SCHROEDER DIFFUSORS

Sigrún Ragna Helgadóttir

Mannvit hf
Verkfræðistofa
Grensásvegi 1, 108 Reykjavík, Iceland
sigrunr@mannvit.is

1. INTRODUCTION

Standing in a room where the acoustics have been considered, the walls often have a particular shape. This might be a broadcast studio, a concert hall or a church. The reason for some of these particular structures can be traced back to so called "Schroeder diffusors".

2. SCHROEDER

Schroeder was born in 1926 in Germany. In the 1950s, Schroeder was a young student at the University of Goettingen, Germany. At this time, acousticians were measuring frequency response curves of various concert halls, puzzled by the many ups and downs on the curve they got. Schroeder started looking at this and published his first article about this subject in his native language in 1954. Schroeder found out the dips in the response were related to the reverberation time of the hall due to random interference of many overlapping room resonances. He found out the human ear naturally filters these fluctuations out when listening to speech or music. Schroeder worked for Bell Labs for many years and has been a professor at the University of Goettingen since 1969.

2.1. A Study on European concert halls

In the 1970s, Schroeder undertook a major study of 20 European concert halls. The London Chamber Orchestra agreed to record a piece by Mozart in BBC's studios, a recording free of environmental factors such as echo and reverberation time. Playing this recording from the stage of various music halls with multiple loudspeakers imitated the orchestra actually performing in the hall.

2.2. Findings of the study

The findings of the study revealed that listeners generally prefer laterally moving sound, generally coming from the sides, the walls, giving them a sense of stereophonic effect as opposed to sound coming from the ceiling, hitting the both ears at the same time, giving them a sense of monophonic effect.

2.3. Diffusors

Following the study on European Concert Halls, Schroeder released an article in 1975 suggesting “diffusors” with high lateral scattering be placed on the side walls and the ceiling of a concert hall. This would increase laterally moving sound decreasing similarity of signals at the two ears and therefore, improve the acoustics of the hall. To diffuse the sound, Schroeder suggested a surface that would scatter the sound energy uniformly into all directions. For the structure of such a surface, Schroeder used sequences from number theory.

3. CONCLUSIONS

A study on European concert halls found the reason for bad acoustics to be the lack of early lateral reflections. A change in architecture has taken away the acoustic quality of the old, narrow, high ceiling concert halls where the decorations acted as natural diffusors. In today’s wide, low ceiling concert halls, early lateral reflections can be accomplished with the use of diffusors on walls and in ceilings, improving the acoustics of the hall. With advancements in Electro-Acoustical Engineering, digital technology can also be used to improve acoustic quality of spaces and has become more commonplace.