Proceedings of The Institute of Acoustics

THE ALFRED BECK CENTRE - HILLINGDON

G. BERRY

AIRO

Introduction

The Alfred Beck Centre is located at Grange Road, Hayes, Middlesex, in the southern part of the London Borough of Hillingdon. The council required a facility to complement the Winston Churchill Hall, Ruislip, but were particularly anxious that the new auditorium should provide excellent conditions for a wide range of performance from cinema and speech through to symphonic and choral music. The design was the responsibility of the Architects Department of the Borough, the Borough Architect being Mr. Thurston Williams.

General Aspects of Design

This paper is to deal mainly with acoustics but it seems desirable to describe, however briefly, the main features of the auditorium. Fig 1 shows a longitudinal section through the auditorium and a control room level plan.(1) The first point to notice is that the design segragates platform events from flat floor events which all take place in an extensive foyer. The bulk of the auditorium seating is raked and fixed but, with the pit lift at auditorium floor level, three additional rows of seats may be fitted to bring the seating capacity up to 598. Without these seats the pit lift may either be lowered to produce an orchestral pit or lowered still further to carry equipment up to auditorium or stage level. In its top position it further extends an already large stage to a total area of the order of 280 m^2.

The auditorium and stage clearly form a single compartment (more of this later) since there is no fixed proscenium. Traditional sight lines for proscenium theatre are achieved by moving auditorium walls which conceal the 30 seats at each side of the auditorium.

The whole space is air conditioned with the main plant room in a completely separate building but with auxiliary plant located behind the rear stage wall and at high level above the stage.

Acoustic Aspects of Design

The first aspect of the acoustic design was the protection of the auditorium from intrusive noise. The site is subject to a high level of road noise but is also subject to occasional overflying from Heathrow Airport and from Gatwick. The walls consist of 150 mm reinforced concrete faced with brick and the auditorium "box" carries a 150 mm reinforced concrete roof, the flat and low pitched roofs being covered by rolled zinc on felt underlay over boarding. The boarding is carried on timber firring and 175 mm x 40 mm timber joists with a 50 mm glass fibre quilt between the boarding and firring. This construction reduces external noise to a level of 25 dB'A' or less.

THE ALFRED BECK CENTRE - HILLINGDON

Since the main plant is housed in a separate building there is no problem of airborne or structureborne noise from this source and the noise from plant housed within the building was a cause of only minor problems during commissioning. The principal difficulty during the commissioning period was due to noise radiated from the air supply grilles in the ceiling. This is now under control.

The auditorium ceiling consists of tongue and grooved boarding, 25 mm thick, in the form of panels suspended from the steel framework. These panels form the horizontal or near horizontal sections of the ceiling above the seats. The more steeply sloping sections above the seats consist of 20 mm plywood and fulfil several functions:-

a) they provide a total length of 41 m x 1 m high (approx) of opening into the void for lighting bars.

b) along their forward (lower) end they house the air supply grilles to the auditorium.

c) the two forward panels each carry 36 loudspeakers for the Assisted Resonance system.

There are four rows of reflectors across the stage area which may be raised or lowered and inclined at any angle appropriate for the performance in hand. In the extreme they may be vertical and vertical and brought up to suspension grid level.

The seats have fabric upholstery and the whole of the seating area is carpeted with good quality carpet laid on the concrete floor. The total area of carpet within the auditorium is of the order of 300 m^2. The walls to the sides of the seating area are faced with 50 mm wide timber strips at 75 mm centres over 50 mm resin bonded mineral wool slabs. Up to 2 m above floor height the mineral wool is faced with plywood whilst at higher levels a proportion of it is faced with black muslin to provide middle frequency absorption.

The volume of the auditorium section, forward of the tower and below the suspended ceiling line is of the order of 2500 m^3 and the volume of the stage house is of the order of 1750 m^3.

The microphones for the Assisted Resonance system are housed in their Helmholz resonators and tubes above the suspended ceiling in the last but one section. The mouths of the resonators and tubes communicate with the auditorium through two transverse slits 55 mm in width.

