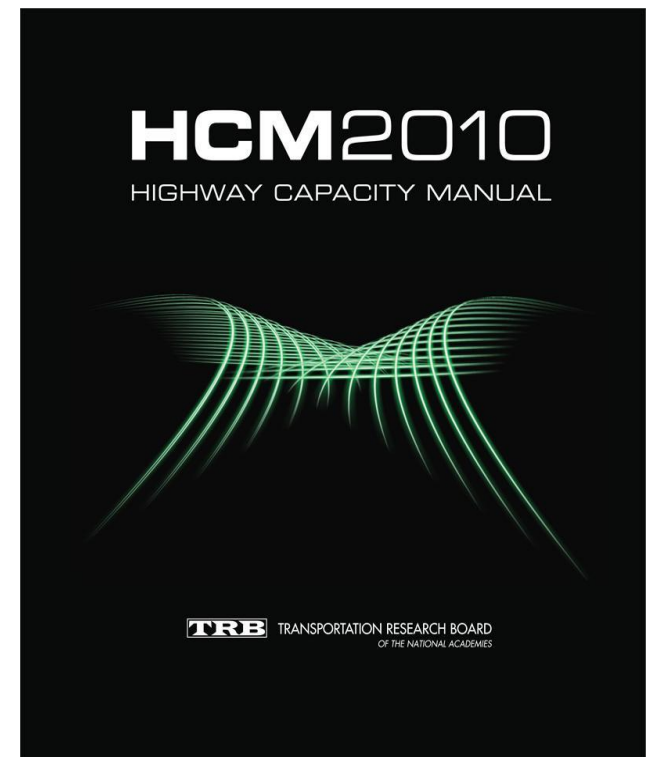


The 2010 Highway Capacity Manual

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Outline

- › Overview of HCM 2010
- › Multi-modal Level of Service
- › Summary of Updates to HCM Procedures
- › Traffic Simulation/ Alternative Tools
- › Planning and Preliminary Engineering Applications
- › Conclusion

Overview of HCM 2010

- › Comprehensive Discussion of Issues Related to the Capacity of Highway Facilities
- › Widely Used in the United States and Worldwide
- › Previous Editions
 - 1950
 - 1965
 - 1985 (*Major Updates in 1994, and 1997*)
 - 2000
- › Transit Capacity Discussed in Transit Capacity Manual

Overview of HCM 2010 (cont.)

- › The HCM 2010 consists of four volumes
 - *Volume 1: Concepts*
 - *Volume 2: Uninterrupted Flow*
 - *Volume 3: Interrupted Flow*
 - *Volume 4: Applications Guide (electronic format only available at www.HCM2010.org)*

Multi-Modal Level of Service

- › Alternative modes will be integrated into the 2010 HCM far better than before
- › Urban street LOS methods will facilitate “complete streets” evaluations
 - *Relative service quality provided to each mode’s travelers can be determined*
 - *Trade-offs of different improvement alternatives or future demand scenarios can be evaluated*
 - *Toolbox of possible LOS improvement measures will include much more than just traditional auto capacity enhancements*

Summary of Updates to HCM Procedures

- › Urban Street Facilities
- › Urban Street Segments
- › Signalized Intersections
- › Two-Way Stop-Controlled Intersections
- › All-Way Stop-Controlled Intersections
- › Roundabouts
- › Interchange Ramp Terminals
- › Freeway Weaving Segments
- › Freeway Merging and Diverging Segments
- › Multilane Highways
- › Two-Lane Highways
- › Freeway Facilities

Chapter 16

Urban Street Facilities

› Scope

- *Facility (= two or more segments)*
 - 0.75 to 2.0 miles long in urbanized downtown areas
 - 1.5 to 5.0 miles long in other areas
- *Separate methodology for auto, ped, bike, and transit modes*
- *Emphasizes combined evaluation of auto, ped, bike, and transit*

