ACOUSTIC BEHAVIOR OF TABIQUE – A PORTUGUESE TRADITIONAL INTERIOR PARTITION

"EuroRegio2016"

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Abstract

Traditional buildings that regularly characterize the center of our towns present the challenge to be updated without losing their uniqueness. Acousticians frequently are in the center of that challenge facing traditional solutions that must fulfill current acoustical requirements.

The lack of knowledge on traditional solutions performance regarding XIX century buildings leads to the replacement of traditional solutions.

In order to meet the traditional solutions performance to assist rehabilitation operations a study has been developed in traditional solutions used as interior partitions aiming its technological characterization and its acoustic performance validation. These wood and plaster walls are commonly known as *tabique* walls.

Aiming the use of *tabique* traditional solutions in rehabilitation operations it is intended to bring together a range of information on their acoustic behavior.

The acoustic performance of the *tabique* walls is obtained by performing site measurements on *tabique* traditional solutions. Airborne sound insulation (DnT) tests are carried out in several buildings with the same traditional solution.

The same *tabique* traditional solution was built and tested in an acoustic chamber (R) in order to realize the performance of the solution without the influence of flanking transmissions.

The potential demonstrated by these enhanced traditional solutions predicted a shift in current paradigms of building rehabilitation and will allow acousticians to support the challenge for heritage buildings rehabilitation.

Keywords: Airborne Sound Insulation, Wood Traditional Solutions, Sustainable Rehabilitation.

PACS no. xx.xx.Nn, xx.xx.Nn

1 Introduction

Currently the rehabilitation operations that take place in the oldest urban centers of our cities tend to replace all the interior solutions and preserve only the facade elements.
The restoration of historic buildings involves specific requirements arising from their patrimonial value.
To adapt the traditional solutions to current standards of comfort can become arduous since the information on the performance of these solutions is unknown.
In order to meet the traditional solutions performance to assist rehabilitation operations a study has been developed in traditional solutions used as interior partitions aiming the technological characterization and the acoustic performance validation.
The interior walls under study are made up of wood and plaster and are commonly known as *tabique* walls.
Aiming the use of *tabique* traditional solutions in rehabilitation operations it is intended to bring together a range of information on their acoustic behavior.

2 Characterization of *tabique* wall

This study addresses the heritage buildings in the old city of Porto built on the time period between the 19th century and the early 20th century. The historical center of Porto is home to a set of buildings of undeniable historical value.
Tabique is one of the most used ancient construction techniques in Portugal until the end of 20th century.
The *tabique* walls are composed by vertical and horizontal rows of wooden boards which serve as a base for thinner wooden tiers of trapezoid shape. This thinner wooden framing provides for the adherence of the coating plaster.
Its mechanical resistance is granted by the wood structure and the mortar functions as filler and coating. As with other traditional building techniques, the *tabique* partition uses natural and available materials on the construction area.

Figure 1 – *Tabique* wall under study.

3 Method

In order to understand how we can act to improve the acoustic performance of traditional solutions, we must understand how these solutions behave in service.
To achieve this goal tests were carried out in several buildings in the historic center of Porto. With the

objective of obtaining the sound insulation index of the tested solutions (*tabique* interior partitions, DnT,w). The site tests were performed in accordance with the EN ISO 16283-1, EN ISO 717-1 and EN ISO 717-2.
The site measurements carried out in traditional buildings test the solution in its original form, naturally aged by the passage of time, so it was understood that to validate the site measurements it would be necessary to rebuild the original solution in the laboratory acoustic chamber.
In this way it would be possible to assess the sound insulation of the *tabique* solution without the influence of flanking transmissions. The laboratory measurements were performed in accordance with the ISO 10140-1, ISO 10140-2, ISO 10140-4 and ISO 10140-5.

3.1.1 Site measurements

The test procedure follows the EN ISO 16283-1 standards. Five microphone positions are registered for each different sound source position in the source room. Simultaneously five positions are registered for the same two sound source positions in the receiving room. In the source room the same five positions for background level are registered.
Reverberation time is measured in the receiving room and three microphone positions are registered for the two different sound source positions.

Figure 2 – Source and receiving room.

