DEGRADATION OF WOOD STUD WALL SOUND INSULATION BY ELECTRICAL OUTLETS

Prepared for

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CLIENT REPORT

for

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Degradation of Wood Stud Wall Sound Insulation by Electrical Outlets

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DEGRADATION OF WOOD STUD WALL SOUND INSULATION BY ELECTRICAL OUTLET BOXES

Most textbooks and building practice guides repeat the widely accepted rule-of-thumb that electrical outlet boxes should not be placed back-to-back or even in the same stud cavity. However, there have not been substantial studies of the factors affecting either the sound transmission loss or fire resistance. This study examines the former.

- Boxes that incorporate built-in gaskets that seal to the gypsum board surfaces and to the wires (e.g. the plastic boxes tested here) offer superior sound insulation to standard metal boxes (with or without treatments). Walls with plastic boxes (even in the back-to-back position) gave sound insulation nearly identical to that without outlets.

- Standard metal electrical boxes may cause significant reduction of the STC. The effect depends on the combination of distance between the boxes and presence of intervening obstacles such as absorptive material and studs. Lateral offset greater than the stud spacing will ensure the effect is very small, even with no absorption in the cavity.

- Several possible treatments for incorrectly placed electrical boxes were investigated and are listed in order of increasing effectiveness:
  - Caulked gap between the electrical box and gypsum board, or a plastic/rubber insert in the box (little effect separately);
  - Foam or neoprene draft stopper under the faceplate (variable);
  - Gap caulked plus plastic/rubber insert or mass-loaded material in the electrical box (virtually eliminates reduction in STC).

- Baffles are effective only if the cavity contains absorption. Baffles intended to ensure fire resistance may reduce the sound insulation if they provide rigid connection between the two faces of the wall.

Well-separated electrical outlets reduce the sound insulation only slightly, and sealing the boxes provides an effective acoustical repair even for back-to-back outlets. However, the effect on fire resistance remains unncertain, especially for plastic boxes.

SOMMAIRE

DÉGRADATION DE L'ISOLATION ACOUSTIQUE DES MURS À OSSATURE DE BOIS PAR LES BOÎTES ÉLECTRIQUES

La plupart des manuels et des guides de construction s'accordent sur une règle d'or, celle qui dit de ne pas placer les boîtes électriques dos à dos, ou même dans la même cavité entre les poteaux. Pourtant, les études importantes sur les facteurs touchant la déperdition sonore ou la résistance au feu brillent par leur absence. La présente étude traite de ce premier sujet.

- Les boîtes comportant un joint statique que l'on scelle à la plaque de plâtre et aux fils (i.e. les boîtes de plastiques testées) assurent une insonorisation supérieure à celle des boîtes de métal standards (avec ou sans traitement). Les murs munis de boîtes de plastique (même dos à dos) étaient presque aussi insonorisés que ceux sans boîte électrique.

- Les boîtes de métal standards réduisent parfois de beaucoup l'ITS. Tout est fonction de l'effet combiné de la distance entre les boîtes et de la présence d'obstacles tels qu'un matériau isolant et des poteaux. Il suffit de décaler l'espacement des poteaux latéralement pour réduire l'effet au minimum, même sans absorption dans la cavité.

- Plusieurs correctifs pour des boîtes électriques mal placées ont été examinés, lesquels sont indiqués dans l'ordre d'efficacité croissante :
  - Calfeutrage de l'interstice entre la boîte électrique et la plaque de plâtre, ou garniture de plastique/caoutchouc dans la boîte (effet négligeable séparément);
  - coupe-bise de mousse ou néoprène sous la plaque frontale (variable);

- calfeutrage de l'interstice et garniture de plastique/caoutchouc ou de matériau dense dans la boîte électrique (élimine pratiquement la réduction de l'ITS).

- Les écrans acoustiques ne sont efficaces que si la cavité contient de l'isolant. Les écrans coupe-feu peuvent réduire l'insonorisation s'ils constituent un lien rigide entre les deux faces du mur.

Des boîtes électriques bien distancées ne réduisent l'isolation acoustique que très peu, et le scellement de ces dernières représente une méthode corrective acoustique même pour les prises dos à dos. L'incidence sur la résistance au feu toutefois reste encore à déterminer, plus particulièrement pour les boîtes de plastique.

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BACKGROUND

It is widely accepted that the presence of electrical outlets in party walls can degrade the fire resistance and sound insulation. Most textbooks and building practice guides state that outlet boxes should not be placed back-to-back or even in the same stud cavity. However, systematic studies of the factors affecting either the sound transmission loss or fire resistance have not been reported. This study attempts to resolve the lack of information for sound transmission loss. The factors considered in this study are:

- Type of box (standard metal box or plastic box with a built-in air barrier);
- Box placement (back-to-back, same cavity or adjacent stud cavity) for various types of wall constructions;
- Box treatment including gaskets to seal the opening and inserts or other materials for lining the boxes;
- Possible structural vibration transmission through gypsum board baffles added to block the stud cavity; or through the electrical boxes when the gypsum board is mounted on resilient channels.

TEST SPECIMENS

The study addressed three types of load-bearing party walls that nominally (i.e. without penetrations) provide a sound insulation greater than the STC 50 specified by the National Building Code of Canada (NBCC). The assemblies selected would also comply with the one-hour fire resistance rating, based on either test data or calculation using the supplement to the NBCC.

All the walls had gypsum board surfaces and 38x89 mm wood studs separated 400 mm o.c. The wall specimens were 3.05 m wide and 2.44 m high, and were installed in the specimen frame between the reverberation chambers in the IRC/NRCC laboratory.

The electrical boxes were positioned such that the bottom of each box was approximately 300 mm from the bottom of the wall. All wiring needed to simulate normal field installation was installed.

There are different possible electrical box locations depending on the framing of the wall. The wall details, the box locations, and the nomenclature to identify box locations are given in Figures 1 through 3.

