Sound Transmission Loss of Masonry Walls: Tests on 90, 140, 190, 240 and 290 mm Concrete Block Walls with Various Surface Finishes

Warnock, A.C.C.; Monk, D.W.

BRN-217

SOUND TRANSMISSION LOSS OF MASONRY WALLS

Tests on 90, 140, 190, 240, and 290 mm Concrete Block Walls with Various Surface Finishes

by

A.C.C. Warnock and D.W. Monk

This is the third in a series of notes reporting laboratory measurements of sound transmission loss of masonry walls. The earlier notes[1,2] dealt with the sound transmission loss of 290 mm (12 inch)† thick lightweight concrete blocks. The present note gives results for a number of block types.

Résumé :

Cette note est la troisième d'une série se rapportant aux mesures de la perte de transmission du son des murs de maçonnerie. Les documents précédents traitaient de la perte de transmission du son des blocs de béton léger de 290 mm d'épaisseur et las présente note examine les résultats obtenus pour un certain nombre de types de blocs.

Test Procedures

The test results reported here were obtained in the wall transmission loss suite at the Division of Building Research, National Research Council of Canada. Measurements were performed in accordance with the requirements of ASTM E90, Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions[3]. Although this method of test has been revised since it first appeared in its present form, the test procedures used still satisfy the latest version of the standard (issued in 1981). The source and receiving rooms in the test suite have volumes of 65 and 250 cubic metres, respectively. Nine microphones in each room are used to obtain space averaged sound pressure levels and reverberation times. A sound transmission class rating (STC) was obtained for each wall in accordance with ASTM E413, Standard Classification for Determination of Sound Transmission Class[4].

Surface Treatments

The most common alteration made to the walls in these tests is the addition of layers of finishing materials, most frequently gypsum wallboard. One might imagine that the addition of extra layers of material to a wall could only improve its performance; this is not necessarily true. When two layers of material in a wall or a floor are separated by an air space, the conditions for

† The original measurements were made in imperial units. Metric values that are given are metric equivalents currently available, not conversions of imperial values

resonance phenomena are created. One resonance, called the mass-air-mass (mam) resonance, usually occurs at low frequencies and can be calculated from the formula:

$$f_{mam} = 60/\left[m_1 m_2 d/(m_1 + m_2)\right]^{1/2}$$

where m_1 and m_2 (kg/m^2) are the masses of the layers and d (m) is the thickness of air gap between them. The transmission loss for the composite wall may actually be reduced at this frequency with respect to the unfinished wall. The effect of this resonance is further complicated by the addition of sound absorbing material in the cavity. This absorbs sound energy and may also provide some physical vibration damping if it is in contact with the wallboard. Other resonances are possible, but in practical situations it can often be difficult to ascribe changes in transmission loss to specific physical mechanisms in composite walls. In any case, it is beyond the purpose of this note to do so.

90 mm (4 inch) Solid Concrete Blocks

For this series, the basic wall was constructed from nominal 90 mm (4 inch) solid concrete blocks with dimensions 193 x 396 x 92 mm (7.6 x 15.6 x 3.6 inch). The average weight per block was 15 kg (33 lbs.). Table 1 lists the different surface finishes that were tested for these blocks. The table also gives the measured sound transmission class (STC) for each configuration as well as the mass per unit area of the finished wall. For completeness, Table 2 lists the measured transmission losses at each frequency.

Comments on the Results

1. Effect of Block Sealer

Although the addition of block sealer to one side of the wall increased the STC by one point, this increase is not significant. An examination of the values in Table 2 for Tests A and B shows that there is essentially no difference between the two measurements. Thus, there is no acoustical reason for applying block sealer to solid blocks of this type. For more porous blocks, the latex sealer would provide some increase in transmission loss.

2. Effect of Additional Layers of Gypsum Wallboard

Tests C to F show the effect of adding extra layers of material to the basic wall. The results are interesting because they show that relatively small structural changes can make large differences to the transmission losses. Figure 1 shows the results for Test C and, for reference, Test A. The extra layers of material and the resilient channels have produced significant benefits at all frequencies except at 125 Hz.

Test D resulted in an STC rating one point higher than Test C, but the data in Table 2 show that the two walls C and D give almost identical results. The difference in STC rating is due to the 1 dB difference at 125 Hz and to the application of the 8 dB rule contained in ASTM E413.

The poor result for Test E shows that one must be careful when attempting to increase the transmission of wall losses by adding extra layers. Figure 2 compares the results for Tests D and E. The significant difference between structures D and E is the omission of the low density glass fibre behind the gypsum wallboard. This leads to the reduced transmission losses in the frequency range 160 to 630 Hz. Resonances between the added wallboard and the basic block wall are undoubtedly the cause of this. In the case of Wall D, the reduction in transmission loss is ameliorated by the low density glass fibre in the wall cavity.

Table 1: 90 mm (4 inch) Solid Concrete Blocks

Weight Per Block 15 kg (33 lbs). Gyp. = gypsum wallboard; RC = resilient channels; LDGF = low density glass fibre; Latex = latex block sealer; WF = wood furring

Test	Side 1 (Source)	Side 2 (Receive)	kg/m^2	STC
A	Plain	Plain	195.2	46
B	Latex	Plain	195.2	47
C	Latex + 25 mm LDGF + RC +13 mm Gyp.	Plain	207.4	51
D	As C	13 mm Gyp. + Adhesive and Nails	215.7	52
E	Latex + RC + 13 mm Gyp.	As D	216.2	44
F	Latex	As D	205.0	46

Table 2: Sound Transmission Loss for 90 mm (4 inch) Solid Concrete Block Walls

Frequency, Hz	A	B	C	D	E	F	G
125	26	27	27	28	32	32	31
160	32	32	35	35	32	35	32
200	35	34	37	36	31	32	30
250	36	36	40	40	32	34	33
315	38	38	46	46	32	36	38
400	39	40	49	48	39	38	41
500	42	44	52	52	40	42	45
630	45	45	54	54	46	45	50
800	49	49	57	58	56	48	54
1000	50	51	58	59	57	50	56
1250	53	54	59	59	58	53	58
1600	55	56	62	62	61	55	61
2000	57	58	63	62	61	56	62
2500	60	60	63	62	60	57	62
3150	60	61	61	60	58	56	60
4000	60	62	63	62	59	57	61
STC	**46**	**47**	**51**	**52**	**44**	**46**	**47**

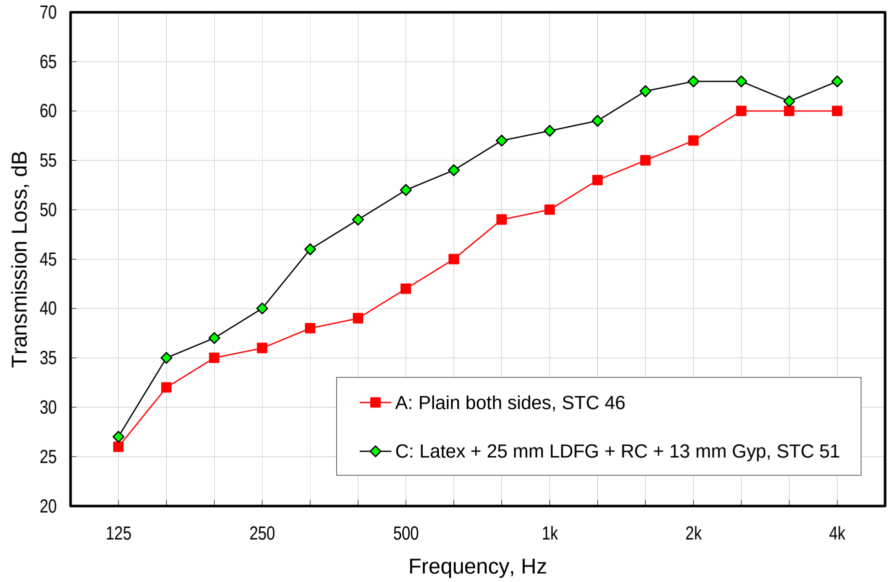


Figure 1: 90 mm Solid Block Walls: Effect of resiliently mounted surface layers.

