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in industry

10. – 11. Oktober 2018 10 – 11 October 2018

Sound Environments
Acoustic: how to give a
value to measurements



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**Studies and techniques of
acoustic measurements in
real sound spaces for voice and sound**

**A new and innovative way to “play” combined
audio systems and spaces features using audio
test file – Mynoise.app**

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12Dodicifacce is an **Italian** Acoustic **Engineering** company that develop professional solutions and innovative products

Our passion for music is what drives us
Our fascination with sound is our motivation

Our R&D team, acoustic engineers and production workers have a common goal

They work to make sure the world sounds a little bit better every day



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In some premises, **conditions** are such that a wall-to-wall sound-absorbing ceiling on its own **is not sufficient to create good acoustics**. New findings show that in day-care centres and schools for younger grades, for example, it is **not only important to reduce the reverberation time**, but also to reduce the sound pressure level as a whole. This is better by maximizing the amount of sound-absorbing material, meaning that the walls have to be used as well for sound absorption.

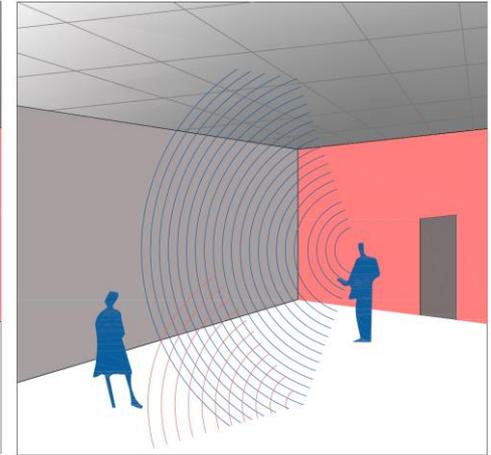
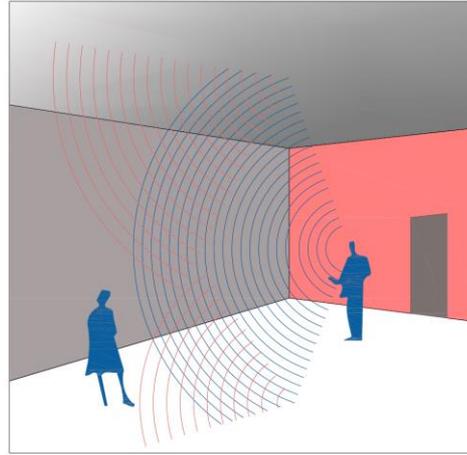
Optimal conditions are achieved by **distributing absorbers on other surfaces in addition to the ceiling**

Another way of installing wall panels is to split them into smaller fields — or even use them singly, scattered over the wall. This can be done in regular or irregular patterns and provide an outlet for all sorts of ideas.

Wall absorbers should be placed at the height of people's ears in both the sitting and standing positions.

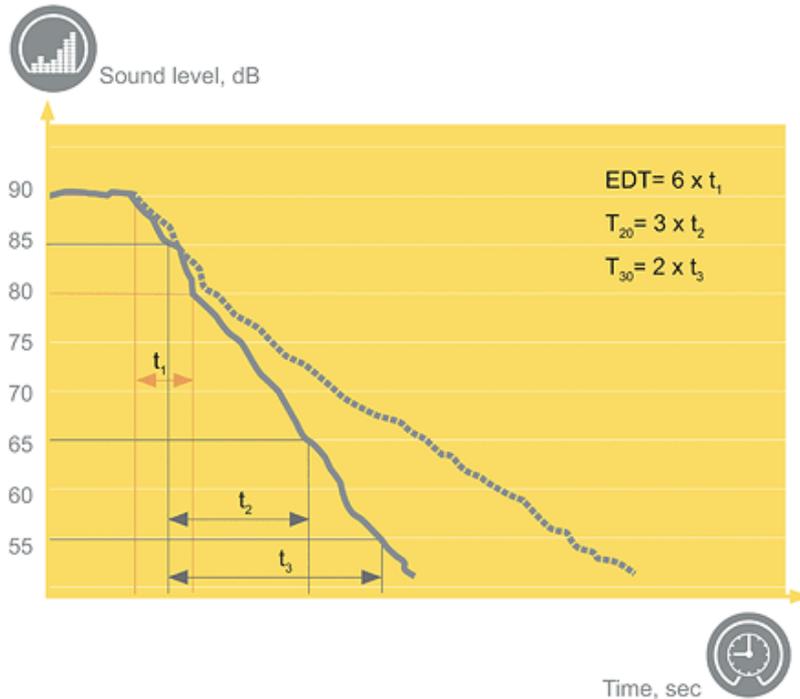
Corners are especially important for the acoustics – corners between walls and corners between the ceiling and each wall – sound absorbers perform optimally there.

