# MyRoom Design

-white paper-

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First of all, I would like to begin by saying that our work originated through the application of common engineering practice.

Eventually in our practice, and somewhat unexpectedly, we found ourselves faced with the predicament of how to acoustically treat a very small control room. The room was:

- 3.25m wide,
- 7.05m long, and
- 3.32m high.

There was no possibility of physically altering the space to make it larger, but it was necessary to provide stereo and surround monitoring.

# This is our solution to such a problem:

**Figure 1. – RES Media Studio , designed by MyRoom principles.**

**Figure 2 – RES Media Studio, designed by MyRoom principles. View from back perspective, surround monitoring system.**

**Figure 3 – RES Media Recording room, designed by MyRoom principles too.**

# Let us go back to the beginning.

We analysed existing acoustical designs such as:
LEDE, Non-Environment, RFZ, ESS, George Massenburg's Blackbird studio, and not one was suitable for the problem at hand.
Completely different acoustic treatment in the front and rear walls was a feature of the majority of designs examined, and appeared to be fuelled by the justification that a room with optimal stereo listening is good for surround monitoring.
With Blackbird studio this was not the case, as it is indeed homogenous, but the treatment principle applied was unsuitable for smaller control rooms.

# First, frequency regions of treatment must be defined

We created two conditions on which our solution, which we called MyRoom Design, is based upon, namely: the diffusion principle, the absorption principle and homogenous distribution of both of them to all reflection surfaces except the floor.

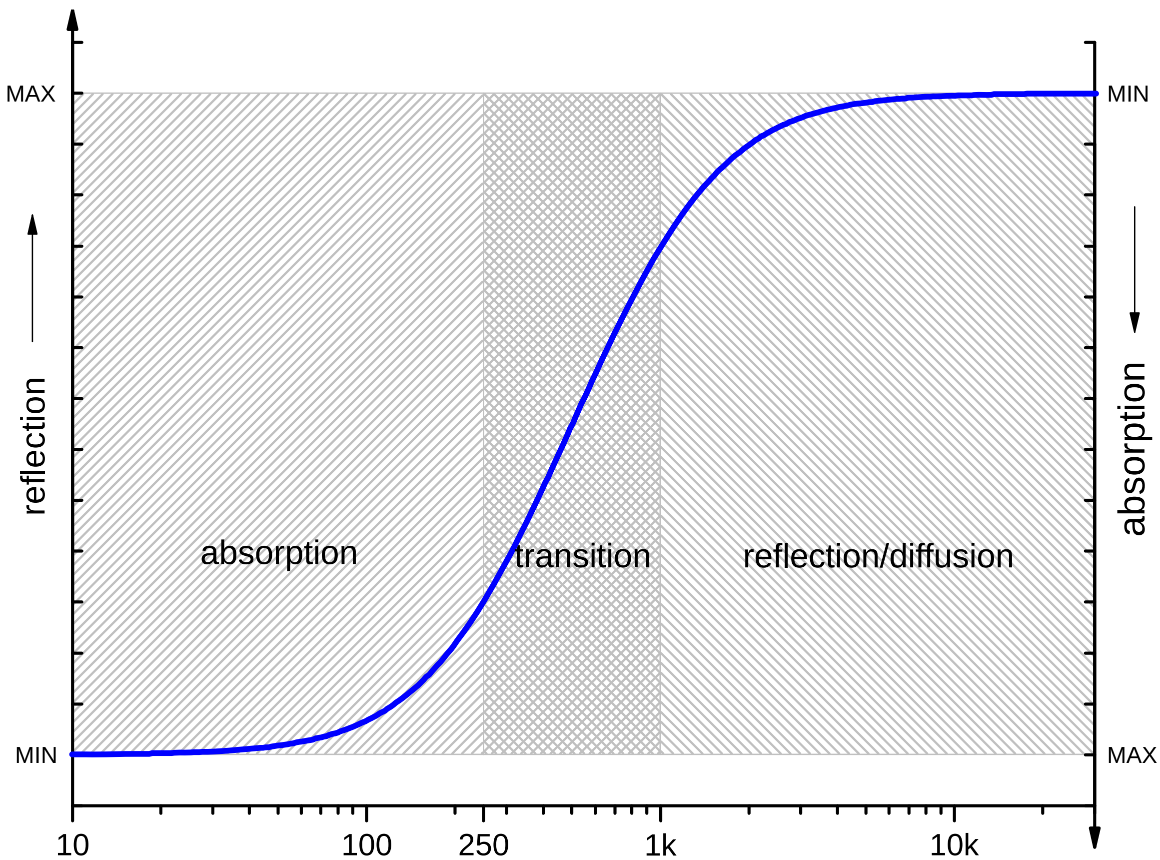

**Figure 4 - Graphical illustration of MyRoom wall/ceiling traitment initial design conditions.**

**Diffusion principle:**
The basic condition in our MyRoom approach to control room design is homogenous diffusion on all of the surfaces except the floor, for the frequencies above approximately 1 kHz. The reason for this is the fact that in small rooms, all surfaces are too near to the listener and the diffusers must be at least three times their lowest designed wavelength away from listener. It should be kept in mind that the depth of

the diffuser is always at the expense of the absorption thickness, and as such, some kind of a compromise is essential.