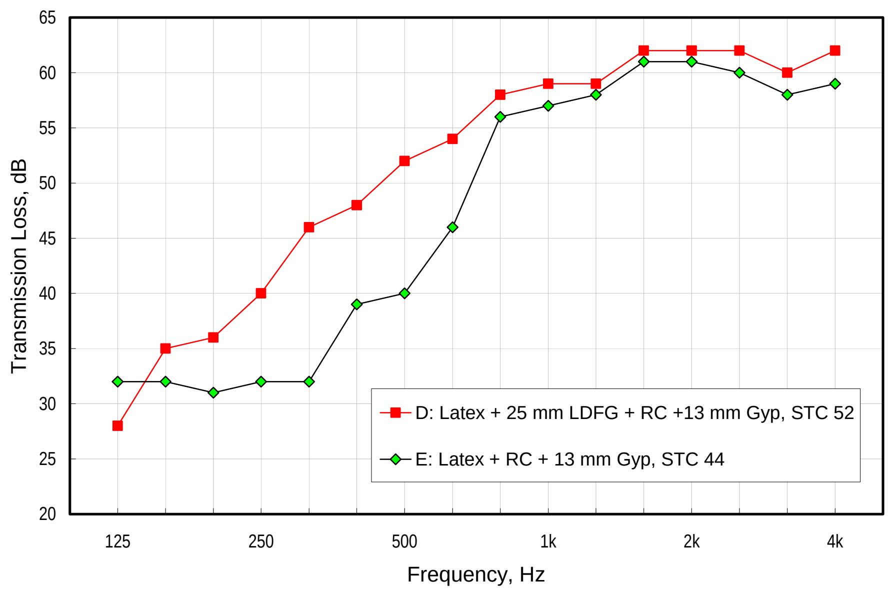


Figure 2: 90 mm Solid Block Walls: Effect of glass fibre in the cavity. (Both walls have 13 mm gypsum board attached with adhesive and nails on one side.)

140 mm (6 inch) Normal Weight Blocks

For this series, the basic wall was constructed from nominal 140 mm (6-inch) hollow normal weight concrete blocks. The block dimensions were 193 x 396 x 140 mm (7.6 x 15.6 x 5.5 inch) and the average weight per block was 15.9 kg (35 lbs.). Table 3 lists the different configurations tested and Table 4 lists the transmission loss values for each.

Comments on the Results

1. Added Layers of Gypsum Wallboard on Furring Strips

Tests A to F in this series once more provide striking evidence that it is possible to seriously reduce the sound transmission losses of a wall through the addition of layers of material to the surfaces. In Tests B to F, layers of gypsum wallboard are attached to the blocks by nominal 19 x 64 mm (1 x 3 inch) furring strips. The extra layers of material provide some slight increase in STC with respect to transmission through the unfinished wall but the STC values in Table 3 do not tell the whole story. An examination of the transmission loss values in graphical form shows more clearly what is happening.

Figure 3 shows the test results for the untreated blocks, Wall A, and for Wall E which has no glass fibre in the cavities. Despite the addition of wallboard and furring strips on both sides of the wall, the STC value has increased by only two points and the character of the transmission loss curve is quite different. The low frequency values are lower and the high frequency values are higher.

Figure 4 shows that although the addition of glass fibre in both cavities in Wall C increases the mid and low frequency transmission loss values considerably with respect to Wall E, the transmission loss at 125 Hz is still lower than that for Wall A and the STC values for Walls C and E are actually determined by the values of transmission loss at 125 and 160 Hz, respectively; examples of the application of the 8 dB rule in ASTM E413.

These results can be explained once again by assuming that a resonance is occurring between the outer layers of gypsum wallboard and the concrete blocks. The same phenomenon occurs in Walls B and F where the furring strips and gypsum wallboard are applied to one side only of the block wall (Figure 5). In this case, since the resonances occur only at one side of the wall, the low frequency transmission loss degradation is not so severe and the improvements due to the extra gypsum board and the glass fibre are not so marked.

2. Added Layers of Wallboard on Resilient Channels

Much the same kind of behavior is seen for Walls G to K where resilient metal channels are used instead of the wood furring strips. In these walls, the high frequency transmission loss is usually greater than that for the corresponding wall using wood furring strips but the reduction in performance at low frequencies is generally worse, probably because the layers of gypsum board can vibrate more freely when mounted on the resilient metal channels. This is a disappointing result because resilient supports are often considered to be essential to good acoustical performance. There is no doubt that in many wall designs, it is very important to reduce the mechanical coupling between the two layers that comprise the wall but the results for Walls A to K show that this alone is not sufficient and that the mass-air-mass resonance is extremely important and must also be considered.

For convenience, some comparisons between four sets of the 140 mm walls are compared in Figs. 6 to 9. Figure 6 shows the effect of adding wall board on furring strips plus glass fibre first on one side and then on both sides. Figure 7 makes a similar comparison where the glass fibre has been omitted from cavities. In Fig. 8, the wallboard layers are supported on resilient channels and there is glass fibre in the cavity. In Fig. 9, there is no glass fibre in the cavity. The deleterious effects of resonances at low frequencies are evident in all four figures.

3. Direct Application of Wallboard

Tables 3 and 4 show that for Walls L and M, the addition of gypsum wallboard directly to the basic block wall does not affect the STC rating. It is interesting however to compare the three Walls A, L and M in detail (see Fig. 10). Although the gypsum board is nominally in direct contact with the concrete blocks, there are still some signs of resonance phenomena in Fig. 10. The addition of the layer of gypsum board increases the high frequency transmission losses but the values around 250 Hz are actually slightly lower than those for the unfinished wall. One can imagine that between the board and the wall there is a small, residual air gap left as a result of the use of daubs of cement to attach the gypsum board. As well, it is possible that the surface of the blocks is slightly porous which would have the effect of increasing any air gap behind the gypsum board. Again, the conditions for resonant phenomena exist. High values of transmission loss at high frequencies are of no consequence in real situations if the low frequency values are inadequate. The STC rating is meant to take this into account and thus the ratings for Walls A, L and M in Fig. 10 are approximately equal.

4. Effect of Plaster

The improvement in the transmission loss throughout the frequency range that results from the application of 13 mm (1/2") of sand plaster to each face of the wall is shown in Fig. 11. The improvement supports the supposition made in the previous paragraph that the untreated blocks are, to a degree, porous and allow sound to leak through their structure. This improvement is not expected because of the added mass of the plaster (only 0.6 dB can be due to this), so it must be due to the effect of sealing the pores of the block. The addition of latex block sealer to at least one face of the blocks might have provided a similar degree of improvement. Unfortunately, this measurement was not made.

