROBLEM OF SAFETY INSPECTIONS AND POSSIBLE REMEDIES

The basic idea of Road Safety Inspection (as mention in chapter 1) is to check the existing road network, i.e. motorways, rural and urban roads, etc. for deficiencies in periodic time intervals. At this point of argument, it has to be stated that the road network in any country usually consists of thousands and thousands of kilometres, of which only a small percentage belongs to the primary road network. In Austria for example, about 2,000 km of motor- and expressways and 35,000 km of roads belonging into the jurisdiction of the federal states ‘officially’ existed in 2006 [BMVIT 2007]. Figures on length of in-town streets, i.e. the road network of municipalities, are several years’ old and very crude at the best. Latest estimates for the year 2003 refer to 80,000 kilometres [KfV 2003]. In total, the Austrian road network consists of about 120,000 km. Following this lead, the legitimate question arises: how can the resulting spatial problem, inspecting the whole network in periodic time intervals of 2-4 years, being solved. Several ways dealing with this situation can be found throughout European.

In Germany for example, a distinction is made between periodic and ad hoc tasks in Road Safety Inspection [FGSV 2006]. The inspections are divided into periodic safety inspections (conducted at fixed intervals), ‘dedicated’ road safety inspections (dealing with a specific topic) and ‘ad-hoc’ inspections (see Table 1). The major advantage of this classification is that along regular safety inspections, specific and highly controversial topics such as pedestrian crossings, tunnels, crossroads, etc. are inspected separately and not mixed together. This approach also makes sense considering the fact that different issues also need different time intervals, i.e. safety related signs and road characteristic have to be inspected in shorter intervals than for example destination signs.

Table 1: Tasks and scheduling of Road Safety Inspections in Germany

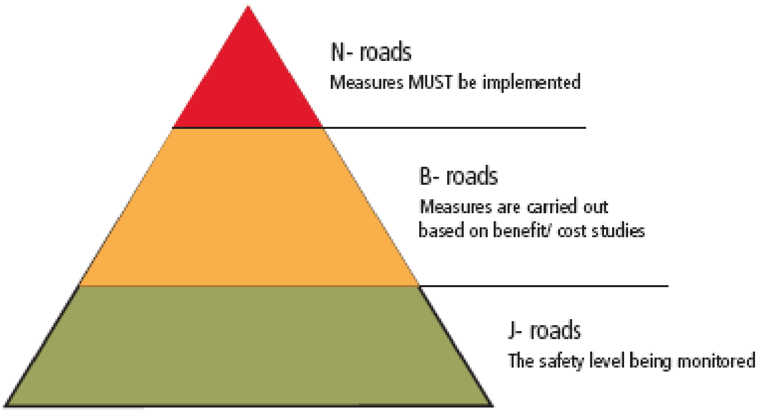
Type of RSI	**Subject of inspection**	**Road categories**	**Interval**
Periodic Road Safety Inspection	Safety-related road signs (including road markings and traffic devices), hazards at the edge of the carriageway and in the road-side environment	Major roads (in built-up areas), federal-state roads, district council roads and motorways (outside built-up areas)	Every 2 years
		Municipal roads and minor roads (in built-up and non-built-up areas)	Every 4 years
Night-time Road Safety Inspection	Road signs (including road markings and traffic devices), road layout, lighting of crossing points	Major roads (in built-up areas), federal trunk roads, federal-state roads, district council roads and motorways (outside built-up areas)	Every 4 years
Railway crossing inspection	Road signs and traffic devices in connection with level crossings	all roads	Every 4 years
Tunnel inspection	Safety-related road sign (including road markings and traffic devices), lighting	all roads	Every 4 years
Destination-sign inspection	Destination signs	all roads	Every 4 years
Inspection of other road signs and traffic devices	Road signs and traffic devices not covered by other RSI	all roads	Every 4 years
Ad hoc road-safety inspection	Selected road signs and traffic devices	all roads	As required

Another approach to the problem stated above is to (pre)select roads on the basis of their safety record. In Norway, for example the safety record of a road is assessed in terms of its expected injury severity density. Injury severity density is an indicator of the cost-weighted number of injured road users per kilometre of road per year. One fatal injury for example counts as much as 33 slight injuries. Expected injury severity density for a given road section is estimated by means of the Empirical Bayes (EB) method. According to this method, expected safety for a given roadway element can be estimated as the weighted average of the predicted safety for similar sites and the accident record for the given element. Safety for similar sites is predicted by means of a multivariate accident model, fitted by means of negative binomial regression.

