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Acoustic design and evaluation of a multi-purpose hall of a new conference centre

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At Forum Acusticum 2005 the building and room acoustic design of a new Conference Centre was presented. Since then the construction work has been finished and the Centre is now open.

The Conference Centre itself is a multi-functional building, having three wings of different functions. The Main Hall of the Centre is a room for 750 people which can be extended with adjacent section rooms for 1100 persons, giving a total volume of 14000 m³. It was designed to host conferences, lectures, and – most of the time – to be used as a concert hall.

The extremely different acoustical demands of being a concert hall and a lecture room had been fulfilled with appropriate room acoustic design and with variable acoustics by employing a DCR (Digital Control of Reverberation) system.

In this paper we give a report on the achieved acoustical performance of the Main Hall of the Conference Centre. We have performed extensive room acoustic measurements in the Main Hall, the results of which are compared to the designed values and are presented in this paper.

The design of the DCR system is discussed in a different paper.

1 Introduction

Concert hall design doesn't have such an old tradition as the design of speech auditoria, which dates back to the ancient Greek and Roman times. Still, its 250-300 years history has brought many good (and bad) examples, a handfull of prototypes to start the sketches from when designing a new concert hall. The main design objectives are clear: typically rather high reverberation times selected according to the volume of the hall, number of seats, type of music to be played, etc.; proper timing and direction adjustment of lateral reflections to give high clarity and the feeling of envelopment; diffusers to help avoiding focusing and flutter echo, etc.

In case of a lecture hall the main objectives include moderate reverberation time, high speech intelligibility and high strength value – which are quite different from the optimal parameters for a concert hall.

For a multi-purpose hall the acoustician has to combine these contradictory objectives within one room. Obviously, variable acoustics are needed. Either the total absorbing area or the room volume must be variable. If the choices of coupled reverberation chambers and moveable walls are excluded due to lack of space or financial reasons, the only remaining solution – known so far – is the use of an electrical reverberation enhancement system consisting of microphones and loudspeakers distributed throughout the hall.

In the following, the acoustical performance of the Main Hall of the Debrecen Conference Centre is discussed. To satisfy the acoustical demands of this multi-purpose hall serving both as a conference room and a concert hall a DCR (Digital Control of Reverberation) system is employed. The design and modelling of this hall was presented at Forum Acusticum 2005 [1], whilst here we give a report on the achieved results. A separate paper deals with the DCR system in more details [2].

2 Layout of the Hall

The hall has a simple square-like ground plan of 27.6×27.6 m, with small cut-offs at two opposite corners, but the main axis of the hall is the diagonal of the square and not the centerline as it would be for typical shoebox shaped room (see Fig. 1). Thus the room is a combination of a fan and a reversed-fan shaped room. The

flat concrete ceiling of the hall is at 16.8 m height, below which a specially designed, curved shaped, sectioned suspended acoustic ceiling, made of sound reflective and absorptive materials is placed (see Fig 2).

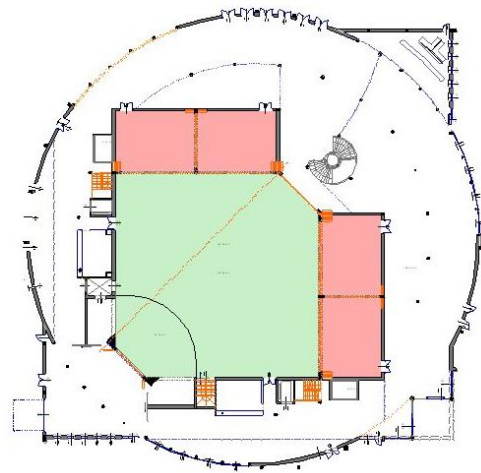


Figure 1: Ground plan of the Main Hall (coloured green) – with the section rooms (coloured pink). Entrance at the top right corner, scene at the bottom left corner of the hall.

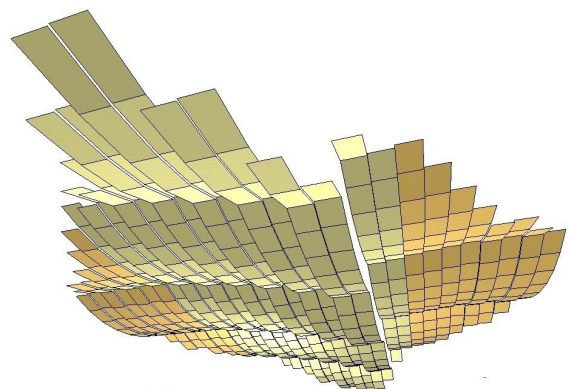


Figure 2: Suspended acoustical ceiling - view of the model.

To allow a larger number of audience, two section rooms of $8.5 \times 20 \times 7.8$ m can be attached to the rear side walls of the main hall.

The main dimensions and number of seats is given in Table 1.

	without	with
	Section Halls	
Volume [m^3]	12000	14000
Seats	750	1100
Volume per seat [m^3]	16	12.7

Table 1: Main dimensions of the Hall – with and without the additional section halls

References

- [1] A. B. Nagy, B. Mesterházy, A. Kotschy, „Acoustic design of the Debrecen Conference Centre, a multifunctional building”, *Proceedings of Forum Acusticum 2005*, 249 (2005)
- [2] G. Balogh Jr., G. Balogh Dr., „Room acoustic enhancement system in a Multifunctional Cultural Centre”, *Proceedings of Acoustics2008*, Nr.3248 (2008)