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RECENT PROJECTS IN BUILDING ACOUSTICS AT NRC

J.S. Bradley, B.N. Gover, R.E. Halliwell, T.R.T. Nightingale, J.D. Quirt, and A.C.C. Warnock
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1. INTRODUCTION

This series of papers presents results from recent major projects on building acoustics at the National Research Council. In each case, major reports providing more detail on the projects are listed at the end of the brief abstracts. The reports are available from the NRC/IRC website at http://irc.nrc-cnrc.gc.ca/ircpubs/, using the code (e.g.- RR-170) in Report# field. For readers with detailed questions, the e-mail address for the most suitable contact is listed at the end of each item.

2. ACOUSTICAL DESIGN OF OPEN-PLAN OFFICES

J. S. Bradley

The recently completed COPE (Cost-effective Open Plan Environments) project examined all aspects of the design of open-plan offices: including lighting and air quality issues, as well as acoustical concerns. The research included both laboratory and field studies including measurements in 700 workstations in a number of buildings.

This presentation will describe how the acoustical aspects of this work and related studies at NRC have be used to develop a better approach to the acoustical design of open-plan offices. Important design parameters will be discussed and new software to simplify design calculations will be demonstrated.

COPE-Calc acoustical design software can be downloaded from http://irc.nrc-cnrc.gc.ca/ie/cope/07.html along with software related to the other aspects of open-plan design.

(Contact: John.Bradley@nrc-cnrc.gc.ca)

Reports available at http://irc.nrc-cnrc.gc.ca/ircpubs/:

1. Describing Levels of Speech Privacy in Open-Plan Offices (RR-138),
2. Measurements of Sound Propagation between Mock-Up Workstations (RR-145),
3. J.S. Bradley, The acoustical design of conventional open plan offices," Canadian Acoustics, 31, (2), (NRCC-46274)

3. METHODS FOR ASSESSMENT OF ARCHITECTURAL SPEECH SECURITY OF CLOSED OFFICES AND MEETING ROOMS

Bradford Gover and John S. Bradley

For speech security, conversations taking place within closed offices and meeting rooms should be difficult or impossible to understand outside those rooms, in adjoining spaces. The degree to which words are audible or intelligible to a listener outside such a room depends on the transmitted speech level and background noise level at the position of the listener, and of course on the listener's hearing abilities.

The transmitted speech level depends on how loudly people are speaking inside the room, and on the amount of sound attenuation provided by the building. For a given voice level, a given background noise level, and a listener with typical hearing abilities, one can rate the degree of architectural speech security of the room. This enables specification, at the design stage, of criteria or constructions that will ensure an adequate level of speech security. Additionally, this allows existing rooms to be measured and rated in terms of the degree of speech security they provide.

This presentation will describe recent and ongoing work at NRC-IRC in these areas, including: subjective testing to determine a suitable signal-to-noise measure that reliably indicates audibility and intelligibility of speech in noise; measurements during actual meetings to determine speech levels within meeting rooms and background noise levels in adjoining spaces; and development of a field measurement protocol for assessment of existing rooms.

(Contact: Brad.Gover@nrc-cnrc.gc.ca)

Reports available at http://irc.nrc-cnrc.gc.ca/ircpubs/:

1. Speech and Noise Levels Associated with Meeting Rooms (RR-170)
2. Measures for assessing architectural speech security (RR-171 to be published late 2004)

4. STUDIES OF SOUND TRANSMISSION THROUGH FLOORS AND WALLS

A.C.C. Warnock

The paper will present an overview of practical information derived from projects focusing on airborne and impact sound transmission through walls and floors. Several projects have been completed in the last ten years or so. Factors such as the number of layers, type of studs, type of joists, and type and thickness of sound-absorbing material have been varied.

An accurate model that predicts transmission loss or impact sound pressure levels has not been developed. Instead, as a practical measure, regression equations have been developed that can be used to estimate single number ratings. The precision of the estimates is thought to be adequate for most practical purposes. A program that implements the regression equations is available and will be demonstrated.

Databases containing the one-third octave band data for the test results used to develop the regression equations are available. The paper will also describe some of the work that has been done on lightweight floating floors used to reduce impact sound transmission.

(Contact:Alf.Warnock@nrc-cnrc.gc.ca)

Reports at http://irc.nrc-cnrc.gc.ca/ircpubs/:

1. Airborne sound transmission through gypsum board walls (IR-693, IR-761, IR-832) and concrete block walls (BRN-217 and IR-586)
2. Airborne and Impact sound transmission through floors (IR-766, IR-811, and RR-169 to be published late 2004)
3. Change in impact sound transmission due to floor coverings (IR-802)
4. Other aspects (BRN-172 on windows, IR-772 on effect of electrical outlets)

5. DESIGN PRINCIPLES AND DETAILS FOR CONTROL OF FLANKING TRANSMISSION IN WOOD FRAMED MULTIFAMILY CONSTRUCTION

T.R.T. Nightingale, R.E. Halliwell, J.D. Quirt

This summary of two recent IRC projects provides a systematic investigation of design details that affect sound insulation, and evaluates several options for treating important flanking paths for both horizontally and vertically separated spaces.

The paper begins by showing the importance of wall type (single, double stud, or shear wall), joist type (wood-I or dimensional lumber), joist orientation (parallel or perpendicular to the wall/floor junction), joist and subfloor continuity (across the wall/floor junction). In general, these details change the magnitude of flanking for particular paths, but typically do not change their ranking.

- For vertically separated rooms, the dominant flanking path (if the floor does not have a topping) is from the subfloor to the lower wall. The path from the upper wall to the lower wall can be ignored for most practical constructions.
- For horizontally separated rooms, the dominant flanking path involves the floor if either the subfloor or the joists provide structural continuity at the wall/floor junction.

Typically, the most effective measure to control flanking will be in the form of a topping to the subfloor, since the dominant horizontal and vertical flanking paths involve this surface. The effectiveness is strongly dependent on several factors relating to the topping (i.e., mass, damping, interlayer, etc.) but also on the details of the floor to which it is applied, namely joist orientation. The paper concludes with estimates of the apparent sound insulation that might be expected for several complete building assemblies.

(Contact: Trevor.Nightingale@nrc-cnrc.gc.ca)

Reports at http://irc.nrc-cnrc.gc.ca/ircpubs/:

1. Sound Isolation and Fire Resistance of Assemblies with Fire Stops (IR-754).
2. Flanking Transmission in Multifamily Dwellings: Effects of Continuous Structural Elements at the Wall/Floor Junction (RR-103 and RR-168 to be published late 2004)