Bonjour,

Voici quelques mesures qui pourraient utilement être étudiées pour renforcer la sécurité routière en Europe, à condition qu'elles soient applicables dans tous les États membres :

- interdire l'importation et la commercialisation des "mini-motos",

- apposition d'une plaque d'immatriculation à l'avant des motocyclettes,

- instaurer un taux réduit de TVA pour les équipements de sécurité obligatoires pour les usagers d'engins à deux roues à moteur (en France cela ne concerne actuellement que le casque),

- rendre obligatoire l'ABS sur tous les engins à deux roues à moteur,

- rendre obligatoire le contrôle technique périodique des engins à deux roues à moteur,

- assurer une véritable lutte contre le débridage des engins à moteurs soumis à des limitation de vitesse, de puissance ou de cylindrée,

- afin de lutter contre la perte de vigilance, rendre obligatoire l'effet sonore du marquage au sol des lignes de rive et axiales (lors de la construction de routes neuves et de la réfection des marquages), voir l'étude suédoise en pièce jointe,

- interdire la commercialisation (sous toutes les formes) et la détention d'appareils, dispositifs ou produits de nature à déceler ou perturber le fonctionnement d'appareils, instruments ou systèmes servant à la constatation des infractions routières (c'est fait en France mais pas dans tous les pays),

- instaurer la réciprocité des mesures de suspension de permis de conduire,

- instaurer la réciprocité de l'homologation des appareils servant à constater les infractions routières (éthylomètres, cinémomètres, pesons mobiles, etc), si un appareil est homologué dans un pays, il doit pouvoir l'être dans un autre sans formalités supplémentaires dès lors que les normes de l'organisation mondiale de la métrologie sont respectées,

- promouvoir l'auto contrôle de l'alcoolémie (donner un éthylotest électronique pour l'achat d'un véhicule neuf par exemple) puis rendre obligatoire l'installation d'éthylotests anti démarrage,

- harmoniser les limitations de vitesse,

- rendre obligatoire la présence d'un témoin de surcharge sur tous les véhicules affectés au transport des marchandises, les transports en commun de personnes et les camping-cars,

- rendre obligatoire, sur le tableau de bord, d'un témoin de baisse de la pression de l'air dans les pneumatiques.

Je serai présent à Bruxelles le 2 décembre prochain.

Cordialement

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Michel BARTHELEMY
Commissaire de police, chef de la division de la sécurité routière Direction Générale de la Police Nationale / direction centrale de la sécurité publique
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Low-cost safety measures on existing normal 2-lane roads

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Low-cost safety measures on existing normal 2-lane roads

1. Objectives

The objectives of this paper are to present the SRA development program to upgrade traffic safety on existing normal two-lane (i.e. 6 to 10 m paved width) roads using low cost measures and to summarize important results and findings from planned and opened projects as yet. This programme is a follow-up after the successful 2+1-cable barrier implementation (ref. 1 and 2).

The accident situation on normal 2-lane roads is similar to the situation on wide 2-lane roads prior with almost 100 yearly fatalities with some 40 % head-on and 30 % single run-off link-based, see Table 1, on some 10 000 km. The event process tends to be the same in these two Swedish accident types. Minor traffic flows explains the difference in distribution. The driver loses control for some reason and crashes against some obstacle in the roadside area (single run-off) or in the shape of an opposing unlucky driver (head on). No other vehicle is involved in the pre-crash process.

