

A high-angle, black and white photograph of two pedestrians walking across a crosswalk on a city street. The pedestrians are silhouetted against the lighter pavement. The street has a dashed white line down the center and a solid white line on the left side. The background is a dark, textured surface, possibly asphalt. The image is overlaid with a green geometric shape on the left and a dark grey geometric shape on the bottom right.

NCHRP 17-87

Guide to Pedestrian Analysis



Pedestrian Operations Analysis

What's in this Chapter?

- Design and operation of pedestrian facilities
- Operational measures support quality-of-service measures
- Methods for evaluating pedestrian flow and storage needs
- Macroscopic analysis
 - Sidewalk, crosswalk, bus stop, and so on.

Delay, flow, speed, storage, and circulation area concepts

Pedestrian Delay

- “Ideal” and “actual” walking time
- Signalized intersections and uncontrolled crossings
- HCM currently uses delay for *pedestrian LOS* determination

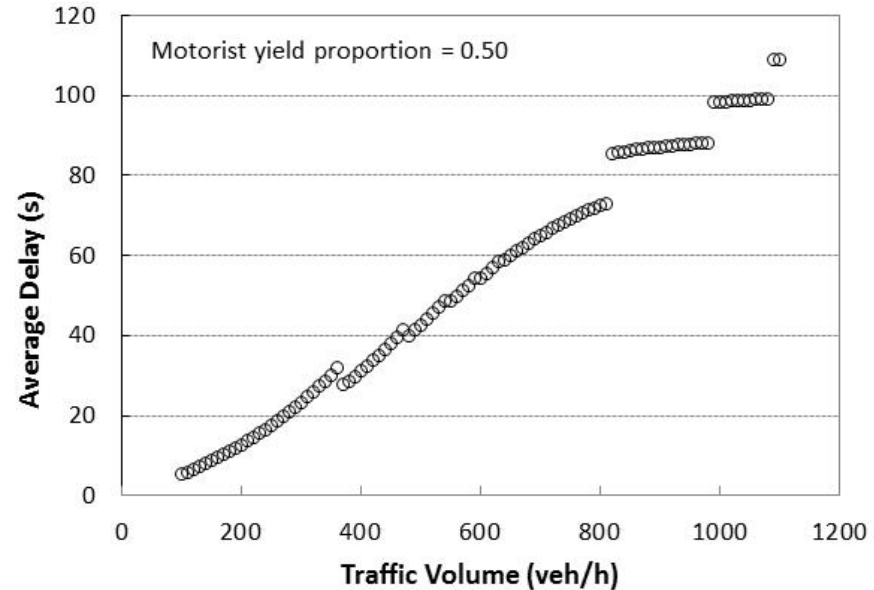
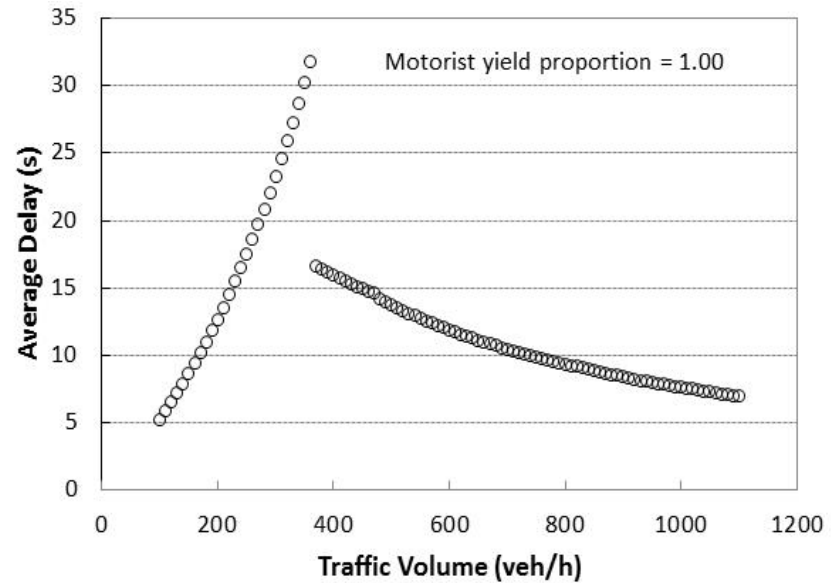
Research team revised pedestrian delay calculation methodology as part of NCHRP 17-87

Uncontrolled Crossings

- Chapter 20 of the HCM 6th Edition
 - Two-way stop-controlled intersections, mid-block locations
- Delay reducing effects of motorist yielding was revised by the research team

- Step 1 – Identify two-stage crossings
- Step 2 – Determine critical headway
- Step 3 – Probability of delayed crossing
- Step 4 – Average delay calculation to wait for gap
- Step 5 – Estimate average delay for crossing stage
- Step 6 – Calculate average delay

