Intreerede

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Dealing with disbelief

Where innovation starts

Inaugural lecture prof.ir. Renz van Luxemburg

Dealing with disbelief

Presented on July 1, 2011
at the Eindhoven University of Technology

Dealing with disbelief

This inaugural lecture sets out to underline the need to anticipate changing attitudes in the world of the built environment by focusing on new technologies and innovative solutions. It will not be an easy challenge. We need to cooperate with the acoustics research groups of other departments and universities all over the world. Why not try to develop an institute of applied acoustic research at our university? Even after decades of research and legislation, we still are confronted with problems related to noise in the built environment, which shows us we still have a long way to go to achieve our goals. Last, but not least, in consultancy we often have to deal with disbelief as the clients and users expect a guarantee of the final result for which the existing objective terms are not sufficient to cover all the subjective quality levels.

Introduction

Working in the field of architectural acoustics is both challenging and disenchanting at the same time. Operating in a number of scientific, creative, economic and artisanal environments demands thinking and acting out of the box with, as a consequence, not fully complying with the terms of these worlds. As often stated, architecture is both a science and an art. Knowledge of physics and physiology is required to understand phenomena of acoustics and auditory perception while knowledge of building technology and psychology are necessary to be able to apply the correct solutions. Designing in architectural acoustics is balancing functionality and perception. Communication is often complicated since solutions must be effective from a scientific perspective as well as acceptable from a designer's perspective. The perception of the acoustic quality is, above all, very subjective. As musical preferences are personal so are the acoustics. Everybody has his own opinion. In comparison to the search for the roots of the acoustic perfection of some musical instruments (Stradivarius), in architectural acoustics we are challenging the acoustics of the highest rated halls.

In our group we try to operate in this complex field of interest by educating acoustic designers as well as acoustic researchers in the tradition of Eindhoven University of Technology where we combine fundamental and applied research. In other words, we educate Masters of Science, who are able to understand the design philosophies of architects and are able to communicate with experts in related fields of interest. The examples presented in this lecture will enable you to better understand what I mean.

Acoustic quality in the built environment

Since the seventies of the last era governments and local authorities have paid attention to protecting people from noise pollution. The Dutch Noise Protection Act (Wet geluidhinder) dates from 1979. Since 2002 European directives have also been in effect. These regulations are based on controlling and reducing the noise at the source. Limits for the production of noise to a great number of products have been established (EU Product Certificate), for example, for vehicles and all kinds of equipment and tools. Secondly, the transmission of the noise source to the receivers is a point of attention. Means to reduce the noise of roads include reducing the speed of traffic, changing the type of tyre and/or type of road surface, increasing the distance to the road, and introducing noise barriers. In almost every European country more or less the same noise limits have to be respected. Noise pollution descriptors have been harmonized. A great number of European cities put noise emission maps at the community's disposal to elucidate the impact of main roads in specific noise zones in which housing and other noise-sensitive functions should not be planned. As a consequence, new buildings must comply with these. Procedures, estimation methods, etc. are very strictly formulated as a result of scientific research and social studies, leaving little scope for urban designers to be creative. The effect of this legislation is disappointing. In the Netherlands we see hardly any difference in the number of people annoyed by noise since 1997.

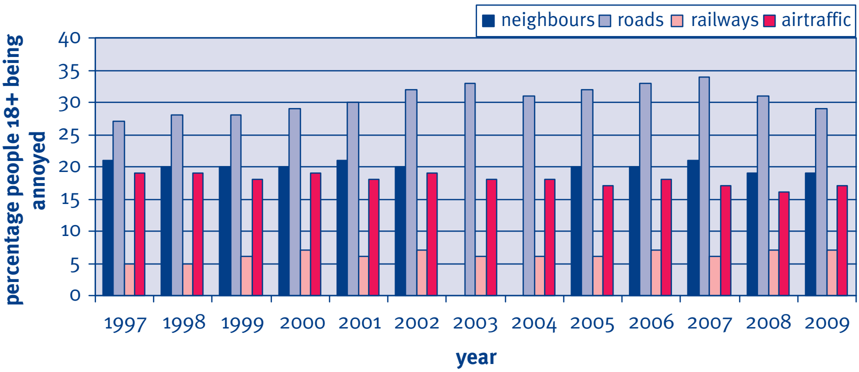

Figure 1

The effect of noise legislation does not show in the number of people being annoyed by most disturbing noise sources over the years. (Source CBS)

