Adaptations to a Church for Chamber Music

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In the year 1565 the church The Nieuwe Kerk in The Hague, The Netherlands, has been built, nowadays being used mostly as a multifunctional space for art-exhibitions, (dinner-) parties and also concerts. It was desired to adapt this large and reverberant volume of 13.500 m^3 and 3,5 seconds in a small concert hall, acoustically suitable for chamber music. Requirements were to shorten the early decay time and increase clarity and intimacy, visually as well as acoustically, as much as possible, but to keep the appearance of the larger volume and late reverberant tail. Therefore it was decided to choose for a semi-open volume build in glass. The adaptations and their acoustical effect and required dimensions have been studied using a computer-model simulation, in which the amount of openings in the smaller, glazed box has been varied. Based on its results, an 60% to 70% closed smaller inner box of 3500 m^3 has been designed and implemented, formed by glazed and diffusive elements. Experimental data and listening experience since then show the successful effect. It will give anyone a remarkable experience of being acoustically in a small concert hall but to be visually in a large church, an effect that is opposite of what is usually done by electronic reverberation systems.

INTRODUCTION

The "Nieuwe Kerk" in the Hague, the Netherlands, being build in 1565 was a typical example of a church with cathedral-like acoustics. Merely suitable for organ and Gregorian chant it was nowadays being used mostly as a multifunctional space for exhibitions, dinners and also concerts. Planning a total refurbishment of the church in 1997 there was a demand to improve its facilities for audience and musicians, and especially to improve its acoustics for chamber music. The principals "Nederlands Congresgebouw" and Dr. Anton Philipshall asked the architects Zaanen Spanjers Architects and Peutz & Associés as acoustical consultants to make suitable proposals.

ACOUSTICAL MODELLING

The existing church that has an acoustical volume of about 13500 m^3 and a reverberation time of 3.5 s was acoustically not very suitable for chamber music, especially with a limited audience of 450 people. The acoustics were generally judged as muddy, remote and unclear but with a nice sound. In order to make the church more suitable for chamber music it was necessary to bend the indistinctness of the acoustics into more clearness and also into somewhat 'smaller' acoustics, in which smaller ensembles should give a sufficiently strong and well defined sound. It was clear that in order to reach an increase of early sound energy compared to late sound energy and to realize "smaller" acoustics, the acoustical volume had to be reduced by creating a smaller 'hall' inside the church. In that way it was comparable with the earlier project of the fully glazed AGA-hall that was build inside the larger volume of the Beurs van Berlage in Amsterdam, also a cooperation between Zaanen Spanjers Architects and Peutz. But is this case of the Nieuwe Kerk, it was required to maintain the late reverberance of the church and that the provisions should be removable for organ concerts etc. In order to do so the smaller 'hall' clearly could not be fully closed and should be designed with partial openings. To investigate acoustically the optimal amount of reflectors and openings in order to gain maximum increase of clarity a computer model was used.

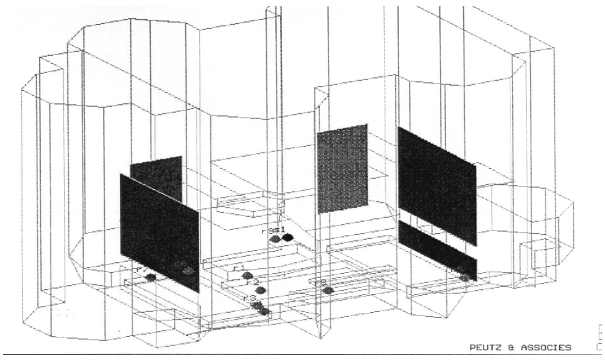

FIGURE 1. Computer model with some reflectors.

After matching the existing acoustics of the church it was studied how ceiling-reflectors and side-reflectors should be added to create the required volume of 3000 to 4000 m^3 and at the same time create more intimacy and clearness. The model, represented in figure 1, was mainly used to investigate to what extent the smaller volume had to be acoustically separated from the main church volume in order to create the acoustic properties aimed for. In this computer simulation study the amount of openings between the small and the main volume was varied between 0 and 100%. It was found that optimal acoustics were to be expected if 60 to 70% of the surface area of the smaller volume was closed, assuming that the reverberation of the main volume would be reduced simultaneously to 2 á 2.5 s. Calculated impulse-responses showed significant increases of early reflected sound energy, leading to a expected increase of loudness of 2 dB and an expected increase of 3 to 4 dB of the clarity-index (C-80, measure for clarity and intelligibility of music). Based on these results glazed and diffusive elements have been implemented above and around the seating area, see figure 2, and additionally retractable curtains have been applied.