In most cases it is **an advantage to combine the wall absorbers with a suspended ceiling**:



- ceiling
- short wall
- long wall
- acoustic chairs
- floor
- door
- curtains
- grazing absorption

Reverberation time (RT) is by far *the most frequently used parameter for calculations and measurements within room acoustics*. The formulas used are normally first the Sabine formula then some modified version of it. They are easy to use – you need just the room volume and the amount of sound absorption, calculated with the absorption coefficient α_p .



These formulas, however, are designed for ideal conditions with diffuse sound fields.

The sound field is far from diffuse

It will probably consist of two main parts:

one grazing and one non-grazing

ACOUSTIC PARAMETERS

Quality parameters commonly used in the design and efficient correction of acoustical environments are linked to reverberation (RT60 Reverberation Time, Early Decay Time EDT) and energy criteria (Clarity C50, C80, D50 Definition).

Added to these are the parameters of speech intelligibility: Speech Transmission Index (STI) and Rapid Speech Transmission Index (RASTI).

It shows a short list:

(Early Decay Time EDT): the reverberation time is calculated on the first 10 dB of the decay curve, extrapolated up to 60 dB. The parameter is used when listening to music because if it continues, you can hear each note only after the first 10 dB, approximately, of the decay of the sound.

EDT optimal values are between 1.8 and 2.6 seconds.



ACOUSTIC PARAMETERS

Clarity C: introduced by Reichardt and Leumann (1974) to evaluate the temporal transparency (clear perception of musical notes played in rapid succession) and transparency harmonic (possibility to distinguish clearly notes of one or more instruments played simultaneously), *is the ratio between the useful sound reverberation and noise*, in dB:

OPTIMAL CLARITY dB	
$-1.6 < C80 < 1.6$	instrumental music as Dresda
$-2 < C80 < +2$	other authors symphonic music
$0 < C80 < +4$	opera
$C50 > +3$	speech

ACOUSTIC PARAMETERS

Definition D50: The definition is a **measure** of the **clarity** with which the listener will listen to the **spoken message**.

D50 is a quality parameter and it is also significant for the **intelligibility of speech**. It remarks the ratio of useful energy and total energy:

$$D_{50} = \text{Useful energy} / \text{Total energy}$$

and can be calculated with:

The acoustic environments suitable for speech require $D50 > 0.5$, while those suitable for the musical performance $D50 < 0.5$.

ACOUSTIC PARAMETERS

Speech Transmission Index STI: The speech intelligibility in a theater or auditorium is a significant parameter for the drama, where will be attended by singers and actors.

Some of the quality parameters described in the previous sections can also be good benchmarks for the intelligibility of speech: *if the reverberation time causes acoustic reflections and reverberation of a syllable reach the next, there will be more complex identification of the word.*

Also, if the sound level of the speech is too weak compared to the background noise, intelligibility will be too low because of this defective masking.

The values of TSI vary from 0 to 1, where 0 indicates no intelligibility and the value 1 total intelligibility.

	STI
Excellent	> 0,75
Good	Da 0,60 a 0,75
Fair	Da 0,45 a 0,60
Poor	Da 0,30 a 0,45
Bad	< 0,3



DESIGN ANALYSIS WITH SOFTWARE

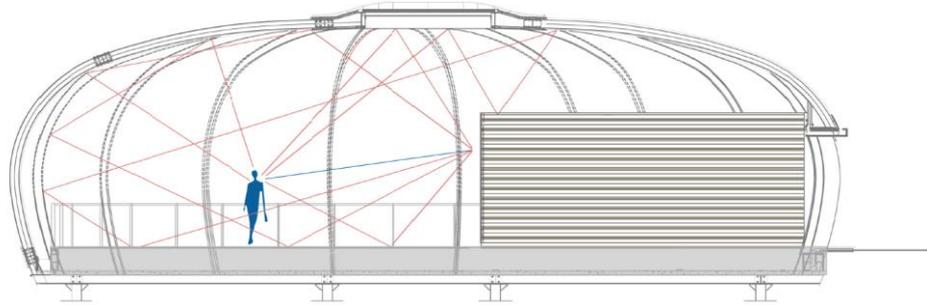
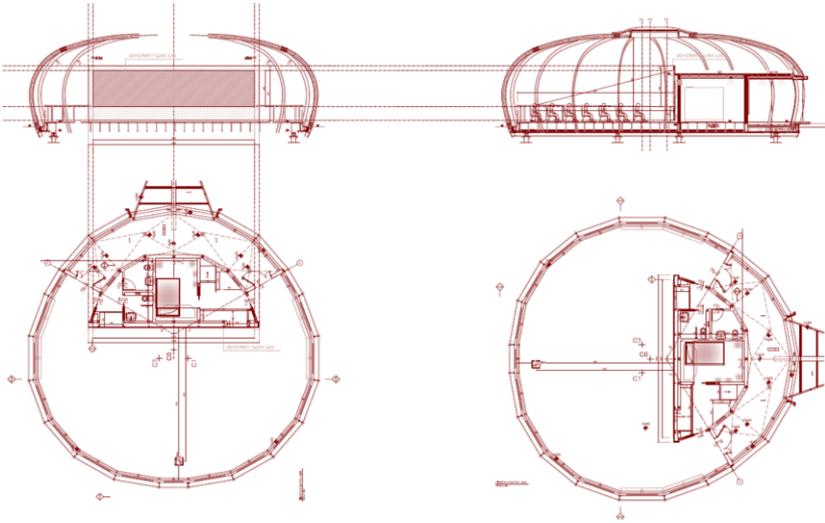
The acoustic comfort related to the technical parameters mentioned in the previous paragraphs, is achieved through **the study of the materials** to be included within the halls:

- insertion of **acoustic panels in order to increase the absorption**;
- **characterization of the floor and ceiling**;
- addition of a system of absorbent towels for transparent components;
- **choice of seats** which complement the technical design of relief.

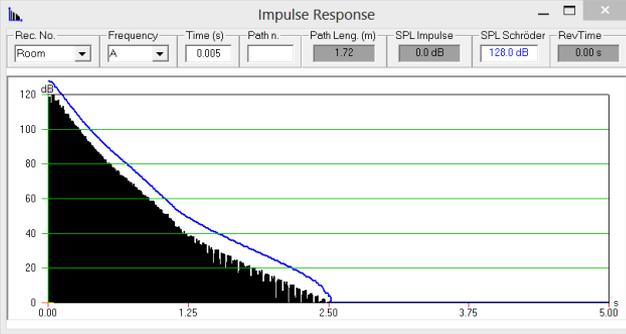
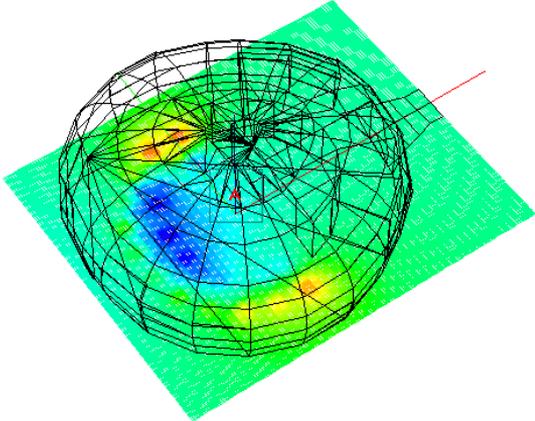
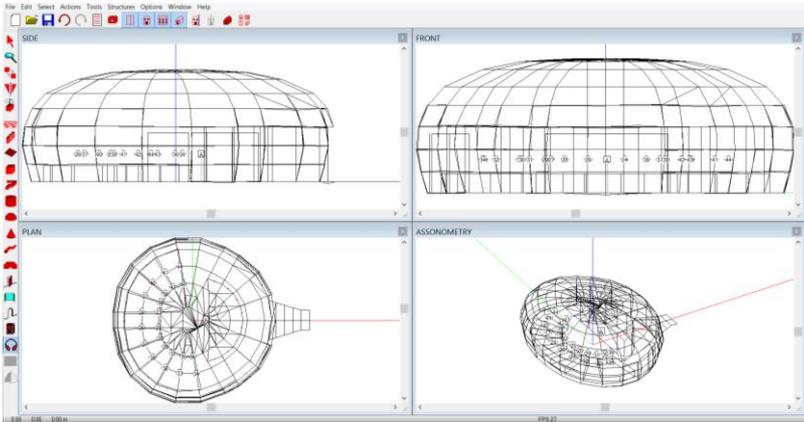
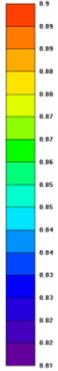
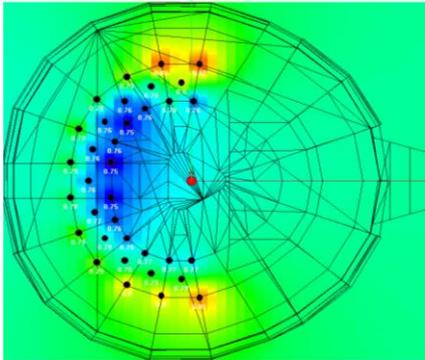


