NEW SOUNDS IN OLD BUILDINGS: REFURBISHING FOR THE PERFORMING ARTS

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1 INTRODUCTION

In the last few years, ambitious plans for new concert halls and theatres have been shelved and what money is available has been invested in refurbishing old buildings to provide facilities for the performing arts.

This paper gives examples a number of old buildings that have been, or are in the process of being, refurbished to provide performing arts venues. The dates of the buildings range from the 1700's to the 1960's and each has its own specific acoustic requirements. Key issues involve improving sound insulation, introducing quiet ventilation and optimising room acoustics whilst at the same time preserving the architectural heritage of the building.

2 ST GEORGE'S CHAPEL, GREAT YARMOUTH

St George's Chapel, located near the centre of Great Yarmouth, is a Grade 1 listed building which was built in 1715. It was modelled on St Clement Danes church in London which was designed by Sir Christopher Wren. The chapel became redundant in 1971 and was used for some time as an arts centre but then fell into disrepair.

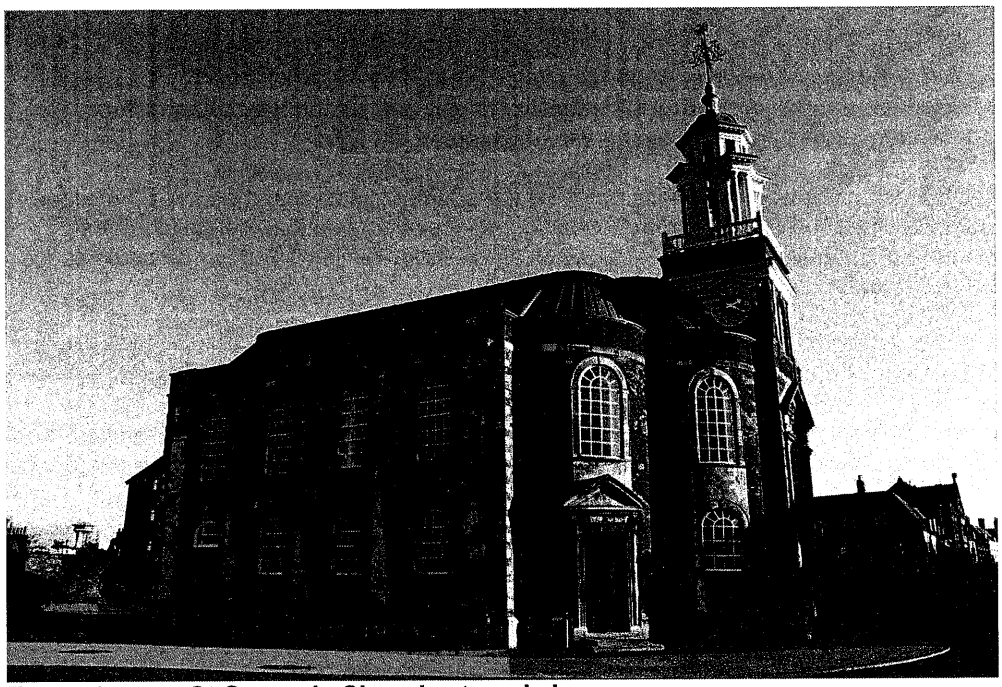

Figure 1 St George's Chapel external view

The opportunity to refurbish the Chapel came from a variety of funding sources including CABE's Sea Change programme, the Heritage Lottery Fund and English Heritage.

The intended uses of the Chapel include classical music recitals, amplified music events, dance, drama and a variety of related civic functions.

Initial surveys of the chapel by the architects led to a strong desire to retain the intricate timber structure supporting the roof as an important visual feature. The alternative was to re-instate the barrel-vaulted plaster ceiling which had been removed.