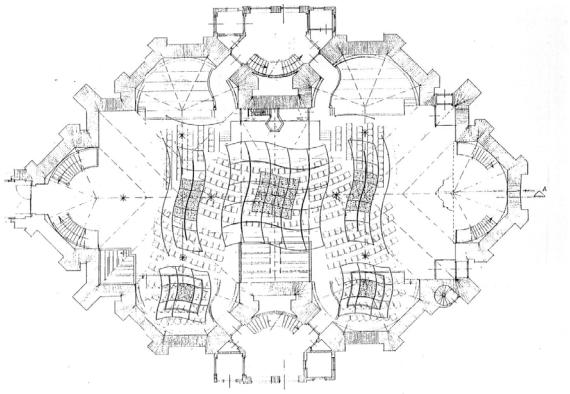

FIGURE 2. Plan of church with added reflectors.

The curved, glazed elements have been partially intersected with wooden panels to obtain additional sound diffusion and to increase visual intimacy.

RESULTS AFTER REALISATION

Based on the acoustic parameters and reflection patterns measured an acoustical smaller volume of about 3500 m^3 can be deduced, which meets the requirements to realize the acoustics of a small hall. Comparison of impulse-responses measured before and after measures taken, shows that an increase of the clarity-index (C-80) of ca. 4 to 5 dB has been reached. An example of two impulse responses before and after is given in figures 3 and 4, in which the addition of early reflections can be seen.

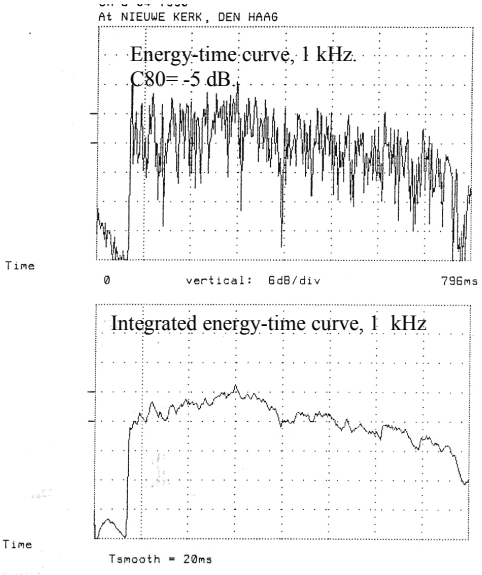

FIGURE 3. Impulse-response measurement before.

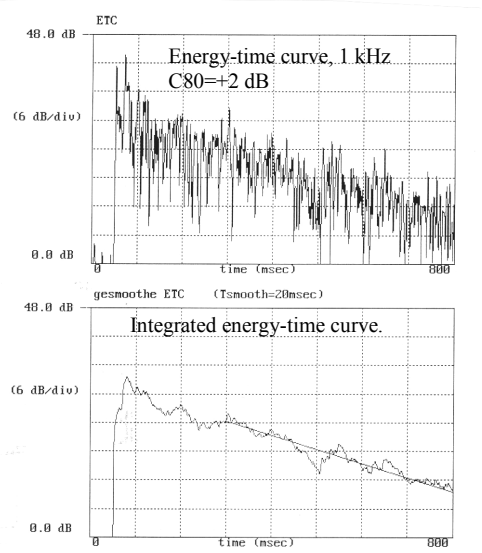

FIGURE 4. Impulse-response measurement after.

The increase of clarity is confirmed by listening experience, in which also the late reverberance of the larger church volume can be experienced at for instance music stop chords. It will give anyone a remarkable experience of being acoustically in a small concert hall but to be visually in a large church, an effect that is opposite of what is usually done by electronic reverberation systems.
The resulting acoustics after the refurbishment have been widely appreciated, and the musical use of the hall has been growing ever since. Even recording companies seem to have discovered its precise and clear though living acoustics.