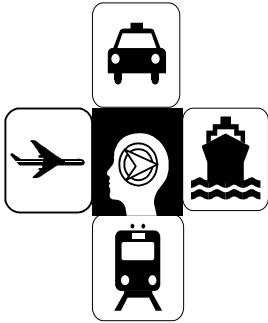


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Tech Brief

STABILITY AND ACCURACY OF HCM LEVEL OF SERVICE

FHWA-NJ-2008-007

Sept. 2008

SUMMARY

The Highway Capacity Manual (HCM) uses average travel speed to assign levels of service (LOS) to urban streets and arterials. However, the HCM procedure for estimating travel speeds has weaknesses, particularly in the determination of the Free-Flow Speed (FFS), by failing to account for the impact of weather conditions (e.g., rain, snow, ice, etc.) and light conditions (e.g., sun glare, darkness, etc.).

In this research, traffic data, under adverse weather, were collected and the impact of weather conditions to speed and density on selected New Jersey highways were investigated. Equations were developed to adjust the capacity estimation formula and figures suggested by HCM (2000) that can be used to accurately estimate travel times for buses and general traffic considering darkness and adverse weather.

RESULTS

- The goal of the study was to gather two days of data at each location under each weather condition. For example, the collected data on I-80 shown in Figure 1 indicates the impact of adverse weather to speed.

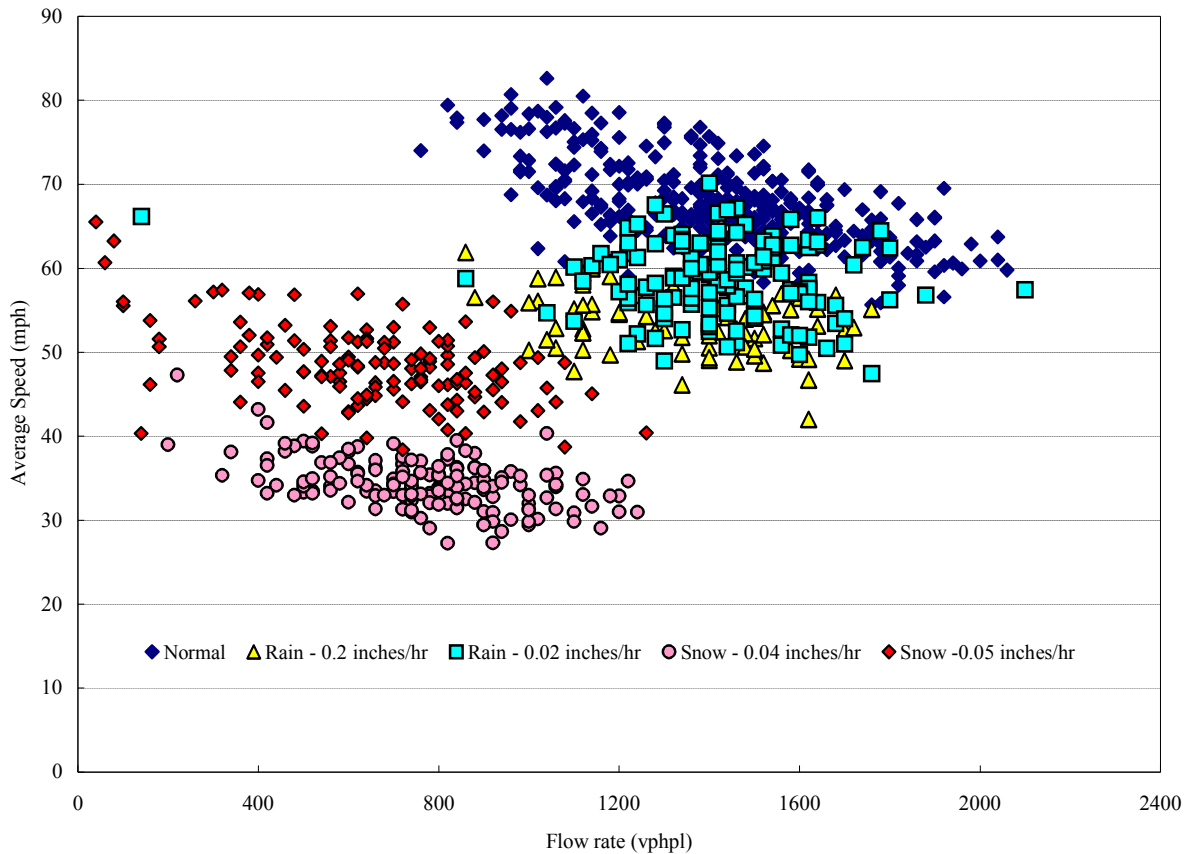


Figure 1. Impact of Adverse Weather to Speed

- Under rain conditions, speeds decreased between 0.82 mi/hr and 37 mi/hr. The rain impact was found to not only be a function of the rain intensity, but also a function of the presence of downstream congestion.
- Under snow conditions, speeds decreased from 5.8 mph to 33.8 mph. The research showed that the snow impact is attributed to the snow intensity as well as the snow accumulation and whether the roadway has been plowed.