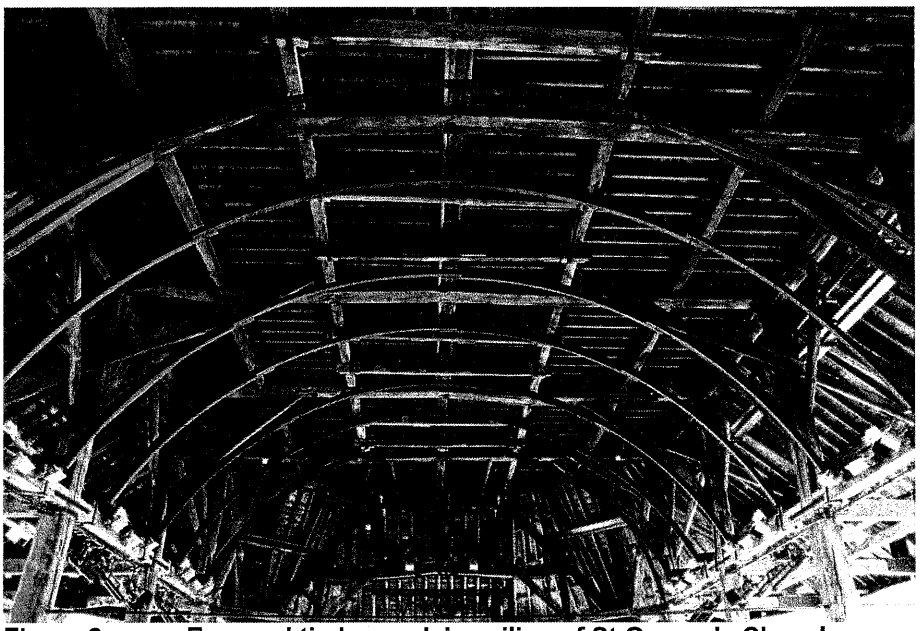

Figure 2 Exposed timberwork in ceiling of St George's Chapel

From an acoustic aspect, the exposed timberwork would provide strong diffusion of sound from the ceiling area which was highly desirable. A barrel vaulted plaster ceiling would be too acoustically reflective and could cause focusing. Thus the acoustic requirements supported the architect's intentions and this design was accepted by the various interested parties.

A major part of the acoustics work involved improving the sound insulation of the chapel envelope to provide a quiet background internally. Improved sound insulation would also help to control sound breaking-out of the building, for example when amplified music is played, which could cause disturbance to neighbours.

As the roof was being re-clad in any case as part of the refurbishment, there was an opportunity to add two layers of heavy boarding in the build-up to provide the necessary sound insulation.

All the large arched windows in the chapel were repaired and sealed and secondary glazing added to block these potentially weak acoustic paths. Also, all the entrance doors were lobbied and doors fitted with acoustic seals.

Ventilation is always a challenge in the acoustic design of buildings: when it is mechanical it can cause noise, and when it is natural, it can let in external sounds.

In the case of the chapel refurbishment, natural ventilation will be the norm although this will be assisted by an extract fan when necessary. So there was potential for external noise ingress and also fan noise.

