The acoustical effect of reveal blocks, from measuring method to prediction

Frigyes Reis[a] and Balázs Tóth[b]

[a]Budapest University of Technology and Economics, Lab. of Building Acoustics, Mûegyetem rakpart 3., 1111 Budapest, Hungary
[b]Wienerberger Co., Bártfay str. 34, 1119 Budapest, Hungary
reis@mail.bme.hu

The paper describes the analyze and test results of the reveal blocks, surrounded the windows in façade walls to reduce heat transfer in the brick elements around the windows. A measuring method was worked out, based on and deduced to standardized measurements of laboratory sound insulation. A "window model" was used to generalize the results. It was found, the use of reveal blocks reduces airborne sound insulation with ΔR_w= 3 dB, $\Delta(R_w+C_{tr})$=2..4 dB, when the size of the "window model" is 1.2 * 1.5 m. The physical phenomenon causing this result is flanking sound transmission through the plastered PS plates in the gutter of the reveal blocks. The measured results can be used in the predicting method of façade sound insulation.

1 Introduction

The heat insulation demands of façade constructions, having the roots in energy saving concepts as well as in thermal comfort of rooms and mechanical stability lead to several new building constructions, new components, products. From the point of view of thermal aspects the general, engineering knowledge of the use of these novelties is widely current, the acoustical aspects are considered only later, the knowledge and consequences coupled to acoustics are not so widely accepted.

Among building constructions, used in buildings, there are ready products, like windows, doors, etc, but there are a lot of constructions which are formed in the constructional site, using building products. Most of the walls for eg. belongs to this group, made of masonry blocks of different type (ceramic blocks, limestone blocks, etc.), the blocks are "glued" to each other using mortar. The products are the masonry blocks and mortar, the building construction, having acoustical characteristics is the wall itself. The technical data of the products (the sizes, the mass of the blocks, etc. are coupled to the acoustical data of the building construction built of the blocks, but the sound insulation data of the building construction, necessary to any prediction procedure depends also on the constructional work in situu.

The subject of the paper is coupled to the reveal blocks: a building component, used around windows in façade walls, to reduce heat transmission. The sound transmission caused by the reveal blocks in not known, and there are no real measuring methods how to determine it.

The present paper deals with solving one of the problem, related to the possibilities use of prediction methods listed and discussed in [1].

2 The reveal block in façade walls

Figure 1. shows a façade wall sample before plastering around a window opening. The normal heat insulating blocks, the half size and full size reveal blocks are marked. The reveal blocks have a gutter in which hard PS plates are placed, the windows are fixed to the blocks where the ceramic element is covered by the PS heat insulation. The PS layer is covered by plaster, the sill or the stool (at the lower horizontal edge). The fine inner structure of the reveal block corresponds to the fine inner structure of the heat insulating façade blocks of the same thickness. They are also plastered.

In figure 2. a schematical view of the cross section of a façade wall and window sample is shown (lower edge). The reveal blocks are located at the lower horizontal and the two vertical edges around the window. The characteristic sound propagation paths are marked as follows.