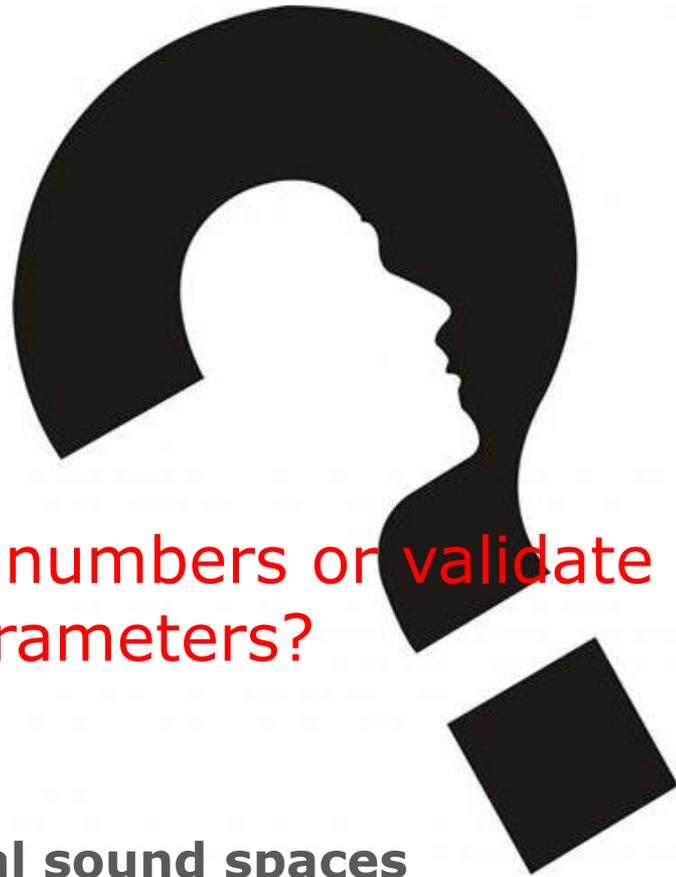
DESIGN ANALYSIS WITH SOFTWARE

OXYGEN PAVILION



DESIGN ANALYSIS WITH SOFTWARE





How we can confirm the numbers or validate the acoustic parameters?

Only with measurements in real sound spaces

TECHNIQUES OF ACOUSTIC MEASUREMENTS

For RT60

- Measure reverberation time using impulse source with the same arrangement. Use alarm gun as a source of impulse sound
- Use **12dodicifacce** system for reverberation time measurement. Use wide-band pink noise signal covering whole measured frequency band





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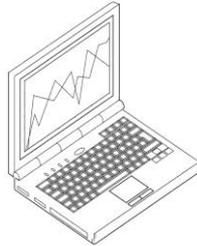
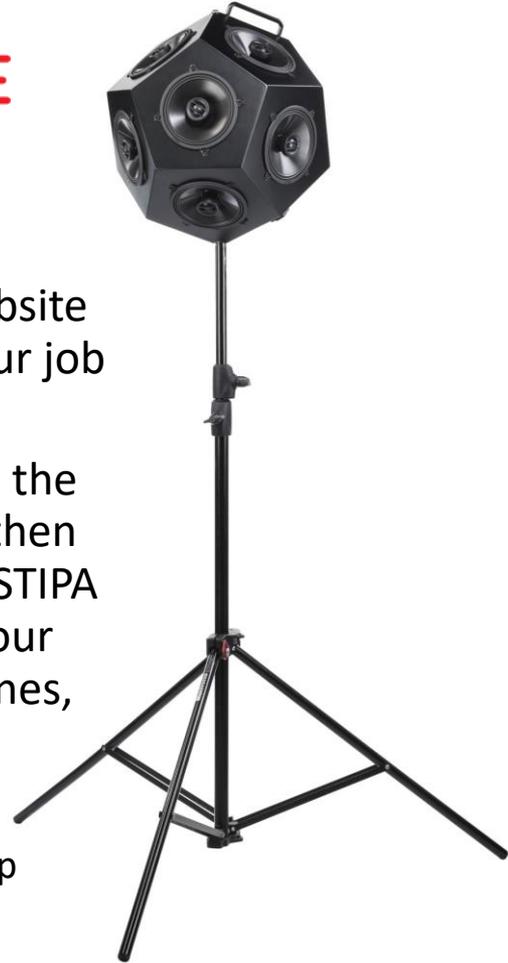
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ACOUSTIC SAFETY ENGINEERING



These audio files provided in the website help you during your job or your passion.

First of all to assess the audio equipment; then to make RT60, STI/STIPA index and to test your speakers, headphones, DAC and more

www.mynoise.app





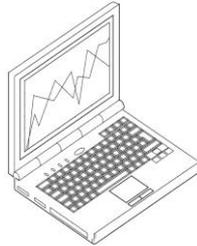
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**Thanks for
the attention**

Find us on 3B.F22

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