



— If you look back at room acoustics in music rooms, or at the acoustic development in the studios' control rooms, it can be stated that different genres have throughout history influenced the technical solutions, both for premises and instrument. Sometimes the construction of the existing acoustic instruments and the composition of the orchestra developed, and the sound image of the instruments has influenced the acoustic design of the venues. Symphony Orchestra, a brass band or a rock band all require different acoustic conditions. Also has knowledge in the acoustic field had a great impact on the soundscape over the years.

Acoustics is usually considered in the field of physics, but when it comes to room acoustics, and especially music acoustics, it is at least as much a question of psychology. All music and all musicians use the function of our hearing and that part of physics which deals with the properties of sound waves, the acoustics. Physics talks about how the signal is modified on the way from sound source to listener and psychology is expected to talk about how to perceive this signal. This combination of two disciplines has proven to be overly complicated. Outside there is no acoustics in any real sense, however, certain acoustic phenomena arise, if sound can bounce against walls and other objects. It is also possible to create acoustics in an artificial way, using electronic equipment. We will, however, devote ourselves to what is called room acoustics.

A little history the importance of acoustics goes far back in history. It was especially important when you could not amplify the sound using electronics. Shall try to identify changes in architectural and acoustic criteria for music halls can be classified these for five time periods.

The Classical period (1750-1820), Romantic period (1821- 1900), Pre-modern period (1901–1950), Modern I 1951–1980), and Modern II (1981- 2000).

The different halls which were built during these periods can be categorized according to different room shapes, shoe box, fan shape, horseshoes, semi arenas, and irregular style. The shoe box style is the room shape that was built in all periods. These halls were built quite narrow, rectangular learn in the bottom surface and with a high ceiling. They were too richly decorated with pillars, pedestals, statues, and had ceilings with beams and ornaments. All this contributed to the good acoustics.

The average number of seats and room volume has increased over the years by about 400 seats to 2,500. The average dimensions of the rooms have increased from a volume of about 17,000 cubic meters to about 22,000. The average ceiling height has also increased. To an average of about eighteen meters. The average the reverberation time today is 1.94 seconds, and it is highest value throughout the era.

Some of the world's foremost concert halls are of shoe box model: Grosser Musikvereinssaal in Vienna 1870, Concertgebouw in Amsterdam 1888 and Symphony Hall in Boston which was built 1900. Due to its narrow, rectangular shape gives the best older halls a lot of side reflexes. The number of decorative elements spreads the sound evenly in the room and the high ceiling height gives one long reverberation. All this together results in good acoustics. The concert halls built during the early 1900s speech (fan shape), on the other hand, has often been less good, sometimes pure disasters.

Now the halls were built wider, to accommodate larger audiences. The decorations disappeared and walls and ceilings came to consist of large, smoother surfaces. The acoustics of these was often not as good as in the older halls. The however, it took a long time before one understood why. In these wide halls, the ceiling was often designed for to reflect sound towards the audience. This made the sound clarity and brilliance that was well suited for speech. Though at the same time the sound became quite thin and gave little sound of the music played in the room.

In the early twentieth century did too science its entry into space acoustics through Wallace Clement Sabine, who defined the term "reverberation time". That is the time it takes the sound level in a room to drop 60 dB after that the audio source is turned off. As space Acoustics research progressed, people became aware of it Most listeners want the music to hang together and not just consist of

a lot of nails. The reflectors in the room also extend the direct sound so that it sounds louder without increasing the level. Many modern recordings have a recorded sound which does not sound in any acoustic reality.

The instruments then often give us a flatter sound experience and a feeling of depth and perspective errors. Tightly damped "super dry" studios are difficult to play in and acoustic instruments sound bad. Only direct sound plus electronic reverberation gives a more scattered sound and gives poor loudness. In general, studio acoustics are needed. Well diffused, irregular reflections from walls, floors and ceilings at a reasonable distance give life and depth both acoustic and electrical instruments.

Can we just check the ugly bass resonances so give the acoustics a much more musical result? It is amazing how little real reverberation can be gild music.