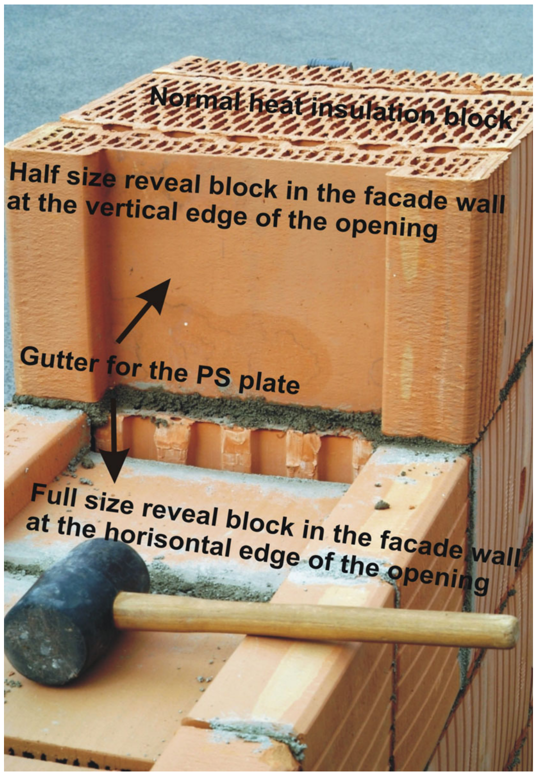

Figure 1. Reveal blocks in an unplastered façade wall sample

- **FW**: sound propagation through the normal wall part, made of heat insulating blocks in the facade, marked with 1.;
- **FR**: direct sound propagation through the reveal block, marked with 2.; the reveal blocks are located around the window;
- **HI**: sound propagation through the PS heat insulation layer in the block, forming a flanking path around the window;
- **WI** sound propagation through the window.

3 Evaluating the propagating paths

FW: direct sound transmission through the façade wall, made of heat insulating blocks; this path can be numerically determined, based on standardized sound insulation measurements [2]. This data can be directly fitted in the prediction of sound insulation of facades [3].

WI: the sound insulation or transmission of this path can be numerically determined, based on standardized sound insulation measurements [2]. This data can be directly fitted in the prediction of sound insulation of facades [3].

FR: The direct sound transmission through the reveal blocks, marked with 2, is not known as primary measured data. No wall sample can be built of only reveal blocks to do standardized measurement on it, because of the properties of the elements. But since its fine inner structure corresponds to the one of the normal heat insulating blocks of the same thickness the direct sound transmission through the reveal block is considered equal to the sound transmission of the normal heat insulating blocks.

HI: There are no measuring methods to characterize flanking sound transmission through **HI** path, and there are no data actually.

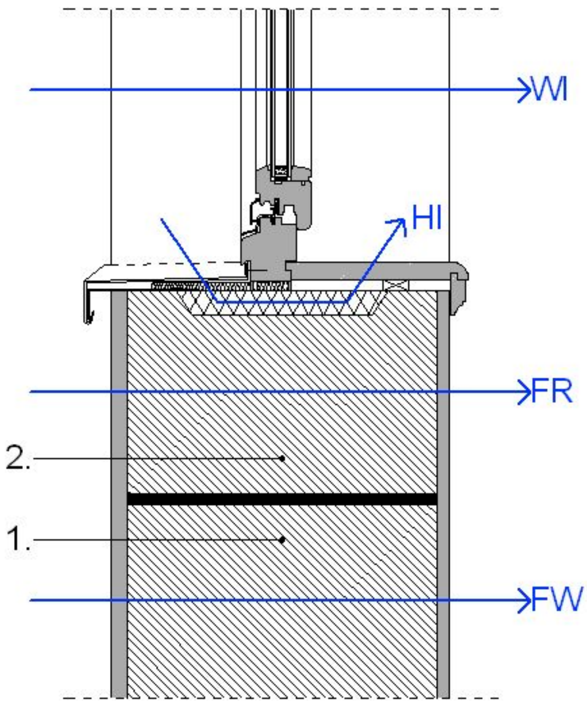

Figure 2. Schematical cross section of a wall with reveal blocks, normal heat insulating blocks and a window in field conditions

4 Measuring method for sound transmission through path HI

Figure 3 and 4 presents laboratory test arrangement to determine sound transmission belonging to reveal blocks, path HI. The items of the test arrangement and measuring process is listed below. Two sound insulation measurements are necessary to carry out.

I. A "window model" has been constructed, consisting of a frame (1), multi layer covering plates (2), and sand filling (3). The thickness of the "window model" is equal to the frame thickness of the normal, regular windows. In the present study the thickness of the "window model" was 56 mm, and 68 mm.