5. Application of Wallboard to Plastered Surface

Walls Q and P have wallboard added to one plastered side supported on furring or resilient channels respectively. These walls also show a depressed low frequency transmission loss relative to the untreated wall (Fig. 12).

The difference in construction techniques for Walls O and Q is shown in Fig. 13. In Wall O, the glass fibre blanket was temporarily attached to the wall with nails and the furring strips were then nailed to the wall through the blanket. This technique is perhaps slightly simpler than that for Wall Q, but although Wall O achieves a slightly higher STC rating, both walls are still seriously limited by their poor transmission loss values at 125 Hz (see Fig. 14).

Table 3: 140 mm (6 inch) Normal Weight Concrete Block Walls with Various Surface Finishes.

Wall	Side 1	Side 2	STC
A	Plain	Plain	45
B	Plain	19 x 64 mm WF + 25 mm GF + 13 mm Gyp.	50
C	19 x 64 mm WF + 25 mm GF + 13 mm Gyp.	19 x 64 mm WF + 25 mm GF + 13 mm Gyp.	48
D	19 x 64 mm WF + 13 mm Gyp.	19 x 64 mm WF + 25 mm GF + 13 mm Gyp.	50
E	19 x 64 mm WF + 13 mm Gyp.	19 x 64 mm WF + 13 mm Gyp.	47
F	19 x 64 mm WF + 13 mm Gyp.	Plain	49
G	Plain	25 mm GF + RC + 13 mm Gyp.	51
H	25 mm GF + RC + 13 mm Gyp.	25 mm GF + RC + 13 mm Gyp.	46
I	25 mm GF + RC + 13 mm Gyp.	RC + 13 mm Gyp.	49
J	RC + 13 mm Gyp.	RC + 13 mm Gyp.	44
K	RC + 13 mm Gyp.	Plain	45
L	13 mm Gyp. Direct	Plain	46
m	13 mm Gyp. Direct	13 mm Gyp. Direct	45
N	13 mm Sand Plaster (SP)	13 mm Sand Plaster	51
O*	13 mm SP + 25 m GF + 19 x 64 mm WF + 13 mm Gyp.	13 mm Sand Plaster	54
P	13 mm SP + 25 mm GF + RC + 13 mm Gyp.	13 mm Sand Plaster	50
Q*	13 mm SP + 19 x 64 mm WF + 25 mm GF + 13 mm Gyp.	13 mm Sand Plaster	52

Table 4: Sound Transmission Losses for 140 mm (6 inch) Normal Weight Concrete Block Walls with Various Surface Finishes.

Frequency, Hz	A	B	C	D	E	F	G	H
125	30.0	27.5	24.4	26.1	25.9	31.3	28.6	22.0
160	30.5	31.3	31.6	29.3	25.9	30.3	30.2	29.8
200	31.6	35.7	38.8	34.9	30.5	33.4	36.4	37.5
250	34.2	36.9	40.9	38.0	33.4	34.6	40.1	42.5
315	38.1	44.4	48.5	45.3	39.5	41.0	45.1	51.8
400	38.7	45.4	51.0	48.0	43.8	43.4	50.3	56.0
500	41.1	48.6	52.5	51.4	49.8	48.3	53.8	57.5
630	43.7	51.7	57.0	56.8	56.3	52.0	57.1	60.6
800	46.1	54.3	60.0	60.0	59.6	54.6	60.4	64.8
1000	48.0	55.8	61.8	62.1	62.4	57.2	63.2	66.5
1250	48.5	56.4	62.7	63.1	63.4	58.1	63.9	66.7
1600	51.7	60.1	63.7	64.2	64.0	60.5	64.9	65.4
2000	55.8	62.8	65.6	66.3	66.6	63.7	66.8	68.3
2500	56.3	60.7	60.8	62.5	64.2	62.5	65.1	66.7
3150	54.3	58.3	58.6	60.5	62.3	60.0	62.9	64.3
4000	55.4	60.7	61.9	62.9	64.4	61.6	63.8	64.9
STC	**45**	**50**	**48**	**50**	**47**	**49**	**51**	**46**

Frequency, Hz	I	J	K	L	M	N	O	P	Q
125	26.0	27.2	28.7	29.3	29.8	36.2	30.4	29.1	28.4
160	27.9	27.2	31.0	32.9	33.2	35.1	33.2	29.1	34.0
200	32.8	26.9	30.4	32.4	32.7	39.2	40.6	37.5	38.4
250	37.8	28.6	31.7	33.6	32.2	40.5	41.5	40.5	39.8
315	45.8	34.6	34.0	36.5	34.6	42.0	46.6	46.8	45.4
400	51.4	39.8	35.6	38.2	35.8	44.0	50.3	50.8	48.2
500	56.4	48.8	44.5	41.4	40.3	47.9	53.9	53.9	51.7
630	60.5	55.8	50.3	45.3	45.6	50.2	55.6	56.7	54.6
800	63.7	60.1	55.4	49.1	52.1	51.6	59.0	59.7	58.4
1000	67.0	64.9	59.1	53.0	57.6	53.6	60.8	60.8	59.7
1250	67.2	65.3	60.9	54.5	60.0	54.9	61.1	60.4	60.4
1600	66.1	63.6	61.6	56.6	61.6	57.4	63.9	63.5	62.4
2000	69.2	68.0	65.4	62.6	66.0	60.3	67.8	67.4	64.8
2500	66.5	65.7	63.2	61.0	64.3	61.7	66.6	66.4	63.3
3150	64.3	64.0	60.8	59.3	62.7	60.4	65.2	64.8	59.9
4000	64.7	65.2	63.0	61.6	63.9	60.3	66.4	66.1	61.8
STC	**49**	**44**	**45**	**46**	**45**	**51**	**54**	**50**	**52**

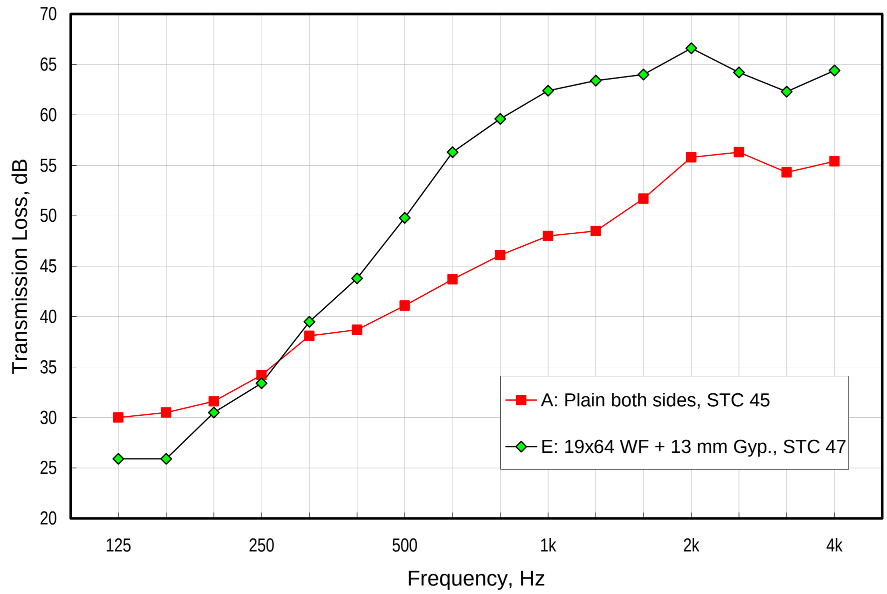


Figure 3: 140 mm Hollow Block Walls: Effect of wallboard on furring strips.

