THE QUEEN'S HALL

THE ROYAL LIBRARY, COPENHAGEN, DENMARK
COMPLETED 1999

Acoustics Consultant:	A. C. Gade Akustisk Rådgivning, Vedbaek Denmark
Architect:	Schmidt, Hammer & Lassen K/S, Aarhus, Denmark
Owner:	Ministry of Cultural Affairs, Denmark
Structural and ventilation Engineers:	Moe & brødsgaard A/S, Rødovre, Denmark
Electrical Engineers	Hansen & Henneberg A/S, Copenhagen, Denmark
Construction Cost (entire 25,000 m^2 extension):	55 Mio. USD

The 25,000 m^2 extension to the Royal Library in Copenhagen placed at the harbour front reflects a change in the "marketing strategy" of the library. Whereas previously the Royal Library mainly served researchers who came with their lunch bags to spend full days studying the archived material, the library now also address the general public by arranging exhibitions, lectures and concerts related to the collections, which also include many original music scores (by Danish composers in particular). This is also the reason why the new extension includes a 530 m^2 concert hall seating up to 600 people, The Queen's Hall.

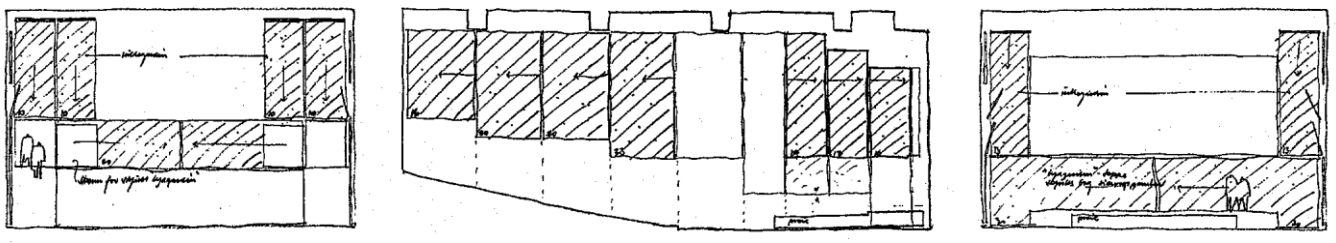
The hall is designed with highly variable acoustics to accommodate equally well chamber music concerts and lectures/-conferences. Besides, a variable stage and ensemble reflectors are incorporated for orchestra rehearsal use (by the Royal Conservatory of Music in Copenhagen, which was lacking a suitable hall for that purpose.)

The hall is rectangular in shape with "macro" diffusing angled panels on the side walls (forming a saw tooth shape as seen in the plan), which prevent flutter echoes and increase the amount of lateral early reflections in the seating area. Modified Schroeder diffusers of wood have been added to the panels on the side walls just in front of the stage where the "saw teeth" change orientation and would otherwise cause serious focused flutter echo's. In order to maintain a proper volume under the limited ceiling height, the floor slope is minimized and given a curved shape with a constant vertical angle of 8 degrees between sightlines and the audience "plane".

The absence of balconies left ample wall areas available for the variable absorption elements which consists of 250 m^2 of sliding panels with cloth covered mineral wool on a steel frames which can be hidden behind the saw tooth side wall pockets) plus 150 m^2 of curtains on the end walls as seen on the sketches below. The total variable area of 400 m^2 makes it possible to change the reverberation time between 1.1 and 1.9 Sec. at mid frequencies. Other variable elements are tilted ensemble reflectors for orchestra rehearsals that can emerge from the side walls in the stage area.

During the design phase, the effect of introducing the variable acoustics elements in the hall was demonstrated to the client through "auralization" (using the ODEON program), which played a major role in convincing the client to spend the necessary money on the variable features.

Proper sound insulation between the concert hall and the other functions in the extension – including a reading hall right above – is obtained by 2x13 mm gypsum board on a steel frames fixed to the 30 cm concrete walls and ceiling with rubber isolators.



Architect's sketches of variable absorption on (from left to right): rear wall, side wall(s) and wall behind stage.

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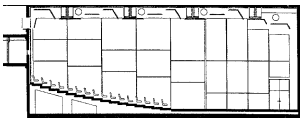
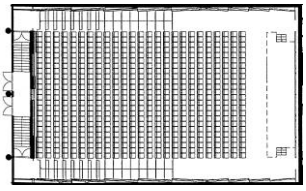
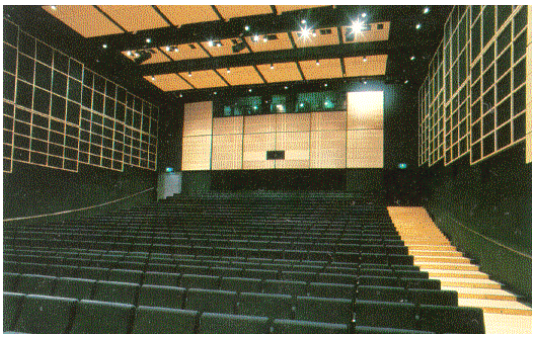


The Royal Library extension, "The black diamond"





Three view's of the hall with the absorbing side wall panels extracted (black squares).

Acoustic data:

Volume: 4,500 m^3
Floor area: 530 m^2
No. of seats: 384 - 600

Reverberation time, T (500 – 1000 Hz):
1.1 - 1.9 Sec. variable
Early Decay Time, EDT (500 – 1000 Hz):
1.1 - 1.8 Sec. Variable
Clarity, C (500 – 1000 Hz):
+2 - -3 dB variable

Background Noise: 22 dB(A)