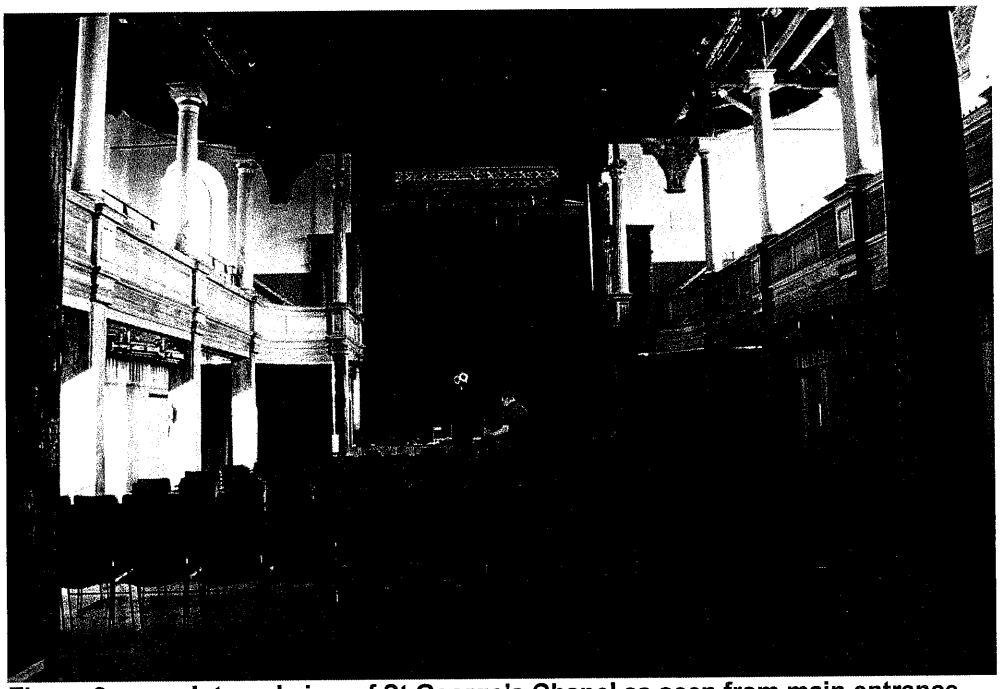

Figure 3 Internal view of St George's Chapel as seen from main entrance

The path for natural ventilation uses two of the arched windows, one on either side of the chapel. The semi-circular tops of these windows can be opened to let in fresh air but to prevent the ingress of noise at the same time, the air is routed through a labyrinthine duct which is lined with acoustic absorption. Exhaust air can pass out through the tower of the chapel. The tower also contains the exhaust fan at the top, the noise from which is reduced by a 3m long sound attenuator.

St George's Chapel has now been renamed St George's Theatre and is putting on a wide variety of performing arts events.

3 HORNSEY ROAD BATHS, LONDON

A Victorian baths and laundry facility on Hornsey Road in Islington, London has been transformed into an arts venue for young people and has been named 'Platform'. This regeneration project was paid for with a government grant and the design was heavily influenced by the young people in the community.

The original baths were completed in 1895 and included swimming pools, slipper baths, a washhouse and a laundry – they became one of the largest bathing facilities in the UK. The building sustained bomb damage in the Second World War but was repaired and re-opened in the 1960's. The baths were finally closed in 1991 and became derelict. In the last decade, regeneration projects have sprung up in different parts of the complex including apartments, offices and now include the new youth performance space 'Platform'.[1]

[1] Katrina Scherebnyj, Hornsey Road Baths New Spaces for Old – Acoustic Considerations, Ramboll Technical Journal Volume 3 (2011)

Figure 4 Hornsey Road Baths

The Client's requirements and the brief were prepared with input from 400 young people in 2008. The new venue has a target range of 13 to 19 years old, and includes:

- A multi-purpose and flexible space for performance (music, drama, dance);
- A multi-purpose room for amplified music;
- A café;
- A music studio;
- Rehearsal studio for fitness/yoga plus ancillary studio spaces

The Client also required that all spaces must be usable concurrently, without limitation.

The planning officer raised the following issues at the outset:

- building conservation: the building is grade II listed;
- sustainability: sustainable solutions must be sought wherever possible;
- noise: neighbouring occupants of flats must not be disturbed.

The above requirements led to the following aims for the conversion of the baths into a performance venue:

- suppression of noise egress from the building so that the requirements of the planning authorities were met and local residents would not be disturbed;
- control of noise transmission between spaces so that activities could be carried out simultaneously without mutual disturbance;
- suitable acoustic environments within spaces to match the use of those spaces;
- reduction of noise ingress into the building to provide a suitably low background noise level.

The dominant acoustic requirement was sound insulation of the building envelope to meet the planning condition imposed on noise egress. The nearest neighbouring apartment is only a few metres distant so all the sound insulation would have to be provided by the building envelope.

The traditional slate roof was the most critical element and this was stripped and the supporting trusses overlaid with two layers of cementitious boarding with a 200mm cavity in between. The slates were replaced for heritage reasons.