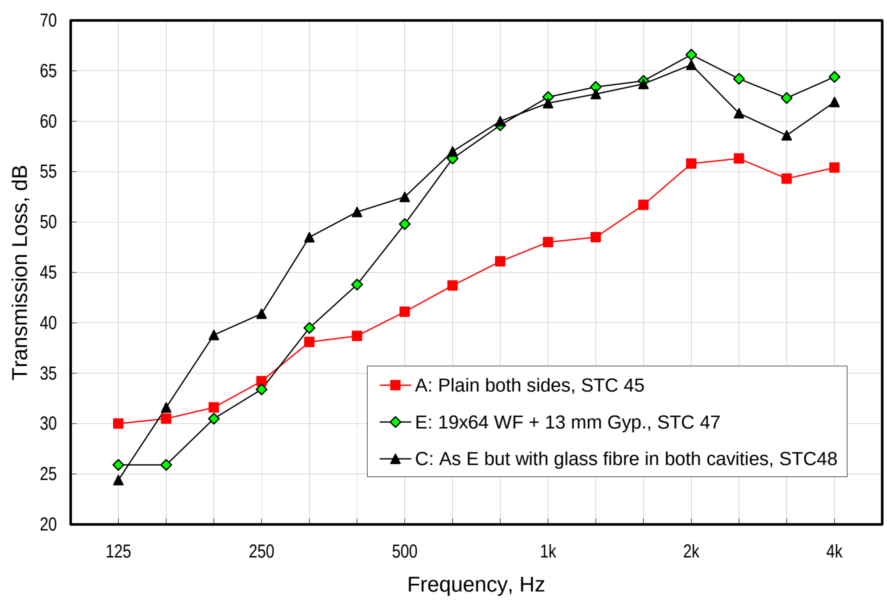


Figure 4: 140 mm Hollow Block Walls: Effect of wallboard on furring strips with glass fibre in the cavity.

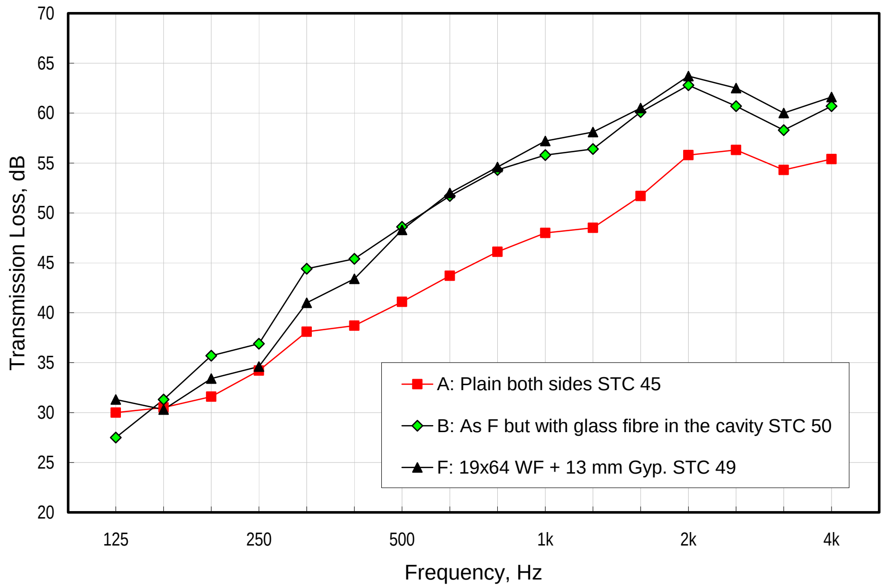


Figure 5: 140 mm Hollow Block Walls: Effect of wallboard on furring strips added on one side of the wall only.

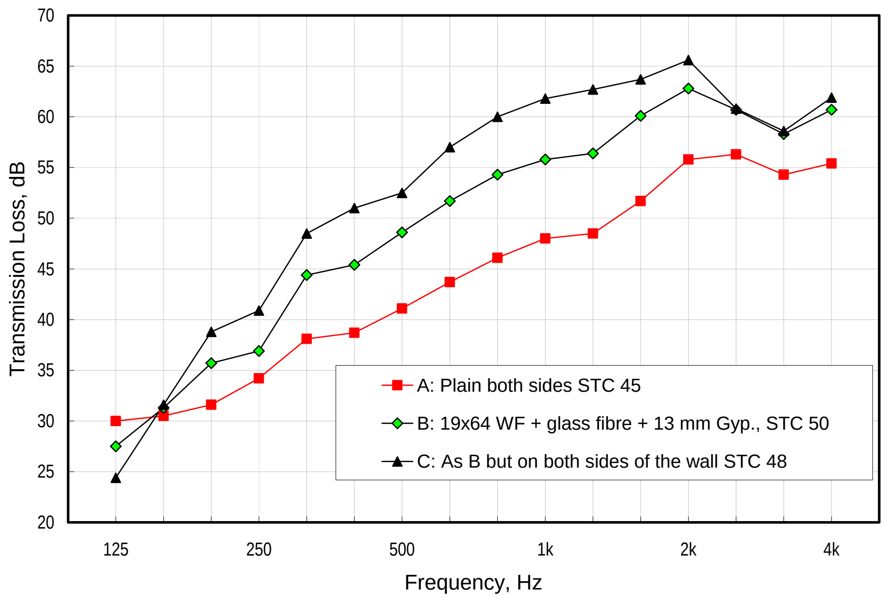


Figure 6: 140 mm Hollow Block Walls: Effect of wallboard on furring strips added to each side of wall in turn.

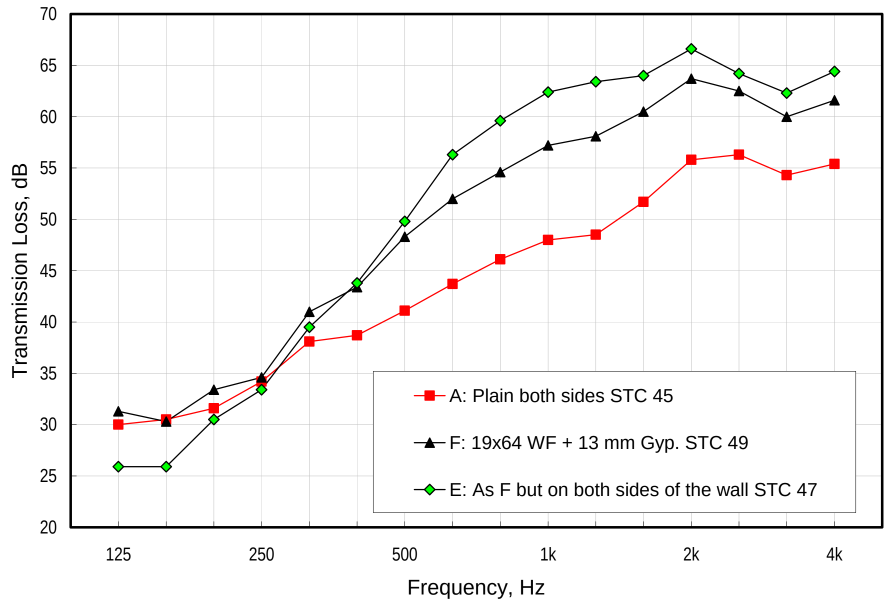


Figure 7: 140 mm Hollow Block Walls: Effect of wallboard on furring strips added to each side of wall in turn.

