48º CONGRESO ESPAÑOL DE ACÚSTICA
ENCUENTRO IBÉRICO DE ACÚSTICA
EUROPEAN SYMPOSIUM ON UNDERWATER ACOUSTICS APPLICATIONS
EUROPEAN SYMPOSIUM ON SUSTAINABLE BUILDING ACOUSTICS

ON THE USE OF ACOUSTIC PARTICLE VELOCITY TO FACE AIRBORNE SOUND INSULATION

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Key words: Particle Velocity, sound insulation, intensity measurements.

ABSTRACT

Airborne sound insulation testing by means of acoustic intensity is a versatile alternative to sound pressure classical methods. An extension of traditional p-p intensity-based method is used, assessing sound power in both sides of a sample under test. Direct particle velocity measurements let a proper estimation of walls transmission lost when having flanking contributions and complex sound fields. Pressure, velocity, and intensity mapping are provided to research sound power through a building element. Results are compared with ISO 10140 standard testing. An analysis of method benefits and drawbacks, and future research lines are presented.

RESUMEN

Los ensayos de aislamiento a ruido aéreo mediante intensidad acústica son una alternativa versátil a métodos clásicos de presión. Se emplea una ampliación del método tradicional de intensidad PP, evaluando la potencia sonora en ambos lados de una muestra de ensayo mediante una sonda PU. Medir directamente la velocidad de partículas permite una correcta estimación de pérdidas de transmisión con transmisiones por flancos y campos sonoros complejos. Se proporcionan mapas de presión, velocidad e intensidad para investigar la potencia a través del elemento constructivo. Los resultados se comparan con ensayos ISO 10140. Se presentan ventajas e inconvenientes, y líneas de investigación futura del método.

1. INTRODUCTION

The standard two-room method for assessing sound insulation (sound transmission loss) of a partition requires complex and big facilities such as test chambers, and a tough procedure where many variables must be controlled [1-2].

Another method for measuring Sound Transmission Loss using Sound Intensity is shown in this paper. Using PU probes instead of PP probe for Sound Intensity measurements, and acquiring and managing the data with Scan & Paint software make it possible to go through this method [3] easier and faster.

In this paper, a deeper study from a previous publication [4] was performed. In the following point 2, the same Experimental Evaluation than [4] is being described.

2. EXPERIMENTAL EVALUATION

Thanks to the invaluable cooperation of the windows manufacturer Aluminios Cortizo, a validity test could be performed on a normalized chamber, where tests according to ISO 10140 are being usually performed.

2.1. Measuring Procedure

With the setup shown in Figure 1, using only one noise source position, we could perform Sound Intensity scanning on both sides of the sample. This test facility has been designed for windows sound insulation tests, thus the sample is composed by a brickwall and a window. The scanning is basically performed over the window sample.

