RESEARCH HIGHLIGHT

Technical Series 00-105

Sound Transmission Loss Measurements Through 190 mm and 140 mm Blocks With Added Drywall and Through Cavity Block Walls (1990)

INTRODUCTION

The economical control of noise through party and exterior walls is an important consideration in the construction of both residential and commercial buildings. At the time of this research project a decade ago, concrete blocks and other types of walls had been used for this purpose for many years. However, new measurements of their effectiveness were needed for the following reasons:

- Discrepancies existed among the data presented in the literature for blocks with and without finished surfaces;
- The 1990 National Building Code increased sound insulation requirements relative to earlier versions, and there was a general demand for greater sound insulation in homes;
- Information about the transmission of low-frequency sounds below the limit normally measured in tests was inadequate; and
- There was a lack of information about block wall systems with very high STC (sound transmission class) ratings.

As a result, the Institute for Research in Construction, under contract to the Ontario Concrete Block Association, undertook a research program to investigate the factors influencing the sound attenuation capabilities of various types of block wall assemblies.

RESEARCH PROJECT

The research project had two objectives:

- To measure the influence on sound transmission loss of various methods of attaching single layers of drywall to a concrete block wall.
- To measure the effects on cavity block walls of various thermal insulators in the cavity and to determine the importance of flanking sound transmission through the wall assembly (the transmission of energy around the periphery of the walls and through other parts of the structure).

Apparatus

190 mm blocks with attached drywall

The researchers conducted a series of sound transmission measurements on various wall assemblies constructed on a wheeled test frame. The different wall assemblies tested were made of 90 mm normal weight concrete blocks, 90 mm split-rib concrete blocks, 140 mm 75% solid concrete blocks, 140 mm 100% solid concrete blocks, and 190 mm normal weight concrete blocks.

The walls also included either a 12.7 mm and a 15.9 mm gypsum wallboard (Gyproc) secured to metal support systems or wood furring. The various types of support systems tested included 50 mm and 75 mm USG z-furring channels, 13 mm resilient metal furring channels, 65 mm non-load bearing steel studs and 40 mm square pine furring strips. For each type, the wall was tested with the cavity empty or filled with sound absorbing material. Various cavity depths were chosen to cover all likely practical cases.

In the air space between the surface of the block and the gypsum wallboard, some assemblies had insulation consisting of SM Styrofoam insulation (blue extruded styrene foam). Others had various thicknesses of Fiberglass Canada cavity wall insulation panels.

After the wall was cured, the researchers applied a bead of caulking compound around the perimeter on both sides of the wall to seal any possible shrinkage cracks between the mortar joint and the wood frame of the wall mounting rack. They then applied two coats of CIL Super Latex Undercoat Primer to the wall surface.

Canada

CMHC SCHL
HOME TO CANADIANS

Cavity block walls
To test cavity block walls, the researchers constructed a wall assembly consisting of one wythe of blocks on the lip of a sound-receiving room and the other on a wheeled test frame in the sound-source room. Both rooms were mounted on steel springs to minimize the amount of flanking transmission.

METHOD

The researchers measured the sound transmission loss through the various wall assemblies to determine their effectiveness in muffling noise at different frequencies. They also tested the viability of a formula for predicting wall performance.

Analysis of results

The data generated by the tests was manipulated in a sequence of mathematical operations to derive the transmission loss results for each wall tested. The data was then plotted to create a series of curves comparing the performance of the various walls.

FINDINGS

General

Concrete block walls can provide high sound insulation at low frequencies when layers of drywall are added in the correct way. In the measurements, sound transmission class ratings (STC) as high as 73 were obtained for a single-wythe 190 mm block wall. However, to achieve such high values, designers and builders must use appropriate drywall mounting techniques and select the correct cavity depth. The addition of sound-absorbing material in the cavity significantly increases sound insulation without adding to the thickness of the wall.

