# Influence of stud on sound transmission in plasterboard partitions

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# INFLUENCE OF STUD ON SOUND TRANSMISSION IN PLASTERBOARD PARTITIONS

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**Abstract**

The plasterboard partition is composed of plasterboard, stud, runner and insulation; each component influences sound insulation performance of partitions. In this study, the sound insulation of plasterboard partitions varied in stud thickness and spacing was investigated. The partition was composed of two layers of fire-proof 12.5 mm plasterboard each side, single frame of 50 mm stud and 24 kg/m$^3$ 50 mm glass wool. The stud spacing was varied from 450 to 900 mm and the thickness of stud was 0.5 and 0.8 mm. The results showed that the sound insulation of plasterboard partitions was improved by increasing stud spacing and decreasing stud thickness.

## 1. INTRODUCTION

The plasterboard partition has been applied more and more in apartments, hotels, accommodations, schools and hospitals in replacement of traditional masonry one. Due to its versatility as a composite building component it has many advantages such as high performance for fire resistance and sound insulation, light weight and fast installation.

The sound insulation performance of plasterboard partition is affected by mass-air-mass resonance at low frequency, coincidence effect at high frequency. Stiffness and mass of plasterboard partition have major effects on sound insulation performance at the below mass-air-mass resonance frequency [1].

The components of plasterboard partition are plasterboard, stud, runner, insulation and screws and each component is related with sound insulation performance. Stiffness and mass are influenced by density of plasterboards, studs, screw spacing, air layers and plasterboard fixing condition [2-6]. The density of insulation in the cavity also influences to sound insulation performance of partition [7-10].

In this study, the spacing and thickness of studs were varied to evaluate the effect of stiffness on the sound transmission of plasterboard partitions.

## 2. SOUND INSULATION MEASUREMENT OF PARTITION

Sound insulation was tested according to ISO 140-3. The panel specimens were installed in the independent frame between source and receiving room of the Acoustic Laboratory at the Lafarge Gypsum Division in Avignon and the test opening is 14.1 $m^2$ (4.7 m x 3 m) and the finishing surfaces for walls, ceiling and floor of both source and receiving rooms are made of concrete for the condition of reverberation room. The source room has a volume of 93 $m^3$ and receiving room has 83 $m^3$.

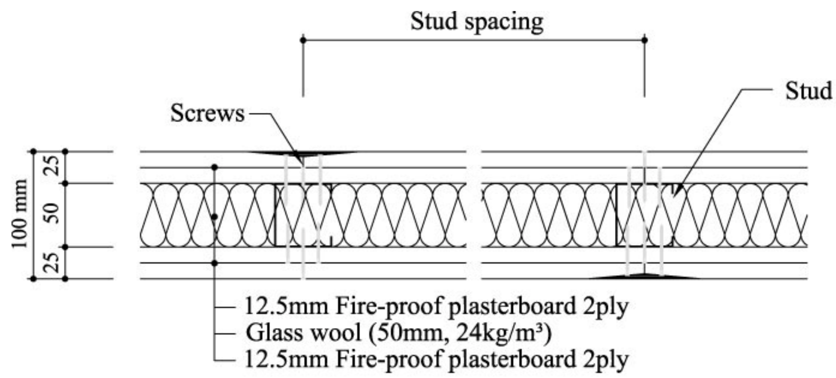


Figure 1. Example of the plasterboard partition

In this study, typical plasterboard partition was investigated. As shown in Fig. 1, the plasterboard partition is composed of plasterboards, stud, insulation and screws. The runner is fixed to the concrete frame on bottom and top and perimeter fixings are at 600 mm centres using screws. The vertical framing is made of 50mm studs which are inserted between bottom and top runners. Two layers of 12.5 mm fire-proof plasterboard are installed to stud each side and the density of 12.5 mm fire-proof plasterboard is 10.7 $kg/m^2$. The first layer of plasterboard is attached with 450 mm centres screw spacing and second layer of plasterboard is attached with 225 mm centres screw spacing. 50 mm thickness glass wool is installed in the cavity and the bulk density of glass wool is 24 $kg/m^3$. All plasterboard joints were finished with joint tape and compound.

