Traffic Noise Modeling

Preliminary Development & Final Design
How do the results compare?

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2003 Purdue Road School

Traffic Noise Modeling

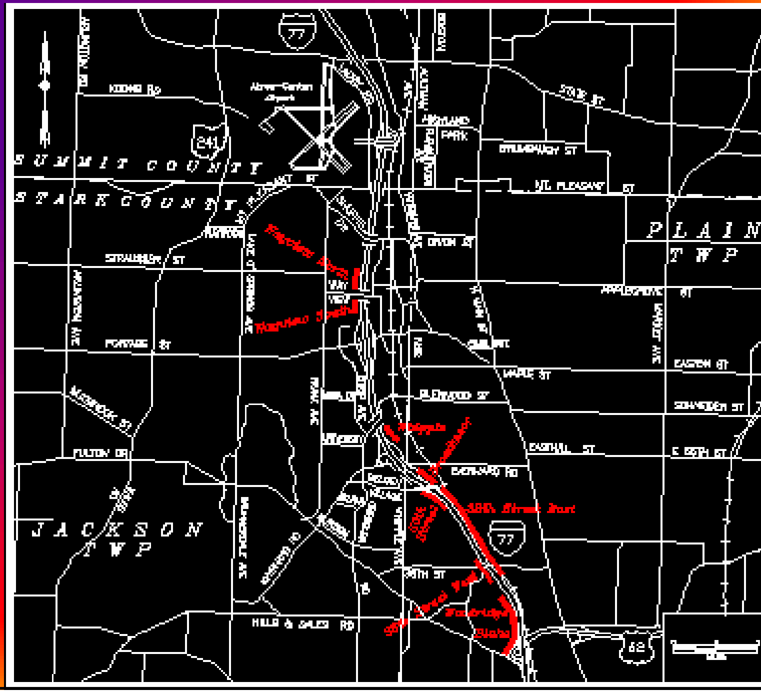
I-77 Case Study
Canton, Ohio

- 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

Study Area Map



38th Street Barriers

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

STA-77-20.502 SUM-77-00.853
NOISE IMPACT ANALYSIS

Table 2 TRAFFIC NOISE IMPACT SUMMARY (See Appendix 2 for additional information)

Location			Noise Levels in dBA		Impacts in D.Y.	
Area	County	Model Name	Monitored Existing	Predicted (D.Y.)	Substantial Increase	FHWA NAC
Woodridge	Stark	wood	70	66-72	no	exceeds
38th Street (west)	Stark	arbor	66 (Taft School)	68-72	no	exceeds
38th Street (east)	Stark	burr	n/a	68-73	**	exceeds
Orchardale	Stark	orch	67	66-71	no	exceeds
50th Street (west)	Stark	bv	62*	66-71	no	exceeds
50th Street (north)	Stark	bv	n/a	66-68	**	exceeds
Broadmoor	Stark	bv	n/a	67-73	**	exceeds
Convenience	Stark	bv	n/a	70-72	**	exceeds

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

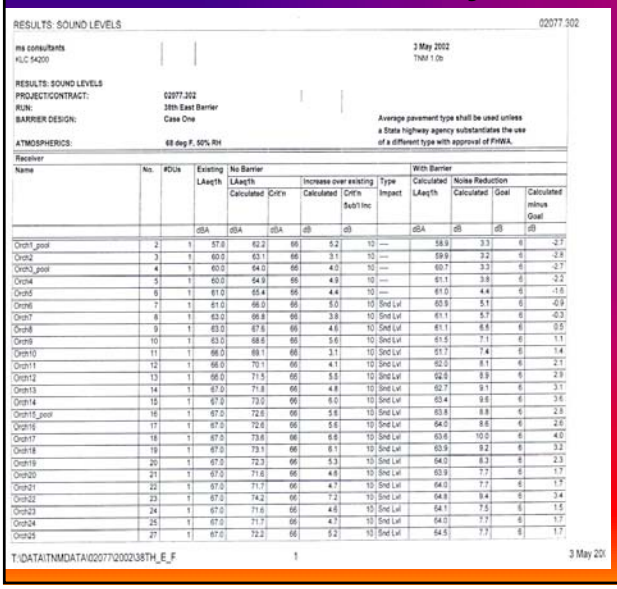
Preliminary Development
(Environmental)
Analysis Results

Table 3 NOISE BARRIER SUMMARY (See Figure 2 and Appendix 2 for additional information)

Location			Barrier			Number of	Estimated
Area	County	Rough Length	Height	Sq. Feet*	Estimated Cost*	Receptors **	Cost per Receptor
Woodridge	Stark	1120'	16'-20'	20,020	$291,000	6 + 6 res	$24,250
38th Street (west)	Stark	2039'	12'	24,463	$354,700	9 + 2 res & school	$22,155 / res $111,000 sch
38th Street (east)	Stark	3705'	12'-16'	51,417	$745,500	82 apts	$9,091
Orchardale	Stark	4055'	14'	56,770	$823,100	37 res	$22,245
50th Street (west)	Stark	1520'	12'-18'	23,034	$333,900	10 res	$33,390
50th Street (north)	Stark	801'	20'	16,024	$232,400	0 + 5 res	$46,480
Broadmoor	Stark	668'	12'-16'	9,100	$131,900	13 + 2 hotel units	$8,793
Convenience	Stark	1083'	18'	19,486	$282,500	14 hotel units	$20,178
Whipple	Stark	625'	16'-18'	10,128	$146,800	6 apts	$24,467

