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"THE HEXAGON, READING"

J R COWELL

SOUND RESEARCH LABORATORIES LIMITED

Introduction

The acoustic design for the Hexagon, Reading offers a case history of a recently built multi-purpose hall - a building type well known for its challenge to good acoustic design. This paper aims to highlight the main aspects of the acoustic design in the context of a brief description of the project.

Following the unfortunate death of Henry Humphreys (who was involved with the early design development), we were commissioned to complete the acoustic design. The outline form of the building had been established, proposals for internal treatment had been discussed and the use of assisted resonance had already been planned. Our contribution was simply to develop the acoustic design within this framework.

Outline Description

The building is sited close to a main ring road and a local service road. Road traffic noise from the ring road produces sound pressure levels at 1 metre from the building in the range 70-75dBA L_{10} during likely times of use of the hall. The facility has been designed to cater for a wide range of use. Functions in the building include orchestral concerts, chamber music, cinema, dance, poetry recitals, banquets, meetings, boxing. Seating capacity is around 1500 when all seating is used.

The auditorium was developed in the form of an elongated hexagon surrounded by a buffer zone of circulation and ancillary space, as a basis for excluding external noise. The roof and upper walls are also developed as double (i.e. separated) constructions, making use of lightweight concrete planks with weatherproofing or lead clad chipboard as the outer skin. Figure 1 shows plans and a section through the auditorium.

The performing area is near one end of the space and plays to a large balcony area of permanent seating. Immediately in front of the stage is a limited flat floor area which can take an audience on extended bleacher seats and loose seating. Audiences may also be extended around the rear of the performing area or raised tiers, which might also be used for e.g. choral work - these are raised up leaving a substantial timber panelled upstand around the rear of the stage. This open form is intended for activities such as concerts, whereas a proscenium can be set across the front of the stage for drama, playing, to the balcony, bleacher seating and flat floor areas. A number of performer/listener arrangements are possible and by means of forestage lift arrangement, an orchestra pit is available.

The ceiling is a combination of reflective (fibrous plaster) panels and painted perforated metal (essentially acoustically transparent) panels. The design of the ceiling was influenced by the growing awareness of the importance of lateral

reflections to performance of music. The ceiling and walls are linked by substantial canted panels offering limited low frequency absorption, but useful lateral reflection. The use of stained timber panelling is extensive over the walls. The balcony area is carpetted and seats are fully upholstered. The rear wall is formed by the projection/control room flanking by walkways behind which are canted panels taking the loudspeakers for assisted resonance.

Room Acoustics

Reverberation Time remains a primary factor for acoustic design and there appear to be four main options for dealing with multi-purpose use, where optimum reverberation times vary so widely with function:-

1) Use of a compromise RT - tends to 'stretch' the intelligibility of speech, and is unlikely to satisfy the needs of e.g. romantic music.

2) Use of longer RT - relying on electro-acoustics to provide for speech (i.e. a strong direct/reverberant ratio in the design of a speech system)- tends to be difficult to use electro-acoustics for all speech e.g. drama.

3) Use of relatively low RT with physical adjustment at room boundaries or of room contents - the adjustment potential of these devices is perhaps not enough to cover the full range of RT required.

4) Use of relatively low RT with scope for adjusting reverberation by other means.

The last of these was selected for the Hexagon and an assisted resonance system was integrated into the design.

The reflection pattern is helped by the canted panels at high level providing useful lateral reflections. There is very little balcony overhang. The usual principles of achieving good sound distribution, some diffusion, freedom from significant acoustic faults and local reflection to performers have been taken into account.

Assisted Resonance

At the time when assisted resonance was proposed for the Hexagon, practical application in the UK was limited to the systems in the Royal Festival Hall and the Central Hall, University of York.

Apart from the uncertainty as to the effect of auditorium geometry on system performance, other important considerations included the selection of the number of channels, the degree of RT extension appropriate, and methods of control. It was agreed that a 90-channel system was about right, giving coverage over the range 80-1400Hz. Tuned assemblies located in the ceiling, suspended from catwalks serve loudspeakers set on canted panels at the rear of the auditorium and

three settings - 'low', 'medium' and 'high' were arranged. The RTs achieved are compared with the natural RT in Fig. 2. It has been interesting to see that the technical staff have also made use of the AR system as a form of equalisation on various music performances in the building. Whereas the location of loudspeakers at the upper rear wall is slightly near to part of the audience for the highest settings, the system has proved a considerable success. The acoustic response of the hall, when used for concerts, has been the subject of complimentary remarks from performers and audience - the assisted resonance clearly plays an important part in this.

Internal Sound Insulation

The location of circulation areas and relatively quiet areas around the auditorium, and the use of sound lobbies help to limit internal noise problems. Nevertheless, low background noise levels tend to allow extraneous noise to be heard more easily. The usual dilemma over the extent of separation of the sound control room from the auditorium has been resolved in the form of sealed single glazing. Noise from dimmer units has also required special attention.

