SOUND AND FIRE PERFORMANCE OF FIRE STOPS IN MULTI-FAMILY DWELLINGS

FLANKING TRANSMISSION AT JOINTS IN MULTI-FAMILY DWELLINGS PHASE I: TRANSMISSION VIA FIRE STOPS

Introduction

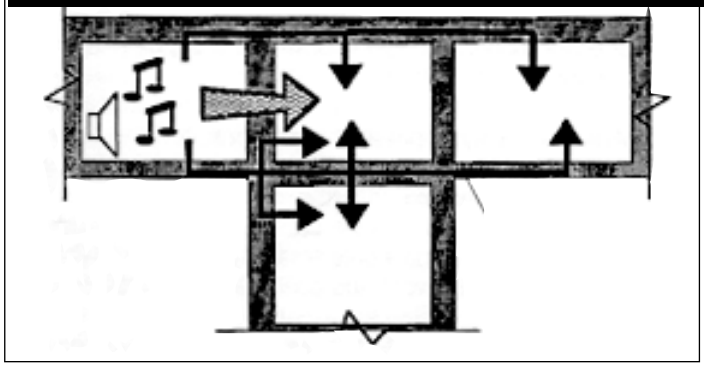
Wall/floor junctions intended for multi-family residential buildings must satisfy National Building Code (NBC) requirements both for noise control and fire resistance. Junction designs control fire but can also increase the transmission of noise. The reason is that fire stops form a physical connection between the two sides of a double-stud wall. This provides a path for the transmission of vibration and reduces sound insulation.

CMHC carried out research with various partners – Forintek Canada, Gypsum Manufacturers Canada, New Home Warranty Programs of Ontario, Alberta, British Columbia and the Yukon, the Ontario Ministry of Housing, Owens Corning Fiberglas Canada Inc., and Roxul Inc. – to examine the sound and fire resistance of wall/floor junctions intended for multi-family residential buildings. The objective of the project was to identify details that provide good fire resistance without increasing sound transmission.

During the first phase of this multi-phase study, the project reviewed flanking transmission at joints, transmission of sound energy from one room to another by a path other than that going directly through the nominally separating floor or wall (see Figure 1). Flanking paths exist in all constructions, regardless of type and design.

Figure 1:

Results



Research Program

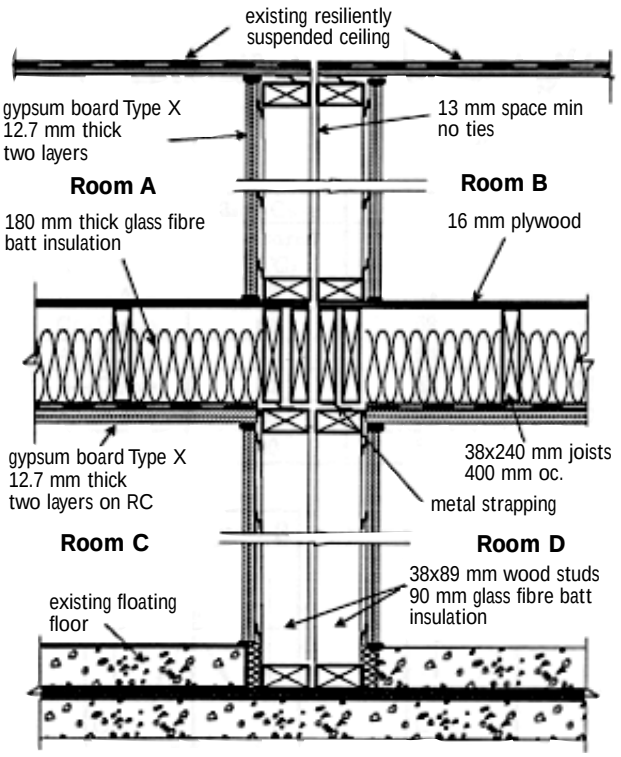
The study focused on wood-framed construction and looked specifically at the junction between a wood joist floor and a separating wall with two rows of 38 x 89 mm wood studs. In all but one of the cases, the floor joists were supported on the party wall. (See Figure 2.)

The test facility for this project was designed specifically for the measurement of flanking transmission in lightweight framed multi-family constructions. (See Figure 3.) The facility allowed for construction changes to be introduced systematically to determine the resulting changes in the sound insulation performance. For this project, construction details were selected to provide data relevant to row housing and apartment-style construction.