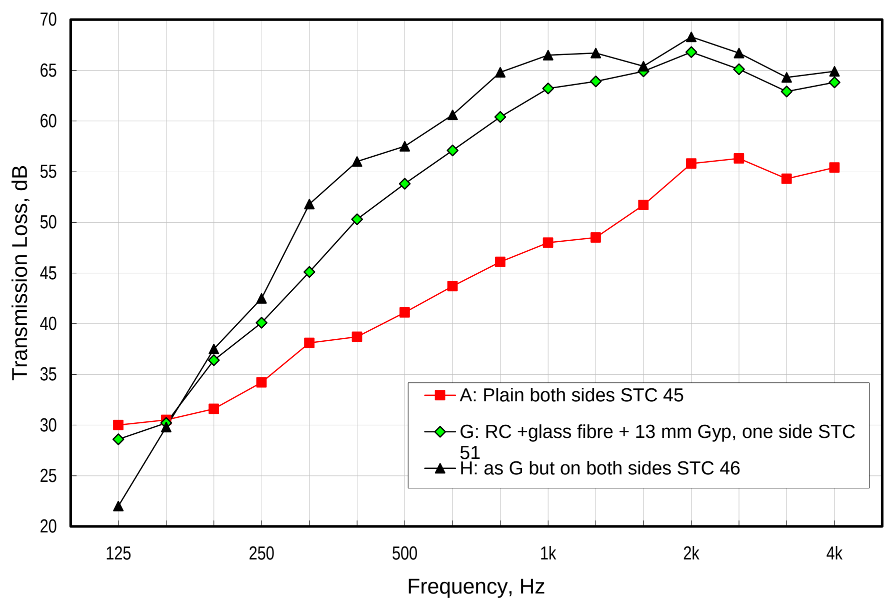


Figure 8: 140 mm Hollow Block Walls: Effect of wallboard on resilient channels added to each side of wall in turn.

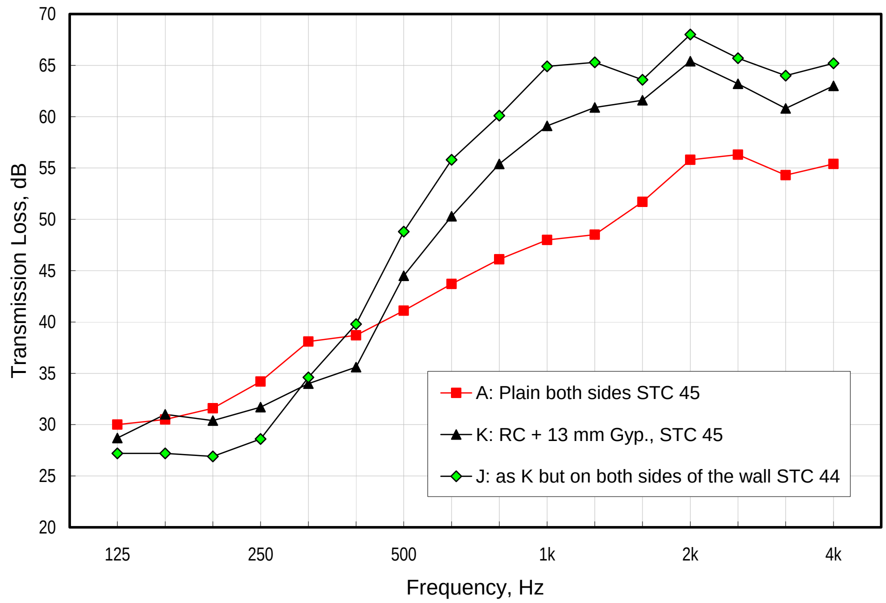


Figure 9: 140 mm Hollow Block Walls: Effect of wallboard on resilient channels added to each side of wall in turn. no glass fibre in cavity.

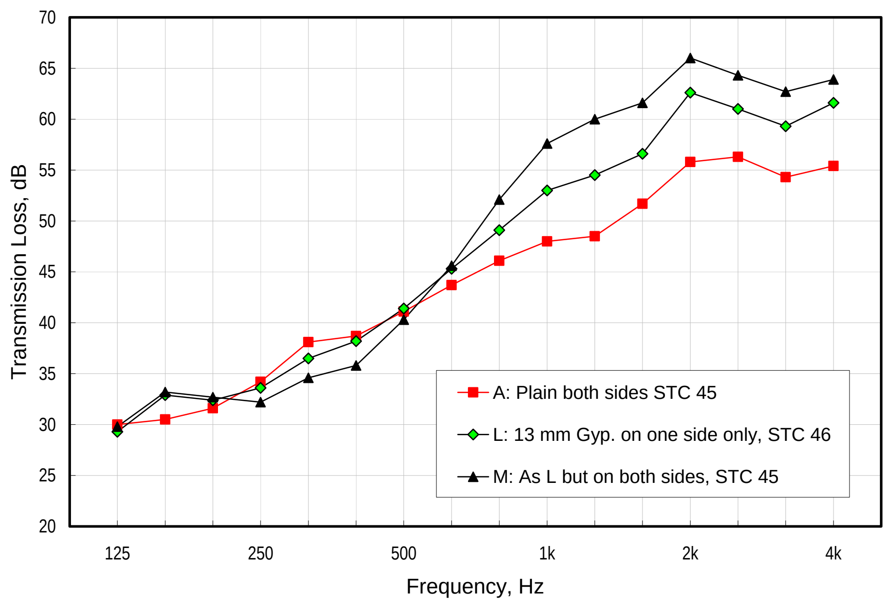


Figure 10: 140 mm Hollow Block Walls: Effect of wallboard applied directly to each side of wall in turn.

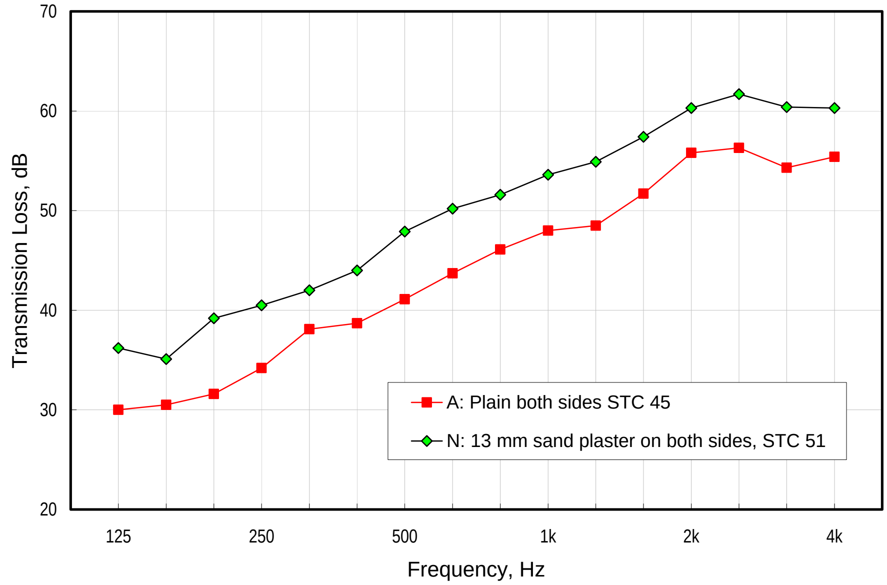


Figure 11: 140 mm Hollow Block Walls: Effect of sand plaster applied to both sides of the wall.

