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Consultation Meeting 19.02.2018, Topic: Architectural acoustics of MIG-Coating

Dear Sir or Madam,

On 19.02.2018, I had a briefing and consultation at your office with the aim of obtaining and exchanging information on the subject: acoustic properties, space, sound reduction, etc. of materials produced by the company MIG.

Since Mr. Dipl.-Ing. B. Brandt was absent due to influenza, it was impossible to meet him in person. As a result, the company's technical experts Mr. Hans Sturm and Mr. Christian Brand joined the meeting on his behalf.

I would like to thank you for the friendly reception at your company and the information that I received on MIG's products.

1. Consultation meeting

In the meeting room, we discussed topics like acoustics, sound insulation, sound attenuation and their physical correlations. In doing so, I addressed the problems of room acoustics arising from the physical phenomena I know and from my many years of practice in room and building acoustics.

I've gained new scientific knowledge in this field through the presentation of your products in an animated film. This includes the impact of water molecules and the acoustic performance of thin layers (e.g., coatings) that I did not fully grasp.

My experience of room acoustics, which is limited to the acoustics of meeting rooms, auditoriums, classrooms, multi-purpose halls, theaters and concert halls etc., is generally determined by the acoustic properties of the room boundary surfaces and the properties of the inventory. Then there is the size of the room volume V and the adjustment to the room's optimal reverberation time in a fixed frequency range of 100 - 4000 Hz.

The relative humidity and the humidity of surfaces have not been the subject of investigations in generally accessible rooms.

It is true that the RH% can indeed play a role in the absorption of sound in gases, but only at frequencies > 1000 Hz and with room volumes > 1000 m3.

When determining the reverberation time of a room according to Prof. Sabine, the attenuation coefficient of the air is taken into account if larger volumes are available.

$$T(f) = 0{,}163 \frac{V}{\sum \alpha F + 8 \alpha L * V}$$

Where:
V – Volumes of the room
T – calculated reverberation time in third octave bands
α (alpha) – absorption value of the material
F – Size of the corresponding room area / material (n)

$8 \alpha L * V$ Effect of air absorption at high frequencies

This mathematical relationship is generally used to calculate reverberation time in the frequency range 125 - 3150 Hz. and is supported by company information and measurement protocols.

In a program library, there are 300 different materials with their respective acoustic parameters. (Absorption factors)

2. MIG Meeting room

Upon stepping into the room, we were immediately impressed with its acoustics. This happened in a short time while we cast a glance at the wall, the ceiling and the floor area. The existing inventory with conference table, seating, kitchen fittings and media technology and showcase of the MIG products on a wall surface evoked immediate interest.

Considering the array of a suspended fiber board ceiling (OWA system) and the existing leather seating, significant sound reflections between the walls should be audible, but these did not seem to be the case.

Since the only visible, effective absorption surface in this room was the suspended ceiling, some questions remained to be answered.

As to why the room climate is so good remains to be explored further.

3. Measurement of reverberation time and room acoustics

After concluding the conversation, I proposed that we calculate the acoustic parameters of the room in order to gain further insights. What's particularly eye-catching about the room was, on a long wall there was a large relief with the emblem of MIG mbH created from the company's own materials. On the opposite side was a wall displaying MIG products. The relief and other surfaces should have been treated with MIG coating.

After discussing with Mr. Sturm, we decided to remove all visible items that may influence room acoustics from the room. In the kitchen area, any object that may possibly absorb sound was stowed away inside the kitchen cabinets. The only visible objects left was the room free of inventory and a meeting table in it.

Assessments before measurements:

Room acoustics changed as expected - yet room was free from unpleasant echoes (flutter echoes).
Room size 142 m^3 – L shape, surfaces in kitchen are not sound absorbing.
Room depth: 11.72m, width: 4.72m, width of the kitchen area: 2.82m
Suspended ceiling: grid ceiling OWA Jura, suspension approx. 0.5m, area: approx. 48m^2

The measurements were carried out together with Mr. Sturm, who offered his superb assistance and professional comments on the subject.

According to the provisions of ISO 3382 and DIN 52216, third-octave noise in the frequency range 100 - 4000 Hz was played into the room (sound level > 100 dB) and the decaying signal was recorded with the help of a standardized measuring system. A sound reduction by 60 dB results in the reverberation values in the corresponding frequency range.

