Airborne sound isolation homework

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Lercari Mattia 10751919, Lampis Alessio 10743504

Room Acoustics - Music and Acoustic Engineering -Politecnico di Milano

1 Calculate the sound reduction index of each components

1.1 Facades

The material that has been chosen to design facades of the room under study is lightweight concrete. Walls have thickness of 300 mm and its sound reduction indexes (dB) are shown in following table.

63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
37	37	42	51	58	58	58

Since they are evaluated in octave bands, it is needed to interpolate linearly values in third octave bands so that can be used in Excel file we reference. Linear interpolation is calculated using

$$R_f = R_{f1} + \frac{f - f_1}{f_2 - f_1}(R_{f2} - R_{f2}). \qquad f_1 < f < f_2 \tag{1}$$

where $R_{fi} = R(f_i)$ indexes are refered to frequencies in third octave bands. The result can be found in "facade wall" sheet. Moreover, its areic mass is $m' = 390\ Kg/m^2$. From the table, as well as from the Excel computations, the weighted sound reduction index is $R_w = 54$ and correction coefficients C and C_{tr} are -2 and -6, respectively.

1.2 Windows

Sound reduction indexes of windows come from a scientific paper [**?**].The measurements of the experimental study were done in one third octave bands from 100 Hz to 5000 Hz according to LST EN ISO 10140 series standards. Measurements results were evaluated according to LST EN ISO 717-1 standard. The glass we chose it is named WOG2/1 in the paper, it is made of two layers of ordinary glass (4 mm and 6 mm) with a 18 mm of argon gas in between. Since the paper doesn't provide any information about material density, we used a common value of soda lime glass density, $\rho = 2530\ Kg/m^3$. The corresponding areic mass is $m' = 25.3\ Kg/m^3$. In following figure it is shown sound reduction indexes for WOG2/1. Here R_w evaluated in the Excel and the one which can

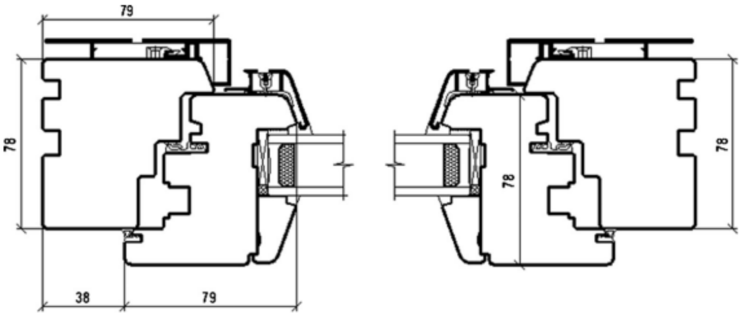
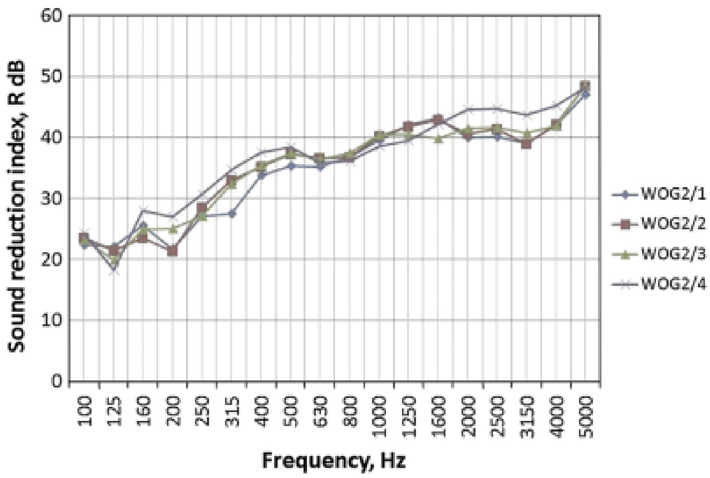


Figure 1: Horizontal cross section of tested window

be found in the paper are coincident, while coefficients C and C_{tr} are -2 and -6 in our computation but -1 and -5 according to the cited study.