Table 1. Mileage, AADTs and fatality data for 2-lane roads 1998-2000

Road Type	Paved width M	Length Km	AADT Axle pair	Fatalities/year 1998-2000 Total	 Wildlife	 Intersection	Percentages head on	 run off	 access	 vulnerable
normal	6.6-7.9	3840	1851	28	1	1	34	22	5	21
	8.0-10.0	6170	3036	60	2	8	44	30	16	15
	Total	10010	2581	88	3	9	41	27	12	17
Wide	>11.5	245	6908	83	4	10	55	17	12	10

The 2+1 cable barrier process has been repeated with the following steps:

- Review of international and national measures, literature review and internal brain-storming in a pre-study presenting alternative measures in a report (ref. 3).
- DG-decision in March 2005 (ref. 4) on a full-scale development program focusing on
  - Centre line rumble strips (CLRS) expected to cut fatalities by 10 to 20 % with investment costs below € 5 per meter

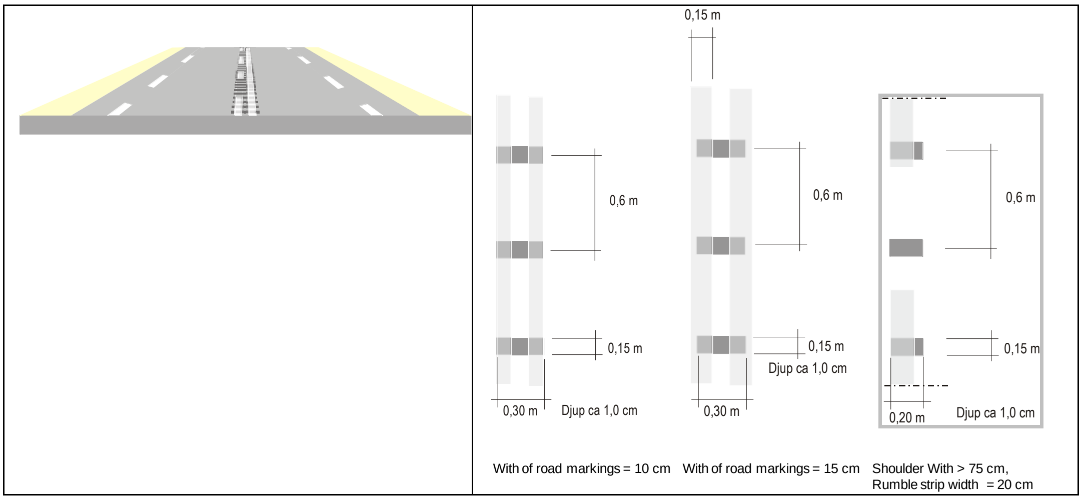

Figure 1. Design of centre line rumble strip.

- Median with rumble strips and overtaking lanes with reasonable intervals expected to cut fatalities by 30 - 50 % to be used at widths around 8 m

- Median with barrier and overtaking lanes with reasonable intervals expected to cut fatalities by 60 - 70 % to be used at widths from 9 m

Later on, at the start of the on-going process to decide on a new long-term investment plan and the overview of existing speed limits, the SRA DG has decided (Ref 5) on a strategy with:

- Centre line rumble strips to be a standard design for two-lane roads over 7 m with posted speed limit 80 km/h

- Median with rumble strips and overtaking lanes to be a standard design for traffic flows over AADT 2000 and posted speed limit 90 km/h

- Medians with barrier and overtaking lanes to be a standard design for traffic flows over AADT 4000 and speed limit 90 km/h and higher

In 2008, a number of test sections with centre traffic lane rumble strip have been implemented on added on roads narrower than 7 m.

2. Follow-up program

A comprehensive follow-up program is carried out to enable thorough control and corrective decisions in response to unexpected results. The program contains:

- Speed and traffic flow measurements
- Accident follow ups

- Lateral vehicle location to estimate wear and maintenance costs
- Investment costs
- Maintenance costs and experience
- Interviews and focus groups with car and truck drivers
- Interviews with emergency authorities
- Continuously up-dated design and maintenance guidelines

3. Centre line rumble strip (CLRS) – experiences as yet

The basic concept is to alert drowsy drivers to avoid serious head-on and single run-off accidents. This measure has been used extensively in US and Canada with impressing results (ref. 6-10). European use is more limited as yet.

The Swedish concept is to introduce continuous rumble strips at broken as well as solid centre lines on roads in the paved width interval 7.5 m and up to 12 m. The minimum width should secure a reasonable manoeuvre margin for heavy vehicles within the traffic lane, see figure 2.