Separate models have been developed for fatalities, critical injuries, serious injuries, slight injuries and injuries accidents. Based on these models, normal values are predicted for fatalities, critical injuries, etc. These are then combined with the recorded values for each road section in order to estimate its predicted injury severity density. Road sections of 1 kilometre and data for 8 years were used in developing the models.

Roads were then classified into three groups based on expected injury severity density. (1) Red roads, comprising the 10 percent worst roads, (2) Green roads, comprising the 50 percent safest roads, and (3) Yellow roads, comprising the remaining 40 percent of roads (see Figure 1). Safety inspections are first carried out on the worst of the red roads, and then proceed to other roads.

Figure 1: Classification of national roads in Norway due to the expected injury severity density

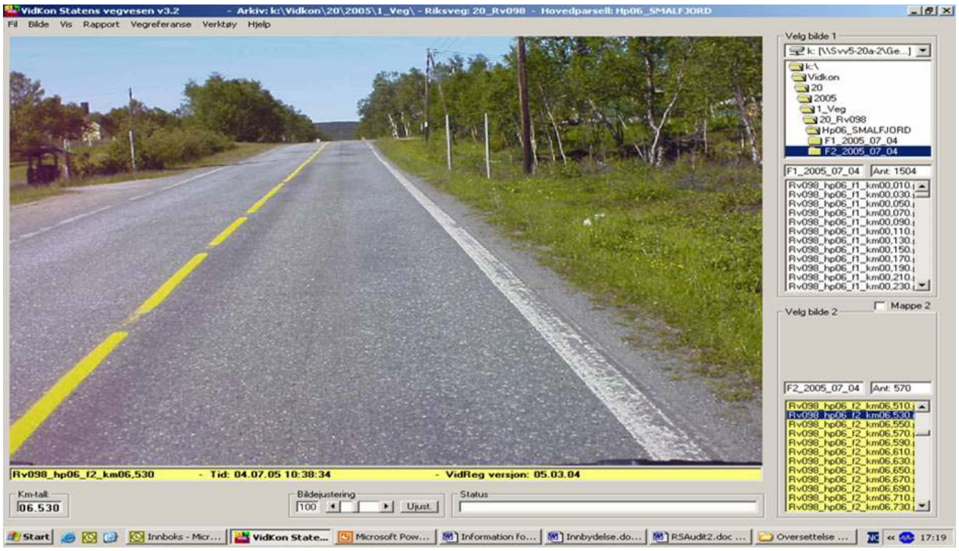


A third solution to the spatial problem is the use of digital video equipment. Experience in Norway [Statens Vegvesen 2005] reveals that field inspections can be undertaken much more swiftly when a so called Vidkon inspection was carried out beforehand. The road section under investigation is driven through several times with a video camera or digital camera being used to make 2 pictures (one of the actual roadway, the other one of the side area) for every 20 metres or a continuous stream of the whole section. On straight road sections much can be checked by driving slowly along the roadside.

For the road section under surveillance, a preliminary inspection/investigation can be conducted in the home office in order to obtain an overview over the section and check for overall factors such as area type (does the road go through different area types), curvature and visibility, intersection types, signing and road markings, etc. Hence, this method gives the opportunity for inspecting the road at any time of the year and not being influenced by weather or traffic flow.

During the winter months when Road Safety Inspections are usually not feasible, those pictures and videos are then used for preparation of standardized spreadsheets (see below) for upcoming inspections during spring. エラー! 参照元が見つかりません。Figure 2 gives an example of a RSI in Norway with Vidkon being used for data acquisition.

Figure 2 – Road Safety Inspection in Norway using Vidkon. Source: Statens Vegvesen, 2005



This kind of ‘preliminary’ road safety inspection offers the following advantages:

- less time spent in traffic, i.e. increased safety for the inspectors
- Inspections are possible throughout the year - the winter season can also be used for preparations
- inspectors have the chance to rewind the tape or look at certain pictures/sites in order to look for common deficiencies
- the inspection team can discuss every situation in the peace and comfort of the home office

The field inspection (= the actual RSI) itself concentrates on checking conditions that are doubtful and supplement/elaborate on specific situations picked up during the preliminary inspection. In Norway, standardized report forms are being used to guarantee that every Road Safety Inspection literally looks the same, irrespective of the inspectors. To reach this goal, standard texts describing a number of typical situations are used in the software for filling in the forms (see Figure 3)

The information entered onto each form contains:

- Route number
- Name of the section, such as from name to name
- Main road section
- Kilometre post and direction
- Km-identification of spot/find or km ‘from-to’ for a section with multiple findings
- 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 (Vidkon)

