Assessment of Sidewalk / Bicycle-Lane Gaps with Pedestrian Safety

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INTRODUCTION

• Transition to the mobility of people requires safe accommodation of all road users

• Public safety has become a focal point for decision makers to emphasize

• Walking & biking have been heavily promoted in recent years

• Pedestrian & bicycle Safety have emerged to be of major concern to Federal agencies & selected States

• Recent trends in pedestrian fatalities raises concern
WHY PEDESTRIAN SAFETY?

- 2003-2012: 47,000 people died while walking
- 2005-2009: fell from 5,000 to 4,200 then back to 4,900
- In 2012: Ped represented 15% of all traffic fatalities

Source: 2014 Dangerous by Design report
WHY PEDESTRIAN SAFETY?

- Pedestrian fatalities remain high in 2014

Source: 2014 Governors Highway Safety Association
WHY PEDESTRIAN SAFETY?

• “Please note that while the distance between the conference hotel and nearby lodging facilities appears short, the lack of sidewalks makes the use of shuttles/private vehicles the best choice”.

Dr. Virginia Sisiopiku

- National PDI = 52.2 (2003-2012)
- Annual Ped Fatality rate = 1.56 per 100,000 people

Source: 2014 Dangerous by Design report
WHY PEDESTRIAN SAFETY?

- FL has consistently ranked among the worst states in ped crashes, injuries & fatalities (NHTSA, 2011)
- Four metro areas in FL are the most dangerous for peds among all states (Ernst et al., 2011).
- Orlando-Kissimmee, Tampa-St. Pete-Clearwater, Jacksonville, Miami-Ft. Lauderdale) areas.
- Pedestrian safety is of particular concern to Florida.
LITERATURE REVIEW

• Several studies attempted to identify significant factors related to ped crashes

• Main factors included:
  ➢ Environmental Factors
  ➢ Human Factors
  ➢ Vehicle Characteristics
  ➢ Roadway Characteristics
  ➢ Special Locations
LITERATURE REVIEW

- FL undivided roadways with greater no of lanes are more dangerous than divided roadways (Lee & Aty, 2005)
- Tourism, elders, exposure to traffic, interstate miles/resident, poverty rate explained 70% of FL ped fatalities (Dewey et al., 2003)
- Factors contributing to pedestrian injury severity at signalized and non-signalized locations in FL were studied at 6,343 intersections (Alluri et al., 2013)
- Most studies focused on the relation between presence of sidewalk & crash severity
PROBLEM STATEMENT

- Pedestrian sidewalks & bicycle lanes in Florida are not continuous
- These gaps constitute discontinuity of flow
- Potentially posing threats to pedestrian safety
- FDOT District 5 utilized GIS to identify gaps within the 9 County region
- Prioritization of these projects is more challenging
- Need to understand the relationship between gaps and safety
DATA SOURCES

- GIS & RCI data were necessary for the study
- Several agencies within District 5 were contacted
- GIS data were not homogeneous
- Spatial Join was difficult to analyze crash data with roadway features
- UCF utilized the FL Unified Basemap Repository (UBR)
- Other sources included Signal 4 Analytics database (http://s4.geoplan.ufl.edu/).
## STATEWIDE PED / BIKE CRASHES

- **5-Year Crash Data (June 2009-June 2014)**

<table>
<thead>
<tr>
<th>District</th>
<th>Total Ped/Bike Crashes</th>
<th>Ped-Related Crashes</th>
<th>Bike-Related Crashes</th>
<th>Ped/Bike Split %</th>
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<tbody>
<tr>
<td>District 1</td>
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<td>3,765</td>
<td>3,353</td>
<td>53/47 %</td>
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<tr>
<td>District 2</td>
<td>5,850</td>
<td>3,359</td>
<td>2,491</td>
<td>57/43 %</td>
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<td>District 3</td>
<td>3,530</td>
<td>2,110</td>
<td>1,420</td>
<td>60/40 %</td>
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<tr>
<td>District 4</td>
<td>12,960</td>
<td>7,295</td>
<td>5,665</td>
<td>56/44 %</td>
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<tr>
<td>District 5</td>
<td>11,352</td>
<td>6,496</td>
<td>4,856</td>
<td>57/43 %</td>
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<tr>
<td>District 6</td>
<td>9,784</td>
<td>6,300</td>
<td>3,484</td>
<td>64/36 %</td>
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<td>District 7</td>
<td>10,951</td>
<td>5,824</td>
<td>5,127</td>
<td>53/47 %</td>
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<tr>
<td>Statewide</td>
<td>61,545</td>
<td>35,149</td>
<td>26,396</td>
<td>57/43 %</td>
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</tbody>
</table>