We also have to deal with building regulations concerning noise control in housing. Some of these date from the fifties. In his inaugural speech in 1969 [1] Prof. P.A. de Lange referred to the building regulations in the Netherlands and the need for houses with good sound insulation. Since the introduction of the anchor-free cavity wall (ankerloze spouwmuur) we know that good sound insulation in houses can be incorporated at minimum cost. In Austria a more radical method is employed to reach a high sound insulation quality: houses are built next to each other on their own individual foundation, separated from their neighbor's foundation. A study for the Dutch Ministry of Housing [2] showed that in 1980 about 87% of the newly built dwellings fulfilled the Dutch standard with respect to the sound insulation requirements between terraced houses, with about 50% showing sound insulation of one class higher. However, meeting the standard does not guarantee acoustic comfort for everybody.

With the Dutch standard NEN 1070 (1999) we have a tool to rate the sound insulating quality of dwellings. The Rule of Practice NPR 5070 rates the acoustic quality of housing depending on the airborne sound insulation and impact sound insulation between houses, the interior sound insulation quality as well as the noise of equipment. The Netherlands Organisation for Applied Scientific Research TNO and the National Institute for Public Health and the Environment (RIVM) regularly carry out social studies with respect to the quality of noise in the living environment. Despite all regulations and measures we still are confronted with a considerable number of complaints. Noise nuisance from traffic and from neighbors still score high in studies with respect to comfort in the living environment.

So it is no surprise that noise control in the living environment is still on the agendas of the EU and the WHO. Despite all attempts, it seems as if the problem is becoming worse instead of better. By raising student awareness of these things, we try to improve the situation. We also formulated an EU proposal for an urban sound planner, probably not an unnecessary luxury given the lack of progress being made to date.

Acoustic quality in buildings

For most people acoustics, and thus acoustic quality, are strongly related to performing arts venues, and more specifically to concert-halls for symphonic music. Since Prof. Wallace Clement Sabine developed his theory on the reverberation time and sound absorption (1900), much research has been done to understand the acoustic quality of rooms. This research has resulted in the development of advanced measurement techniques and increasingly accurate analysis and prediction methods. Nowadays we are able to quite accurately reproduce the acoustic properties of concert-halls and to compare them according to a great number of physically well defined parameters, most of which can be determined by analyzing impulse responses. Many parameters are interdependent.

Advanced knowledge has shifted the focus from audience acoustics to performer's acoustics. We know that for all the acoustic quality descriptors of rooms a statistical range has to be taken into account. As a consequence, the number of parameter combinations is unlimited. As far as I know nobody has yet found the key combination for the perfect concert-hall but we are all familiar with famous concert-halls with an imperishable reputation for acoustics: the Concertgebouw in Amsterdam, the Boston Symphony Hall in Boston and the Grosser Musikvereinsaal in Vienna. These halls can be considered the standard for good concert-hall acoustics. What must be realized, however, is that such a reputation is linked to a certain type of music (Romantic) and personal preference. We also should not forget that their reputation was not excellent during the inauguration and also some elements in the halls have been modified. Music preferences and interpretations change over time, as does the size of orchestras, etc.

I now arrive at the main theme of my lecture, which is that the results of physical measurements give us the opportunity to describe a hall or a room in reproducible quantities, which enables us to compare the acoustic quality of different halls. However, the acoustics of a hall are not only determined by the physically reproducible parameters. What makes a hall good for performers or a performance? Leo Beranek [3] developed a rating system more geared to the subjective judgment of the acoustics of a hall. The system is widely used and, because of that, the statistical reliability must be taken seriously. However, to what extent the system is reproducible is still disputable as the main reference is the developer of the system. Several studies, for example by Kahle [4], have shown that it is very difficult to develop a reproducible method to objectively judge the acoustics of a concert-hall for symphonic music. Simply put, musicians, audience and architects do not speak the same language.

However, the findings of scientific research are increasingly used to define the acoustic quality for a new building in its design brief, not only in case of a performing arts venue but for all kinds of buildings. In order to better unify the interpretations of measurement results, standards like ISO 3382 [5] have been developed to present these results. What does this all mean for the discipline of architectural acoustics?

