NEW MUSIC IN OLD BUILDINGS – CONVERTING A GRADE 1 LISTED BUILDING INTO A MUSIC COLLEGE

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1. INTRODUCTION

After deciding to move from their central London home, Trinity College of Music undertook an extensive search for a new home. After a long search, and much investigation of alternatives, the decision was taken to move to the disused Kings Charles Building at Greenwich.

The building started life in 1663 as a palace for Charles 1st. It was ultimately finished by Wren in 1694 and was initially used as a hospital. It was used as part of the Royal Naval College but became redundant when they moved to other premises. It is now a grade 1 listed building on a world heritage site.

The building is constructed around a large central courtyard. There are three floors in two L—shaped 'ranges' that join together around the courtyard. The construction is typical of buildings from this period with a heavy stone façade and timber floors. Floor to ceiling heights are generous and ventilation is via large sash windows.

Although in a busy part of London, the building is in its own large grounds near the Cutty Sark. Other buildings on the site provide screening of the roads that run to the south. The Thames forms the northern border of the site. The north-east part of the site, with the frontage was retained by the previous occupants as a residential facility for selected naval staff.

2. ACOUSTIC STRATEGY

An early listening test in the open courtyard highlighted how this made an excellent performing space. Roofing over the courtyard to create a performance space was considered early but deemed impracticable within the budget. However, to safeguard future use of the space, it was decided to impose strict limits on noise from plant connecting to the courtyard to allow for summer events.

A large percentage of the useable space was to be given over to music practice rooms. The heritage and budget constraints meant that these would need to be naturally ventilated using the existing sash windows, although the option of future installation of mechanical ventilation was kept open.

Existing floors had to be retained and preserved, so any treatments to control floor to floor sound insulation had to be removable so that the building could be put back to its original condition at some date in the future. Weight was a critical issue with all the partitioning above ground floor and so dry constructions were adopted. This gave advantages also in terms of speed of erection.

A recording studio and control room were also provided within the scheme. The Control Room was constructed to EBU guidelines and was fully air conditioned.

Unfortunately, there was no space within the existing building large enough to provide a full orchestral hall and this had to be provided off site. It was however possible to create two spaces of sufficient size to hold recitals and dance events on a modest scale.

3. SOUND INSULATION ISSUES

Good sound insulation was critical to the design of the facilities. The building has more than 50 music practice rooms that are built on the three floors. Initial inspections showed that the ground floor was relatively substantial with thick concrete slabs supported on brick arches. The rooms on this floor were capable of achieving the higher standards.

Floor to ceiling heights were also generous on the 1st floor and allowed relatively large floor cavities to be provided. The second floor had a much reduced ceiling height and this limited scope to provide upgrades to the floor sound insulation.

The practice rooms were created along each façade and accessed from a central corridor. Each practice room had access to a window.

Ideally, for a leading music college, targets for sound insulation between practice rooms would be in the range Dw 60 – 75. In a renovation within the restraints of a grade 1 listing, and as a price for the chance to learn in this magnificent building, it was necessary to reduce the targets. The following target sound insulation values were adopted:

- Ground floor to ground floor rehearsal room: D_w 50 to 55
- Ground floor to first floor rehearsal room: D_w 50 to 55
- First floor to first floor rehearsal room: D_w 50 to 55
- Second floor to first floor rehearsal room: D_w 45

Whilst these are not high by standards normally adopted for purpose-designed buildings, they represented an achievable and workable standard taking account of the heritage and budgetary constraints and the inevitable consequences of having naturally ventilated spaces. The choice of constructions for the practice rooms was decided on the basis of what gave best value for the limited funds available. Wherever possible, options to allow further improvements in sound insulation were kept open.

The scope for controlling flanking around partitions was limited. It was determined that isolated wall constructions were feasible (see below). Isolated ceilings however could not be accommodated at this stage although this is an option that may be incorporated at a later date when funds allow. Saw cuts were made in the practice room ceilings over partition lines to provide a degree of flanking noise control via this path.

The massive masonry façade wall constructions provided good control of flanking via the external façade. The floor had a variety of amounts of sand pugging internally and offered a reasonable degree of airborne sound insulation, although upgrading this was considered essential.

