Data-Driven Safety Training
Freeway Segment Safety Analysis
Part 1 Segmentation

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Outline

1 Safety analysis methodology and segmentation

2 Data requirements

3 Laclede I-44 example

4 Laclede I-44 solution

Freeway Segments vs. Interchanges

- HSM scope
  - Freeway segments
    - rural and urban
    - 4 or 6 lanes
    - speed change lanes
      - uncontrolled terminal between a ramp and a freeway
    - ramps
  - Freeway interchanges
- Workshop focuses on urban 4-lane segments

Safety Prediction Structure

- crashes (N) = SPF x CMFs x C
- SPF prediction based on level of exposure: traffic and segment length
- CMFs modification based on other facility characteristics, e.g. lane width, median barriers, curve radius
- C calibrates the national model to our Missouri conditions

Types of Crashes

- Types of crashes modeled differently
- Single vehicle (sv) vs. multi-vehicle (mv)
  - different mechanism at play, so model differently
  - e.g. common sv is run off the road due to inattention
  - e.g. common mv is rear end with congestion ahead
    - it takes two to tango

Severity of Crashes

- Severity of crashes modeled differently
- Fatal and injury (FI) vs. property damage only (PDO)
  - different mechanism at play, so model differently
  - more serious crashes have different mechanism than minor crashes

Combine Various Types of Crashes

- N(tot) = N(mv, FI) + N(sv, FI) + N(mv, PDO) + N(sv, PDO)
  - N(tot) = combined total
  - N(mv, FI) = multi-vehicle, fatal + injury
  - N(sv, FI) = single vehicle, fatal + injury
  - N(mv, PDO) = multi-vehicle, property damage only
  - N(sv, PDO) = single vehicle, property damage only

Freeway Segment SPF

$$N = L^{*} \times \exp(a + b \times \ln[c \times AADT_{fs}])$$

- L^{*} = effective length of freeway segment (mi)
- $AADT_{fs}$ = AADT volume of freeway segment (veh/day)
- *a, b, c* = regression coefficients
- This is the base model
  - tweak by using CMFs