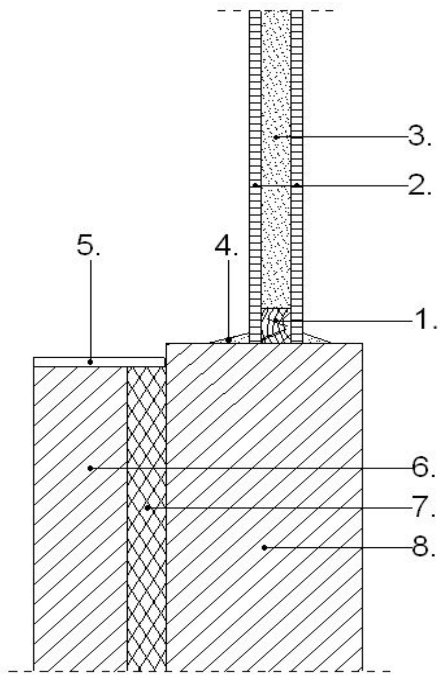

Figure 3. Laboratory test arrangement for the sound insulation of window model in standardized conditions

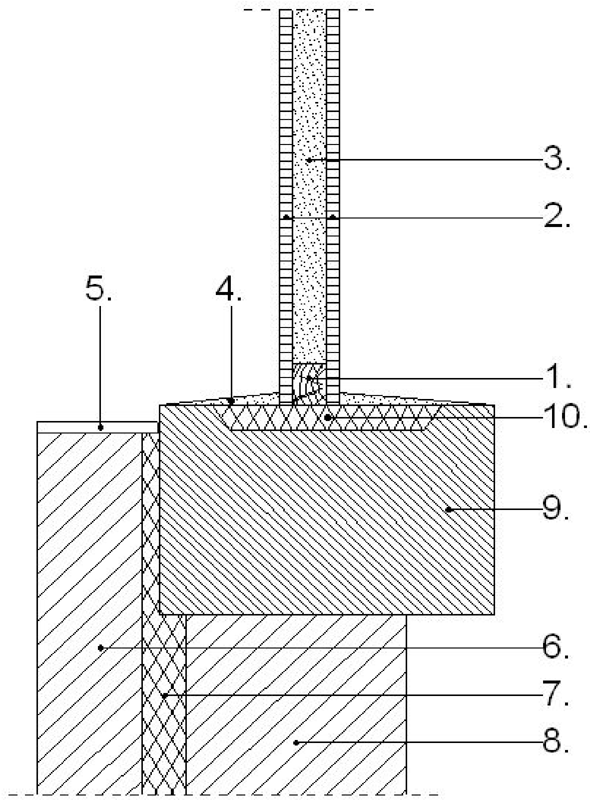

Figure 4. Laboratory test arrangement for the sound insulation of window model with reveal blocks

II. The airborne sound insulation of the "window model" is measured in the standardized test arrangement, shown in Fig 3., where 6, and 8 are dense wall layers, 7 is the airgap between the wall layers, 4 is a mortar covering, 5 is a gypsum plate covering the airgap.

III. The same "window model" is built into the modified test arrangement, where the "window model" is surrounded with reveal blocks, according the use of these building components, see Fig 4. Item 9 is the reveal block, 10 is the hard PS plate, covered by mortar, 4.

IV. Calculating power transmission, addition and subtraction it is possible to calculate the flanking sound propagation, caused by the reveal block, filled with PS plates. The calculation background is the same as for calculation resultant sound reduction index, like in [3].

5 Results, discussion

Figure 5. presents direct test results of measured sound reduction index, related to the same opening for the "window model". The nominal size of the "window model" is 1.2*1.5 m. The numerical data, 56mm and 68 mm means the thickness of the wall model. The expression "standard" in the legend corresponds to the test situation shown in Fig. 3, the expression "with reveal" in the legend corresponds to fig 4. The difference between the standardised arrangement and the one with reveal block is marked with "DR 68 mm standard – reveal".