Nowadays we have relatively reliable computational methods to study the effect of design decisions. The common practice in architectural acoustics is to analyze in close cooperation with the architect the brief of the client and the future users, thus developing a mutual strategy and design concept. Such an approach is very relevant to being able to develop completely new solutions. Architects are challenged to propose options nobody had ever thought were possible. The role of the acoustician is to assist the architect and to study the effect and impact of such proposals as well as to come up with alternative solutions. The value of an acoustician lies in his interdisciplinary and essential back-to-basics approach. Designing is also a matter of being familiar with the rules of ‘Gestalt Theory’.
In our built environment we have a lot of redundancy. All senses operate interdependently. Designers must be aware of this. The quality of a new design is determined by its appearance, how it is experienced and its functionality. Our ears check what our eyes see.

Casa da Música, Porto

A good example of this approach is the design for Casa da Música in Porto, Portugal (2005). The design process started in April 1999 with an impossible task to fulfill. Six architects were asked to present a design proposal for a building comprising a concert-hall for 1500 people with excellent acoustics for symphonic music, a 400-seat auditorium meant for all kind of music, amplified and non-amplified, a number of rehearsal rooms, a high quality recording studio and management rooms. The idea was to select an architect within three months and immediately start the design process so that the building would be ready in 2001 when Porto would become cultural city of Europe. Such an assignment is only realistic by reproducing an existing building. Nevertheless the Office for Metropolitan Architecture came up with a completely unexpected proposal: a concert-hall with fully transparent front and rear walls. The acoustic consequences are evident: no visual obstructions and no special features to disperse the sound and, because of the design approach, a shoe-box shape. Furthermore, the architect was not in favor of big balconies and wanted to expose the acoustic features only when they were really scientifically justified. The basic requirements for a concert-hall with the required capacity and shape were communicated: a width between 22 to 24 meters and a volume of approximately 18,000 cubic meters. The location and dimensions of the stage were also proposed. The volume and shape approached that of the Grosser Musikvereinsaal in Vienna. This resemblance is pronounced by the golden finish of the walls. Instead of elementary sound scattering surfaces such as statues and a coffin shaped ceiling here quadratic residue diffusers were introduced, both in the walls and in the ceiling. The latter is very important to avoid the risk of the so-called seat dip that may occur in the case of a long raked audience surface without balconies. The problems concerning the transparent walls were solved by introducing a sine shaped glass with varying amplitude and wavelength between both walls. Windows in the side walls were similarly shaped to contribute to diffuse the sound in the hall. The organs on both sides of the stage were carefully taken into account. The seating in the hall was specially designed, from both an architectural and acoustic point of view. Safety regulations created complications, which resulted in the row distance being increased to 1.05 meters. Last, but

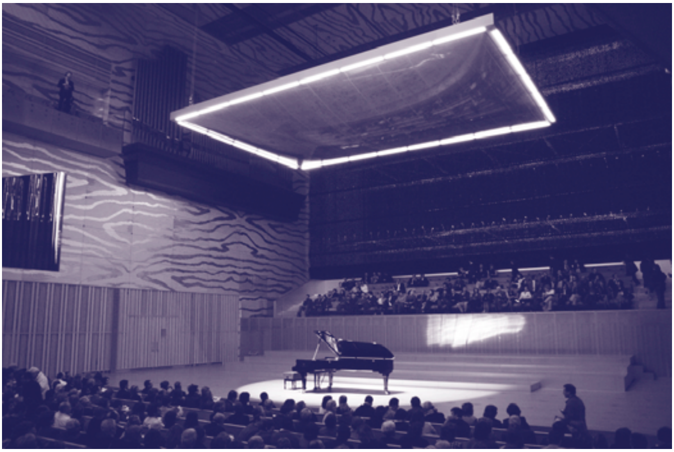

Figure 2

The stage of Casa da Música with the transparent canopy.

not least, a transparent canopy over the orchestra area was introduced. As this solution was unique a new parameter to study the efficiency of the canopy was developed and is now the basis for one of the PhD studies in our group.

An experienced acoustic consultant from Spain was contracted by the client to check our approach and evaluate the acoustic design. Luckily he was used to cooperate with well known Spanish architects like Rafael Moneo, so he was able and willing to understand our design approach. Such an open mind is not usually encountered in the world of acoustic consultancy. Finally, all the measured acoustic data met the criteria for concert-halls of this size; positive visitor reactions confirm this. The different comments we get on the acoustics can be explained by the subjective perception of the hall that does not in any respect meet people's preconceptions of a traditional concert-hall for symphonic music. We can learn from these designs on how to deal with the expectations of clients and performers alike, and discover what new research is required to address these issues.