Freeway Segment SPF

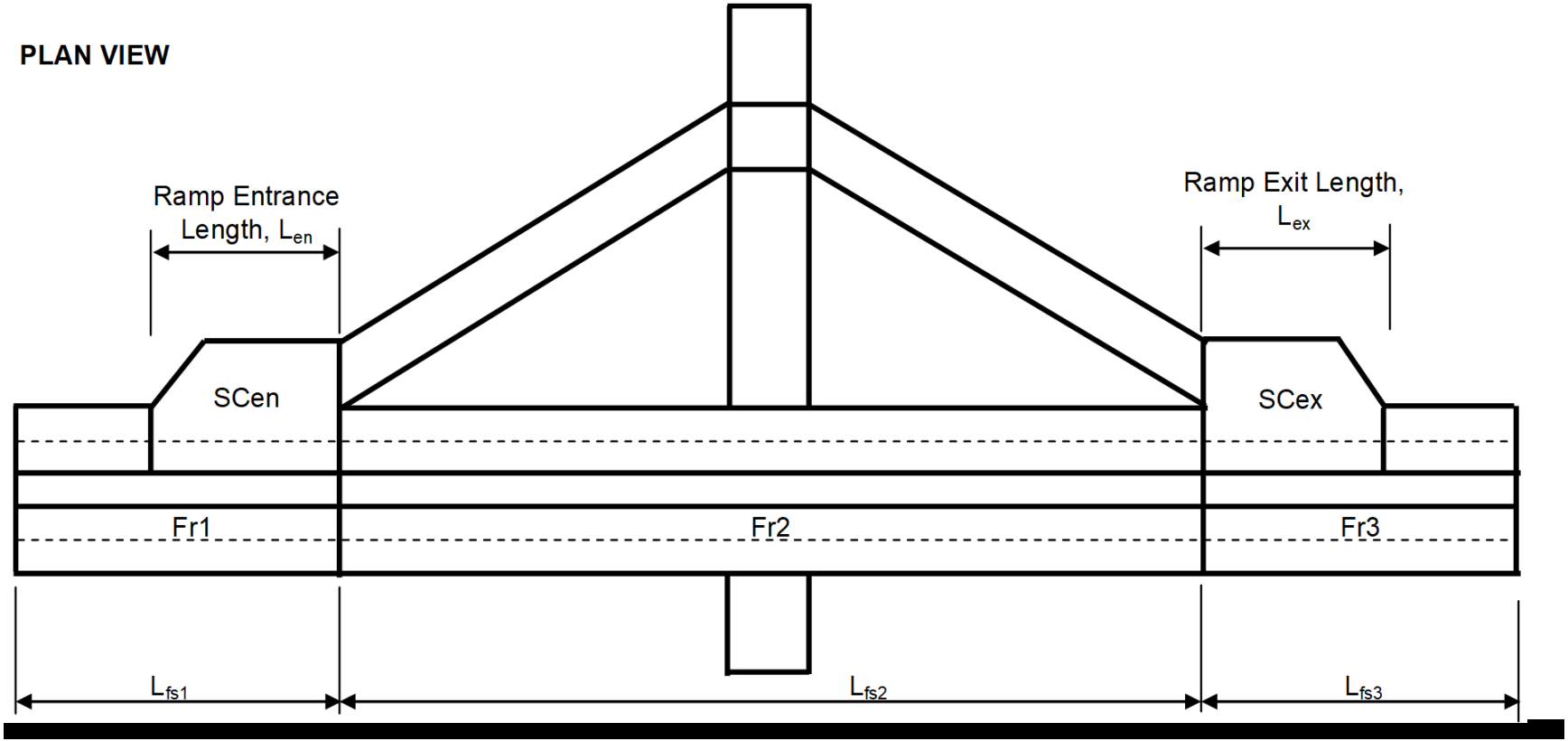
$$N = L^{*} \times \exp(a + b \times \ln[c \times AADT_{fs}])$$

- L^{*} = effective length of freeway segment (mi);
  - effective because we adjust the physical length by components such as the speed-change lanes

Segmentation

- Purpose - produce homogenous segments
  - with respect to characteristics such as traffic volumes, key geometric design features, and traffic control
- Why homogeneous segments?
  - homogeneous segments have similar safety performance,
  - if segments change in characteristics, their safety performance also changes

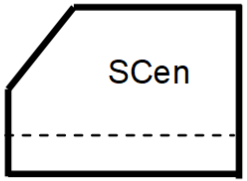
Segmentation Illustrated



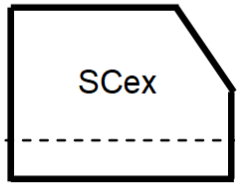
Segmentation Illustrated

COMPONENT PARTS

Speed-Change Lane
Type: ramp entrance
Seg. length = L_{en}



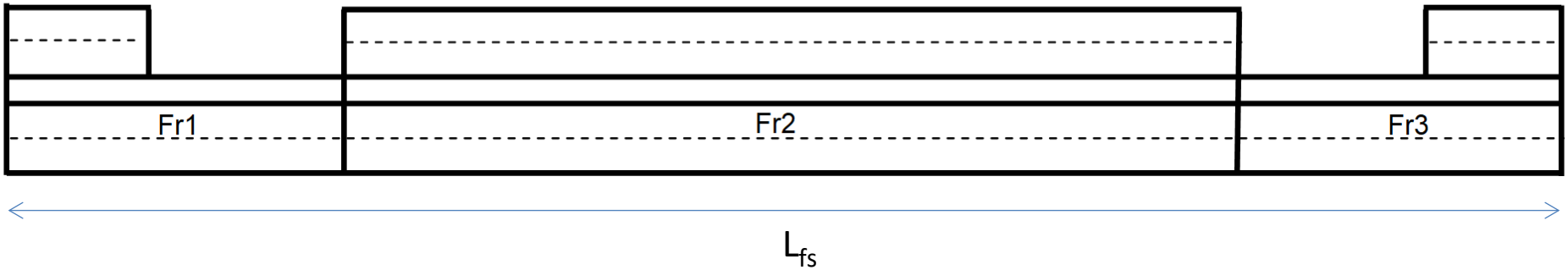
Speed-Change Lane
Type: ramp exit
Seg. length = L_{ex}