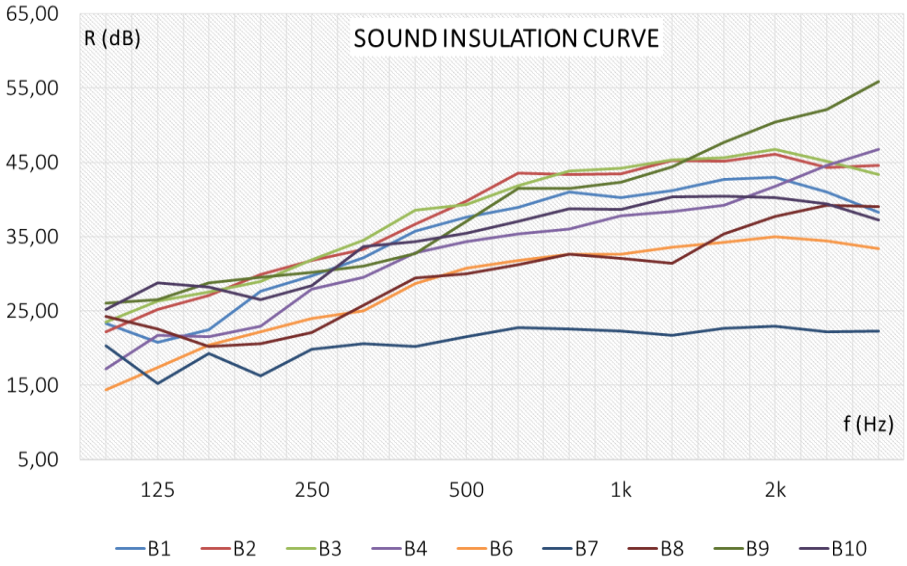


Figure 3 - Site measurements curves (B- Building).

3.1.2 Laboratory measurements

The test procedure follows the ISO 10140 standards. Five microphone positions are registered for each different sound source position in the source room (R1). Simultaneously five positions are registered for the same two sound source positions in the receiving room (E2). In the source room the same five positions for background level are registered.
Reverberation time is measured in the receiving room and three microphone positions are registered for the two different sound source positions.
The test specimen was constructed between source and receiving room E1 and R1 and test sample was approximately 10 m^2.

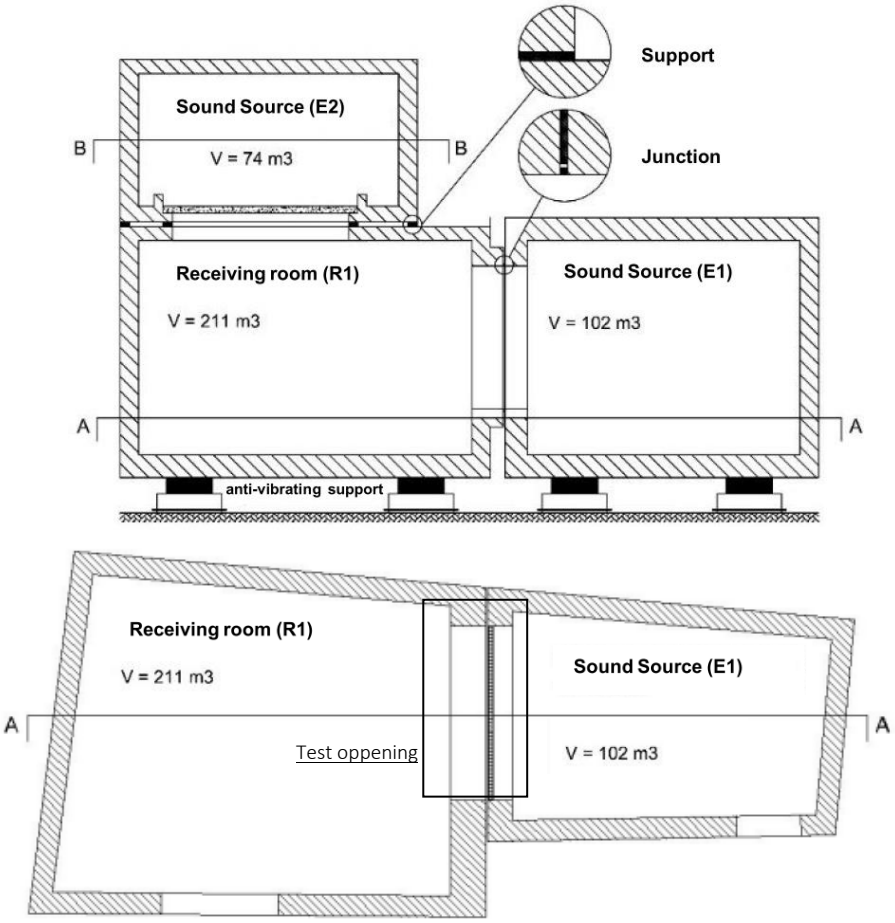


Figure 4 – Acoustic chamber.

The test sample is composed of a double wooden planking disposed vertically and diagonally. Above this structure are nailed trapezoidal shape boards which serve to receive the filling plaster.

