DEVELOPING DESIGN GUIDELINES FOR COMMERCIAL VEHICLE ENVELOPES ON URBAN STREETS

Edward McCormack
Anne Goodchild, David Hurwitz

I-NUF, Long Beach, Oct 17, 2019

University of Washington, Civil & Environmental Engineering

Oregon State University OSU

PACIFIC NW TRANSPORTATION CONSORTIUM PACTRANS REGION 10

UNIVERSITY of WASHINGTON

Overview

- Why we need to understand commercial vehicle loading zone (CVLZ) envelopes
  - Examples of problems
- Research needs
  - More freight
  - Lack of design support
- Data collection by direction observation and simulated deliveries
- Findings and how we apply the findings
- Further tests using a driving simulator

Handicapped parking zone buffer

Insufficient unloading space for trucks

Credit: Jonathan Shuster

Lift gate extends into a crosswalk

Credit: Jose Machado

Truck longer than available load zone

Credit: Manali Sheth

Drivers walking in roadway

Loading zone too short

Credit: Polina Butrina

Research background

- With pressure from multiple modes for curb capacity, cities are considering the allocation of curb space
- Rapid growth in urban freight deliveries (e-commerce)
- Safety - drivers killed and injured making deliveries
- Existing road infrastructure does not accommodate needs of a delivery truck - ad hoc solutions prevail so drivers often blocks roadways and paths

Research needs

- Needs of a delivery trucks are not acknowledged in roadway design and standards guides

- Significant gaps concerning freight in street design prescriptions such as *Complete Streets* and *Smart Growth*

Research needs

Commercial vehicles using loading zones are often not provided with usable or consistent envelope adjacent to the vehicle for loading and unloading activities.

Project goals

- Explore where commercial vehicle activity disrupts pedestrians, bicyclists, and motorists
- Support better roadway and loading zone design guidelines

Research approach

1. Observation of current practice and evaluation of existing infrastructure
2. Simulation of roadway user behavior

Observation of current practice

Observed 25 deliveries in urban Seattle

Observation of current practice

Recorded:

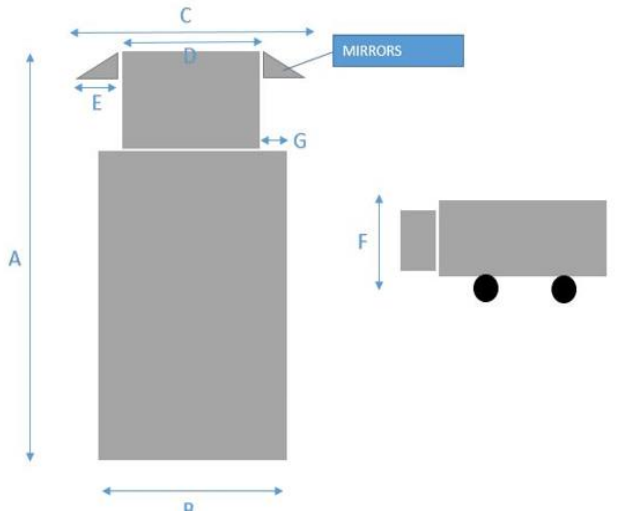
- Truck type
- Door (location and design)
- Driver behavior and paths
- Loading accessories (ramps, hand trucks, pallet jacks, etc.)
- Delivery characteristics
- Delivery environment

Selected findings

- Many vehicles (72%) had swing out doors (as opposed to roll up)
- Drivers walked on the back (64%) and passenger side of the vehicle (30%)
- Drivers use hand trucks (53%), nothing (15%), or pallet jacks (9%)
- 43% of the drivers unload out the back

Simulated deliveries

- Needed to safely capture quantitative measurements of the movements
- Simulated urban deliveries in controlled environment



Simulated deliveries

Worked with 3 companies & 7 different vehicles

- Moving services company
- United Parcel Service (UPS)
- Restaurant supply company

Simulated deliveries

Measured:

- Closed vehicle footprint
- Open vehicle footprint
- Active vehicle footprint
- Interviewed drivers