To determine the acoustic parameters of the room, we conducted approx. 8 series of measurements at different places with a minimum distance of v. 50 cm to the wall surfaces.

In the vicinity of the large wall relief (size approx. 16 m^2), 5 further series of measurements were recorded.

The results of the measurements can be seen from the enclosed two graphs, but also from the original graphs of the measuring device (partial presentation).

Comment:

The measured values of the reverberation time also confirmed the pleasant room acoustics. The increase in reverberation times in the lower frequency range is common. Reverberation values in the frequency range 500 - 1000 Hz are significant for sound quality, which are even below the parameter according to DIN 18041.

An ideal acoustic value was achieved even in an empty room - without furniture!

Deviations from the mean value are also normal, as they are always higher in the low-frequency range.

Visible sound absorbing surfaces are:

- OWA suspended ceiling, model: Jura or ‘‘Harmony‘‘
- two persons in the room
- a measurement loud speaker (dodecahedron)

Invisible sound absorbing surfaces: MIG-Products, including the relief?

4. Calculating reverberation

The measured values of the existing space led to the question: “Can we prove if other room surfaces or components have a positive effect on the reverberation values, which are initially invisible?’’

In the office we carried out a usual reverberation calculation with the building materials, the surface sizes and the acoustic properties that we can assign to the building materials. For this we have the already mentioned database available.

For standard surfaces, such as fine plaster, plaster board wall surfaces, floor coverings, wood panels, painted surfaces, glass facades, etc., data are available, some of which are documented by measurement protocols by professional institutes.

Suspended ceilings with acoustic effect are widely available, including, in our opinion, the “worm hole ceiling” from the manufacturer OWA, which is extensively used to regulate the reverberation time of rooms. The final reverberation values are determined by those areas whose absorption factor αw or αs should be as high as possible. Then according to DIN ISO 11654, it can be classified in the absorbing class A - D.

The calculation process is conducted according to the above-mentioned correlation by Prof. Sabine with information on surface areas and properties of the materials as detailed as possible.

The initial situation for the calculations and results can be found in the appendix.

We conducted two calculations here, as the first one did not include a wall surface.

The more accurate the surface dimensions or the more detailed the acoustic parameters of the materials, the more accurate the calculation is.

Results of reverberation calculation for MIG meeting room

Data Octave - center frequency

	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	3k Hz
MIG meeting room	0.84	0.62	0.6	0.53	0.46	0.41

Value: Standard RT 60 in seconds

Acoustic particularities of the room:
- Balanced room acoustics
- Ceiling height 2.96m, airspace 50cm
- OWA grid ceiling as built-in boards, 600/600, model Jura? Good absorption in ceiling area
- Surfaces treated with MIG coating, relief and other surfaces?
  (not considered in calculation as data are not available)

A comparison between calculated values of the reverberation time and the real measured values in the frequency range 100 - 3150 Hz shows a good consistency.

However, when performing conventional measurement procedures, we cannot tell in which areas there are changes in the acoustic parameters.

If energy transformations occur at interfaces or there are special absorptions in porous building materials within the molecular range, these are apparently not detected by means of the applied measuring method.

We recommend commissioning another specialised institute, e.g. Fraunhofer Society, Stuttgart, who would provide additional evidence to strengthen the claims.

The investigations made here are restricted to determining the reverberation times in an object or attempting to separate the acoustic property of a company product MIG coating from that of other objects. Apart from that I cannot make further statements.

Enclosed are datasheets of the existing acoustic ceiling, whose general material designation should be double checked to ensure accuracy.

The company OWA has a representative office near you (please refer to the address below). I have also carried out a reverberation calculation with the OWA program, which is also enclosed as an original.

Naturally, I am happy to assist you and the MIG team with any questions, even like conducting an investigation in a reverberation room or a comparison object.

Once again, it seems useful to me to consult the Institute of Building Physics, Stuttgart or another institution for further investigations.

OWA representative office
OWACoustic – Ceiling Boards, 63912 Amorbach
Please refer to attachments for details (copy)

I hope that you are satisfied with my services and I trust that you've recovered from the viral infections.

Kind regards,

H. Wietfeldt

Appendices