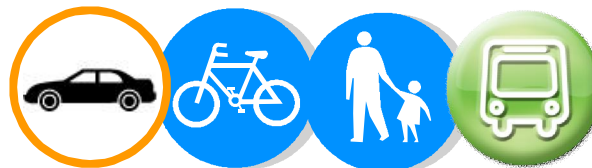


› Methodology

- *Aggregates key segment performance measures*

› Example Problems


- *Demonstrate integrated multimodal evaluation process*



Chapter 17

Urban Street Segments

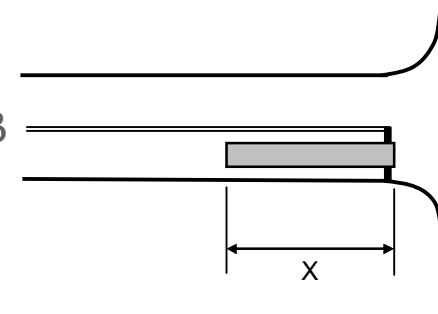
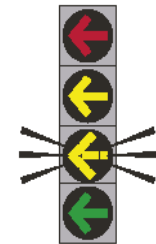
› Scope

- *Segment (= link + boundary intersections)* 
- *Signal, TWSC, AWSC, or roundabout boundary intersections*
- *Models signal coordination*
- *Separate methodology for auto, ped, bike, and transit modes*

Chapter 18

Signalized Intersections

- › Automobile Methodology
 - *Actuated phase duration prediction*
 - Controller operation inputs
 - Simultaneous gap-out
 - Flashing-yellow-arrow operation
 - Controller phase inputs
 - Passage time
 - Minimum green
 - Recall
 - Dual entry
 - Detector design
 - Detector length
 - Based on HCM 2000 Chapter 16 -Appendix B