**Absorption principle:**

The second condition was for MyRoom treatment to provide maximum possible absorption of frequencies below 250 Hz, homogenously on all the surfaces, except the floor. Without that condition, the effect of the diffuse field would not be satisfactory, because the strong room modes would acoustically mask them.

# Second, air-transparent diffuser:

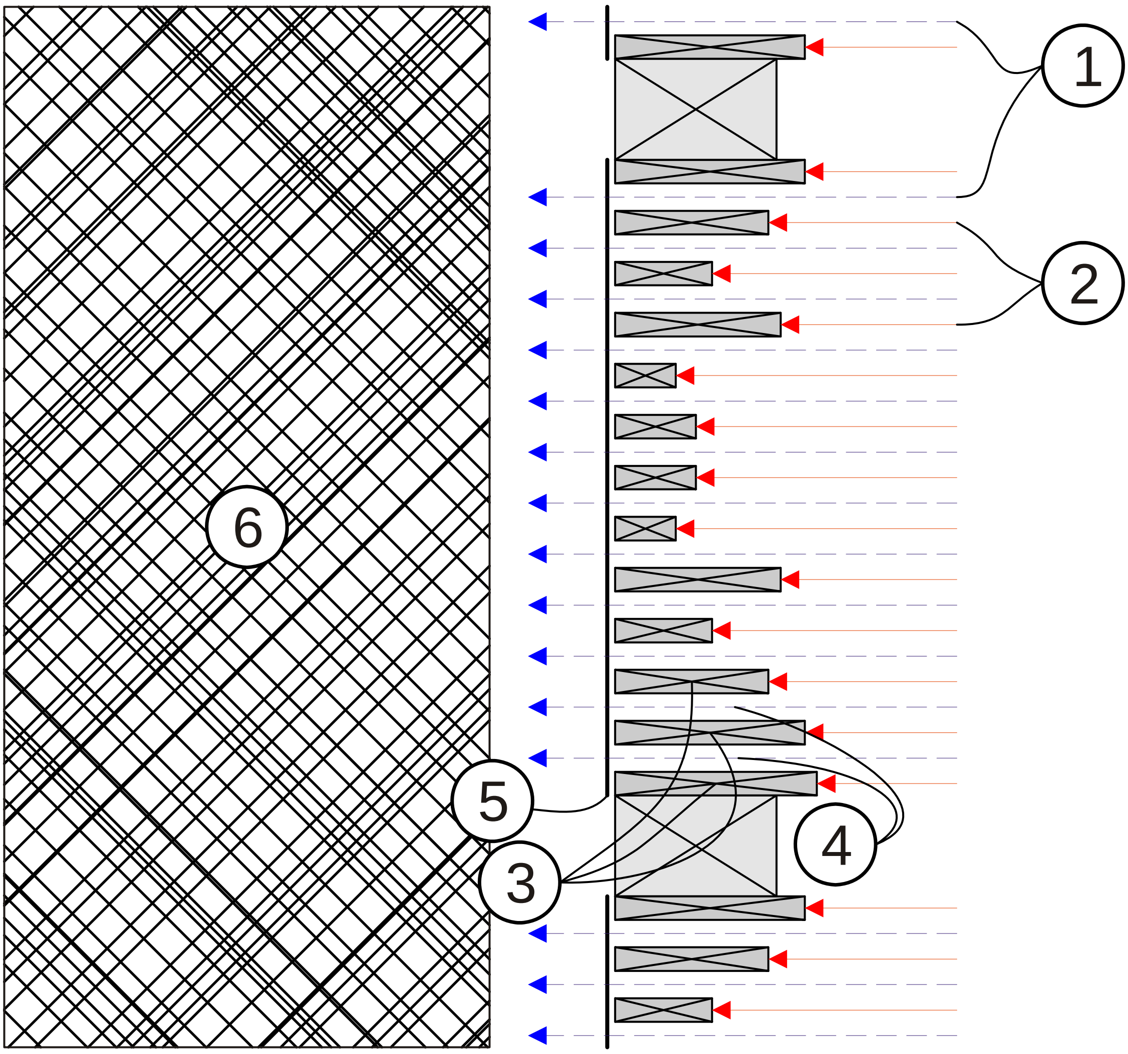


**Figure 5 - Side wall applied MyRoom treatment principle, horizontal cross-section, (top view): 1. air which passes through (absorbed/diffused), 2. Air which cannot pass through (reflected/diffused), 3. Diffuser slats, 4. “Through hole” wells, 5. air transparent fabric, 6. Wideband absorber.**

Looking at the image you can see how the MyRoom Design approach is achieved.
The diffuser is made of slats, wells, (marked as 3.) with openings for air flow. Slat depth is calculated by using Schroeder’s formula.
Only wells without fins were used, there are no solid spacers between the wells (marked as 4.). The divider between the wells is the only air.
Part of the sound wave is reflected and / or diffused, while the other part passes through the diffuser, and is further absorbed, in smaller or larger quantities, through the wideband absorber.
For implementing more than one of the same kind of diffusers on surfaces in RES Media Studio, we used a Maximum Length Sequence (MLS), a pseudorandom sequence, to determine each diffuser element orientation and avoid aliasing of the diffuse sound field.

