Traffic Noise Modeling

Preliminary Development & Final Design
How do the results compare?

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Traffic Noise Modeling

I-77 Case Study
Canton, Ohio

- Existing interstate highway with 2 lanes each direction
- Adding 1 median lane in each direction within existing ROW
- Study area = 10 miles in length (4 projects)
- Engineer’s Total Cost Estimate (Project 2) $22 M
  Barriers $4.3M (20%)

- Single and multi-family homes
- Park, school, motels, churches, commercial development

- No existing noise barriers, numerous complaints from residents
Preliminary Development Noise Analysis
(Environmental)

Data Utilized

• Roadway
  – County planimetric maps (hardcopy with elevation data & no centerlines)
  – XYZ manually determined with grid paper

• Traffic
  – IR 77 Area Development Study predicted future traffic volumes
  – ADT only, DHV and % Trucks assumed

• Receivers
  – as shown on planimetric maps

• Assumptions
  – analysis would likely result in recommendation for barrier construction
  – 1998 Study Stamina 2.0/Optima

Planimetric Map
Final Design Noise Analysis
(Construction Plans)
Data Utilized

- Roadway
  - Lane group centerlines from design plan CAD files
- Traffic
  - Project design designation (DHV, % Trucks, Design Speed)
- Receivers
  - Scanned planimetric maps & digital airphotos referenced into CAD files
- Barriers
  - Locations determined in conjunction with design team (cross-sections)
  - Edge of shoulder with snow storage area
  - L/A Line in place of fence
  - 2002 Study TNM

Preliminary Development
(Environmental)
Analysis Results

- Noise Levels
  - Predicted within 3dB of monitored
- Impacts
  - DY levels exceed FHWA NAC

<table>
<thead>
<tr>
<th>Location</th>
<th>Model</th>
<th>Existing</th>
<th>Predicted (dBA)</th>
<th>Substantial Increase</th>
<th>FHWA NAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodridge</td>
<td>Stark</td>
<td>n/a</td>
<td>66</td>
<td>72</td>
<td>no</td>
</tr>
<tr>
<td>7th Street (south)</td>
<td>Stark</td>
<td>n/a</td>
<td>66</td>
<td>72</td>
<td>no</td>
</tr>
<tr>
<td>York St (north)</td>
<td>Stark</td>
<td>n/a</td>
<td>66</td>
<td>72</td>
<td>no</td>
</tr>
<tr>
<td>Orchard St.</td>
<td>Stark</td>
<td>n/a</td>
<td>66</td>
<td>72</td>
<td>no</td>
</tr>
<tr>
<td>500 St (north)</td>
<td>Stark</td>
<td>n/a</td>
<td>66</td>
<td>72</td>
<td>no</td>
</tr>
<tr>
<td>5th St. (north)</td>
<td>Stark</td>
<td>n/a</td>
<td>66</td>
<td>72</td>
<td>no</td>
</tr>
<tr>
<td>Broadview</td>
<td>Stark</td>
<td>n/a</td>
<td>66</td>
<td>72</td>
<td>no</td>
</tr>
<tr>
<td>Conscience</td>
<td>Stark</td>
<td>n/a</td>
<td>66</td>
<td>72</td>
<td>no</td>
</tr>
</tbody>
</table>
Preliminary Development
(Environmental)
Analysis Results

- Mitigation
  - 12-16’ barrier > 5dB IL for 38th Street East Barrier

- Cost Effectiveness
  - 38th < $ 25,000 receptor
  - 50th > $ 25,000 receptor

- Environmental Commitment that cost effective barriers be investigated in final design
  - must be in design scope
  - don't underestimate effort

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**Table 3: Noise Barrier Summary**