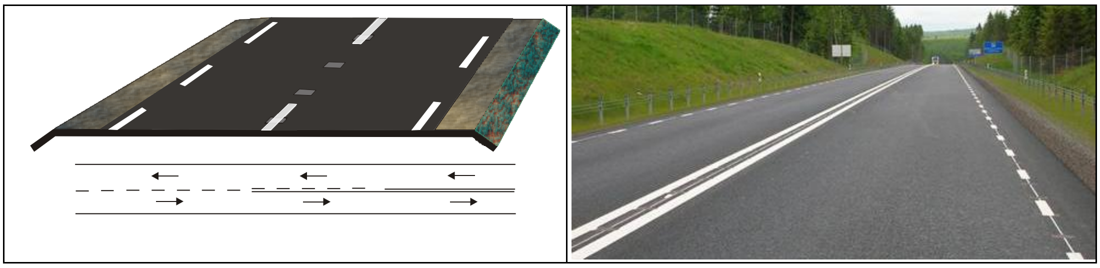

Figure 2. Centre line rumble strip design.

A total mileage of some 3 400 km covering a total traffic load of approximately 10 300 Million vehicle km with CLRS has been implemented so far (from 2005 until 2008). Another 1 000 km is expected during 2009.

Traffic noise

Possible noise disturbance problems – especially single max level values - were recognised in the pre-study as a disadvantage and potential problem. The Swedish environmental regulations require 30 dBA (24 hours average value) and 45 dBA (5 times for single maximal noise pushes) indoor as threshold values for new con-structions. Noise specialists claim rumble strip noise to be more disturbing than average traffic noise and to be created by the road owner. No legal decisions are taken as yet but SRA has decided to use 25 and 40 for rumble strips.

A minimum distance of 150 m between the road and adjacent inhabited houses has been used to deal with noise problems, see figure 3.

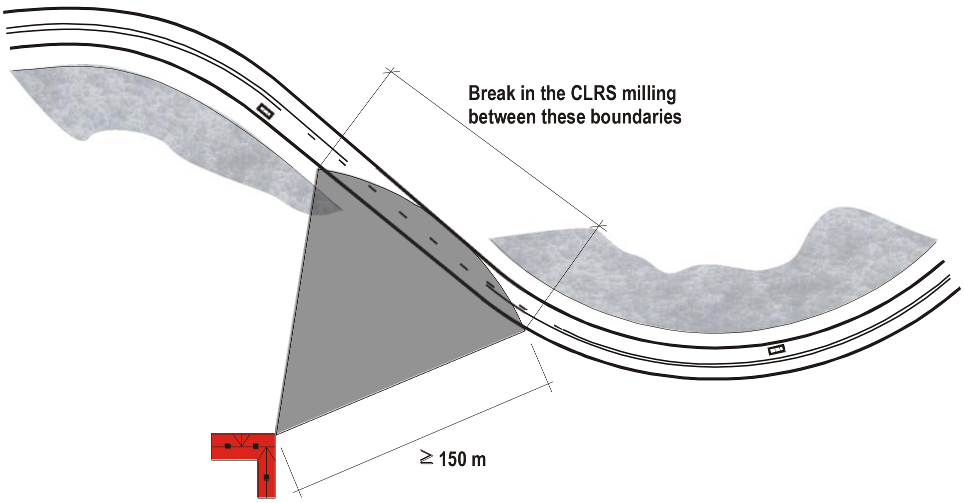

Figure 3. Minimum distance due to noise disturbance problems

This decision is based on a report from Finland (ref. 11) and project noise evaluations (ref. 12). The additional source noise energy due to a CRLS Pennsylvania design for a single passenger car at 80 kph is some 15-20 dBA; see blue line for Pennsylvania and red without in figure 4 for a normal cross-section fill of 1 m. Additional reduction after 75 m is very minor. The Swedish rumble strip design is smoother, some 3-4 dBA in noise energy, compared with the Pennsylvania one. Data suggest variations due to tyre and surface design to be of more importance than vehicle type. All together the 150 m distance has been used.

