



A Model for Capacity Reduction at Roadwork Zone

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Abstract

This paper presents an investigation of capacity reduction in connection with roadwork zones. The paper presents a state-of-the-art description on roadwork effects on capacity. Based on the literature on this topic the most important parameters that should be incorporated in a Swedish capacity manual for the operation and maintenance roadwork are: the proportion of heavy traffic; lane width; number of closed lanes; closed road shoulder; proportion of commuter traffic; and length of roadwork zone. The paper presents a comparison of a composite model of correction factors from Germany, USA and Denmark and the Dutch model for computation of capacity reduction. The comparison show that the two models essentially gives the same results. Based on these results a model was developed. The model developed was validated using empirical data from a full scale test at the motorway network in Gothenburg. The throughput was measured in two cases during the morning and afternoon peak hour. The capacity for the normal site conditions was estimated based on traffic flow and speed data from the same site. The result shows that the empirically estimated capacity reduction is consistent with the reduction calculated with the new model for the different road work designs evaluated. The conclusion is that the model developed seems to be valid for capacity reduction estimations of roadworks on Swedish motorways but that more empirics are needed to ensure general validity.

Keywords: roadwork, workzone, motorway, capacity

1 Introduction

People are in constant motion and in the metropolitan areas it is difficult to perform the necessary operation and maintenance work of the road network. At some parts of the urban motorway network maintenance operations are only allowed during the night time off peak. Maintenance of the existing network normally implies roadworks including closing or narrowing of lanes and/or slow moving maintenance vehicles. Thus, roadwork zones have a significant impact on traffic flow as these often constitute bottlenecks, resulting in queues with delays as a result. Knowledge of the road's capacity at

roadwork areas is crucial for traffic planners in planning the operation and maintenance activities. Although the problems are not tied to a specific road type the effect is usually greatest in the semi-urban motorways, which in general carries the highest traffic volumes.

In general, national guidelines and manuals give good estimates of road capacity. Several capacity manuals also give good enough estimates on the average capacity reduction at roadwork zones. However, there is a lack of knowledge about which factors that affect the work zone capacity and how variation in those factors influence the capacity. Various studies (mostly micro-simulations) show that there can be a large variance of the impact on the capacity for variation in different factors such as number of lanes closed, lane widths, roadwork length, time of day, type of roadwork, etc. This means that the effect of such factors on capacity is not clear. In general, there are (too) few empirical studies focusing on the differences in capacity caused by these situation-specific variables. This might be due to that traffic measurements in connection with roadworks have had lower priority compared to traffic measurements for normal conditions or that measurements in connection with roadworks are more difficult to conduct due to that the measurement devices obstruct the maintenance work. Anyway, the lack of empirical data and analysis constitutes an important gap.

The aim of this paper is to present a model for estimation of capacity reduction at roadworks that consider relevant influencing factors and which is applicable for Swedish traffic conditions. This was achieved by first investigating and analyzing the roadwork zone capacity models available in the literature and studying their applicability in a Swedish context. Based on the state-of-the-art comparison a model for estimation of capacity reduction on Swedish motorways was developed. The model developed was then validated using results from a field study in Gothenburg where throughput was measured in two road work cases during a morning and afternoon peak hour.

The paper is organized as follows: a review of the state-of-the-art is given in Chapter 2, a new model for capacity at roadwork zone at motorways is presented in Chapter 3; Chapter 4 gives a description of a full scale real world validation of the model developed; Chapter 5 ends the paper with concluding remarks and suggestions for further research.

2 Literature review

There are two countries that are in the lead in terms of simple models for the calculation of capacity at roadwork zones, it is the Netherlands (Rijkwaterstaat, 2011) and Germany (BASt, 2011). Both countries have in slightly different manners estimated correlations between roadwork capacity and a number of restrictive parameters. In the Dutch capacity manual for roadworks (Rijkwaterstaat, 2011) capacity values is described for different roadwork configurations. Also background to capacity in relation to roadworks and the factors that influence the ongoing roadworks is described. HCM 2010 (Transportation Research Board, 2010) includes models for capacity reduction for roadworks on motorways, which gives an estimate of capacity and average values, not specific values for specific situations (TRB 2010). A study that analyzes driving behavior in connection with road work shows that with more cooperative driving the capacity can be increased by 37.5%, the reverse is when a minimally cooperative driving occurs then capacity can be reduced by 36% (Heaslip et al 2008).

In US (Lindly et al 2004) and UK (Department for Transportation UK 2006) software's have been developed in which a small road network is represented, which making it a bit more complex to do a quick estimate of the capacity, queue length and delay since a lot more data is necessary. Denmark has a simple model that considers roadworks on both motorways and two lane rural highways (Vejdirektoratet, 2010). Temporary short-term roadworks with a relatively short duration, generally give a lower capacity than long term roadworks. If a temporary roadwork lasts for a long time, drivers will get acquainted with the situation and thus have a safer/more effective behavior. This has a generally positive effect on capacity.

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