Noise Control in Wood-Frame Construction

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SUBJECT

NOISE CONTROL IN WOOD-FRAME CONSTRUCTION

In Canada wood-frame construction is used extensively in single-family dwellings and is permitted in most regions for small multi-family dwellings including double houses, row houses and small apartments of up to 3 storeys.

Little consideration is given to sound insulation within a single-family dwelling. It is assumed that the individual householder can control the noises within his own household; furthermore, the usual open planning used within modern dwellings is not compatible with the requirements for sound insulation.

For multi-family units, there are mandatory requirements in Residential Standards (Supplement No. 5 to the National Building Code of Canada) covering party walls and floors that separate dwelling units. At present, only airborne noise is subject to mandatory regulation, chiefly because there is no satisfactory standard for impact noise. The Standards contain a list, however, of acceptable constructions and this list provides some guidance on the performance of floors under impact noise.

Standards

Acoustical standards in Canada have been developed in conjunction with standards groups in the United States, and the same documents are used. Of particular importance

is ASTM E90-66T, "Tentative Recommended Practice for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions." It will be noted that this Standard covers the performance of a partition installed in the laboratory rather than in an actual building. It is our view that it is essential to provide guidance at the design stage and, thus, it is necessary to provide data based on a laboratory test of a building component rather than on the finished product. There are two reasons for this:
(1) generally, when a structure is completed, it is too late to make major improvements in sound insulation;
(2) in Canada there is no corps of competent acousticians that would be required to make measurements on all buildings. DBR/NRC is interested, however, in the performance of buildings, and this is a major field of research for the Building Physics Section.

It is our understanding that in other countries, for example France, the building requirements are based on the sound transmission losses averaged in three frequency ranges. The requirements for party walls and floors in France in the three frequency ranges are as follows:

Frequency -	Low 100-315 Hz.	Medium 400-1250 Hz.	High 1600-3150 Hz.
Sound Separations Between Dwellings	36 dB	48 dB	54 dB

On this continent, a single-figure rating known as the Sound Transmission Class (STC) is used. This is obtained by comparing the graph of sound transmission loss with a standard contour which gives greater emphasis to the middle and high frequency ranges than to the low frequency range. There is no exact correspondence between the two methods of rating, but it appears that the French requirement is about equivalent to STC 50. The main distinction is that the Canadian requirement is more flexible in the interpretation of results for various frequency ranges. For lightweight constructions, for example, it would be possible to achieve STC 50 and yet not meet the low frequency requirement of the French standard. In Canada the mandatory minimum is STC 45, but STC 50 is recommended.

Wall Construction

The simplest type of wood frame wall consists of 2 in. by 4 in. (5 cm by 10 cm) wood studs and $\frac{1}{2}$ in. (13 mm) gypsum plasterboard nailed to each side. Such a partition would be rated at about STC 33. The addition of mineral wool or glass fibre would bring this wall up to STC 36 to 38 and it would then be limited by coupling through the wood studs. To improve the wall still further requires that the connection from surface-to-surface through the studs be interrupted. One of the standard procedures is to use two sets of studs, one for each wall surface with no direct connection from face to face. Such a wall, with mineral wool or glass fibre, will provide STC 47, but it will still be slightly deficient at low frequencies for purposes of the French standard. It could be made to meet the French requirement by additional weight on the surfaces (for example, two layers of plasterboard laminated together) or by increasing the spacing between wall surfaces.

An alternative way of reducing coupling through the studs is to introduce a layer of softer material, such as glass-fibre board or soft wood fibreboard on one or both sides before the final plasterboard is applied. This is reasonably effective, and the glass-fibre board may serve the additional purpose of acting as an absorbent filler in lieu of the mineral wool or glass fibre mentioned above. Another approach is to use a resilient metal furring strip between the studs and the plasterboard.

Floor Construction

For floors, the Division is concerned not only with airborne sound, but also with impact sounds such as footsteps. The same airborne sound requirement applies, and the construction requirements are similar to those for party walls. In addition, for impact there are a number of recommended constructions designed to minimize impact sound, although it is not mandatory to employ these. Two approaches are used, both designed to reduce structural continuity between the finished floor and the ceiling below. One is to introduce a relatively soft layer between the sub-floor and the finished floor. This soft layer might consist of a soft wood fibreboard, cork, or a

relatively dense glass-fibre board similar to that which is used for thermal insulation of roof decks. This might support furring strips on which another sub-floor and finished floor, or a heavy hardwood floor, might be applied. The alternative procedure is to support the lower ceiling on separate joists or on resilient suspension elements. In either case, it is important to introduce mineral wool or glass fibre in the space. Here, as in the case of the walls, the exact amount of absorbing material is not critical. Typically, in Canada a thickness of 2 or 3 in. (50 to 75 mm) is used.

Either of these procedures meets the Canadian requirement of STC 45, and brings it in the "recommended" category for impact sound. To meet the low frequency requirement for France would require that the ceiling consist of two or more layers of plasterboard.

More detailed information on the various aspects of noise control in wood-frame construction is contained in a publication of the Division entitled "Noise Control in Residential Buildings" ("Règlementation du Bruit dans les Bâtiments Résidentiels") (NRC 9162).