Analysis by the structural engineer determined that floor loadings would be critical on the 1st floor and this required that any raised floor added had to be supported only at the column lines. A structural solution was developed which allowed a floor to be supported on a lattice of timber and steel beams which spanned directly between the walls. This became known as the ‘Murphy Floor’ after the engineer who developed the concept.

4. MOCK UP TESTING OF PRACTICE ROOMS

It was decided that with the large number of practice rooms to be constructed, a programme of mock up testing was justified to optimise the design. The key issues to be resolved by the testing was the benefits of different floor constructions in terms of controlling vertical sound transmission and horizontal flanking noise.

The opportunity was also taken to assess the levels of sound flanking via the external façade and openable windows.

The mock up tests looked at vertical and horizontal transmission under the following conditions:

- Floor with a hardboard cover
- Floor with batten type floated floor (50 mm cavity) using "sylomer" as the isolation medium
- Floor with spanning raised floor supported from isolated walls (Murphy floor – 300 mm cavity)

The walls were built using 3 layers of 15 mm gypsum board on separate studs giving an overall wall thickness of 390 mm. The 300 mm cavity between the wall elements included a 100 mm thick mineral wool quilt. On the ground floor and second floors, the channels supporting the walls were mounted on resilient materials. For the first floor, the wall and floating floor were integrated and mounted on Tiflex pads bearing onto the main structural beams. The arrangement is illustrated below.