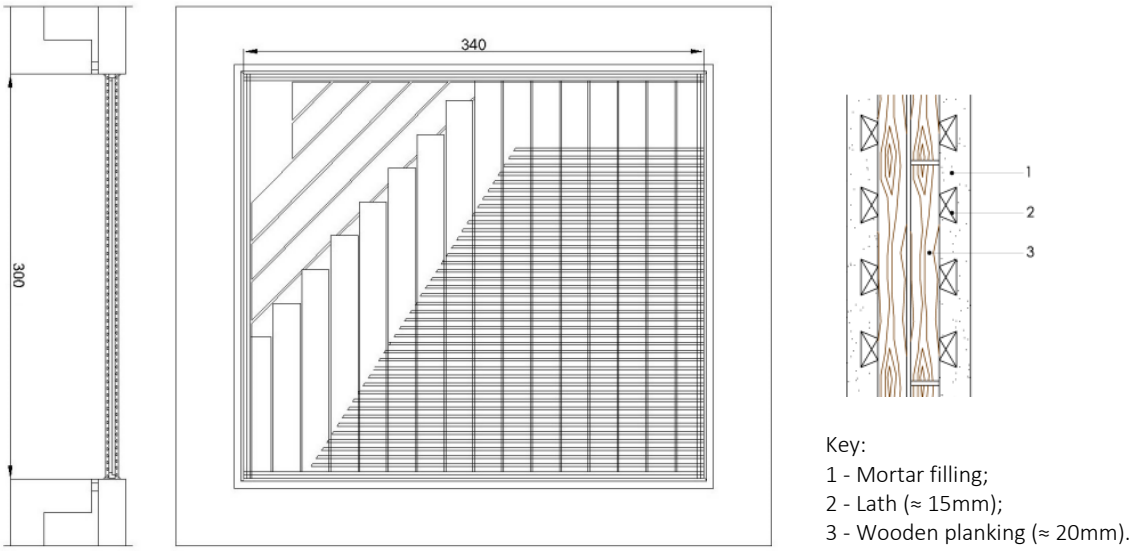
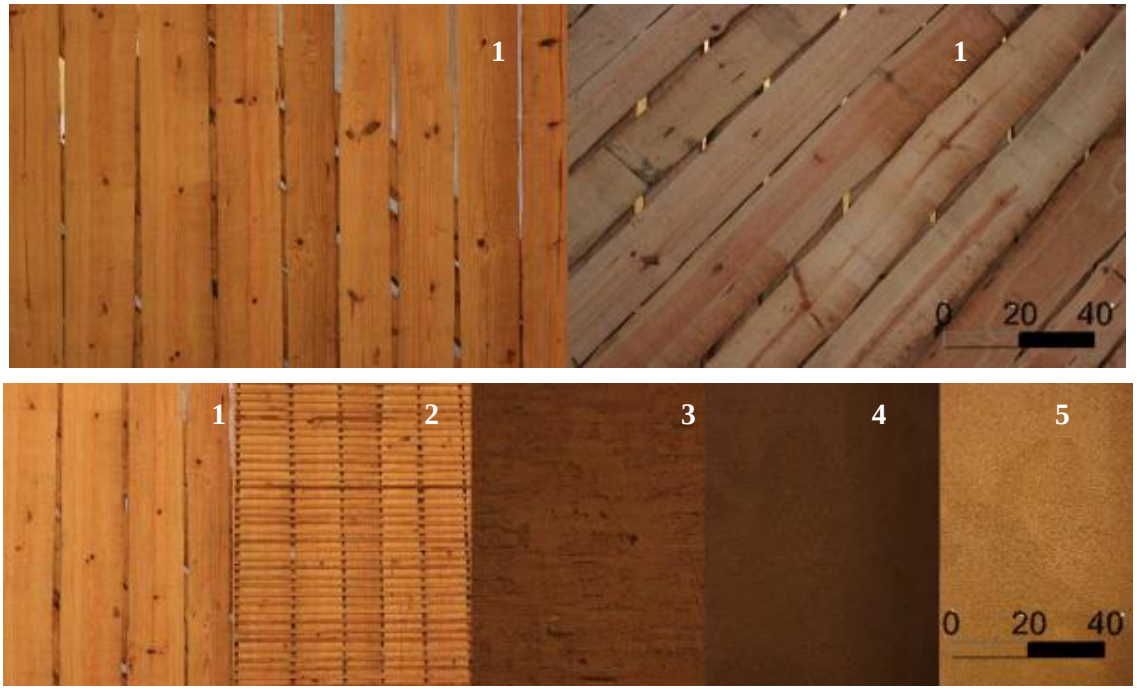


Figure 5 – Assembly of the *tabique* wall.



Stage 1 – Vertical and horizontal rows; Stage 2 – Tiers of trapezoid shape; Stages 3, 4 and 5 – Coating plaster.

Figure 6 – *Tabique* construction stages.

