Implementation of Adequate Street Lighting Level and Uniformity to Improve Pedestrian Safety at Night

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Can you see me now?
Nighttime crashes are overrepresented.
Many pedestrian and bicycle crashes occur at night.
Visibility is a major factor for nighttime pedestrian and bicyclist fatalities, injuries and crashes.
Roadway illumination is a vital component of traffic safety.
It is necessary to regularly measure roadway lighting levels.
Without effectively addressing nighttime visibility problems, it is difficult to see significant reduction of nighttime fatalities.
Past Studies

- Most studies considered the presence of roadway lighting
- Limited studies assessed safety effects of street lighting
  - Inconsistent, even counterintuitive conclusions
  - Few studies considered uniformity of illumination levels
  - Outdated lighting and crash data
Problems with “manual” street lighting data collection:

- Costly ($5,000+/mile)
- Worker safety concerns
- Driver safety concerns
- Manpower
- Accuracy/reliability
Innovative Solution - Advanced Illumination Measurement System (ALMS)
Data points are automatically collected for each lane every 10 feet.
Output 2: Heat Map

Points are aggregated and averaged based on the roadway’s characteristics (number of lanes, light source locations, etc.)
Measurement of Lighting Level and Uniformity

High Pressure Sodium (HPS)

<table>
<thead>
<tr>
<th>Wesley Chapel Blvd</th>
<th>HPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>0.03</td>
</tr>
<tr>
<td>Max</td>
<td>4.05</td>
</tr>
<tr>
<td>Avg</td>
<td>0.43</td>
</tr>
<tr>
<td>Avg/Min</td>
<td>13.29</td>
</tr>
<tr>
<td>Max/Min</td>
<td>126.69</td>
</tr>
</tbody>
</table>

Light-emitting Diode (LED)

<table>
<thead>
<tr>
<th>Wesley Chapel Blvd</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>0.03</td>
</tr>
<tr>
<td>Max</td>
<td>2.92</td>
</tr>
<tr>
<td>Avg</td>
<td>1.07</td>
</tr>
<tr>
<td>Avg/Min</td>
<td>35.66</td>
</tr>
<tr>
<td>Max/Min</td>
<td>97.33</td>
</tr>
</tbody>
</table>

Histograms showing the frequency and cumulative distribution of lighting levels for HPS and LED.
Lighting Data Collection
(300+ centerline miles in Tampa Bay including 91 signalized intersections from 2012 to 2014)
Expected Nighttime Crash Frequency (Signalized Intersections)

Increase Illuminance from < 0.2 fc to 0.2 fc – 1.1 fc will reduce nighttime crash number by
- 53% at 3-leg intersections and 52% (3.1 per year) at 4-leg intersections
Predicted Probability of Fatality and Severe Injury in Nighttime Crashes by Crash Types (Signalized Intersections)
Predicted Probability of Fatality and Severe Injury in Nighttime Crashes by Crash Types with Alcohol or Drug Involvement (Signalized Intersections)
Expected Nighttime Crash Frequency (Corridor segments)

- Average Horizontal Illuminance (fc):
  - 0
  - 0.2
  - 0.4
  - 0.6
  - 0.8
  - 1
  - 1.2
  - 1.4
  - 1.6

- Overall:
- Good Uniformity
- Poor Uniformity

- Expected Nighttime Crash Frequency (per 4 years):
  - 3.5
  - 4
  - 4.5
  - 5
  - 5.5
  - 6
  - 6.5
  - 7
Conclusions and Recommendations

- Improvement of street lighting level is an effective countermeasure to improve nighttime safety of all road users.

- Compared to the low illuminance (<0.2 fc), the medium illuminance (>0.2 fc and <1.1 fc) could significantly reduce nighttime crash frequencies by approximately 50%.

- Increasing illuminance from under 0.9 to 0.9 foot candles or higher will reduce the probability of fatality and serious injury:
  - pedestrian or bicycle involved crash by 10.7%
  - head-on crash by 9.0%
  - angle crashes by 6.3%.

- If alcohol or drugs were involved, these reductions were even higher.
Conclusions and Recommendations

- To effectively reduce nighttime fatalities and crash severity, illuminance should be ≥ 0.9 fc.

- Good illumination uniformity can reduce nighttime crash frequency.

- It is recommended to maintain the average illuminance at signalized intersections **0.9 fc or higher**.
Thank You!

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