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Harmonization with Variable Speed Limits on Motorways

Per Strömgren[1, 2] and Gunnar Lind[2]

[1]*Royal Institute of Technology (KTH), Division of Transport planning, Economics and Engineering, SE-100 44 Stockholm.*

[2]*Movea Trafikkonsult AB, SE-117 37 Stockholm, Sweden*

perstro@kth.se, per.stromgren@movea.se, gunnar.lind@movea.se

Abstract

This paper presents an investigation and a state-of-the-art description of traffic effects of harmonization with variable speed limits.

Expansion of the E4 south of Stockholm has been carried out during the years 2009-2013. The expansion includes a rearranged lane configuration within the existing road section (25 m) and traffic management systems. Previous design with two lanes and hard shoulder has been replaced with three lanes without shoulder. In addition, the road has been equipped with variable speed limits (with red ring); queue warning system with recommended speed (without red ring) and emergency refuge areas (ERAs).

The queue warning functionality was activated in 2011 and harmonization in 2013. Reduced speed variance is an important goal for the traffic management system and is considered to both reduce rear-end collisions and the risk of capacity breakdown.

German experience shows that harmonization affects capacity down to about 80 kph. English experience is that the harmonization and monitoring can reduce accidents by 40 % at normal speed of 70 mph (112 kph). Germany and England decrease the speed with approximately 20 kph at the degree of saturation of 0.7 to let the flow be harmonized before the traffic density has increased too much.

Two different models of harmonization have been developed and one of them implemented on the E4 south of Stockholm. The model in field-tests has been iteratively designed and ultimately set to 325 vehicles/5 min across all lanes, with speed limit is reduced to 80 kph, which has worked well.

Keywords: Harmonization, Variable Speed Limits, Motorway, Capacity

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1 Introduction

On the Södertälje motorway (E4 Södertälje-Stockholm), see Figure 1, harmonization has been tested, the speed limit is normally 100 kph, which means that one cannot expect the same great effects as measured in other countries.

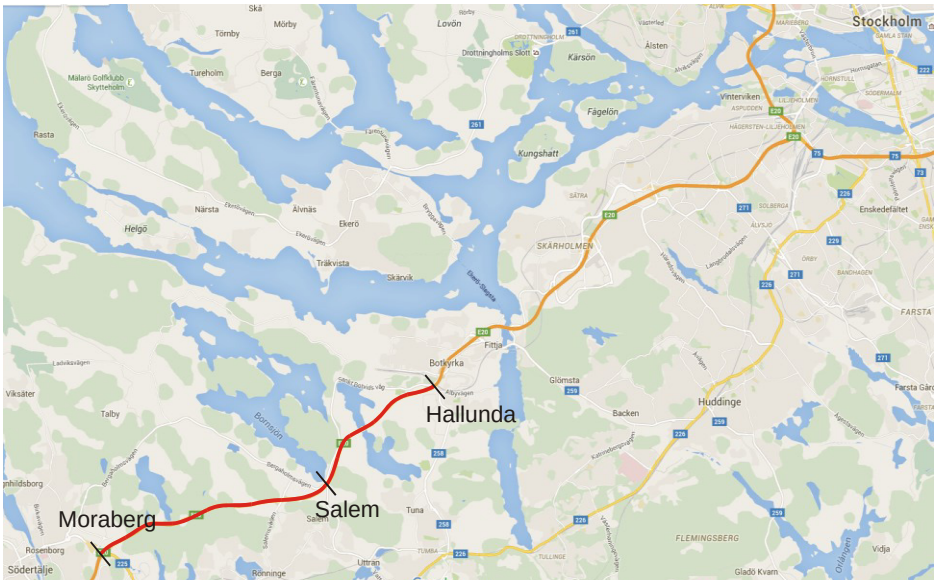

Figure 1: The E4 Södertälje motorway with the project between interchange Hallunda and interchange Moraberg and the interchange Salem in between.

Once the queues formed, which normally means speeds below 60 kph, it is no longer possible to influence the flow. It is therefore important to quickly reduce speed as a preventive measure before the queues is formed. The reconfiguration of the E4 Södertälje motorway lasted for 2009-2012. The reconfiguration includes a rearranged lane configuration within the existing road section (25 m) and a new motorway control systems (MCS). The motivation for traffic to be controlled is that on Friday and Sunday afternoons and during the major holidays there is big risk for congestion, long queues and rear-ends collisions.

Earlier design with two lanes (3.75 m width) and shoulder (2.5 m width) per direction is replaced with three lanes (3.5 m width) and a variable narrow shoulder. Additionally the road is equipped with queue warning system (recommended speed), dynamic speed limits (with a red ring), new lighting and lay-bys (ERAs). The detector sites and sign gantry is spaced between 250 and 350 m on the 10.6 km long stretch. There are 33 gantries in the south direction and 38 in the north direction. Three existing measure stations was located at Hallunda, Salem (called Aspen) and Moraberg, therefore was these points selected as evaluation sites.

The reconstruction of the E4 Södertälje motorway means a new type of motorway section with narrow shoulders where the increased accident risk is assumed to be compensated by a comprehensive traffic management system. This type of road is likely to become increasingly common on busy motorways in the future. It is therefore in the national interest to document the technical, functional, socio-economic and impact goals, so that any adjustments in the design and application can be made.

The study consisted of evaluation of extended number of lanes, variable speed limits and harmonization. The calibration of the implemented harmonization algorithm was iterative performed during an eighteen month long period.