# Nominal Reverberation Time

If we use the equation for the nominal value RT60 (Reverberation time), for the control room, we get (in our instance) 0.183s.
The Recommended value for RT60, Tm, is calculated from:

$$Tm = 0.25\text{s} \cdot \sqrt[3]{\frac{V}{100\text{m}^3}}$$

Where, V is the leftover volume of the room in m³.

| Name | Basic ($m^3$) | Spent on treatment | $T_m$ [s] |
|---|---|---|---|
| RES Media | 76.00 | 37.23$m^3$ (49%) | 0.183 |
| Pressed Lizard | 33.30 | 19.40$m^3$ (58%) | 0.130 |

Table 1 - Room volume before and after treatment.

The red, broken line shows the AES recommended limits for RT60. As you can see, all 5 speakers satisfy the AES recommendations.

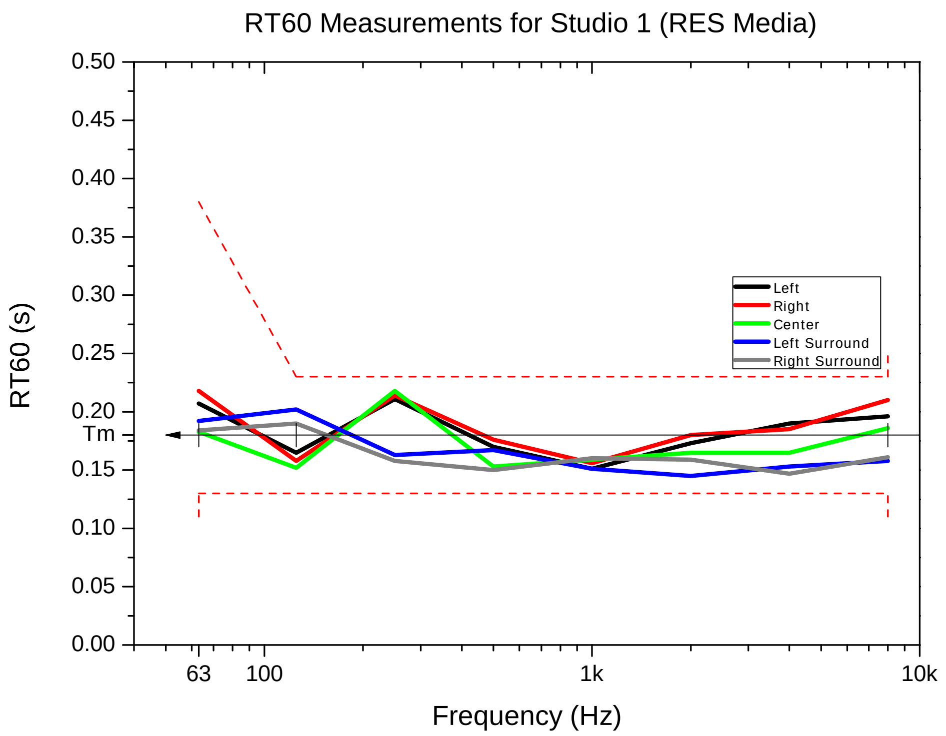


Figure 6- RT60 Frequency dependence for the control room in the RES Media Studio , with AES limitations. Graph shows the response of all five speakers.

# Energy Time Curve

Energy Time Curve for RES Media Control Room measurements show that the response is similar to Massenburg's Blackbird Studio C Control Room, with the difference being where decay starts from around 20dB and not from 30dB as is the case there. The difference of 10dB can be explained by the different level of absorption and the fact that, in our case, the diffusers are closer to the listening spot, since the room base is smaller.