Uncontrolled Crossings



Uncontrolled Crossings – Input Data

- Crosswalk length
- Number of through lanes crossed
- Presence of two-stage crossings
- Conflicting vehicular flow rate
- Average pedestrian speed
- Pedestrian start-up and end clearance times
- Average motorist yielding rate

Signalized Crossings (1)

- Chapter 19 of the HCM 6th Edition
 - Current method addresses delay for a one-stage crossing of an intersection leg of a pre-timed signal, assuming random pedestrian arrivals
 - Guidance for multiple-stage crossings and multiple crossings is to calculate delay for individual stage/crossing and sum the results

Signalized Crossings (2)

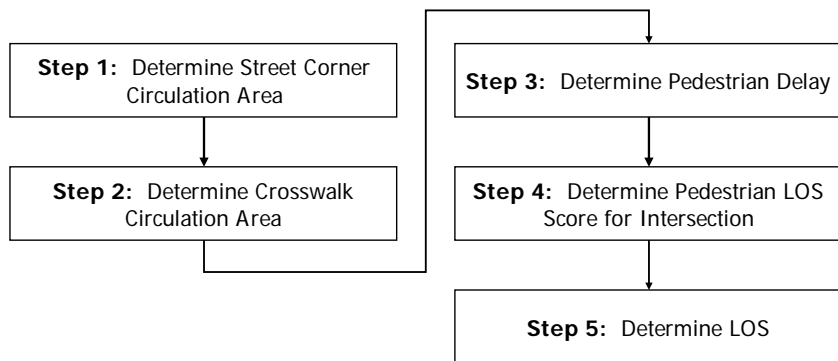
- Methods in Guide and proposed for HCM
 - Crossing one intersection leg in one stage (current method)
 - Assumes random arrivals and pre-timed
 - Crossing one intersection leg in two stages (median island)
 - Based on Wang and Tian (2010)
 - Crossing two intersection legs in two stages (diagonally opposite corner)
 - Based on Zhao and Liu (2017)
- Two-stage crossing delay data
 - First-stage crossing length
 - Average pedestrian speed
 - Effective walk time for second stage
 - Start time of the walk phase for first and second stages

Signalized Crossings (3)

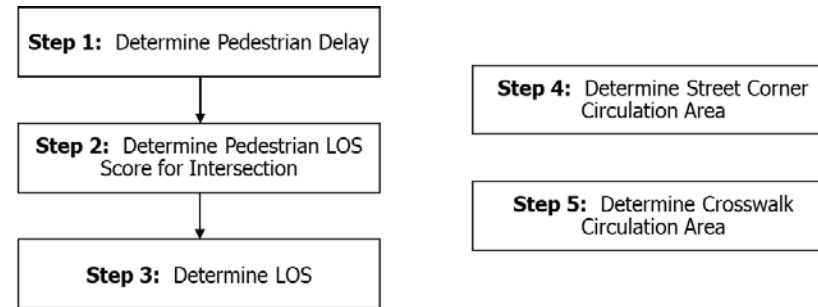
- Possible extensions being considered for HCM
- Have a theoretical basis, but no supporting data as of now
 - Delay for semiactuated and actuated signals & hybrid beacons (Kittelson on behalf of PBOT 2015)
 - 3-stage crossing delay, extra delay associated with crosswalk closures (extensions of Zhao & Liu)
 - Exclusive pedestrian phase/Barnes dance
 - Lower of diagonal crossing delay (current method) and performing a two-stage crossing (if feasible) (Zhao & Liu)

Signalized Crossings (4)

- Proposed change in methodology step sequence
 - Calculate delay, then LOS
 - Crosswalk & corner circulation area calculations are optional



