ACOUSTIC PLANNING EXPERIMENT AND FINAL VERIFICATION OF ACOUSTIC REQUIREMENTS, IN RESTORED OLD COUNTRY BUILDINGS NEAR PORDENONE

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Introduction

The subject of this report is the acoustic planning and final on-site verification, about the acoustic requirements of a group of old country buildings near Pordenone (Marignana, Sesto al Reghena).

The houses were built since early XVI century.

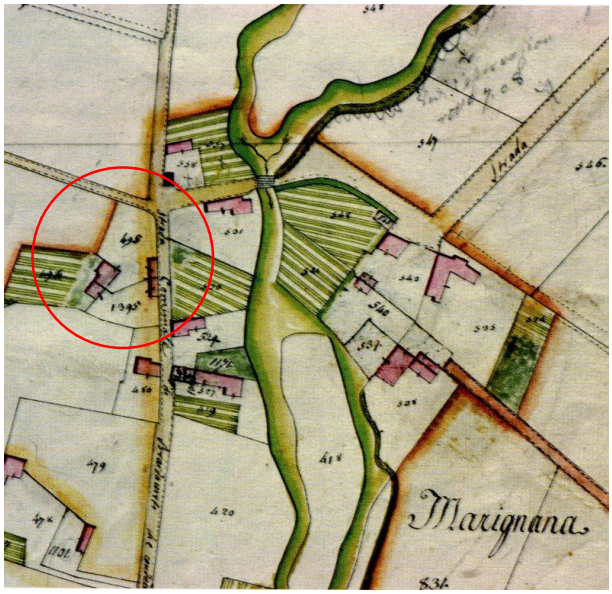

Figure 1: Marignana, Catasto Lombardo Veneto (1830-1847).

The buildings, recently restored by ATER - Pordenone (Azienda Territoriale per l'Edilizia Residenziale della Provincia di Pordenone), were transformed into sixteen dwellings and individual carports [1].

Figure 2: court yard view.

Figure 3: court yard view.

Design simulations.

Design simulations were performed in December 2008, according to the regional law (Legge Regionale Friuli–Venezia Giulia 18/06/2007 nr. 16), basing on technical design approach, described in UNI EN ISO 12354, parts I – II – III.

The software used for the simulations was Microbel Sonido Pro v. 1.4.

According to the different periods in which each building was built, the horizontal and vertical partitions are quite different: as a consequence, starting from different restore construction solutions, the design acoustic performances are not the same.

The simulation was performed, using the simplified method introduced by ISO 12354, about the following single number indexes:

- R'_w Apparent Sound Reduction Index (walls and floors), according to ISO 140-4
- L'_{nw} Normalized Impact Sound Pressure Level (floors), according to ISO 140-7
- D_{2mnTw} Standardized Sound level difference (façades), according to ISO 140-5

In the following three tables we can see the various predicted values of the single number indexes.

Partition between dwellings / Building A		**Partition type**	***R'w* dB**
Unit # 3 diningroom	Unit # 4 diningroom	vertical 4	**51.6**
Partition between dwellings / Buildings C-D-E		**Partition type**	***R'w* dB**
Unit # 5 bedroom 2	Unit # 6 bedroom 2	vertical 7c	**52.5**
Unit # 2 bedroom 3	Unit #3 kitchen 1	vertical 7g	**50.8**
Unit #2 bedroom 3	Unit #3 dining-room 1	vertical 7c	**51.6**

Table 1: R'_w predicted values

Partition between dwellings Building A		**Partition type**	***L'nw* dB**
Unit # 6 dining-room	Unit # 4 dining-room	horizontal B5 wood	**59**
Buildings C-D-E			
Unit # 4 dining-room	Unit # 5 dining-room	horizontal	**49**
Unit # 4 bedroom 2	Unit # 5 bedroom 2	horizontal	**50**

Table 2: L'_{nw} predicted values

Façade	**Windows / doors**	***Rw glass dB***	***D2m,nT,w dB***
Bldg. A unit 6 dining-room	2x840x1400 - 33.1/12/4	*37*	***41.1***
Bldg. C-D-E unit 5 dining-room	900 x 2000 (door)+ 900 x 1950 - 33.1/12/4	*37*	***42.2***
Bldg. C-D-E unit 3 bedroom 4	2x800x1320 - 33.1/12/4	*37*	***41.7***
Bldg. C-D-E unit 3 dining-room	3x800x1320 - 33.1/12/4	*37*	***44.1***
Bldg. C-D-E unit 10 bedroom 3	Roof window 880x1000 33.1/12/4	*37*	***42.5***

Table 3: $D_{2m,nT,w}$ predicted values

About the mechanical noise, i.e. the noise produced by water closet flush, a simple list of technical recommendations were indicated into the acoustical design, instead of previsional calculations, due to its difficulty.