Dee and Charles Wyly Theatre, Dallas

A second example, in which the expectations of the patron became a real challenge, is the new Dee and Charles Wyly Theatre in Dallas, US (2009). The architectural concept was to create a very flexible theatre on the ground floor, which was open to the surrounding environment. In the concept the chamber with fly tower was wrapped by glass panels. The idea was to have a theatre in which a proscenium stage, thrust stage and open floor would be possible. Because of this concept movable balconies were introduced. Furthermore, an innovative system to modify the floor was designed. The main acoustic challenges were determining to what extent variable acoustics had to be introduced and if it would be possible to mitigate external noise sources sufficiently by just using the glass facade. Because of the fly tower and the lifting system of the balconies the volume of the chamber was relatively spacious. We decided to control the acoustics by finishing the opaque walls above the glass with highly sound absorbing material. The acoustics in the chamber were solved by introducing sound reflectors in the voids of the technical grid. It proved that no extra sound absorption was required to adapt the acoustics to the use of the hall in the different settings.

Working in the US brings extra pressure since introducing a concept that has not proven itself includes the risk of prosecution. The concept of this theatre was so new that the theatre consultant kept expressing his worries about the concept being risky. After the successful inauguration they were the first to broadcast the innovative approach and its success!

Figure 3

The Dee and Charles Wyly Theatre in Dallas, a theatre machine with no acoustic limitations.

Also a very critical solution, in which we had to deal with the client's disbelief, was the transparent facades with a height of almost 10 meters. The original idea was to have windows that could be opened in such a way that the stage could be extended to the outside area. Finally this proved to be too expensive. Also the first proposal to use windows as a cassette, with double laminated glass at a substantial interval, had to be reviewed because of cost. Here we were confronted with a dilemma. To what extent would it be possible to solve the problem to reduce the traffic and airplane noise with a thin (50 mm) double glass package? And what would happen if we were not successful? It may be obvious that neither the contractor nor the patron wanted to take the risk of failure. No glass manufacturer would guarantee the sound insulation required. So finally the design team had to make the decisions. We did tests using a prototype and after a number of modifications, e.g. the type of interlayer and mounting, we decided to go ahead. Also sound demos revealed the effect of sound-insulating measures. In the end we succeeded, albeit just on the limit of what we had predicted.

The patrons and the users are very happy with this theatre machine in which almost everything is possible. The design received several awards and challenged the theatre companies to create new concepts that seem to be very popular. These are the kind of experiences I want to share with students and colleagues in the hope of bringing our discipline to a higher level.

Muziekpaleis Utrecht

After more than three decades of intensive use the Music Centre Vredenburg in Utrecht is being renovated. The arena type concert-hall, one of the first of this type and probably the most extreme, will be untouched as the concert-hall is considered to be an acoustic monument already. So a period of 30 years is enough to establish a certain reputation. The modifications of the Music Centre consist of an extension with four new music venues: a chamber music hall, a jazz hall, a pop music hall and a cross-over hall. Besides the requirement to design halls that will meet the acoustic quality of similar top ranked halls, all the halls must be able to function at any time without causing any noise interference between each other. For this the four new halls must be vibration insulated from each other, even though the building is very compact. The architect responsible for the design, Herman Hertzberger, demands and expects the highest quality. He wants as much proof as possible that this top quality will be reached. The main constraints in this challenge are the budget and unforeseen new insights the users bring in with respect to the use of the building.

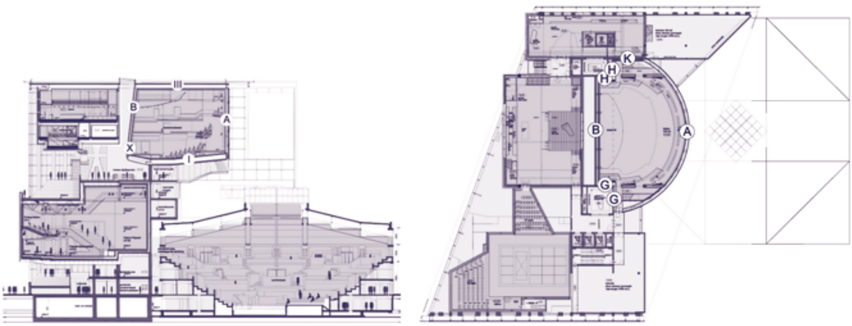

Figure 4

Section and plan for the new Muziekpaleis Utrecht.