Figure 1(a): Positions of the electrical boxes in the double stud wall. The double wood stud wall was constructed in the following manner:
12.7 mm regular gypsum board
12.7 mm regular gypsum board
38x89 mm wood studs
400 mm o.c
25 mm air space
38x89 mm wood studs
400 mm o.c.
12.7 mm regular gypsum board
12.7 mm regular gypsum board

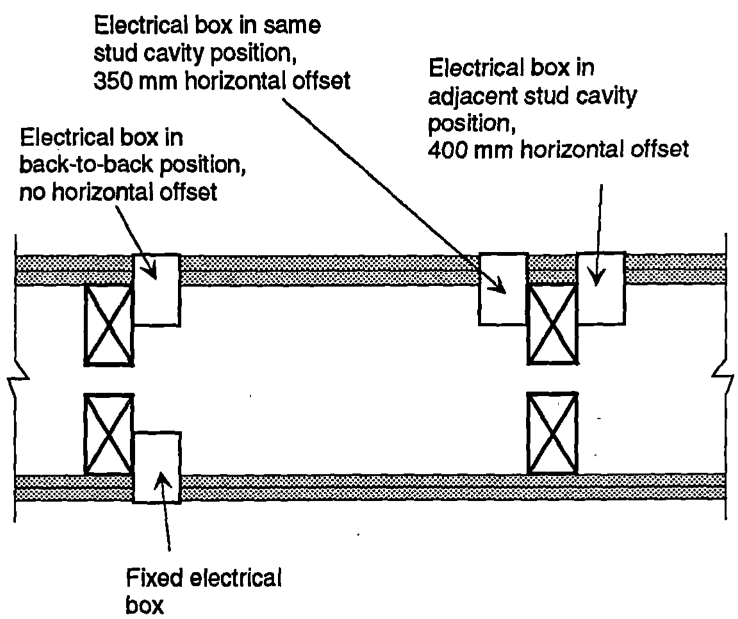


Figure 1(b): Positions of the electrical boxes in the double stud wall. This construction was the same as in Figure 1(a), but with 90 mm glass fibre batt displaced around the electrical boxes in the stud cavity (see also Fig.4).

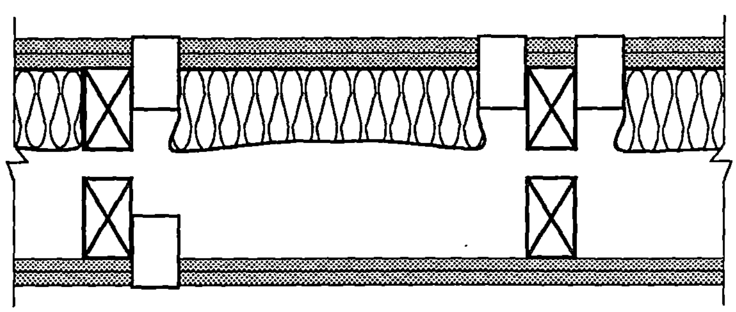


Figure 1(c): Positions of electrical boxes in the double stud wall. This construction was the same as in Figure 1(b), but with 90 mm glass fibre batts installed against the studs and between outlets.

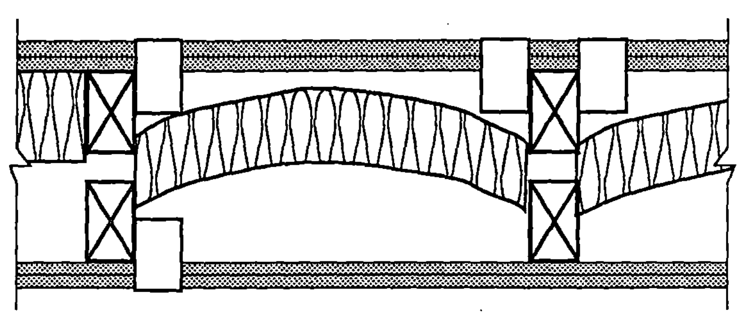


Figure 2: Positions of electrical boxes in the staggered stud wall. The wall was constructed in the following manner:
- 12.7 mm regular gypsum board
- 12.7 mm regular gypsum board
- 38x89 mm staggered wood studs, 400 mm o.c.
- 90 mm glass fibre batts installed vertically in the cavity and displaced around electrical boxes (see Fig. 4)
- 12.7 mm regular gypsum board
- 12.7 mm regular gypsum board

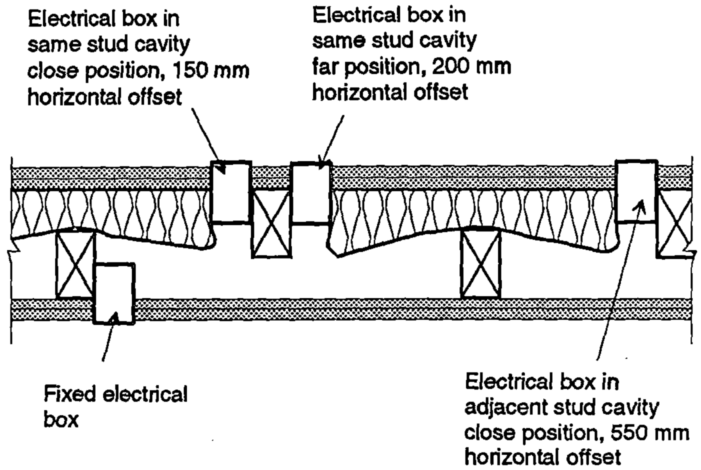


Figure 3: Positions of electrical boxes in the single stud wall. The single stud wall was constructed as follows:
- 15.9 mm Type X gypsum board
- 15.9 mm Type X gypsum board
- 38x89 mm wood studs, spaced 400 mm o.c.
- 90 mm glass fibre batts displaced around electrical boxes (see Fig. 4)
- 13 mm resilient metal channel spaced 600 mm o.c.
- 15.9 mm Type X gypsum board