Table 1. The plasterboard partition specimens used in the test

| Specimen | Stud thickness (mm) | Stud spacing (mm) |
|---|---|---|
| A | 0.8 | 450 |
| B | 0.8 | 600 |
| C | 0.8 | 900 |
| D | 0.5 | 450 |
| E | 0.5 | 600 |

The sound insulation performance of five different type plasterboard partitions shown in Table 1 was investigated. The stud spacing varied from 450 to 900 mm with 0.8 mm thickness stud and the thicknesses of stud were 0.5 and 0.8 mm with 450, 600 mm stud spacing.

## 3. RESULTS AND DISCUSSION

The sound insulation performance of plasterboard partition was evaluated by weighted sound reduction index ($R_w$) specified in ISO 717-1 and Sound Transmission Class (STC) specified in ASTM E 413-03. Table 2 shows each test result of five specimens. The weighted sound reduction index is considered from 100 to 3150 Hz and the Sound Transmission Class from 125 to 4000 Hz.

Table 2. The test results of the specimens

| Specimen | $R_w$ (C; $C_{tr}$) (dB) | STC (dB) |
|---|---|---|
| A | 47 (-4; -12) | 47 |
| B | 51 (-2; -9) | 52 |
| C | 51 (-1; -5) | 51 |
| D | 50 (-6; -14) | 51 |
| E | 53 (-3; -9) | 53 |

### 3.1 Increasing Stud Spacing

The stud spacing varied from 450 to 900 mm with 0.8 mm thickness stud and 450 to 600 mm with 0.5 mm thickness stud. The differences of sound reduction index ($R_w$) between stud spacing 450 and 600 mm are around 3 ~ 4 dB in plasterboard partition of 0.8 and 0.5 thickness stud.

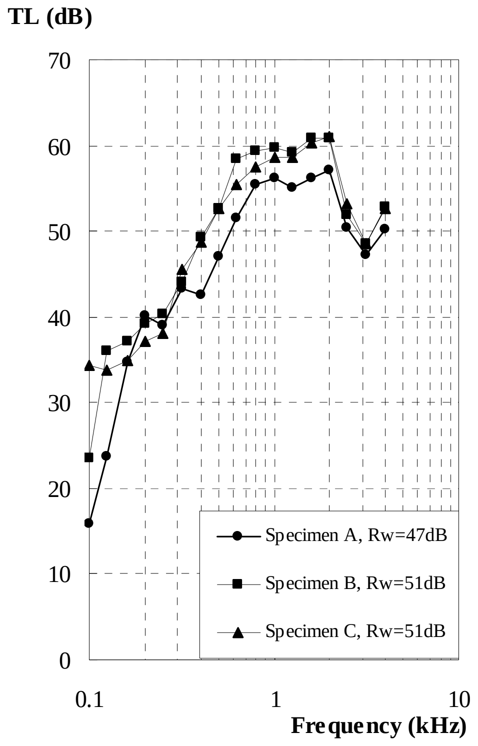


Figure 2. Increasing Stud spacing with 0.8 mm Stud thickness

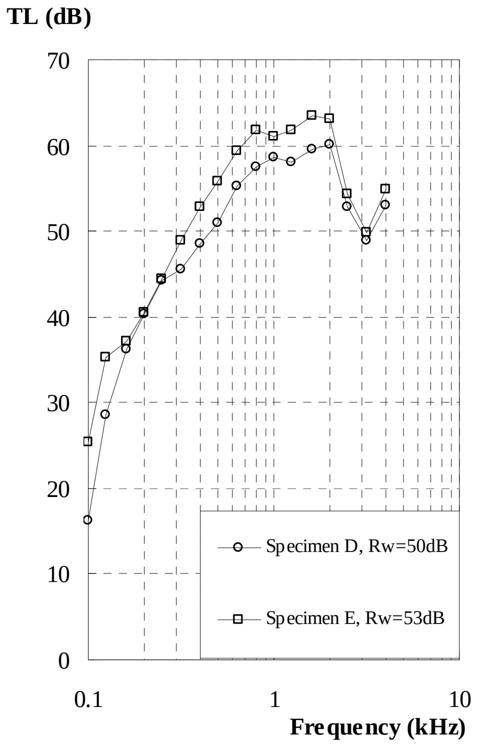


Figure 3. Increasing Stud spacing with 0.5 mm Stud thickness

*3.1.1 Increasing Stud spacing with 0.8 mm Stud thickness*

Fig. 2 shows the test results of sound transmission loss for Specimen A, B and C. It shows that according to increase stud spacing, sound insulation performance of partition is also increased. When the spacing of stud increases, the stiffness of plasterboard partition increases having effect on sound transmission at low frequencies.

