

Danish Radio Concert Hall Project Enters Construction Phase

By Motoo Komoda

Nagata Acoustics' work on the Danish Radio Concert Hall Project recently progressed from the design phase to the construction execution phase. In this article, I will give a project overview and a report on some of Nagata Acoustics' work, on-site in Copenhagen.

Project Overview

The Danish Radio Concert Hall project is part of a large-scale program to relocate and consolidate all of the facilities of the Danish Broadcasting Corporation ("DR") at a single new development area in the capital city of Copenhagen, replacing the scattered buildings and facilities now in use with a central location that will enhance the efficient functioning of the DR's broadcasting activities. The project's Danish name "DR Byen" means "DR City" in English, and the DR's mission is for the new campus' suite of buildings to be a "multimedia powerhouse."



Figure 1: Danish Radio Construction Site

The DR Byen campus includes four buildings, each being constructed as a separate project or segment of the program that unites them physically and conceptually under an overall plan. The segment (1) building will primarily house the main TV studios, broadcasting technology and information technology functionalities and the equipment for all of DR's program production work. Every DR channel and program will be transmitted via this building. The segment (2) building will be dedicated to the production of news and sports broadcasting, as well as providing office space for the heads of the journalism and entertainment media, trade unions and other key personnel, and for the DR's archives. DR's radio station, administrative offices, conference rooms and internal service operations will occupy the segment (3) building, and the concert hall, a production studio, rehearsal rooms and other music- and media-related support rooms will reside in the segment (4) building.

The world-class, 1,800-seat concert hall will be the new home of the DR's well-established Danish National Radio Symphony Orchestra. In addition, this building's facilities include three large studios for DR Entertainment Orchestra, DR Big Band Jazz Orchestra and DR National Choir to use for production work, rehearsing and concerts, as well as practice rooms for each section of the orchestra and recording and sound-editing studios all under the same roof.

DR held separate design competitions for the campus' overall plan and each of the campus' 4 buildings, and intentionally selected a different architect for each project segment in order to create diversity in "DR City." The French architectural firm of Ateliers Jean Nouvel won the competition for the architectural design and management of the segment (4) building. Construction is scheduled to complete by September 2007 and will be followed by acoustical testing and fine tuning before the hall opens in early 2008.

Currently at the construction site, I can see workers busy laying the poured-in-place concrete parts of the building and work has progressed to where I can clearly identify the general outlines of the concert hall. The completion of one of the other segments will be in 2006, ahead of the concert hall segment, and some 3,000 DR staff are expected to relocate to DR Byen next year. Preparations are already underway for this major relocation effort since DR will begin use of each building as soon as it becomes available for occupancy, independent of the other buildings' construction schedules.

Concert Hall 1:10 Scale Model Acoustical Testing

Early last year, as a predecessor activity to the start of the concert hall's construction phase, Nagata Acoustics used a scale model of the concert hall to perform acoustical testing of the planned design's acoustical characteristics. In a corner of the project's job site, the construction crew erected a temporary enclosure and built us a 1:10 scale model for this purpose. While we brought most of the scale model's acoustical measuring equipment from Japan, the scale model's enclosure, the detailed scale model, monitoring cameras and lighting adjustment devices, proposed interior wall treatment alternatives and the nitrogen tanks used during testing were all procured and built locally under the supervision of a single Danish architect hired to manage this piece of work. The duration of the scale model-related tasks lasted a half year from the start of the scale model's construction through the end of our testing inside it.



Figure 2: 1:10 Scale Model

The advantage of scale model testing is that real sound can be propagated in the scale model, and the sound-wave patterns that result can be observed and analyzed by the acoustician. The acoustician can also listen directly to the way the sound waves behave in the scale model. In the Danish Radio Concert Hall scale model, we set up both directional and omnidirectional speakers and both omnidirectional and bidirectional microphones designed specifically for acoustical testing. This robust assortment of equipment gave us the ability to select at will the right combination of equipment needed for each test.

We tested in the scale model with 2 sound sources placed at different positions on the stage. Since the new concert hall's right and left sides are asymmetrical, we measured the acoustical characteristics at a total of 43 different stage and audience seating locations. We gave scrupulous care to checking the ceiling and interior wall shapes for

the undesirable phenomenon of echoes and, based on our testing results, we altered the angle of the terrace walls in several places. In addition, we used scale model test results to finalize the surface area dimensions for sound absorbing materials. Then, as the last round of scale model testing, we filled the scale model with nitrogen to measure the scale model's sound reverberation characteristic, successfully confirming that the scale model values approximated our reverberation time objective for the concert hall.

In addition to our acoustical testing, the 1:10 scale model has also been used for evaluations of architectural design elements and lighting considerations for the concert hall. I continue to step inside the scale model, from time to time, in the course of meetings and discussions, and I consider it an outstanding design management tool.

Proximity to a Train Station and Our Anti-vibration Strategy

The segment (4) site is located near a subway line train station. The portion of the train line nearest the site runs along an elevated track that comes within 20 m. (66 ft) of the concert hall building (measured as a straight line from the railroad track to the building). Our investigation of the situation revealed that the subway lines are relatively small in size and, luckily, do not generate enough noise to need a sound isolation mitigation strategy. The vibration from the passing trains, however, is significant and required our design attention to prevent transmission of the vibrations to the concert hall.

For our anti-vibration strategy, we installed a layer of water-repellent rock wool, below ground level, against the perimeter of the building's concrete structure. The accompanying photo shows the rock wool layer being applied to the concrete wall before being covered with soil. This anti-vibration technique is rarely used in Japan, but buildings in the vicinity of DR Byen and structures in other countries provide examples of its successful implementation.



Figure 3: Rock Wool Barrier

On a personal note, I took up residence in Copenhagen last April to manage Nagata Acoustics' on-site acoustical design and related construction management tasks. In the Nordic metropolis of Copenhagen, winter is already upon us. Still, it is a wonderful time to visit Denmark. I hope you will make the opportunity to do so, at this season or at another time.

The DR Byen project's home page on the Web is at

<https://drkoncerthuset.dk/dr-koncerthuset-english/guided-tour-in-dr-byen-dr-koncerthuset/>