The research program investigated how commonly used fire control solutions for the floor/wall junction change the sound insulation between the rooms separated by the wall and the floor.

Twelve different fire stop cases were tested. Construction details were changed to simulate a range of conditions against which to compare two reference cases. Research also tested two retro-fit

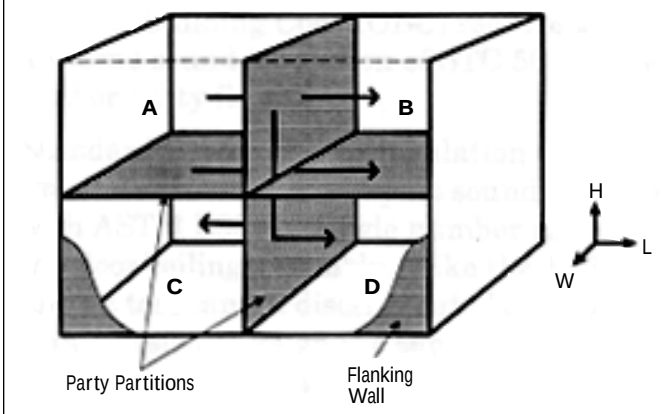
Figure 2: Section through the party wall



approaches to reducing the effect of noise transmission via fire stop construction.

Sound transmission was measured in terms of sound transmission class (STC) or field sound transmission class (FSTC).

Figure 3: Schematic drawing of the flanking facility with some possible flanking paths shown by arrows



Results

The study report describes construction details for each specimen tested, along with the associated FSTC ratings and other measurements.

The study shows that the impact of a fire stop is highly dependent on the construction of the building elements to which it is connected. Key construction variables included details in the floor construction, the orientation of the floor and its framing members with respect to the party wall and use of certain materials (e.g., plywood rather than oriented strand board (OSB)).

The study also showed how fire stops can affect sound transmission. Basically, the strength of the flanking transmission

Table 1 - Rank Ordering of Fire Stops

Material	Group Rank #	Definition	Installation	Application
Batt absorption almost filling wall stud category	0	No fire stop	Fill wall cavity with insulation	Row and apartment
No fire stop*	0		N/A	N/A
Semi-rigid fibrous insulation board	1	Transmits negligible forces	5 lb./ft.^{3} density, 25 mm thick, between headers	Row and apartment
Gypsum board	2	Tranmits only in-plane forces	25 mm thick between headers	Row and apartment
Sheet steel	2		0.38 mm thick under wall plates, over floor deck	Row
Continuous OSB or plywood	3	Transmits in-plane and bending forces	Continuous sheets under wall plates	Row

** While the absence of fire stop is not acceptable in terms of fire control, this case is included as a point of reference.*

depends on how the fire stop transfers vibrational energy and how effectively that vibrational energy is converted to radiated sound.

Fire stop materials or techniques can be grouped according to the method of vibrational energy transmission. The study enabled researchers to rank the various fire stop constructions from 0 to 3 in terms of acoustical performance or suitability. The groups, their rank and other characteristics are shown in Table 1.

By manipulating the combination of various construction techniques and materials, researchers determined that the impact of fire stops is a function of the apparent sound insulation of the assembly without fire stopping: the greater the insulation, the greater the impact.

The study indicated that various approaches to increasing floor mass and stiffness, such as the use of concrete topping on the floor surface, were expected to provide comparable benefits in limiting the transmission of structural vibration.

Implications for the Housing Industry

Fire stops can introduce a physical connection between two sides of a double stud wall, thus providing structural flanking paths for the transmission of vibration. This worsens sound insulation. The amount of flanking transmission can be controlled, at least to some extent, by the use of suitable construction details.

This study found that the degradation of sound insulation is a function both of the fire stop material and of the building elements that it connects.

Ideally, designers, consultants and engineers would be able to predict the apparent sound insulation for the construction assemblies and assess the correct fire stop detailing. The study concluded, however, that this is not always practicable, since the projected results are strictly applicable to the construction tested. Furthermore, the mechanism for flanking transmission through a structural connection in the form of a fire stop is very complex and not always fully understood.

Research report: Sound and Fire Performance of Fire Stops in Multi-Family Dwellings, Flanking Transmission at Joints in Multi-Family Dwellings, Phase I: Transmission via Fire Stops, 1997

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A full report on this research project is available from the Canadian Housing Information Centre at the address on the next page.

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