CONCERT STUDIO FOR THE BBC PHILHARMONIC ORCHESTRA AT MEDIACITYUK, SALFORD

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1 INTRODUCTION

This paper describes the acoustic design of a new concert studio for the BBC Philharmonic Orchestra at MediaCityUK, in Salford, Greater Manchester. The studio was completed and commissioned on October 2010 with the BBC Philharmonic moving in permanently in May 2011.

The concert studio is within a Studio Block which also contains seven TV studios and a multi-purpose audio studio. The Studio Block was developed by The Peel Group and is operated by Peel Media Ltd with the concert studio, five TV studios and the multi-purpose audio studio leased to the BBC.

The principal design and construction team members were: Fairhurst Design Group (Architect); AECOM (MEP Engineer); Jacobs (Structural Engineer); Bovis Lend Lease (Contractor) and Gleeds (Cost Consultants and Project Management). Sandy Brown Associates were appointed as a sub-consultant to AECOM. The BBC appointed Akustikon/Gade & Mortensen to review the design and assist with commissioning on behalf of the orchestra.

2 PREVIOUS STUDIO

Studio 7 at New Broadcasting House, Oxford Road, Manchester was the home of the BBC Philharmonic Orchestra for 30 years. The studio was used for recording, rehearsals and live broadcast concerts with an audience of up to 250 people. The studio had a flat floor with loose movable risers for staging. Bleacher seating accommodated audiences for concerts but was normally retracted during recording sessions and rehearsals

The gross internal dimensions were L: 26.6 m, W: 22.2 m, H: 14.025 m with a volume of 8282 m^3 and floor area of 590 m^2. A 0.3 m zone within this was used for sound absorbent treatments, diffusing fins and for ventilation routes, which resulted in an effective net floor area of approximately 560 m^2.

The studio was well regarded for recording and considered by sound engineers to have a ‘balanced acoustic with minimal colouration’. Musicians had a less favourable opinion of the studio with regard to the ease of hearing each other.

Measured reverberation times in the studio are shown in Table 1. Measurements were made with the room unoccupied but with musician stands, chairs and percussion instruments present.

Table 1 – Measured reverberation times in Studio 7, Oxford Road, Manchester (August 2007).

	$T_{30,mid}$, s	$T_{30,(125\text{-}250\ Hz)}$, s
Seating retracted	2.0	1.7
Seating exposed	1.9	1.6

An average Early Support, ST_{Early} of -15.1 dB was measured on the stage area when set up for a typical orchestra rehearsal. A photograph showing the studio is provided in Figure 1.

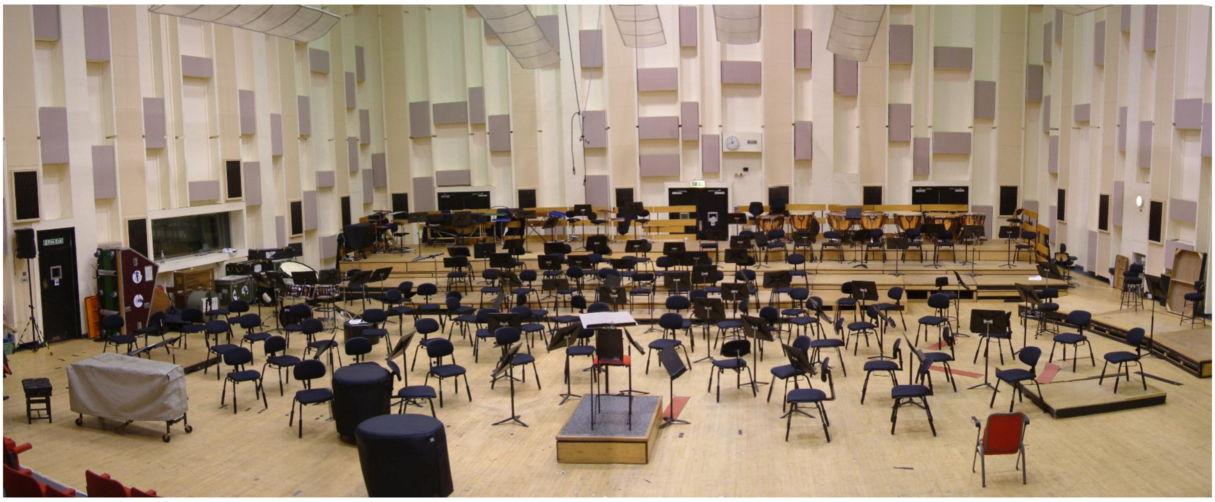

Figure 1 – Previous Concert Studio at New Broadcasting House, Oxford Road, Manchester

3 BRIEF FOR NEW CONCERT STUDIO

The new Concert Studio was specified to have variable acoustic treatments to enable the following reverberation time conditions to be achieved:

1) Live Condition, T30 (average 250-4kHz) to be greater than 1.8 s in an occupied state with audience.
2) Dead Condition, T30 (average 250Hz–4kHz) to be less than 1.6 s in an unoccupied state with audience seating retracted.