The original sash windows in the building had to be retained and these were sealed and secondary acoustic glazing with a deep cavity installed. In addition, all external doors were lobbied and acoustically rated.

Internal sound insulation requirements were governed by the requirement to be able to use all spaces simultaneously without disturbance.

The basic Victorian construction of the building was very robust with heavy masonry walls and thick concrete slabs. For example, the main slab between the upper and lower spaces of the laundry building was several hundred mm thick so it became obvious to use this to separate the amplified music space from the non-amplified music/drama space.

New walls to separate internal spaces were also built of masonry to match the performance of existing walls and acoustic doors were installed into acoustically sensitive spaces and lobbied where necessary. A specialist box-in-box construction was used for the recording studio.

Room acoustic criteria were set for the various spaces based on their proposed uses. For example, the reverberation time criterion in the performance space on the upper ground floor was set at 0.8 – 1.2 seconds. The shape of the space namely, rectangular in plan with a pitched roof, lent itself well to providing good acoustics. To enhance sound diffusion, a wall lining of timber slats was added which was made absorbent on the rear wall. Drapes were added to provide some acoustic variability.

The scheme has been very well received and has its motto "I am the creation of your imagination". It was highly commended by the Royal Institution of Chartered surveyors in their London region awards in 2012.

Figure 5 Views of Auditorium in Hornsey Road Baths

4 WILTON'S MUSIC HALL, LONDON

Wilton's music hall is the oldest serving music hall in Europe and is Grade II listed. It is a unique building comprising a mid-nineteenth century grand music hall attached to an eighteenth century terrace of three houses and a pub. The popular music hall star '*Champagne Charlie*' used to perform here in its nineteenth century heyday. Amid the peeling paintwork there are frescoes of ladies playing flutes and sitars, recalling the days of the East India Company and the 19th century gentlemen who came here to indulge their darker sides.

Towards the end of the nineteenth century it was converted to a Methodist Mission and subsequently managed to survive the slum clearances of the 1960's. In 1997 it was re-opened as a theatre and concert hall.

Figure 6 Wilton's Music Hall

In 2012 Wilton's received funding which is aimed at securing the fabric of the building for future generations. The first phase of the work was to refurbish the music hall itself.

The fundamental acoustic problem with the hall was poor sound insulation. It was built according to fairly conventional Victorian house building techniques using brickwork walls, timber rafters and a slate roof. Windows in the stage-house and at the rear of the auditorium were conventional sash windows. A number of penetrations in the walls for fire exits made the sound insulation even poorer.

The dominant external noise is from the Docklands Light Railway which runs around 30m from the building with trains passing by every few minutes in peak periods. This noise comprises both airborne and groundborne components, In addition, there is the typical level of road traffic noise found in a central London location.

Disturbance from these noise sources was significant during performances and needed to be reduced to a minimum.

The key areas where improvements were made were:

- A new roof with substantially higher sound insulation;
- Secondary panelling behind glazing;
- New fire exits with acoustic doors and lobbies

(reduction of groundborne noise was not possible with the funding available)

Increasing the sound insulation of the new roof involved adding layers of heavy cementitious boarding over the existing rafters. This did not have any heritage issues providing the height of the roof was not increased by any significant amount which was possible. However, there were structural issues and the rafters required strengthening. A second layer of sound insulation was provided by the internal barrel vaulted plaster ceiling which was sealed and made heavier with a layer of applied plaster on the back surface – the cavity in between was lined with several layers of mineral wool.

The original Victorian sash windows introduced substantial weaknesses in the sound insulation and ideally would have been bricked up. This was not possible from a heritage viewpoint and all the original windows had to be retained. Where light from the windows was not required, in the stage house for example, these were backed with multiple layers of heavy boarding and sealed. Windows at the rear of the auditorium which are normally screened but are sometimes used to admit light, were sealed and acoustic secondary glazing added.