The design of the control room and the early reflexes. These first reflexes from walls and ceilings have proven to be of great importance for acoustics in musical contexts. The use of technology increased sharply during its later part of the 20th century and new forms of music were created. Electronics became an important basic element and electroacoustics gained the same importance which the instrument makers had in their time. Today knows one enough about room acoustics to be able to build good concert halls, or at least to be able to avoid bad solutions. During different eras, the development of instruments can be explained with changes in the environment in which the music was performed.

The acoustic quality of the room is of great importance for the musicians' ability to play a different kind of music require different acoustics. One has ever defined art as a science with more than six variables. In that case, room acoustics truly an art!

Sound is reflected, with some limitations, on the same way as light and you can draw sound rays to show how sound propagates in a room. When we are seeing a picture, we are very aware of perspective and depth: parallel lines entering the image, and which eventually seems to coincide. The depth experience in the image is also conveyed by colour shifts, haze, shadows, and the like. Similarly, a good recording can convey an experience from an acoustic perspective, as the hearing experience is strongly affected of the time course of the audio information. When we listen on a live orchestra, we hear the live sound, but we also hear the early reflexes, that is sonic filtering provided by the greater distance. These space reflexes give us a perspective and a deep experience. To obtain good acoustics must measurements and calculations are made in four dimensions. *Three room dimensions and time.*

Since they must also be meaningful out of the listener's perspective the design of the control room from an early age 1950s Here is the different acoustic of the last fifty years design ideas for control rooms in both broadcast and music studios up to today's standard. It is during this period that the technical development has affected the conditions for recording technology. Various and sometimes quite controversial schools have emerged over the years. On it at the time, the control room was a small apparatus room, usually located in the corner of the studio and most often acoustically untreated. Today we can still find such rooms in opera houses, theaters, and concert halls. These rooms are usually for the inspector who has the main responsibility for the technical equipment. During this time, there were often dedicated technicians who did everything themselves? The acoustic adjustments were mainly based on what their ears perceived. Acoustic measuring equipment was exceedingly rare and not available. They were mainly on acoustic laboratories. The

absorbents of that time were perforated plates of wood or fiberboard with holes drilled in different pattern. Behind these was mineral wool. These absorbents were usually absorbent in the intermediate register and at higher frequencies. The design is rarely operating below 125 Hz (which even today is standard in building acoustic constructions).

This means that the low-frequency reverberation time is uncontrolled. Here are some milestones in the acoustic changes that have been implemented from the middle the 60's.

1965 – 1967 Drum set, and bass platforms were isolated from the studio floor with coil springs. The use of hardwood on studio walls and floors were introduced. Carpets on studio floors were installed. Isoroom was built. The design of the control room from an early age **1950s** Here is the different acoustic of the last fifty years design ideas for control rooms in both broadcast and music studios up to today's standard.

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An LEDE room gives you following Depth, width, height, and individual placements of instruments becomes significantly clearer than before. The temporal conditions of the sound become clearer than before. The precision of the sound image increases individual sound sources become point shaped. The base becomes tight, dry, fast, deep, and almost scary strong compared to earlier. Dynamic contrasts in the base area that previously did not could be perceived to be heard now. The more bass you absorb, the more bass will be heard. At first it may seem that one has lost stereo width, but it is because one no longer has a wall reflex that adds an extra virtual sound source next to the speakers.

On music, recorded with the correct microphone setup, however, the soundscape extends deeper and further out to the sides than ever. This concretely means that you have a greater range of dynamics. Small details will be heard better when they are no longer drowned out by louder sounds and reverberation. Large dynamic eruptions will also come into their own. The very most listening rooms have their greatest impact from about sixty hertz up to five hundred hertz, which strongly colors instruments and human voices. These will now sound significantly smaller swollen and more natural. You notice the difference in that voices suddenly sound completely natural in the LEDE room.

