Microsimulation of Freeway Work Zones to Assess Flow and Capacity

Alan Horowitz
University of Wisconsin–Milwaukee

Smart Work Zone Deployment Initiative

Purpose

- Interpolation and limited extrapolation on actual work zone capacity data.
- Build experience in calibrating and running traffic microsimulations for work zones.

Data

- Work zone capacity data was obtained from Marquette University for two sections on the Milwaukee freeway system.
- Original data was analyzed in 15 minute time intervals.

Two capacities?

- Regime 1. Relatively free flow conditions, perhaps with reduced speeds; and
- Regime 2. Queued conditions, exhibiting stop and go speeds.
- Capacity is also a random variable.

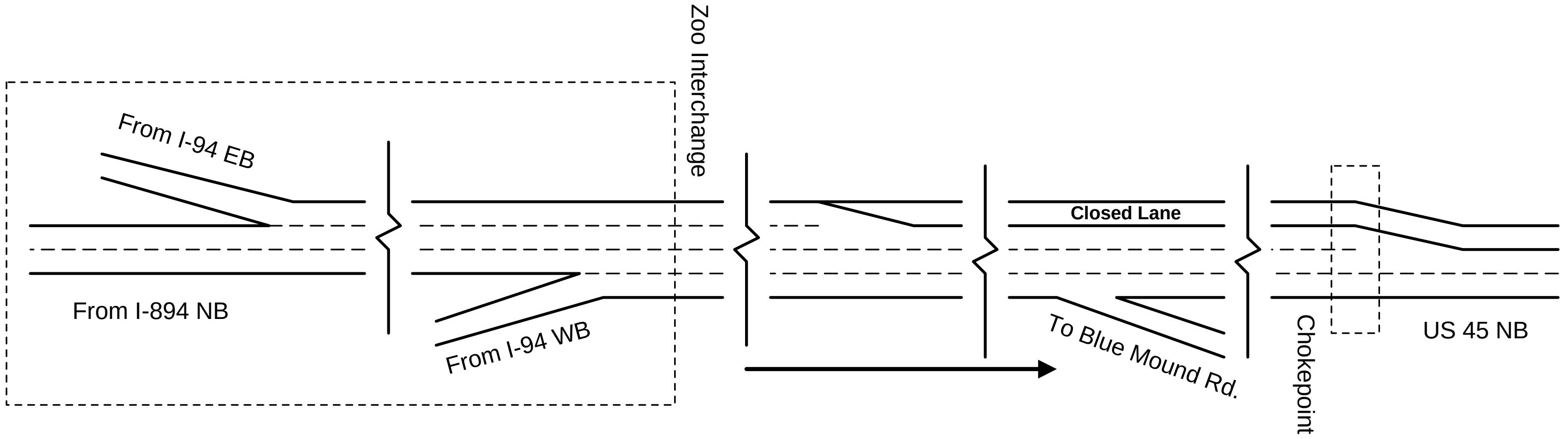
Software

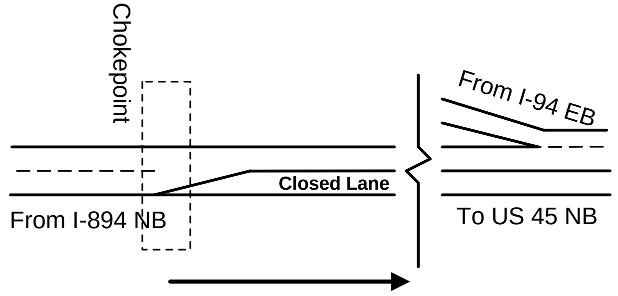
- FRESIM/CORSIM
- Source code was obtained but not modified.
- Calibration started with Pitt car-following parameters adopted from Houston, then adjusted to local conditions.
- Needed to employ an incident “rubbernecking factor” in some cases.
- All runs repeated 100 times (after many trials).

Squarely Hitting each Regime

- Regime 1. Flow downstream of the chokepoint reaches a maximum while speeds average approximately 35 mph at the chokepoint. Density is between 45 and 50 vehicles per lane-mile upstream of the chokepoint and approximately 45 vehicles per lane-mile within the work zone.
- Regime 2. Speeds are, on average, lower than 15 mph just upstream of the chokepoint, with queues greater than 10 vehicles per lane over substantial intervals of time. Density is greater than 80 vehicles per lane-mile upstream of the chokepoint and also approximately 45 vehicles per lane-mile within the work zone.

Marquette Work Zones 1 & 2





Predict the effects of...

- Percentage of heavy vehicles
- Grade
- Ramp location relative to closed lanes (left or right)
- Ramp distance upstream of the taper
- Upstream lane distribution, particularly trucks
- Upstream ramp volume
- Number of closed lanes
- Merging scheme

Sensitivity to HV Percent

	Reduction in Capacity from a 1% Increase in Heavy Vehicles*	Passenger Car Equivalent Factor at 0% Grade
Work Zone 1, Regime 1	1.04%	2.04
Work Zone 1, Regime 2	0.86%	1.86
Work Zone 2, Regime 2	0.64%	1.64

Baseline condition: 8% trucks

Effect of Grade on Capacity

	Capacity Reduction Per 1% Increase in Grade*	Passenger Car Equivalent Factor at 4% Grade
Work Zone 1, Regime 1	2.56%	2.55
Work Zone 1, Regime 2	1.99%	2.52
Work Zone 2, Regime 2	0.26%	1.81

Effect of Early Merge/Late Merge

Work Zone and Condition	Capacity
Base Case, Natural Merge	1492
Perfect Early Merge	1477
Perfect Late Merge	1525

Ramp Locations and Ramp Flow Rates

- Generally, the effects of ramps are modest (less than 5%), either upstream or downstream.

Observations

- Random variations in capacity can be large (120 vph)
- There is a single chokepoint for any work zone and it is most likely at a taper.
- Lane distribution of trucks in important to capacity.
- Microsimulation can be helpful for planning work zones.

Acknowlegements

- Thanks to Tom Notbohm and Alex Drakopoulos.