Noise From Mechanical Services

Great care was taken with the design of mechanical services to limit noise to a design target of NC20. Representative sound pressure levels in the empty auditorium, with the assisted resonance system off are given in Fig. 3.

The main plantroom is physically separated from the auditorium. Apart from adequate primary attenuation, severely restricted airflow rates and secondary attenuation were used. The terminal assemblies were laboratory tested to check on air noise output.

Speech/Music Reinforcement

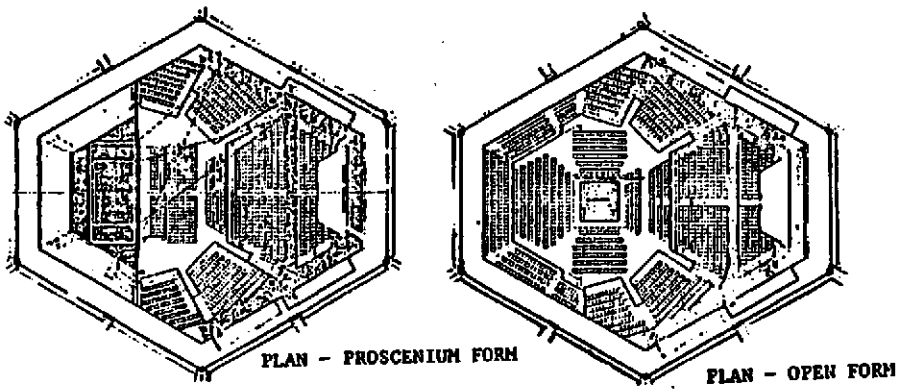
At the time when the building was being designed, the provisions for reinforcement by loudspeakers were very limited. But early experience of use of the building has highlighted this as a particular area of concern for new multi-purpose halls.

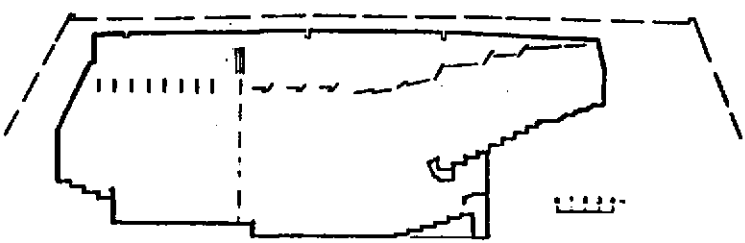
The provisions of a speech system with limited capability for relaying music was considered essential as a minimum. But it is difficult to go far beyond this without failing to satisfy the wide range of aspirations of different performers. On the other hand, the absence of a system which performs well over a wide range of music and a wide range of power output restricts the potential for the management to offer facilities to artists not wishing to bring their own equipment. It has been found appropriate to extend the earlier system in the Hexagon to allow a wider facility for performers. But the question of how far to go in providing for music remains an important one for multi-purpose halls built to a limited budget.

Conclusions

The acoustic design of the Hexagon, Reading represents one particular approach to the multi-purpose hall. It will take time for experience of use of the building

to build up - at this stage, on the whole, results are encouraging. The building is already providing a useful reference for other projects with similar aims.





SECTION

Fig. 1 Plans and Section of Auditorium

Architects: Robert Matthew Johnson Marshall & Partners

Mechanical Services: Parsons Brown

Assisted Resonance: AIRO

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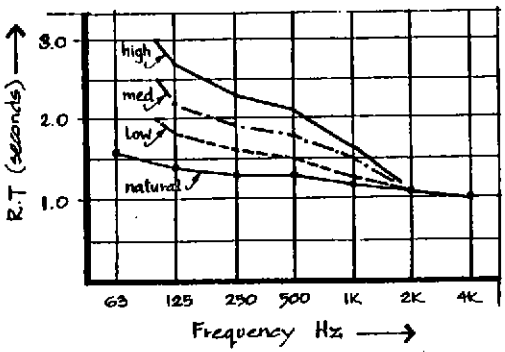

Figure 2 Comparison of Reverberation Time with and without Assisted Resonance.

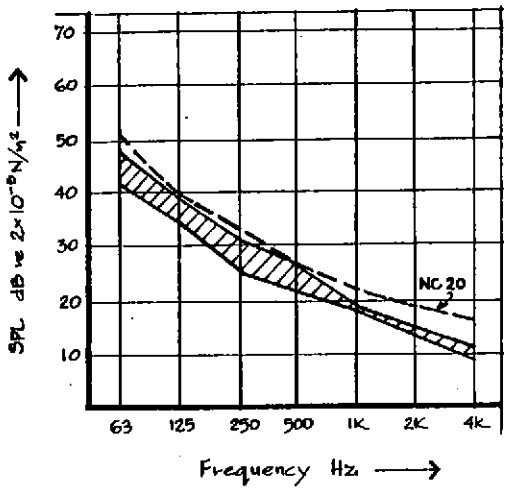

Figure 3 Range of background noise levels in the empty auditorium with ventilation on.