Road Directorate

Nordisk samarbejde 2010

Kenneth Kjemtrup, Vejdirektoratet

Nordiske samarbejdsgrupper

- Nortek vägmarkering
- Nortek vägmärken
- NMF (Nordisk möte for forbedret vägudstyr) Forskning
- Nortek vägarbejde
- NEXT (Signalanlæg)
- Nordisk sideområde (master og autoværn)
- Nordisk vejgeometri Forskning

NMF projekter

- Mobil måling af vägmarkeringers funktion. Test af måleudstyr.
- Vejmarkeringers trafiksikkerhedsmæssige værdi.
- Forståelse og respekt for kørebaneafmærkning.

  * Varningslinjer.

  * Spärrlinjer.

Delta

Monitoring on the move

Having pioneered a handheld system to monitor the health and performance of road markings three decades ago, this latest-generation system moves the concept to a whole new level

Words | **Hans Ole Nielsen, DELTA, Denmark**

To deliver an efficient and safe road network, public road authorities must have a continued focus on maintenance. Yet this is challenging task. The issue of maintenance has gained even more attention with the increasing number of private companies being enlisted to conduct such ongoing duties. Managing maintenance operations requires effective planning and optimisation, which is equally important for the company conducting the maintenance as it is for the authority. An efficient system to monitor road system conditions can pay huge dividends.

Road markings and raised pavement markers (RPMs) are vital tools in securing efficient and safe traffic flow and ensuring high visibility of both is an important task for those involved in road maintenance. Visibility in this sense is characterised by the optical retroreflective properties of the markings and RPMs.

Such measurements have until now mostly been recorded with handheld instruments, such as DELTA's LTL-X. Despite the accuracy and ease of use of such instruments for conducting a limited number of measurements, they are not the best option for monitoring longer distances such as motorways. Retroreflection measurements can vary quite widely, even on short distances, and at bends in the road, where visibility is probably most important.

Furthermore, roads sometimes have to be partly closed off for such measurements to be taken, to ensure the safety of those people actually obtaining the measurements. But with increasing traffic, there has been a growing demand for mobile measurement systems that can monitor retroreflective properties at normal highway speeds.

Easily mounted on vehicles, the LTL-M monitors several parameters simultaneously

Existing technology

Existing mobile retrometers on the market have limitations in terms of accuracy. In several tests performed by road research laboratories, for instance, comparisons between handheld retrometers and mobile retrometers have shown variations frequently up to as much as 50%.

The limited accuracy of existing mobile retrometers is caused mainly by factors such as vehicle movement and changes in wind pressure and car load (both of which affect fuel consumption) relative to the road surface. This movement changes the geometry of the measurements and causes inaccurate readings. To increase the accuracy, frequent adjustments and checking of the systems are necessary, which limits the amount of miles measured per day and requires skilled personnel.

For this reason, until now, mobile retrometers have been used only for screening purposes. Handheld instruments are still required for precise measurements if low values are screened, and for maintenance planning purposes, as well as for potential contractual disputes.

Cost of operation has also been another limiting factor preventing the more widespread use of mobile systems. Most of those currently available require the use of special vehicles, modified for the purpose.

The use of mobile monitoring will increase only if problems such as these are addressed. A new generation of mobile retroreflectometer should obtain measurements as precisely as a handheld solution yet also be as simple to operate. It should be easy to integrate on existing road monitoring vehicles, able to monitor several types of parameters simultaneously, and be possible to mount easily on standard vehicles without any modifications.

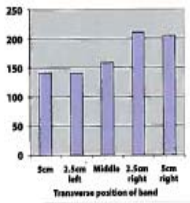
New generation

Thirty years ago, DELTA pioneered the concept of collimated optics technology in handheld retroreflectometers and is now introducing LTL-M, a new generation of mobile retroreflectometers.

In addition to being as accurate as handheld retrometers, the LTL-M is easy to install and operate, as well as boasting additional features for measuring RPMs. Based on a high-speed pulsating light source, fast digital camera technology and digital image processing, this patent-pending technology has demonstrated accuracy comparable to that of handheld instruments (2.5% deviation), subsequently confirmed by several laboratory and field tests performed by the Swedish Road Research Institute, the VTI, which analysed the LTL-M alongside an existing mobile retroreflectometer, using a handheld instrument as a reference.

LTL-M measures the detailed cross-sectional retroreflection of the markings.

RL value of a 5cm band along a 30cm marking



Many markings have strong transversal variation, as a reading taken by a handheld instrument with a 4-5cm wide measurement field in the centre does not necessarily represent true visibility. This is illustrated in the graph above, which shows variations of up to 25%. The LTL-M provides a detailed analysis of this variation, which can be correlated both to the true visibility as the driver sees the marking, or to a middle section for correlation with a handheld unit.