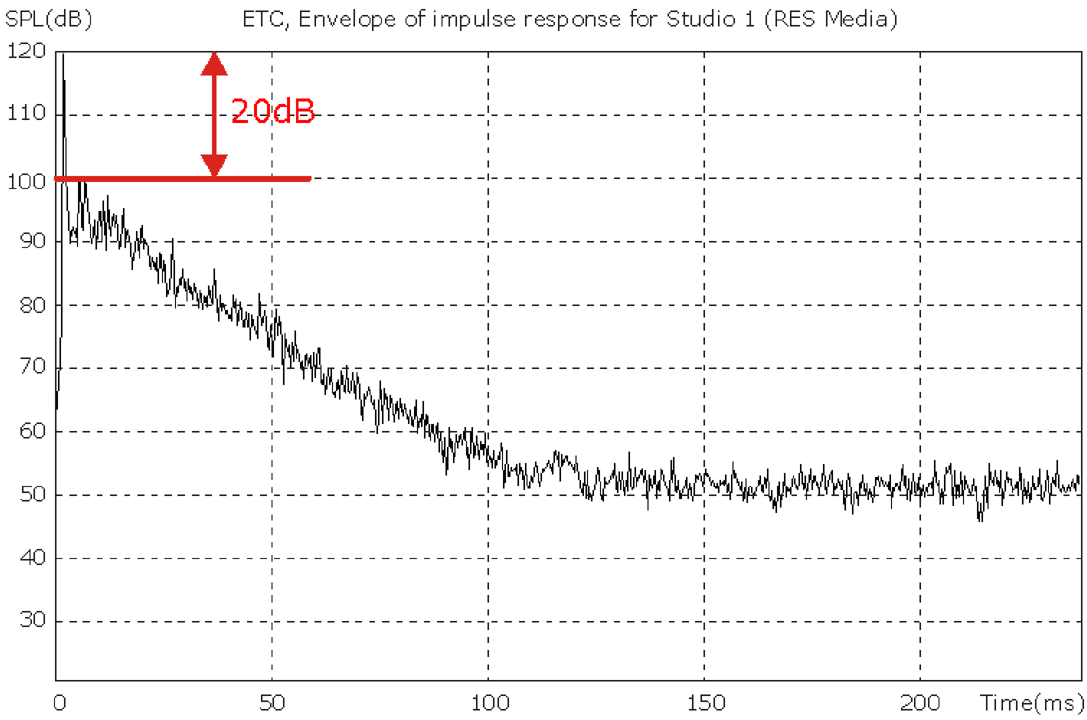


**Figure 7 – Envelope of impulse response for RES Media Control Room. Similraties with Blackbird Studio C are obvious, only attenuation of first reflections isn't 30dB.**

# Frequency response

The red broken lines represent the AES recommended limits for room frequency response.

The deviation of frequency response from the AES recommended criteria can be seen in certain frequency ranges below 100 Hz for front speakers is a consequence of the lack of space and the possibility to optimally position all five surround speakers in such a space. Also, the Control Room has a starting problem of one of its cross sections being almost square-shaped.