- 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**

Final Design
(Construction Plans)
Analysis Results


RESULTS: SOUND LEVELS 02077.302

ms consultants
KLC 54200

3 May 2002
TNM 1.0b

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: 02077.302
RUN: 38th East Barrier
BARRIER DESIGN: Case One
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n 5wb1 Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Orch1_pool	2	1	57.0	62.2	66	5.2	10	---	58.9	3.3	6	-2.7
Orch2	3	1	60.0	63.1	66	3.1	10	---	59.9	3.2	6	-2.8
Orch3_pool	4	1	60.0	64.0	66	4.0	10	---	60.7	3.3	6	-2.7
Orch4	5	1	60.0	64.9	66	4.9	10	---	61.1	3.8	6	-2.2
Orch5	6	1	61.0	65.4	66	4.4	10	---	61.0	4.4	6	-1.6
Orch6	7	1	61.0	66.0	66	5.0	10	Snd Lvl	60.9	5.1	6	-0.9
Orch7	8	1	63.0	66.8	66	3.8	10	Snd Lvl	61.1	5.7	6	-0.3
Orch8	9	1	63.0	67.6	66	4.6	10	Snd Lvl	61.1	6.5	6	0.5
Orch9	10	1	63.0	68.6	66	5.6	10	Snd Lvl	61.5	7.1	6	1.1
Orch10	11	1	66.0	69.1	66	3.1	10	Snd Lvl	63.7	7.4	6	1.4
Orch11	12	1	66.0	70.1	66	4.1	10	Snd Lvl	62.0	8.1	6	2.1
Orch12	13	1	66.0	71.5	66	5.5	10	Snd Lvl	62.6	8.9	6	2.9
Orch13	14	1	67.0	71.8	66	4.8	10	Snd Lvl	62.7	9.1	6	3.1
Orch14	15	1	67.0	73.0	66	6.0	10	Snd Lvl	63.4	9.6	6	3.6
Orch15_pool	16	1	67.0	72.6	66	5.6	10	Snd Lvl	63.8	8.8	6	2.8
Orch16	17	1	67.0	72.6	66	5.6	10	Snd Lvl	64.0	8.6	6	2.6
Orch17	18	1	67.0	73.8	66	6.8	10	Snd Lvl	63.6	10.0	6	4.0
Orch18	19	1	67.0	73.1	66	6.1	10	Snd Lvl	63.9	9.2	6	3.2
Orch19	20	1	67.0	72.3	66	5.3	10	Snd Lvl	64.0	8.3	6	2.3
Orch20	21	1	67.0	71.6	66	4.6	10	Snd Lvl	63.9	7.7	6	1.7
Orch21	22	1	67.0	71.7	66	4.7	10	Snd Lvl	64.0	7.7	6	1.7
Orch22	23	1	67.0	74.2	66	7.2	10	Snd Lvl	64.8	9.4	6	3.4
Orch23	24	1	67.0	71.6	66	4.6	10	Snd Lvl	64.1	7.5	6	1.5
Orch24	25	1	67.0	71.7	66	4.7	10	Snd Lvl	64.0	7.7	6	1.7
Orch25	27	1	67.0	72.2	66	5.2	10	Snd Lvl	64.5	7.7	6	1.7

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- 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

RESULTS: BARRIER DESCRIPTIONS 02077.302

ms consultants 17 June 2002
KLC 54200 TNM 1.0b

RESULTS: BARRIER DESCRIPTIONS
PROJECT/CONTRACT: 02077.302
RUN: 38th East Barrier
BARRIER DESIGN: Case One

Barriers

Name	Type	Heights along Barrier			Length	If Wall	If Berm			Cost
		Min	Avg	Max		Area	Volume	Top Width	Run:Rise	
		ft	ft	ft	ft	sq ft	cu yd	ft	ft:ft	$
38th East & Orchandale Barrier	W	8.00	12.31	14.00	6695	82426				1442400
									Total Cost	1442400

- 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?

	Preliminary Development 1998	Final Design 2002
Noise Model	Stamina 2.0/Optima	TNM 1.0b
No Barrier Noise Level *	72.5 dB	71.4 dB
Barrier Height	12-16’	8-14’
Barrier Effectiveness* (IL)	9.3 dB	8.3 db
Barrier Location	Shoulder	Shoulder with snow storage
Number of DU	119	128
Cost per DU	$ 13,182	$ 11,262

* Burrshire pool receiver

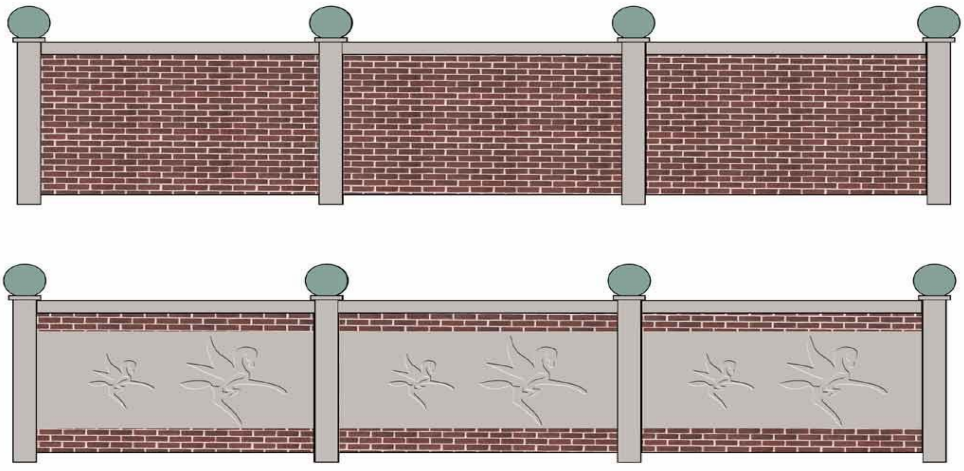
I-77 Study
Areas for Improvement

- "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!***

I-77 Noise Barrier



US 42 Noise Barrier