Message from the Director

I am very grateful to have our diverse, competent, motivated, and professional team at McTrans Center. This past year presented an unprecedented challenge for our team by primarily working remotely where daily or hourly communication with one another is unavoidable. Our priority was and is to protect the health and safety of our employees. Given all this, I am happy to see McTrans is moving forward at a rapid pace to deliver more value to our customers using our software packages as well as training modules. In 2021, we are planning to provide a couple of major products both on the software releases and training packages to our valued customers. I invite you to review our progress, plans, and announcements through our social media.

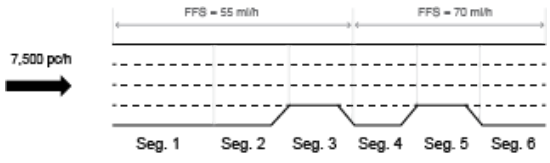
Sincerely,
Behzad Aghdashi
McTrans Center Director
April 2021

Analyzing Active and Hidden Bottlenecks

Dr. Fabio Sasahara

Public agencies invest much to mitigate bottlenecks, which are frequent sources of congestion in freeways. However, an important question follows: will treating a bottleneck actually reduce congestion? In order to answer this question, it is crucial to understand the concepts of "*Active bottleneck*" and "*Hidden bottleneck*" and how to properly identify them.

An active bottleneck has a demand greater than capacity, but the actual volume served in this location is metered by its capacity. Due to this metering effect of active bottlenecks, downstream segments will experience a demand shorter than the real demand. One of these downstream segments might have a capacity smaller than the real demand, but still greater than the volume served by the upstream active bottleneck. This is the concept of a "Hidden bottleneck", which is not easily identifiable by field measurements but can be identified using the Highway Capacity Manual methods.



A short example will illustrate how can the Highway Capacity Software (HCS) identify hidden bottlenecks. The first figure shows a short freeway facility with six basic segments and an entering demand of 7,500 pc/h. Since there are no ramps in this facility, the demand on all segments is also equal to 7,500 pc/h. Segments 3 and 5 have a lane drop, making them potential bottleneck candidates. The measured free-flow speed 55mi/h for segments 1-3 and 70 mi/h for segments 4-6.

Before proceeding, it is important to recall the concept of *Queue Discharge Capacity Drop*. When breakdown occurs at a bottleneck, the queue discharge occurs at a rate smaller than the segment's capacity (a 7% drop, based on a national average). This drop in capacity is a required input when analyzing freeway facilities, as shown below:

The results of the capacity analysis of this short facility are summarized in the following table:

	Segment					
	1	2	3	4	5	6
Capacity c (pc/h)	9,000	9,000	6,750	9,600	7,200	9,600
Demand flow rate v_d (pc/h)	7,500	7,500	7,500	7,500	7,500	7,500
Volume served v_a (pc/h)	7,500	6,285	6,285	6,285	6,285	6,285
v_d/c	0.83	0.83	1.11	0.78	1.04	0.78
v_a/c	0.83	0.70	0.93	0.65	0.87	0.65
LOS	D	F	F	C	F	C
Density (pc/mi/ln)	34.2	54.4	39.6	23.0	34.5	23.0
Speed (mi/h)	54.9	28.9	52.9	68.4	60.7	68.4

Segment 3 is the first bottleneck met by a traveler in this facility. Although the segment capacity is 6,750 pc/h, this segment serves only 6,285 pc/h. This occurs due to the queue discharge capacity drop of 7%, and can be confirmed by the ratio of volume served and capacity (v_a/c) of 0.93. Therefore, Segment 3 is an "Active Bottleneck", causing queues to extend upstream to Segment 2 which also yields LOS F .

Downstream of Segment 3, the arriving flow in subsequent segments is 6,285 pc/h because of the constraining bottleneck. Segment 5 has a capacity of 7,200 pc/h, resulting in a ratio of volume served and capacity v_a/c = 0.87. Even though the volume served is below capacity, this segment still yields a LOS F because of the true demand (7,500 pc/h) that exceeds capacity (v_d/c = 1.04). Also note that the estimated speed in this segment is 60.7 mi/h, higher than Segment 3. Therefore, this segment is a "Hidden Bottleneck". It does not experience breakdowns due to the upstream active bottleneck, but as soon as the bottleneck in Segment 3 is removed it would become the next active bottleneck in the facility. Therefore, the issue of congestion would not be solved, but would simply move to a new location.

In summary, for truly removing congestion, all active and hidden bottlenecks may need to be addressed. The analytical tools provided in the Highway Capacity Manual and implemented in the Highway Capacity Software are a powerful tool for this purpose.