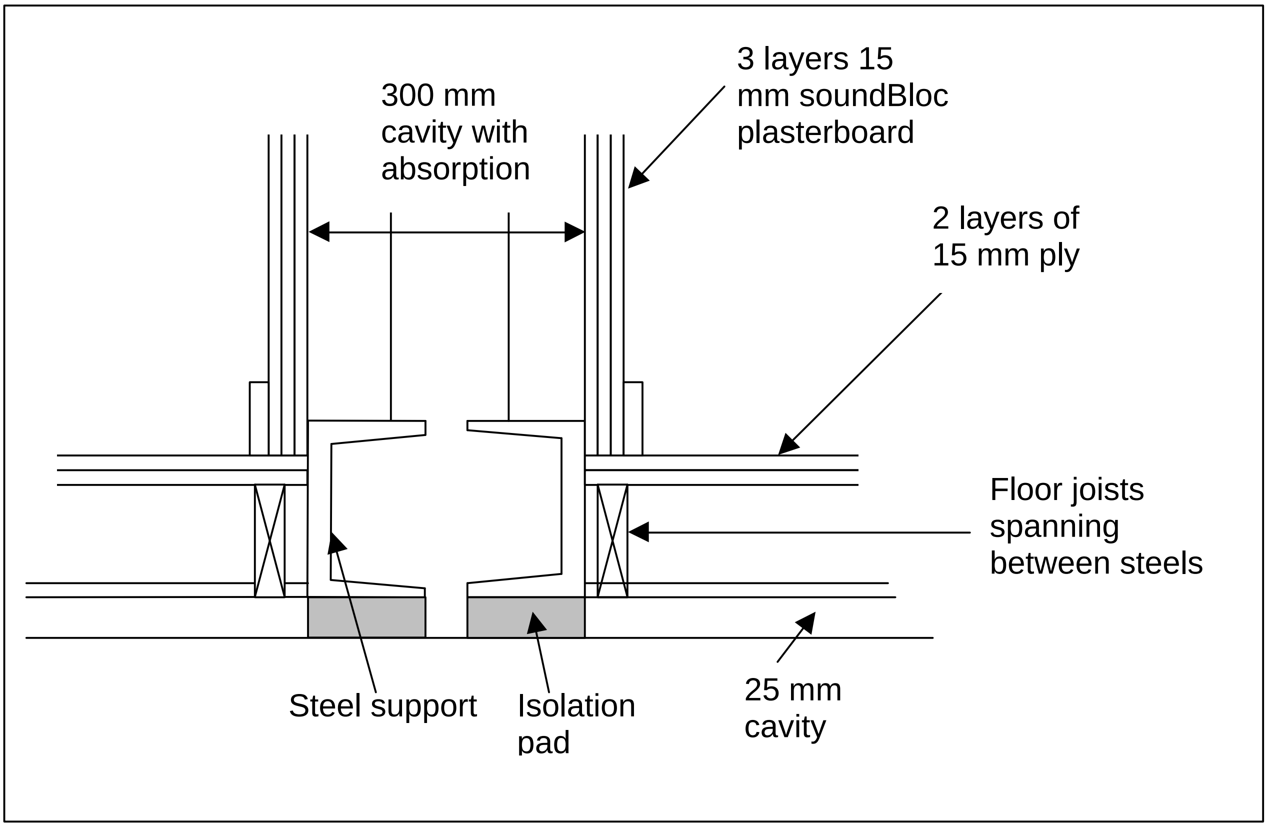

Figure 1: Section through 1st floor practice room showing Murphy Floor

Figure 2 below shows the improvements that were gained in the horizontal flanking sound transmission. Not surprisingly, the larger floor cavity and improved separation of the Murphy floor provided the best improvement.

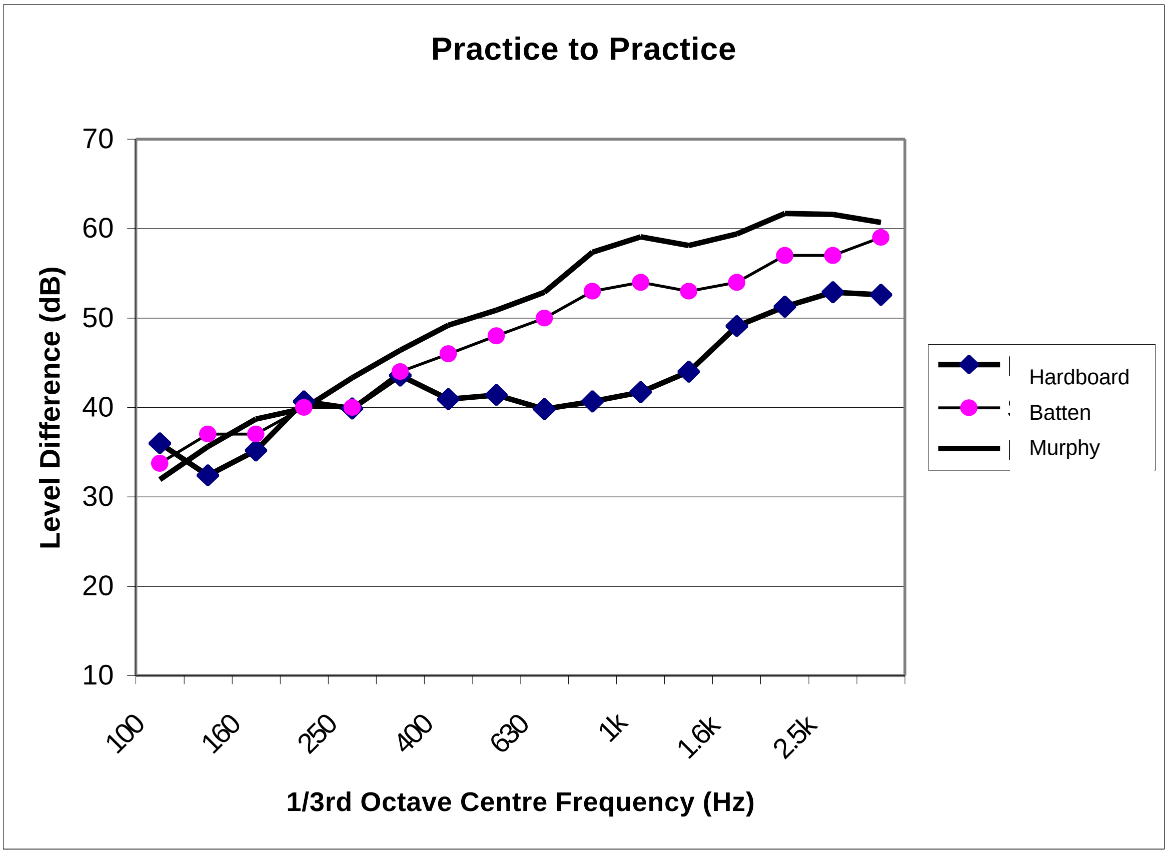

Figure 2: Effects of floor construction on horizontal sound transmission

The opportunity was also taken to measure the effects of the windows on the sound insulation between rooms. Not surprisingly, opening a window in either the source or receiver room greatly reduced the overall sound insulation achieved.