The safe approach for such a design is to create a huge heavy platform to support the new halls while structural bearings or high vibration damping elements will enable the acoustic separation of the halls. In this design, however, the new halls are more or less vibration isolated by being hung in a heavy structure. Such an approach is very critical and highly demanding with respect to construction. This implies that besides a deep understanding of acoustics also a high level of communication skills is required.

The interesting part about participating in this kind of project is discovering that each discipline still has its own vocabulary and codes. The architect wants and expects maximum involvement of the acoustician to support and defend his ideas, often counting on a proactive attitude by the consultant towards the design. The patron expects warranties with respect to the acoustic quality even if the budget is not sufficient and the brief is modified in between. Last, but not least, the contractor often does not want any responsibility even for the quality of his own work.

The project now is under construction and it is striking to experience that every problem that has been solved in the past is being questioned from a different perspective: that of the contractor. So the viewpoint has shifted from “is it possible to build” to “what is the risk to build” and “how can we avoid any risk”. The result of this is often disbelief about the effect or ability to construct the solution.

Taipei Centre for Performing Arts

These kinds of problematic processes get worse when the patrons bring in their own expert. Then you have to deal not only with the client’s interests but also with a competency problem: who is the real expert? The design for the Taipei Centre for Performing Arts in Taipei is a good example to illustrate this. The Office for Metropolitan Architecture won a competition for an ambitious program for the building of a new performing arts venue in Taipei, Taiwan. The design comprises three different types of auditoria which can also be interconnected to form a super theater. Every hall in itself must meet the highest acoustic standards, but they also apply to the connected spaces. The design is highly challenging for every discipline involved. It is innovative and has lots of opportunities. However, as in marketing, opportunities always imply threats. So from the moment the client’s representative comes in all possible scenarios have need to be proven in order to ensure that every approval will not have to be constantly a reflection of the expert’s competency.

Although our discipline goes back to 1900 we must be aware that from a scientific point of view not all problems can be solved based on a theoretical approach. Designing is like modeling, with a high degree of trial and error. Also the possible number of combinations is unlimited. As a consequence, most tools appropriate for the design phase are mainly intended to study trends and to justify decisions rather than prove their correctness. But since the client’s expert has his responsibility he wants to understand the design decision process and the easiest way to do that is to question design solutions. If you are not fully convinced of the quality of your own design, the other expert will force you to redesign in order to secure the acoustic quality.

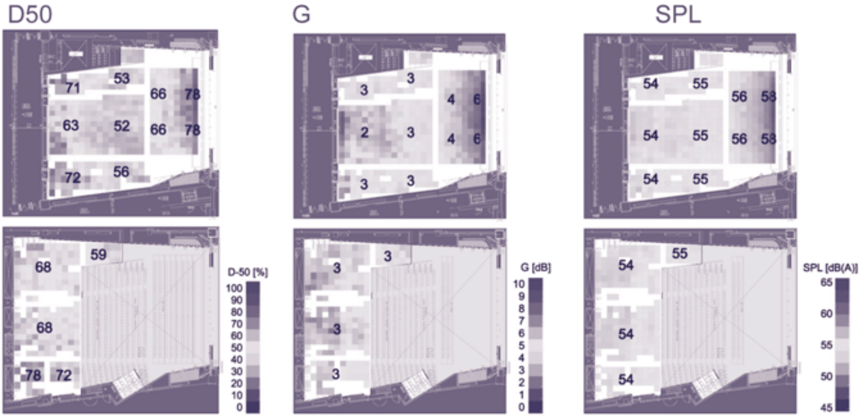

Figure 5

Example of results for computer estimations of the acoustic quality descriptors of rooms.

What is interesting to note is the shift in the use of computer models. The development and value of acoustic prediction models for rooms have progress at a fast pace lately and are much more reliable than they were a few years ago. Nowadays, the main problem in discussions related to the evaluation of design proposals is the way these models are being used rather than their validity. Investigating design possibilities demands a different approach than checking the reality of it. More and more we seem to rely too much on the results of computer estimations (instead of looking at the essence of an acoustic design).

Research vs. consultancy

Luckily working in such a design environment also generates new research questions. Knowing that we will be confronted with questions to prove the effectiveness of design proposals, our attitude has to move in the direction of executing experiments rather than staying on the safe side and only proposing what has been proven to be effective in the past.