- Description of proposed measures

Figure 3 – Standard report form (T-ess) used for safety inspections in Norway

ROAD SAFETY INSPECTION — **Point nr.:** 6

Route number:	Road section – name:	Hp	Km	Direction
E 6 - 69	Tana Valley - North Cape			

Situation description:

Too high and steep slope, ref. HB231, Figure 2.8

Photo 1:

Ref. to handbook:

HB 231

Deviation:	X	Fault:		Note:	
Immediate measure:	X	Minor investment measure:		Route investment measure:	Put a mark in the appropriate box to the left

Description of measure

Erect guardrail

Photo 2 (alternatively a sketch may be included)

Severity (Mark in appropriate box)

Consequence → / Probability ↓	Light	Serious	Very serious/fatal
Small			X
Medium			
High			

The major advantages of this method are as follows:

- easy to read and use
- easy to compare
- easy to insert pictures from Vidkon or any other video system
- standardized text for most common errors (text bank)
- includes risk matrix
- simpler and standardized report form
- better basis for prioritizing among hazardous conditions being identified

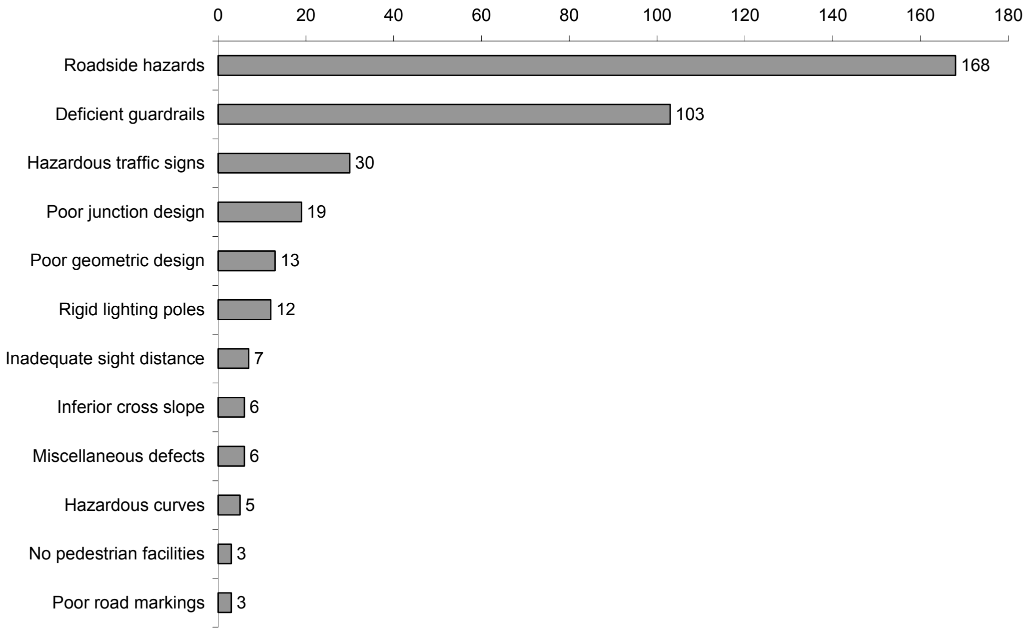
3. DEFECTS IDENTIFIED IN ROAD SAFETYY INSPECTIONS

The items that are covered in road safety inspections may vary from one country to the other. This chapter briefly presents the items addressed in Austria and Norway with similar experiences made in Germany and Portugal.

In Austria, the first pilot cases of Road Safety Inspections began in 2003. Until now, around 270 km of the Austrian motorway network have been inspected and some are still under inspection. The inspection included highway design parameters, an analysis of traffic operations, light conditions, weather management and the surroundings of the road. Each item was rated as highly important, of middle importance or of low importance for road safety. For each item rated as highly important, measures were proposed to reduce the hazard associated with the problem. Most measures proposed are typically low-cost measures that can be implemented on short notice and do not require the acquisition of more land or extensive planning. Most of the items covered by the inspection are known to be traffic hazards. This applies, for example, to sight restrictions [Elvik and Vaa 2004], curve radius on entry ramps [Erke 2006] speed [Elvik, Christensen and Amundsen 2004], rain, snow or ice [Elvik and Vaa 2004] and fog.