<table>
<thead>
<tr>
<th>Location</th>
<th>Barrier Length</th>
<th>Height</th>
<th>Sq. Feet</th>
<th>Estimated Cost</th>
<th>Receptors</th>
<th>Cost per Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodridge</td>
<td>167'</td>
<td>10'</td>
<td>20,400</td>
<td>$291,000</td>
<td>6-6ms</td>
<td>$24,250</td>
</tr>
<tr>
<td>38th Street (east)</td>
<td>17'</td>
<td>5'</td>
<td>34,485</td>
<td>$354,700</td>
<td>9-7receptors at school</td>
<td>$32,145 / recess</td>
</tr>
<tr>
<td>38th Street (west)</td>
<td>17'</td>
<td>5'</td>
<td>34,485</td>
<td>$354,700</td>
<td>9-7receptors at school</td>
<td>$32,145 / recess</td>
</tr>
<tr>
<td>Crookedale</td>
<td>14'</td>
<td>6'</td>
<td>36,750</td>
<td>$594,500</td>
<td>6</td>
<td>$100,000</td>
</tr>
<tr>
<td>5th Street (west)</td>
<td>17'</td>
<td>5'</td>
<td>25,054</td>
<td>$333,900</td>
<td>10 recess</td>
<td>$33,390</td>
</tr>
<tr>
<td>5th Street (north)</td>
<td>20'</td>
<td>7'</td>
<td>26,054</td>
<td>$522,400</td>
<td>9-5 recess</td>
<td>$64,500</td>
</tr>
<tr>
<td>Broadmoor</td>
<td>17'</td>
<td>5'</td>
<td>31,000</td>
<td>$331,800</td>
<td>13-2 hotel units</td>
<td>$20,178</td>
</tr>
<tr>
<td>Convenience</td>
<td>18'</td>
<td>5'</td>
<td>31,485</td>
<td>$382,500</td>
<td>14 hotel units</td>
<td>$26,178</td>
</tr>
<tr>
<td>Whipple</td>
<td>16'</td>
<td>10'</td>
<td>10,125</td>
<td>$146,900</td>
<td>6 hotel units</td>
<td>$24,487</td>
</tr>
</tbody>
</table>

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Final Design
(Construction Plans)
Analysis Results

- Noise Levels
  - Predicted > Existing

- Impacts
  - Exceed FHWA NAC

- Mitigation
  - 12-14’ Barrier
  - Exceeds goal (6 dB) at first row impacted receivers
Final Design
(Construction Plans)
Analysis Results

- Cost Effectiveness
  - $25/ sq ft double sided sound absorptive barrier material
  - Total Cost $1,442,400
  - Cost per DU = $11,262

Did the environmental level analysis accurately predict design level modeling results?

<table>
<thead>
<tr>
<th></th>
<th>Preliminary Development</th>
<th>Final Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Model</td>
<td>Stamina 2.0/Optima</td>
<td>TNM 1.0b</td>
</tr>
<tr>
<td>No Barrier Noise Level*</td>
<td>72.5 dB</td>
<td>71.4 dB</td>
</tr>
<tr>
<td>Barrier Height</td>
<td>12-16'</td>
<td>8-14'</td>
</tr>
<tr>
<td>Barrier Effectiveness* (IL)</td>
<td>9.3 dB</td>
<td>8.3 dB</td>
</tr>
<tr>
<td>Barrier Location</td>
<td>Shoulder</td>
<td>Shoulder with snow storage</td>
</tr>
<tr>
<td>Number of DU</td>
<td>119</td>
<td>128</td>
</tr>
<tr>
<td>Cost per DU</td>
<td>$13,182</td>
<td>$11,262</td>
</tr>
</tbody>
</table>

* Burrshire pool receiver
I-77 Study
Areas for Improvement

• “No New ROW” = no mapping or survey beyond L/A fence, all receiver info from non-project sources

• “No New ROW” = no adjacent property owner mailing list, a public involvement challenge

• Design Year Traffic data = Predicted truck volume may be low
  – Design Designation (2024) = 10%
  – Field Observed (2002) = 14%

I-77 Study
Lessons Learned

• Assumption that barriers would be part of final design = detailed environmental noise study, not last minute decisions

• Detailed environmental study allowed time for aesthetic considerations and public involvement during final design

• Close coordination between Noise Analysts, Highway Design Team, DOT, Local Officials, and the Public - ESSENTIAL

• Can do / must do attitude of entire team!