Fire exits were re-fitted with acoustic doors, existing lobbies were heavily lined with acoustic absorption and new lobbies were added where previously there had been none. As these exits already existed, there were no heritage problems.

The new ventilation system had to be sufficiently quiet (NR20 was specified) which was facilitated by using a low air velocity displacement system. The plant was located in the roof space of an adjacent building so ingress of plant noise was not a problem although penetrations into the auditorium had to be well sound insulated.

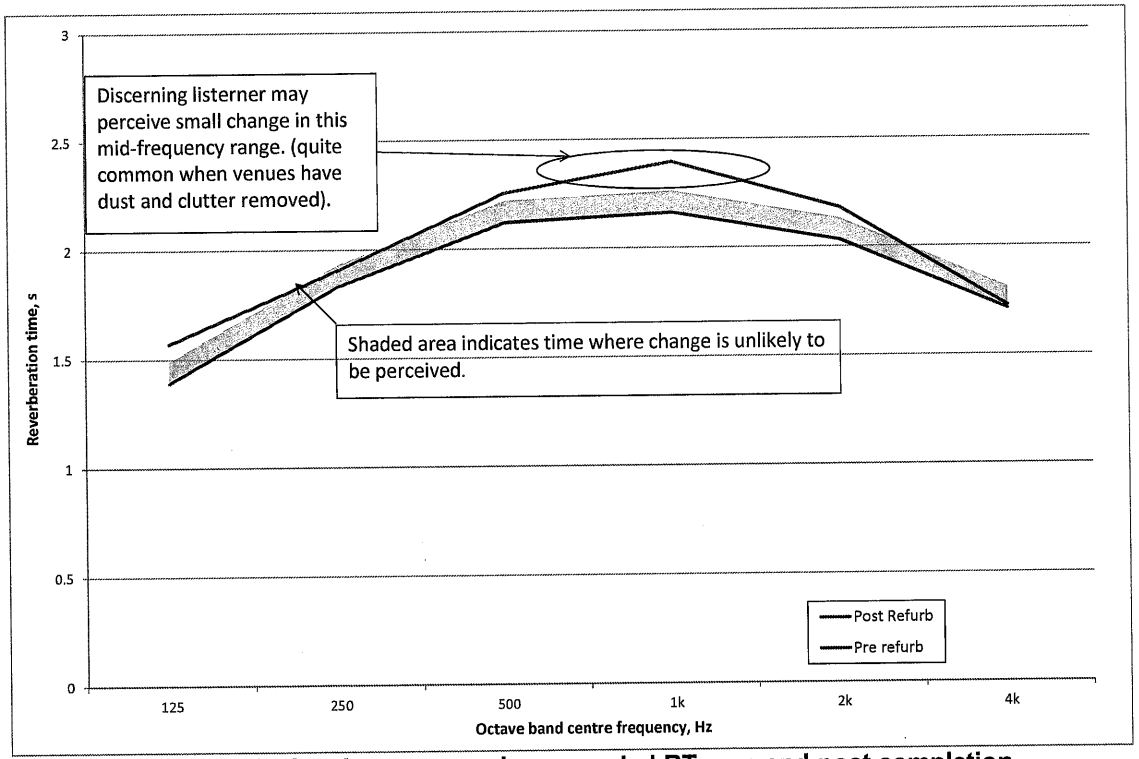

Figure 7 Graph showing measured unoccupied RTs pre and post completion

The room acoustics of the hall were well liked before the refurbishment and the Client wished them to remain the same. On completion, the Client was convinced that the reverberation had increased despite there having been no changes to the surface finishes. Measurements of reverberation time before and after showed remarkably similar curves and helped to provide reassurance that nothing

had changed in terms of the acoustics. However, the ingress of external noise has been reduced to a very low level and is not noticeable to audiences.

