SUPPORTING BETTER NOISE CONTROL IN CANADIAN BUILDINGS

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1 Introduction

A simplistic requirement for minimum STC of the wall or floor/ceiling assembly separating adjacent units in multi-family residential buildings has been used in North American building codes for over 50 years. Effective noise control requires replacing the traditional design objective with a requirement including the effect of flanking transmission, such as the Apparent Sound Transmission Class (ASTC). This paper discusses key projects at the National Research Council of Canada both to establish the technical infrastructure supporting such a change in Canada's building codes and to provide the tools needed by designers seeking to provide enhanced noise control.

2 Impediments to Change

Such a transition requires a supporting set of technical standards for measuring direct and flanking sound transmission for typical assemblies and junctions, plus a credible procedure for calculating system performance from these inputs.

Although using ASTM E336 to measure ASTC in a building is routine for Canadian consultants, predicting the ASTC due to the set of transmission paths in a building is much more complex, and there are no ASTM standards for measuring transmission of flanking sound (in lab or field) or for calculating ASTC.

However, ISO has developed a standardized framework for calculating overall sound transmission. ISO 15712-1 (aka EN-12354-1) has been used for over 20 years to support performance-based European code systems. It uses inputs from laboratory tests to characterize sub-assemblies (ISO 10848 and ISO's counter-parts of ASTM E90). But there are significant impediments to applying ISO 15712-1 procedures in a North American context:

1) ISO standards for building acoustics differ appreciably from the ASTM standards used by the construction industry in North America – both in their terminology and in the specific technical requirements for both measurements and ratings.
2) ISO 15712-1 provides reliable estimates for heavy homogeneous constructions such as concrete floors and masonry walls, but not for the lightweight steel- or wood-framed construction widely used for low-rise and mid-rise buildings in North America.

3 Supporting a Transition

A brief description of the proposed NBCC calculation procedures in a companion paper[1] indicates how the new building code straddles the ISO/ASTM divide, but glosses over some details of the calculation process. More importantly, it ignores the issue of finding the necessary laboratory test data to use as inputs for the calculations, and the practical need for software tools to ease the calculation process for both the design and regulatory communities. These shortcomings are addressed in supporting materials published or planned by NRC.

3.1 Guideline to clarify calculation details

The proposed Code directs users to document RR-331, "Guide to Calculating Airborne Sound Transmission in Buildings" for additional advice. A first version of this guideline was published in 2013, and updated editions are expected at the end of each year as content is refined and additional sections are approved by the industry steering committee.

This Guide presents extended descriptions of the calculation process (both simplified and detailed methods) for specific types of construction, and includes numerous benchmark examples of the calculations. It is intended mainly as a reference document for acoustical experts.

3.2 Data and examples for specific constructions

A set of reports are being prepared to present the data needed for the calculations and to provide guidance on spreadsheet calculations following the Simplified Method. These reports and the related experimental studies are being developed in collaboration with the industry associations representing specific construction materials, and are intended to provide guidance to a broad industry and regulatory audience.

These reports are based on the results of a series of large experimental studies performed in the NRC flanking transmission facilities with strong support from industry partners. These studies have characterized a broad sample of the generic constructions most commonly used in North American buildings. The plan is to publish a set of 5 documents with some overlap in content:

- RR-333, Apparent Sound Insulation in Concrete Buildings (2015),
- RR-334, Apparent Sound Insulation in Concrete Block Buildings (2014),
- RR-335, Apparent Sound Insulation in Cross Laminated Timber Buildings (2014),
- RR-336, Apparent Sound Insulation in Wood-framed Buildings (2015),
- RR-337, Apparent Sound Insulation in Steel-framed Buildings (2015).

The first of these documents (RR-334) was published in the summer of 2014 and the remainder will follow before the end of 2015. All will be reviewed and updated periodically, and can be downloaded from the NRC website at: http://nparc.cisti-icist.nrc-cnrc.gc.ca/npsi/ctrl?lang=en

Each of these reports presents sound transmission data pertinent to design calculations for buildings that include the construction cited in the title, plus worked spreadsheet examples combining that construction with other constructions with which it is commonly paired. The data presentation combines convenient summary pages giving single-number ratings (needed for the Simplified Method) in the body of the report with tables in the appendices giving the corresponding 1/3-octave-band data (needed for the Detailed Method). The worked examples illustrate the Simplified Method using single-number ratings, as illustrated in Figure 1.