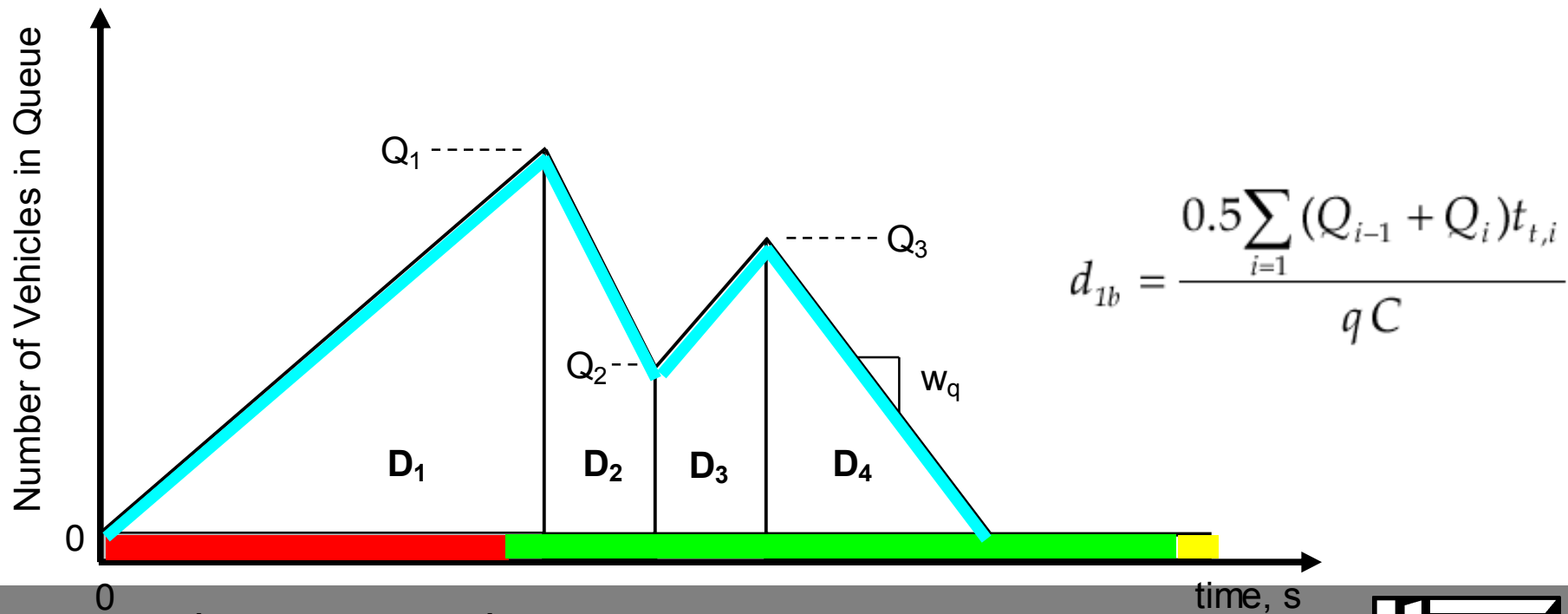
Chapter 18

Signalized Intersections

Automobile Methodology

– Procedure for estimating uniform delay

- Computes delay by integrating queue polygon
- Works for all movements and lane assignments
 - Permissive-only left turns from shared lane



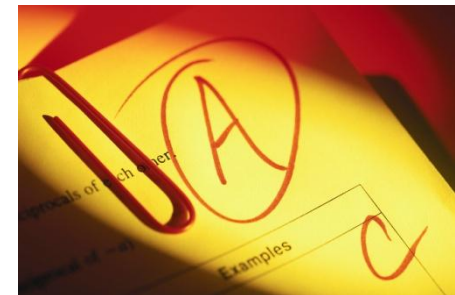
Chapter 18

Signalized Intersections

› Automobile Methodology

– *Performance measures*

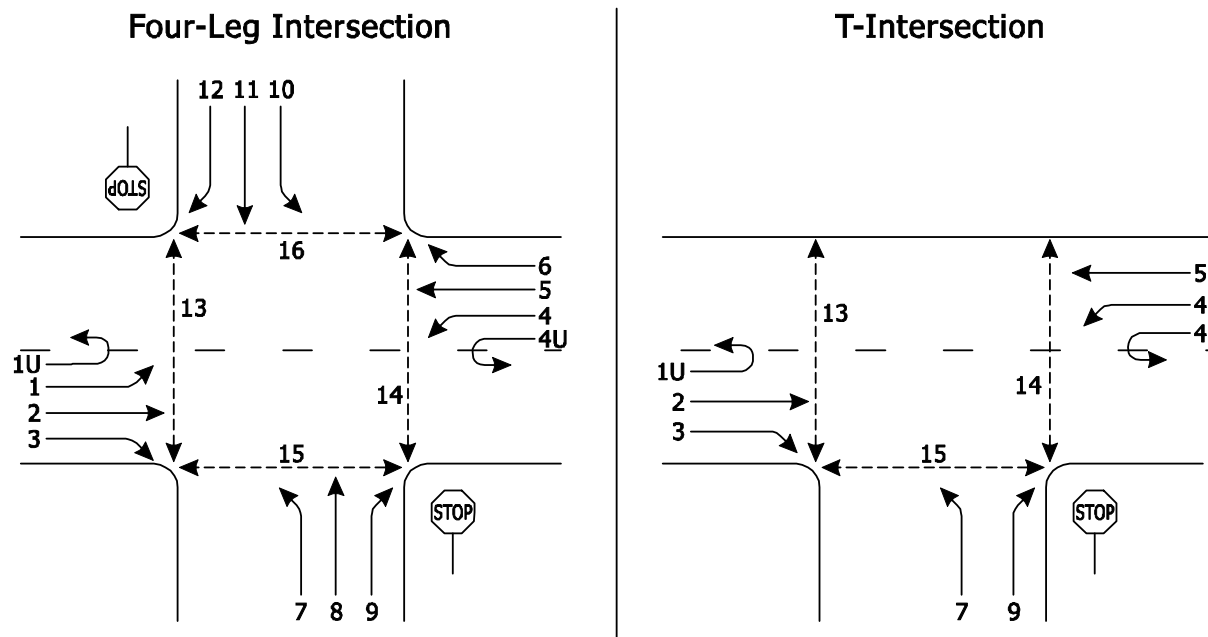
- Automobile control delay
- Queue storage ratio
 - Percentile queue procedure
- Volume-to-capacity (v/c) ratio
- Level of service is based on control delay and v/c ratio