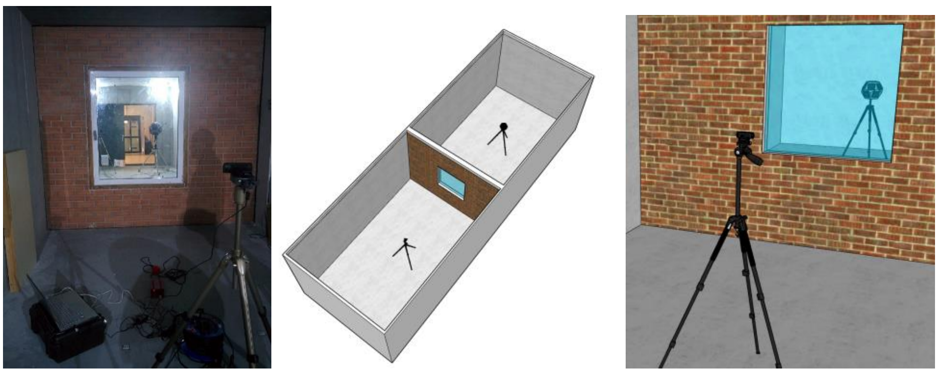

Figure 1 - Scanning measurement setup

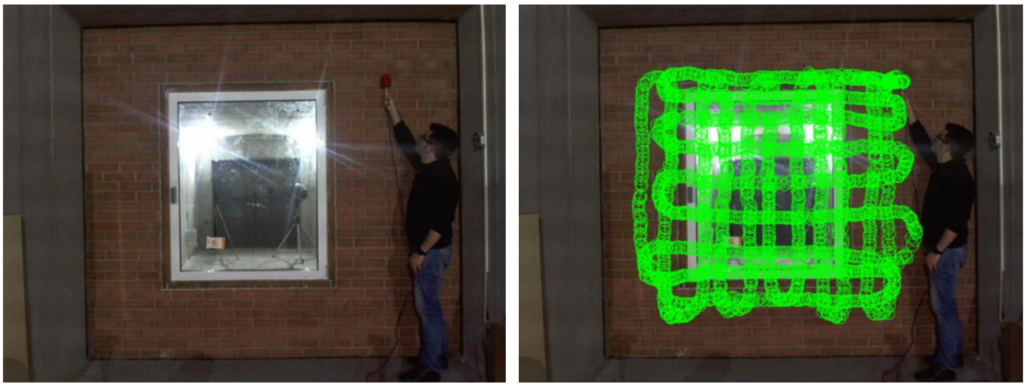

Figure 2 - Receiver room scanning

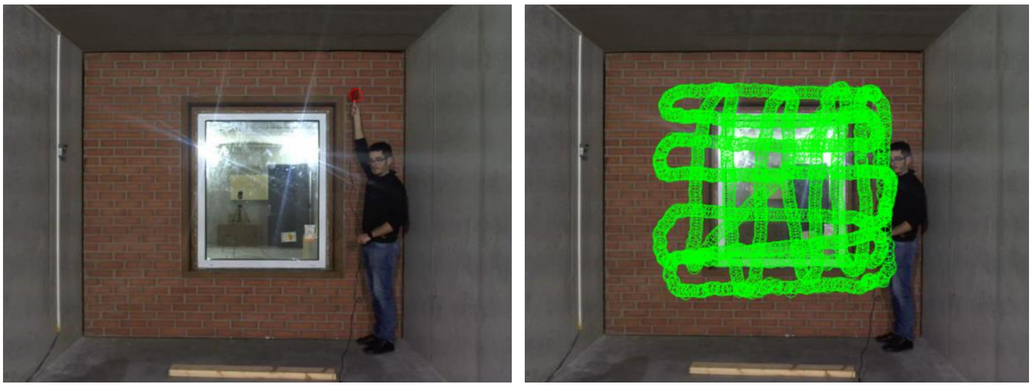

Figure 3 - Source room scanning

Scan&Paint software captures the position and acquires the sound data: sound pressure and particle velocity, in every position. It can be seen in Figure 2 and Figure 3 all the tracked positions when performing the scanning on both sides of the sample.

2.2. Data analysis

The data is processed following a grid structure.

With Scan&Paint we can visualize any of the performed scannings, getting Particle Velocity, Sound Pressure and Intensity (among others).

In the receiving side, it can be seen in Figure 4 that the weak points in the sound insulation of the window are easily found with Particle Velocity compared with Figure 5 with Sound Pressure. This is due to the directivity in 8-figure of the Particle Velocity sensor and also due to the higher dynamic range of this velocity sensor. Then, even in such a broadband, the velocity colour map provides with a higher space resolution than pressure or intensity ones.

