Overview of Interrupted Flow Chapters

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Acknowledgments for Slides

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Presentation Overview

- Vision for 2010 HCM - Interrupted Flow Facilities
- 2010 HCM Organization
- Highlight Changes
  - Chapter by chapter
- Closing Comments
Vision for 2010 HCM - Interrupted Flow Facilities

- Full System Coverage
  - Points, segments, facility

- Recognize Need for Computational Engine
  - Computational intensity of some methodologies too great for manual worksheet presentation
  - Essential tool for committee to maintain methodology and document the more detailed calculations
  - Typically implemented in a spreadsheet
Vision for 2010 HCM - Interrupted Flow Facilities

- Multimodal Evaluation
  - Emphasize combined evaluation of auto, ped, bike, and transit
2010 HCM Organization

- Volume 1 - Concepts
- Volume 2 – Uninterrupted Flow
- Volume 3 – Interrupted Flow
- Volume 4 – Applications Guide
2010 HCM Organization

- Volume 3 – Interrupted Flow
  - Urban Street Facilities
    - Urban Street Segments
    - Signalized Intersections
    - Two-way Stop-Controlled Intersections
    - All-way Stop-Controlled Intersections
    - Roundabouts
    - Interchange Ramp Terminals
  - Exclusive Pedestrian and Bicycle Facilities
Highlight Changes Since 2000 HCM

- Urban Street Facilities
  - Urban Street Segments
  - Signalized Intersections
  - Two-way Stop-Controlled Intersections
  - All-way Stop-Controlled Intersections
  - Roundabouts
  - Interchange Ramp Terminals
Chapter Structure

- Outline
  - Introduction
    - Level of service criteria
    - Required input data
    - Scope and Limitations
  - Methodology
    - Automobile mode
    - Pedestrian mode
    - Bicycle mode
    - Transit mode
  - Applications
    - Default values
  - Example Problems
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

▪ A Closer Look
  • Automobile methodology
  • Transit methodology
Chapter 17
Urban Street Segments

- Automobile Methodology
  - New input data
    - Number of lanes/bays at access points
    - Median type
    - Curb presence
    - Speed limit
    - Phase splits, offset
  - Running time prediction procedure
    - Free-flow speed
    - Segment length
    - Volume adjustment
    - Delay due to mid-segment turns
Chapter 17
Urban Street Segments

• Automobile Methodology
  • Coordinated operation procedure
    ➢ Controller inputs
      – Splits → used to estimate force off & yield points
      – Offset & offset reference point
Chapter 17
Urban Street Segments

- **Automobile Methodology**
  - Arrival flow profile prediction procedure
    - Adjusts input turn movement volumes if needed
      - Balance flows between junctions
      - Check and honor capacity constraints to entry flows
    - Computes origin-destination matrix
      - Distribution of entry movements to exit movements
Chapter 17
Urban Street Segments

- **Automobile Methodology**
  - Performance measures
    - Stop rate
    - Travel speed
    - Level of service
    - Auto traveler perception index

FDOT Quality/LOS Handbook 2002
Chapter 17
Urban Street Segments

- Transit Methodology
  - Input data
    - Dwell time
    - Excess wait time
    - Passenger trip length
    - Transit frequency
    - Passenger load factor
    - Stop location (near/far) and amenities
    - Auto running speed and delay
    - Pedestrian LOS score describing segment level of service
    - Transit re-entry delay
Chapter 17
Urban Street Segments

- Transit Methodology
  - Elements
    - Transit travel speed analysis from Chapter 27 of HCM 2000
    - Traveler perception of service (NCHRP Report 616)
      - Perceived time spent waiting for transit service
      - Perceived travel time rate
  - Performance measures
    - Segment running time
    - Transit travel speed
    - Transit wait-ride score
    - Transit passenger LOS score
    - Level of service based on LOS score

A Look Ahead to the 2010 HCM
Chapter 18
Signalized Intersections

- **Scope**
  - Isolated signalized intersection
  - Separate methodology for auto, ped, and bike modes

- **A Closer Look**
  - Pedestrian Methodology
  - Bicycle Methodology
  - Automobile Methodology
Chapter 18
Signalized Intersections

- Pedestrian Methodology
  - Input data
    - Motorized vehicle intersection traffic volume
    - Right-turn-on-red (vehicle) volume
    - Pedestrian volume
    - Number of traffic lanes on each intersection approach
    - Crosswalk length
    - Pedestrian signal head presence
Chapter 18
Signalized Intersections

- Pedestrian Methodology
  - Elements
    - Time-space analysis from Chapter 18 of HCM 2000
    - Delay analysis from Chapter 18 of HCM 2000
    - Traveler perception of service (NCHRP Report 616)
  - Performance measures
    - Corner circulation area
    - Crosswalk circulation area
    - Pedestrian control delay
    - Pedestrian LOS score
    - Level of service based on LOS score
Chapter 18
Signalized Intersections

- Bicycle Methodology
  - Input data
    - Motorized vehicle intersection traffic volume
    - Bicycle flow rate
    - Number of traffic lanes on each intersection approach
    - Presence of a bicycle lane
Chapter 18
Signalized Intersections

- **Bicycle Methodology**
  - **Elements**
    - Delay analysis from Chapter 19 of HCM 2000
    - Traveler perception of service (NCHRP Report 616), NEW!
  - **Performance measures**
    - Bicycle control delay
    - Bicycle LOS score, NEW!
    - Level of service based on LOS score
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

\[
d_{1b} = 0.5 \sum_{i=1}^{n} \left( Q_{i-1} + Q_i \right) t_{t,i} / q C
\]
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

- Four-Leg Intersection
- T-Intersection

Graphs showing different traffic flow patterns at intersections.
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 Rodegerdts
Chapter 21
Roundabouts

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

Photo: Casey Bergh
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

<table>
<thead>
<tr>
<th>Control Delay (s/veh)</th>
<th>Level of Service by Volume-to-Capacity Ratio*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>v/ c ≤ 1.0</td>
</tr>
<tr>
<td>0 - 10</td>
<td>A</td>
</tr>
<tr>
<td>&gt;10 - 15</td>
<td>B</td>
</tr>
<tr>
<td>&gt;15 - 25</td>
<td>C</td>
</tr>
<tr>
<td>&gt;25 - 35</td>
<td>D</td>
</tr>
<tr>
<td>&gt;35 - 50</td>
<td>E</td>
</tr>
<tr>
<td>&gt;50</td>
<td>F</td>
</tr>
</tbody>
</table>
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
Closing Comments

- **Chapter Status**
  - Chapters have been reviewed by HCQSC
  - Submitted to TRB in Spring 2010
  - TRB editor comments addressed in Summer 2010

- **Questions?**