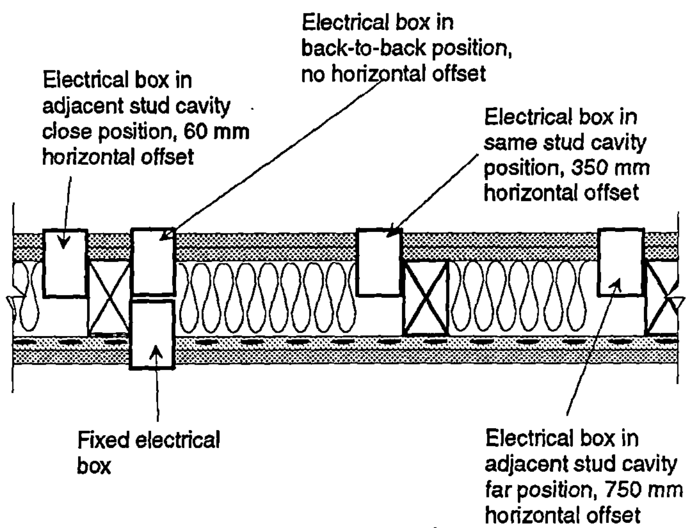
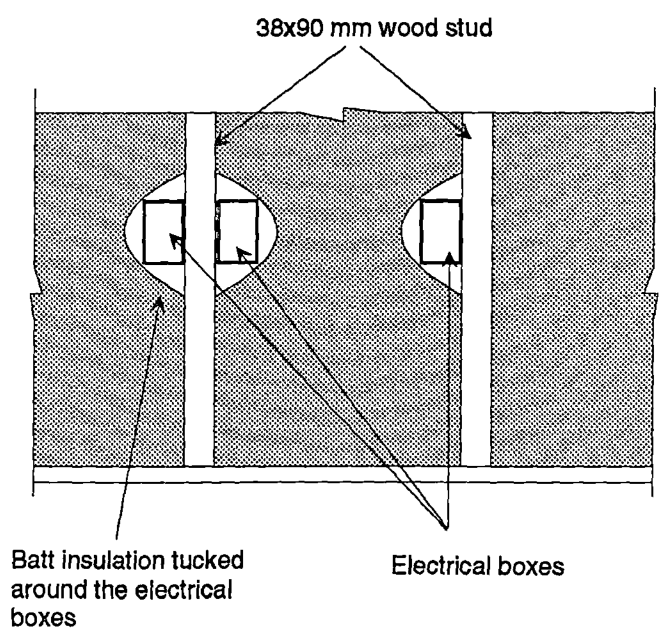


Figure 4: Sketch of a vertical wall section showing the insulation 'displaced' around each electrical box. Note that boxes are exposed to adjacent airspace behind the box, or to each other in case of back-to-back outlets.



TEST METHOD

The tests were conducted in accordance with the requirements of ASTM E90-1990[1], Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions. The Sound Transmission Class (STC) was determined in accordance with ASTM Standard Classification E413.

The STC is a single number rating of the acoustical performance for a partition element under typical conditions involving office or dwelling separation. A higher rating value indicates better sound insulation performance. The rating is obtained by fitting a reference curve to the measured one-third-octave sound transmission loss data.

As with any single-number rating, it is possible for two transmission loss results to obtain the same STC despite obvious differences in some frequency bands. However, many subjective studies have shown that the STC does correlate rather well with people's assessment of the sound insulation. Thus the STC values give the most reliable indication of the practical impact of the electrical boxes on sound insulation, and are used for presenting most of the data.

The effect of the electrical boxes was strongest in the frequency range around 1 kHz. In many cases the STC was not reduced, or was only slightly reduced, despite an obvious reduction in the transmission loss at 1 kHz. Although the STC is used as the basic indicator of significance of the change, the effect around 1 kHz permitted more sensitive identification of relative strength of leaks, and hence is used as the secondary basis for some comparisons.

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1 ASTM E90 Standard Test for Laboratory Measurement of Airborne Sound Transmission of Building Partitions.

TEST PROCEDURE

The test procedure was designed to optimize the accurate comparison between the different electrical outlet positions for the same wall specimen.

For each type of framing, a base wall specimen was constructed with no penetrations. Its sound insulation was measured and compared to previously tested walls of nominally identical construction. In all cases, good agreement was obtained with previous tests. Then the gypsum board was removed and saved for later re-installation.

The four or five electrical outlet boxes and associated wiring were installed in accordance with the Canadian Electrical Code. Holes were cut in the gypsum board to accommodate the boxes and the gypsum board was re-installed. The openings in the gypsum board for each outlet were masked with covers, made from a double layer of 12.7 mm thick gypsum board, whose dimensions were about 25 mm larger than those of the opening. A 3 mm neoprene gasket was placed on the back side of these masks to form an air-tight seal. The masks were held in place by screwing them to the electrical boxes' threaded tabs. With the masks installed, the wall was re-tested. In all cases, the difference between the result with all the outlets masked and that with no penetrations was less than the known repeatability error associated with removing and replacing a layer or layers of gypsum board. This justified using the case with no penetrations as the base case relative to which the results with various outlet configurations were assessed.

Electrical outlets and cover plates were then installed and tested for each outlet configuration in turn, with the other outlet positions masked. This masking technique enables the examination of many different box locations without reconstructing the wall specimen. This enables the accurate measurement of sound insulation changes resulting from small changes to the electrical outlet location and/or treatment(s).

TEST RESULTS

Fifty-six tests were conducted, to investigate the parameters expected to affect the sound insulation of walls having electrical boxes. The transmission loss data were used to calculate the sound transmission class (STC) for easy comparison with each other and with the NBCC criterion of STC 50 for a party wall. Appendix A contains tables of the measured data, grouped by the wall construction type.