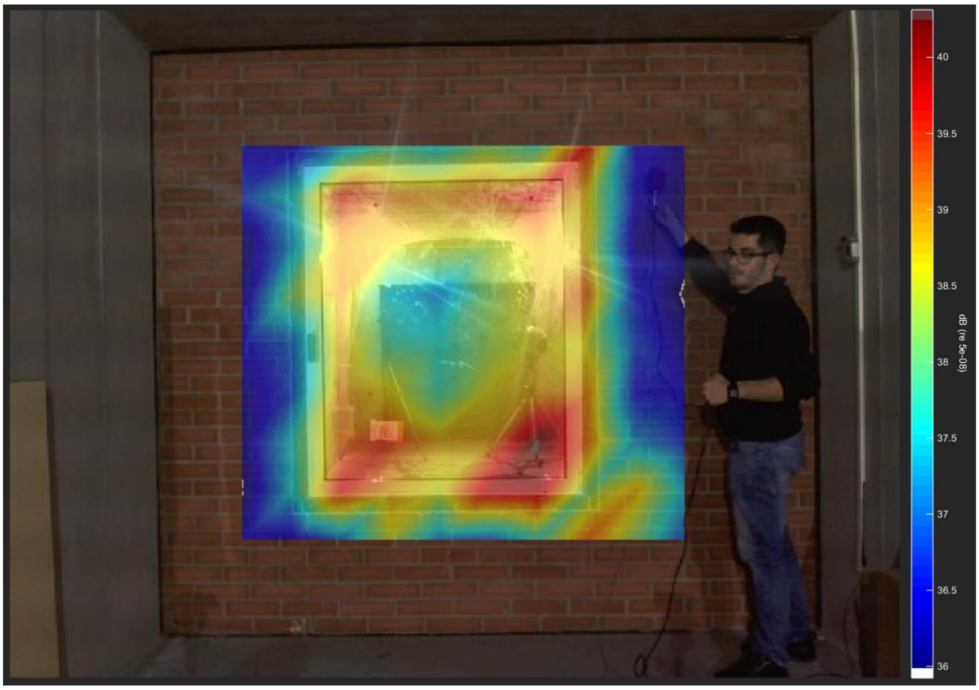

Figure 4 - Averaged Particle Velocity 3000Hz-5000Hz

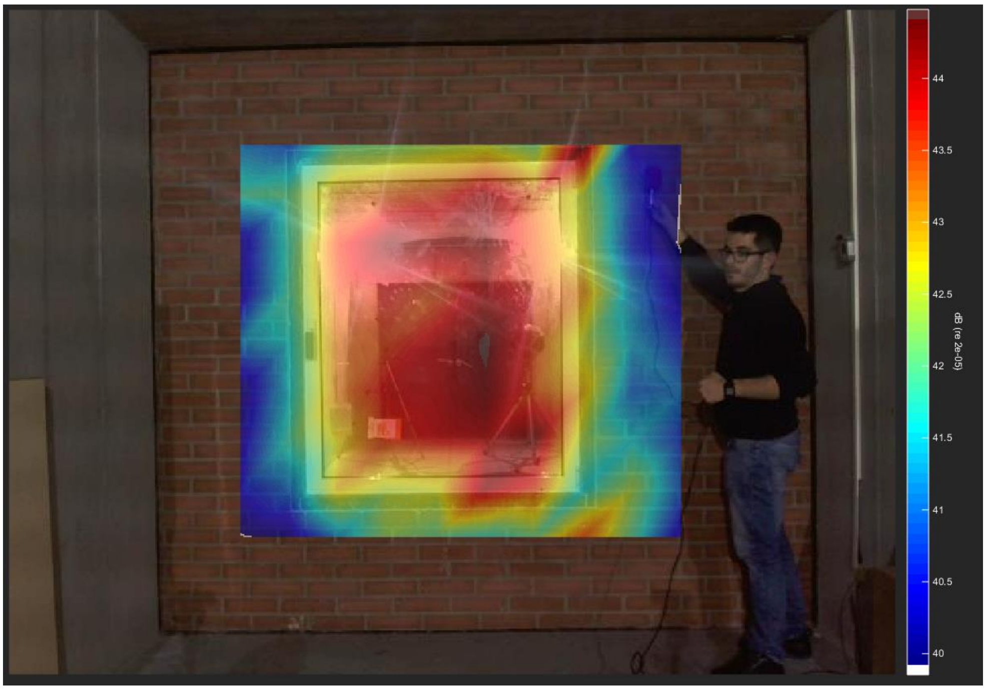

Figure 5 - Averaged Sound Pressure 3000Hz-5000Hz

Transmission Loss is calculated getting the data from two grids: the incident and the transmitted as it can be seen in Figure 6. On those screenshots the grids definition and the probe positions in the scanning are highlighted.