Chapter 19

Two-Way Stop-Controlled Intersections

- › Gap acceptance parameters for six-lane streets added
- › Interface with urban street segment methodology for upstream signal effects

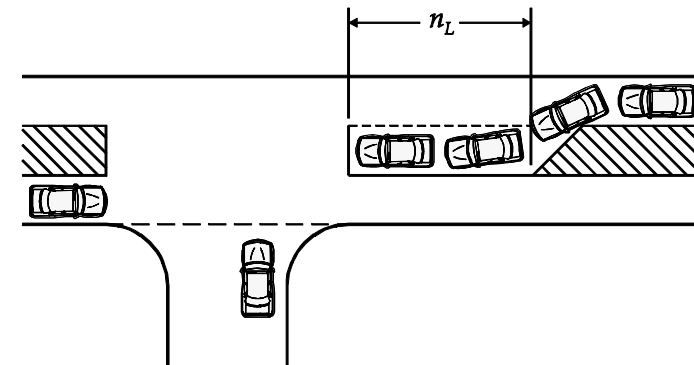
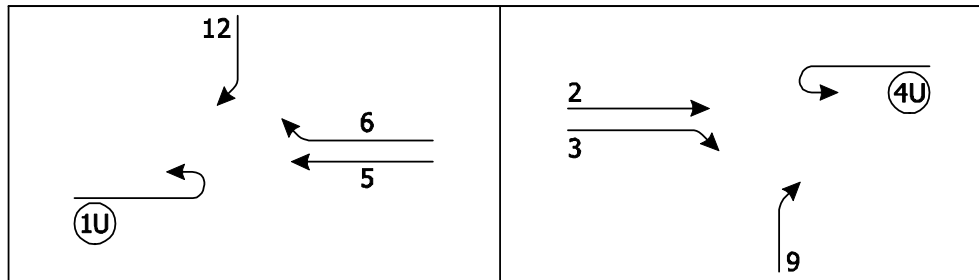


Chapter 19

TWSC Intersections (cont.)



- › Analysis of major street U-turns on 4-lane and 6-lane streets
- › Improved analysis of shared/short lanes
- › Updated procedure for analyzing unsignalized pedestrian crossings



Chapter 20

All-Way Stop-Controlled Intersections

- › Restructure of chapter to make procedure clearer
- › Explicit incorporation of details to calculate AWSC with three-lane approaches (details in Volume 4)
- › Queuing model added



Photo: Lee Rodegerdt

Chapter 21

Roundabouts



- › Incorporates NCHRP Report 572 methodologies (with enhancements and extensions)
- › Lane-by-lane analysis of multilane roundabouts



Photo: Casey Bergh

Chapter 21

Roundabouts (cont.)



› LOS table for roundabouts

- *Consistent with TWSC and AWSC due to similar delay formulation and lack of guaranteed service (unlike signals)*
- *Recognized need for additional research*

Control Delay (s/veh)	Level of Service by Volume-to-Capacity Ratio*	
	$v/c \leq 1.0$	$v/c > 1.0$
0 – 10	A	F
>10 – 15	B	F
>15 – 25	C	F
>25 – 35	D	F
>35 – 50	E	F
>50	F	F