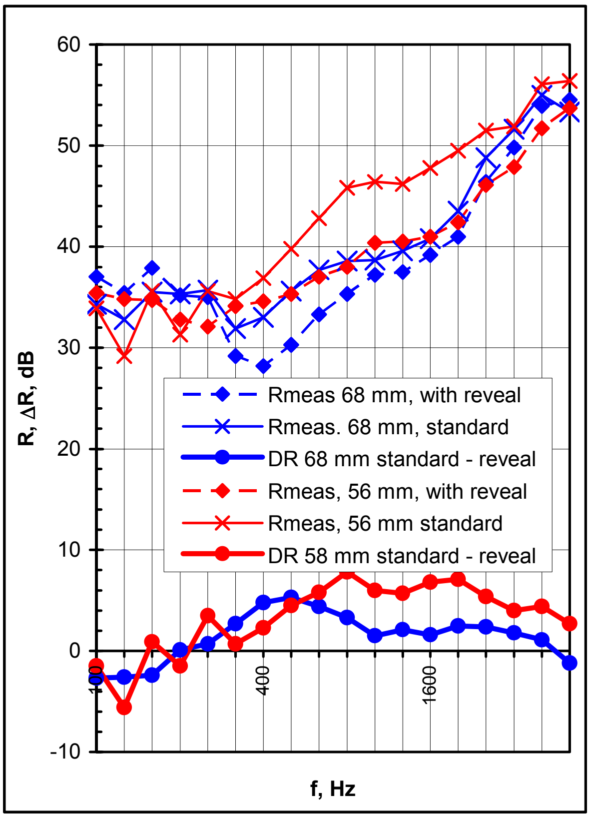

Fig 5. Direct comparison of the measured results

These experiments clearly show the effect of the flanking path, marked with HI in fig. 2. The path HI reduces sound reduction index above 200 Hz. Using the weighted terms, ΔR_w= 3 dB,, $\Delta(R_w+C_{tr})$= 2..4 dB. This effect has importance in noisy external environment, where windows of high sound insulation are required, and where the costs of the windows increase rapidly with increasing sound insulation.

A detailed analyze is presented in Fig 6. of the experiment with the 68 mm thick model. The pink curve is the measured sound reduction index with the model according to fig. 3. related to the total surface of the laboratory wall. The brown curve is the sound reduction index of the lab wall. The light blue line is the calculated sound reduction index of the wall model in standard conditions, without the laboratory effects. Of course in contains the effect of the perimeter around the window model the same way as in case of all the standardized measurements of windows and glasspanes. The green line is the direct sound reduction index of the reveal blocks, according to the real sizes. The blue line with triangles represents the measured results of the situation of Fig. 4. The orange curve is the calculated flanking sound reduction index of the reveal block according to Fig 4., related to the size of the opening.

The calculated results show the sound reduction index caused by the flanking transmission is in the same order as the other components of propagation above 200 Hz. Therefore it is necessary to consider this component too in the prediction procedures.

Qualitatively the same result can be reached repeating the experiment with the 56 mm thick "window model", see Fig. 7.. The legend, the color of the curves correspond to each other.

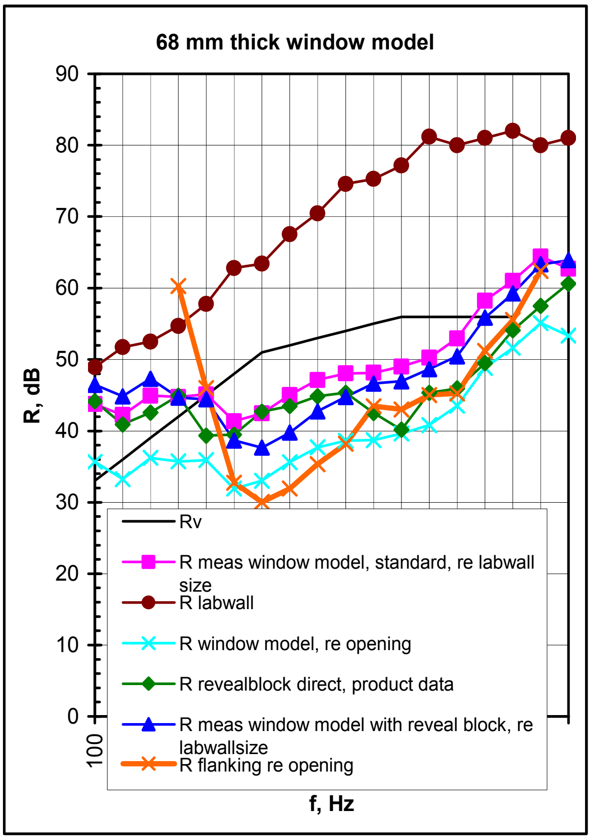

Fig 6. Detailed analyse of the effect of reveal block with a 68 mm "window model"

