

NOISE ISOLATION STANDARDS IN CONDOMINIUMS -- AWAITING  
REVISION OF SECTION 9.11 OF THE NATIONAL BUILDING CODE

Paper presented at the Canadian Acoustical Association  
meeting in Ottawa - October 1985

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SOMMAIRE

Jusqu'à récemment, la plupart des édifices à logements multiples de la région de Montréal n'avaient qu'une vocation locative. Les prix des loyers étaient fixés selon le marché et selon la qualité des constructions. Le déménagement était la solution la plus souvent adoptée lorsque les conditions de location étaient jugées inacceptables, à cause du manque d'isolement acoustique, ou pour toutes autres raisons.

L'accession à la propriété par condominium modifie les règles du marché. La réglementation existante régissant l'isolement acoustique entre les logements des édifices à vocation locative ne semble plus être appropriée lorsqu'appliquée aux édifices vendus en copropriété divise.

A l'intérieur du présent article, l'auteur passe en revue la réglementation existante régissant l'isolation sonore des condominiums bâtis à l'intérieur des limites de la communauté urbaine de Montréal. Il propose de plus une liste de critères d'isolation sonore dont il juge l'application souhaitable durant la conception et la construction d'édifices destinés à la vente en condominiums.

SUMMARY

Until recently, most multi-dwelling buildings in the Montreal area were intended solely for rental purposes. Rental rates were generally based on the

state of the market and the quality of the construction. When rental conditions were deemed unacceptable because of insufficient acoustical isolation or other reasons, most tenants simply moved.

The trend towards condominium ownership has changed the rules of the market. The existing regulations governing acoustic insulation between dwellings in rented buildings no longer seem appropriate when applied to buildings intended for divided co-ownership. In this paper, the author reviews the current regulations in the Montreal region and proposes a series of noise isolation criteria for condominiums. These criteria are not intended to cover exhaustively all the aspects of noise isolation in multi-dwelling buildings; they are intended to serve as guidelines during the design and construction.

#### Municipal Regulation

At the present time, with the exception of Ville Lasalle, the member municipalities of the Montreal Urban Community have no construction regulation dealing specifically with noise control in condominium buildings. They usually refer to the requirements set forth in the National Building Code, section 9.11.

According to the new regulation of Ville Lasalle (bylaw 1873-1), each dwelling must be separated from any other space in a building, or from any adjacent building, by a construction having a sound attenuation capability of at least 55 decibels for buildings having one (1) to four (4) dwellings inclusively, and of at least 58 decibels for buildings with five (5) or more dwellings. Underground dwellings are not taken into account when calculating the number of dwellings but must be isolated in the same way as the rest of the building. The composition and Sound Transmission Class of these constructions must be indicated on the plans and specifications, complete with reference to the standards used and approved by Ville Lasalle. (It should be noted however that the standards approved by Ville Lasalle are not defined in the regulation).

#### National Building Code (NBC)

Section 9.11 of the National Building Code (NBC), 1985 edition, stipulates that each dwelling unit belonging to a multi-dwelling building must be separated from any space likely to contain a sound source by a construction having a Sound Transmission Class of at least 45. Furthermore, a partition separating a dwelling from an elevator or garbage chute must have a Sound Transmission Class of at least 50.

The National Building Code (NBC) deals with buildings intended to be sold as condominiums on the same basis as rental buildings. Also partitions separating dwelling units from hallways are subject to the same requirements as those separating two dwellings. One could note on this subject that activities taking place in hallways are generally not as noisy as those resulting from human activity in dwellings. In addition, the NBC does not regulate the degree of insulation provided by access doors to dwellings, which constitute a weak point in a partition adjacent to a corridor.

Finally, experience has proven that the requirements set forth in the current edition of the National Building Code are clearly insufficient to assure future condominium occupants a satisfactory degree of noise isolation. One can therefore expect a high rate of dissatisfaction on the part of residents with regard to the degree of interdwelling acoustical privacy afforded by condominiums built in strict accordance to these requirements.

