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## Design Solutions for Minimizing Flanking of Sound in Wood Buildings

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<b>Program Area:</b>	Building Systems	<b>Start Date:</b>	April 2006
<b>Program Goal:</b>	BTT	<b>Completion Date:</b>	March 2010*
<b>Project No.:</b>	5324	<b>Date of Last Update:</b>	March 31, 2009
<b>Project Liaison(s):</b>	Rodney McPhee, Canadian Wood Council; Paul Newman, COFI/Canada Wood; Sylvain Labbé, Quebec Wood Export Bureau		

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\*See Status below.

### Long Term Goals / Strategies

- Focus on members' customers and product end-use performance by identifying design solutions which minimize the flanking transmission of sound in wood-frame houses and "small" buildings complying with requirements in the National Building Code of Canada (NBCC).
- Increase value of research through alliances with the National Research Council of Canada (NRC) and the other government and industry partners in this collaborative project.

### Key Objective

- Consolidating our existing knowledge about minimizing flanking transmission of noise in wood structures into a web-based electronic design guide with smart system that is easily accessible and useable by builders, architects, engineers and building officials, and that could be easily referenced in Canadian building codes.

### Key Actions and Deliverables

Deliverables	Expected Delivery Date
A web-based electronic design guide with smart system that consolidates the knowledge gained through the collaborative NRC-industry and NRC-CMHC research projects and presents it in a form that is easily accessible and useable	September 2009*
Supplemental information on the acoustical performance of panelised toppings, and wood I-joists from different manufacturers.	March 2010*

\* Revised December 2007

### Status

In March 2005, after nearly ten years of research on flanking noise transmission in wood-frame construction, the collaborative research project involving NRC and various industry partners came to an end with the publication of *Guide for Sound Insulation in Wood Frame Construction – Part 1: Controlling Flanking at the Wall-Floor Junction* by J.D. Quirt, T.R.T. Nightingale and R.E. Halliwell. Subsequently, Canada Mortgage and Housing Corporation (CMHC) established an agreement with NRC to supplement the information developed through the collaborative NRC-industry research project with additional information on the flanking of sound involving directly attached gypsum board on the ceilings of row housing and on the corridor walls in row and apartment buildings. While two of the partners in the collaborative NRC-industry research project, Marriott Hotels and Owens Corning, are using information in the *Guide* for design and construction of hotels and for marketing their products, the *Guide* is not readily available and is not a practical tool for use by architects, engineers, builders and regulatory officials. It is a compendium of constructions which pose varying degrees of flanking problems and offer varying levels of sound insulation. This project proposes to consolidate

the knowledge gained through the collaborative NRC-industry and NRC-CMHC research projects and present it in a form that is easily accessible and useable – a web-based electronic design guide with smart system. In addition, there is a small experimental component which will expand the number of toppings, especially panelised toppings, and investigate the range in results that might be expected by use of wood I-joists from different manufacturers. Again, there will be a number of funding partners working on this; however, because it deals exclusively with wood construction, Forintek's participation is essential.

Unfortunately difficult times for the construction industry in general, made it difficult for NRC to secure sufficient funding to get the project off the ground. However, in November 2007, FPInnovations – Forintek Division signed a contract to participate in this NRC project which NRC is calling *Flanking Sound Transmission in Wood Frame Multi-Family Dwellings. Phase V: Consolidation for Electronic Design Guide*. Several other industries had already agreed to sign on so that Forintek's commitment to the project was sufficient for NRC to finally launch the work.

Consolidating and enhancing the number of practical sound insulation details for wood-frame construction in the *Guide* published in 2005 has become more important than when this project was first envisioned. NRC has submitted a request for change to the sound insulation provisions of the NBCC so that flanking transmission would be explicitly included in the sound insulation requirements. Deemed-to-satisfy solutions for this new requirement would logically be taken from this current flanking project and from those already completed. A revised *Guide* would serve as the basis for a commentary on the sound insulation requirements in the NBCC.

### **Partners**

Canadian Wood Council

### **Rationale and Potential Impact**

Increasingly, the Provinces of Ontario, Quebec and British Columbia are moving to limit noise transmission in multi-family dwellings. Canada Wood faces ever growing challenges to their efforts to market wood construction and the wood products used in construction of those buildings in Japan, Korea and China because of excessive noise transmission in wood structures. While costly, design solutions which meet regulations in those countries for fire performance have been developed. However, government officials and the public continue to perceive that wood structures are too noisy and that design solutions are too impractical to construct. This project will go a long way in overcoming those perceptions.