The studio was to provide suitable conditions for an orchestra and be able to provide stage conditions to provide ease of ensemble and ease of hearing for musicians.

The background noise level was to meet BBC criteria GT0. This provides maximum 1/3 octave band sound pressure levels, which are approximately equivalent to an A-weighted sound pressure level of 22 dB, along with requirements for controlling tonal, temporal and spatial variations.

4 NEW CONCERT STUDIO CONSTRUCTION

4.1 Dimensions and layout

The new concert studio has internal dimensions of L: 26.8 m, W: 22 m, H: 16.5 m with a volume of 9728 m^3 and floor area of 590 m^2. The floor area is therefore similar to the previous studio but with a larger volume.

The layout is arranged so that the studio is buffered from other studios and service areas by corridors and other rooms. A stage takes approximately half of the floor area with the remaining floor area available for bleacher seating, or for larger orchestra layouts when required. The general arrangement is shown in Figure 2.

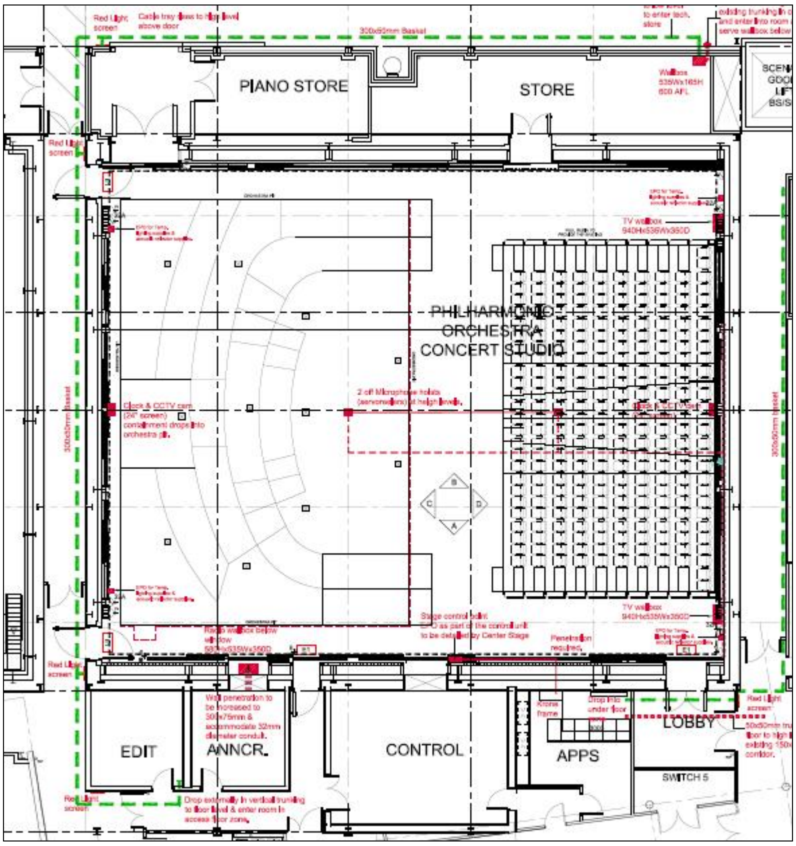

Figure 2 – Plan of New Concert Studio

4.2 Shell construction

The structural floor is concrete on piles with a floated concrete floor above on jack-up isolation mounts. A stage pit is provided to house mechanical risers for an adjustable stage, as indicated in Figure 3.

The walls are a cavity construction of floated dense blockwork inner leaf with an independent plasterboard outer leaf with mineral fibre cavity insulation. The studio has a lid of concrete on profiled metal decking to complete a floated inner box. A concrete roof is located above this. Air supply ducts drop along the two side walls and these are boxed with 2 layers of cement board and 2 layers of plywood to reduce low frequency resonance. All door access is lobbied and wide-air spaced angled double glazing is used to the control and announcer rooms and high level internal viewing windows.