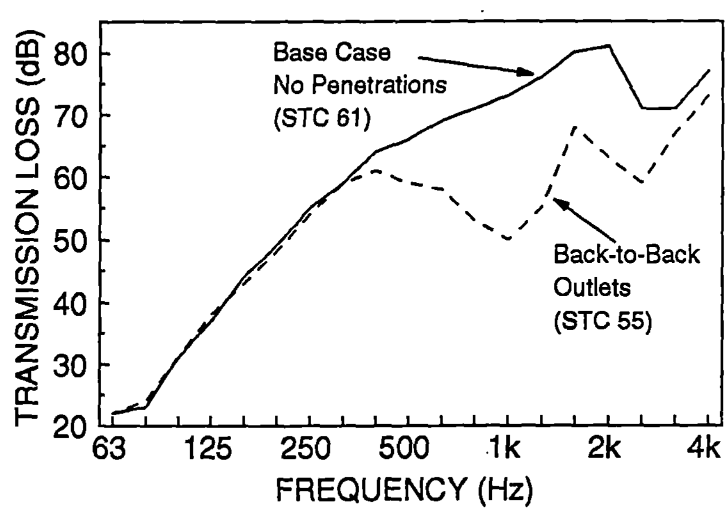
FACTORS AFFECTING SOUND INSULATION

The key factors affecting the sound insulation of wood stud walls with electrical outlets were systematically investigated. The results are examined here in four groups:

1) Type of electrical box;
2) Treatment of standard metal boxes;
3) Effect of box separation (distance, presence of absorptive material, intervening stud structure, etc.);
4) Baffles separating electrical boxes.

Figure 5 shows the large reduction in transmission loss that can occur when electrical boxes are placed in the back-to-back configuration in a double wood stud wall. The effect is strongest in the frequency range around 1 kHz, where the reduction of 18 dB is much greater than the change of 6 in the STC.

Figure 5: Comparison of the sound transmission loss of a double stud wall with and without metal electrical boxes in the back-to-back configuration. The wall had 90 mm glass fibre cavity absorption that was displaced around the box.



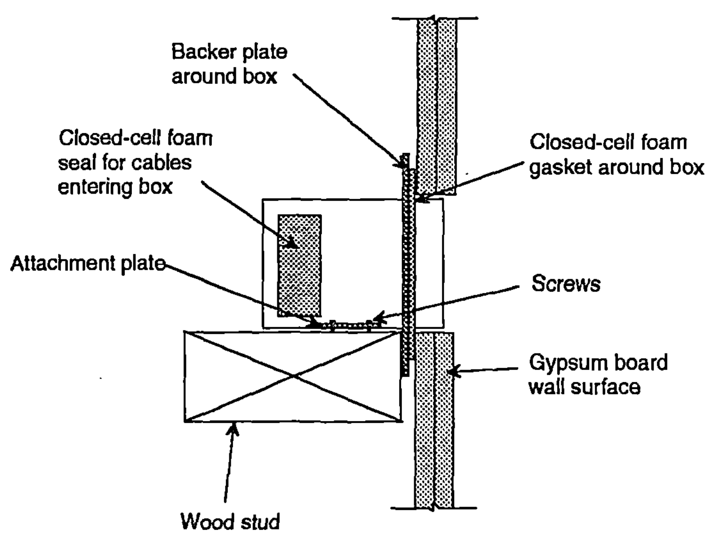
Effect of Box Type:

Two types of boxes were investigated:

- **Standard Metal Boxes:** These were used for most specimens.

- **Plastic boxes:** These boxes are designed to be placed in walls where maintaining the integrity of the air/vapour barrier is important (e.g. exterior walls). The boxes tested had total dimensions of 140 mm height, 105 mm width, 75 mm depth. They were mounted using four nails — two each at top and bottom. The boxes were able to accept four NMD type cables, two through the top and two through the bottom. The penetrations for the cables were covered by an air-tight closed cell foam membrane that provides a seal to the cable(s) inserted into the box. Set back 13 mm from the mouth of the box was a backer plate that was 25 mm larger than the box's outside dimensions. This backer plate had closed cell foam mounted on its front face such that it would form an air-tight seal with the gypsum board. Figure 6 shows a sketch of an installed box.

Figure 6: Plan view through a stud wall showing the mounting of a typical plastic (vapour barrier) electrical box.



The sound insulation for standard metal boxes without any treatment was compared to that with the plastic boxes, when installed in the double wood stud wall without cavity absorption (a sensitive case).

Table 1: Measured sound insulation expressed in STC, for untreated metal boxes and plastic boxes with built-in air barrier in the double wood stud wall without cavity absorption.

COMPARISON OF BOX TYPE		Electrical Box Location	
Box Type	Base Case	Back-to-back	Adjacent Cavity (Far)
Metal (untreated)	55	51	53
Plastic (untreated)	55	55	55

The plastic boxes provided consistently better sound insulation than the untreated metal boxes, especially in the back-to-back configuration. Further, as evident from the STC values above and the curves shown in Figure 7, the sound insulation of a party wall with plastic boxes installed in any position, even back-to-back, was nearly identical to that without any penetrations. These plastic boxes are no more difficult to install than the standard metal boxes and yet provide air-tight seals to both the gypsum board and the penetrating cables which are critical to obtaining good sound insulation.

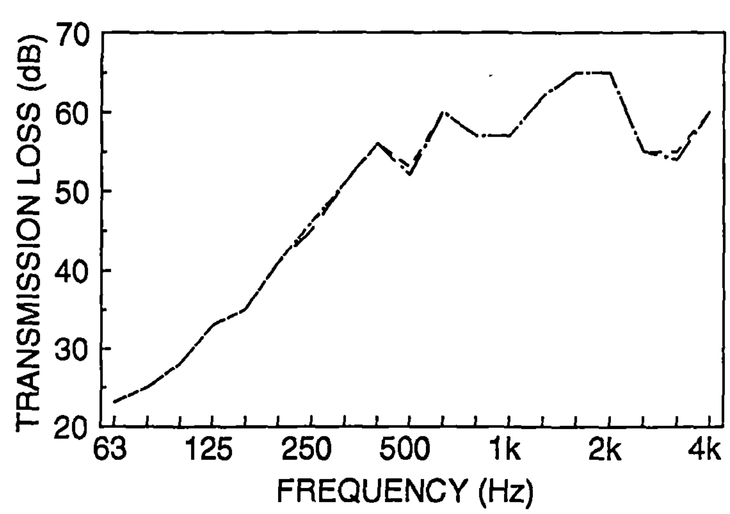


Figure 7: Measured sound insulation for a double wood stud wall without cavity absorption, with plastic electrical boxes installed as follows:
no boxes (base case),
back-to-back, and
same stud cavity positions.
The performance with the plastic boxes is almost indistinguishable from that of the base case.