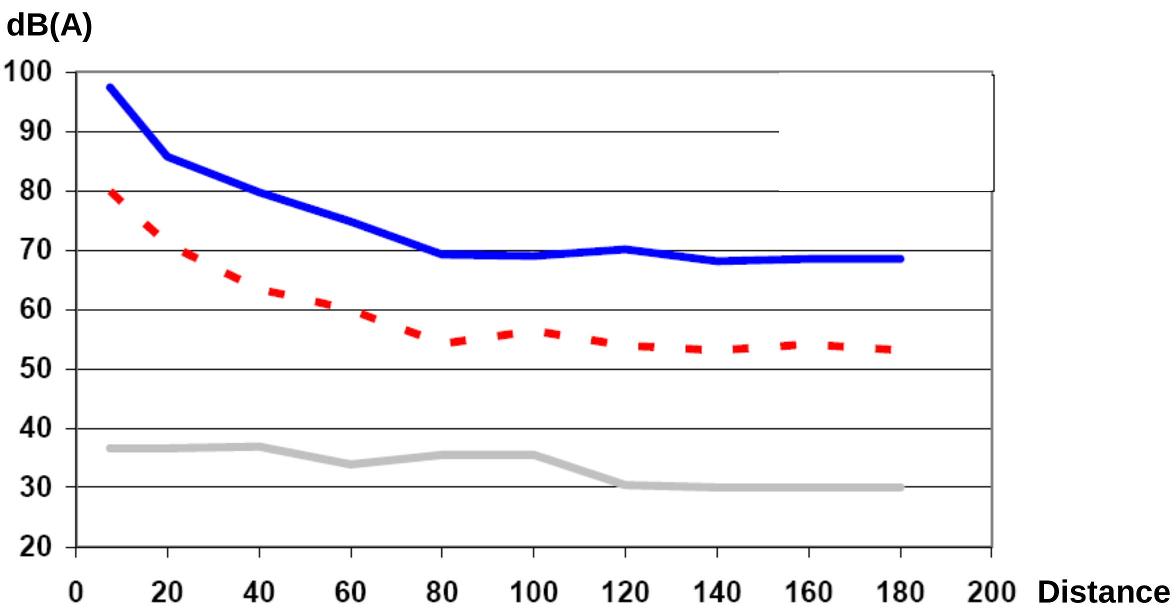

Figure 4. Noise “reduction” as function of distance from source.

So far noise is still a problem with complaints in some parts of Sweden. No legal decisions have been taken on the particular complaints.

Rumble strip design

Milling effects due to overlay design were subjectively evaluated in the pre-study. ABS (overlays with a large portion of gravel) as well as thin layers were judged sensitive and excluded very sensitive due to particle size and layer depth. A few ABS overlays (mainly old ones) have been milled with poor results causing pot-hole and fissures.

Speeds

Speeds are evaluated at 19 sections. The average decrease is 1.6 kph for CLRS on existing overlays and 0 combined with a new overlay and road markings see figure 5.

