THE ACOUSTIC DESIGN OF THE ROYAL WELSH COLLEGE OF MUSIC AND DRAMA

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1 ABSTRACT

In May 2011, the Royal Welsh College of Music and Drama is to open significant new facilities for teaching and performance on their campus in Cardiff. These include a 450 seat concert hall, a 160 seat training theatre and four movement and drama studios. Since 1949, the college has been providing specialist practical and performance-based training in music, acting, theatre design and stage management. The college has nearly 600 students with previous alumni including Sir Anthony Hopkins,Ruth Jones and Rob Brydon. The new facilities will raise the profile of the college as an international conservatoire as well as enhancing opportunities for local professional and amateur groups that contribute to Cardiff's vibrant cultural life. This paper presents the acoustic design of the concert hall and the theatre for both performance and rehearsal, including the integration of a variable absorption system.

2 INTRODUCTION

The Royal Welsh College of Music and Drama, Cardiff was established in 1949, providing specialist practical and performance-based training in music, acting, theatre design and stage management. Existing facilities include a black box theatre, studio theatre and a several 80 seat recital room as well as a number of practice rooms and classrooms. Until the opening of the new facilities, the college symphony orchestra and larger ensembles rehearsed and performed in a local church and occasionally in St David's Hall.

The site for the new building was identified as an area within the existing college boundary, but essentially a zone being used as a car park.

The new facility includes a 450 seat concert hall, a 160 seat fly tower theatre, named after actor Richard Burton and four movement and drama studios. This paper focuses on the acoustic design of the concert hall.

3 ACOUSTIC CRITERIA

The concert hall is expected to be used for a variety of events but the brief made it clear that it was to be designed with no compromise regarding its primary use, namely recital, chamber music and chamber orchestra (up to 40 players) performance and rehearsal.

The hall is also required to accommodate larger orchestral forces and a choir, primarily for rehearsal, by extending the stage and removing seats. However, the college appreciates that given the volume of the space, loudness levels will be significantly higher than desirable and reverberance significantly lower than desirable for a large orchestra, and does not intend to use the hall for performance by large ensembles.

The hall is required to accommodate amplified performances of contemporary classical, jazz and spoken word events, such as lectures or podium discussions, using amplification. A variable acoustic system will be used to tailor reverberation and reverberant loudness accordingly.

The acoustic design target was for an occupied reverberation Time of 1.6 – 1.8 seconds for an occupied chamber orchestra concert.

The background noise criterion was specified at NR15 for noise from building services and intrusive noise from environmental sources. The hall is located on the boundary between a busy four lane road to east and a quiet park to the west.

4 SOUND INSULATION

The stringent background noise level is necessary to create a high quality environment for rehearsals and performances to both students of the college and the fee paying public. The site is adjacent to the A470, one of the main roads into Cardiff from the M4, so significant sound insulation was required. In addition to controlling intrusive noise, it was important to ensure that events in the concert hall do not disturb creative activities in other parts of the building such as the training theatre and drama studios.

For structural reasons, the concert hall walls are formed from a ‘drum’ of 400mm thick reinforced concrete, which is independent of the surrounding building elements. The drum is buffered by circulation routes and dressing rooms, providing additional control over intrusive noise. The hall has a 300mm thick concrete lid which is independent of the mass loaded roof which sails across the entire building.

To achieve an architecturally clean ceiling and control noise from performance lighting, the technical walkways and lighting gantries are positioned above a multi-layered plasterboard ceiling which contains five glazed panels for focusing light through.