Acoustic measurements

The need for relevant and reliable acoustic descriptors for rooms is still great. The acoustics of a room are subject to strong subjective experiences, where different groups of listeners, speakers and performers use different languages to express themselves. Reliable objective parameters can help to improve the understanding of what is relevant in rooms. The reliability depends to a large extent on the accuracy and reproducibility of the measured room acoustic parameters. New and improved measurement methods will help to improve the acoustics in many different types of existing and new rooms.

Figure 6

Advanced measurement techniques help to improve acoustic knowledge.

Recently Hak [6] started a PhD research project on advanced acoustic measurement techniques for rooms based on room impulse responses, or RIR. The aim of this project is to improve existing techniques and to develop new practical measurement methods to control the measurement uncertainties in the acoustic parameters of rooms. The new or improved methods will be useful to better and unambiguously understand the influence of architectural measures in many different acoustic environments. The final results will be converted into guidelines and tools for researchers, engineers and consultants in the field of room acoustics. The starting point is the RIR that fully describes the acoustic transfer from a sound source to a sound receiver in a space. The acoustic parameters of a room are derived from this RIR. However, the method of determining the RIR can introduce uncertainties. Different types of sound signals can be used which have advantages and disadvantages. Also, the choice of transducers, like the type of sound source and microphone, is of influence. Finally, the type of measurement chain will influence the quality of the measured impulse response and thereby the uncertainty of the measured acoustic parameters of the room.

Stage acoustics

Designing a transparent canopy as a floating cushion as used in Casa da Música is a nice idea but its effect must be studied in advance. So a mock-up of the canopy was produced to test its reflectivity. After the canopy was installed, the fine tuning with respect to height and position was an issue. Next to that we had to deal with the conductors' and musicians' opinions. It proved that a reliable and reproducible parameter that could be measured and was sufficiently related to the orchestras and conductors opinion was not available. As we discovered that the comments and experience of the orchestra were strongly related to the positions of the instruments on stage, we developed our own parameter.

Our first experience with this new stage parameter was, as mentioned above, in Casa da Música in Porto. Our second project in which stage acoustics was an issue was the temporary hall for Vredenburg where a former stage building had to be transformed to a concert-hall for symphonic music as well as for pop music. The building had a very deep stage. It was higher than the connected hall and narrower. The height of the stage area was reduced to what was acceptable for pop music. The stage environment had to be modified to be acceptable for a symphonic orchestra so that the musicians could hear each other and also get sufficient feedback from the hall. To this end diffusing elements had to be incorporated in the rear wall of the stage and the lateral walls of the stage.

Above the stage reflectors have been introduced. These measures proved not to be sufficient so an extra vertical orchestra chamber had to be introduced. The parameter developed in Casa da Música was used to study the effect of the measures and to qualify the stage acoustics of this hall. In this project the parameter was quite useful to qualify the impact of the measures for the orchestra members.

Pursuant to these promising results, a Master project by two students, Kivits and Heijnen, [7] involved them following the Dutch Students Symphonic Orchestra during their 2009 tour, visiting seven well known Dutch concert-halls. Measurements to determine stage acoustic parameters were taken in these concert-halls and the musicians were interviewed with respect to the acoustic quality of the stage. The result of the study was that there is no high correlation between the subjective experiences of the musicians with the averaged values of the new parameter. Also studying the measured values of the new parameter it was obvious that this new parameter enabled the different stages to be rated more in detail than what is possible with the more common stage acoustic parameters.

The research that focused specifically on stages in recently built concert-halls now will be continued in the PhD study under my responsibility in my group. Wenmaekers [8] has just started this research.