#### Current standards in the construction industry

After realizing the inadequacy of the inter-dwelling noise isolation criteria set forth in section 9.11 of the NBC, the Canada Mortgage and Housing Corporation (to be more precise, the CMHC branch offices of the Province of Quebec) has set its own noise isolation criteria in an attempt to improve the quality of the condominium projects in which it is involved. According to these criteria, all inter-dwelling partitions (including floors and walls) should have a composition capable of achieving an air-borne sound isolation of at least STC 55. In addition, it is required that the floor/ceiling assemblies be designed to provide an impact noise isolation of at least IIC 65. These criteria seem to be accepted by most builders of the Province of Québec as the current standards in the construction industry.

#### Towards a new regulation

Several factors influence condominium owners' subjective impression of the noise isolation provided by their dwelling. Among these factors are:

- their auditory acuity
- their, and their neighbors' habits and lifestyle
- their rapport with their neighbors
- the background noise level inside their dwelling
- the spectrum, nature and frequency of occurrence of the transmitted sounds
- the message carried by the transmitted sounds, etc.

The National Research Council of Canada is currently conducting a study across Canada in order to simultaneously observe the subjective reactions of condominium and apartment

occupants and the transmission loss provided by the partitions separating them from their neighbours. This research will attempt to correlate the residents' subjective evaluation of the noise isolation provided by the partitions of their dwelling, with the actual performance of the same partitions measured objectively using a recognized standard. A preliminary report based on a small sampling of data collected in the Ottawa region was published in Canadian Acoustics (1) and is available from the National Research Council (2). In this report it is established that inter-dwelling partitions with a Field Sound Transmission Class (FSTC) of 55 met the noise isolation expectations of 90% of the condominium owners surveyed. An FSTC 52 rating leads to a percentage of satisfaction of approximately 80%.

Ultimately, it is expected that the final compilation of all the results collected across the country will serve to redefine the criteria for noise isolation and to rewrite section 9.11 of the National Building Code.

#### PROPOSED SOUND ISOLATION CRITERIA IN CONDOMINIUMS

While awaiting a revision of section 9.11 of the NBC, the author proposes a series of minimal sound isolation guidelines which in his opinion should be applied during the design and construction phases of buildings intended for sale by divided co-ownership.

- 1.0 EXTERIOR NOISES \*
- 1.1 The building envelope should be capable of attenuating the noises produced by vehicular traffic or by industries and businesses located near the site to the sound pressure levels shown in Article 1.2.
- 1.2 Sound pressure level criteria in interior spaces:
  - bedrooms: Leq (24 hrs) = 35 dB(A)
  - living room, dining room, den: Leq (24 hrs) = 40 dB(A)
  - kitchen, bathrooms: Leq (24 hrs) = 45 dB(A)
- 1.3 Vehicular traffic noise should not exceed Leq (24) = 55 dBA in outdoor living or recreation areas (balcony, exterior courtyard, etc.).

\* Criteria established by the CMHC for buildings in urban areas (3).

#### 2.0 NOISE PRODUCED BY HUMAN ACTIVITY WITHIN DWELLINGS

- 2.1 Partitions separating two dwellings  
Horizontal and vertical partitions separating two

dwellings should have the following sound isolation characteristics:

- 2.1.1 Possess a Sound Transmission Class of at least 55 (average of at least 5 different laboratory tests)

NOTE: As was mentioned earlier, according to the preliminary report produced by the Division of Building Research of the National Research Council, 80% of the occupants express satisfaction with a partition rating FSTC 52. This percentage of satisfaction has been selected by the author as a minimum acceptable noise isolation target.

In item 5.3 of the present guidelines, the acceptable deviation between the Sound Transmission Class obtained in laboratory conditions (STC) and that measured in the field (FSTC) is 3 decibels. Consequently, STC 55 has been selected as the design performance criteria of interdwelling partitions.

- 2.1.2 Provide a transmission loss of at least 35 decibels in the third octave band for which the central frequency is 125 Hz.

NOTE: Rock and pop music contains a considerable amount of energy in the lower end of the frequency spectrum. The author ran a third octave band analysis of a 257 sec. sample of a popular rock music extract: Michael Jackson - Beat it. The Leq and L 10 levels were then obtained and used to calculate the transmission loss required to reduce the L 10 levels produced in the source room (listening level Leq = 85 dBA), to levels equal or below the Preferred Noise Criteria (PNC) 25 in the receiving room. With this specific sample, it was found that a TL of 40 dB was required in the third octave band for which the center frequency is 125 Hz.