Chapter 22

Interchange Ramp Terminals

- › Scope
 - *Operational evaluation of signalized ramp-crossroad Intersection*
 - *Quick estimation method for interchange type selection*
 - *Methodology addresses auto mode only*
- › Methodology
 - *Signalized intersection methodology in Chapter 18*
 - *Roundabout methodology in Chapter 22*
- › Elements
 - *Additional saturation flow rate factors*
 - Lane utilization factor
 - Traffic pressure factor
 - Turn radius factor
 - *Additional lost time procedure*



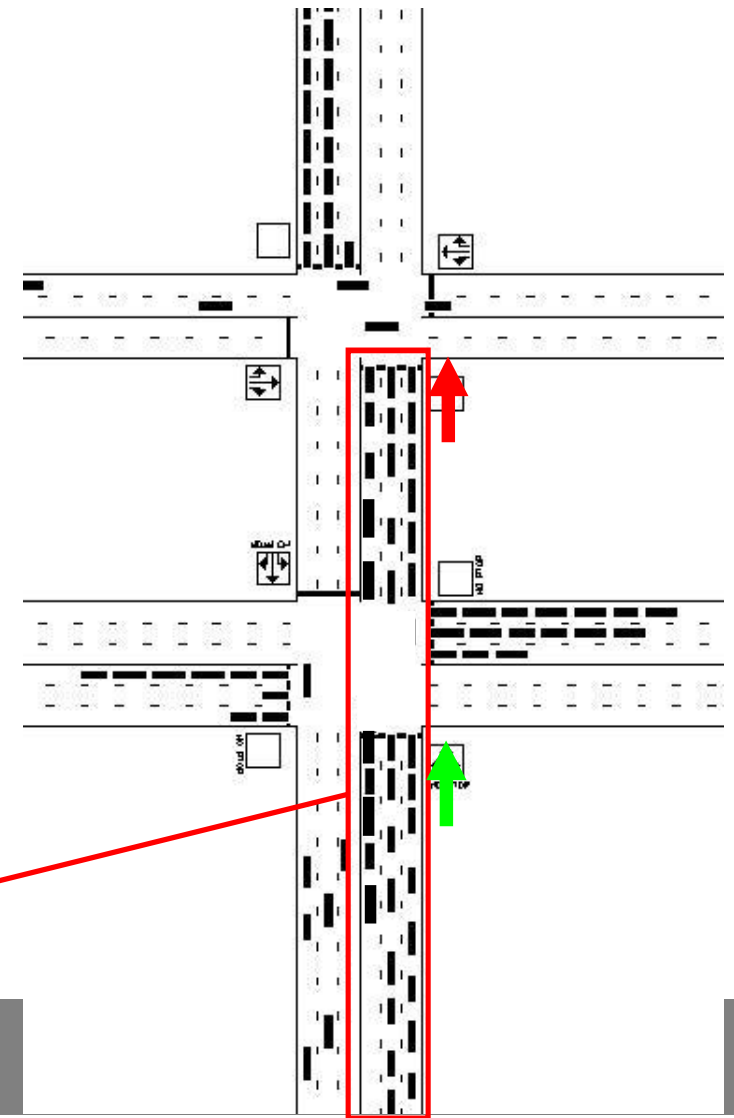
Chapter 22

Interchange Ramp Terminals

- › Additional Lost Time Procedure
 - *Reduction in effective green period*
 - *Two causes for reduction*
 - Queue spillback
 - Demand starvation
- › Lost Time Due to Queue Spillback



