MnDOT's Interior Noise Procedure

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DEPARTMENT OF TRANSPORTATION

FHWA Criteria

Activity Category	Activity Criteria[1,2] $L_{eq}(h)$ dBA	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	67	Exterior	Residential
C[3]	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E[3]	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	--	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	--	--	Undeveloped lands that are not permitted

Notes
(1) Leq(h) shall be used for impact assessment
(2) Leq(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement
(3) Includes undeveloped lands permitted for this activity category

FHWA Current Guidance on Interior Noise

Table 6: Building Noise Reduction Factors

Building Type	Window Condition	Noise Reduction Due to Exterior of the Structure
All	Open	10 dB

Light Frame	Ordinary Sash (closed)	20 dB
	Storm Windows	25 dB
Masonry	Single Glazed	25 dB
	Double Glazed	35 dB
*The windows shall be considered open unless there is firm knowledge that the windows are in fact kept closed almost every day of the year.		

FHWA publication *FHWA-DP-45-1R, Sound Procedures for Measuring Highway Noise: Final Report* provides procedures to measure building noise reductions.

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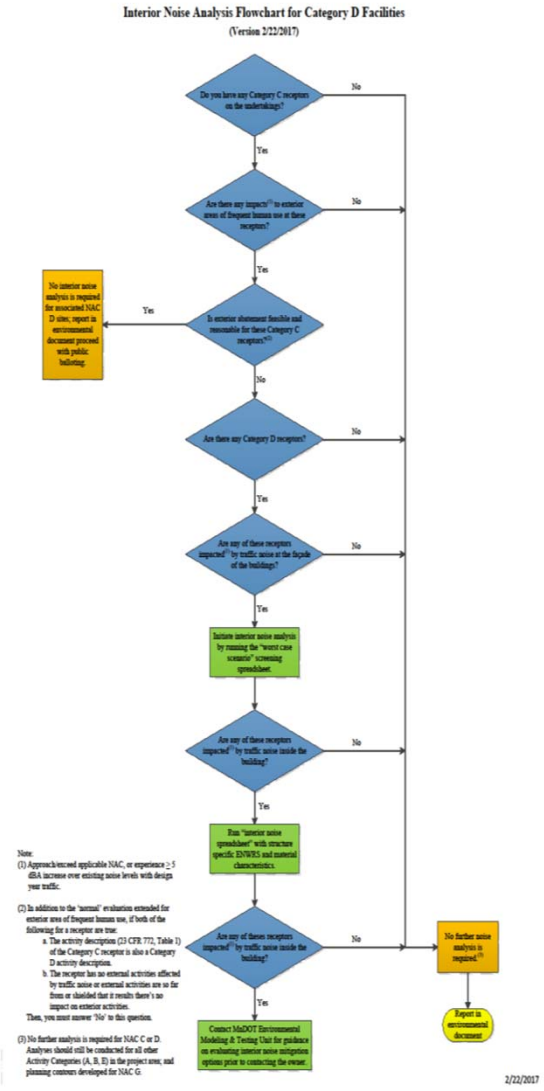

Flow chart available at:
http://www.dot.state.mn.us/environment/noise/policy/index.html

MnDOT Interior Noise Procedure

- Procedure developed using the FHWA-TS-77-202 *Insulation of building against highway noise*
- Developed two Excel workbooks:
  - One which requires window sizes/type and also requires wall size (height and length) and type of wall construction (exterior/interior)
  - Other looks at percent of open/closed window(s)/type and percentage/type of wall construction

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Where and how to model exterior noise and interior noise

The analysist should place a modeling point at the facade of the building. Typically that placement would be along the middle of the wall which
would face the roadway (for larger building such as schools, you may need a number of modeling points).
You would then take your exterior noise level (from your modeled point(s) and subtract 13.2 dBA (this number is used for screening as a worst case)
to determine your calculated interior noise level. If your interior noise level exceeds standards/criteria then proceed below for a more detailed analysis

How to determine the factor to use from exterior noise level to interior noise level

You should first input the available window information into the "window input" tab. You are required to know the following:
1. Height of the window(s)
2. Width of the window(s)
3. Type of window(s)
4. Number of windows

You will then need to select the correct exterior wall noise rating (EWNR) for the windows from the table on the right hand side of the tab

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You will then need to move over to the tab "wall input". You are required to know the following:

1. Length of wall
2. Height of wall

3. Type of exterior wall construction

4. Type of Interior wall construction

You will then need to find the composite wall EWNR using the chart by first finding the closest exterior wall construction on the left tab and then finding the closest interior wall construction on the top. You will then move to the right from the left tab and down from the top to find the composite number

You would then go back to the "window input" tab to find the composite window and wall EWNR

Some things to remember

If the interior noise level would exceed standards with the window(s) open you can assume the window(s) could be closed if the activity area has air conditioning

If your exterior/interior wall composition is not listed use the closest type from the table but never assume a higher EWNR value than the nearest material