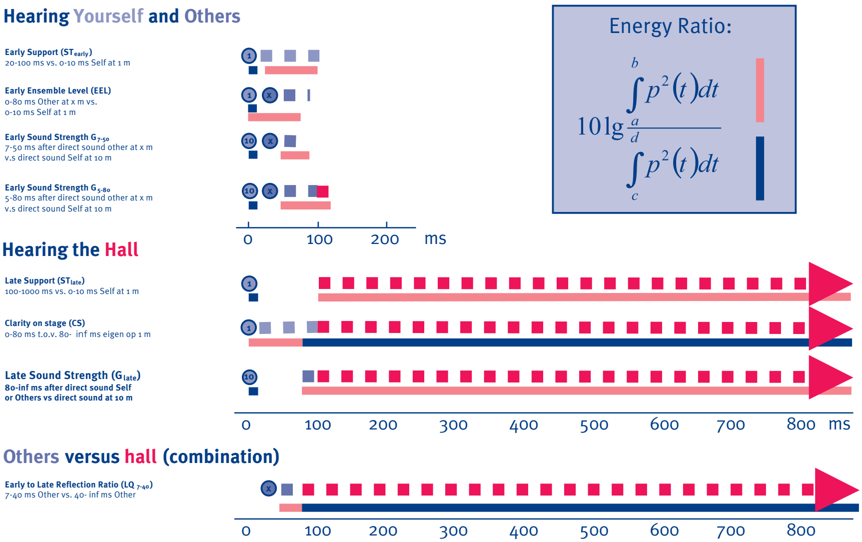

Figure 7

Typical range for the parameters to describe stage acoustic quality.

Orchestra pits

Another interesting subject of study resulted from a project investigating the noise exposure of an orchestra in an orchestra pit. It is obvious that a big orchestra in an orchestra pit can generate excessive noise levels depending on the music program. The study revealed that in a number of situations noise levels exceeded legal limits so the next step was to study what could be done to protect the musicians and to comply with legal limits for noise exposure. Possible measures that were discussed related to the finishing of the orchestra pit, the use of noise barriers between musicians and musicians wearing ear protection.

Recently the graduation of my Master student, Van der Heide [9], involved a literature study on orchestra pits and measurements of four different orchestra pits. Noise exposure measurements were also carried out in a 1:10 scale model of an orchestra pit. In this project she focused on the shape and dimensions of the orchestra pit and the acoustic treatment of the rear wall in the pit. The existing orchestra pits that were measured were selected due to their size and acoustic wall treatment. Three different wall treatments have been compared: hard reflective wall finish, high diffusing and poor absorbent wall finish and absorbent wall finish. The parameters used to compare the orchestra pit were comparable to the stage acoustic descriptors. The orchestra pit measured represented the whole palette of possible configurations. The results of the measurements clearly showed the acoustic difference between the pits and also gave sufficient indications of what are important elements to examine when applying measures to reduce and control excessive noise levels in orchestra pits. The main finding is that the diffuse treatment seems to be the most promising from a noise exposure point of view and the conditions for the playing ensemble.

Room acoustic knowledge in retrospect

Dealing with the design of a new concert-hall we will be confronted with the reputation of existing halls. In the case of concert-halls for symphonic music the acoustic world agrees on the reputation of three reference halls with the highest acoustic rating. These are Amsterdam Concertgebouw, the Boston Symphony Hall and the Grosser Musikvereinsaal in Vienna. An easy approach would be to copy one of these halls. In reality this is not possible for a lot of reasons: safety, architecture, comfort, etc. It is better to try to understand on what knowledge their design is based. It is common knowledge that the foundations of room acoustics as a science lie in Harvard where Wallace Clement Sabine discovered the sound absorption of materials in relation to volume and reverberation. It is striking that two of the famous concert-halls date from before Sabine's discovery. So during discussions with my students we were intrigued and decided to try to discover on what acoustic knowledge the concert-halls of pre-1900 were based. Postma did his Master's thesis on this subject. He visited the archives of Amsterdam, Leipzig and Vienna to try to find this specific information. It is really refreshing to read how architects dealt with acoustic issues before 1900. Besides the trial and error methods, it became clear that Sabine was not the first one who tried to understand room acoustics. Some persons we had never heard of, such as Carl Ferdinand Langhans, Ernst Florenz Chladni and J.C. Rode, were aware of certain acoustic phenomena long before Sabine wrote about it in relation to specific projects.

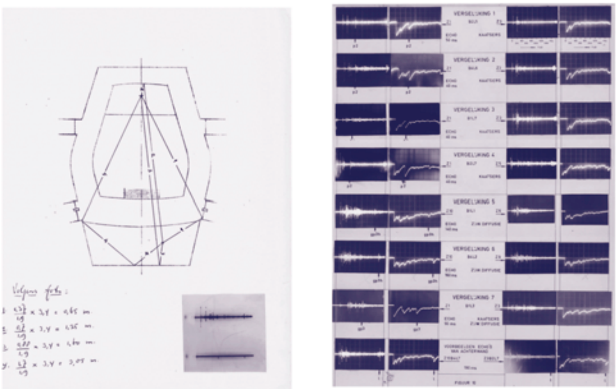

Figure 8

Some examples of tools to study possible echoes and reflections in the scale model of the De Doelen in Rotterdam in 1961.