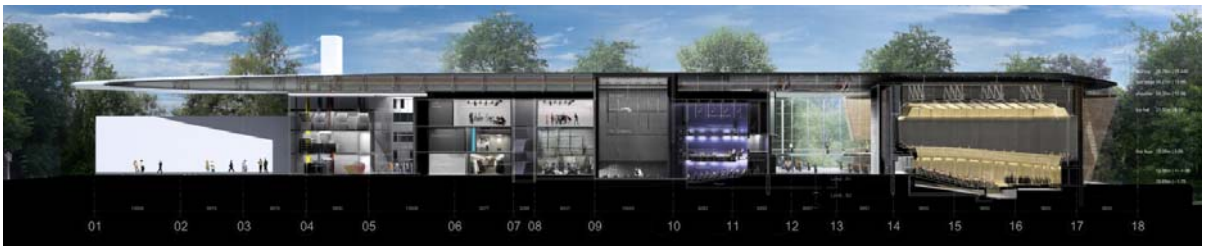


Figure 1: Long section through the entire building

5 VENTILATION DESIGN

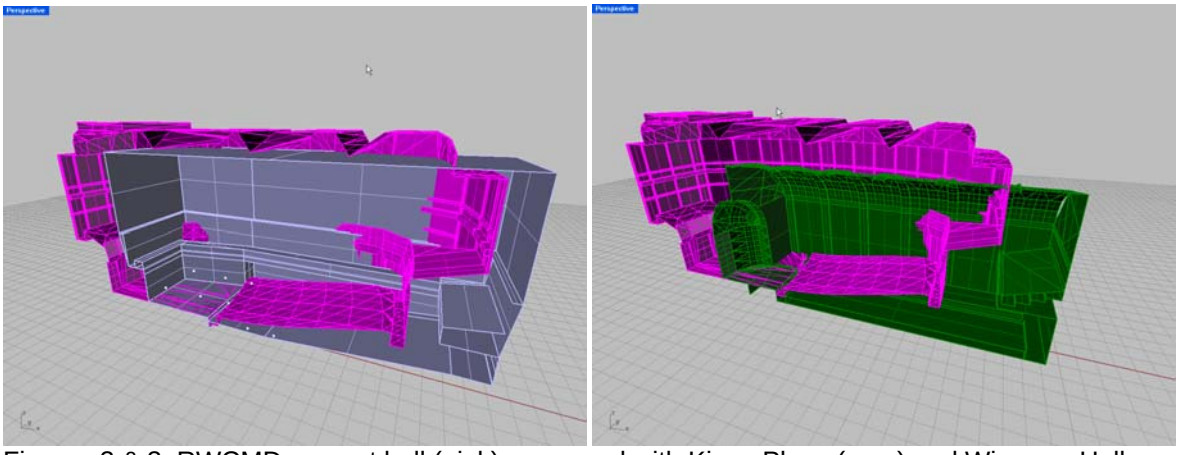
To maximize the efficiency of the ventilation system whilst keeping air velocities low, the concert hall is served by a displacement system.

Fresh air is drawn in from the quiet park side of the building into a basement plant room and then fed into a plenum beneath the stalls rake. Warm air is drawn out at high level via perimeter slots into the technical zone which serves as a return plenum.

6 ROOM ACOUSTIC DESIGN

One of the key acoustic design concepts for the hall was to maximize the volume to control loudness, adding strategically placed fixed sound absorbing surfaces where necessary to achieve appropriate reverberance for the primary use. This is a commonly adopted strategy in many of the Japanese recital halls.

The volume of the concert hall is 5000m^3 giving a volume per seat of 10.2m^3 with a full audience and 40 piece orchestra. In comparison, Kings Place in London (420 seats) is 3540m^3, and Wigmore Hall (544 seats) is 2900m^3.