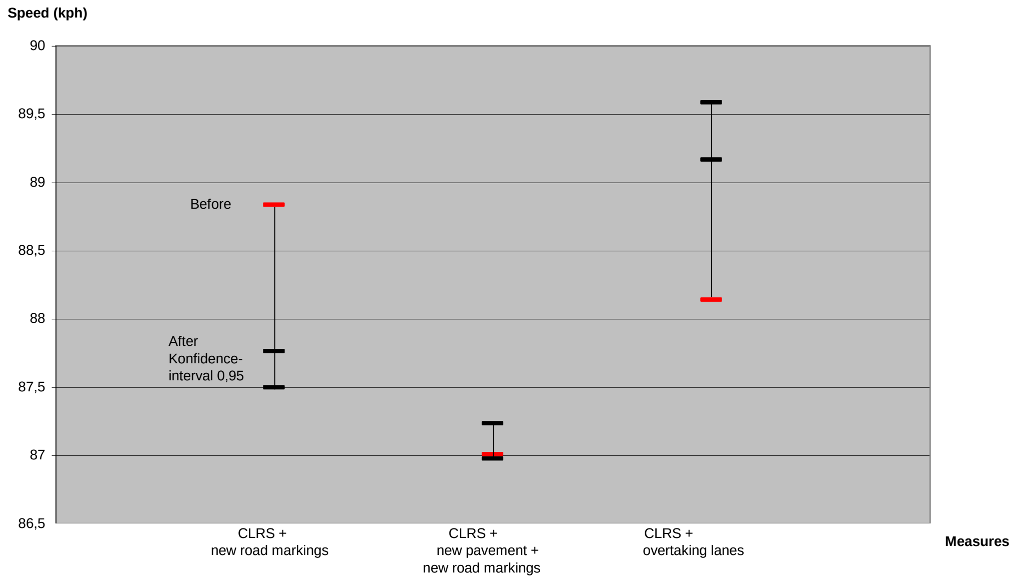

Figure 5. Speed reduction for different CLRS configurations.

The very rough SRA speed index, see Figure 6, (ref. 13) proposes a reduction of some 0.5 %, e.g. 0.4 kph, between 2006 and 2007. The power-law effect of this speed reduction should be some 5 % in fatalities. The basic hypothesis, though, proposes the alert effect to be the essential one.

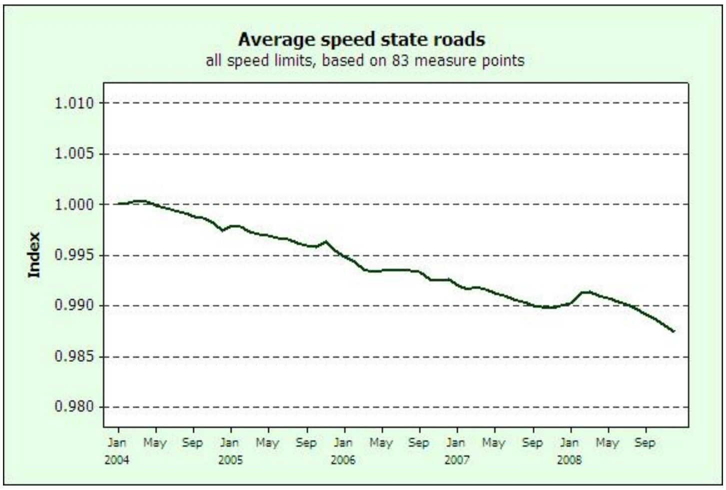

Figure 6. SRA monthly speed index.

Traffic safety

Traffic safety effects are analysed using speed data combined with the speed-power law claiming a 4.5 power relation between relative speed change and fatality change, see above, and accident data, see table 2 below.

Table 2. Traffic accident data due to speed limit and paved width

Speed paved width Kph/m	Number of sections	FSI- rate Before 2000-05	FSI- rate After 2006-07	TL Before 2000-05	TL After 2006-07	FSI Before	FSI After 2006-07	FSI SRA Pred. model	Rel. change %
70	6	0.0064	0.116	157	8.6	1	1	0.05	
110	14	0.056	0.0000	728	86	41	0	4.9	
90 < 8.0	24	0.031	0.028	1075	106	33	3	3.2	-8
90 8.0-10.1	91	0.035	0.020	4422	799	154	16	27.8	-43
90 >10.1	7	0.036	0.142	718	42	26	6	1.5	292
Other	21	0.047	0.068	1299	263	61	18	12.4	46
Total	163	0.038	0.034	8399	1305	316	44	49.1	-10

FSI-rate = fatal and severe injuries per million axlepairkm TL= traffic load million axlepairkm

The total effect without trend and regression effects is some 10 % on fatal and sincere injuries close significant on a 10 % level based on before-after data as well as a comparison with the SRA accident prediction model (ref. 14). Sections are not selected based on accident black spot techniques and the total accident picture was worse for 2007 than 2006 in Sweden. Another 2 000 Million axlepair km will be included in the analysis in a near future for 2008.