### **Proposed Approach**

The Acoustics Group at NRC was to work with a consortium of partners (including FPInnovations – Forintek Division) to develop a web-based design guide on how to abate flanking noise transmission in wood-frame construction. The guide was to consolidate knowledge gained in earlier collaborative research ventures and to supplement that knowledge with data generated by testing several new designs involving innovative wood-based floor toppings.

### **Work Completed this Fiscal Year**

FPInnovations – Forintek Division is a member of the Consortium and Steering Committee overseeing NRC's project *Flanking Sound Transmission in Wood Frame Multi-Family Dwellings. Phase V: Consolidation for Electronic Design Guide*. Due to the difficult times facing the construction industry, NRC has only been able to attract one other Consortium member: Owens Corning.

Early in the year, NRC scientists circulated a proposal to the Steering Committee proposing construction details for the first three floor assemblies to be tested. A brief description of the three assemblies follows.

- **Assembly – Case 9A:** This is would be the reference assembly for the project. It would employ PRI-40 I-joists which differs from wood-I joists in previous projects in order to evaluate the effect of wood-I joist type. The hope was that it could be demonstrated that wood-I joists of the same depth could be treated as being generic in the Guide.
- **Assembly – Case 9B:** This is a non-fire and sound rated floor/ceiling assembly typical of row housing. This assembly was necessary to address row housing in the Guide.
- **Assembly – Case 9C:** This is the reference assembly (Case 9A) with a floating wood raft (layer of 15.9 mm plywood, over 15.9 mm OSB, over a Owens Corning QuietZone® Acoustic floor mat).

The Steering Committee gave its approval of this proposal.

In the same communication, NRC reported that it had characterized the effect on sound insulation due to the static load expected in a building. They found direct transmission is unaffected but there is a systematic frequency-dependent effect that is most pronounced for the floor-floor and floor-wall flanking paths. NRC planned to re-compute sound insulation estimates in the earlier Guide to assess any possible changes in the Apparent-STC and IIC single-number ratings for these paths. All Phase 5 characterization will be done with the bearing walls loaded.

During the spring, NRC developed several graphical User Interface concepts and investigated existing technologies necessary to deliver a good web-enabled experience with the electronic design guide. This included consulting with a few architects, contractors and design/build operations that develop or design multi-family wood-frame residences. On July 11, a draft proposal focussing on the editor component of the user interface was forwarded to Steering Committee members to solicit feedback. Forintek scientists commented that the proposal looked promising, but that without seeing a working model it was hard to make a final judgement.

J. Mehaffey and S. Craft participated in the 2<sup>nd</sup> Meeting of the Steering Committee for this project on December 15 at the Ottawa Laboratories of the National Research Council Canada. Also in attendance were NRC scientists as well as two representatives from Owens Corning, a representative from Lauzon Floors (a manufacturer of pre-finished hardwood and engineered wood flooring products) and Claude Beaudet (a Québec-based builder of multi-family buildings). A copy of the Minutes is available from J.R. Mehaffey. The following summarises the discussion:

- NRC reported that acoustical testing using two manufacturers' I-joists (different OSB webs and different flanges) found almost identical performance for both airborne sound and impact sound performance. This means it is possible to treat I-joists on a generic basis in the Guide.
- The difference in flanking transmission between attaching the ceiling to resilient channels or directly to framing is significant and must be considered in the Guide.
- Changes to flanking transmission due to loading are small. In fact direct paths are often (but not always) the most important paths and they are not affected by loading.
- Tests were conducted to evaluate the effectiveness of a two-layer (plywood over OSB) raft placed on Owens Corning QuietZone Acoustic Floor Mat to control direct and flanking transmission. Overall the topping was very effective at controlling flanking.
- A detailed testing program was developed. Among the data to be generated is the acoustical performance when a wood raft is employed above the sub-floor and the floor covering is vinyl, carpet, laminate or hardwood strips. All testing will be completed by June 2009.
- A prototype of the electronic design guide was show-cased and Committee Members made a number of suggestions for change. The electronic design will be reworked before the next meeting tentatively scheduled for June 2, 2009.

**Publications**

None.