Freeway Segment

Effective segment length, $L^* = L_{fs} - L_{en}/2 - L_{ex}/2$

(note: freeway segment length does not include the length of speed-change lanes, if these lanes are adjacent to the segment)



Segmentation Example 1

- Traditional symmetric diamond interchange
- Speed-change lane distance
  - on-ramp=gore to taper, off-ramp=taper to gore
- Here ~417 ft of speed change lane for WB on-ramp

Segmentation Example 1

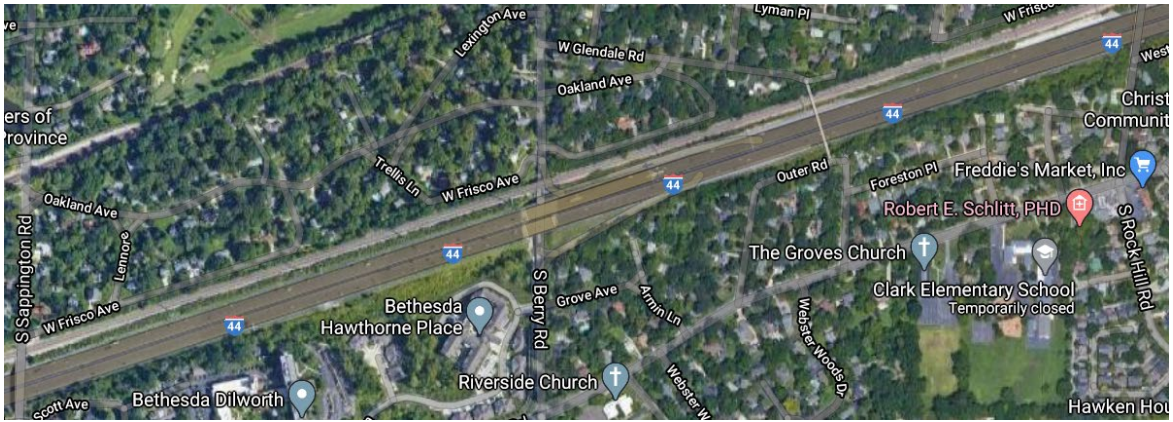
- Assume 1 mile segment, L_{fs}= 5280 ft, includes interchange
- For an entire interchange with 2 on and off ramps
- WBon=417 ft, WBoff=224 ft, EBon=647ft, Eboff=340ft
- $L^*=L_{fs}$ – 417/ 2 – 224/2 – 657/2 – 340/2 = 4461 ft

Segmentation Example 2

- I-44 & S. Berry Rd. near St. Louis, asymmetric east side ramps
- Speed change: WB off ramp 710.34 ft, EB on ramp 642.02 ft

Segmentation Example 2

- Again, assume 1 mile segment, L_{fs}= 5280 ft, includes interchange
- Speed change length: WBoff=710.34 ft, EBon=642.02 ft
- $L^*=L_{fs}$ – 710.34/2 - 642.02/2 = 4603.82 ft



Segmentation Example 3

- MO-370 & Earth City Expy, partial cloverleaf

Segmentation Example 3

- Assume 4000 ft segment, includes interchange
- Speed change lengths: WBon=626.83 ft, WBoff= 941.96 ft (clover), EBon=800.70 ft, EBoff=776.82 ft
- L*=4000 – 626.83/2 – 941.96/2 – 800.7/2 – 776.82/2 = 2426.85 ft