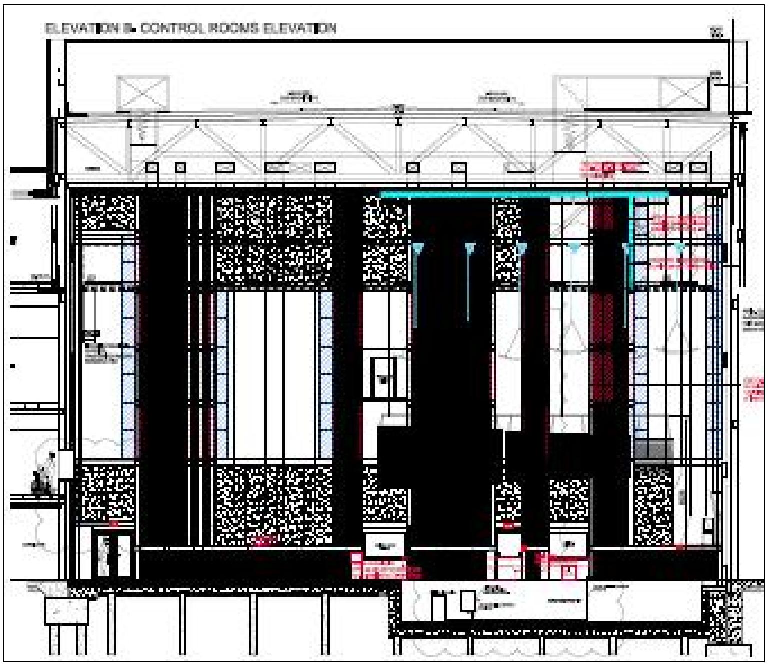

Figure 3 – Long section of studio showing pit for stage

4.3 Ventilation and lighting

The studio is air conditioned using a displacement system with a roof mounted dedicated air handling unit. The air supply is fed through sound insulating ductwork at roof level via the roof void and ductwork to low level grilles along the side walls. High level extracts return air through attenuated ductwork through the studio lid and roof void.

High frequency fluorescent lighting is used for general lighting and this is supplemented by smaller adjustable task lighting fixed within the orchestra canopy.

5 ROOM ACOUSTICS

5.1 Finishes and acoustic treatments

The floor finish is solid timber directly fixed to the floated concrete floor for the non-stage areas. The end walls are of painted blockwork. The side walls are of painted cement board. The ceiling is an exposed soffit of profiled metal decking supporting a concrete lid.

Three types of sound absorptive treatment are employed:

- Panels of medium-high sound absorber of 50 mm melamine foam
- Low frequency absorbers of BBC ‘D2’ modular boxes
- Movable ‘duvets’ of 100 mm thick fabric-wrapped mineral fibre panels on sliding rails.

Bands of slatted timber positioned 0.3 m from the walls are used to provide surface scattering. The slats are open where over untreated wall and foam panels and backed by plywood where they conceal movable duvets. Behind the open slats, the foam panels are arranged in patches on the painted walls to provide diffusion through impedance differences. A photograph of treatment on the wall behind the stage treatments is shown in Figure 4.

At high level, the concrete lid has a profiled soffit on which patches of foam absorbers and D2 modular boxes are arranged.

Figure 4 – Photograph of wall treatments

5.2 Stage design

Design of the stage was carried out in close collaboration with representatives of the BBC Philharmonic Orchestra. The design intent was to provide a defined stage area with tiered risers to minimize distances provide clear lines of sight between orchestra members. To achieve this, the starting point of the design was a tiered semi-circular riser arrangement, similar to that used at halls such as the Berlin Philharmonie, Muza Kawasaki Symphony Hall, Tokyo and the Walt Disney Concert Hall, Los Angeles.

The BBC Philharmonic Orchestra regularly tour internationally so are familiar with different stage types and arrangements. During the development, an initial riser layout, following the semi-circular form was marked out on the flat floor of the existing concert studio and the Orchestra arranged themselves for rehearsals for a week. The feedback from this exercise was informative. It illustrated that the simple semi-circular arrangement limited the space available for musicians. While musicians were prepared to accept space constraints when performing on tour, when they may only need a few hours on a stage, they did not feel it was suitable for everyday rehearsals. In many of the halls with semi-circular risers visited by the orchestra, risers provided insufficient space for cellists and double bassists to use spikes on the stage. This meant extension pieces were required to hold instrument spikes off stage risers so players lost the low frequency resonance assistance often provided by risers. The BBC Philharmonic also plays a wide repertoire of music which often requires use of large or unusual instruments, which they like to be able to locate towards the side or rear of the orchestra. The riser layout was therefore developed to provide sufficient space and flexibility for the different uses.