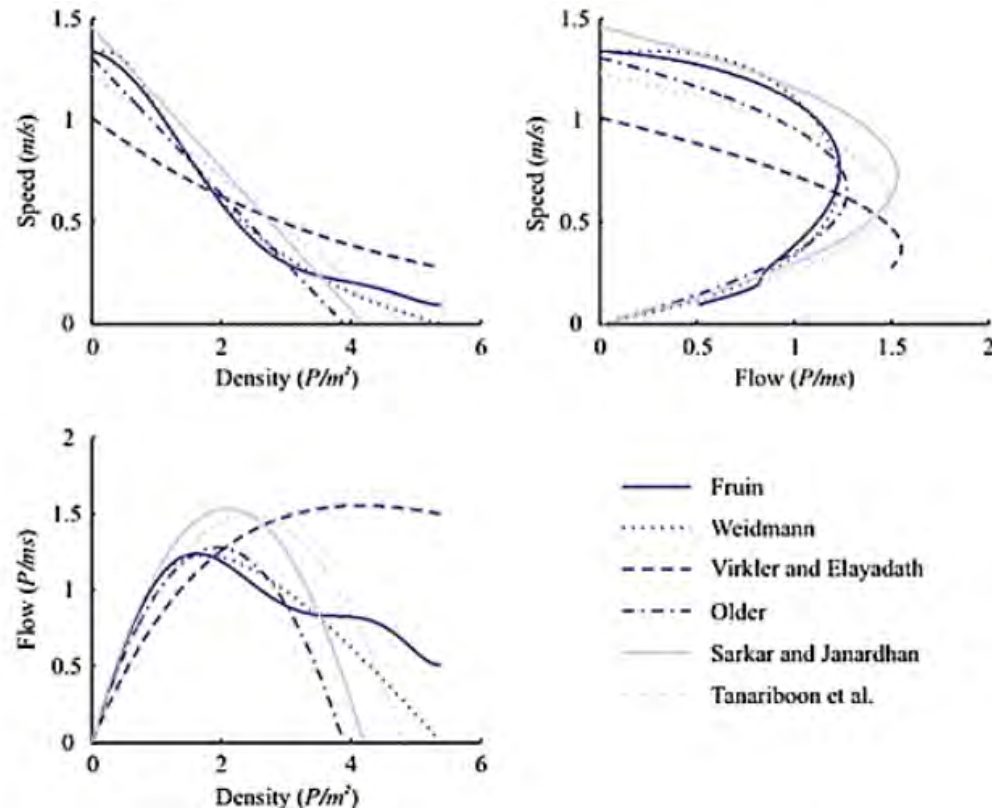
Current



Proposed

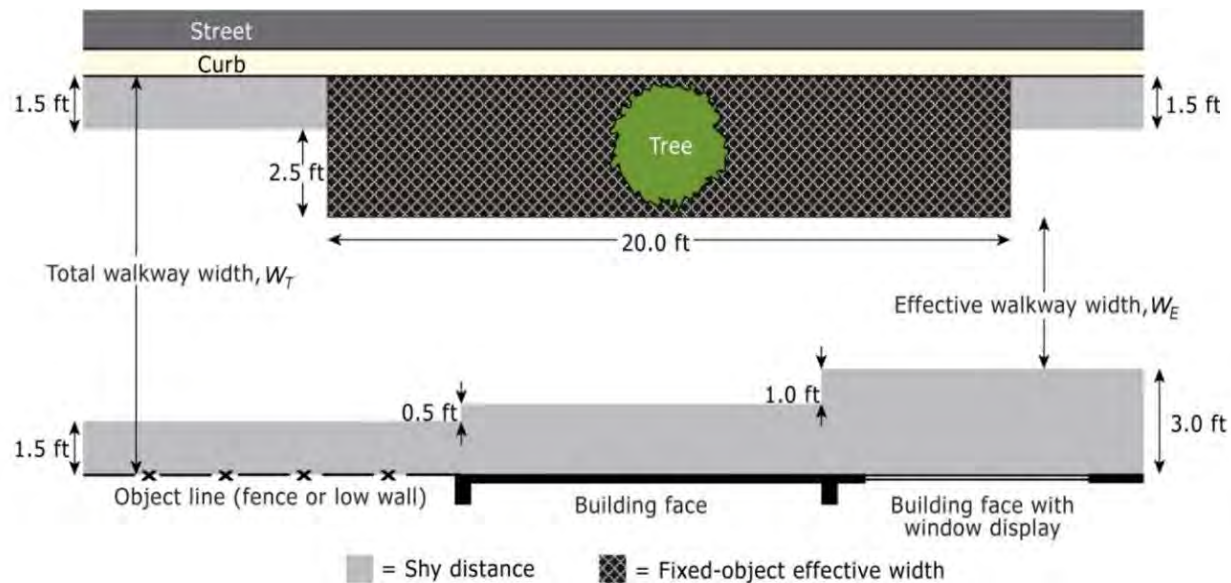
Pedestrian Flow

- Number of pedestrians served per unit width in a given period of time



Design Applications

- Pedestrian circulation facilities
 - Sidewalks (effective width)



Pedestrian Speed

- For signal timing applications
 - MUTCD guidelines – 3.5 ft/s
- Sidewalks and signalized crossings
 - HCM criteria – 4.0 ft/s
 - 20% are elderly – 3.3 ft/s
- Uncontrolled crossings
 - HCM criteria – 4.4 ft/s
 - NCHRP 17-87 field data – 4.7 ft/s

Pedestrian Circulation Area Analysis

- Performance measures
 - Pedestrian flow
 - Effective width
- Sidewalks and walkways (HCM 2000)
 - Average flow and platoon flow
- Stairways (HCM 2000, TCQSM)
 - Stairway capacity by lane width – TCQSM

Pedestrian Circulation Area Analysis

- Ramps and grades
- Crosswalks
 - HCM Chapter 19
- Transit station corridors (TCQSM)
 - Space, Flow rate

Pedestrian Storage Area & Traffic Signal Warrants

- Transit platform and signalized intersection corner storage
- MUTCD pedestrian volume traffic signal warrant
- MUTCD school crossing signal warrant