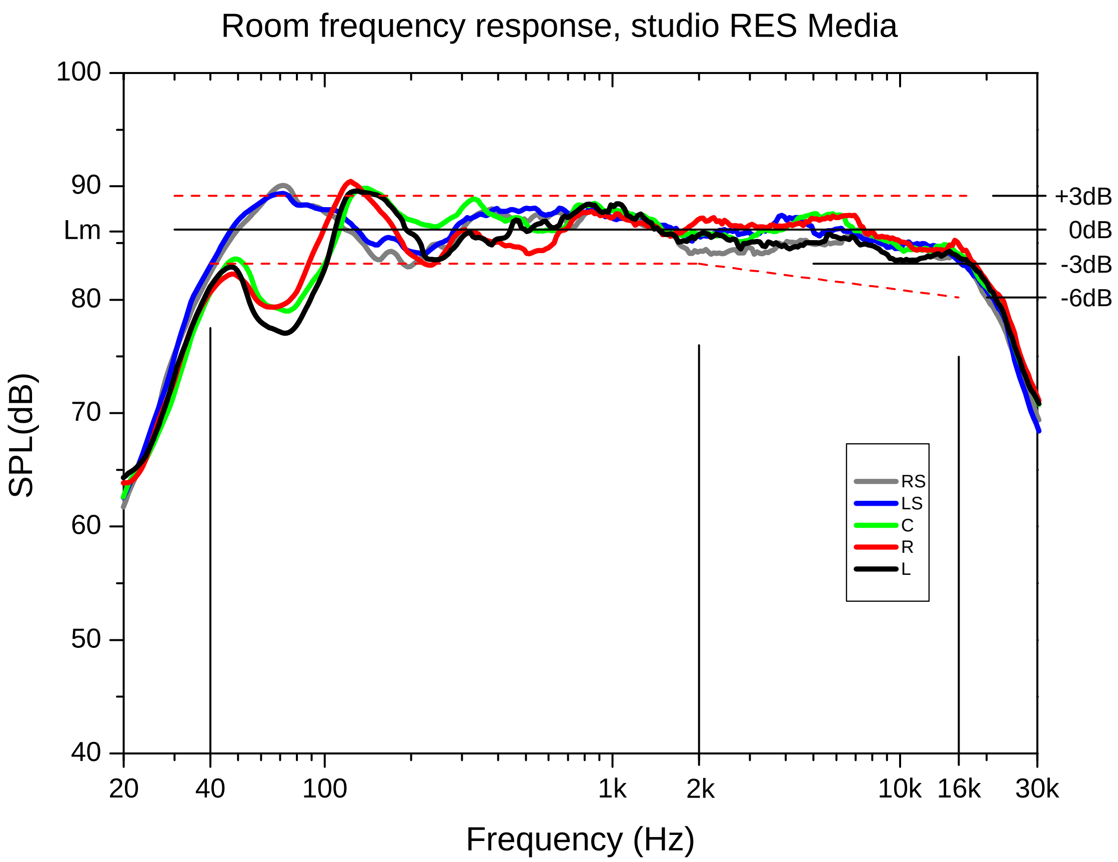


**Figure 8 - Acoustical frequency response of the surround control room in the RES Media Control Room along with the limits defined in AES recommendations. Graph shows the response of all five speakers.**

# Pressed Lizard, a smaller, stereo only control room

Pressed Lizard was second Control Room that we designed with same principle, and this room is even smaller than the first. Dimensions are width=3.56m, length=3.67m and height = 2.55m. There are a full range stereo monitors.

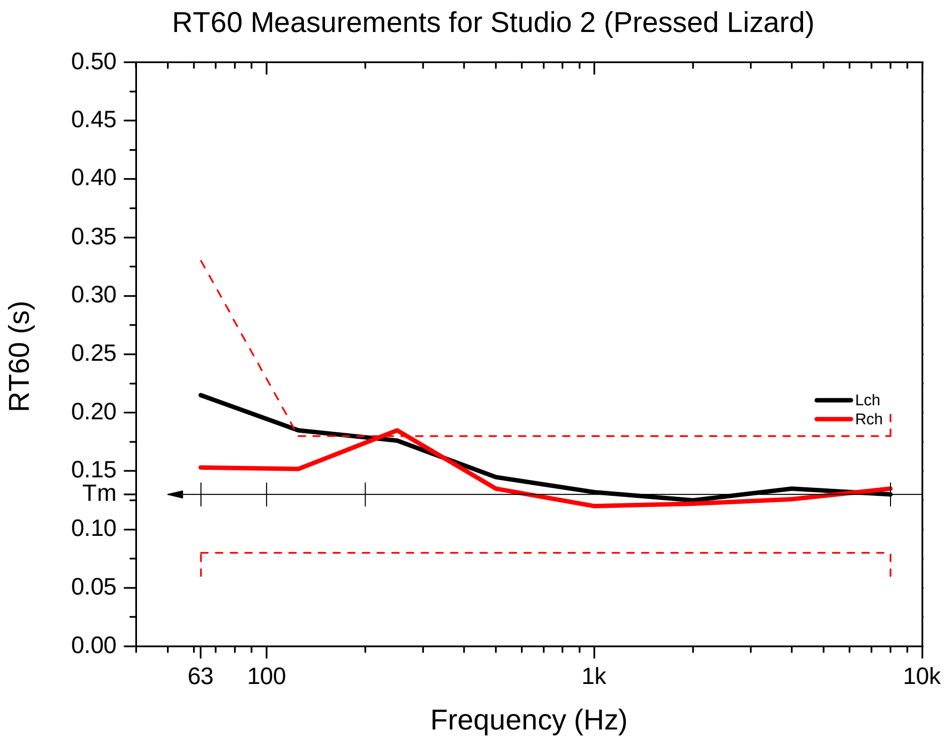


**Figure 9 - RT60 Frequency dependence for the control room in the Pressed Lizard Control Room, with included AES limitations.**

