

# THE ABSENCE OF STRUCTURE – BORNE SOUND TRANSMISSION REGULATION IN THE ONTARIO BUILDING CODE

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## INTRODUCTION

The Ontario Building Code (OBC), last revised in 1997, regulates airborne sound transmission through demising structures separating suites or dwelling units from any other areas in a building [1]. However, structure-borne sound transmission (SBST) can potentially be the most dominant sound transmission path between two spaces, yet it is not regulated in the OBC. Figure 1 illustrates the potential dominance of SBST compared to airborne sound transmission in a residential condominium unit situated above a fitness centre. The high levels of airborne sound reduction compared to the relatively low levels of vibration reduction between the fitness centre and the living room in the unit above are apparent. The tenant of this unit had concerns originating from floor impacts in the fitness centre, which were found to travel through the building structure to the unit above.

This paper outlines how SBST can propagate, describes why regulation of SBST is desirable, and suggests methods for reducing this sound transmission path in building construction.

## BACKGROUND

SBST involves the transfer of vibrational energy from one structure to another through physical connections. Due to low damping of typical building components, a significant amount of the vibrational energy is not dissipated near the source of the vibration. The vibrational energy can then be transferred to any structures in direct contact, with the amplitude of the resulting vibration on the contacting element being a function of the nature of the connection between the two structures.

In multi-tenanted buildings such as residential condominiums and office buildings, there are many vibration sources. These sources can include mechanical equipment such as pumps, chillers, and boilers, and physical activities such as jumping, walking, and the moving of objects. For example, noise generated by a pump is transmitted through both the flanges and through the contained fluid into the adjacent piping. As the pipe runs and risers extend through the building, they must be supported from the structure at various locations. If these connections are rigid, then the pipe vibrations can cause the adjacent structures to vibrate at the same frequency. Depending upon the type of physical connection, the amplitude of vibration may not be significantly reduced,

and the resulting vibration and/or sound radiated from the building structure may be perceptible.

The acoustical environment within a space can be significantly impacted by vibrational motion of the room surfaces. These effects may include sound intrusions caused by radiation from these surfaces and perceptible vibratory motion on the surfaces of lightweight supported objects. These effects have the potential to be disturbing to those subjected to them.

## REGULATION

The OBC does not currently include any regulations to prevent significant vibration propagation throughout building structures. In Appendix A-9.11.1.1 of the OBC, the potential annoyance caused by SBST is discussed and a recommended level of impact isolation is provided. However, impact isolation is not mandated by the OBC. As a result, some buildings do not achieve a suitable level of vibration isolation, and SBST can be the dominant form of sound transmission. In addition, vibration isolation for vibrating equipment supported from the building structure is suggested, but not required. The result of the lack of regulation of SBST is that relatively simple methods of vibration isolation within building structures are commonly not incorporated into the building design by profit-minded developers.

SBST can be addressed at the source, along the path of transmission, or at the receptor. Source isolation usually involves installing a resilient layer on surfaces subject to vibrational impacts and balancing the vibrating equipment to reduce the amplitude of the oscillations. Path isolation can be achieved by ensuring that structural discontinuities or separations are present between the vibration source and receiver, installing vibration isolation between the source and the structure, and by incorporating vibration damping treatments on the transmitting structure. If these methods are not feasible, then the vibration of the receiver can be reduced by treating the radiating surfaces with a resilient layer or by vibration damping [2]. The type of vibration reduction method depends on the source of the vibration. Impact-induced vibration can successfully be dampened by altering the interaction between the source and receiver through the use of rubber, plastic, or other soft cushioning material. Noise induced by plumbing vibrations can be addressed with flexible connections and resilient pipe mountings, usually incorporating a liner, pad, or sleeve between the pipe and support structure.