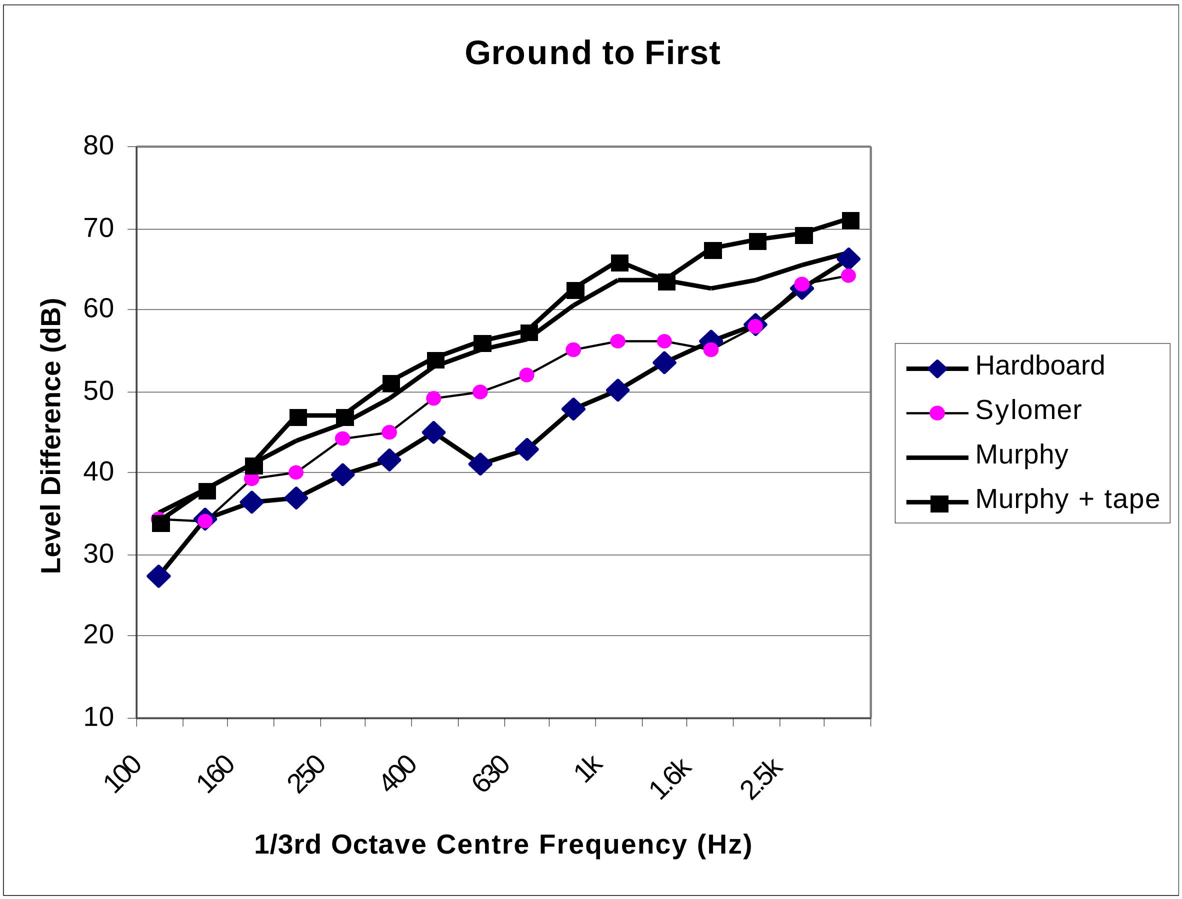

Figure 3: Floor to floor sound insulation

What was particularly interesting was the effect that sealing the windows had on the vertical sound insulation. As can be seen in Figure 3 above, applying tape to the window frames gave significant benefits in the vertical sound insulation, particularly at higher frequencies.

5. PERCUSSION FACILITIES

The provision of facilities for the percussion department was a major concern during the design stage. The very high sound power of modern percussion instruments meant that loudness affecting players was a major issue, as was sound insulation As is well known, sound levels well in excess of 100 dB L_{Aeq} are to be expected with even small percussion ensembles.