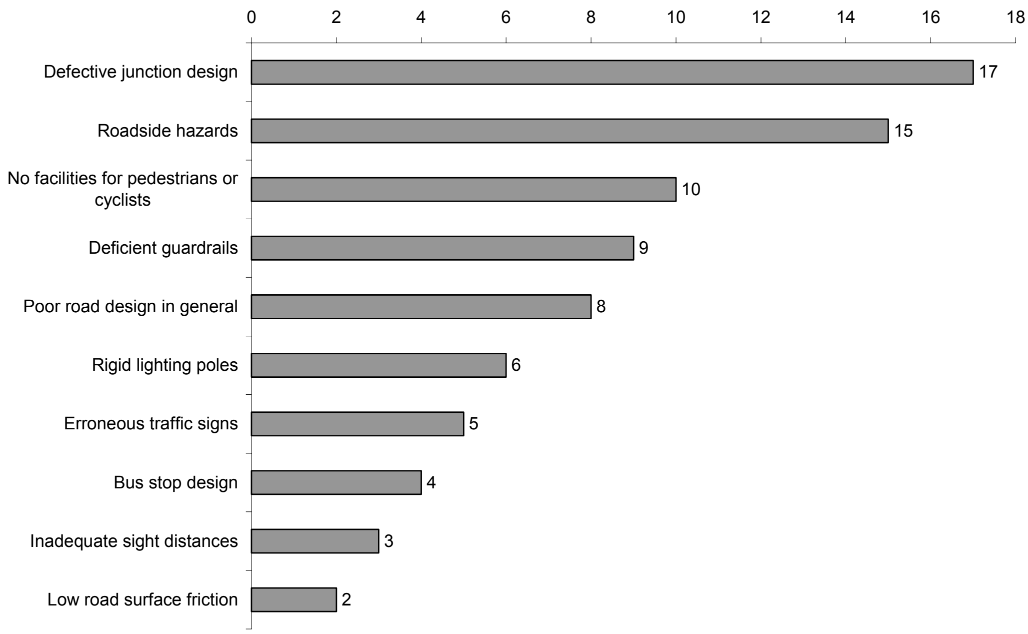
A Norwegian study [Haldorsen and Hvoslef 2003] summarised the findings of 56 reports from road safety inspections. 41 reports dealt with roads outside urban areas, 15 reports dealt with roads inside urban areas. A total of 365 remarks about traffic hazards were made in the 41 reports for roads in rural areas. **Figure 4** summarises the number of remarks made by main category. The mean number of hazards identified was 8.9 per report. Nearly half of the hazards that were mentioned were roadside hazards, such as rock cuttings close to the road, large trees close to the road and high and steep embankments. Various deficiencies related to guardrails were also mentioned quite often. The most frequently mentioned deficiency of guardrails was that guardrail ends were not protected and represented a preventable traffic hazard.

Figure 4 - Number of hazards mentioned in reports from road safety inspections of rural roads in Norway. Source: Haldorsen and Hvoslef 2003



15 reports for urban roads identified a total of 79 defects. **Figure 5** shows the main categories of defects pointed out in the reports dealing with urban roads. The mean number of hazards identified per report was 5.3. Analysing these deficiencies, it can be seen that the hazards identified for urban roads are quite different from those identified for rural roads. Characteristics of junction design and of the facilities provided for pedestrians and cyclists are mentioned quite often.

Figure 5 - Number of hazards mentioned in reports from road safety inspections of urban roads in Norway. Source: Haldorsen and Hvoslef 2003



Due to the studies mentioned above, it can be stated that Road Safety Inspections point out deficiencies which usually can be solved by low cost measures. This experience also reflects the very nature of the instrument RSI following the principle 'You look what you see'. In the next chapter, best practice concerning measures for different kinds of road deficiencies will be presented.

4. ROAD SAFETY EFFECTS OF TREATMENTS IMPLEMENTED AS A RESULT OF ROAD SAFETY INSPECTIONS

There are very few studies of the effects of road safety of measures that are known to have been implemented as a result of road safety inspections. In fact, only two studies, both of them dealing with the correction of erroneous traffic signs, have been found [Lyles et al 1986, Ford and Calvert 2003]. Both of these studies are from the United States. Their findings will be discussed below.

While few studies evaluating road safety treatments explicitly state that they were initiated as a result of road safety inspections, there are very many studies of road safety measures that are identical to the measures that tend to be proposed in reports from road safety inspections. It therefore seems reasonable to assume that the effects of measures that are introduced following road safety inspections will be the same as the effects of these measures as reported in general in evaluation studies. Based on this assumption, this chapter will give a brief overview of current knowledge regarding the effects of the following road safety measures:

- Removing sight obstacles located close to the road
- Roadside safety treatments
- Installing guardrails along embankments
- Guardrail end treatments
- Using frangible or break-away poles
- Low cost treatments of horizontal curves
- Correcting erroneous traffic signs

The overview is based mainly on the Handbook of Road Safety Measures [Elvik and Vaa 2004], but some studies are discussed in more detail.