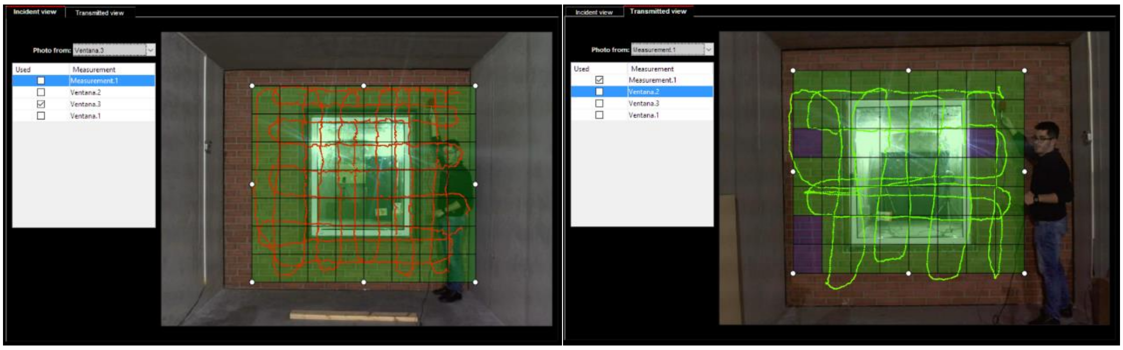

Figure 6 - Grid configuration for TL calculations

As shown in Figure 7, three different scanning distances from the sample have been chosen. The values acquired were quite similar, showing the diffusivity of the sound field in the source room, so only the closest scanning surface has been chosen.

Figure 7 – Source room positions

2.3. Results

Scan&Paint software calculates Transmission Loss and displays the results in an overlaid colormap, as it can be seen in Figure 8 and Figure 9. Figure 8 shows the averaged Transmission Loss in the frequency bands between 100 Hz and 3150 Hz. Figure 9 displays Transmission Loss in the 4000 Hz frequency band.

The abrupt change of the Transmission Loss values between the window and the brickwall can be clearly seen in these figures. The space resolution of the colormap could be improved processing the data with a grid with smaller cells and even a more detailed scanning. But, in this case, this rough scanning contains information enough for assessing the overall Transmission Loss of the window. Do not misunderstand this level difference window-brickwall with the flanking transmission, defined as the sound transmitted through the lateral concrete walls.

In Figure 9, it can also be seen the different Transmission Loss values in the frame area. This would help to perform product enhancement following a more detailed analysis.

s the aim of this study is focused on comparing the Scan&Paint Transmission Loss PU measurement procedure with the standard ISO 10140, a region of interest has been defined with a black thick square as shown in both Figure 8 and Figure 9. It could be defined in some other region too.

Scan&Paint software can process the Transmission Loss spatial values and create a frequency averaging graph as it can be seen in Figure 10, where the results are also compared with the Transmission Loss values obtained following the process defined in the ISO 10140.