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Composite window value input

Width of open area (in feet)	4
Height of open area (in feet)	2.5
Sq. Ft. open area	10
EWNR value	4

Width of closed area (in feet)	4
Height of closed area (in feet)	2.5
Sq. Ft. closed area	10
EWNR value	24

Composite EWNR value or each window	6.967086219

# of windows	1

Total EWNR of wall + windows	13.20818754

Single Glazed Window	EWNR
1/16", 1/8", 1/4" glass	24
5/16" glass	28
3/8" glass	30
2-ply glass .53" total	38
3-ply glass .82" total	41

Double Glazed Window	EWNR
3/32" glass, 4" airspace, 3/32" glass	30
1/8" glass, 2-1/4" airspace, 1/8" glass	32
1/8" glass, 2-1/4" airspace, 1/4" glass	36
1/4" glass, 2-1/4" airspace, 1/4" glass	38
3/16" glass, 2" airspace, 1/4" glass	39
1/4" glass, 2" airspace, 3/8" glass	40
3/16" glass, 2" airspace, 3/8" glass	41
3/16" glass, 4-3/4" airspace, 1/4" glass	44

Notes:

The addition of a storm window increases the windows EWNR by 5 dB

If window can fully open EWNR value is 4 dB. If window can't completely open (sliding or double hung) use 4 dB for open area and given value for closed area.

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Wall information	
Length of wall	10
Height of wall*	9
Total Sq. Ft. of wall	90
EWNR value of wall	24

Exteriors \ Interiors	1/2" to 5/8" Gypsumboard	1/8" to 1/2" Plaster on 3/8" Gypsum Lath	1/2" Soundboard on 3/8 to 1/2" Gypsumboard	1/2" to 7/8" Plaster	1/2" Plywood	1/4" Plywood Paneling	1/4" Hardboard Paneling	Exposed Solid Wall
Alum/Vinyl Siding on 1/2" wood	28	31	29	32	25	29	31	--
7/8" Stucco	36	34	37	30	33	37	38	--
7/8" Stucco on 1/2" Wood	37	36	37	32	34	38	39	--
Wood Siding	27	29	27	31	24	28	30	--
4-1/2" Brick Veneer	44	42	44	39	42	45	46	--
9" Brick	47	50	50	45	45	45	45	45
4" Concrete	46	47	47	41	40	40	40	40
6" Concrete	46	48	48	42	42	42	42	42
6" Concrete Block	38	40	40	34	33	33	33	33
8" Concrete Block	40	42	42	36	35	35	35	35
6" Block w/ 1/2" Stucco	39	41	41	35	34	34	34	34
8" Block w/ 1/2" Stucco	41	43	43	37	36	36	36	36

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How to determine the factor to use from exterior noise level to interior noise level

You should first input the available window information into the "window input" tab. You are required to know the following:

1. Percent of open window area per window
2. Percent of total wall area per window.
4. Number of windows

You will then need to select the correct exterior wall noise rating (EWNR) for the windows from the table on the right hand side of the tab

You will then need to move over to the tab "wall input". You are required to know the following:

1. Nominal % of total wall area of Wall 1.
2. Nominal % of total wall area of Wall 2 is automatically calculated.
3. Type of exterior wall construction for wall 1 & 2 (from EWNR table in the wall input sheet using the exteriors columns).
4. Type of Interior wall construction for wall 1 & 2 (from EWNR table in the wall input sheet using the interiors rows).

You will then need to find the composite wall EWNRs for wall 1 and wall 2 using the chart by first finding the closest exterior wall construction on the left tab and then finding the closest interior wall construction on the top. You will then move to the right from the left tab and down from the top to find the composite rating for a exterior/interior wall combination.

You would then go back to the "window input" tab to find the composite window and wall EWNR

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Composite window value input	
Enter EWNR of Windows.	24
Enter % of window that's open (EWNR=4)	50
Composite EWNR value for each window	6.967086219
Enter % of entire wall area per window	22
Enter # windows in the wall.	3
Composite EWNR of the wall with windows.	**Composite EWNR** 8.727568836

Single Glazed Window	EWNR
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Wall information

Enter EWNR Wall 1	Enter EWNR Wall 2
24	24
Enter % area Wall 1	% area Wall 2
of entire wall area	of entire wall area
including windows	including windows
50	50

Exteriors	Interiors: 1/2" to 5/8" Gypsumboard	1/8" to 1/2" Plaster on 3/8" Gypsum Lath	1/2" Soundboard on 3/8 to 1/2" Gypsumboard	1/2" to 7/8" Plaster	1/2" Plywood	1/4" Plywood Paneling	1/4" Hardboard Paneling	Exposed Solid Wall
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8" Concrete Block	40	42	42	36	35	35	35	35
6" Block w/ 1/2" Stucco	39	41	41	35	34	34	34	34
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Questions?

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Thank you again!

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