MONITORING ROAD TRAFFIC SOUND LEVELS

William J. Gastmeier, MASc[†], PEng and Sheeba Paul, MEng, PEng[*]
HGC Engineering, 2000 Argentia Road, Plaza 1, Suite 203, Mississauga, Ontario, Canada L5N 1P7

1 Introduction and Background

In the 1980's the Ontario Ministry of the Environment, now the Ministry of the Environment and Climate Change (MOECC) in cooperation with the National Research Council (NRC) developed a set of assessment criteria and Acoustical Engineering analysis procedures to assist Municipalities in ensuring that sufficient mitigation of traffic noise is properly incorporated into new housing developments. These procedures were universally adopted by Municipalities across the Province and remain in use almost unchanged after 30 years.

Occasionally homeowners express complaints and dissatisfaction that road traffic is audible inside their homes and that it interferes with their enjoyment of their property and can disturb sleep. Since the original research supporting these procedures was partly based on sleep disturbance, and estimates of the percentage of persons who may be awakened or annoyed, it is of interest to Engineering Consultants, Municipalities, Land Developers and Home Builders to investigate these complaints.

This article describes one such complaint investigation and involves simultaneous monitoring of traffic sound levels inside and outside a multi-storey residential dwelling located beside an arterial roadway in a medium density row townhouse development. Analysis is conducted to confirm the accuracy and applicability of the Engineering prediction methods used to design building envelopes for residential dwellings located near busy roadways across the Province.

2 Criteria and Assessment Procedures

Guidelines for acceptable levels of road traffic noise impacting residential developments are given in MOECC Publication NPC-300[1] and are listed in Table I below. The values in Table I are energy equivalent (average) sound levels [L_{EQ}] in units of A-weighted decibels [dBA].

Table I: MOECC Road Traffic Noise Criteria (dBA)

Area	Daytime $L_{EQ\ (16\ hour)}$	Night-time $L_{EQ\ (8\ hour)}$
Outside Bedroom Windows	55 dBA	50 dBA
Inside Living/Dining Rooms	45 dBA	45 dBA
Inside Bedrooms	45 dBA	40 dBA

[†] bgastmeier@hgcengineering.com
[*] spaul@hgcengineering.com

Daytime refers to the period between 07:00 and 23:00, while nighttime refers to the period between 23:00 and 07:00.

Predictions of future road traffic sound levels use ORNAMENT, an analysis method implemented in STAMSON 4.1 software available from the MOECC.

A central air conditioning system as an alternative means of ventilation to open windows is required for dwellings where future nighttime sound levels outside bedroom windows are predicted to exceed 60 dBA. At that level of noise impact, which is common near busy roadways, building envelope components such as walls, windows and doors must be designed to achieve the indoor sound level criteria.

Building envelope components are designed using calculation methods were developed by the National Research Council (NRC)[3]. They are based on the predicted future sound levels at the building facades and the ratio of the area of the facade components to the floor area of the adjacent room.

3 Building Envelope Design

A partial site plan showing the location of the subject townhouse unit and its relationship to Busy Street is shown below.

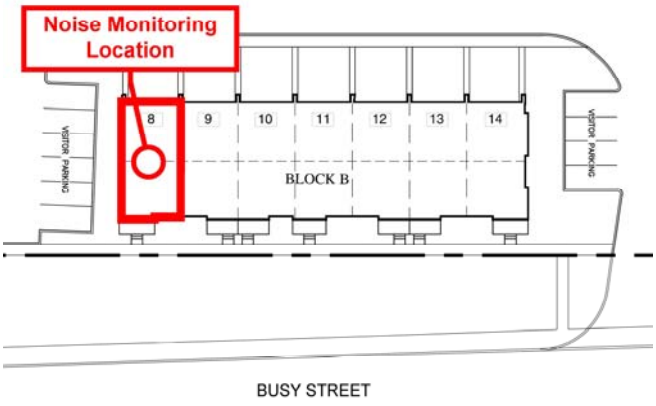

Figure 1: Site Plan

The results of the STAMSON predictions originally conducted for the Noise Impact Study required by the Municipality before Site Plan Approval indicated future daytime/nighttime sound levels of 68 dBA $L_{EQ(16\ hour)}$ daytime and 62 dBA $L_{EQ\ (8\ hour)}$ nighttime at the building façade of the

subject townhouse unit. Using the NRC calculations methods a glazing construction with an STC-30 rating was specified, considering that the exterior walls of the subject townhouse units would be constructed with a brick veneer with stone/EIFS accents.