Results, so far, support the initial hypothesis on 10 – 20 % effect on fatal and severe injuries. This would indicate some 15 % for fatalities only.

Investment and maintenance costs

Investment cost has varied between € 2-3 per meter at new overlays and € 4-5 per meter at existing overlays, more expensive due to extra costs for traffic control devices and changed road markings. Some tests are performed to press rumble strips in warm asphalt at repavement works. A problem encountered so far is to produce pressure enough to create the correct design.

Maintenance experience and any additional costs are not available and evaluated with only three years for the oldest CLRS.

A major concern is potential effects on lateral vehicle positions especially with the 2+1-cable barrier experience with 30-40 % higher track depth increase. Measures, see figure 7, above, suggests larger spread. This is a surprise and should, if correct, probably give less rutting in the long run. Average position closer to the outer edge might give long term bearing capacity problems.

Pedestrians and bicyclists

Pedestrians and bicyclists are expected to get slightly decreased level-of-service.

Measures on lateral position for vehicles indicate an average lateral position some 5 cm further to the right road with a larger spread, see figure 7 for CLRS on new overlays, existing overlays and rumbled medians (red lines before average)

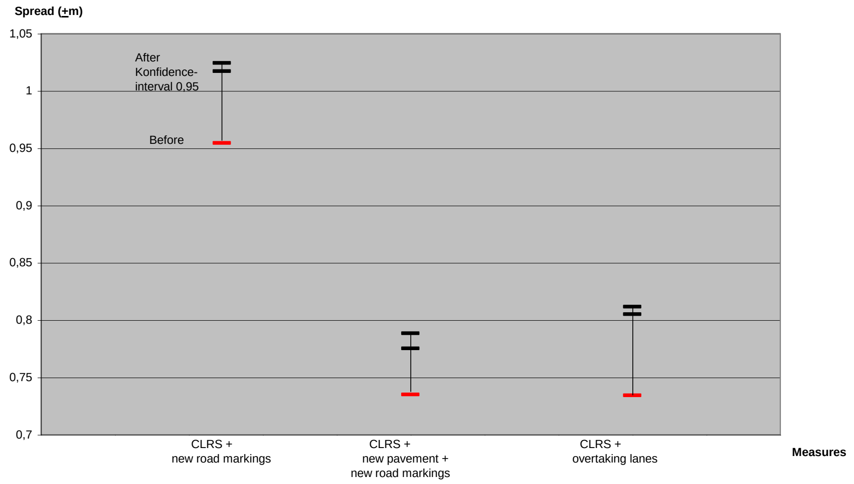

Figure 7. Change in distribution of lateral positions for vehicle in 19 measure sections.

Driver attitudes

Road user interviews and focus group interviews have been used to estimate attitudes. Results generally give good marks for the design and the information about the new road measures. The road user interview made by means of the traffic police is very positive, see figure 8.

Figure 8. Results from interviews with car drivers.

The focus group study used dialogues with two groups with 10 to 15 persons each. A prepared set of issues were to be discussed with possibilities for participators to raise new subjects. The groups selected were motorcyclists and car commuters.

Both where positive and had no major negative objections. Predefined questions at issue where:

- How does the CLRS feel?
- Viewpoints on the design and visual guidance of CLRS.
- Changed driver behavior as a result of CLRS.
- The view on the traffic safety potential for the CLRS.
- Pros and cons with CLRS
- The acceptance within road user group.

The result was as follow:

- Good acceptance for both motorcyclists and commuters, the participants could not see any negative effects.
- No obvious opinion on design and visual guidance.
- Fundamental speed impact
- Car commuters claim to be more impacted than motorcyclists
- Car commuters claim t driver behavior because of the CLRS
- Changed driver behavior can be related to increased traffic safety.