1.3 Floor and ceiling

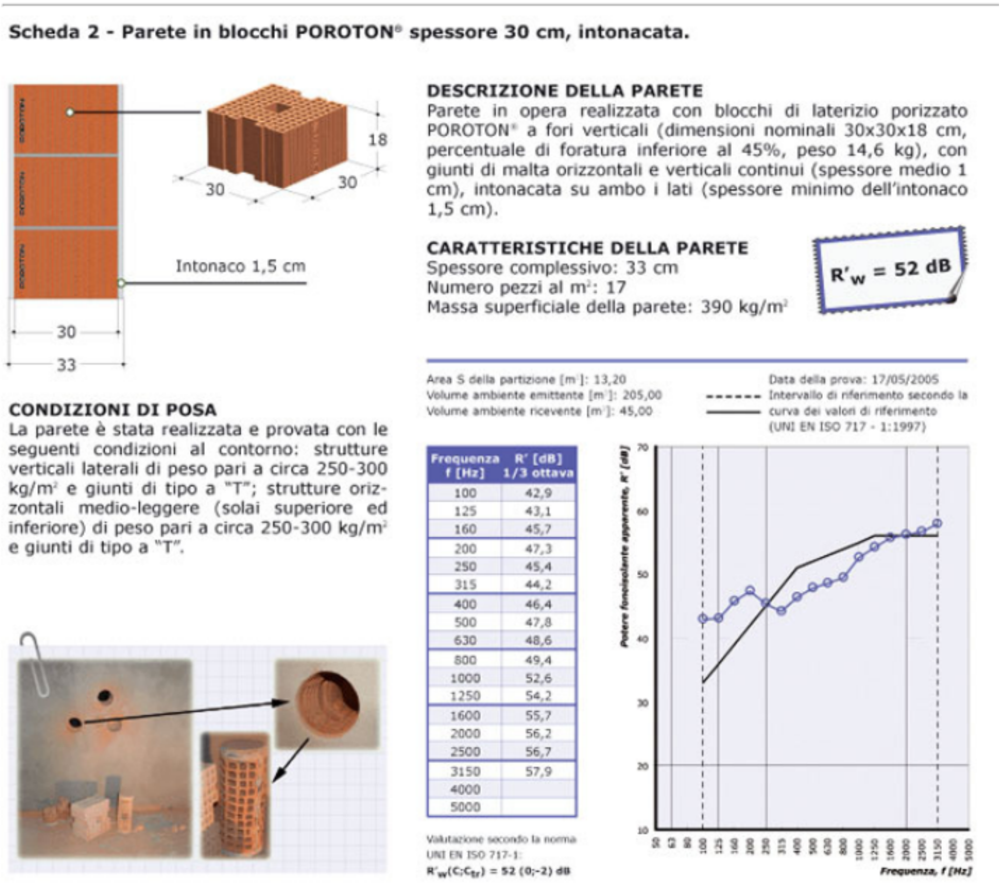
From table of material we chose 240 mm of Ca-Si blocks as construction which has a remarkable areic mass (420 Kg/m^2) and no linear interpolation was computed because "floor" and "ceiling" sheets in our Excel are based on one octave bands subdivision. Reduction indexes are

63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
38	38	46	54	62	68	68

The weighted value given by table is 56 while it is 57 in the Excel, as well as correction coefficients are $-1, -6$ in the table while $-2, -7$ in the sheets.

1.4 Internal walls

From the catalogue of an italian company called FOROSON we found results of measurement realized on their bricks. It has been taken a FOROSON brick with plaster and a total thickness of 33 cm. Isolation properties were studied according to UNI EN ISO 140-4, R'_w has been calculated following the UNI EN ISO 717-1 and since we used the same standards, our indexes are the same of the catalogue (see figure 2).


Scheda 2 - Parete in blocchi POROTON® spessore 30 cm, intonacata.

DESCRIZIONE DELLA PARETE
Parete in opera realizzata con blocchi di laterizio porizzato POROTON® a fori verticali (dimensioni nominali 30x30x18 cm, percentuale di foratura inferiore al 45%, peso 14,6 kg), con giunti di malta orizzontali e verticali continui (spessore medio 1 cm), intonacata su ambo i lati (spessore minimo dell'intonaco 1,5 cm).

CARATTERISTICHE DELLA PARETE
Spessore complessivo: 33 cm
Numero pezzi al m²: 17
Massa superficiale della parete: 390 kg/m²

R'w = 52 dB

CONDIZIONI DI POSA
La parete è stata realizzata e provata con le seguenti condizioni al contorno: strutture verticali laterali di peso pari a circa 250-300 kg/m² e giunti di tipo a "T"; strutture orizzontali medio-leggere (solai superiore ed inferiore) di peso pari a circa 250-300 kg/m² e giunti di tipo a "T".

Area S della partizione [m²]: 13,20
Volume ambiente emittente [m³]: 205,00
Volume ambiente ricevente [m³]: 45,00

Data della prova: 17/05/2005

Frequenza f [Hz]	R' [dB] 1/3 ottava
100	42,9
125	43,1
160	45,7
200	47,3
250	45,4
315	44,2
400	46,4
500	47,8
630	48,6
800	49,4
1000	52,6
1250	54,2
1600	55,7
2000	56,2
2500	56,7
3150	57,9
4000	
5000	

Valutazione secondo la norma UNI EN ISO 717-1:
R'w(C;Ctr) = 52 (0;-2) dB

Figure 2: Poroton results on plastered brick wall

1.4.1 Door

Since we wanted to have a wooden door but keep an high sound reduction index compared to the second homework, we decided to use one of the most heavy wood, the ITIS (Prosopis kuntzei). "This small South American tree could be considered a super-mesquite. Related to mesquite, it's very dark, very dense, and very hard; a good substitute for ebony" [?]. Its density is $1275Kg/m^3$ and we designed two layers of *1cm* of wood and a *4cm* of rockwool in between. Having these parameters and assuming a diffusive sound propagation through the door, we applied the mass law and obtained $R'_w = 40dB(-4, -12)$.

2 Verify the passive acoustic requirements of buildings

In the Excel, section "data", are resumed sound absorption of each component between room A and room B given by direct and flanking contributions. In section "joints" are computed vibration reduction index for each junction. The main result is the total weighted sound reduction index between room that is $50,29$ dB, above the legal threshold of 50 dB (D.P.C.M 5-12-1997) as well as the facade sound reduction index, which is 53.3 dB.