Box Treatments:

If an existing wall has reduced sound insulation due to improperly located electrical boxes, it would be desirable to have a simple and effective retrofit solution. Several possible methods are discussed in this section:

- Draft Stopper: This is a closed cell foam gasket, typically 2 mm thick, that is placed between the gypsum board of the wall and the face plate of the electrical outlet. It has cutouts designed to form a tight fit with the electrical fitting (outlet plug or switch) that is in the electrical box. They are very simple to install, inexpensive, and provide reduced air penetration through the electrical box.

- Electrical Box Inserts: These are also designed to provide reduced air flow through the electrical box. These inserts fit tightly inside the box and are made from a rubber or plastic material about 1.5 mm thick. A hole or slit in the insert is cut by the installer to allow the electrical wires to pass through to the fitting. The fitting holds the insert firmly to the mouth of the box. The insert has a flange that is designed to provide a seal with the gypsum board. Unfortunately, in some instances, this flange may not be quite wide enough (especially in the top and bottom near the cut-out for the fitting's mounting screws) where there is only 4 mm of material to provide a seal with the gypsum board. Thus, for the insert to seal with the gypsum board, the gypsum board cut-out must be made with great care. The inserts are easily installed but a bead of caulk should be placed between the box and the gypsum board to ensure an air-tight seal.

- Caulking: Filling the gap between the electrical box and the cut-out in the gypsum board with a bead of caulk is an easy way of reducing the air leakage and hence increasing sound insulation of the wall.

- Mass-Loaded Materials: Lining the interior of an electrical box with a pliable material impervious to air will help to increase the air flow resistance and the acoustic performance. A wide range of materials can provide the desired acoustical properties; caulking would be a common example. In this series, a petroleum-based material designed to fill cracks was used because it is much easier to remove than caulking. The material used was not certified for this type of application (i.e. Canadian Standards Association approved) but similar products are available.

Table 2: Wall sound insulation (expressed in STC or change in STC relative to untreated case) for the various treatments used.

	Treatments	Double Stud back-to-back (no absorption)	Single Stud back-to-back
Worst	None	STC 51	STC 50
.	Gap Caulked	+1	
.	Draft Stopper under Faceplate	+1	+4
.	Gap Caulked and Insert in box	+3	+3
.	Mass Loaded Material		+5
Best	No Penetrations	+4	+5

Table 2 shows the change in sound insulation of the wall with various box treatments; some other cases are listed in the Appendix. The increase in sound insulation due to a treatment appears dependent on wall type and construction. Treatments in the table are listed in order of their effectiveness. In some cases it was necessary to examine the one-third-octave transmission loss data to determine the better performer.

In a case where poorly placed electrical boxes are compromising the sound insulation of a party wall, either of the following retrofits is recommended:

- Caulk the gap between the box and the gypsum board and place an insert in the box; or
- Line the interior of the box with mass-loaded material and extend it to fill the gap between the box and the gypsum board.

The draft stopper is especially easily installed, but the resulting improvement in sound insulation was variable.

Box Placement and Cavity Absorption:

Table 3 shows the change in sound insulation relative to the base case for various locations of the untreated boxes. From the table is immediately obvious that the effect of electrical boxes on the sound insulation of a party wall can be large — degradations of up to 6 STC points were experienced for poorly located boxes.

Table 3: Wall sound insulation (expressed as STC or change in STC relative to the base case) for walls with untreated metal boxes at various locations.

UNTREATED METAL BOXES			Electrical Box Location		
Wood Stud Framing	Cavity Absorption	Base Case	Back to Back (no offset)	Same Cavity (offset 350mm)	Adjacent Cavity (offset > 400 mm)
Double stud	None	STC 55	- 4	- 6	- 2
	90 mm displaced	STC 61	- 6	-1	- 0
	90 mm	STC 62	- 1	- 1	- 1
Single stud	90 mm displaced	STC 55	- 5	-1	-1

The reduction in the sound insulation depends on several factors: the separation (horizontal offset) of the electrical boxes, the construction of the wall, and the location of absorptive material. These cannot be fully separated, but general trends can be identified.

The greatest reduction of the STC occurred when there was a short unimpeded path between boxes — that is, the sound did not have to travel through the cavity absorption or through the narrow gap between studs into the next cavity. The back-to-back and same cavity positions without cavity absorption, and the back-to-back position with the displaced batts show this well.

When the sound must travel through the absorption (i.e. all other absorption cases), the degradation is greatly reduced.

Very little reduction of the STC was evident for walls that have the electrical box in the adjacent stud cavity position at least 400 mm from the fixed box. This is presumably due to the increased distance that the sound must travel between the two boxes, plus the losses in transmission from one cavity to the next. The combination of absorptive material and a horizontal offset greater than the stud separation ensure the outlets have negligible effect on the STC.

The trend of increased sound insulation with increased separation does not hold true when comparing the same *cavity* and *back-to-back positions for the* double wood stud wall without absorptive batts. Presumably this is due to standing wave patterns in the cavity.

Table 3 and Figure 8 show the change in sound insulation for the double stud wall with cavity absorption installed in two ways: displaced around the side of the box (as was shown in Figure 4) or placed completely over the back of the box.. The table shows that for boxes located in back-to-back positions, having the layer of insulation between them greatly reduces the impact on the STC. Figure 8 shows that some increased performance is observed even when the outlets are separated, although the effect is much smaller.