- Under normal weather and darkness conditions, there is little difference between the speeds for the two days under which data were collected. In general the reduced speeds range from 0.71 mi/hr to 5.2 mi/hr..
- Under rain and darkness (rain-darkness) conditions, the reduced speeds generally range from 7.11 mi/hr to 7.14 mi/hr..
- Similarly under snow and darkness conditions, the increased speeds range from 0.19 to 4.9 mi/hr. At one location snow and darkness caused a significant speed reduction of 19.8 mi/hr..
- Under sun glare, speeds reduced from 6.6 mph to 20.6 mph showing that the sun glare impact can be as significant as the rain and snow impact.
- The collected data indicated the impact of adverse weather on driving behavior.
- After evaluating the bus travel time from the collected APC data, it was shown that buses operating with late arrival times at the beginning TPs can catch up at later TPs under normal weather condition. However, the cumulative travel time could be hard to catch up to under rain.
- The mean travel times between each pair of TPs under rain were generally greater than under normal weather. The significance level or p-values generated in the statistical analyses showed that the differences of the travel time means for each pair of TPs are not quite significant in most situations. A reason for this result could be the fact that the number of trips under adverse weather was very small.

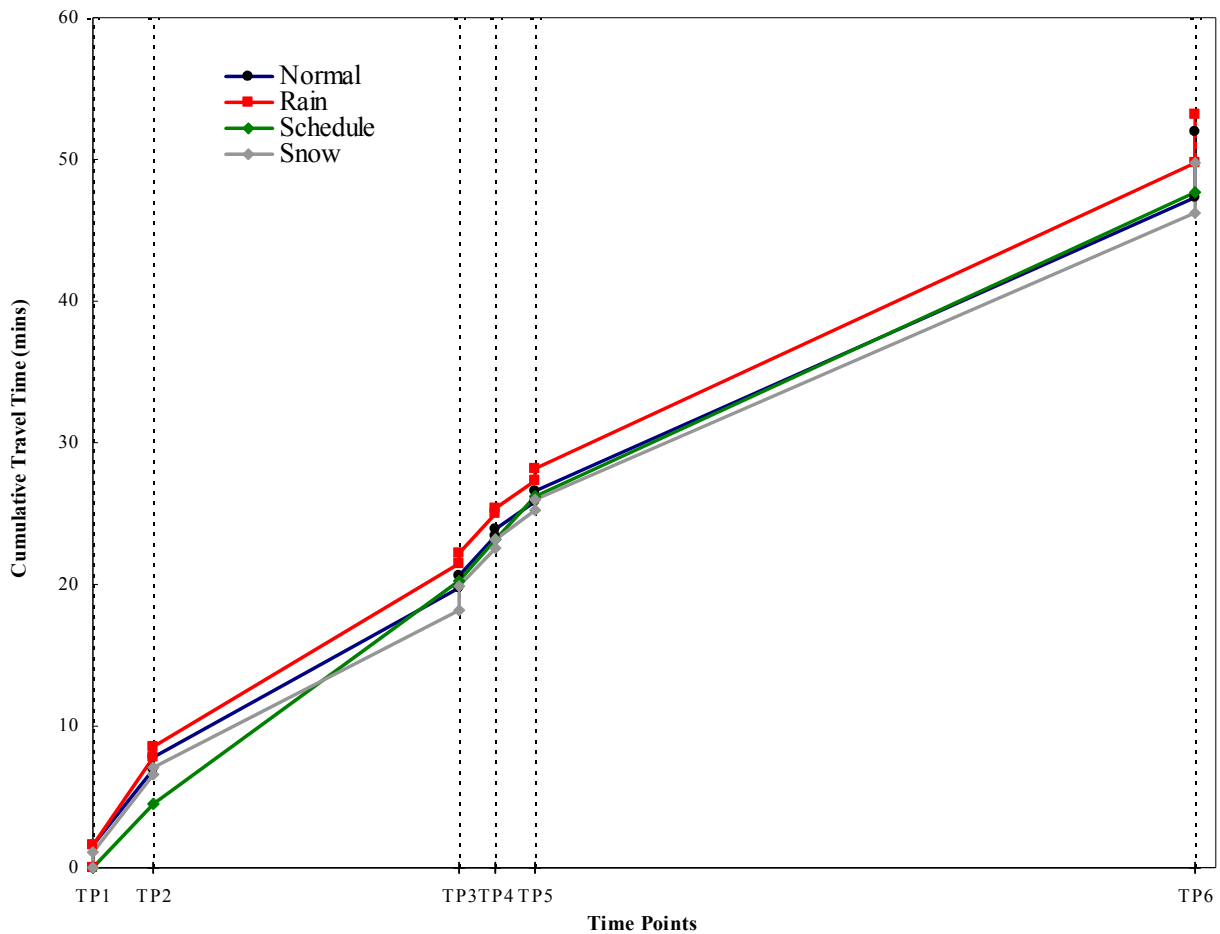


Figure 2. Cumulative Travel Time vs. Distance from Starting Time Point

CONCLUSIONS AND RECOMMENDATIONS

The potential applications of the study results will help in exploring the weather impact on speed, density, headway, and capacity on different type of roadways and transit travel times and schedule adherence. The immediate extensions of this research include but are not limited to (1) estimating delay and travel time to assist the public in making decisions on when to travel and by what route or mode under adverse weather; (2) incorporating the estimated delay and potential congested locations due to adverse weather and developing network-wide adaptive traffic control strategies; and, (3) assessing the operational performance and identifying bottlenecks of existing transportation infrastructure under adverse weather.

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A final report is available online at:

<http://www.state.nj.us/transportation/refdata/research/>

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722 or send an email to Research.Bureau@dot.state.nj.us and ask for:

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