However, there are more benefits to using the LTL-M. It can measure white and yellow markings without recalibration, and markings with a profile depth up to 10mm can be measured, as well as the daylight contrast between the road surface and the road marking. It additionally measures the geometry of the road marking, including width and gaps in broken lines and damaged lines. One or two lines, such as double centre lines, can also be measured simultaneously. A marking offset function enables the transverse offset on a restriped marking to be measured.

Users can also detect missing or non-working RPMs used separately or in combination with road markings. Easily calibrated in the field, using a calibration standard in line with international primary laboratories such as NIST and PTB, the system can also be integrated in existing road monitoring vehicles or in standard cars with minimal effort and modification, negating the need for special vehicles.

(Above) DELTA's LTL-M measurement system (Left) Variations of up to 25% are seen in measurements made by handheld systems

Future marking management

Measurement data from the LTL-M can be exported to a GIS system to map the markings and requisite RPM properties. Annual monitoring coupled with additional data such as traffic density and accident site evaluations, can be used for decision-making in maintenance planning to help optimise safety and efficiency. ■

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Zentner

Visible difference

The effect of road markings on safety should not be underestimated. Ensuring that drivers can clearly see the markings is key to their efficiency

Words | **Ingrid Bloss, Zehntner Testing Instruments, Switzerland**

To find one's way in traffic is easy – in daylight. Even on overcast days, sunlight is 10,000 times brighter than the brightest artificial lighting. Therefore drivers can easily see all objects relevant for navigating.

At night-time the situation is very different. The performance of our eyes decreases to 5% of daytime performance. In darkness, many objects used for navigation cannot be perceived. In darkness, good visibility of road markings is essential: these 'simple lines' indicate the course of the road.

If we cannot see the white lines well, we start to feel insecure and focus our whole attention on them, which is not a good recipe for safe, anticipatory driving.

Good visibility of road furniture – primarily road markings – is not a question of prestige or luxury; it is a crucial factor in ensuring traffic safety.

Decent road markings are designed to reflect the light of a vehicle's headlamps in the driver's direction – what's known as retroreflection. It can be achieved, for example, by embedding small glass beads in the marking material.

The ZDR records data on road markings

However, just like the road surface itself, the markings suffer considerable wear and tear through constant overrunning by vehicles. Gradually the glass beads become detached and the retroreflection (meaning the night-time visibility) will deteriorate more and more.

Because of this deterioration, it is recommended that the quality of road markings be checked at regular intervals.

How to check markings

The quality of markings can be assessed using a retroreflectometer, which is an optical measuring device that measures the night visibility of the road marking from the driver's perspective. The marking is illuminated with a light source similar to a vehicle's headlamps; an optical sensor stands in for the driver's eyes. A reproducible objective measuring value can be taken within seconds.

Minimum requirements for the performance of road markings are standardised in national and international standards and local regulations, making an objective assessment of the marking easy. With the help of the measuring value it can be decided whether the marking still meets the requirements and can be seen well by road users.

Even higher requirements apply for wet road surfaces: a regular marking is often not enough to guarantee good visibility in these situations. If a marking is to be

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Varslingslinjer,forståelsestest, Danmark

21. Du kommer kørende og ser ud af din forrude, at afmærkningen på vejmidten skifter Hvad betyder afmærkningen, du ser her i din køreretning?	Pers.	%
Den synliggør vejmidten og køresporene gennem svinget for mig	14	10
Der kommer overhaling forbudt for mig lidt længere fremme	88	66
Der er overhaling forbudt for mig	26	19
Jeg må gerne overhale og de modkørende skal vige for mig	1	1
Ved ikke	5	4
Besvarelser i alt	134	100

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Varslingslinjer,forståelsestest, Danmark

	Paneltest		Internettest	
34. Hvad betyder denne afmærkning på vejmidten?	**Pers.**	**%**	**Pers.**	**%**
Den synliggør vejmidten og køresporene for de to Kørеretninger	85	65	830	70
Der er dårlige oversigtsforhold på strækningen	26	20	280	24
Der er overhaling forbudt for mig	4	3	9	1
Jeg må gerne overhale og de modkørende skal vige for mig	10	8	45	4
Ved ikke	6	5	18	1
Besvarelser i alt	131	100	1182	100