With the room acoustic modeling tools currently available we can study the effect of measures that have been taken, even in these famous halls, to improve the acoustics. None of these halls started with the reputation they have now directly after inauguration. Demolition had even considered because of the lousy acoustics.

Postma will receive his Master's degree in a few weeks. These kinds of studies are necessary to bridge the gap between designers and researchers. As the judgment of acoustics is strongly subjective we must realize that emotions play an important role as well. Therefore we can learn from experiences in the past.

Recalling how room acoustic expertise developed in the Netherlands we come back to Prof. C.W. Kosten just after WWII. His name is still well known in our discipline. Three of his protégés, Prof. P.A. de Lange, C. van Dorsser and ir. V.A.M. Peutz, continued his work and now I see it as one of my challenges to build further on the foundations they laid.

The future

Reflecting on the past and the present is necessary but it is more important to look at the future. After decades of more or less the same people leading the group, we now get the opportunity to bring in fresh blood and new perspectives. Our laboratory has a good reputation with respect to research on building acoustics because of the work of Em. Prof. Gerretsen en Dr. Martin. So our main challenge will be to consolidate this position. Some topics such as sound transmission through pipe systems and into building structures [11] and flanking sound transmission through lightweight framed doubleleaf walls [12] invite further development since funding for this type of PhD research might be more accessible than for room acoustic subjects. For the latter we have enough expertise; with respect to sound transmission we need new support. Another field of interest will be urban acoustics and sound scaping. In the tradition of our department we must serve all fields of interest and so also take urban design into account. The feasibility of modeling urban environments for sound scaping (auralisation) and the development of an echolocation simulator to train visually handicapped persons are new subjects on which we can and will focus our energy. From an architectural point of view the acoustic comfort of elderly people will also be a focal point.

Although it is well known how to reach good sound insulation in buildings, I believe we must pay attention to the transfer and availability of this knowledge. Also keeping this knowledge up to date is very important. So architecture students must be aware about how to obtain and use this knowledge. We will make an effort to open the doors of the acoustic laboratory to serve as a platform for practicing acousticians in the Netherlands. In addition we will establish students exchange with foreign universities like Taiwan Tech and Tsinghua University in Beijing. We will initiate new PhD studies as new knowledge must be the basis of the group.

Master classes

New building techniques imply new research into how to control the acoustic quality. However, the dissemination of knowledge may even be more important. We started organizing master classes that have already proven to be successful, three on room acoustics and three on flanking transmission. We will continue with them.

Acknowledgements

I want to express my gratitude to the executive board of the university, the advisory board of deans and the board of the department of Architecture, Building and Planning for my appointment and the belief they have in me to entrust me to broaden the chair of architectural acoustics. I also want to thank my colleagues in the group Building Physics and Services for their support and loyalty to the acoustics group. I want to especially thank Jan Hensen for his support and belief in our group.

As I strongly depend on the support on the work floor, I want to thank Constant, Heiko, Remy, Nicole and Kito without whose expertise and knowledge I would get lost.

I was lucky to have my first employment at the Institute of Applied Physics TNO in Delft amongst professionals. Only few are still active in the field of acoustics. I was invited to join the group of Bert Booy, who succeeded Prof. de Lange. Both introduced me in the field of architectural acoustics. They gave me the opportunity to experience my talents in practical projects like the design for the Music Centre Vredenburg in Utrecht and the Muziektheater in Amsterdam. I owe both my gratitude. Prof. de Lange initiated an affiliation with the department that has lasted twenty years. In this group I was lucky to work with experts such as Cor Pernot, Laurens Zonneveldt, Ella Braat, Theo Raijmakers, Susanne van der Jagt and Jan Hensen.

After my career at TNO, DHV gave me the opportunity to broadcast my expertise on acoustics. I wish to thank Peter Heringa, John Kraus and Ad van Hamburg who supported me in the mission we formulated together. Theo Raijmakers, Gerard de Graag and Leo Koster still give me the feeling that I am important to the company by giving me the opportunity to broadcast myself as leading professional.

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Curriculum vitae

Prof.ir. Renz van Luxemburg was appointed part-time professor of Architectural Acoustics in the department of Architecture, Building and Planning at Eindhoven University of Technology (TU/e) on September 1, 2010.

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