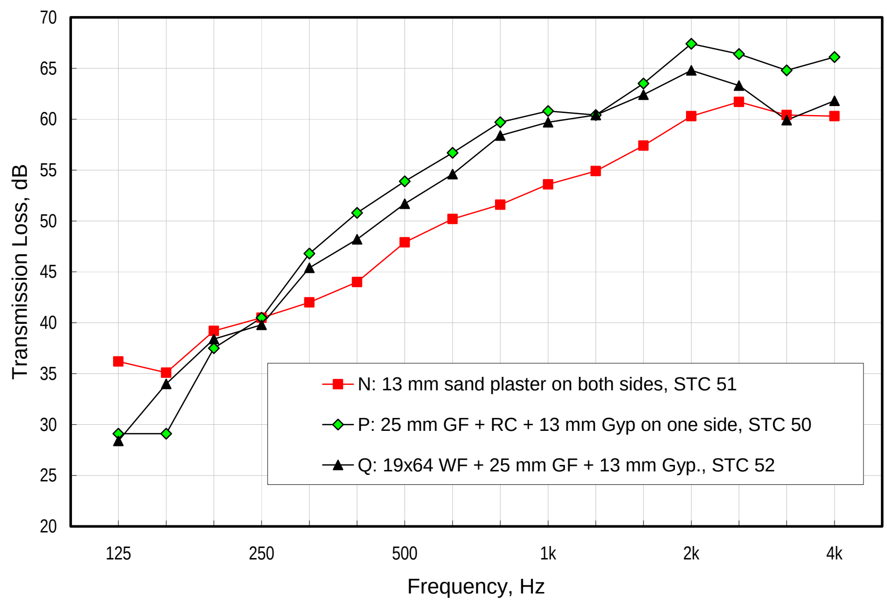
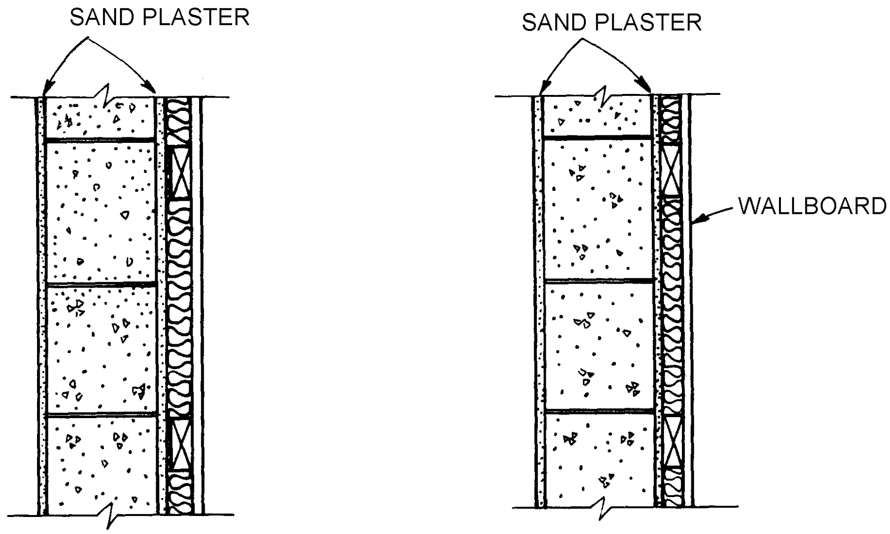


Figure 12: 140 mm Hollow Block Walls: Effect of wallboard applied to one face of the plastered wall.



Wall O: Glass Fibre under the furring strips.

Wall Q: Furring strips in direct contact with the concrete blocks.

Figure 13: Two methods used to attach wood furring strips to plastered wall.

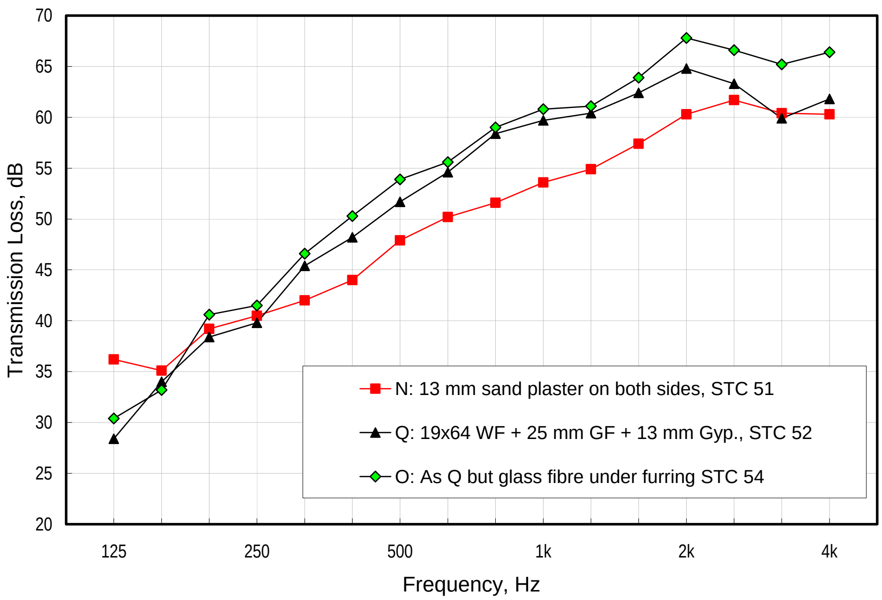


Figure 14: 140 mm Hollow Block Walls: Effect of method of attaching wallboard on furring strips to one face of the plastered wall. 25 mm of glass fibre in the cavity in each case.

190 mm (8 inch) Acoustical Blocks

For this series, the basic wall was constructed from two-core, normal weight 190 mm (8 inch) concrete blocks with two slots in each face to provide some sound absorption.

Each block was 190 x 390 x 190 mm (7.5 x 15.4 x 7.5 inch) and weighed 17.8 kg (39.25 lbs.). The non-slotted face of the wall was sealed using three coats of latex block sealer. This treatment alone increased the STC from 46 to 52. Three different finishes using a single layer of 16 mm gypsum wallboard were examined. They are described in Table 5. Each wall had a finished surface weight of 249 kg/m^2 (51 lbs/ft^2). Table 6 lists the transmission loss values in each case.

Comments on the Results

1. The direct application of wallboard to the slotted side of the wall has little effect at low frequencies except at 200 and 250 Hz. The cavities in the blocks resonate in this frequency region and the addition of the wallboard eliminates the increased transmission loss in these bands (see Fig. 15).

2. The use of resilient channels to support the gypsum board provides a further increase in the STC by increasing the sound transmission losses at all frequencies relative to the case where the gypsum is directly applied. The addition of 25 mm of glass fibre in the cavity makes little difference to the sound transmission class in this case but there are significant effects in the transmission losses at high frequencies (Fig. 15).