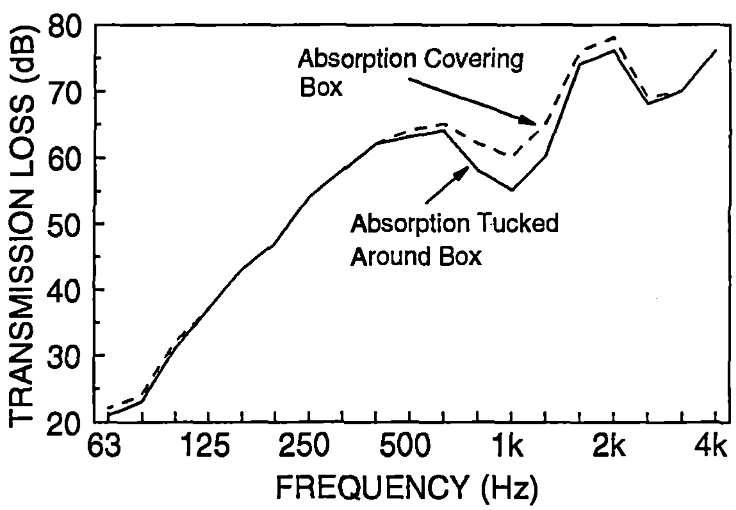


Figure 8: Comparison of the sound transmission loss of a double stud wall with and without the cavity absorption displaced around the boxes. The electrical boxes are in the same *cavity, but offset 350 mm.*

Cavity absorption reduces the effect that poorly placed electrical boxes have on the sound insulation of a party wall. Where possible, the batt insulation should not be displaced around the electrical boxes as this will reduce the effectiveness of cavity absorption.

Structural Treatments: Baffles may be used in walls to maintain the fire resistance despite the addition of electrical outlets. They may also provide some acoustic benefit if designed and installed correctly. However, if they introduce a stiff connection between the faces of a double or staggered stud wall, they may actually reduce the sound insulation.

Figure 9 shows a sketch of a baffle that might be used in a double stud wall. Table 6 shows the measured effect of adding this baffle, for two box locations.

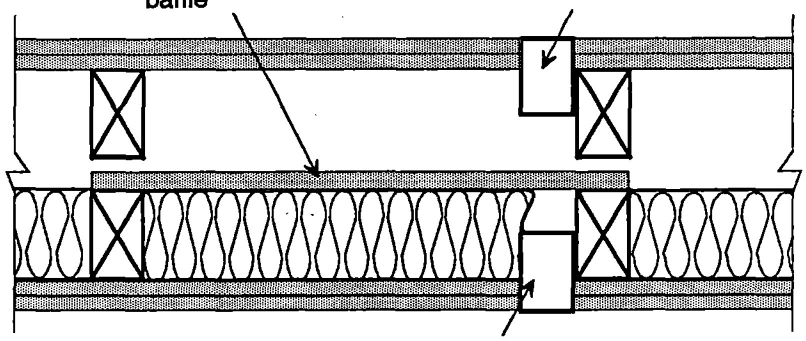


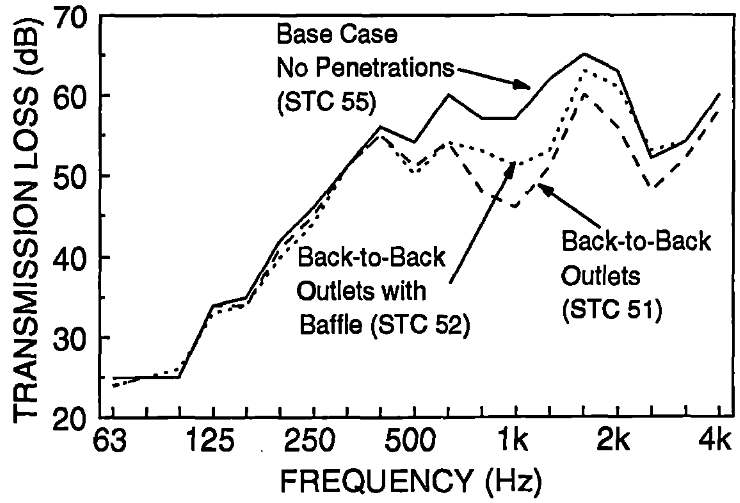
Figure 9: Sketch of a baffle for a double stud wall (note that the structural isolation between the two faces is preserved).

Table 6: Comparison of the effectiveness of a gypsum board baffle in a double stud wall with and without absorption to reduce the effect of poorly located electrical boxes. The sound insulation is expressed in terms of the STC.

METAL ELECTRICAL BOXES		Back-to-Back Box Location		Same Stud Cavity Location	
Cavity Absorption	Base Case	No Treatment	Baffle	No Treatment	Baffle
None	55	51	52	49	52
90 mm displaced	61	55	62	60	61

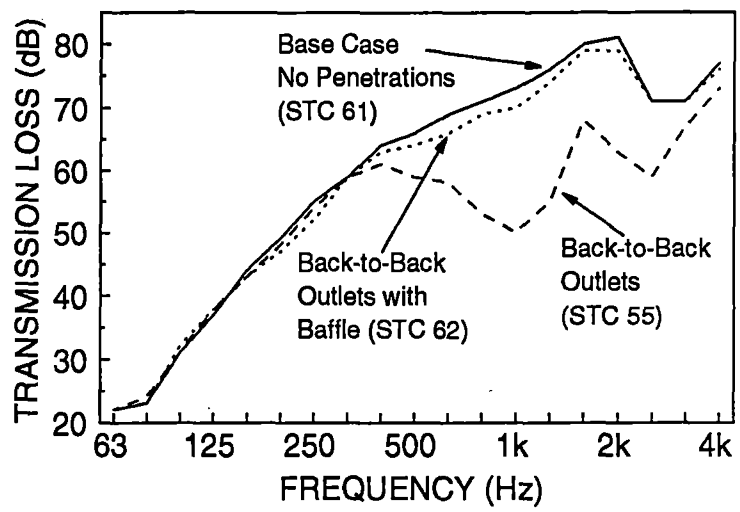
The effectiveness of a baffle depends on the presence of cavity absorption. This is to be expected since the absorption controls the reverberant field in the cavity and a baffle will only be effective if the reverberant energy is much less than that traveling directly between the two outlets. Consequently, reducing the direct component with the use of a baffle will only provide marginal improvement without absorption.

Figure 10: Measured transmission loss of the double stud wall with and without the baffle, no cavity absorption.