Source: Signal 4 Analytics Database
STATEWIDE PED / BIKE CRASHES

- District 4 = 21.0%
- District 5 = 18.4%
- District 7 = 17.8%
- District 6 = 15.9%

- D5 was selected for further analysis
- Kernel Density was used to identify Hot Spot locations
KERNEL DENSITY FUNCTION

- Hot Spot Ped crashes – District 5
KERNEL DENSITY FUNCTION

- Hot Spot Bike crashes – District 5
PED CRASHES BY AADT

Legend
- Intersections with pedestrian crashes more than 1.04
- 30,001 - 50,000
- 50,001 - 70,000
- 70,001 - 110,000
- 110,001 - 160,000
- 160,001 - 30,000

Annual Average Daily Traffic

Annual Average Daily Traffic
- 30 - 15,000
- 15,001 - 30,000
BIKE CRASHES BY AADT

Annual Average Daily Traffic (AADT)

Legend
- Intersections with bicycle crashes more than 1,036
- Annual Average Daily Traffic
  - 30,001 - 50,000
  - 50,001 - 70,000
  - 70,001 - 110,000
  - 110,001 - 160,000
  - 160,001 - 30,000

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics
PED / BIKE CRASHES BY AREA TYPE

Legend
- Bicycle crashes above average

Area type
- Rural
- Urban
- District 5 of DOT
ON & OFF SYSTEM CRASHES

- Total Ped crashes were identified from the UBR over the 5-Year period 2008-2012
- A 125 ft buffer was used to eliminate crashes at intersections
- FDOT 2012 sidewalk & sidewalk gap layers were mapped
- 50 ft buffer was used to locate roadway segment crashes
CENSUS DATA

- Area population contributes to pedestrian activity within the area
- Population metric was used as a surrogate measure for pedestrian activity
- Population GIS layer for 2010 Census data at the tract level was overlaid on top of crashes
- 0.5 mile radius was used as a reasonable walking distance surrounding crash locations
CENSUS DATA

- Year 2010 population data within 0.5-mile radius of pedestrian crash location
The following parameters were selected for the modeling process:

- No. of Ped Crashes (Crash)
- AADT (vpd)
- Posted Speed (mph)
- Avg Population within 0.5 mile radius (person)
- Sidewalk (0) = No sidewalk (sidewalk gap)
  Sidewalk (1) = Sidewalk exists
- Roadway Category (23 categories)
PED CRASH MODELING

Roadway Category (23 categories)

1 – Urban interstate
2 – Rural interstate
8 – Rural ramp
12 – Urban 2-3 lanes two-way undivided
13 – Suburban 2-3 lanes two-way divided raised median
14 – Suburban 2-3 lanes two-way divided painted median
15 – Suburban 2-3 lanes two-way undivided
16 – Rural 2-3 lanes two-way divided raised median
17 – Rural 2-3 lanes two-way divided painted median
18 – Rural 4-5 lanes two-way undivided
20 – Urban 4-5 lanes two-way divided raised median
21 – Urban 4-5 lanes two-way divided painted median
22 – Urban 4-5 lanes two-way undivided
23 – Suburban 4-5 lanes two-way divided raised median
24 – Suburban 4-5 lanes two-way divided painted median
25 – Suburban 4-5 lanes two-way undivided
26 – Rural 4-5 lanes two-way divided raised median
30 – Urban 6 or more lanes two-way divided raised median
31 – Urban 6 or more lanes two-way divided painted median
33 – Suburban 6 or more lanes two-way divided raised median
34 – Suburban 6 or more lanes two-way divided painted median
40 – Urban one-way
41 – Suburban one-way
# PED CRASH MODELING

<table>
<thead>
<tr>
<th>CRASHCOUNTS</th>
<th>ROADCATGRY</th>
<th>AADT</th>
<th>SPEED</th>
<th>SIDEWALK</th>
<th>AVGPOP</th>
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</table>
PED CRASH MODELING