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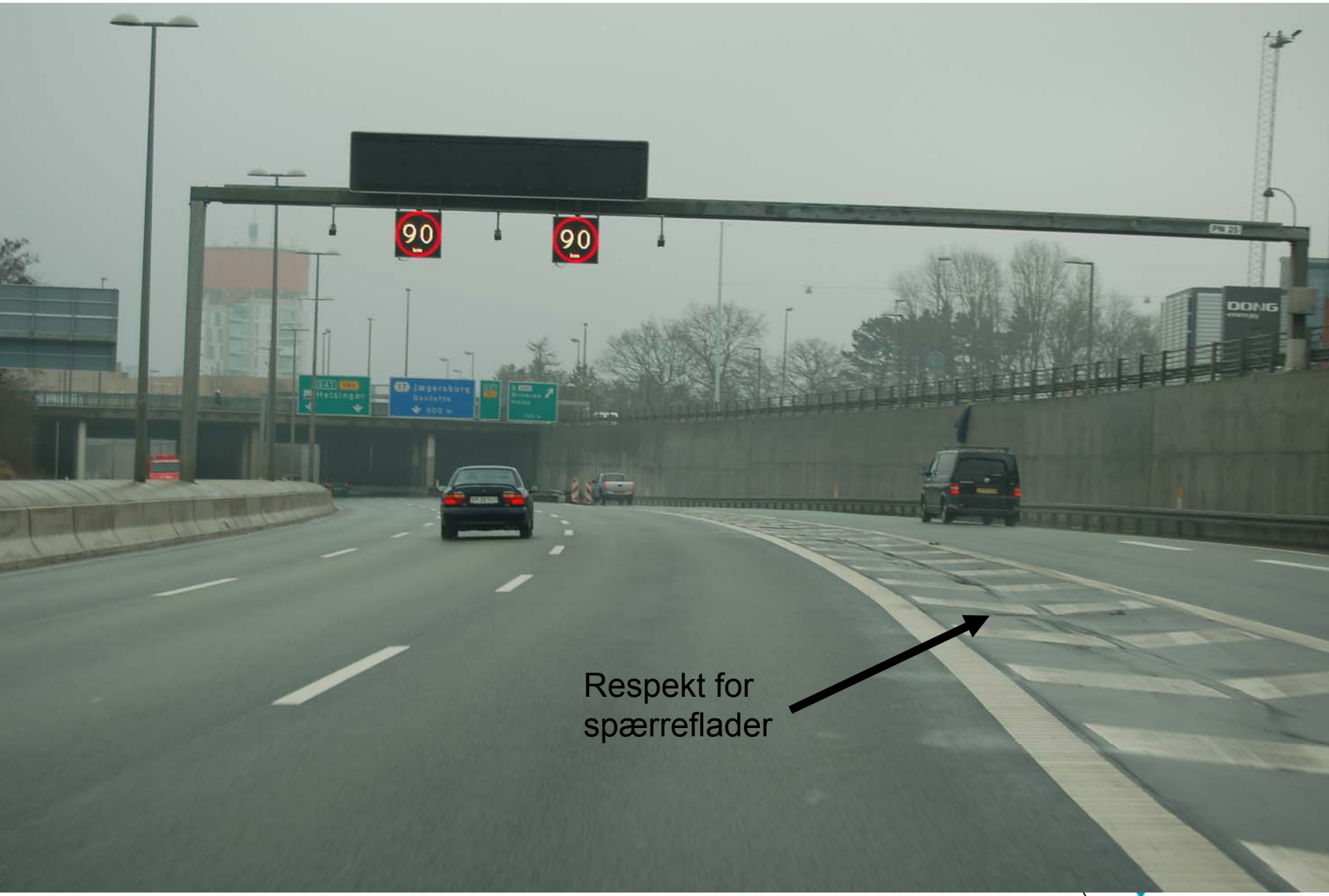
Profilerede linjer,forståelsestest Danmark

Må du køre i din bil hen over det afmærkede midterareal?	Antal svar	%
Ja	494	45
Nej	530	49
Ved ikke	66	6
Besvarelser i alt	1090	100

Profilerede linjer,forståelsestest Danmark

Må du køre i din bil hen over det afmærkede midterareal?	Antal svar	%
Ja	541	50
Nej	464	43
Ved ikke	77	7
Besvarelser i alt	1082	100


90
90
DONG
Respekt for
spærreflader

NMF projekter

- Kantstolpar som trafikleder
  * Afstand på strækning og i kurver
  * Udformning og refleksion

- Lysteknisk lærebog
- Variable tavlers læsbarhed

A VMS with 48 times 48 pixels
used for most of the tests

Each pixel has a white and a red LED

Legibility of LED-based VMS, NMF study

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Example, Minimum height of capitals

Table A.5: Minimum heights of capitals assuming a legibility index of 6 m/cm and a distance D2 where reading must be completed of 25 m.