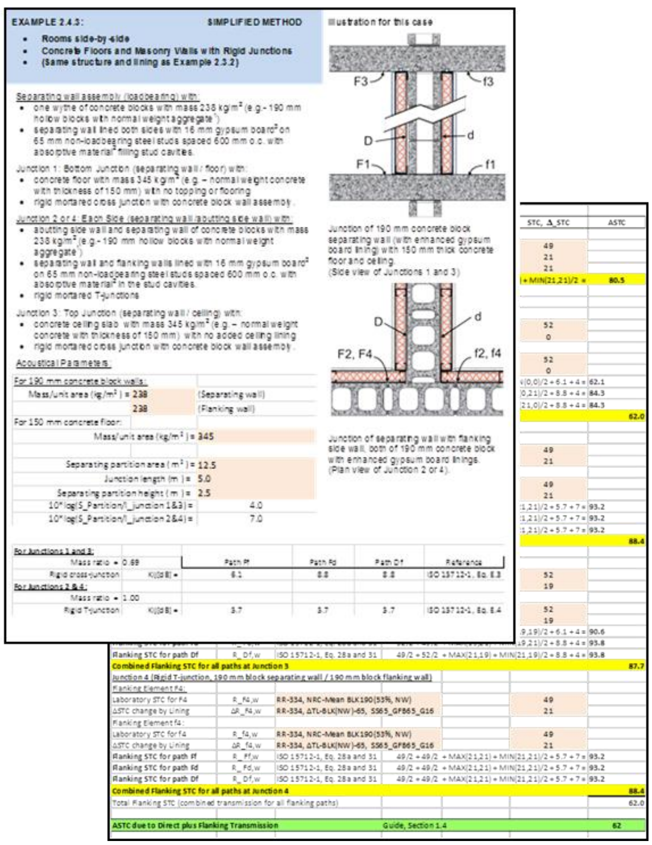

Figure 1: Worked example from RR-331 for a pair of side-by-side rooms. The 2-page example begins with drawings and text description of the assemblies and their junctions, followed by spreadsheet images showing all steps of the calculation

3.3 Software for calculation and data access

An online software tool called ***soundPATHS*** has been developed, and is currently being extended. The application ***soundPATHS*** provides a user friendly interface with drop-down menus to select the construction details, combined with a secure database that provides flanking transmission data for each junction and direct transmission data for the separating assembly. An image of the user interface (after elements have been selected for the displayed wall/floor assemblies and their junction) is shown in Figure 2.

Drop-down menus permit selection of the common generic building materials and sub-systems comprising each wall or floor/ceiling assembly. The calculation provides ASTC for the complete system together with direct STC for the separating assembly and Flanking STC for each junction at its edges. This identifies the weakest paths, and helps the designer to explore options to improve designs for higher ASTC performance and/or cost optimization.

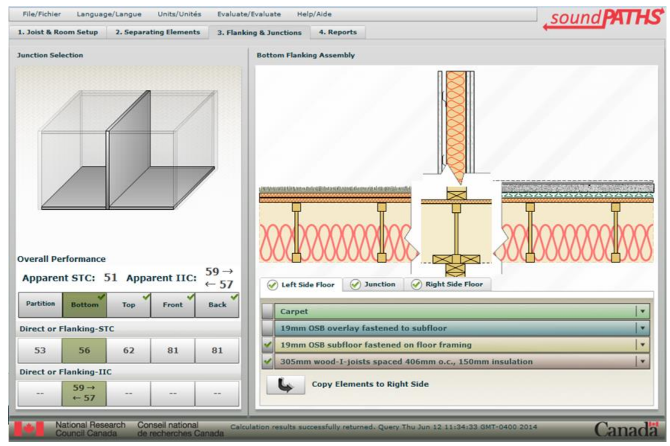

Figure 2: Image of the user interface for the ***soundPATHS*** online calculation of ASTC for a pair of side-by-side rooms with wood-framed wall and floor assemblies.

The current version of the ***soundPATHS*** software deals only with common Canadian wood-framed constructions. It can be accessed at: http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/soundpaths/index.html

A ***soundPATHS*** upgrade that deals with other common types of wall and floor assemblies is under development. This will include a much-expanded supporting database using the data from the reports discussed in section 3.2.

Conclusion

Re-focusing the noise control requirements of Canada's building codes on the performance of the complete system should both avoid the worst designs and shift industry focus to optimizing the transmission paths that limit the ASTC. NRC will continue to pursue projects with industry partners to obtain and provide more generic data and to improve supporting calculation tools, to make this transition more manageable.

References

[1] J.D. Quirt and B. Zeitler, A new approach to building acoustics regulation in Canada, *AWC 2014*

[2] D. Quirt, B. Zeitler, S. Schoenwald, I. Sabourin, T. Nightingale, "RR-331: Guide to Calculating Airborne Sound Transmission in Buildings, *NRC Canada*, 2013.

[3] B. Zeitler, D. Quirt, S. Schoenwald, I. Sabourin, F. King, RR-334: Apparent Sound Insulation in Concrete Block Buildings *NRC Canada*, 2014.