4.1. Removing sight obstacles

The Handbook of Road Safety Measures [Elvik and Vaa 2004] quotes two studies that have evaluated the effects of removing sight obstacles near the road – mostly by means of cutting down trees and bushes. One of the studies was Swedish, the other Norwegian. It is probably the treatments evaluated in the Norwegian study [Vaa 1991] that come closest to those one would typically expect to be implemented following a road safety inspection. Figure **6** shows a picture of one road section, before and after treatment.

Figure 6 - Sight distance before and after clearance of trees and bushes. Source: Vaa 1991

Figur: Kurve på Rv 306. Før siktrydding.

Figur: Kurve på Rv 306. Etter siktrydding.

As can be seen from the picture, there was a remarkable improvement in sight distance. The study found that the frequency of overtaking increased. Mean speed also increased. Both these finding show that drivers tend to adapt their behaviour to changes in sight conditions, and will take the opportunity to drive faster when sight obstacles are removed. The net effect on safety was small. Injury accident rate changed from 0.31 per million vehicle kilometres before to 0.30 per million vehicle kilometres after. This small change (a reduction of 3%) was not statistically significant.

4.2. Roadside safety treatments

There are two main types of roadside safety treatments: flattening of sideslopes and removing fixed obstacles from the safety zone. The safety zone is the area close to the road, up to about 10 metres from it. The Handbook of Road Safety Measures [Elvik and Vaa 2004] summarises evidence from studies that have evaluated the effects of roadside safety treatment. Possibly the best study was reported by Zegeer et al (1988). Table 2 summarises the findings of that study with respect to flattening of sideslopes.

Table 2 - Expected reduction of single-vehicle-off-the-road accidents attributable to flatter sideslopes. Source: Zegeer et al 1988

	Sideslope after				
Sideslope before	3:1	4:1	5:1	6:1	7:1 or flatter
2:1	2%	10%	15%	21%	27%
3:1		8%	14%	19%	26%
4:1			6%	12%	19%
5:1				6%	14%
6:1					8%

These estimates are based on an accident prediction model that controls statistically for the effects of several other variables, including traffic volume, lane width, shoulder width and clear recovery distance (clear recovery distance is the width of the zone without any fixed obstacles).

Flattening steep sideslopes is not always feasible and can be very costly. Removing fixed obstacles near the road (providing a clear recovery zone) can be cheaper. According to Zegeer et al, the number of single-vehicle-off-the-road accidents can be reduced by up to 44% if the clear recovery distance is increased by 6 metres.

4.3. Guardrails and guardrail end treatment

A review of current knowledge regarding the effects of installing guard rails and providing safety treatment of guardrail ends is presented in the Handbook of Road Safety Measures [Elvik and Vaa 2004]. The main points of the review are presented below. Table 3 presents summary estimates of the effects of installing guardrails along embankments.

Guardrails along embankments strongly reduce the number of fatal accidents and the number of injury accidents in the event of driving off the road. Guardrails also appear to reduce the total number of accidents, including property damage only accidents, but the effect is smaller and more uncertain. Changing to more yielding guardrails is also associated with a reduction of injury severity, but this is smaller than the effect of setting up guardrails in places where previously there were none.

Table 3 - Effects on accidents of guardrails along the roadside. Percentage change in the number of accidents. Source: Elvik and Vaa 2004

	Percentage change in probability of injury		
Accident severity	Types of accident affected	Best estimate	95% confidence interval
New guardrail along embankment			
Fatal injury	Running-off-the-road	-44	(-54, -32)
Any injury	Running-off-the-road	-47	(-52, -41)
Accident rate	Running-off-the-road	-7	(-35, +33)
Changing to softer guardrails			
Fatal injury	Running-off-the-road	-41	(-66, +2)
Any injury	Running-off-the-road	-32	(-42, -20)

As far as guardrail end treatments are concerned, Elvik [2001] provides an overview of effects as presented in Table 4. While only 1.4% of drivers are killed when they strike a guardrail along the length of need, 2-5% of drivers are killed when striking a guardrail end. Turned down guardrail ends can act as “rocket launching pads”, literally lifting the car into the air and throwing it a considerable distance. The safest solution appears to be to attach the guardrail end to the back slope, i.e. not have any exposed guardrail end at all. If it needs to be exposed, de-signing the guardrail end as a crash cushion will reduce injury severity.