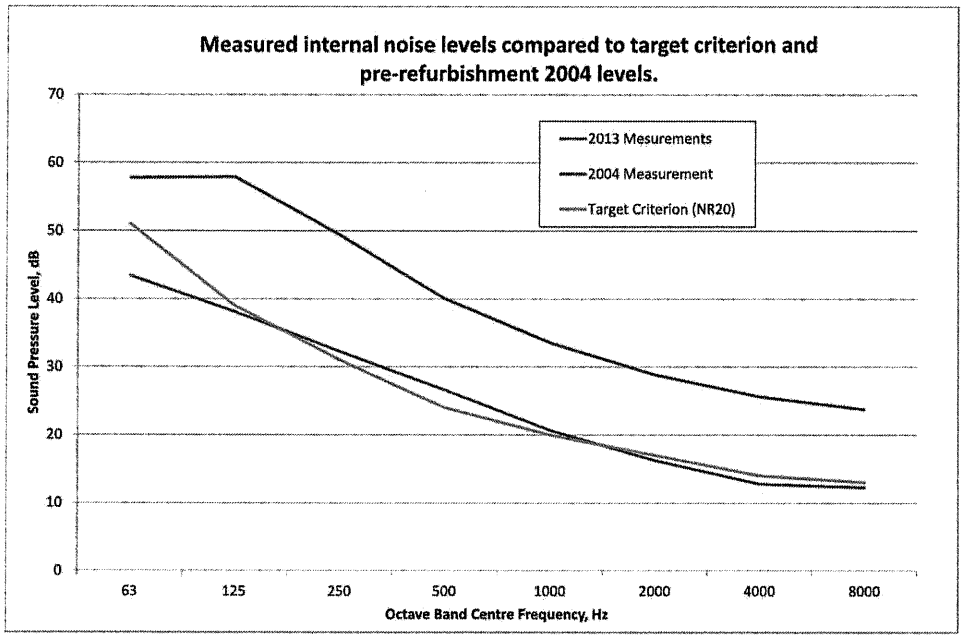

Figure 8 Measured background noise before and after refurbishment

The Music Hall re-opened in early 2013 and performances there are already receiving high acclaim in the press.

5 SOUTHBANK, LONDON

Southbank is the largest performing arts centre in Europe. It includes the Royal Festival Hall, the Queen Elizabeth Hall, the Purcell Room and the Hayward Gallery.

The Royal Festival Hall was fully refurbished a few years ago and the current plan is to refurbish the east wing which was built in the 1960's and will be renamed 'Festival Wing'. This involves refurbishing the two main performances spaces namely, the Queen Elizabeth Hall and the Purcell Room as well as the gallery, foyers and ancillary spaces.

The Queen Elizabeth hall was acoustically designed by Hugh Creighton as a chamber music hall with 1100 seats. It has a good reputation for acoustics but not an outstanding one. The challenge in the refurbishment is to maintain its acoustic quality and enhance it where possible. The same objective applies to the Purcell Room.