It was initially hoped that facilities could be found in nearby outbuildings for the percussion players. This ultimately proved impracticable and it was therefore decided to provide fully-engineered free standing proprietary practice rooms. The only location where these could be accommodated was in the centre of the building. This gave concerns with sound transfer to above and below. However, a structural analysis showed that the modular practice rooms could not be supported off the existing floors and therefore it was decided to install new beams spanning across between the facades. The beams were built into small pockets in the external walls and the opportunity was taken to install vibration isolation bearings between the wall and the steels. Careful design of the access ramps ensured that there was no direct connection between the practice rooms and the existing floor.

The height limitations resulted in rooms that were less than ideal in terms of volume. However, the extensive internal acoustic treatment provided good control of loudness, albeit at the expense of limiting the musical feedback to the players.

The modular practice rooms were slightly modified to optimise the acoustic absorption for the frequencies expected from the different types of instrument and care was taken to ensure that the ventilation system provided air at low noise levels. It also was designed to ensure that noise breakout via the ventilation system was appropriately controlled.

6. MECHANICAL AND ELECTRICAL SERVICES

All the standard practice rooms were heated by radiators connecting using flexible piping and with detailing to minimize thermal expansion/contraction noise. Hot water was provided from boilers in the basement. The chillers and air handling plant for the studio facilities and the recital rooms were also located in the basement. Conventional attenuators were provided to control fan noise and ducting sized to give appropriate velocities. The percussion rooms were heated electrically.

Providing air conditioning in an architecturally sensitive manner for the main recital room required the use of a displacement ventilation system. The space for this was created by excavating below the current floor to create the large plena necessary. This has allowed the room to be air conditioned with minimal effect on the overall interior architecture. A services noise level of NR 20 was achieved in this space which was deemed satisfactory for the intended use.

7. ROOM ACOUSTICS

Loudness is a major issue for any space used regularly by musicians. Although the rooms at Trinity College were generally a reasonable volume because of the high ceilings, it was important to incorporate room acoustic controls to limit sound buildup.

A simple wall panel solution was adopted for the practice rooms making use of inexpensive perforated metal ceiling tiles, which were fixed to the walls on battens to provide an air cavity. The floor finishes were generally timber with carpet provided in some rooms.

8. STUDIO CONSTRUCTION

The studio was built on the ground floor alongside the central courtyard. The recording room and control room were fitted into two rooms separated by a heavy brick wall. One of the key requirements of the EBU guidelines is that the listening room be acoustically symmetrical. This proved difficult to achieve in practice as the conservation authorities wanted to maintain the overall visual appearance from the courtyard, which meant that the glazing had to be retained. The problem was eventually resolved by orientating the listening plane diagonally across the room and providing removable absorptive elements over some of the windows.

A box in box construction was considered essential and this was achieved using an isolated steel construction. A cast-in-situ concrete slab was used for the roof of the box and the walls were plasterboard. Fixed glazing was provided in the internal skin to match with the retained external windows, resulting in a very light and airy studio facility that has excellent sound insulation characteristics.

9. CONSTRUCTION ISSUES

Construction proceeded at a fast pace in order to enable the College to move into the facilities over the summer vacation of 2002. There was good cooperation between Project Manager, the design team and contractor to resolve issues quickly as they arose on site.

The various wall and floor constructions were found to work well. Sealing of gaps around penetrations and gaps was critical and was dealt with ultimately by having a 'mastic man' whose job was to make good any unsealed openings.

Whilst the combined wall / floor construction provided excellent sound insulation for the 1st floor practice rooms, it was found that the relatively low dead weight of the construction resulted in significant movements when the rooms pianos were moved in. Several of the joints between the floating and fixed structures had to be re-pointed with mastic when the furnishing was completed.

10. CONCLUSIONS

The users have found that the completed facilities provide acceptable standards for music teaching in a cost effective and architecturally sensitive way. The college wished there to be a degree of openness to the facilities so that students would not shut themselves away in practice rooms all day and fail to interact. The natural ventilation solution has been found to work well and gives the building a 'buzz' of excitement as music is audible around the outside of the building.

A semi-derelict gem of a building has been rescued and converted to a new educational use, which has benefited the College and the site. The design has focused on best value whilst allowing for significant improvements to be made when funds allow.

Acknowledgements

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