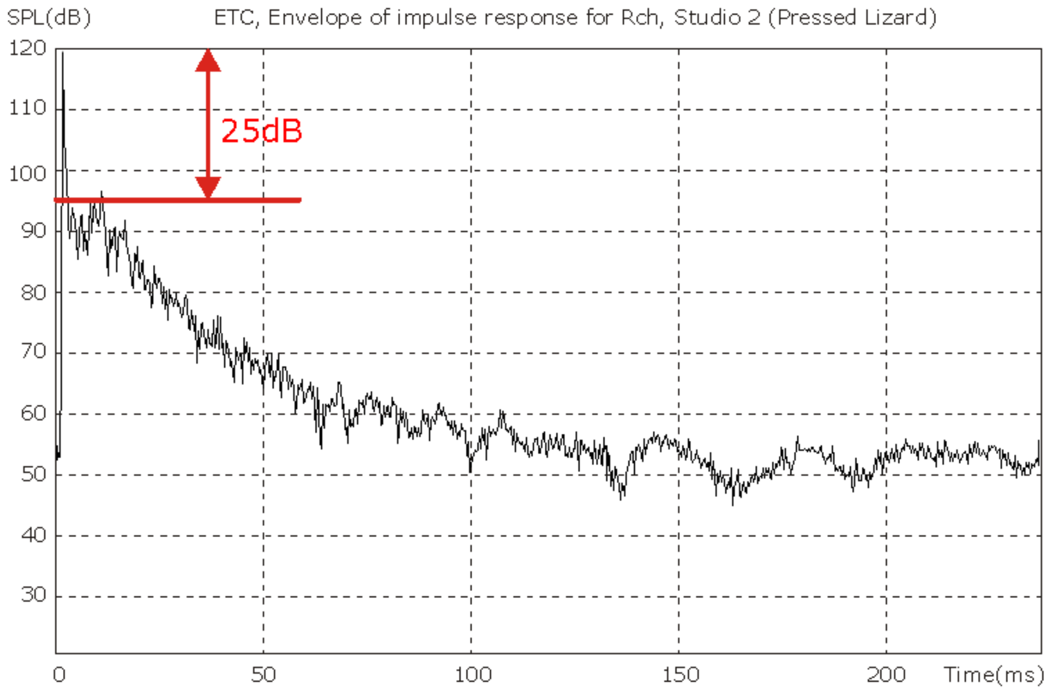


**Figure 10 - Envelope of impulse response for left channel in the Pressed Lizard Control Room. This is a second Control Room designed, much smaller, and ETC response is different.**

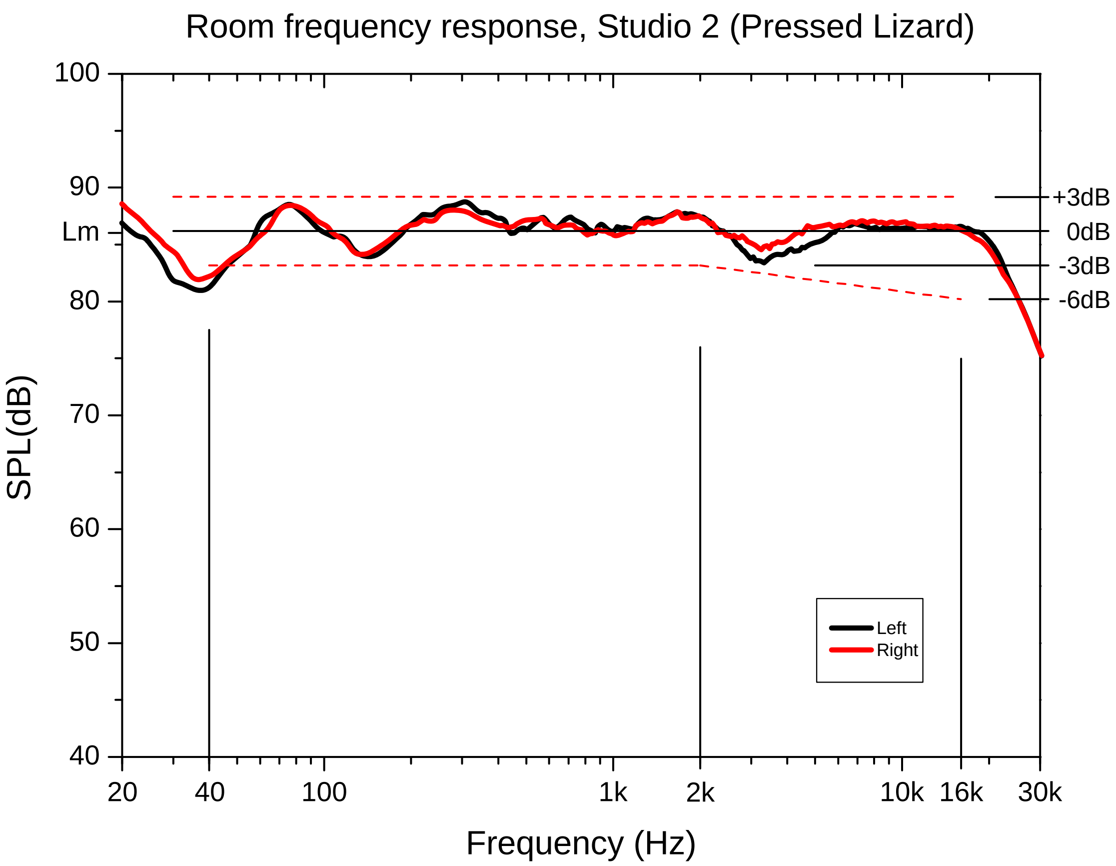


**Figure 11 - Acoustical frequency response of the control room in the Pressed Lizard Control Room with AES limits shown.**

# Subjective impressions of couple of professional mixing engineers were as follows:

- Reproduction is much more realistic and closer to the natural source compared to the conventional acoustical design.
- A sense of extremely flat room frequency response.
- Feeling that the low frequency is evenly distributed throughout the room, not independent of the listening position.
- Wider, deeper, and more detailed stereo image.
- A large level of detail at low SPL
- Excellent mix translation.
- The time required to adjust to the room is very short. Listeners perceive the space as being acoustically larger than it physically is.
- Instilled in listeners is a sense that the “walls” are much more neutral and “quiet” than in a traditionally designed room.
- Tangible walls virtually “disappear”.