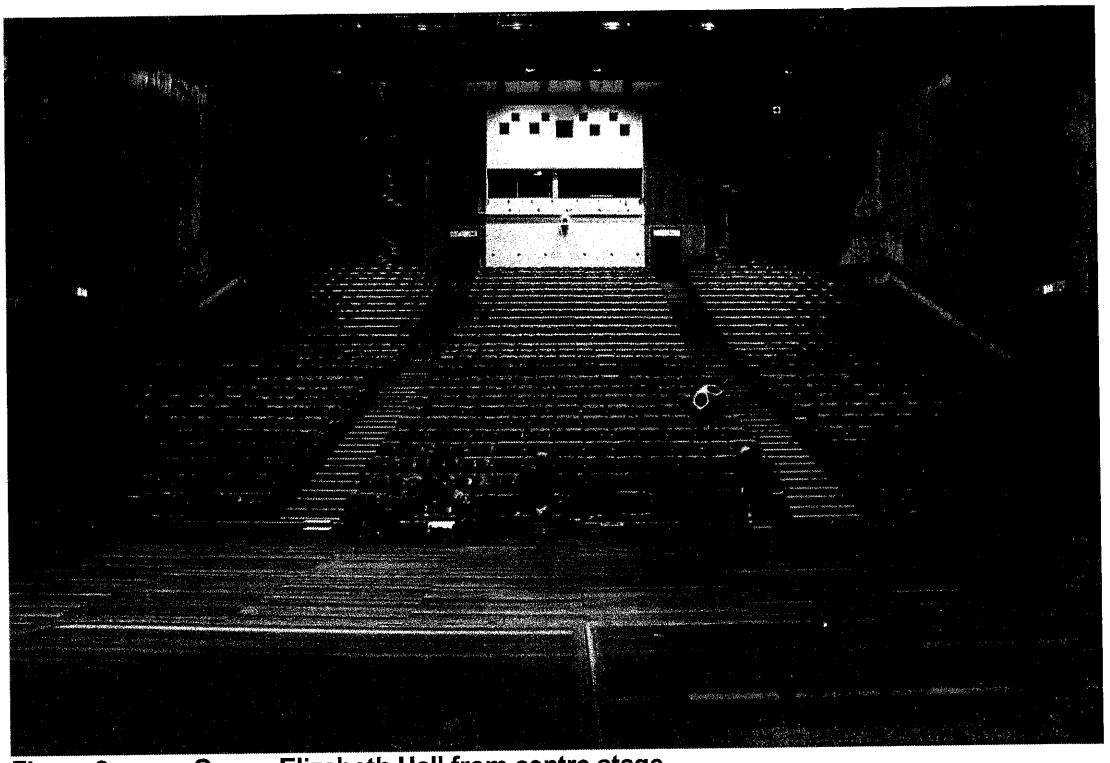

Figure 9 Queen Elizabeth Hall from centre stage

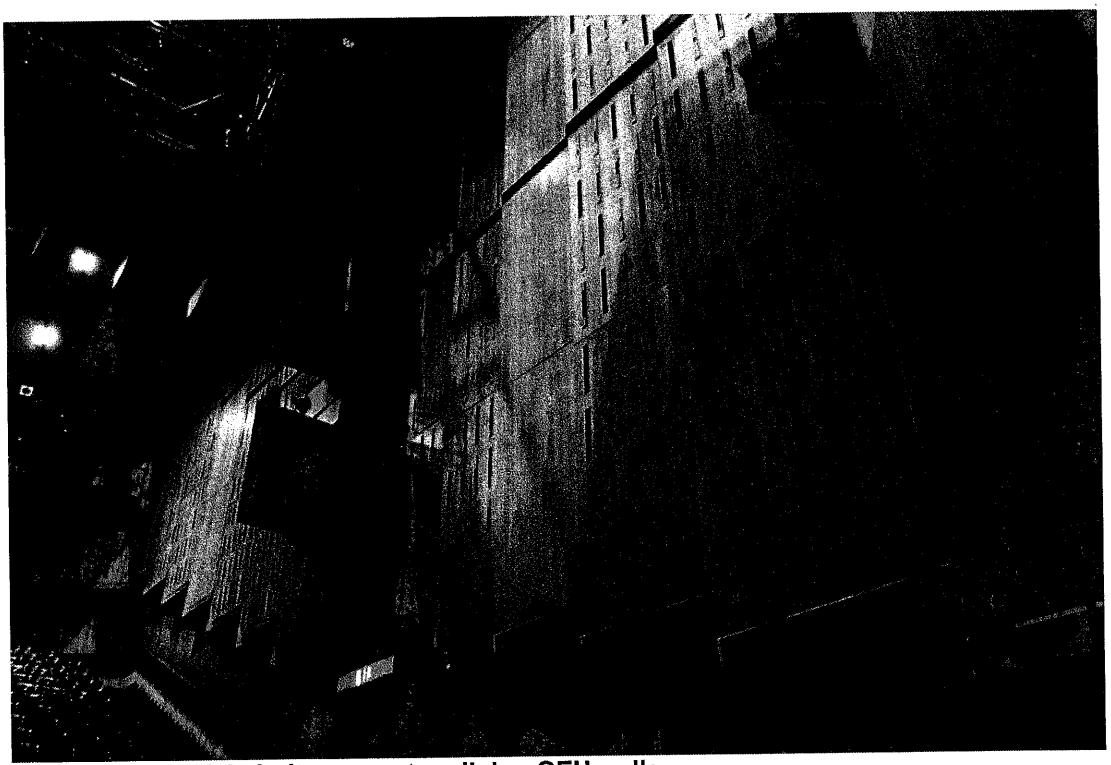

Figure 10 Helmholtz resonators lining QEH walls

An intriguing aspect of the original design is the Helmholz resonators which line the walls – 2300 of them in total. They have degraded over the years because the foam lining in the throat of each

resonator has disintegrated. We are currently doing a study to determine how best to refurbish these resonators.

Sometimes refurbishment presents the opportunity of adding a new space. At the Southbank, there is a plan