It is interesting that for these walls there is no reduction observed in low frequency transmission loss caused by the addition of the layers of gypsum wallboard. This is due to the presence of the slots which create a much greater volume of air in the wall cavity behind the wallboard. Thus, the effective depth of the cavity becomes much greater and any resonances are displaced to lower frequencies.

Table 5: 190 mm (8 inch) Acoustical Block With Different Surface Finishes

Wall	Side 1	Side 2	STC
A	3 Coats Latex	Unfinished	52
B	3 Coats Latex	16 mm Gypsum Board Directly Applied	54
C	3 Coats Latex	Resilient Channels + 16 mm Gypsum Board	59
D	3 Coats Latex	Resilient Channels + 25 mm Glass Fibre + 16 mm Gypsum Board	59

Table 6: Sound Transmission Losses for 190 mm (8 inch) Acoustical Concrete Blocks.

Frequency, Hz	A	B	C	D
125	36.9	37.5	40.3	40.2
160	38.6	37.8	41.8	40.9
200	45.1	40.7	46.3	43.7
250	46.0	41.8	48.1	47.5
315	43.9	44.2	50.7	50.4
400	44.2	46.7	56.1	55.1
500	46.2	50.3	56.8	58.9
630	49.5	54.4	57.0	63.5
800	52.2	56.8	61.7	65.7
1000	53.7	59.0	64.9	66.9
1250	55.7	62.2	67.1	68.2
1600	57.8	64.6	69.1	70.4
2000	59.1	62.4	68.1	69.6
2500	58.6	62.8	66.6	69.4
3150	60.1	65.3	68.2	71.4
4000	60.3	67.5	71.4	74.6
STC	**53**	**54**	**59**	**59**

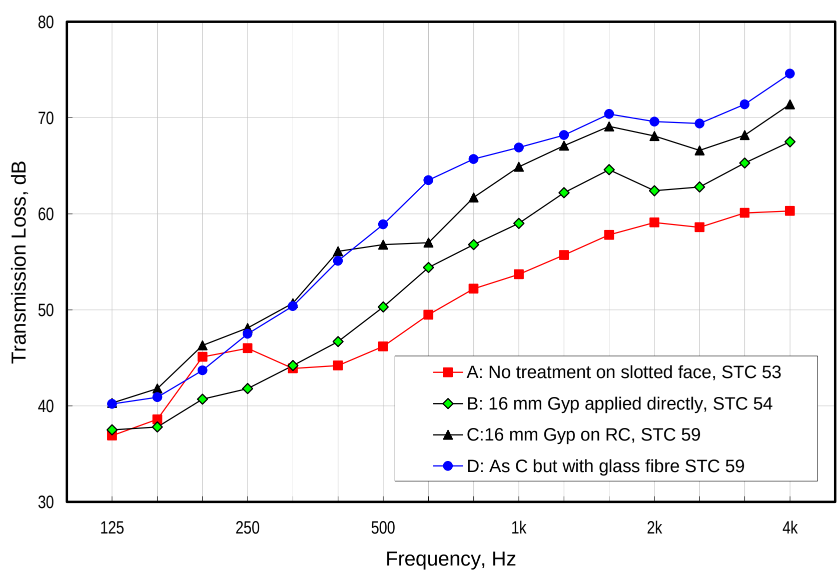


Figure 15: 190 mm Acoustical Block Walls: Effects of method of attaching gypsum wallboard to the slotted face of the wall.

240 mm (10 inch) Blocks: Light and Normal Weight

Table 7 gives the descriptions of the five nominal 240 mm (10 inch) block walls tested in this set. In this case, both surfaces were given the same finish. Each block was 193 x 396 x 244 mm (7.6 x 15.6 x 9.6 inch). The average weight per block was 17 kg (37.4 lbs.) for the lightweight blocks and 21.3 kg (47 lbs.) for the normal weight blocks. Table 8 lists the transmission loss values for each case.

Comments on the Results

For the lightweight blocks, the sealing of the block pores produced increases in transmission loss at all frequencies (Fig. 16). For the normal weight blocks, the effect of the sealer was only significant in the lower frequency bands (Fig. 17).

The application of gypsum board to both faces of the lightweight wall results in increased high frequency transmission loss with respect to the unfinished or painted walls (Fig. 16). This indicates again that the application of wallboard using daubs of cement permits the wallboard to vibrate as an independent layer. This could have the deleterious effects at low frequencies that have been shown earlier but in this case they are not evident.

Table 7: 240 mm (10 inch) Concrete Block Walls

Wall	kg/m^2	Surface Finish (Both Sides)	STC
A	229	Bare	44
B	249	13 mm Gypsum Board	50
C	229	3 Coats Latex Block Sealer	47
D	277	Bare	48
E	277	3 Coats Latex Block Sealer	49

Table 8: Sound Transmission Loss for 240 mm (10 inch) Lightweight (A,B,C) and Normal Weight (D,E) Concrete Block Walls.

Frequency, Hz	A	B	C	D	E
125	34.4	34.3	34.6	32.4	33.3
160	28.5	28.7	30.6	31.2	33.7
200	33.6	34.6	35.4	34.0	37.4
250	34.4	38.2	38.3	36.2	40.4
315	36.2	42.1	38.9	39.8	41.4
400	37.6	43.9	39.3	40.7	41.2
500	40.0	49.3	42.6	43.5	44.1
630	42.5	53.8	44.7	46.6	46.2
800	43.9	57.6	47.2	48.9	49.4
1000	44.2	60.2	49.0	51.6	51.4
1250	44.1	62.6	51.7	53.9	54.1
1600	50.4	66.4	55.0	56.4	57.0
2000	50.9	67.9	53.9	55.6	55.9
2500	52.2	65.3	55.5	58.6	58.7
3150	54.8	61.0	58.2	60.5	61.2
4000	56.8	63.5	59.9	61.0	61.7
STC	**44**	**50**	**47**	**48**	**49**

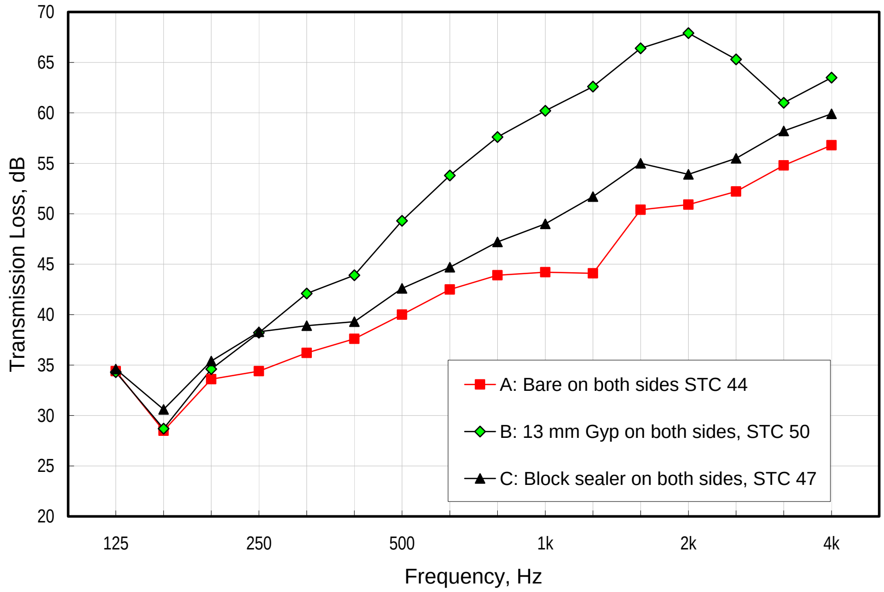


Figure 16: 240 mm Lightweight Blocks: Effects of block sealer and directly applied wallboard.