4. Medians with centre line rumble strip (CLRS) and overtaking lanes– experiences as yet

The basic concept is to convert a normal 2-lane road to a 2+1 road concept with a low cost strategy with a median consisting of two solid road marking lines and rumble strips.

Swedish (ref. 2) and international experience, especially from Germany (ref. 15), report on very positive results. SRA has used this design at 13 m wide roads with a 40 % decrease in fatal and severe injuries. German results based on roads with 11 m paved widths are in the same range. The new, extended concept is to create similar positive effects on existing roads with paved widths down to 8 m. 3.25 m wide and some 800 m long overtaking lanes are added with frequency due to traffic and costs up to 6 to 8 km, see figure 9.

Figure 9. Example of centre line rumble strips design with overtaking lanes.

Only 60 km covering a traffic load of approximately 230 Million vehicle km has been introduced so far. Problems in the legal design process for individual projects and to some extent budget constraints have limited the programme.

So far, this road type has worked very well, except for problems during the first winter. The winter maintenance routine with only one snow ploughing set was not changed producing an overtaking lane not usable in snowy conditions. This problem is solved with tandem snow ploughing equipment, a major cost, and some extra lane configuration information signs installed.

Production cost is app. € 120 per meter excluding new overlay and improved road side area designs. The project was adapted to the overlay maintenance program.

Figure 5 above; indicate 1+1- section speeds to increase with approximately 1 to 1.5 kph. No measures have been carried out at 2+1- sections.

One objection against the design was an uncertainty on drivers' willingness to obey the overtaking prohibition at 1+1-lane sections. A one week survey took place in November during the first year of operation using ocular and video supervision. Results don't support obedience to be any problem.

A still, unsolved legal problem in Sweden is the use of continuous solid centre lines. The Swedish traffic code states centre solid lines only to be implemented by road authority decisions due to geometric sight hindrances such as curves or crests. In other cases, a formal legal decision is needed also with possibility to appeal. The main reason for this legal system is the heavy punishments with possible loss of driver's license and prison. This problem is still unsolved.

Planned project within the next five years with median guard rail and overtaking lanes can be seen in table 3. Total length is approximately 75 km with a traffic load of 100 million vehicle kilometer.

Table 3. Projects planned during the next 5 years.

ROAD NR.	START-END	AADT	LENGTH (KM)	CONSTRUCTION START	YEAR TO BE OPENED
41	Kinnarumma-Borås	6500	26	2009	2009
19	Tomelilla-Brösarp	3500	23	2009	2010
E10	Mojärv-Västra Svartbyn	2000	22	2009	2010
210	Björstad-Söderköping	2500	4	2009/10	2010

5. Median guard rail and overtaking lanes– experiences as yet

The basic concept is to blueprint the 2+1-cable barrier concept on existing normal 2-lane roads with paved widths of 9 m, see figure 8. Up to now, over 2 000 km are opened, based on mainly 13 m paved width roads. Results are exceptional (ref. 1 and 2) with:

- a 60 % percent decrease in accident costs and a 75 % decrease in fatalities
- a 20 % percent capacity loss but improved level-of-service in normal traffic conditions
- and the major negative effect, problems with overlay tear and wear to overcome with improved pavement technology

3.25 m wide and some 800 m long overtaking are implemented with a frequency up to 4 to 6 km due to traffic and costs. The driver will experience a 2+1-road with alternating one and two-lane sections without and with overtaking opportunity with some minor differences:

- one lane sections will be slightly narrower, 4.5 m compared with 5.1 m
- overtaking opportunities will be slightly more frequent from on average every 2 to 3 km to every 4 to 6 km