However, when there is significant cavity absorption the amount of reverberant energy is very low and reducing the direct energy with the use of a baffle will be most effective. This is demonstrated in Figure 11.

Figure 11: Measured transmission loss with and without the baffle, for a double stud wall with 90 mm glass fibre batt absorption in the cavity.



For double wood stud constructions having cavity absorption, the baffle is the most effective treatment. However, it is among the least effective if there is no cavity absorption.

Figure 12 shows a baffle design from a 'better building practice' guide. This baffle may increase the fire resistance of the wall, as intended, but it does so at the detriment of the sound insulation.

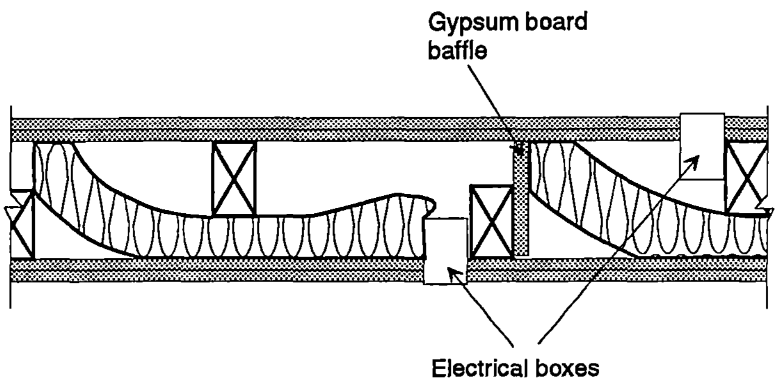


Figure 12: Sketch of an incorrectly designed baffle for a staggered stud wall (note the bridging between either side of the wall; the structural isolation is not preserved).

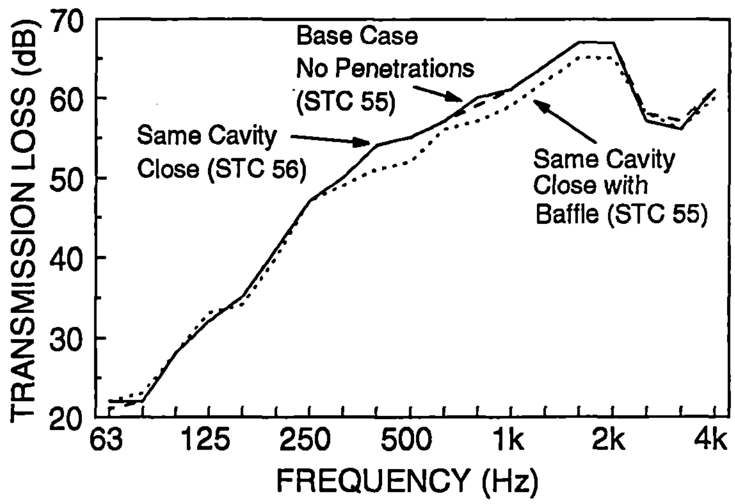


Figure 13: Measured transmission loss of the staggered stud wall with and without the baffle, 90 mm glass fibre batt absorption in the cavity.

As shown in Figure 13, the performance of the wall without the baffle was better. If several of this type of baffle were used in a wall, then it is probable that the sound insulation would affected even more than the small reduction in STC observed here.

Baffles that are designed correctly (so that structural isolation between the two faces of the wall is maintained) can provide a very effective method to improve both the fire resistance and the acoustical performance, especially if there is cavity absorption.

RESILIENT CHANNELS:

Resilient channels are used in building constructions to improve sound insulation. They are used as a resilient mounting for the wall or ceiling finish surfaces, to reduce vibration transmission from those surfaces to the supporting structure, or vice versa. They are most effective at increasing sound insulation in constructions that would otherwise be limited by structural transmission through the framing.

One concern of this study was to establish whether the effectiveness of resilient channels would be limited by electrical boxes, which might provide an effective alternate path for vibration energy to travel from the gypsum board surfaces to wood stud framing.

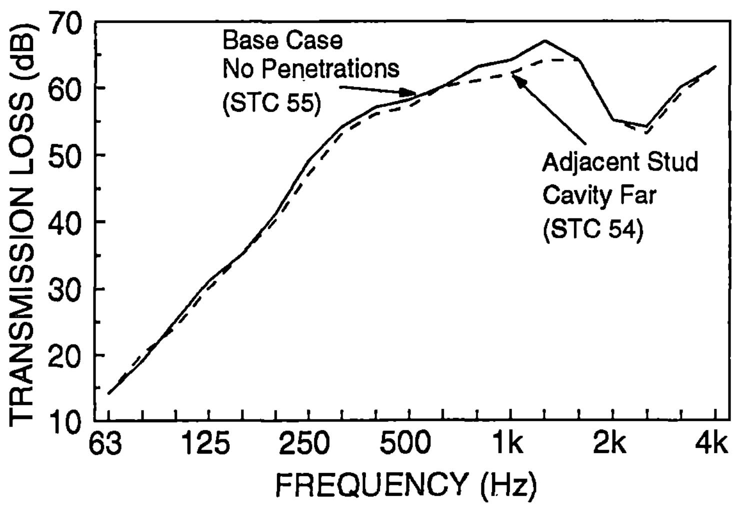


Figure 14: Comparison of the sound insulation for a wall having resilient channels with and without electrical boxes installed in the adjacent cavity far position.

Figure 14 shows the measured sound insulation (with and without electrical boxes) of a wall with one gypsum board surface mounted on resilient channels. The electrical fitting and the faceplate were screwed firmly against the gypsum board.