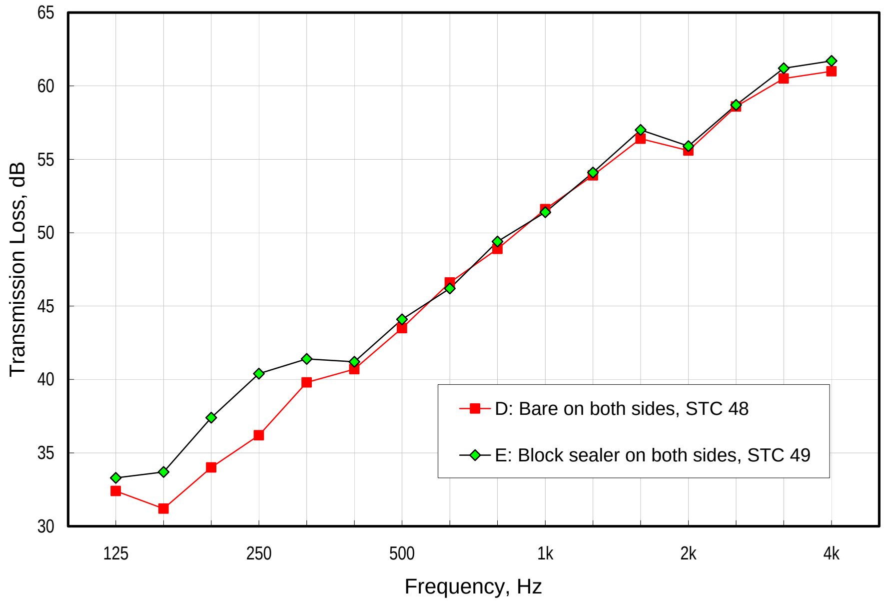


Figure 17: 240 mm normal weight blocks: Effects of block sealer.

290 mm (12 inch) Normal Weight Block Walls

In this series, each block was 190 x 310 x 295 mm (7.5 x 15.4 x 12 inch) and weighed 24.7 kg (54.5 lbs.). Only two surface treatments were examined in these measurements: latex block sealer and sand plaster. The three walls are described in Table 9, the transmission loss values are presented in Table 10 and plotted in Fig. 18. In this case, the addition of the sand plaster makes a significant improvement in the transmission loss throughout the frequency range whereas the block sealer has very little effect.

Table 9: 290 mm (12 inch) normal weight concrete block walls.

Wall	Side 1	Side 2	kg/m^2	STC
A	Bare	Bare	337	49
B	Bare	Latex block sealer	337	50
C	13 mm sand plaster	Latex block sealer	352	52

Table 10: Sound Transmission Loss for 290 mm (12 inch) Normal Weight Concrete Block Walls.

Frequency, Hz	A	B	C
125	31.3	32.5	36.0
160	37.1	37.5	36.0
200	38.9	39.8	42.0
250	40.3	40.9	42.0
315	43.1	43.2	45.0
400	43.2	43.3	46.0
500	44.3	44.8	47.0
630	46.0	46.0	48.0
800	48.9	49.5	52.0
1000	51.0	51.2	54.0
1250	53.2	53.3	56.0
1600	55.6	55.9	58.0
2000	56.6	56.6	58.0
2500	59.7	60.0	62.0
3150	59.3	59.4	62.0
4000	60.6	60.5	63.0
STC	**49**	**50**	**52**

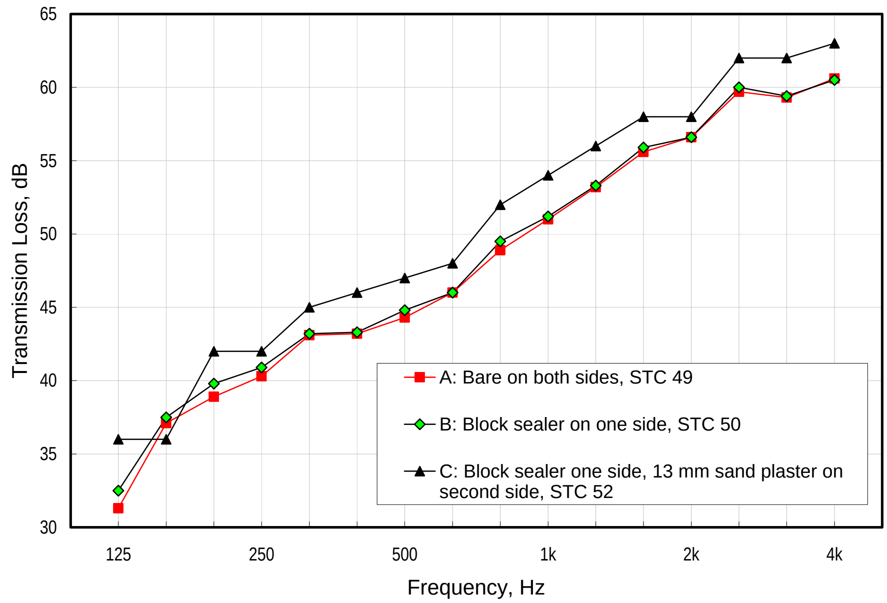


Figure 18: 290 mm Normal Weight Block Walls: Effects of block sealer and sand plaster.

Summary

The data presented here is by no means a complete set but it does clearly illustrate one important point: one must be very careful when considering the addition of extra layers of wallboard (or any other board material) to the surface of a basic wall to improve the transmission losses. The examples here are all for concrete block walls but the same phenomena occur in gypsum board walls.

The formula given at the beginning of this note allows one to calculate the frequency at which the mass-air-mass resonance should occur. The frequency at which it really occurs may be different because of surface porosity or other factors. The resonances can be moved to lower frequencies by increasing the air space or by increasing the mass of the panels. If the resonance occurs at a frequency that is below the range used in the STC calculation, then the effect on the STC value will be minimized. However, one has to resort to measurement to be sure that a particular wall assembly is meeting the design goal.

Although good STC values may be obtained in standard tests, resonances may occur in a wall just below 125 Hz, the lowest value used in the STC calculation. As well, two walls with identical STC values can have quite different low frequency transmission loss characteristics as illustrated here. Research is needed to determine just how important the low frequency transmission losses of walls are subjectively. This information can only come from subjective studies.

References

[1] Northwood, T.D. and Monk, D.W., "Sound Transmission Loss of Masonry Walls: Twelve-Inch Lightweight Concrete Blocks with Various Surface Finishes", National Research Council Canada, Division of Building Research, Building Research Note No. 90, April 1974.

[2] Northwood, T.D. and Monk, D.W., "Sound Transmission Loss of Masonry Walls: Twelve-Inch Lightweight Concrete Blocks - Comparison of Latex and Plastic Sealers", National Research Council Canada, Division of Building Research, Building Research Note No. 93, September 1974.

[3] ASTM E90, "Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions," American Society for Testing and Materials, 1983.

[4] ASTM E413, "Standard Classification for Determination of Sound Transmission Class," American Society for Testing and Materials, 1983