

## Highway Capacity Manual (HCM) Systems Analysis Methodology

by Lily Eleftheriadou (UFTI) and Michael Armstrong (McTrans)  
for the Federal Highway Administration (FHWA)

The procedures detailed in the current version of the Highway Capacity Manual (HCM 2010) estimate capacity and several operational measures dictating level of service for freeway facilities as well as surface streets. However, the existing methods do not consider cases in which spillback occurs from one type of facility to another. Currently, the procedure for Signalized Intersections (HCM 2010 Chapters 18 and 31) predicts the average expected queue length at an approach given any combination of geometric- or traffic-related inputs within the scope of the methodology. Similarly, the Freeway Facilities procedure (HCM 2010 Chapters 10 and 25, via the FREEVAL-2010 computational engine) estimates the maximum expected queue length at an on-ramp in the case of oversaturated conditions on the freeway mainline. However, the effects of these queues as they propagate upstream – onto a freeway mainline or a surface street intersection – are not accounted for.

The purpose of this ongoing project is to propose a series of modifications to existing HCM 2010 procedures provided in Chapter 14 (Freeway Merge and Diverge Segments), Chapter 13 (Freeway Weaving Segments), Chapter 10 (Freeway Facilities), Chapter 23 (Interchange Ramp Terminals), Chapter 20 (Two-Way Stop-Controlled Intersections), Chapter 21 (All-Way Stop-Controlled Intersections) and Chapter 22 (Roundabouts) in order to address spillback conditions. This project collected a very small amount of data primarily for illustrative purposes, as data collection was not within its scope. Therefore, the framework developed here uses assumptions that should be further explored

through an extensive data collection effort.

Since data collection was not within the scope of the research, several assumptions were used to produce quantitative procedures for this project. Future work should collect data and calibrate the following parameters:

- Percent of freeway mainline traffic on each lane, as a function of spillback regime and queue length
- Speed along each freeway mainline lane, as a function of spillback regime and queue length
- Lane by lane capacity adjustments on the freeway mainline as a function of spillback regime and queue length
- Discharge rates for on-ramps during congested conditions, as a function of freeway geometry and demands

The final report, to be released by June 2016, summarizes the limited literature related to this topic; describes procedures to predict the maximum expected queue length from surface street intersections; describes the effects of surface streets' queues on diverge segments and weaving segments; describes procedures to estimate the maximum expected queue length from oversaturated freeway on-ramps; describes the effects of this queue on signalized intersections and unsignalized intersections; and provides conclusions and recommendations for data collection to calibrate the procedures recommended here.

**Note: McTrans is developing software to implement these new procedures in prototype versions of the HCS7 Streets and Facilities modules.**

---

## Highway Capacity Software (HCS)

### HCS 2010™ Release 6.80

(Scheduled for distribution in February 2016, after the HCQS meeting in January at TRB)

- Roundabouts – Completely new interface consistent with TWSC within the upgraded architecture
- AWSC – Adding the computation of 95th Percentile Queue by lane as prescribed in the HCM 2010
- Facilities – Expanding range allowed for ramp demand values to accommodate two-lane weaving
- TwoLane – Revised computation of capacity values when opposing flows dictate other than 1700

### HCS7™ Release 7.1

(Planned for release with Highway Capacity Manual 6th Edition, probably in Spring 2016)

- HCS 2010™ users with current support receive HCS7™ automatically

## Webinar Series Schedule

### Highway Capacity Analysis Webinar Series

*Including Detailed Information on HCM 6th Edition and HCS7*

This webinar series presents lectures, software demonstrations and application examples on the Highway Capacity Manual (HCM) procedures – including updates coming in the 6th Edition. Step-by-step instruction of the HCM methodologies will be provided for each analytical chapter. The Highway Capacity Software (HCS) implements and automates the HCM procedures. Each lecture will be followed by working example problems and a software demonstration using the HCS7 prototype. A comprehensive workbook is provided to include all slides. Registration is provided in four sections (Streets, Unsignal, Freeways and Highways) with the Overview included with any registration and a discount for the entire series. The series is organized as follows with all presented from 3:30 PM to 5:00 PM EST. Detailed course descriptions and registration are here: <http://mctrans.ce.ufl.edu/training> (12 PDH)

January 19	HCM and HCS Overview, Major Changes, Principles, Concepts
January 20, 21, 22	Signalized Intersections (NEMA, Phase Duration, Multiple-Period Analysis) Urban Streets (Flow Profile, Access Points, Travel Time Reliability, ATDM) Ramp Terminals and Alternative Intersections (DDI, DLT, RCUT, MUT)
January 26	Unsignalized Intersections (TWSC, AWSC, Roundabouts, Corridors)
January 27, 28	Freeway Segments (Basic, Weaving, Merge & Diverge) Freeway Facilities (Travel Time Reliability, ATDM)
January 29	Highway Segments (Multilane Highways, Two-Lane Highways)

### Traffic Engineering Fundamentals Webinar Series

*Presented through the Florida Technology Transfer (T2) Center*

This series of webinars on Traffic Engineering Fundamentals will cover several traffic engineering topics with practical application guidance for each. The course is designed to present each topic with problem-solving workshops to reinforce concepts in practical application exercises.

The series is organized as follows with all presented from 10:30 AM to 12:00 PM EST. All webinars will be limited to the first twenty five registrations to ensure questions and discussion can be managed appropriately. You can access the course description and register for the series or sections at T2 here: <http://www.t2ctt.ce.ufl.edu/tef/> (12 PDH)

January 19, 20 & 21	Control: Overview of congestion issues and volume, speed and delay studies; MUTCD and traffic control devices with signal warrant study and analysis; and actuated and coordinated signals with signal timing data and methods.
January 22 & 26	Safety: Concepts and safety issues including younger and older driver strategies; and Highway Safety Manual overview and urban crash prediction model.
January 27, 28 & 29	Capacity: Capacity and Level of Service including unsignalized capacity analysis; signalized intersection analysis including models and multiple periods; and urban streets segment analysis and traffic impact analysis overview.