On-site final measurements.

The final measurements, performed in August 2012, were made according to national law, D.P.C.M. 05/12/1997 (obligatory since February 1998), and verified the design predictions.

However, the final results were very good (see table 4).

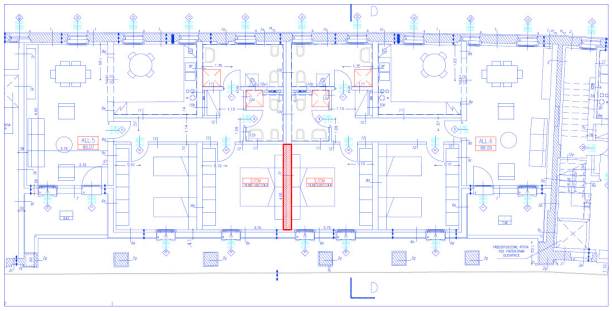

Figure 4: Example plan view with tested partition in red.

Figure 4: outside view.

Every single number index value, among thirteen measurements, is in compliance with the values recommended by the D.P.C.M. 05/12/1997.

Building Element	Bldg	AMBIENTE SORGENTE	AMBIENTE RICEVENTE	Single number index	Field measured values dB
Floor	C	Dining room 1-3 (A3)	Dining room 1-1 (A1)	L'_{nw}	50
Floor		bedroom 1-3 (A3)	bedroom 1-1 (A1)	L'_{nw}	39
Floor		Dining room 1-3 (A3)	Dining room 1-1 (A1)	R'_w	65
Floor		bedroom 1-3 (A3)	bedroom 1-1 (A1)	R'_w	65
Wall		Dining room 1-3 (A3)	bedroom 1-2 (A2)	R'_w	60
Façade		Exterior	bedroom 1-2 (A2)	$D_{2m,nT,w}$	45
Wall	D	bedroom 1-6 (A6)	bedroom 1-5 (A5)	R'_w	62
Façade		Exterior	bedroom 1-5 (A5)	$D_{2m,nT,w}$	45
Floor	A	Dining room 1-14 (A6)	Dining room 1-12 (A4)	L'_{nw}	55
Floor		bedroom 1-14 (A6)	bedroom 1-12 (A4)	L'_{nw}	55
Floor		Dining room 1-14 (A6)	Dining room 1-12 (A4)	R'_w	55
Wall		Dining room 1-14 (A6)	Dining room 1-15 (A5)	R'_w	55
Façade		Exterior	Dining room 1-16 (A2)	$D_{2m,nT,w}$	44

Table 4: Field (on site) results.

A comparison was made between the design simulations of the single-number indexes (R'w, L'nw, D2m,nT,w) referred to various partitions of the buildings, and the corresponding values, determined by means of final on-site measurements.

That comparison between designed (simulation) and field (on site) values of the indexes is shown in the following table.

Single number index	Building type / Element	Values	
		Designed (dB)	**Field (dB)**
R'_w	A / Wall	**51.6**	**55**
R'_w	D / Wall	**52.5**	**62**
R'_w	C / Wall	**51.6**	**60**
R'_w	C / Floor	**-**	**65**
R'_w	C / Floor	**-**	**65**
R'_w	C / Floor	**-**	**55**
L'_{nw}	C / Floor	**50**	**50**
L'_{nw}	C/ Floor	**49**	**39**
L'_{nw}	A / Floor	**59**	**55**
L'_{nw}	A / Floor	**-**	**55**
D_{2mnTw}	D-Façade	**44**	**45**
D_{2mnTw}	C-Façade	**42.5**	**45**
D_{2mnTw}	A-Façade	**41**	**44**

Table 5: Comparison between designed and field values.

All the measured on-site values are better than the designed ones, expecially about R'_w (apparent sound reduction index, according to ISO 140-4), referring to walls.

Figure 5: interior view.