As a TL of 40 dB at 125 Hz represents the practical limit which can be attained in wood construction, the author has opted for a minimum TL of 35 dB at 125 Hz.

- 2.1.3 Floor/ceiling assemblies should have an Impact Isolation Class of at least 55 in kitchens and bathrooms, and 65 in the other rooms.

NOTE: The Impact Insulation Class Standard has been criticized for not providing results which can be used to predict the subjective evaluation of the occupants with regards to the impact noise isolation which is provided by the floor/ceiling assembly separating them from their neighbors. The argument at the base of these criticisms is that the characteristics of the impacts produced by the tapping machine bare no resemblance to those produced by a human being walking on a floor.

The author uses the much criticized Impact Insulation Class standard for the sole purpose of ensuring that carpet will be used in living rooms, and that some means will be provided to attenuate the high frequency content of the transmitted sound resulting from impacts on the hard floor surfaces in kitchens and bathrooms.

- 2.2 Partitions separating a dwelling from a corridor
- 2.2.1 Partitions separating a bedroom from a corridor should have a Sound Transmission Class of at least 50.

NOTE: The <sup>r</sup>STC 50 value was obtained by calculating the transmission loss required to attenuate to PNC 25 or below, the noise levels which could be generated in corridors during a discussion held at normal voice (the levels used for calculations are those contained in the ANSI S35-1969 Standard).

- 2.2.2 In the case of partitions separating a common hallway from any other room of a dwelling, a Sound Transmission Class of at least 45 is required.

NOTE: The background noise in living areas is generally higher than in sleeping quarters. See item 1.2 of the present criteria.

- 2.2.3 The use of carpeting with a resilient underlay as floor treatment in the hallways is highly recommended.

NOTE: For reducing the levels of both reverberant airborne noise and impact noise produced in hallways.

- 2.2.4 Access doors to dwellings should have a Sound Transmission Class of at least 25. To preserve the sound-insulating qualities of the doors, they should be installed in appropriate frames equipped with air-tight gaskets.

NOTE: STC 25 is generally the highest rating which could be expected from a normal solid core door (the core is generally made out of particle board), when the door is fully gasketed. Some 1 3/4" wood sound rated doors such as Weyerhaeuser DPC-1 are rated at STC 31; the use of such doors or vestibules with two doors could be considered in order to improve sound isolation between dwellings and corridors. For fire security reasons, double doors such as those used between hotel rooms are not recommended for access from a corridor to a dwelling.

- 2.3 Partitions separating a stairwell from a dwelling  
2.3.1 Partitions separating a stairwell from a bedroom should have a Sound Transmission Class of at least 55. The partition should consist of two leaves free of any mechanical coupling (i.e. each leaf should have its own frame). If an unbalanced construction is considered (e.g. two layers of drywall on one side, one layer on the other side of the partition), the heavier leaf should be installed on the side of the dwelling.

NOTE: The salt and sand used on Montreal streets to melt the snow during the winter generally creates maintenance problems in the entrance of buildings. In a large number of walk up apartments, the main stairway is located at the entrance of the building; for maintenance reasons, the floor covering of the landings and of the stairs is a hard washable finish. This results in a very reverberant space, where the reverberant noise build up can be considerably higher than that which would be experienced if the space were carpeted. For this reason, it is deemed that a STC of 55 is required for the partition located between a stairwell and a bedroom.

The landings are usually attached to the stairway walls. Providing independent structures for each leaf should reduce the amount of impact noise transmitted during the use of the stairs. If an unbalanced construction is used for these partitions, installing the heaviest leaf on the side of the dwelling should provide a better impact noise isolation.

- 2.3.2 A partition which separates a stairwell from any room of a dwelling other than a bedroom, and which does

not contain an access door to the stairwell, should have a Sound Transmission Class of at least 50. The partition should consist of at least two leaves with a minimal amount of mechanical coupling.

NOTE: Cf. notes 2.2.2 & 2.3.1.

- 2.3.3 Partitions incorporating an access door to the stairwell should have a Sound Transmission Class of at least 45.