- “R” statistical package was utilized
- Poisson regression model was developed but suffered from over dispersion
- A negative binomial model was appropriate for the data
- Final form of the model:

\[
\ln(\text{Expected Number of Crashes}) = 0.82 - 0.114 \times (\text{AADT} \times 5 \times \frac{365}{1000000}) + 0.513 (\text{“1” if sidewalk present or “0” for gap}) + \text{Roadway Category coefficient (18, 20, 21, 23, 24, 26, 30, 31}) + 0.000278 (\text{Average Population within 0.5-mile radius}).
\]
| Coefficient                        | Estimate  | Std. Error | Z Value | PR(>|Z|) | Significance |
|-----------------------------------|-----------|------------|---------|----------|--------------|
| **INTERCEPT**                     | 8.217e-01 | 1.193e+00  | 0.689   | 0.49113  |              |
| **5-YEAR VOLUME**                 | -1.114e-02| 3.620e-03  | -3.077  | 0.00209  | ***          |
| **SIDEWALK**                      | 5.129e-01 | 2.025e-01  | 2.532   | 0.01134  | ***          |
| **POSTED SPEED**                  | -1.992e-02| 2.224e-02  | -0.896  | 0.37026  |              |
| **ROADCATGRYRCAT12**              | 4.124e-01 | 1.064e+00  | 0.388   | 0.69836  |              |
| **ROADCATGRYRCAT13**              | 1.488e-01 | 9.553e-01  | 0.156   | 0.87624  |              |
| **ROADCATGRYRCAT14**              | 6.086e-01 | 7.656e-01  | 0.795   | 0.42665  |              |
| **ROADCATGRYRCAT15**              | 1.153e+00 | 7.729e-01  | 1.492   | 0.13579  |              |
| **ROADCATGRYRCAT16**              | 3.104e-01 | 1.419e+00  | 0.219   | 0.82685  |              |
| **ROADCATGRYRCAT17**              | 7.438e-01 | 8.412e-01  | 0.884   | 0.37659  |              |
| **ROADCATGRYRCAT18**              | 1.668e+00 | 8.185e-01  | 2.038   | 0.04157  | ***          |
| **ROADCATGRYRCAT2**               | 9.920e-01 | 1.527e+00  | 0.650   | 0.51582  |              |
| **ROADCATGRYRCAT20**              | 2.032e+00 | 7.182e-01  | 2.830   | 0.00466  | ***          |
| **ROADCATGRYRCAT21**              | 1.986e+00 | 7.168e-01  | 2.770   | 0.00561  | ***          |
| **ROADCATGRYRCAT22**              | -7.635e-02| 9.290e-01  | -0.082  | 0.93450  |              |
| **ROADCATGRYRCAT23**              | 2.178e+00 | 7.278e-01  | 2.992   | 0.00277  | ***          |
| **ROADCATGRYRCAT24**              | 1.299e+00 | 7.351e-01  | 1.767   | 0.07729  | ***          |
| **ROADCATGRYRCAT25**              | -7.356e-01| 1.035e+00  | -0.711  | 0.47733  |              |
| **ROADCATGRYRCAT26**              | 2.025e+00 | 9.007e-01  | 2.249   | 0.02453  | ***          |
| **ROADCATGRYRCAT30**              | 2.412e+00 | 7.344e-01  | 3.285   | 0.00102  | ***          |
| **ROADCATGRYRCAT31**              | 1.429e+00 | 7.383e-01  | 1.935   | 0.05297  | ***          |
| **ROADCATGRYRCAT33**              | 6.722e-01 | 7.609e-01  | 0.883   | 0.37702  |              |
| **ROADCATGRYRCAT34**              | -4.781e-01| 9.928e-01  | -0.482  | 0.63012  |              |
| **ROADCATGRYRCAT40**              | 3.684e-01 | 8.047e-01  | 0.458   | 0.64711  |              |
| **ROADCATGRYRCAT41**              | -6.359e-01| 1.019e+00  | -0.624  | 0.53262  |              |
| **ROADCATGRYRCAT8**               | -9.575e-01| 1.431e+00  | -0.669  | 0.50341  |              |
| **AVGPOP**                        | 2.782e-04 | 6.247e-05  | 4.452   | 8.49e-06 | ***          |
CONCLUSIONS

• Absence of sidewalk is one of the main factors with significant impact on the likelihood of a pedestrian crash.

• Other factors included AADT, Roadway Category, specifically along rural & urban two-way undivided arterials with 4-6 lanes, & avg population within 0.5 mile radius.

• Speed was not significant. (affects crash severity).

• The analysis showed that the likelihood of a pedestrian crash along roadways with no sidewalk is 2/3 the likelihood of a crash with the presence of a sidewalk.
Thank You