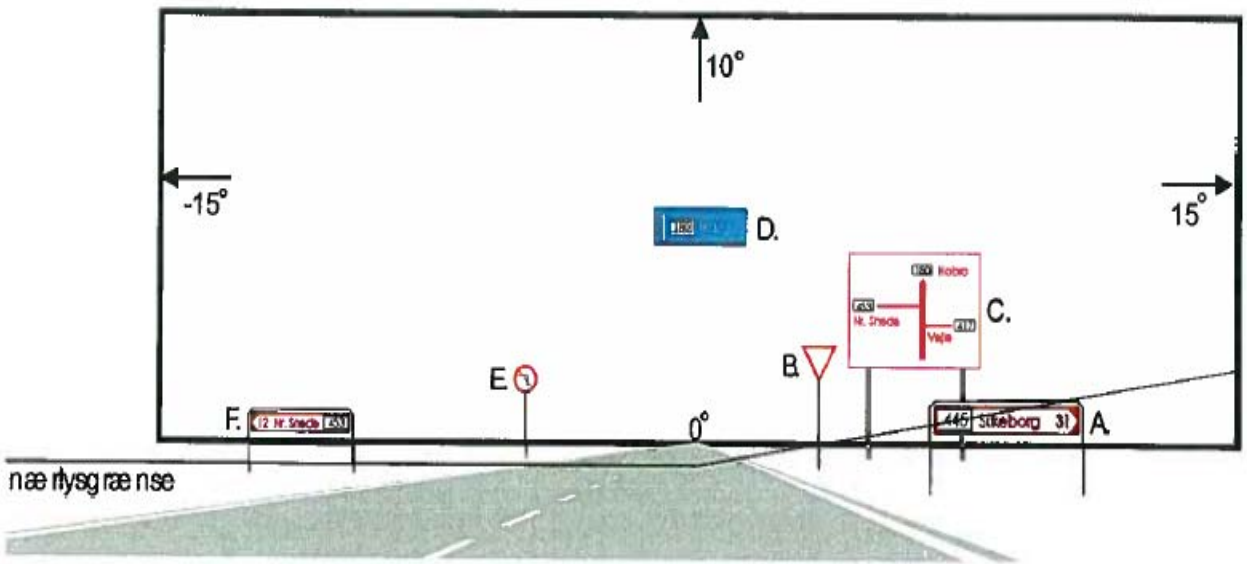
number of information units	Driving speed									
	40 km/h	50 km/h	60 km/h	70 km/h	80 km/h	90 km/h	100 km/h	110 km/h	120 km/h	130 km/h
1	85	96	106	117	128	139	150	160	171	182
2	91	103	116	128	140	153	165	177	190	202
3	97	111	125	139	153	167	181	194	208	222
4	103	119	134	150	165	181	196	211	227	242

NMF-projekter

- Vejtavlers funktion og læsbarhed

- * CEN TC226 WG3 Samarbejde om funktionskrav til sheets
- * Fælles nordisk grundlag for valg af folietype.

Tavlers opsætning i tværprofilet



Figur 9: Det vinkelrum, der er relevant for læsning af vejtavler, og typiske positioner af:

A. pilvejviser i højre side
B. færdselstavle i højre side
C. diagramorienteringstavle i højre side
D. portaltavle
E. færdselstavle i venstre side
F. pilvejviser i venstre side.

NMF projekter

- Afmærkning i tunnel
- Vejbelysningens energieffektivitet

Vejgeometrigruppen

- Udformning af vejens sideområde (slänt, grøft mv)
- Dimensionsgivende trafikant, NHFG

Dimensionerande trafikant - projektide

- **Projektsamarbejdet omhandler de enkelte trafikantgruppers krav til vejsystemets udformning og indredning – baseret på viden om trafikanters fysiske og mentale formåen /problemer i forskellige trafiksituationer**

Dimensionerande trafikant – start 2005

- **Nordisk vägregelgrupp fattade år 2005 ett beslut att sätta i gång projektet med tre huvudmål**

- **samla befintligt vetande om trafikanternas funktionskrav på vägsystemet - med särskild fokus på äldre bilister och äldre fotgängare (äldre, barn, fysisk handikappade)**

- **utveckla en förklaringsmodell för frafikantbeteende**

- **framföra kunskapsluckor och brister på vetandet – behov av FoU -projekt**

Dimensionerande trafikant

Del 2: Trafikanternes fysiske formåen

Samle eksisterende viden og udarbejde en kort anvendelsesorienteret sammenfatning om:

- Reaktionstid – bremsereaktionstid og beslutningstid
- Synsevne og alder:
  - Blænding (luminansgrænser)
  - Synsskarphed (fokuseringsforsinkelse)
  - Kontrastfølsomhed og Synsfelt
- Øjenhøjde
- Læseafstand og læsetid
- Ganghastighed

m.m.