It worked great both for conversations and for listening to music the significance of the control room for the result It is sometimes overlooked that a control room has several functions. On the one hand, it is the control room tools that, together with the speakers, should manage or auralize the sound engineer and / or the producer's efforts in the creative process for a sound production. But the control room should also mimic the acoustics of the average listening environments that the product should played in. The room is the part of your sound system that adds the most errors. It is important not to skimp with knowledge, as well as the financial resources during construction. To spend a lot of money on a pair of monitors without doing anything to the room can be a waste of money. The room is the weakest link and contributes to the fact that you do not get replacement of your expensive speakers. How big an impact does the listening room have the sound? Yes, the room can add amplitude deviations of +/- 15 dB or more, which also means sharp throws between amplification and attenuation at different frequencies. Speakers are smoother in this regard. The reverberation time of the room must be shorter than the recorded material to distinguish the sound from the

recording situation. Are you listening? on the kick of a bass drum in two different control rooms, a room with and a room without satisfactory absorption of low frequencies you get two a lot different listening perceptions precisely depending on the reverberation.

The early reverberation time is perhaps that which affects the sound perception the most? But it is also important to look at how the resonance of the room affects all frequencies, which should sound out into the room. A control room must never be added to or delete some frequencies. So, it is of great importance to have such a neutral control room as possible. Absorbents and diffusers provide you better sound!

A new generation of control rooms in the early '60s, *Tom Hedley* was involved in to build new studios for the major record companies. The control rooms were intended for those who had sharp ears for acoustics. There is little published about his design ideas, but more about his business ideas. His idea was that many control rooms should sound the same. Then the opportunity is created to be able to send recordings to each other around in the world and still get the same listening experience as where it was recorded. Hedley's interpreter the sound image was realized in a series of control room with the following common features: Absolute symmetry along a center plane of the room to create a stable stereo image, no reflections coming from the back wall, no reflections coming from the ceiling, the speakers built in and fasten together with the front the wall in the room, and a short reverberation time in the control room down to the low frequencies (63 Hz octave band).

The latter has already been mentioned by designers as Bill Putnam and Mike Rettinger, and this can be the single most important acoustic parameter in a control room. For unclear reasons, early reflections along with it were recommended direct sound from speakers in the room. To get so much sound absorption in such a wide frequency range as possible, Hedley created their famous "base traps" which consist of parts of mineral wool hanging vertically side by side at a height of about 2-3 meters. The effect can be compared to the effect of the wedges of mineral wool boards found in an eco-free chamber.

The wedges create an impedance match between the air and the acoustic limits of the room, so that no one, or extraordinarily little, reflection comes back from the different frequencies in the room. the speakers would be provided with hard and reflective surfaces, preferably in some exotic stone material, this for to create early reflexes in the sound. The knowledge was already applied in the 60s by building mixing rooms according to the LEDE concept (Live End - Dead End). It took however, time before the construction was established. In and with the establishment of LEDE rooms, discovered one rightly that exceedingly early reflexes from the speakers did more harm than good. LEDE control rooms are common today and have has been in Sweden since the late 70s. The room is eco-free from the speaker to the technician's ears. The time difference that arises between its direct sound reaching the ear and the first reflexes makes you hear transients more clearly. That way one can more easily determine the quality of the different ones sounds coming from the speakers. This room gives both a desired clarity and a room sound. Maybe it should be called "Dead End - Live End" because it is heavily muted around the speakers, but acoustically lively and subdued at the opposite end. Left half of the room should thus be equal to the right half.

Rear part of the room should be designed so that it diffuses the sound. Constructive and destructive interference can occur between the direct sound and the reflected sound from the wall behind you. If the wall is three meters behind you, its reflected sound will come maturity is delayed by approximately twenty milliseconds (equivalent to six meters). A frequency whose wavelength

corresponds to a period of twenty milliseconds (approximately fifty hertz) will then result in that the direct sound and the reflected sound meet in phase and reinforce each other in the listening position, that is, constructive interference.

- If we can only control the ugly bass resonances, the acoustics give a much more musical result. It is amazing how little genuine reverberation can gild music.

Previously, a control room would be proper asymmetric. Today, symmetrical listening applies, which is obvious when all listening is done in stereo and you want the left and right speakers to sound identical. Therefore, a control room must be identical on the right and left sides, calculated from a centre position. This is the reason why that compression ceilings were introduced. The compression ceiling would provide better listening width. This was later replaced by so-called two-dimensional acoustics, that is, that the roof or some part of it was dampened to the maximum. Until the middle of the 80's it was about the area around the speakers would be provided with hard and reflective surfaces, preferably in some exotic stone material, this for to create early reflexes in the sound.

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