Northbound incurs additional lost time

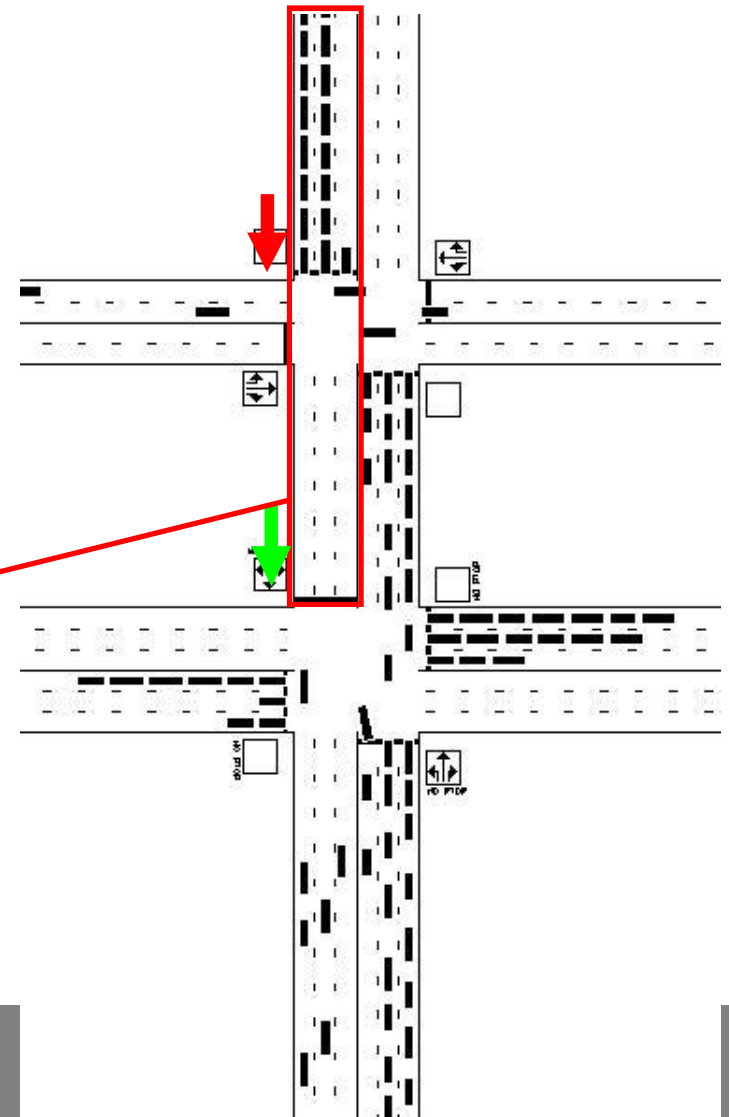


Chapter 22

Interchange Ramp Terminals

- › Additional Lost Time Procedure
 - *Reduction in effective green period*
 - *Two causes for reduction*
 - Queue spillback
 - Demand starvation
- › Due to Demand Starvation

Southbound incurs additional lost time



Chapter 22

Interchange Ramp Terminals

› Performance Measures

- *Automobile control delay*
 - By lane group and movement
 - By origin-destination
- *Queue storage ratio*
- *Volume-to-capacity (v/c) ratio*
- *Level of service is based on control delay, queue storage ratio, and v/c ratio*

CH 12: FREEWAY WEAVING SEGMENTS

- › New ways to consider length, width, and configuration.
- › New speed-prediction algorithms.
- › New approach to weaving capacity.



CH 13: FREEWAY MERGING AND DIVERGING SEGMENTS

- › No significant changes to HCM 2000.
- › “Reasonableness Check” added to initial predictions of flow in Lanes 1 and 2.
- › Two minor changes in predictive equations for v_{12} to avoid discrepancies in extreme cases.



CH 14: MULTILANE HIGHWAYS

- › No major changes in base methodology.
- › Like basic freeway segments, no interpolation between free flow curves.
- › Added analysis procedure for bicycles on multilane highways.



CH 15: TWO-LANE HIGHWAYS

- › Two-way analysis methodology deleted.
- › Some basic characteristic curves and tables were revised and updated.
- › Third class of two-lane highway added as an alternative procedure: Two-Lane Highways in Built-Up Areas. FDOT procedure used.
- › Procedure added for bicycles on two-lane highways.