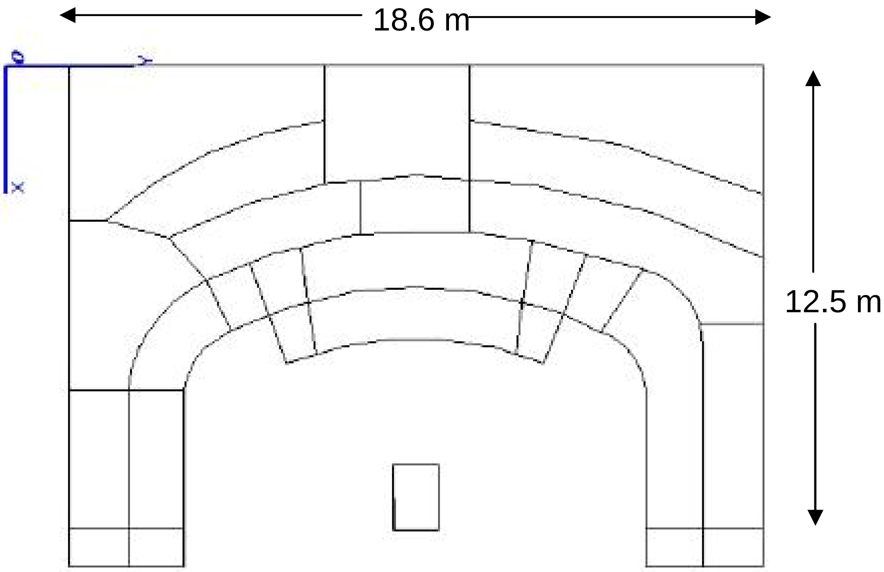

Figure 5 – Sketch plan of stage riser layout

All main risers are mechanically operated from a central control. Loose 1 m wide extension pieces are also provided for addition during pieces requiring extra musicians. Each riser is adjustable with a step height of up to 0.3 m.
To assist with resonance, 38 mm solid timber on 300 mm battens is used for areas designated for cellos and double basses. The remaining stage floor is a 38 mm laminated construction of timber on a plywood backing.

5.3 Orchestra reflectors and diffusers

To the rear of the stage a timber reflector with applied battens of different dimension is used to provide surface scattering. The upper half of the reflector is to be angled and be adjusted during tuning with the orchestra.

To the sides of the stage, timber reflectors with applied battens are suspended and angled downwards and forwards. These provide early diffuse reflections and reduce early decay time on the stage. Forty five acrylic reflectors with dimension of 1.8 x 0.8 m and a thickness of 10 mm are arranged over the orchestra with increased numbers over the strings to provide more support where needed. These are suspended at the corners to curve under their own weight. The overhead and side reflectors are suspended on mechanically operated hoists which are set using the same central control as for the stage risers.

A photograph of the stage with risers at full-height showing the side and overhead reflectors (prior to tuning) is shown in Figure 6.

Figure 6 – Side view of stage with side and overhead reflectors (prior to 'tuning')

6 TUNING & COMMISSIONING

6.1 Subjective tuning

As part of the commissioning process, acoustic tests were carried out with the orchestra during three days in September and October 2010. The first day's testing was carried out with a small orchestra playing Mozart and Schumann/Holloway pieces. The overhead reflectors were adjusted in height and feedback from the orchestra indicated a preference for lower reflector heights than anticipated. The curvature of the reflectors was greater than expected and it is thought that this reduced harshness even with very low reflector positions.

A second day of testing was carried out with a full orchestra playing Rachmaninov's 2nd Symphony. Musicians completed a subjective questionnaire, provided by Akustikon/Gade & Mortensen, to rate different configurations of reflectors, stage positions and absorption. The results of this testing were used to optimise the reflector positions and variable absorption settings. These were set for the final day of testing to ensure that the orchestra was happy with them. Initial feedback from the BBC Philharmonic has been positive, particularly in respect to the ease of musicians hearing each other.

6.2 Objective measurements

6.2.1 Reverberation times

A summary of the measured reverberation times with in various configurations for comparison with the brief requirements is presented in Table 2.

Table 2 - Summary of RT results in Studio with Orchestra

Configuration	Variable Absorption	Bleacher Seating	Requirement	RT, s (average 250Hz –4 kHz)
A	Dead (All panels exposed)	Occupied	RT ≤ 1.6	1.44
B	Live (All panels hidden)	Occupied	RT ≥ 1.8	1.81
C	Dead (All panels exposed)	Seating exposed	RT ≤ 1.6	1.47
D	Live (All panels hidden)	Seating exposed	RT ≥ 1.8	1.86
E	Dead (All panels exposed)	Seating retracted	RT ≤ 1.6	1.60
F	Live (All panels hidden)	Seating retracted	RT ≥ 1.8	1.86

6.2.2 Early support

During the commissioning tests, average Early Support, ST_{Early} values of -11.6 and -12.2 dB were measured on the stage area with absorbent panels fully exposed and fully retracted respectively. However, further tuning was undertaken following the measurements which resulted in increased height of the overhead reflectors. It is therefore proposed to repeat measurements during May 2011 to be presented at the Auditorium Acoustics 2011 conference.

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