# Possible solutions of control rooms in free-standing and soffit mounted configurations for loudspeakers for MyRoom Design:

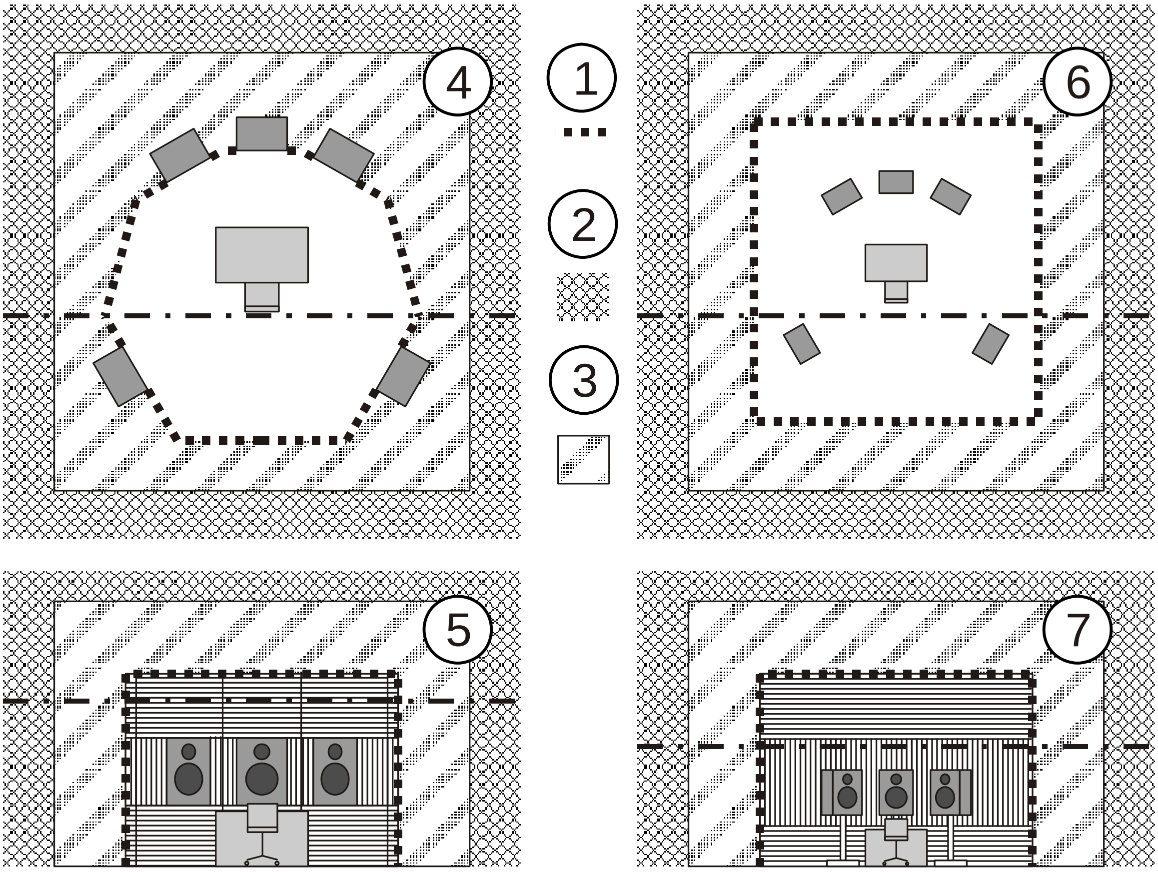


Figure 12 - Some possible ways of MyRoom design: 1(dotted line). air-transparent diffuse surface, 2(hatches). stiff wall, 3(striped area). low frequency absorption, 4. horizontal cross-section of room with soffit monitors, 5. vertical c.s. of room with soffit monitors, 6. horizontal c.s. of room with free-standing monitors, 7. vertical c.s. of room with free-standing monitors.

The top two pictures represent depict a horizontal cross section of each room, whereas the bottom pictures depict the vertical cross section of the rooms.

# Summary

The principle of having all of the surfaces, except the floor, air transparent and diffusive, and good low frequency absorption is definitely the right approach for the rooms in which surround monitoring is expected.
The MyRoom principle can be a better alternative to conventional design for rooms with a volume of 30m3 and more.
The described design principles are tested for stereo and surround monitoring, and are applicable for smaller control rooms as well as for rooms of large volume.

Subjective impressions are very good. Listeners were impressed with the results produced by applying the MyRoom design techniques, and were appreciative of its functionality and value, regardless of their small volume. The ability to overcome issues associated with limitations of physical space becomes particularly important, given that physical spaces are becoming increasingly divided and reduced in modern cities, with large spaces only available at a premium.