Figures 2 & 3: RWCMD concert hall (pink) compared with Kings Place (grey) and Wigmore Hall (green)

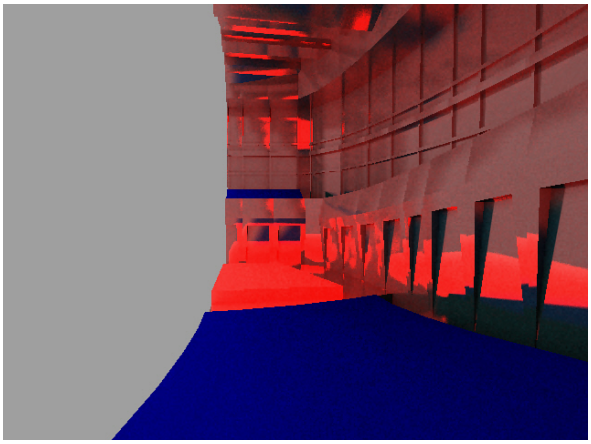
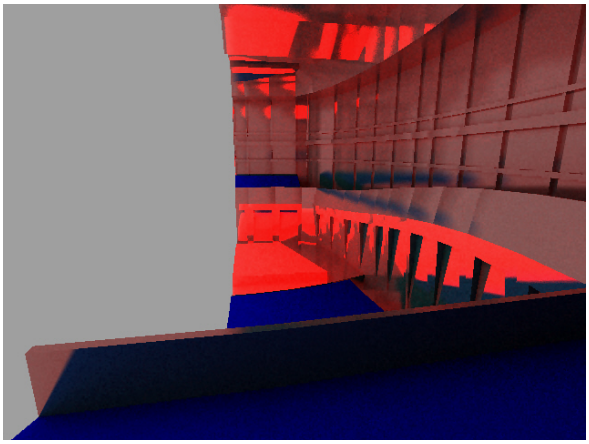
The hall is essentially a shoebox with a modest rake and gently curving side walls. A single balcony wraps around the entire space. This is also raked towards the front to allow the choir seating to be closely integrated with the musicians on the platform. The choir stalls may also be used to seat audience along with the remaining zones around the balcony, helping to enhance the intimacy of the performances.

The height of the ceiling above the platform is 12.5m. The decision was taken that a suspended orchestral refection canopy was not necessary in a room of this size given the proximity of useful sound reflecting surfaces around the fan shaped 14m wide platform.

Flexible orchestra arrangements are facilitated by the use of three rows of manually operated 'Nivoflex' platforms across the rear half of the performance area. These help avoid the need for storage for modular orchestral risers. For performances or rehearsals of large ensembles, the platform may be extended using a forestage elevator and by removing the front two rows of seating which store beneath the platform.

The platform walls gently curve out from the rear wall at around 10^o. This helps to control the risk of flutters across the platform, as well as helping to project the music from the performers towards the audience.

Early acoustic modeling studies were carried out to investigate and optimize the distribution of lateral reflections. The red areas in the figures below illustrate the key sound reflecting surfaces. Note that the balcony fronts have been angled back to direct reflected sound up into the room volume. In a room of this size, the balance of early energy can often outweigh reverberance, so shaping and angling the balcony fronts can help address this.

Figures 4 & 5: Distribution of reflected sound when seated at the rear of the stalls and in the balcony

The low level walls around the stalls and the platform have a timber diffusing finish to aid string tone, to control harsh reflections and to diffuse sound throughout the space. This is achieved by routing grooves of different depths into timber panels which are rigidly mounted against the masonry walls and even across the doors.

Figure 6: Installation of low level timber paneling

'Columns' connecting the stalls floor with the balcony front provide a geometrically changing reflecting surface, and provide for a narrow horizontal shelf, useful for providing 'cue-ball' reflections to the stalls.

7 VARIABLE ACOUSTIC SYSTEM

To achieve variation in the room acoustic response for amplified or spoken word events, electronically operated wool serge banners can be deployed via a weighted bar system from the technical gantry area to cover all of the upper walls. Each banner is in the region of 1m wide and can be lowered to any height required. This provides huge flexibility which will be narrowed down to 4 or 5 'modes' during the acoustic commissioning process.

Diffusion in the form of vertical timber members of various spacing and depth were applied to the painted concrete at high level to control harsh reflections when the variable absorption is retracted. All painted black, these give the impression of a flowing drape around the perimeter of the room.

