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Technical Note

# Experimental sound insulation performance of double frame partitions with slits

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**Abstract**

In this paper the influence of slits on sound reduction index of double steel frame partitions with and without mineral wool in the cavity was examined. It was shown that the sound insulation of the partition is strongly dependent on the relative position of the slits on each steel frame. As could be expected, the reduction in sound insulation due to slits is lower in partitions without mineral wool in the cavity, since the effect of slits is more important in the case of partitions with high sound insulation.


*Keywords:* Sound reduction index; Sound leaks; Slit; Gypsum board; Lightweight partitions

## 1. Introduction

Lightweight partitions are widely used throughout the world, because airborne sound insulation requirements can be achieved with low overall surface weights in addition to high strength and thermal insulation. Their advantages also include quick and easy construction and flexibility. Single frame partition assembly only provide modest sound insulation, however, when high levels of sound insulation are desired, double frame partition assembly is preferred.

The airborne sound insulation is highly sensitive to air leakage, and therefore the construction must be as airtight as possible. It is common that when lightweight partitions are built in the field, at the perimeter of the partition, small unintentional sound leaks occur between frames and structural members. These sound leaks cause a significant degradation of the sound reduction index of the partition.

Simplified mathematical models for sound transmission through apertures in a thick wall have been carried out by Gomperts [1–3] and Wilson and Soroka [4]. Hongisto [5,6] applied the Gomperts model for a slit-shaped aperture in order to calculate the sound reduction index of doors. Kang et al. [7] investigate the effect of in situ sound leaks by means of experimental and theoretical studies in the cabins of a ship. They found that sound insulation can be degraded by up to 15 dB under field conditions, mainly because sound leaks. Recently, Uris et al. [8] examined the influence on sound reduction index of the length and the depth of sound leaks at the perimeter of single frame partitions. They found that the most important decrease on sound reduction index is caused by the first slit between lightweight partition and one of the structural members.

In this paper, the influence on sound reduction index of a slit at the perimeter of double frame partitions is studied. It will be also shown that the relative position of the slit on each frame affects the sound reduction index of the whole partition.

## 2. Experimental arrangement

Two different types of test structures were examined. The first type are double frame partitions with mineral

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wool in the cavity and the second one without mineral wool in the cavity.

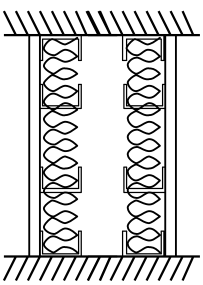
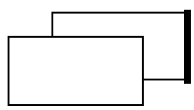
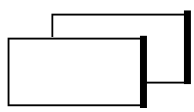
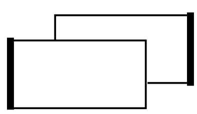
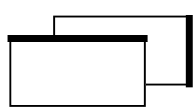
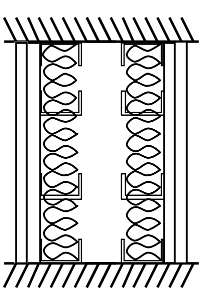
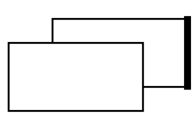
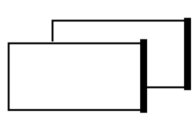
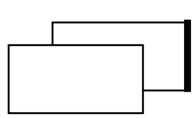
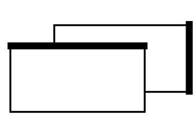
Double frame partitions with mineral wool in the cavity had one or two layers of gypsum board on each side of two separated $50 \times 50$ mm steel frames, with each frame fitted with 50 mm thick mineral wool, and with an air gap of 100 mm between frames. Double frame partitions without mineral wool in the cavity had one or two layers of gypsum board on each side of two separated $50 \times 50$ mm steel frames with an air cavity depth of 200 mm thick.

For each partition, five airborne sound reduction index measurements were conducted. Tables 1 and 2 show a schematic representation of the partitions considered, an illustrated situation of the different slits and the code used for each partition. The width of the slits, $d_s$, was 1.5 mm, as is shown in Fig. 1.

The gypsum boards dimensions were $3 \times 1.2 \times 0.0125$ m, with a mass per unit area of 9.5 kg/m$^2$. The properties of the rockwool used were as follows: bulk density =50 kg/m$^3$, flow resistivity = 12,600 Ns/m$^4$, and porosity = 0.97.

Test specimens were installed between the adjoining source and receiver chambers of the Building Acoustics Laboratory at the Polytechnic University of Valencia in Spain. Walls, ceiling, and floor of each chamber were con-

Table 1
Description and code of the partitions with mineral wool in the cavity tested

| Partition | Slit position | Sample description | Code |
| --- | --- | --- | --- |
|  |  | Partition without slit<br>Perimetral slit in the lateral edge on the emission suite side | 1G-MW<br>1G-MW(ls) |
| |  | Perimetral slit in the lateral edge on the reception suite side in front of the slit on the emission suite | 1G-MW (ls + ls)f |
| |  | Perimetral slit in the lateral edge on the reception suite side opposite the slit on the emission suite | 1G-MW (ls + ls)o |
| |  | Perimetral slit in the upper edge on the reception suite side and a perimetral slit in the lateral edge on the emission suite side | 1G-MW (ls + us) |
|  |  | Partition without slit<br>Perimetral slit in the lateral edge on the emission suite side | 2G-MW<br>2G-MW (ls) |
| |  | Perimetral slit in the lateral edge on the reception suite side in front of the slit on the emission suite | 2G-MW (ls + ls)f |
| |  | Perimetral slit in the lateral edge on the reception suite side opposite the slit on the emission suite | 2G-MW (ls + ls)o |
| |  | Perimetral slit in the upper edge on the reception suite side and a perimetral slit in the lateral edge on the emission suite side | 2G-MW (ls + us) |