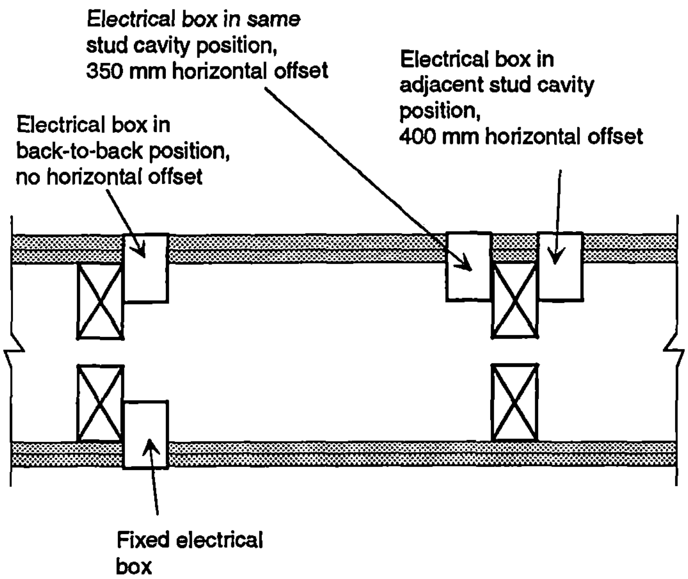
The figure shows that placement of the electrical boxes in a wall having resilient channels did not affect the wall's sound transmission significantly. Apparently, normally installed electrical boxes do not significantly alter the effectiveness of resilient channels.

Appendix A

Measured Sound Transmission Class (STC) for the Various Walls and Electrical Box Configurations

DOUBLE WOOD STUD WALL
Measured Sound Transmission Class (STC)

Double 38x89 mm wood studs, 400 mm o.c., double layer of 13 mm thick regular gypsum board both sides, cavity absorption as noted.

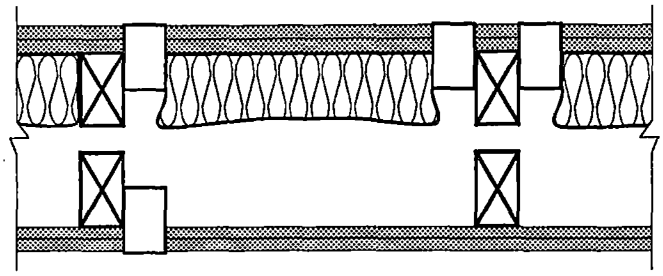


Metal Electrical Boxes

No Cavity Absorption		Electrical Box Location		
Treatment(s)	Base Case	Back-to-Back	Same Cavity	Adjacent Cavity Far
None	55	51	49	53
Draft Stopper		52	53	
Gap Caulked		52	50	
Gap Caulked + Insert		54	53	54
Baffle		52	52	

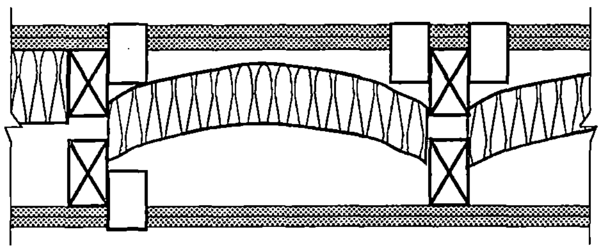
Plastic Electrical Boxes

No Cavity Absorption		Electrical Box Location		
Treatment(s)	Base Case	Back-to-Back	Same Cavity	Adjacent Cavity Far
None	55	55	54	55



Metal Electrical Boxes

90 mm Glass Fibre Batt — Displaced		Electrical Box Location		
Treatment(s)	Base Case	Back-to-Back	Same Cavity	Adjacent Cavity Far
None	61	55	60	61
Draft Stopper		61	61	
Gap Caulked				
Gap Caulked + Insert		62	61	
Baffle		62	61	

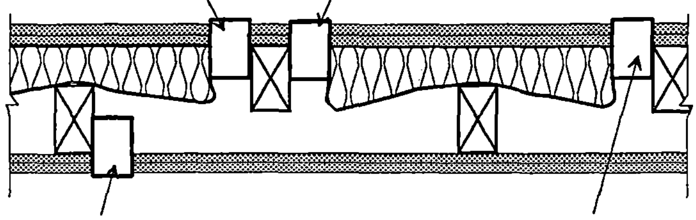


Metal Electrical Boxes

90 mm Glass Fibre Batt		Electrical Box Location		
Treatment(s)	Base Case	Back-to-Back	Same Cavity	Adjacent Cavity Far
None	62	61	61	61
Draft Stopper		61		
Gap Caulked		61		
Gap Caulked + Insert		61		
Baffle				

STAGGERED WOOD STUD WALL
Measured Sound Transmission Class (STC)

Staggered 38x89 mm wood studs, 400 mm o.c., double layer of 13 mm thick regular gypsum board both sides, glass fibre insulation 90 mm thick in cavity.

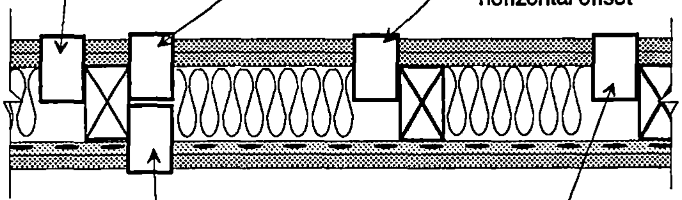


Metal Electrical Boxes

90 mm Glass Fibre Batt — Displaced		Electrical Box Location		
Treatment(s)	Base Case	Same Cavity Close	Same Cavity Far	Adjacent Cavity Far
None	55	54	56	55
Draft Stopper		55		
Gap Caulked		55		
Insert Only		55		
Gap Caulked + Insert		56		
Mass Loaded Material		56		
Poorly Designed Baffle		54	55	

SINGLE WOOD STUD WALL
Measured Sound Transmission Class (STC)

Single 38x89 mm wood studs, 400 mm o.c., double layer of 16 mm thick Type X gypsum board one side, single layer mounted other side mounted on resilient channels 600 mm o.c., glass fibre batt insulation 90 mm thick in the cavity.



Metal Electrical Boxes

90 mm Glass Fibre Batt — Displaced		Electrical Box Location			
Treatment(s)	Base Case	Back-to-Back	Same Cavity	Adjacent Cavity Close	Adjacent Cavity Far
None	55	50	54	54	54
Draft Stopper		54			
Gap Caulked			54		54
Gap Caulked + Insert		53			
Gap Caulked, Insert, Draft Stopper		55			
Mass Loaded Material		55			