Dimensionerande trafikant

Del 3: Trafikanternes mentale formåen

Forudsætninger/begrænsninger mht. at opfatte og bruge info for at træffe korrekte og hensigtsmæssige beslutninger

- **Vurdering af Fart og Afstand**
- **Opmærksomhed og Distraktion**
- **Informationsopfattelse**
  - **Blindhed under øjenbevægelse**
  - **Indsnævret opmærksomhed/ Useful field of view**
- **Informationsforståelse**
- **Informationsbearbejdning (max info/tid)**
- **Trængsels-bearbejdning**

Dimensionerande trafikant

Del 4: Forklaringsmodel for trafikantadfærd

- Formulere nogle grundlæggende tankegange og generelle principper om trafikanters adfærd – i et let forståeligt sprog

- En forståelsesramme (værktøj), der kan bruges til
  - at forstå trafikanternes problemer
  - at forklare de løsninger vi foreslår

Dimensionerande trafikant

Del 5: Informationstyper i forskellige trafikmiljøer

- For de enkelte trafikantgrupper opstilles forslag til, hvordan informationer og geometrisk udformning skal være for at opnå en god balance mellem trafikanternes formåen og de krav, der stilles til trafikanterne.

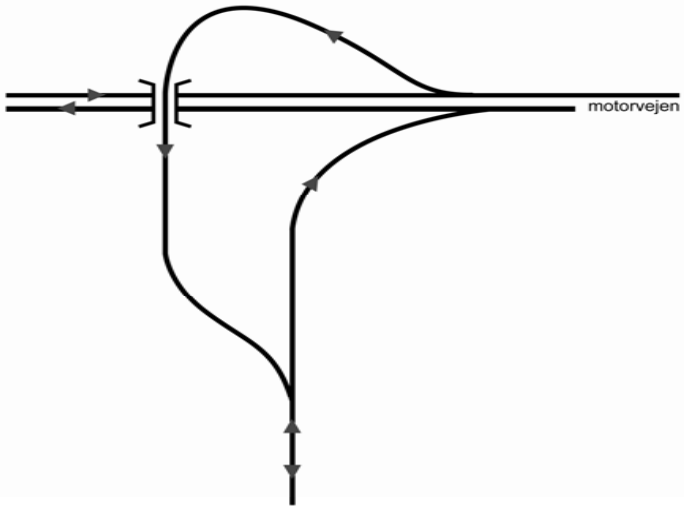
- Udvalgte trafikmiljøer:

  Rundkørsler, Signalkryds, Vigepligtskryds, Accelerationsbaner, Fletning, Stikryds m.m.

Road design principles

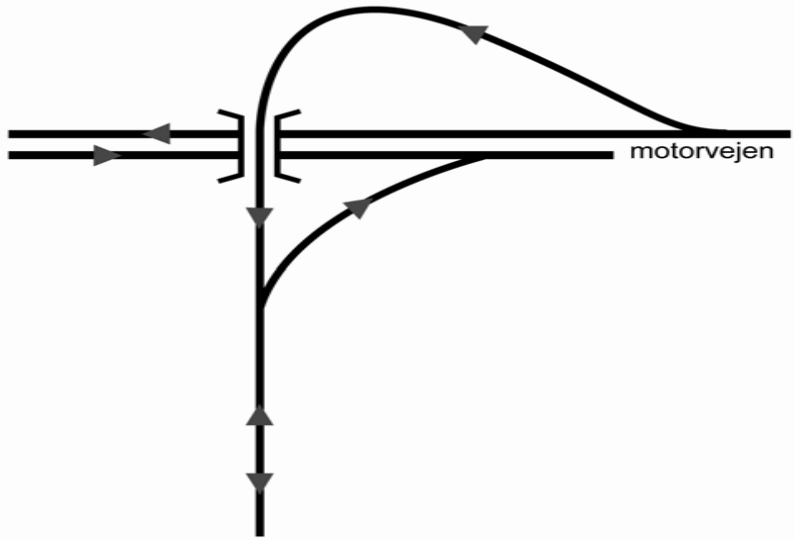
Halvt tilslutningsanlæg

"Rigtigt"



Halvt tilslutningsanlæg

"Forkert"



Tak for opmærksomheden!