Acoustics measurements are more than satisfying, bearing in mind the volume of the space.

There is no limit in size; we see no reason as to why the suggested MyRoom approach would be incompatible with larger rooms (100m3 and more). We can expect that the described design principles will perform even better in larger rooms.

We also concluded that diffuse early reflections in control rooms are extremely important for quality, and more precise (hence more objective) assessment of sound image, and thus faster decision making during the production. This assumes a hypothesis that the presence of diffuse room reflections above 1 kHz causes better mix translation, even during the trial attempts, and also causes less work fatigue and a more relaxed approach to work. Also, the already mentioned phenomenon of the diffusers causing a psychoacoustics feeling of a larger space than it in physical reality is helps to reduce the feeling of discomfort caused by smaller spaces.
By applying MyRoom design to two completely different small rooms, impressive stereo monitoring resulted.
We believe that by using any of the traditional designs, we’d not be able to achieve such stereo imaging, detail level, and mix translation, with rooms with such small volumes, for both stereo and surround monitoring.

# Appendix A

## Change Log

### December 03, 2010

- First Release

### December 05, 2010

- Some photos are changed with better.

### February 25, 2011

- Added our website at front page.

# BIBLIOGRAPHY


[1] B.Petrovic, Z.Davidovic, "Acoustical Design of Control Room for Stereo and Multichannel Production and Reproduction--A Novel Approach", 129th AES Convention, Sun Francisco, 2010.

[2] B.Petrovic, Z.Davidovic, "A new acoustical design of control room for multichannel production and reproduction", 18th TELFOR, Belgrade, 2010.

[3] W. Hoeg, L. Christensen, R. Walker, "Subjective assessment of audio quality– the means and methods within the EBU", EBU Technical Review Winter 1997, pp. 40-43.

[4] "Methods for the subjective assessment of small impairments in audio systems including multichannel sound systems", ITU-R Recommendation BS.1116 (rev. 1), ITU, Geneva, 1997.

[5] Heinrich Kuttruff, "Room Acoustics", Fourth edition, London: Spon Press, 2000. pp. 147-268

[6] "AES recommended practice for professional audio - Subjective evaluation of loudspeakers", AES recommendation 20-1996 (Reaffirmed 2002), New York, 2002.

[7] AES Technical Council, Document AESTD1001.1.01-10, "Multichannel surround sound systems and operations", New York. Available: http://www.aes.org/technical/documents/AESTD1001.pdf

[8] Philip Newell, "A proposal for More Perceptually Uniform Control Room for Stereophonic Music Recording Studios", 103rd AES Convention, New York, 1997.

[9] Mr. Bonzai, "George Massenburg Builds a Blackbird Room", Digizine, Digidesign. Available: http://www2.digidesign.com/digizine/dz_main.cfm?edition_id=101&navid=907

[10] Floyd E. Toole, "Sound Reproduction – Loudspeakers and Rooms", Focal Press, New York, 2008. pp. 298

[11] Trevor J. Cox, Peter D'Antonio, "Acoustics Absorbers and Diffusers", Second edition, Taylor&Francis, New York, 2009. pp. 46.

[12] Manfred R. Schroeder, "Number Theory in Science and Communication", Fifth edition, Springer, Berlin, 2009. pp. 207.

[13] Soledad Torres-Guijarro, Antonio Pena, Norberto Degara-Quintela, "Objective evaluation of a non-environment control room for 5.1 surround listening", 124th AES Convention, Amsterdam, 2008.

[14] Dr. Peter D'Antonio, "iRoom: The Next Generation Critical Listening Room", RPG Diffuser Systems, Inc. 2007. Available: http://www.rpginc.com/news/seminars/Diffuse_Seminar_2007_iRoom.pdf

[15] Jan Voetmann, "50 Years of Sound Control Room Design", 122nd AES Convention, Vienna, 2007.

[16] S.Torres-Guijarro, A.Pena, A.Rodríguez-Molares, N.Degara-Quintela, "Sound field characterisation and absorption measurement of wideband absorbers", 126th AES Convention, Munich, 2009.

[17] H.Olson, "Direct Radiator Loudspeaker Enclosures", JAES Volume 17 Issue 1 pp. 22-29, January 1969

[18] Philip Newell, "Recording Studio Design", Second Edition, Focal Press Oxford, 2008.

[19] Siegfried Linkwitz, http://www.linkwitzlab.com

[20] R. Walker, “Controlled Image Design: The management of stereophonic image quality”, BBC RD 1995/4

[21] A. Parry, “Better by Design – Early Sound Scattering And Control Room Design”, Sound on Sound, January 1997, http://www.soundonsound.com/sos/1997_articles/jan97/controlrooms.html,

[22] A.Baskind and Jean-Dominique Polack, “Sound power radiated by sources in diffuse field”, 128th AES Convention, Paris, 2000.