Assisted Resonance System

The system employs 72 channels having tuned frequencies covering the range from 75 Hz to 1125 Hz. The frequency spacing between adjacent channels is greatest at low frequencies i.e.:-

Hz	75	125	250	500	1000	1125
%	6.1	5.4	4.4	3.4	2.4	2.2

It was designed to allow the natural reverberation time to be increased in the manner shown in Fig 2. This shows the design natural RT and the maximum assisted RT which it was undertaken to provide.

Final Outcome

In the final outcome the natural reverberation time of 500 Hz turned out to be much lower than the design figure of 1.1 second, intended for cinema, conference and drama. It is fortunate indeed that the design included Assisted Resonance and that it was possible to achieve the longer RT's required for music.

Even being wise after the event it is difficult to see where an "error" was made. Considering the auditorium and stage as a single volume and, in the absence of this experience I would still consider it as such, we have a volume per seat of the order of 7.1 m^3/audience seat and still as much as 6.5 m^3/person with 100 people on stage. With the exception of the carpets, seats and audience there is little middle frequency absorption in the audience area and it is possible to estimate this extra absorption quite accurately. There are two main possibilities:-

i) there is a single volume and the absorption of carpets, seats and audience has been seriously underestimated. For this to be the case the absorption presented by the carpet and seats would need to be 700 m^2. This possibility must, I suggest, be rejected.

ii) there is not a single volume. This may appear to be a strange suggestion but let us suppose that we have:-

a) a stage house, volume V_1 and absorption A_1

b) a seating region, volume V_2 and absorption A_2

c) a proscenium opening separating these with area A_p and an absorption coefficient of unity

This is a procedure which might be adopted in a traditional theatre design. With values as given below and assuming a simple Sabin relationship we find:-

$V_1 = 1750$ $V_2 = 2500$

$A_1 = 200$ $A_2 = 435$ $A_p = 110$

Anticipated RT for the whole volume	1.07 second
RT for stage assuming separate volume	0.90 second
RT for seating area assuming separate volume	0.73 second

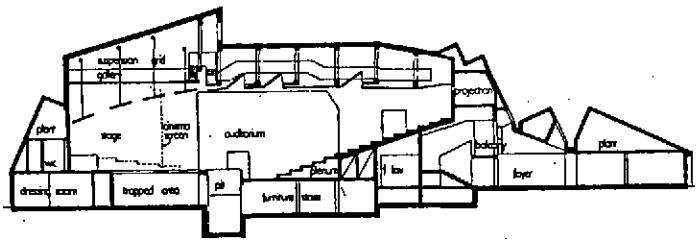
This latter value of 0.73 is close to the actual measured value and it is interesting to note that the stage value is not higher than the design RT. This form of analysis is clearly over simplified. Probably it would be more appropriate to say that a single volume treatment using the Sabine relationship does not apply in a situation of this type. In the stage area the absorption is

reasonably well distributed over the available surfaces but in the seating area the absorption is essentially presented over one surface. A more sophisticated procedure for the calculation of reverberation time seem to be required.

So far as the Assisted Resonance system is concerned the outcome is satisfactory. The management tends to use the system on its lower setting for musical comedy or light opera and on its full setting for larger musical performances. To date there has been one concert given by the English Chamber Orchestra which attracted a critic from the national press. He certainly felt that there was adequate resonance, in fact he thought there was too much towards the front. His most positive comments was to the effect that "Sound is successfully defused (sic) rather than localized". One has to be thankful for every kind word, even for a misspelt one.

Reference

Copied from The Architects' Journal, 28th September 1977



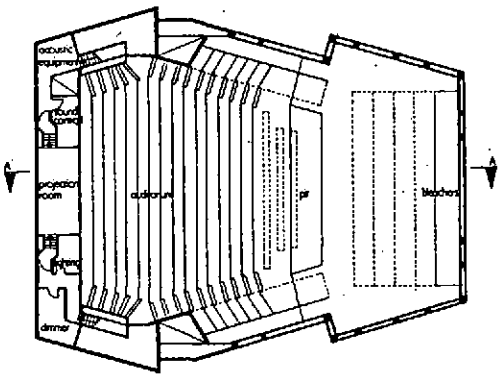


Fig. 1

Control level plan.