Theoretically, cavity block walls can provide very high values of sound transmission class. In one test, an STC of 79 was measured. To achieve such performance in practice requires very careful design and construction.

In addition, lightweight blocks might perform as well as normal weight blocks due to their higher porosity. Thus, it might be possible to achieve high STC and good low-frequency performance with lightweight blocks. However, further research is required to test this hypothesis.

There is a simple method of calculating expected sound transmission loss values for certain block wall systems. It can be used to predict the STC for some common wall thicknesses.

Other

190 mm blocks with attached drywall
In walls with unfilled cavities, increasing the depth of the cavity improved the performance of the wall at lower frequencies. However, at the important low frequencies, it reduced the performance.

Other tests measured the performance of walls with the same drywall mounting method used and the cavity both unfilled and filled with absorptive material. The walls with the cavity filled performed better at lower frequencies than those with the cavity unfilled.

The addition of a second layer of drywall to the other side of a block wall improved the sound transmission loss of the wall at higher frequencies but reduced it at lower frequencies.

Similar measurements were taken for walls constructed of 140 mm blocks with added drywall. The data showed greater discrepancy between the results predicted by theory and the experimental results. However, the overall agreement between the two sets of results was fairly good. As a result, the researchers were able to predict STC ratings for normal weight blocks of other sizes.

Cavity block walls
For this type of construction, the STC rating was high, and there was no evidence of degraded performance at the lower frequencies when compared with the single-wythe 190 mm or 90 mm block walls.

In addition, when the 190 mm block wall on the test frame was replaced with a 90 mm block wall, there were only slight reductions in the performance of the wall due to the lighter block.

In another configuration, two 90 mm block walls were constructed on the test frame only. This allowed the researchers to measure the effect of the transmission of acoustical energy through the structure of the frame. This wall performed worse than the walls in which the wythes were isolated.

IMPLICATIONS FOR THE HOUSING INDUSTRY

The data from the research program serves as an aid to a good understanding of acoustical principles, which the designer can use to modify wall assemblies. For example, it enables the designer to customize wall assemblies to best fit his or her needs by changing the various components, while still being assured of the end performance of the wall.

The following are some of the major implications to be derived from the research project.

Wall mass and dead-air cavities are important factors affecting the ability of a wall to muffle sound. In fact, designers can combine mass and space to achieve any desired effect, but material cost and spatial loss will limit ideal solutions.

To achieve optimal sound resistance, designers should use an appropriate combination of mass, air space and absorptive materials.

In some cases, the simple addition of mass can lead to decreased wall performance. For example, laminating board materials directly to the block wall reduces its STC value because it eliminates the air cavity between the board material and the block. Sound attenuation will improve if the width of the air cavity increases. The use of absorptive material can also enhance the width of the cavity.

The depth of the cavity between the blocks and the drywall, as well as the choice of sound-absorbing material, is critical to the effectiveness of the wall assembly in muffling sound. Making the correct choice in each case improves the wall performance in the frequency range that is important to the consumer. However, making the wrong choice results in extra costs and a reduction in performance.

In addition, it is possible to reduce the width of the wall by substituting smaller block of an equivalent mass without affecting its ability to dampen sound.

Another consideration is the intended use of the space and the type of sound. For example, massive walls will perform much better than lighter-framed walls at low frequencies even though the STC value may be the same. Therefore, the STC value alone may not always provide the best solution.

Project Manager: Ontario Concrete Block Association

CMHC Project Manager: Jacques Rousseau

Research Consultant: A.C.C.Warnock Institute for Research in Construction National Research Council

Housing Research at CMHC

Under Part IX of the ***National Housing Act***, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

To find more ***Research Highlights*** plus a wide variety of information products, visit our website at

www.cmhc.ca

or contact:

Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, Ontario
K1A 0P7

Phone: 1-800-668-2642
Fax: 1-800-245-9274

Printed in Canada
Produced by CMHC 15-05-08
Revised: 2008

62577