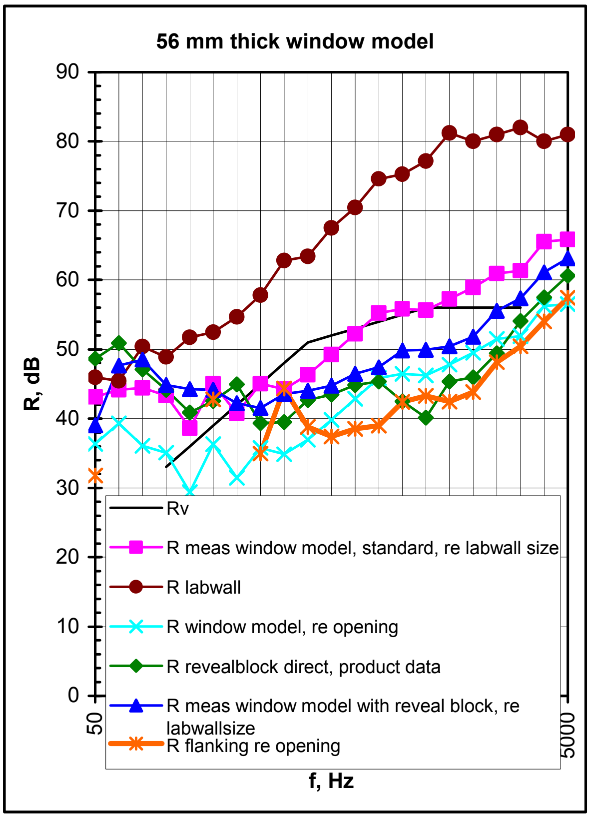

Fig 7. Detailed analyse of the effect of reveal block with a 56 mm "window model"

6 Use of the data in prediction

To make use of the laboratory results possible in the standardised prediction procedure it is necessary to make two conversions of the measured data.

The calculated data of flanking sound reduction index of path HI in Fig. 2. are related to the nominal size of the opening. It can be recommended to transfer the measured data to a nominal size of 10 m^2.

The amount of transmitted sound power through the flanking path depends on the length of the reveal blocks (in the actual experiment it is 1.5 m + 2*1.2 m). It could be useful to convert the measured data to a nominal length, L_0.

As a result the product data of the reveal blocks, D_{nrev} can be calculated from the measured data, $R_{revmeas}$, according to the equation below. S_{meas} is the size of the test opening, L_{meas} is the length of the reveal blocks in the tests.

$$D_{nrev} = R_{revmeas} + 10 * lg\left(\frac{10}{S_{meas}} * \frac{L_{meas}}{L_0}\right)$$

A conversion in the opposite direction is necessary to use product data D_{nrev} in prediction with real sizes (nominal surfaces of windows, and length of the reveal blocks).

7 Proposals for the further work

There are more possibilities of the technical realization of junctions containing reveal blocks. At the lower horizontal edge there is for eg. the sill and the stool. This part is always different from the junctions at the vertical edges. It is necessary therefore to collect further data on the effect of the technical realization of the junctions.

Acknowledgments

The paper summarizes the results of a part of a complex research project, sponsored by Wienerberger, Hungary. The results will be introduced to the technical information, to increase accuracy of prediction.

References

[1] Reis, F.: Product standards - measuring standards – prediction standards. Proc. of 19th ICA, 2007, Madrid

[2] EN ISO 140-3:1998

[3] EN 12354-3:2000