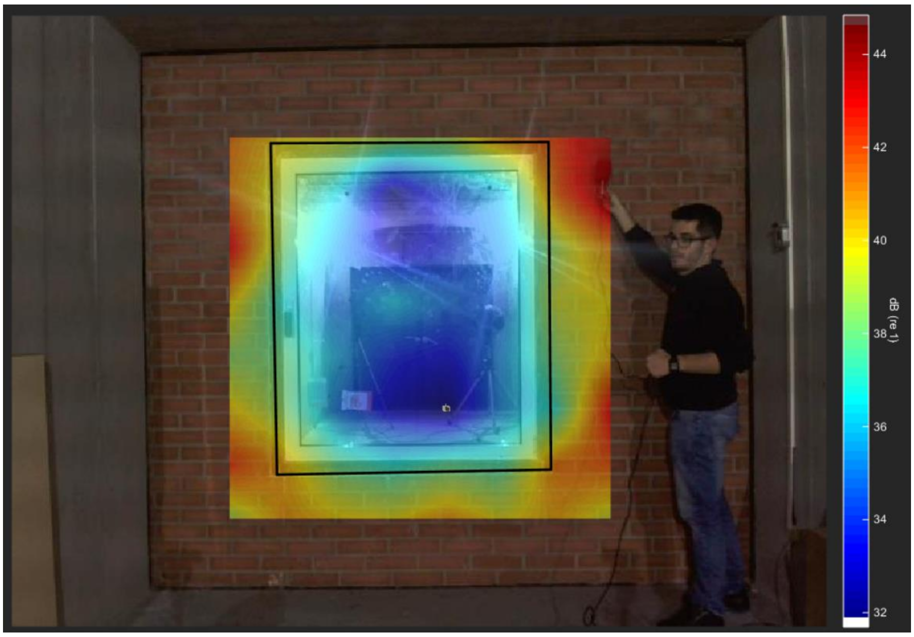

Figure 8 - Averaged Transmission Loss 100Hz-3150Hz

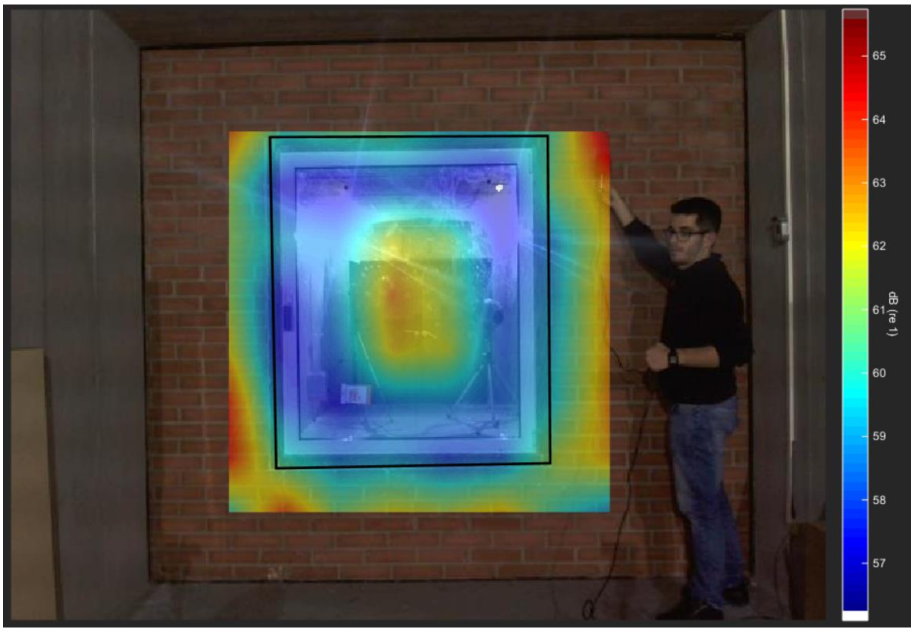

Figure 9 - Transmission Loss in 4000Hz band

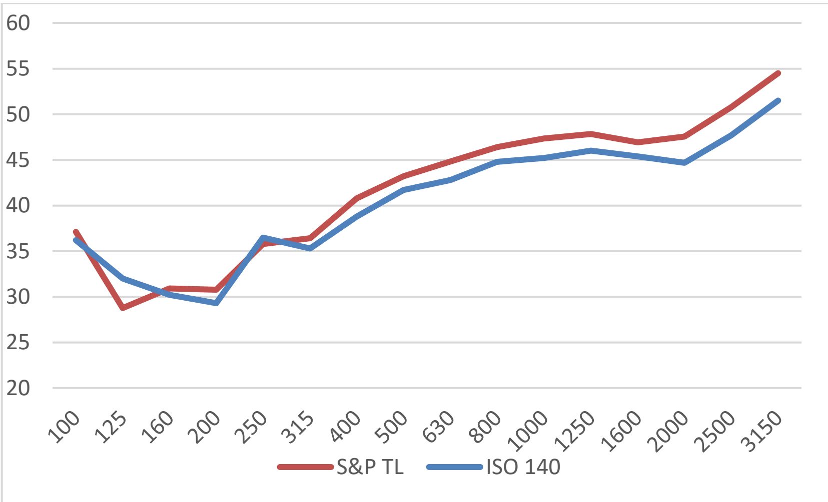

Figure 10 - Comparison of Sound Transmission Loss results

3. CONCLUSIONS

As shown in Figure 10, a very good agreement is obtained between the Sound Transmission Loss measured in the test chamber using the sound intensity method and a PU probe, compared with the standardized 2 room method. Slightly better results are obtained using PU Intensity measurements since they are scarcely influenced by flanking paths as in ISO 10140 methods. So, on site sound insulation measurements can be comparable to those performed in a acoustic transmission suite.

More successful measurements have been performed, but due to the customer privacy cannot be currently published.

It is demonstrated that a new method for measuring Sound Transmission Loss using Sound Intensity is possible with the proposed approach. The usage of Microflown PU probe in combination with the software tool Scan & Paint enables capturing additional information compared to the traditional methodology, such as the spatial distribution over the sample visualized through color maps, for detecting weak points, leakages or mounting defects, thanks to the performance of the particle velocity sensor.

4. REFERENCES

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