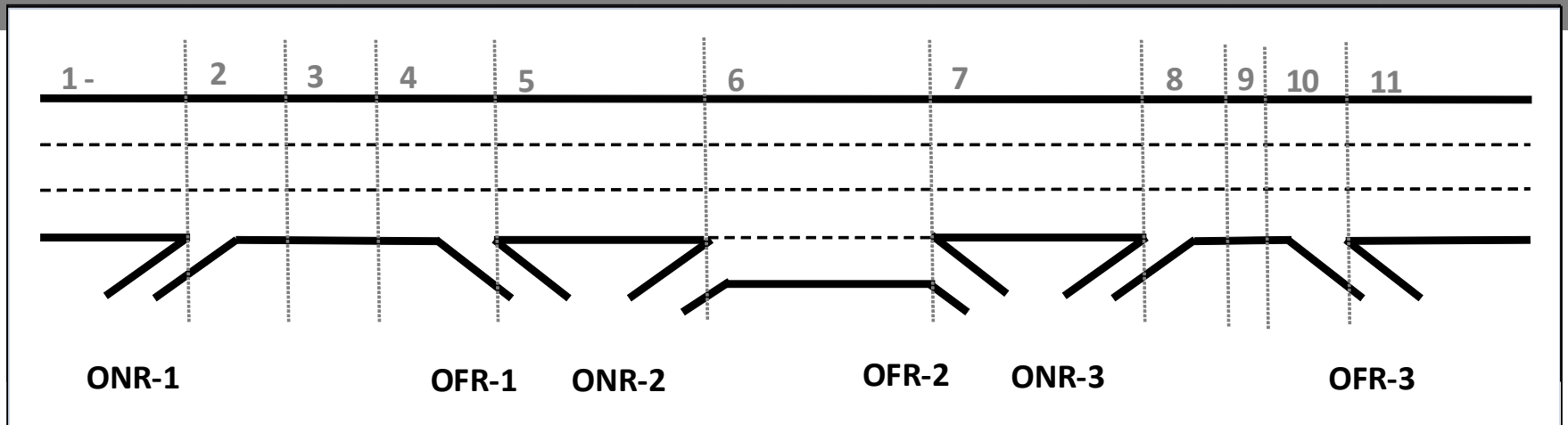


HCM2010 Updates

Chapter 10: Freeway Facilities

- › Incorporates all Freeway Chapter Changes, plus
- › Definition of Average Facility Density
- › LOS Measure and Table
- › Increased Emphasis on Impacts of Weather and Work Zones

Facility and Segments



Segment Number	1	2	3	4	5	6	7	8	9	10	11
Segment Type	B	ONR	B	OFR	B	B or W	B	ONR	R	OFR	B
Segment Length (ft.)	5280	1500	2280	1500	5280	2640	5280	1140	360	1140	5280
No. Lanes	3	3	3	3	3	4	3	3	3	3	3

Directional Facility

Traffic Simulation / Alternative Tools

- › New Guidance Based on NCHRP 3-85 and FHWA Research
- › Excellent Discussion of the State of the Art of Traffic Simulation
- › Gaps in HCM Procedures
- › Comparisons of Traffic Simulation Results to HCM Results
- › Guidance on How to Use (and Not Use) Traffic Simulation