Table 4 - Effects of guardrail end treatments. Source Elvik (2001)

	Car drivers by injury severity and treatment type			
Type of end treatment	**Not injured**	**Slight injury**	**Serious injury**	**Killed**
Results of Hunter, Stewart and Council 1993				
Guardrail (length of need)	294 (50.4%)	217 (37.3%)	63 (11.0%)	8 (1.4%)
Blunt end	60 (44.8%)	49 (36.5%)	22 (16.4%)	3 (2.2%)
Turned down end	51 (47.2%)	36 (33.4%)	16 (14.8%)	5 (4.6%)
Attached to back slope	11 (31.4%)	18 (51.4%)	6 (17.1%)	0 (0.0%)
Results of Gattis, Alguire and Natta 1996				
Exposed	99 (52.1%)	61 (32.1%)	21 (11.1%)	9 (4.7%)
Turned down end	177 (54.3%)	97 (29.8%)	42 (12.9%)	10 (3.1%)
Results of Ray 2000				
Parabolic flare	54 (60.7%)	22 (24.7%)	13 (14.6%)	
BCT simple curve	32 (48.5%)	17 (25.8%)	17 (25.8%)	

4.4. Frangible or break-away poles

The Handbook of Road Safety Measures [Elvik and Vaa 2004] presents the following information regarding break-away or frangible lighting poles. The effect on injury severity of using deformable lighting poles has been studied in Great Britain [Walker 1974] and the United States [Ricker, Banks, Brenner, Brown and Hall 1977; Kurucz 1984]. On the basis of these studies, frangible or break-away poles can be estimated to reduce the probability of personal injury in the event of a collision by about 50% (lower 95% confidence limit 72%, upper 95% confidence limit 25%).

4.5. Low cost treatment of horizontal curves

Sharp curves on otherwise straight roads have a high accident rate. An estimate of the accident rate in curves classified as unexpected using the Norwegian URF program [Elvik and Muskaug 1994] shows that the accident rate in such curves is highest when they are located on roads with few similar curves. The number of injury accidents per million vehicle kilometres with different numbers of curves was:

Table 5: Number of unexpected curves (curves with an URF-value above around 4-5) per km road

More than 0.75	0.51-0.75	0.26-0.50	Up to 0.25
0.19	0.24	0.59	0.66

The risk in unexpected curves is around 3 times as high when there are fewer than 0.5 such curves per kilometre road as when there are more than 0.75 curves per kilometre road. A study from New Zealand [Matthews and Barnes 1988] found a similar pattern. The longer the straight section before a sharp curve (radius less than 400 metres), the higher the accident rate in the curve.

It is not always possible to improve sharp curves by rebuilding the road. The accident rate in sharp and unexpected curves must therefore be reduced using other methods. In Norway a computer program has been developed in order to identify unexpected curves [Amundsen and Lie 1984]. The program is known as the URF program (URF stands for UtforkjøringsRisikoFaktor – the driving off the road risk factor). The URF-value of a curve depends on the curve's degree of unexpectedness, the width of the road and the gradient of the road. The degree of unexpectedness of a curve depends on how great the difference is in driving speed, curve radius and the super elevation of the road in the curve compared to average values of these quantities for a section of road.

The URF-program has been used in Norway to identify unexpected curves and to improve these [Eick and Vikane 1992, Eriksen 1993, Stigre 1993]. The most common type of treatment is signs showing directional arrows that indicate the alignment of the curve. Background markings are sometimes also used. The studies of Eick and Vikane (1992), Eriksen (1993) and Stigre (1993) have been re-analysed to control for regression-to-the-mean by relying on the study of Sakshaug (1998). That study provided a set of normal accident rates for horizontal curves that were not known at the time of the original studies. Based on the re-analysis, the effect on injury accidents of directional and background signing of hazardous curves is estimated to 16% reduction. This reduction is not statistically significant (lower 95% limit: 35% reduction, upper 95% limit 9% increase).

4.6. Correcting erroneous traffic signs

Two studies have evaluated the safety effects of correcting erroneous traffic signs. Both studies [Lyles et al 1986, Ford and Calvert 2003] were made in the United States. The first of these studies is discussed in the Handbook of Road Safety Measures [Elvik and Vaa 2004]. The study found that improvements to make traffic signs conform to the MUTCD (Manual on Uniform Traffic Control Devices) led to a 15% decrease in the number of injury accidents (lower 95% limit 25% decrease, upper 95% limit 3% decrease). Property damage only accidents were reduced by 7% (lower 95% limit 14% decrease, upper 95% limit 0.3% decrease). The authors of the study incorrectly concluded that upgrading substandard signs did not reduce the number of accidents, on the basis of an inadequate statistical analysis of the data.