to build a new rehearsal hall which will be able to accommodate the largest orchestras and choirs – for example, a Wagner orchestra of 150 with a choir of 220. The hall will also be used for occasional public performances, recording and broadcasting. This is an exciting opportunity for adding a new music space in London as a result of refurbishment.

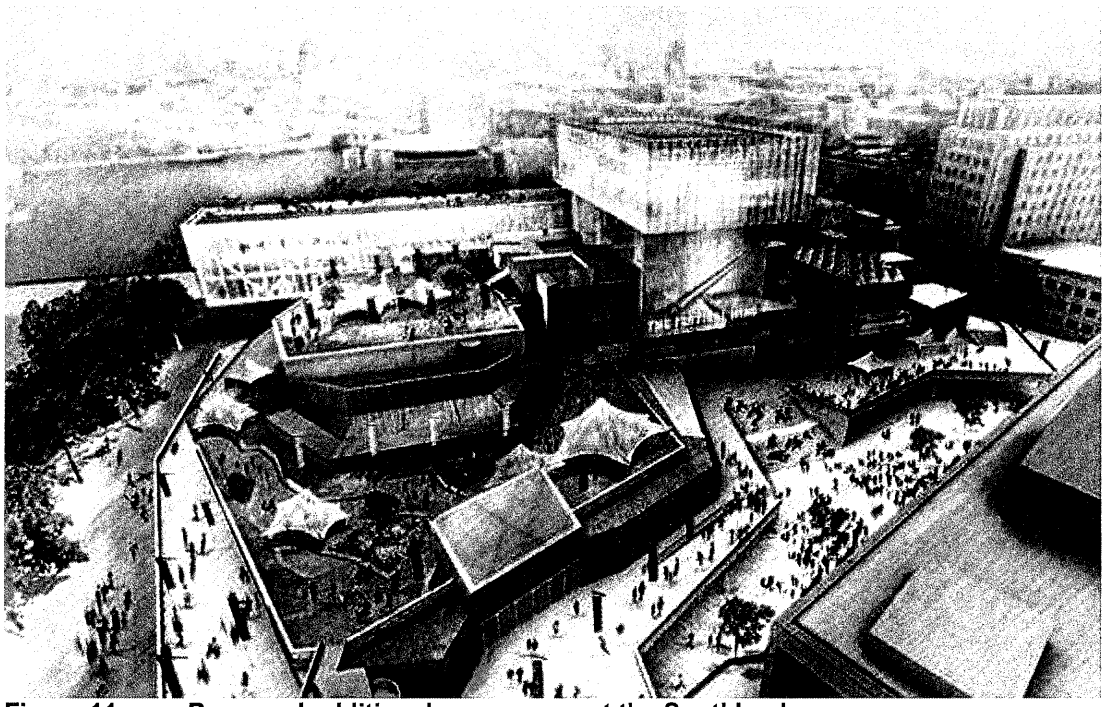

Figure 11 Proposed additional new spaces at the Southbank

6 REFERENCES

1. Katrina Scherebnyj, Hornsey Road Baths New Spaces for Old – Acoustic Considerations, Ramboll Technical Journal Volume 3 (2011)