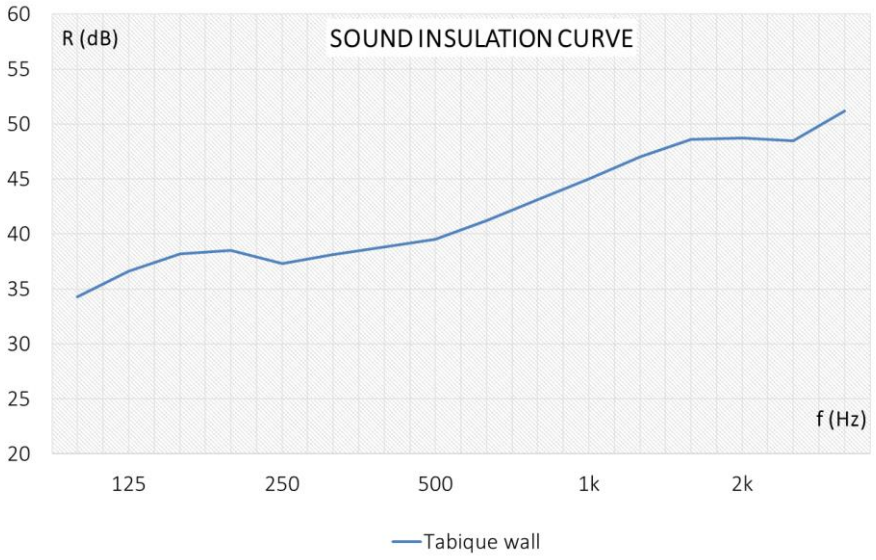


Figure 7 – Laboratorial sound insulation curve of tabique wall.

4 Results

The following table shows the obtained results from site and laboratory measurements for the same *tabique* wall solution.

Table 1 – Obtained results for site measurements and laboratory test.

	Sound insulation index (dB)									
Element	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**	**B9**	**B10**
Site measurements ($D_{nT,w}$)	39	42	42	37	38	38	22	32	41	33
Laboratorial test (R_w)	45									

The following figure shows the obtained results by frequency from site and laboratory measurements.

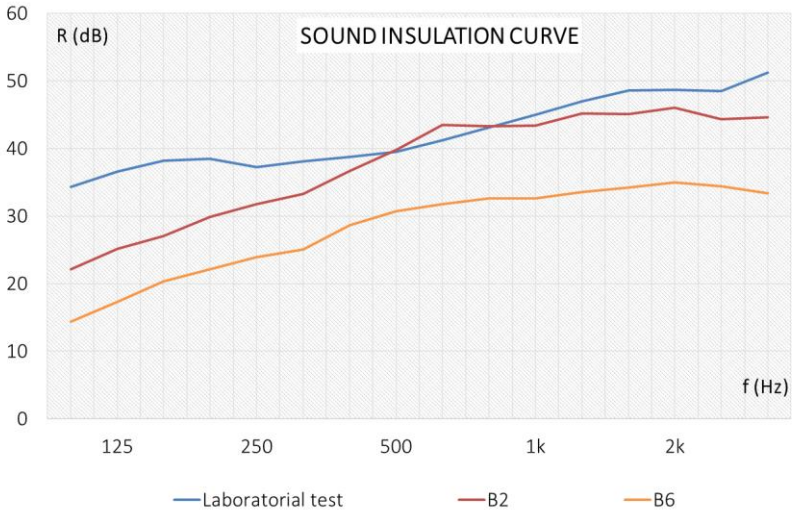


Figure 8 – Site measurements curves (B6 – Lower value in the eighty percent of the obtained results; B2 – Higher value in the eighty percent of the obtained results) and laboratory curve.

5 Conclusions

Traditional building rehabilitation will only be possible if we are able to adapt the existing solutions to the requirements of contemporary comfort, by making use of technological development.
The first step on the path to achieve this purpose is the study of the performance of traditional solutions. Thus, the evaluation of a considerable amount of different solutions will allow us the definition of characteristic intervals of sound insulation for each of these standard solutions in order to understand if the existing solutions become competitive.
With this study it was possible to characterize both the site and laboratory behaviors of the *tabique* wall. Site measurements show eighty percent of sound insulation index results between 38dB and 42dB. The laboratory test results show a difference between 3dB and 7dB compared to the site measurements results. This variability is explained by the preservation state of the building under study. Tested solutions are in its original condition so the influence of flanking transmission play an important part in the sound insulation index results.
Interior walls fall outside of the regulatory scope since they cannot ensure the insulation regulatory standards between separate households of 50dB. Although both site and laboratory measurement results for air sound insulation index values are satisfactory, since they lead us to conclude that an intervention for the improvement of these elements can ensure compliance with contemporary legal standards.
With this study we can affirm that the *tabique* wall traditional solution has potential and it can function as interior partitioning without any intervention.
This study intends the optimization of rehabilitation actions in traditional buildings with outdated construction methods, in such a way that the rehabilitation actions prioritize the improvement of existing solutions, maximizing the use of existing materials and minimizing the implicit costs on rehabilitation actions.

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