The second, more recent study [Ford and Calvert 2003] evaluated the effects of a low cost programme of upgrading signs and road markings based on road safety inspections. The study found a reduction of 55% in the number of fatal accidents, a reduction of 31% in the number of injury accidents and a reduction of 46% in the number of property damage only accidents. The study did not control for regression-to-the-mean, and the treatments were targeted to high-risk sites. It is therefore very likely that the true effects are considerably smaller than those reported.

4.7. Effects that can be expected as a result of road safety inspections

Table 6 summarises the effects that can be expected if the measures described above are introduced as a result of a road safety inspection. All estimates refer to injury accidents. All estimates are given as an interval only, as there is bound to be local variations and as there is a fairly large element of uncertainty in many of the estimates presented above.

Based on these estimates of effect, it is reasonable to conclude that road safety inspections can lead to the implementation of measures that can improve road safety considerably.

Table 6 – Summary of effects on injury accidents to be expected as a result of road safety inspections. Source: TØI report 850/2006.

Treatment	Accidents that are influenced	Expected accident reduction (%)
Removing sight obstacles	All accidents	0-5%
Flattening side slopes	Running-off-the-road	5-25%
Providing clear recovery zones	Running-off-the-road	10-40%
Guardrails along embankments	Running-off-the-road	40-50%
Guard rail end treatments	Vehicles striking guardrail ends	0-10%
Yielding lighting poles	Vehicles striking poles	25-75%
Signing of hazardous curves	Running-off-the-road in curves	0-35%
Correcting erroneous signs	All accidents	5-10%

5. CONCLUSIONS

In view of the findings of this report and the report of Nadler and Lutschounig [2006], the following guidelines for best practice with respect to road safety inspections are proposed:

1. The elements to be included in road safety inspections should be known to be risk factors for accidents or injuries.

2. Inspections should be standardised and designed to ensure that all elements included are covered and are assessed in an objective manner. For this purpose, developing check lists may be of help.

3. The list of elements to be included in road safety inspections (check lists) should include those that are recognised as important. The following elements should be included in all road safety inspections:

    a. The quality of traffic signs, with respect to the need for them, whether they are correctly placed and whether they are legible in the dark.

    b. The quality of road markings, in particular whether the road markings are visible and are consistent with traffic signs.

    c. The quality of the road surface, in particular with respect to friction and evenness.

   d. Sight distances and the presence of permanent or temporary obstacles that prevent timely observation of the road or other road users.

   e. The presence of traffic hazards in the near surroundings of the road, such as trees, exposed rocks, drainage pipes, etc.

   f. Aspects of traffic operation, in particular if road users adapt their speed sufficiently to local conditions.

4. For each item included in an inspection, a standardised assessment should be made by applying the following categories:

   a.) The item represents a traffic hazard that should be treated immediately. A specific treatment should then be proposed.

   b.) The item is not in a perfectly good condition, but no short term action is needed to correct it. Further observation is recommended.

   c.) The item is in good condition

5. Inspections should report their findings and propose safety measures by means of standardised reports.

6. Inspectors should be formally qualified for their job. They should meet regularly to exchange experiences and to ensure a uniform application of safety standards in inspections.

7. There should be a follow-up of inspections after some time to check if the proposed measures have been implemented or not.

As far as the selection of roads for inspection is concerned, arguments can be given in favour of both the approaches that are currently used: (1) Inspecting roads known to have a safety problem only, or (2) Inspecting all roads. Both these approaches make sense, and the choice between them will often depend on whether highway agencies have sufficient resources to inspect and treat all roads or not.

During an initial stage, it may be appropriate to select roads with a bad safety re-cord for inspection. However, as more experience is gained, road safety inspections may increasingly be used as a preventive tool and extend to roads that do not have a bad safety record. Today, road safety inspections are primarily used as a preventive tool in some countries, notably Germany, but still mainly as a corrective tool in other countries, notably Norway.