Recording simulated deliveries

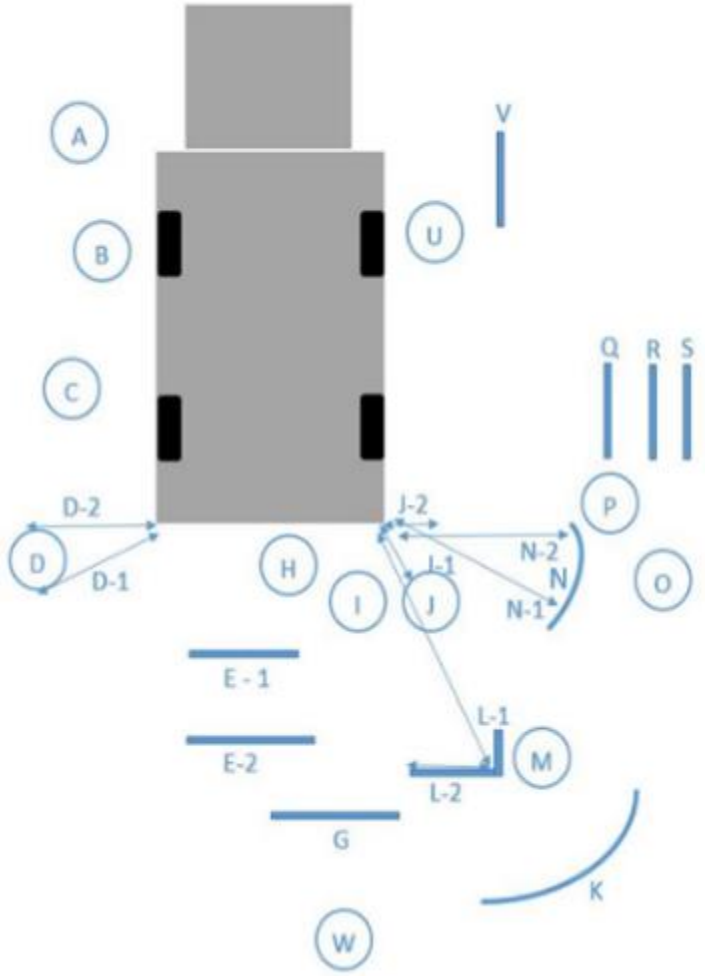
Recording simulated deliveries

Driver position

Accessories

Accessories limits

Turning radius



Example measurements

- Maximum width of trucks is 9.8ft/3.0m with mirrors
- Swing out doors require 3.2ft/1.0m
- Liftgates require up to 15.4ft/4.7m behind truck

Example measurements

Ramps on back require 13ft/4m but also need to add 6ft/1.8m for de-acceleration and hand truck maneuvering

Products

- Estimate the appropriate commercial vehicle envelope to reduce conflicts with other road users
- Envelopes is provided for different vehicle types, handling equipment, and cargo characteristics
- Develop educational materials oriented towards roadway design guides

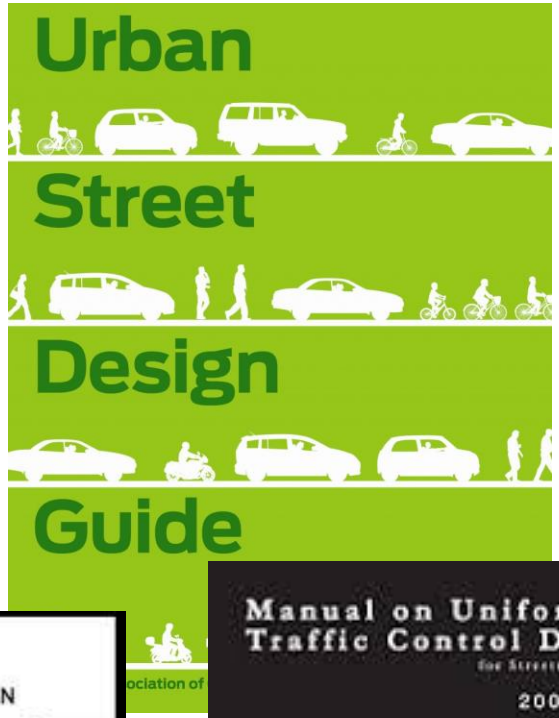
Application of Findings

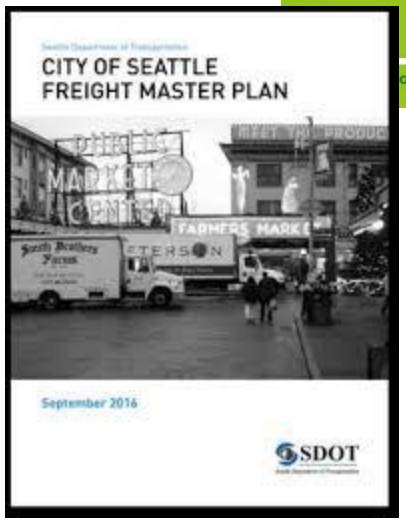
- Open vehicle foot print **+** active vehicle footprint **=** load zone envelope
- Example in restaurant district:

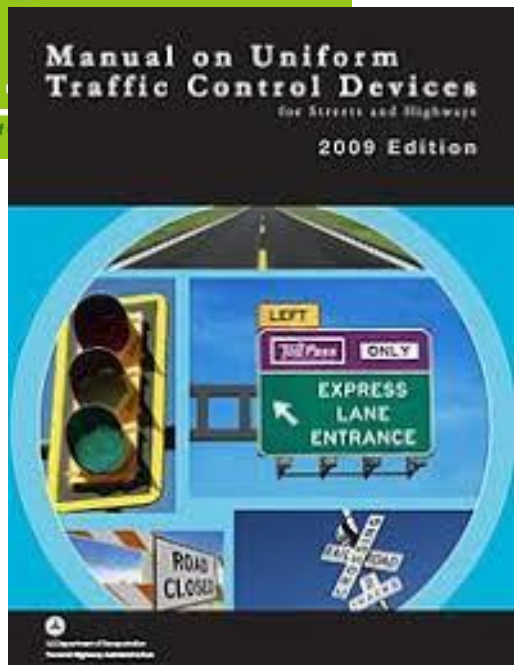
1. Typical truck size: 25ft/7.7m x 10ft/ 3.1m (FHWA class 5)
2. Add 2.3ft/0.7m width to open door
3. Ramps and hand trucks commonly used so add 18.7ft/5.7m to back
4. Add 0.6 m for driver access on side
5. **Total load zone envelope of 44ft x 15ft (13.4m x 4.4m)**

Application of findings

- Add precise measurements to design and standard guides
- Support more effective curb space management and urban freight







Next steps using simulator

- Our research partners are using this data to test driver and cyclist behavior around trucks to estimate an envelope that would reduce conflicts
  - Determined dependent and independent variables
  - Coded the static and dynamic elements of the virtual environment
  - Recruited and conducted subject tests in simulator

Simulation

For more information:

Edward McCormack

edm@uw.edu

University of Washington