The Hong Kong Cultural Centre Halls - Acoustical Design and Measurements

A. Harold Marshall, Johan L. Nielsen, and M. Miklin Halstead

Acoustics Research Centre, University of Auckland, New Zealand.

Abstract: The main performance spaces in the Hong Kong Cultural Centre comprise the Concert Hall, seating 2000 and the Grand Theatre seating 1700. The design of the former is derived from the Christchurch (NZ) Town Hall which it develops in several important ways, while the latter is a Lyric Theatre/Opera House with several unique features. Design process, including modelling, acoustical measurement on building components developed for the project and recent measurement results are described in this paper.

INTRODUCTION

The Hong Kong Cultural Centre was opened in November 1989. Its two major halls provided the opportunity to apply current research to achieve significantly different impulse responses at typical seats in the two spaces. High early energy in the Grand Theatre for vocal clarity with a relatively long reverberation time in support of singers, was contrasted with a more uniform energy distribution the Concert Hall as would be more appropriate for the Symphonic repertoire. The design process for both halls was undertaken in the following phases: graphical architectural design, optical model studies, calculation, acoustical model studies at a scale of 1:50 using the MIDAS program for digital data acquisition, absorption measurements on ceiling panels and QRD reflectors at full-size, and detailed commissioning measurements at completion. A recent stage extension was reported to have affected the orchestral sound and this gave the opportunity to repeat the measurements in both halls with a significantly improved technique. More than 1000 impulse responses were captured during our recent visit. These measurements are reported here.

THE CONCERT HALL

The Concert Hall is equipped with a Rieger Organ and this requires a measure of adjustability in the reverberant conditions. Approximately 200 m² of adjustable absorption was designed for this purpose. This material can be rolled out over a 100mm subdivided air space on the upper side walls (in the reverberant volume) and preferentially absorbs the mid and low frequencies, unlike most deployable drapes which tend to be more effective at high frequencies. It is deployed for the symphonic repertoire and rolled away for Organ concerts.

Like the Christchurch Town Hall the floor plan is roughly elliptical with, in this case a degree of asymmetry toward the rear, reflective of the asymmetry of the orchestral radiation. The upper reverberant volume is separated from the lower by large suspended reflectors surfaced by QRDs. These differ in form from those in Christchurch (as will be illustrated) with the intention of giving more uniform impulse responses between the balcony and stalls (orchestra) seats, avoiding too early or too energetic lateral reflections, and coupling the upper reverberant volume with the under-balcony seats. Ensemble reflections are provided by a large over-stage reflector/lighting frame with a 2-d QRD. Design objectives were to optimize RT/EDT ratio, Lateral energy fraction and C80 for the symphonic repertoire.

FIGURE 1. Concert Hall
THE GRAND THEATRE

Our solution was aimed at producing the high level of early energy required for opera by (predominantly lateral) reflectors and maintaining the desirable reverberant field for the singers with a high and diffusing ceiling. The task was complicated by the fact that the overall rectangular shape was already fixed at the time of Marshall Day Associates’s appointment. (The piling was already in place).

Figure 2 is a photograph of the 1:50 model in which the effectiveness of the design was proven using MIDAS. The entire space between the panels shown is covered with prefabricated glasscrete QRD ceiling panels with prime 7 and a design frequency of 500 Hz. The absorption coefficient of these panels was measured in the Reverberation Chambers of the Acoustics Testing Laboratory and was found to be negligible. The desired early energy ratios with high subjective clarity, were achieved in a considerably longer reverberation time than is usual in Opera halls and the space was well received by the Cologne Opera Company whose singers particularly appreciated the reverberance.

The following graphs compare the acoustic properties of the two spaces. Results are averages at 13 positions from a stage centre source position.

Additional results will be presented in the expanded form of this paper. In total the results indicate that the specific design objectives for the two halls respectively have been realized.

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REFERENCES
