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Improving Traffic Flow at Long-term Roadworks

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Abstract
Long-term roadworks on highways are vital as part of roadway and bridge renovations. They generate bottlenecks and can consequently cause congestion and accidents. If the number of lanes is reduced, this will lead to a significant decrease in capacity. Even if all lanes can be kept operational, narrower lanes and roadway switching will reduce the capacity. Intelligent solutions to support the traffic flow at long-term roadworks therefore need to be evaluated.
The "Traffic Change" (TC) system was developed for this purpose. This system enables lanes to be dynamically assigned to the roadway with the higher demand. It can be applied in the case of bridge maintenance, road resurfacing and repair (entire roadway), tunnel renovation with two-way traffic in the operational bore, or temporary adaption of the number of operational lanes, depending on the traffic demand. In this way, the work space needed for roadworks can be enlarged.
Thus TC has beneficial effects on capacity and thus on traffic flow when the number of traffic lanes is reduced in roadworks. Even if all traffic lanes are kept operational during the roadworks, TC provides several advantages concerning road- and bridgeworks operation and costs.
The TC concept leads to improved traffic safety and optimized traffic flow at roadworks, as well as shorter interruptions and lower costs. Finally, using TC at roadworks will result in major cost savings that can be computed using the "Traffic Change Simulation" tool (TC-Sim).

Keywords: **capacity management at long-term roadworks, tidal-flow management, Quick-Change Moveable Barriers, traffic safety and optimized traffic flow at roadworks, microscopic traffic simulation, computation of cost-benefit ratio**

1 Introduction

1.1 Initial situation

Long-term roadworks on highways are a vital part of roadway and bridge renovations. They generate bottlenecks and consequently congestion and accidents. If the number of lanes is reduced, it also leads

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to a significant decrease in capacity. Even when all lanes can be kept operational, narrower lanes and roadway switching will affect the capacity.

The impact of roadworks on capacity has been analyzed in detail by (Beckmann, 2001). For every capacity-influencing factor, parameters and thresholds were determined for various configurations of roadworks, so that a deterministic value of capacity can be set for any planned roadworks site. On 6-lane freeways (3+3 lanes) for example, a 6+0 roadworks traffic routing (6 auxiliary lanes on one, 0 lanes on the other roadway) is not possible. Normally a 5+1 or a 4+2 traffic routing is used. That means, part of the traffic (1 or 2 lanes) uses the roadway where the roadworks are situated (see Figure 1).

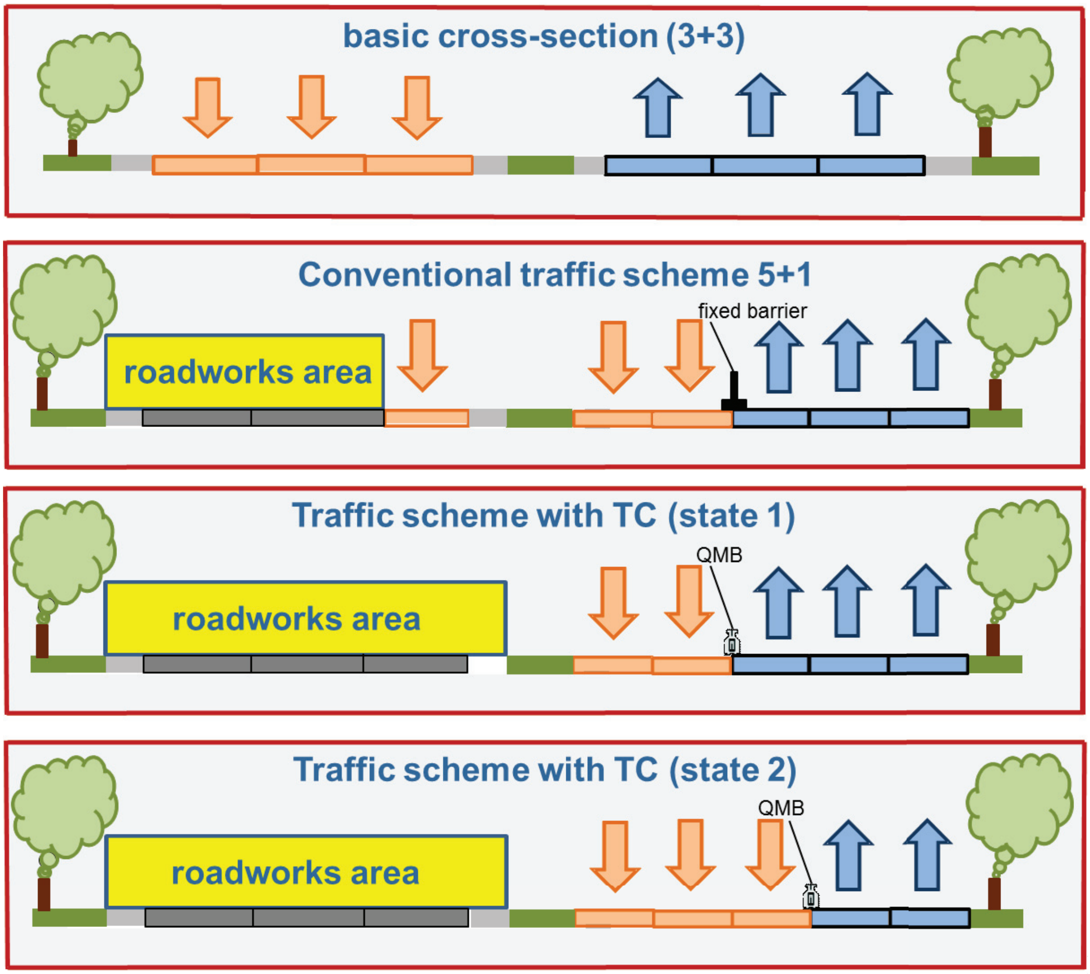

Figure 1: Traffic routings: Basic, conventional and with TC

Based on predicted demand patterns and the determined capacity for planned roadworks, traffic engineers are able to estimate the impact by using a deterministic queueing theory approach. So key values, such as total delay time, average time loss, maximum queue length or time variation curves of the queue length, can be calculated.

Conventional traffic routing for all possible setups of roadworks are usually defined in guidelines, for example, (Ministry of Transport, 1995) in Germany. Since the requirements for safeguarding roadworks personnel has become stricter, the available lateral space to route the traffic through the roadworks is limited. This often leads to lane closures or complex procedures to manage the roadwork