The upstage wall of the performance platform may also be made sound absorbing by an operable sliding slat arrangement as illustrated below. This facilitates a sound absorbing platform surround (as required for amplified performances) without significantly altering the visual appearance of the platform.

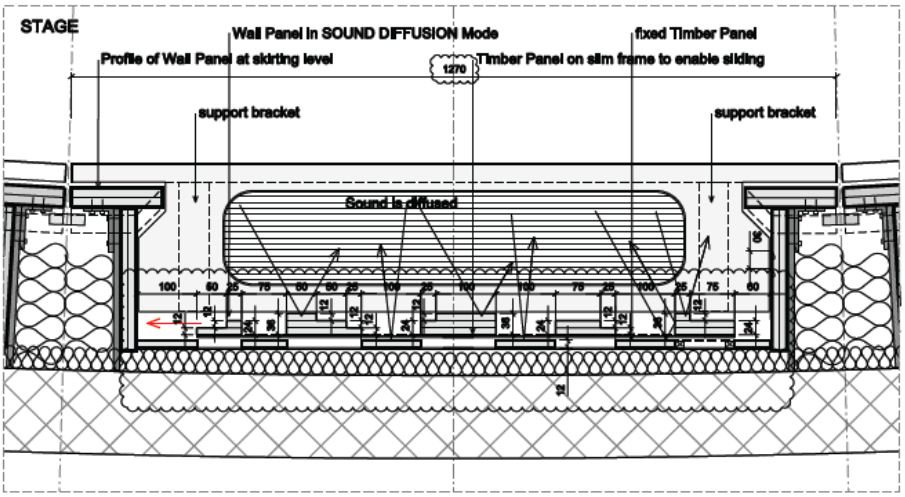


Figure 7: Plan of sliding slat arrangement on platform surround (diffusing mode)

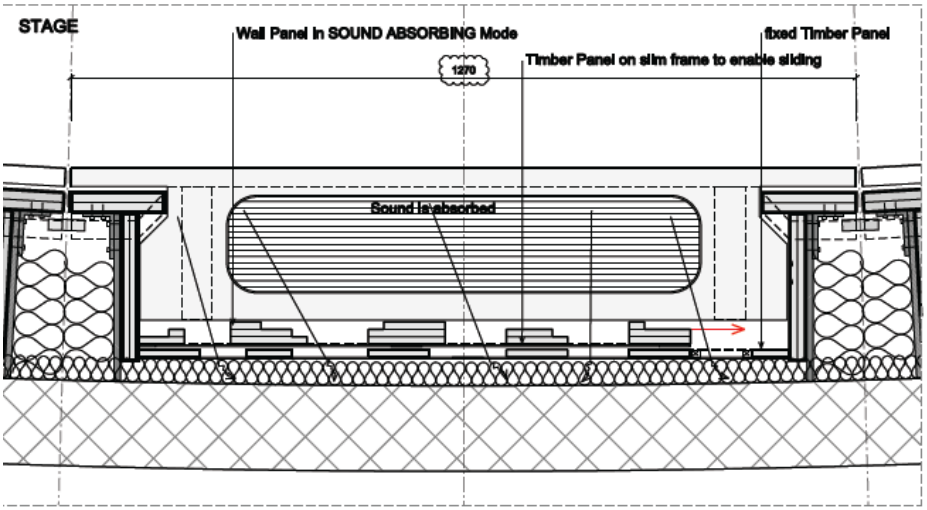


Figure 8: Plan of sliding slat arrangement on platform surround (absorbing mode)

Special thanks to Anne Heuke and Paul Bavister of BFLS for their collaboration in developing these details.

8 FINAL RESULTS

At the time of writing, the hall is not yet complete. A detailed programme of objective measurements and critical listing during rehearsals and performances of different styles of music is proposed in May 2011.

9 ACKNOWLEDGEMENTS

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