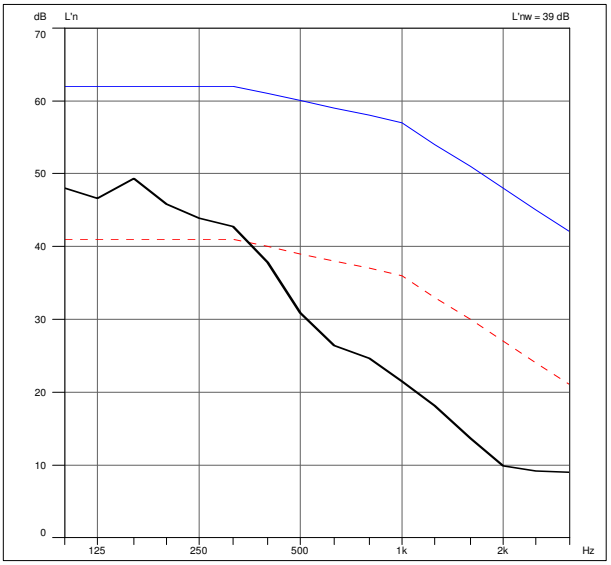

Figure 6: L'_n measure and reference curves.

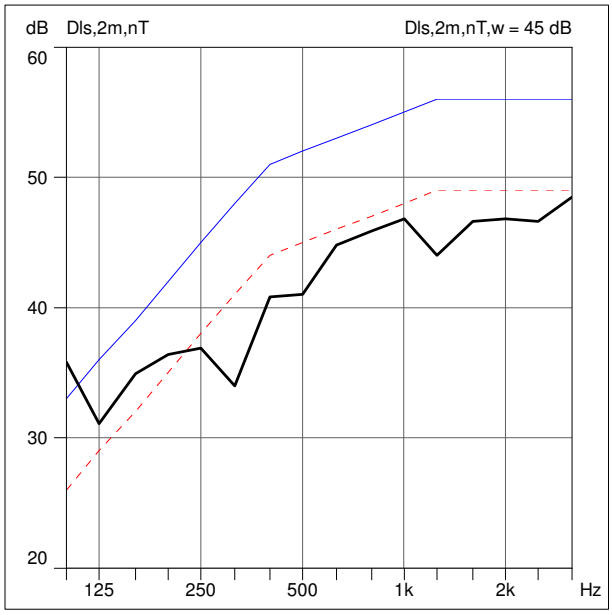

Figure 7: $D_{2m,nT}$ measure and reference curves.

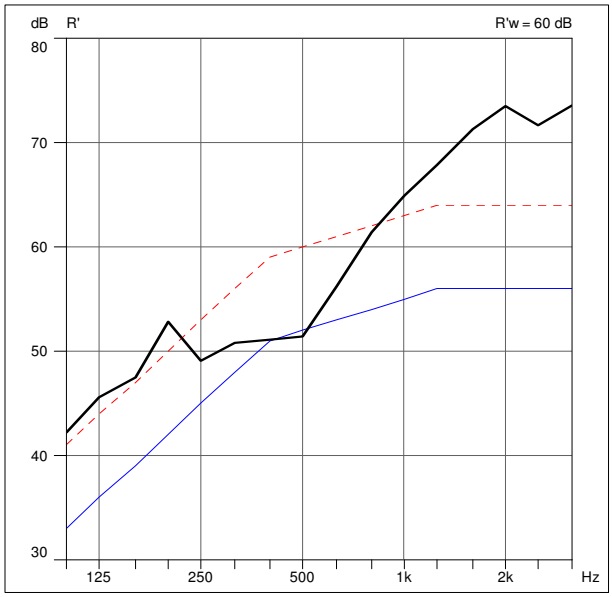

Figure 8: R' measure and reference curves.

The complete design report, with prediction simulations, and final on-site one, with field measurements, are both available on the author's web site:

http://www.ingdinoabateacustica.eu

References.

[1] ATER – PN: Progetto e Restauro / Residenza pubblica e recupero di un Complesso Agricolo a Marignana di Sesto al Reghena, 2012, Futura Cooperativa Sociale ONLUS, www.futuracoopsociale.it

[2] Legge Regionale F.V.G. 18/06/2007 n. 16, published in B.U.R. Friuli Venezia Giulia n. 26 - 27/06/2007

[3] D.P.C.M. 05/12/1997 "Determinazione dei Requisiti Acustici Passivi degli Edifici", published in G.U. n° 297 – 22/12/1997