The sound reduction index ($R_w$) of Specimen B is 4 dB higher than Specimen A and the sound transmission loss is increased at frequencies between 100 and 4000 Hz. Although the sound reduction index ($R_w$) of Specimen B and C is same, the difference of sound transmission loss between Specimen B and C is around 10 dB at 100 Hz due to the stiffness of plasterboard partition is still increased.

*3.1.2 Increasing Stud spacing with 0.5 mm Stud thickness*

Fig. 3 shows the sound transmission loss test results of Specimen D and E. Fig. 3 shows that increasing stud spacing from 450 to 600 mm with 0.5 mm thickness stud influences at frequencies between 100 and 4000 Hz and the sound reduction index ($R_w$) is increased around 3 dB.

## 3.2 Decreasing Stud thickness

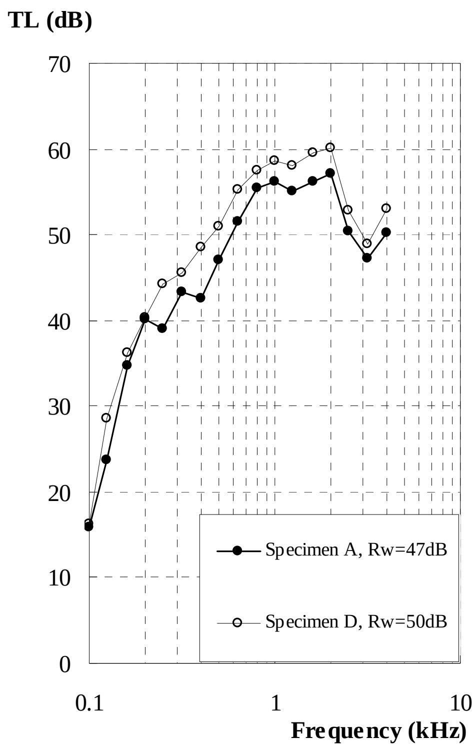


Figure 4. Decreasing Stud thickness with 450 mm Stud spacing

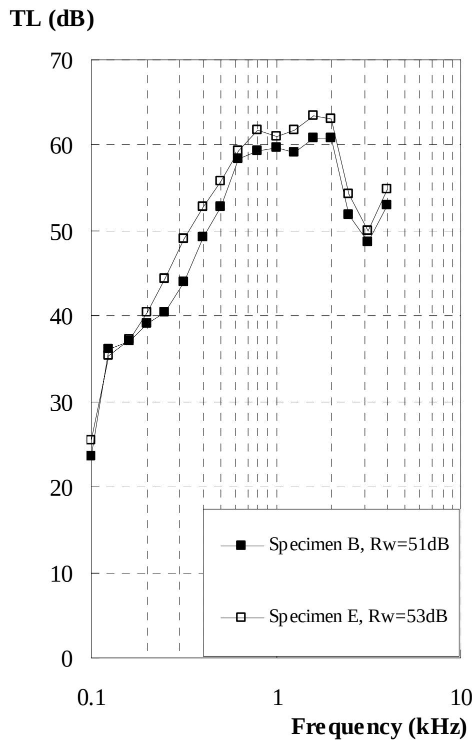


Figure 5. Decreasing Stud thickness with 600 mm Stud spacing

Fig. 4 shows the sound transmission of Specimen A and D. Test result shows according to decrease stud thickness with 450 mm stud spacing, the sound insulation performance of plasterboard partition is increased at frequencies from 100 to 4000 Hz. The sound insulation performance of plasterboard partition is also increased according to decrease stud thickness with 600 mm stud spacing in Fig. 5. Decreasing stud thickness mainly influences at middle frequencies between 250 and 2000 Hz.

## 4. CONCLUSIONS

In this study, the effect of stud spacing and stud thickness on sound insulation performance of plasterboard is investigated. To increase sound insulation performance of plasterboard partition, it is effective to increase stud spacing and decrease stud thickness due to the factors influencing the stiffness of plasterboard partition. Increasing stud spacing influences at low frequencies, whereas decreasing stud thickness has effect over middle frequencies. Therefore, the sound insulation performance of plasterboard partition can be improved around 6 dB by changing stud spacing and stud thickness.

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