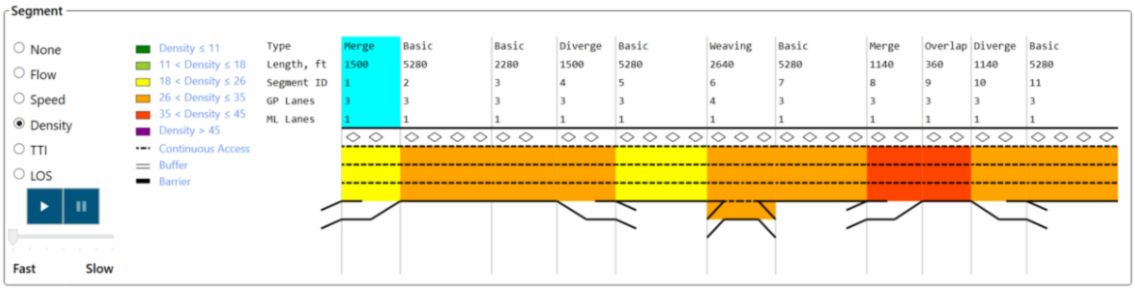
What's New in HCS 7.9.6

The Highway Capacity Software (HCS7) includes modules to implement the Highway Capacity Manual 6th Edition (HCM6) and Highway Safety Manual (HSM) procedures for interrupted and uninterrupted flow facilities.

New Updates

In HCS Release 7.9.6, the Freeways module allows importing/exporting of Access Demand for Managed Lanes. Unsaved Freeway-to-Freeway demand in single segment Weaving analyses and increasing Freeway demand for the first segment in facility analyses with cross weaving are also fixed in the Freeways module. The Freeways Reliability module corrects Average Density results when exporting

summary results to CSV. The Two-Lane and Multilane modules add a Full View option to view inputs and reports simultaneously.



The figure above shows the new visual feature added to the freeway module. It is displaying the density of different freeway segments.

Features

Signalized Intersections:
Unsignalized Movements
Combined Grade/Heavy Adjustment
Animation

Alternative Intersections:
Models Median U-Turn
Restricted Crossing U-Turn
Displaced Left Turn and DDI

Roundabouts:
Capacity Equations Analysis of Roundabout Corridors

Freeway Segments:
Managed Lane Analysis
Capacity and Speed Adjustments
Advanced Truck Procedures

Weaving Segments:
Capacity and Speed Adjustments
Advanced Truck Procedures

Urban Streets:
Travel Time Reliability
Parking Adjustment and
Calibration Factors incorporated to method
LOS A/B Threshold

Merge & Diverge Segments:
Allows Capacity and
Speed Adjustments Factors for Calibration
Advanced Truck Procedures

Freeway Facilities:
Travel Time Reliability
Managed Lanes
On-Ramp to Managed Lane Cross Weave Adjustment
Animation

Tools:
Highway Safety Software
HCM Reference Guide
MUTCD Signal Warrants
Service Volumes

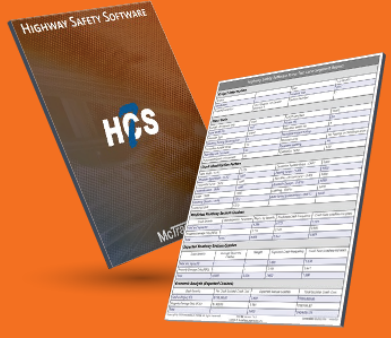
Ready to Update Your HCS?

You may download the software to any computer within your immediate office.
To access the download, enter your 13-digit registration number in the link below.
Remember to include the leading zero and dashes. Example: 012345-00-06789
Click here to update HCS

Did you know?

The Highway Safety Software (HSS) is included within the latest HCS versions

The HSS implements the crash prediction models of the first edition of the Highway Safety Manual (HSM) and its supplement. In addition, you can find crash prediction model for roundabouts, based on NHCRP 17-70.



STAFF SPOTLIGHT

David H Nazef

Software Developer at McTrans Center

When I was in college, I pictured large developer teams of 50+ members working both against the clock, and the inevitable mishaps that would occur when so many people are involved. I was pleasantly surprised when I began working at McTrans, alongside a much smaller team where everyone could coordinate with one another while making sure no one was out of the loop. This aspect also made working remotely a lot more straightforward than I had anticipated. Since I have not had the chance to experience a non-remote work environment in this field, working remotely now feels natural to me, especially with the support of my co-workers.

In addition, as this is my first professional position, this was also my first real exposure to the Highway Capacity Manual and the transportation field as a whole. Initially it seemed confusing, however, over time I learned more and more terminology and acquired a myriad of programming skills while working together with the other team members. But the most important experience I have gained, has been working alongside others on a professional team, which I am still so thankful to be a part of.

Training Webinars

Ready to Register?

McTrans offers training for transportation professionals throughout the year.

For additional information about courses, click here.
Have questions or want more information? Send us an email at mctrans@ce.ufl.edu

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