REFERENCES

1. Amundsen, F. H. and T. Lie (1984). Utforkjøringer kan begrenses. Temahefte 15 i temaserien Trafikk. Transportøkonomisk institutt, Oslo.
2. Bundesministerium für Verkehr, Innovation und Technologie (BMVIT), Abteilung II/ST1 – Planung und Umwelt. Statistik Straße & Verkehr, Jänner 2007. Wien
3. Eick, H. and G. Vikane (1992). Verknaden av URF-tiltak i Hordaland. Rapport. Statens vegvesen Hordaland, Trafikkseksjonen, juli 1992. Bergen.
4. Elvik, R. (2001). Nyttekostnadsanalyse av ny rekkverksnormal. Rapport 547. Transportøkonomisk institutt, Oslo
5. Elvik, R., P. Christensen and A. Amundsen (2004). Speed and road accidents. Report 740. Institute of Transport Economics, Oslo.
6. Elvik, R. and R. Muskaug (1994). Konsekvensanalyser og trafikksikkerhet. Metode for beregning av konsekvenser for trafikk¬sikkerheten av tiltak på vegnettet. TØI-rapport 281. Transportøkonomisk institutt, Oslo.
7. Eriksen, T. (1993). Analyse av Running-off-the-road i Akershus fylke 1987-92. Hoved¬oppgave i samferdselsteknikk. Norges Tekniske Høgskole, Institutt for Samferdselsteknikk, Trondheim.
8. Erke, A. (2006). Revisjon av Trafikksikkerhetshåndboken: 1.9 Toplankryss og 3.13 Vegoppmerking. Arbeidsdokument SM/1812/2006. Transportøkonomisk institutt, Oslo.
9. Elvik, R. and Vaa, T. (2004). The Handbook of Road Safety Measures. Elsevier Science, Oxford.
10. Ford, S.H. and E.C. Calvert (2003). Evaluation of a low-cost program of road system traffic safety reviews for country highways. Transportation Research Record, 1819, 231-236, 2003.
11. European Commission (2001). European transport policy for 2010: time to decide, White paper of 12th September 2001, COM (2001) 370
12. European Commission (2003). European Road Safety Action Plan – Halving the number of road accident victims in the European Union by 2010: A shared responsibility, COM (2003) 311
13. Gattis, J. L., M. S. Alguire and S. R. K. Narla (1996). Guardrail end-types, vehicle weights, and accident severities. Journal of Transportation Engineering, 122, 210-214.
14. Haldorsen, I. and H. Hvoslef (2003). Trafikksikkerhetsrevisjon av eksisterende veg. Oppsummering av resultater og erfaringer fra gjennomførte revisjoner. Rapport TS 08/2003. Statens vegvesen, Vegdirektoratet, Veg- og trafikkavdelingen, TS-seksjonen, Oslo.
15. Kuratorium für Verkehrssicherheit (KfV). Verkehrsunfallstatistik 2003, In: Verkehr in Österreich, Heft 36. Wien, 2003
16. Kurucz, C. N. (1984). An analysis of the injury reduction capabilities of break-away light standards and various guardrails. Accident Analysis and Prevention, 16, 105-114.
17. Lyles, R.W. et al. (1986). Efficacy of Jurisdiction-Wide Traffic Control Device Upgrading. Transportation Research Record, 1068, 34-41
18. Matthews, L. R. and J. W. Barnes (1988). Relation between road environment and curve accidents. Proceedings of 14th ARRB Conference, Part 4, 105-120. Aus-tralian Road Research Board, Vermont South, Victoria, Australia.
19. Nadler, H. and S. Lutschounig (2006). Comparison of the common understanding approach with current practice of RSI in European countries to detect main differences and similarities. Report of WP 5 of RIPCORD-ISEREST.
20. Ricker, E. R. et al. (1977). Evaluation of Highway Safety Program Standards within the Purview of the Federal Highway Administration - Final Report. Re-port DOT-FH-11-9129. US Department of Transportation, Federal Highway Administration, Washington.
21. Road and Transportation Research Association (FGSV), Working Group Traffic Engineering and Safety, Guidelines for Road Safety Inspections, Draft version. 2006
22. Sakshaug, K. (1998). Effekt av overhøyde i kurver. Beskrivelse av datamaterialet. Internt notat av 2.11.1998. SINTEF Bygg og miljøteknikk, Samferdsel, Trondheim.
23. Statens vegvesen (Norwegian Road Administration), 2005. Road Safety Audit and Inspection. The handbook is found at: www.vegvesen.no
24. Stigre, S. A. (1993). Tiltak mot utforkjøringsulykker i Vestfold. Effektundersøkelse. Opp¬dragsrapport til Statens vegvesen Vestfold. Svein A. Stigre, Rykkinn.
25. Vaa, T. (1991). Effekt av siktforbedrende tiltak på strekninger. Rapport STF63 A91014. SINTEF Samferdselsteknikk, (utgitt av Vegdirektoratet, Driftsavdelingen). Trondheim
26. Walker, A. E. (1974). Field experience of breakaway lighting columns. TRRL Laboratory Report 660. Transport and Road Research Laboratory, Crowthorne, Berkshire.
27. Zegeer, C.V. et al (1988). Accident Effects of Sideslope and Other Roadside Features on Two-Lane Roads. Transportation Research Record, 1195, 33-47.