4 Sound Level Monitoring

Automated sound level measurements were simultaneously conducted at four locations: outside the building façade at ground level, inside in the first floor den, inside in the second floor living room and inside in the third floor bedroom. All of the measurement locations had direct exposure to Busy Street. The Sound Level Meters are maintained in yearly laboratory calibration and were field calibrated before and after the measurements.

An elevation drawing of the row of townhouses showing the monitor locations is provided below.

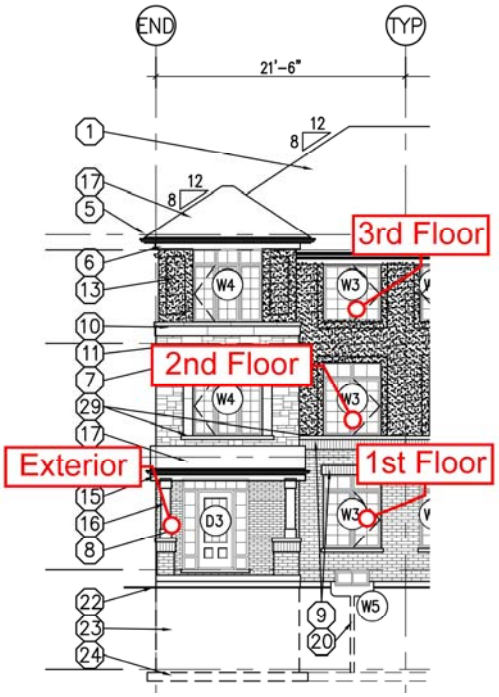

Figure 2: Measurement Locations

During the site visits it was confirmed that the appropriate glazing had been installed. Test data from the window manufacturer confirmed greater STC values than required.

The results of the monitoring are provided in the following figure and summarized in Table 2.

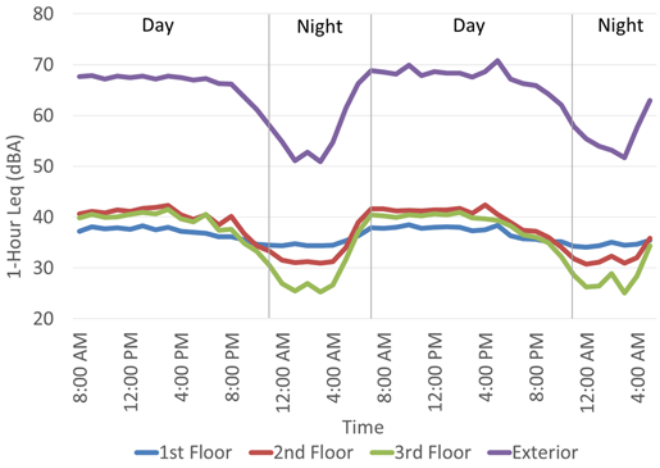

Figure 3: Measured Sound Levels, Hourly Leq, dBA)

Table 2: Measured Daytime $L_{EQ\ (16\ hour)}$ and Nighttime $L_{EQ\ (8\ hour)}$ Sound Levels

Monitor Location	Measured Sound Levels (Day/Night), dBA
Exterior	67 / 60
Inside 1st Floor Den	37 / 35
Inside 2nd Floor Living Room	40 / 34
Inside 3rd Floor Bedroom	40 / 31

5 Conclusion

These results confirm the accuracy of future sound level predictions using the ORNAMENT calculation method. They also confirm the applicability of the NRC calculation methods used to design the facades of residential buildings in terms of acoustical insulation and that they incorporate a reasonable degree of conservatism in terms of protecting the public and the interests of Municipalities and Home Builders alike.

Perhaps more interestingly, they remind us that assessment methodologies based on statistical distributions of annoyance in humans do not result in 100% satisfaction. You cannot make all the people happy all the time.

References

[1] NPC-300, "Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning"

[2] ORNAMENT "Ontario Road Noise Analysis Method for Environment and Transportation, Ontario Ministry of the Environment, October 1989

[3] National Research Council of Canada Building Research Note # 148 "Acoustic Insulation Factor: A Rating for the Insulation of Buildings against Outdoor Noise"