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Traffic Flow at a Freeway Work Zone with Reversible Median Lane

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Abstract

Work zones on freeways usually affect the quality of service for road users. Aiming to reduce traffic flow disruptions to a minimum, Hessen Mobil – Road and Traffic Management installed an innovative reversible lane system in a work zone on Autobahn A 3 south-east of Frankfurt, Germany. The section with three lanes and temporary hard shoulder running in both directions carries a high amount of commuter traffic with considerable fluctuations in peak traffic flow direction. During road works, four lanes in the peak direction and three lanes in the off-peak direction could be maintained through the use of a reversible lane system. The paper discusses the effects of the reversible lane system on traffic flow and road safety. Radar measurements revealed a maximum traffic volume of roughly 1500 veh/h on the reversible lane. The capacity of the work zone was estimated with the stochastic capacity estimation technique based on models for censored data. Compared with the capacity of the unaffected three-lane carriageway with temporary hard shoulder running, a decrease of the capacity by around 15% was estimated for the four-lane work zone configuration including the reversible lane. Similar to other freeway work zones, the road safety analysis revealed an increase of crash rates during road works. However, based on police accident reports only 10% of the total number of crashes and none of the severe crashes could be linked to particular features of the reversible lane system. Altogether, the investigation shows that a reversible lane system is a useful, safe and accepted instrument of intelligent traffic management for freeway work zones with high fluctuations in peak traffic flow direction. At the analyzed work zone, estimated travel time losses of 400000 veh · h could be saved during two months of road works by the application of the reversible lane compared with a permanent lane reduction in one direction.

Keywords: work zone, reversible lane, capacity, accident rate

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1 Introduction

Work zones on freeways usually affect the quality of service for road users. Aiming to reduce traffic flow disruptions to a minimum, Hessen Mobil – Road and Traffic Management installed an innovative reversible lane system in a work zone on Autobahn A 3 between Offenbach interchange and Hanau junction south-east of Frankfurt, Germany. Regularly, the section has three lanes with temporary (dynamic) hard shoulder running in both directions. The average annual daily traffic (AADT) amounts to more than 130000 veh/day with a high amount of commuter traffic. In the direction of Frankfurt, the peak traffic volume is reached in the morning hours. In the opposite direction towards Wuerzburg, the peak occurs in the afternoon.

For pavement reconstruction works, a 7 km long work zone was installed. The pavement renewal on the carriageway in the direction of Wuerzburg was successively realized in two phases with different work zone layouts. Five provisional lanes were marked on the carriageway in the direction of Frankfurt, two lanes on the opposite carriageway. During peak hours, four lanes in the peak direction and three lanes in the off-peak direction could be maintained through the use of a reversible lane system. The reversible lane was equipped with provisional barriers on both sides. The geometric layout of the work zone during the first construction phase is given in Figure 1. In the second construction phase, when the right part of the carriageway in the direction of Wuerzburg was under construction, the two provisional lanes were shifted from the outer to the inner part of the carriageway, while the five provisional lanes on the opposite carriageway were left unchanged. For road safety analysis, the work zone was divided into five segments as shown in Figure 1: approaching area, upstream crossover, interior section, downstream crossover and accelerating area.

The reversible median lane enabled the provision of four lanes in the peak direction and three lanes in the off-peak direction. The driving direction of the reversible lane was changed twice a day in the time span between the peak hours. The status of the reversible lane was announced by dynamic traffic signs in the approach upstream of the work zone. For this, both the traffic signs from the existing line control system as well as additional LED signs were used. When the reversible lane was closed, the beginning of the lane was blocked by a vehicle with a “keep right” sign as shown in Figure 2b.

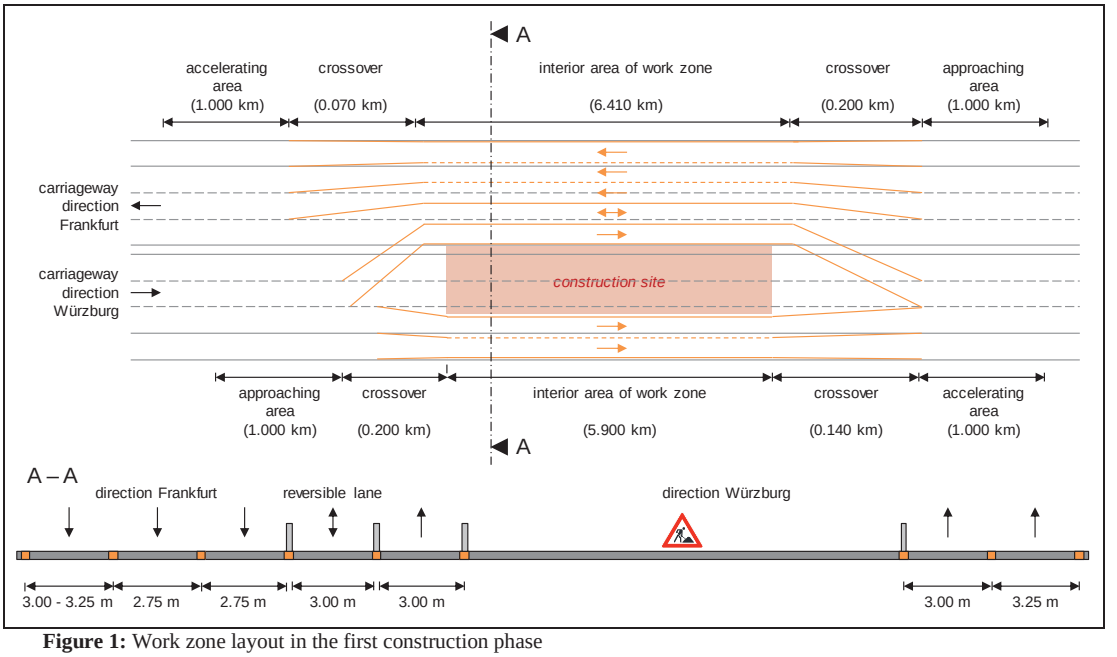

Figure 1: Work zone layout in the first construction phase