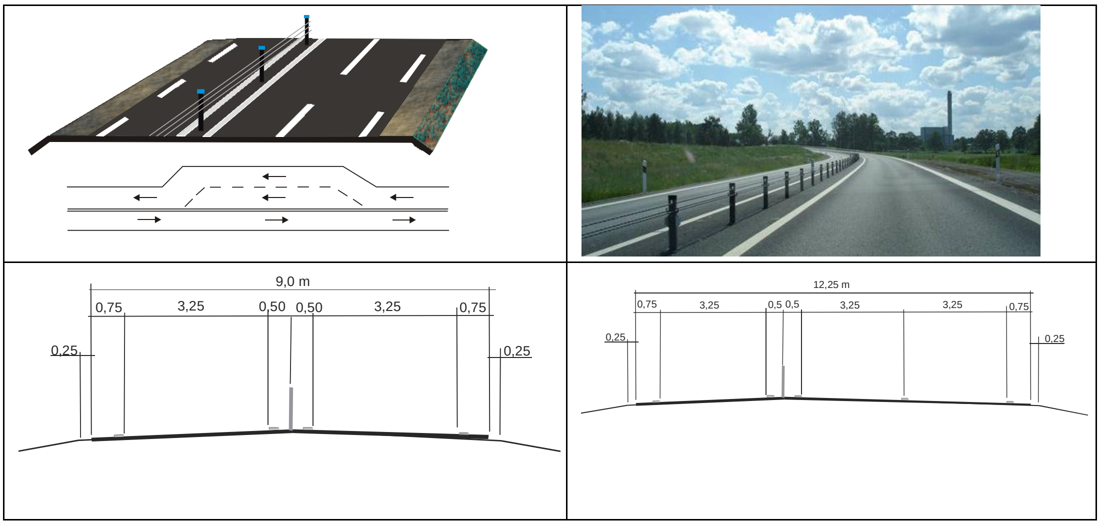

Figure 8. Median with barrier and overtaking lanes design

The major challenge will be to operate and maintain this road type with longer, narrow 1+1-sections.

The first projects are still in the construction phase. Experiences as yet are based on the preliminary, final design and construction phase. The situation is similar to the preliminary phase of the 2+1-project with numerous discussions with land owners on local access and rescue departments with fire fighting and ambulance with separate administrations worrying about accesses and rescue service.

The first project to be opened for traffic in December 2009 will be National 26 Växjö - Braås; see figure 9, an old 9 m road with many accesses and AADT varying from 6 to 12 000.

Figure 9 . National road 26 before barrier and overtaking lane implementation

Planned project within the next five years with median guard rail and overtaking lanes can be seen in table 4. Total length is approximately 370 km with a traffic load of 680 million axlepair kilometer.

Table 4. Projects planned during the next five years.

ROAD NR.	START-END	AADT	LENGTH (KM)	CONSTRUCTION START	YEAR TO BE OPENED
E45	Ånimskog-Åmål	6500	21	2010	2012
44	Hålle Täng-Lidköping	4500	23	2009	2010
41	Västra Derome-Berghem	6000	20	?	?
27	Kilakorset-F länsgräns	5000	34	2010	2012
47	Vara-Grästorp	3500	20	2010	2012
156	Ryamotet-Skene	6500	29	2010	2012
63	Karlstad-Filipstad	4500	43	2010	2012
19	Brösarp-Degerberga	4050	15	2009	2010
70	Broddbo-Brovallen	6400	16	2009	2010
71	Dala Järna-Vansbro	3000	7	2012	2014
56	Ändebol-Strångsjö	5500	6	?	?
56	Kvicksund-Västjädra	8000	10	2010	2011
56	Katrineholm-Bie	4700	10	?	?
25	Eriksmåla-Boda	2500	16	200812	2010
34	St. Åby-Glahytt	2500	17	200812	2011
23	Sandsbro-Drättinge	6700	20	200904	2009
26/195	Hedentorp-Bankeryd N	10700	12	200910	2010
34	Kisa-Rimforsa	4100	17	200909	2010
34	Skeda Udde-Kåparp	7500	11	200906	2010
195	Bankeryd N-Habo	8700	4	2010	2011
34	Brokind-Skeda Udde	5200	12	2010	2011
71	Dala Järna-Vansbro	3000	7	2012	2014

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