General Guidance for Volume 1

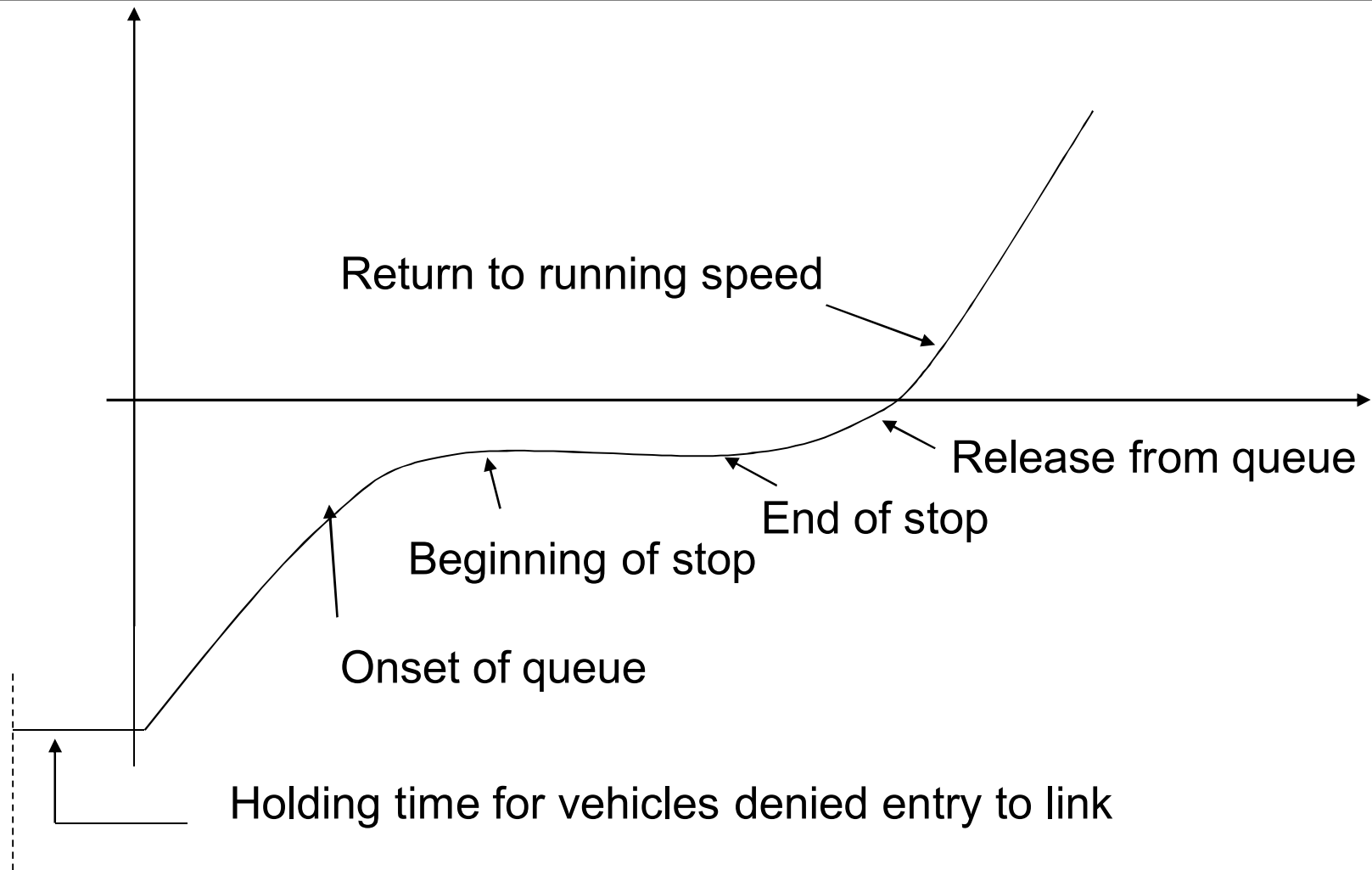
Ch 6: Analysis Tools

**Ch 7: Interpreting
and Presenting
Results**

- **Traffic Modeling Concepts,**
- **Selection Criteria**
- **Application Framework and Guidelines**

- **Performance Measures**
- **Trajectory Analysis**
- **Stochastic Aspects**

Use of Vehicle Trajectory Analysis in Comparing Performance Measures



Planning and Preliminary Engineering Applications

- › Improved Guidance on Default Values
- › Use of V/C and Similar Measures for LOS F Conditions

Conclusion

- › HCM 2010 Has Arrived
- › Software Available
- › Courses Available Through ITE and TRB
- › Provide Feedback, Obtain Errata, Review Reference Materials, View Applications Guide Through www.HCM2010.org