NOTE: This is to provide an STC Value appreciably higher than that provided by the door which represents a weak point in the partition. It is worth noting that sound leaking through the doors is more easily accepted by occupants than sound leaking through the partitions. Providing a partition having a STC rating 20 points superior to the rating of the door appears to be more than sufficient to insure that sound leaks will be perceived to be coming from the door and not the partition.

- 2.3.4 The use of carpeting with underlay as floor treatment in the stairwells is highly recommended.

### 3.0 VENTILATION

- 3.1 The noise levels generated in the hallways by ventilation or pressurization systems should not exceed the Preferred Noise Criterion of 40. (45 dBA).

- 3.2 If for ventilation purposes it is necessary to introduce an opening in a partition separating a hallway from a dwelling, this opening should be located above the door and acoustically treated to provide a noise reduction consistent with that provided by the door.

NOTE: The ventilation opening can be located anywhere in the partition as long as it is treated to provide a noise attenuation consistent with that of the partition in which it is located.

For economy, the author opted for the location of the opening above the door: the vent should then be treated to achieve a noise reduction consistent with the noise isolation provided by the door (STC 25) instead of that provided by the partition (STC 45).

4.0 PLUMBING

- 4.1 The water speed in the pipes should be limited to 1.8 m/sec in circulation systems, and 2.4 m/sec in water supply systems.
- 4.2 Pressure in the pipes should be reduced to a minimum acceptable level.
- 4.3 All rigid contact between the piping and the building structure should be avoided.

NOTE: These guidelines are intended for the control of cavitation noise at the source. Additional measures should be recommended by the acoustical consultant during the project design phase.

5.0 ACCEPTED STANDARDS

- 5.1 The recognized standards for the measurement of the Sound Transmission Class (STC) of a partition are:

Laboratory measurement

ASTM E90-85

ISO 140/3 1978 (provided that a TL measurement is performed at 4000 Hz).

Field measurement

ASTM E336-84

ISO 140/4, /5 1978 (provided that a TL measurement is made at 4000 Hz).

- 5.2 The recognized standards for the measurement of the impact noise isolation provided by a floor/ceiling assembly are ISO 140/6, /7 1978 and ASTM 492-77.
- 5.3 The acceptable deviation between the Sound Transmission Class obtained in laboratory conditions (STC) and that measured in the field (FSTC) is 3 decibels.

NOTE: It is the author's opinion that a wideband, "A" weighted noise reduction made by a qualified consultant would be all that is necessary to provide a quality control on the airborne noise isolation performance of the inter dwelling partitions (horizontal and vertical).

This simple test could be performed quickly and easily on a large number of partitions using a pink noise source and a type II SLM.

If as a result of these tests, it is felt that certain partitions do not perform as well as they should, more complete testing using appropriate standards should be undertaken to determine the cause of the poor performance and to recommend mitigating measures.

## 6.0 GENERAL CONSIDERATIONS

- 6.1 It is highly recommended that a professional consultant in acoustics be engaged from the preliminary design stage.
- 6.2 The Sound Transmission Class (STC) of partitions and floor/ceiling assemblies governed by the present sound isolation criteria should be indicated on the plans and specifications and confirmed by the acoustical consultant.
- 6.3 The methods and materials used to preserve the sound-isolating qualities of the partitions and floor/ceiling assemblies should be indicated on the plans and specifications (e.g. caulking, gaskets around the doors, etc.).

It should be noted that these guidelines:

- a) are considered minimal;
- b) are also applicable to multi-dwelling buildings intended for rental;
- c) are not intended to cover all possible situations which could occur during the design of multi-dwelling units; care and judgement should be exercised at all times by the design & construction team to ensure a proper degree of acoustical comfort within each unit.

Comments will be well received by the author.

## REFERENCES

- 1- J.S. Bradley, "Subjective rating of Party walls" Canadian Acoustics, Vol. 11(4), p.37 - 45, 1983.
- 2- J.S. Bradley, "Subjective rating of Party walls" NRC Division of Building Research, Paper 1147 Ottawa, 1983.
- 3- Canada Mortgage and Housing Corporation, "Road and Rail Noise: Effects on Housing" Publication NHA 5156, October 1981.