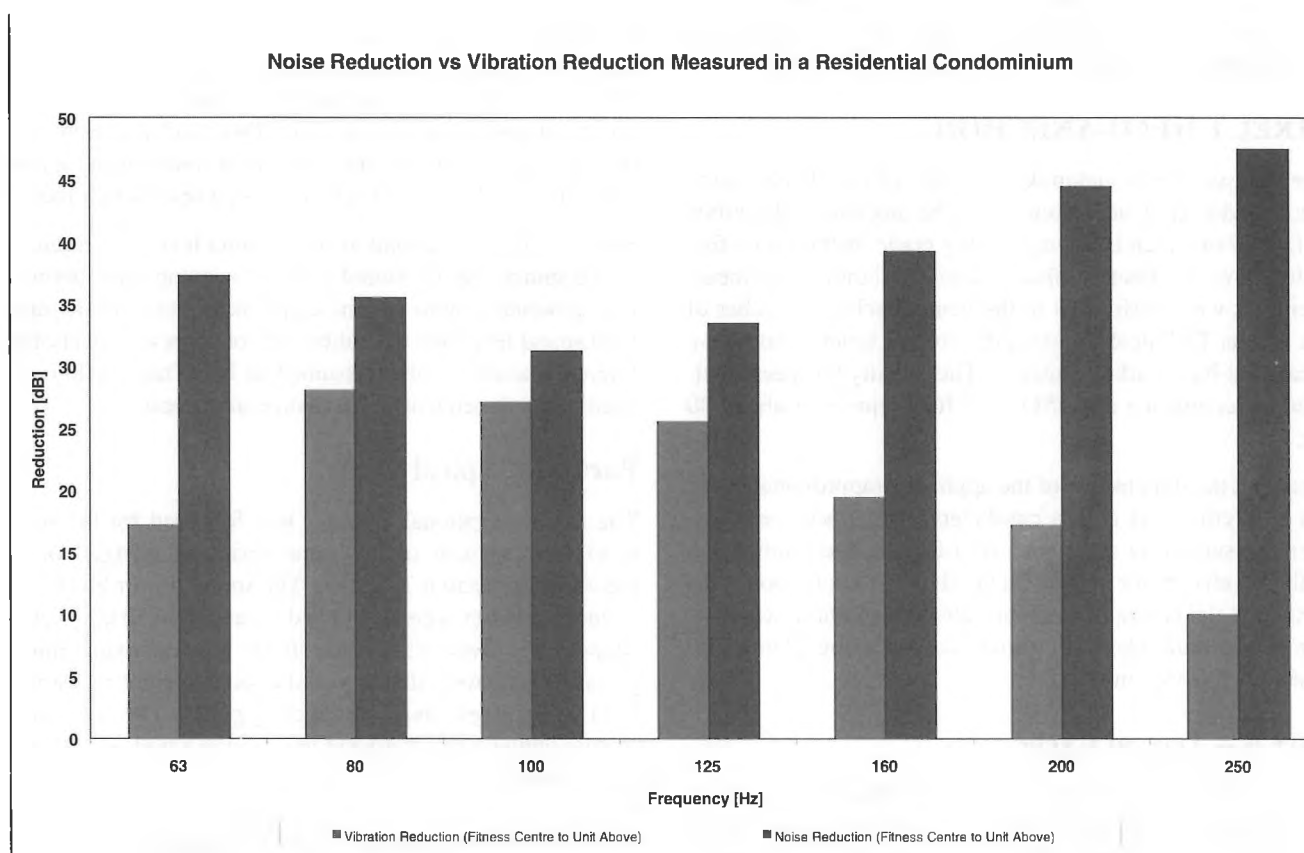
Mechanical equipment isolation can be reduced through semi-rigid mounts, such as molded rubber or neoprene pads made of a resilient material, springs, or a combination of the two.

These vibration isolation methods all involve replacing a rigid connection with one that is able to successfully isolate the vibrations that would otherwise pass through it. The methods suggested are relatively easy and inexpensive to install during construction. However, if the vibration propagation characteristics of the structure and building components are not considered during design and construction, then costly retrofits may be required due to future complaints.

## REFERENCES

[1] Ministry of Municipal Affairs and Housing, *Ontario Building Code 1997 containing the Building Code Act and O. Reg. 403/97*, June 1999 update.

[2] Harris, C.M. *Handbook of Noise Control*, McGraw Hill Book Company, 1979.



**Figure 1: Noise reduction compared to vibration reduction measured between a fitness centre and the unit above. Typical sources of impacts in the fitness centre were simulated, such as the skipping of rope, the dropping of weights, and treadmill activity. Those activities did not provide sufficient signal to noise ratios in frequency bands outside of the 63 to 250 Hz range, and were excluded from the results.**