EXAMINING AIRBORNE SOUND TRANSMISSION LOSS IN VARIOUS WALL CONSTRUCTIONS

Wilson Byrick[1]

[1] Pliteq Inc., 1370 Don Mills Rd., Toronto, Ontario, M3B 3N7, wbyrick@pliteq.com

1. INTRODUCTION

Wood stud walls show poor sound isolation properties unless treated with additional mass or decoupling techniques. In this paper the performance of various common wall constructions are compared. This study is intended as a guide to better design and construct wall assemblies that meet and exceed minimum code for multi-family dwellings.

1.1. Wall Types

There are 5 wall types tested in this study. They are single stud, staggered stud, double stud, single stud with resilient channel and single stud with GenieClip™ sound isolation clips.

Single Stud Wall

In all constructions tested the following materials were used; nom 2x4 wood studs spaced 406mm O.C., R-13 un-faced fibreglass batts 89mm thick and 15.9mm Type X gypsum board was screwed to the studs or framing members with 25mm drywall screws spaced 203mm O.C. around the perimeter and 305mm O.C. in the field.

Staggered Stud Wall

The perimeter frame was 2x6 wood with a single head and sill plate. Nom 2x4 wood studs were staggered at 203mm O.C. R13 insulation was installed in the stud space.

Double Stud Wall

Two frames were constructed consisting of 2x4 wood studs spaced 406mm O.C. There was a 25mm gap between the two frames. R13 insulation was installed in both stud spaces.

1.2. Non-Structural Framing and Gypsum Board Layers

Two types of framing were used in an attempt to decouple the gypsum board from the structural studs. The first was a 12.5mm Dietrich single leg RC deluxe resilient channels with dog bone slots. These were attached to the studs and oriented horizontally with the resilient leg above the screw leg and spaced 610mm O.C.

The GenieClip™ type RST was also used and attached to the studs at a vertical spacing of 610mm O.C. and a horizontal spacing of 1.22m O.C. 22.2mm, 25 Gauge drywall furring channels were installed into the GenieClips.

All five assembly types were tested with 1 and 2 layers of gypsum board on both sides.

2. METHODS

All constructions were assembled and tested in accordance to ASTM E90-09, and ASTM E2235-04. The test chamber source and receiving room volumes are 204 and 148.4 cubic meters respectively. Western Electro-Acoustic Laboratory is accredited by the United States Department of Commerce, National Institute of Standards and Technology under the National Voluntary Accreditation Program (NVLAP) Lab code 100256-0 for this test procedure.

3. RESULTS

The data is shown below. Where 1,1 is denoted this indicates that the test had 1 layer of 15.9mm Type X gypsum wallboard on both the source and receiving side of the wall. 2,2 denotes a double layer on either side.

In figures 1 and 2 the legend is as follows: Double Stud – Black, GenieClip – Red, Deluxe RC – Orange, Staggered stud – Blue, Direct attach – Green. The bars at the bottom show the deficiency from the STC contour, providing an idea of where the curve and overall rating was controlled.

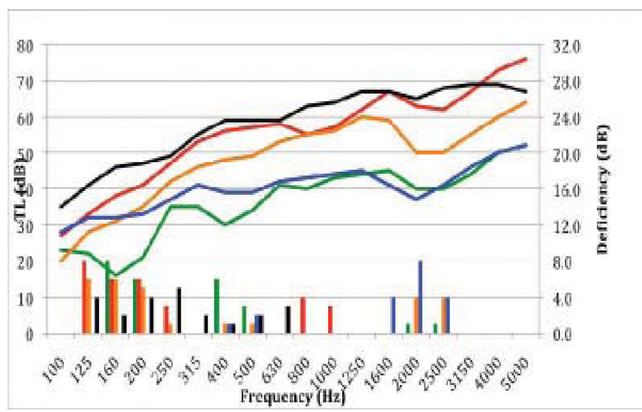

Figure 1. ASTM E90 Test Results for Single Layer (1,1) Wall Constructions

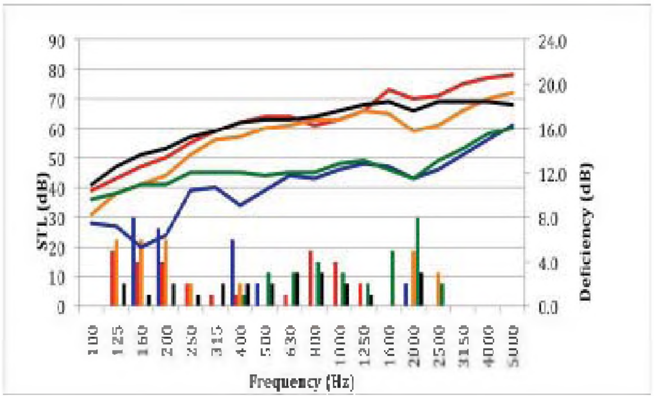

Figure 2. ASTM E90 Test Results for Double Layer (2,2) Wall Constructions

Table 1. STC Test Results for All Constructions

Wall Type	STC – 1,1	STC – 2,2
Single Stud	37	41
RC Channel	50	60
GenieClip	57	64
Staggered Stud	41	47
Double Stud	61	65

4. DISCUSSION AND CONCLUSIONS

The double stud construction yielded the highest transmission loss results at low frequencies and the highest overall STC. The decoupled wall is much more effective than simply adding mass. Doubling the drywall only produced a 4dB increase, while creating a decoupled second row of studs and top and bottom plates produced an increase of 24dB. The low frequency performance of the double stud wall was 3-4dB better than any other partition in this test series.

The staggered stud walls performed very poorly overall with large deficiencies from 500Hz and up. High frequency vibration easily by-passed any attempt to decouple the opposite drywall layers via the common top and bottom plates. At the critical resonant frequency of 2000Hz, (for 5/8" drywall) the staggered wall produced the same TL as a single stud wall, providing zero improvement.

Although the drywall layers were attached to separate and staggered stud rows, the common plates allowed most vibration to by pass this attempt to decouple the wall. The increase in performance on single and double layer systems was only 4 and 6 dB respectively. Even a staggered stud wall with double layers of drywall on both sides did not achieve minimum code for multi-family construction.

When it is not feasible to build a double stud wall, decoupling can be simulated by using resilient metal framing materials. The "z" shaped deluxe resilient channel produced a 13dB improvement. By using the GenieClip the overall STC was increased by 20dB. The rubber isolation material molded to the GenieClip resulted in a 7dB improvement over resilient channel. The isolation clip wall was also better than RC-channel at low frequency by 2-3dB from 63 Hz and up. Above 1600Hz in a double layer system, the GenieClip wall actually outperformed all others including the double stud.

It is important to note that the resilient channel was installed with the resilient leg up, which allows gravity and the weight of the drywall to pull the channel away from the structure. Also screws were carefully placed as not to be driven through the channel to the structural studs. Both of these installation errors result in resilient channel commonly being "short-circuited". Resilient channel failure is a common observation by Acoustical Engineers. Short circuited resilient channel results in up to a 10 STC point reduction. The GenieClip system cannot be short-circuited provided 2.5" screws are not used to secure gypsum board.

REFERENCES

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