Proceedings of The Institute of Acoustics

ABBEY ROAD RECORDING STUDIOS

P.C. DIX

THORN EMI CENTRAL RESEARCH LABORATORIES

The freehold building site and house at No.3 Abbey Road was purchased in 1930 and the house, which has remained essentially unchanged to this day, was converted into offices. In the 200ft. garden at the rear of the house a studio block comprising three studios, plant room, transfer rooms, laboratory, listening rooms, workshop and a garage to house the mobile recording unit was constructed.

Two classical studios, No.1 and No.3 with dimensions of 98 x 56 x 40ft. and 39 x 31 x 19ft. respectively, were constructed in 1931 followed two years later by the No.2 studio with dimensions of 60 x 40 x 23ft. The studio walls were constructed to a high standard using 13½" brick, solid wood block floors were specified and the layout between the studios provided good separation, for the acoustic levels produced at that time.

A plant room serving all three studios was constructed adjacent to the large No.1 studio and low speed large diameter fans were used to ensure low noise levels.

Although the studios were generous in size, the control rooms were very compact but adequate to accommodate the wax recording machine, single loudspeaker, small control panel and a rack of equipment.

The studios were opened in November 1931 with a recording in No.1 studio by the LSO directed by Sir Edward Elgar of his symphonic poem, Falstaff. At about this time Electrical and Musical Industries was formed as the result of a merger between the Gramophone Company and the Columbia Graphophone Company and the studio in Petty France was closed in 1932. The Abbey Road Studio was to be the first custom built recording complex in the world.

Several changes have been made to the control rooms and studios during the last 50 years. With the introduction of tape recording, stereo and multi-track recording, the 1931 designed control rooms were too small to house the equipment and were too reverberant. No.2 and No.3 control rooms have been relocated to reduce the interference between adjacent recording areas and also provide larger and less reverberant rooms. No.1 control room was enlarged but remains in its original position.

The introduction of stereo requiring precise image position, Pop multi-track recording utilising artificial reverberation and electronic effects, the gradual increase in the band-width of the recording and reproduction chains has demanded a gradual reduction in the RT of the control rooms during the past 25 years. It has also been necessary to create a control room environment where personnel can work for periods of up to fifteen hours without fatigue but not catering for any temporary hearing loss.

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A typical control room in the fifties would have an RT of 0.5S, lino floor tiles and a modest area of medium and high frequency absorption. The only low frequency absorption would be that provided by the room shell. During the sixties the RT was reduced to approximately 0.4S but lino floor covering was still in fashion. In 1970 the RT was reduced to 0.3S and carpets were introduced to improve the general comfort. With the modernisation of No.2 control room, completed in October of this year, the RT has been reduced to 0.22S but it is possible that this may have to be increased by about 10%. I do not foresee any further reduction in RT in the future. Our experience of some North American designed control rooms, with an RT of about 0.18S is that they are acoustically and visually claustrophobic and can be tiring after a period of several hours. The decor in the control room is very important but only has a life of 5 - 7 years and it is essential to be able to quickly and cheaply remove and change the decor without altering the acoustics. As a Company we prefer domestic type decor rather than a flamboyant style.

To assist us in trying to optimise the RT characteristic of monitoring rooms and to attempt to obtain some correlation between subjective assessment and acoustic measurements we have constructed an experimental listening room in the Central Research Laboratories at Hayes. In this room we can change the reverberation time from 0.2 to 0.4S and in order to understand some of the designs and claims originating mainly from the USA we have included a suspended timber ceiling. This ceiling has front and rear wings which are fixed by hinges to a horizontal central area and these wings can, independently, be raised or lowered by a maximum of 20 degrees.

Recording Engineers were individually invited to bring a selection of their tape recordings, which they had balanced, and listen to them under different room conditions using the same loudspeaker which they had used for the recording. Each subject was given a chart containing a list of acoustical qualities and they were asked to rate the room for each of the acoustic qualities. With a small number of subjects such a study cannot be completely reliable but can indicate a trend and also helps to foster good relations. In general, the majority of the listeners preferred an RT of about 0.25S with a horizontal ceiling with absorption distributed on it.

The loudspeaker is as important as the control room acoustics and it is usually the first part of the chain to be criticised, followed closely by the room acoustics. For Pop monitoring, the loudspeaker and power amplifier must be capable of producing very high sound pressure levels without breakdown and the majority of loudspeakers found in Pop studios have a very high power handling capacity and high sensitivity. Unfortunately, this is usually achieved by restricting the band-width and allowing a tolerance of up to plus or minus 5dB on the frequency response. We do not electrically equalise the response of the loudspeaker in our rooms. Several years ago we tried the then fashionable method of using one-third octave equalisers but after subjective tests it was quickly decided to abandon the technique and adopt the policy of optimising both the loudspeaker and the control room acoustics separately.

During the past few years sophisticated loudspeakers have appeared on the domestic market having a frequency response of plus or minus 2dB from 40 to

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20,000 Hertz but their sensitivity is rather low and for classical monitoring we use amplifiers with power ratings between 150 and 600 watts per channel in order to produce adequate SPL with sufficient head room in the amplifier.

The studio complex was designed for orchestral, piano and dance band recording. The smallest studio, No.3, (39 x 31½ x 19ft) originally had a mid-frequency RT of about 1.0S rising to 1.15S at about 3KH$_z$. Problems occurred with some piano recordings and it was said that this studio lacked diffusion and had irregular decays. Curtains were used to improve the acoustics and reduced the RT to about 0.9S. Between 1960 and 1970 the mid-frequency RT was reduced to 0.6S rising to 0.8S at the low frequencies and falling to 0.4S at the high frequencies. Cabots quilt was used to obtain the reduction in RT which was necessary to enable the studio to be used for Pop recording. In 1970 the volume of the studio was reduced by lowering the visual/acoustic ceiling and the RT was reduced to approximately 0.3S in order to improve the acoustic separation within the studio.

Very few changes have been made to No.2 studio (60 x 40 x 23ft). The original RT was about 1.1S in the mid-frequency range rising to 2.0S at 100Hertz with Cabots quilting providing the absorption. This RT/frequency characteristic was retained until the early 1950's when the low frequency RT was reduced to 1.0S using panel and membrane absorbers. With the Pop explosion in the late 1950's and early 1960's it was necessary to provide improved acoustic separation within the studio and initially large mobile acoustic screens were used but within a few years, were replaced by four even larger acoustic screens which were hinged to two opposite walls. With this arrangement it was possible to provide a large floor area for large bands or swing the acoustic screens out from the walls to reduce the RT and provide good separation for Pop recording. Under these conditions the mid-frequency RT was reduced to 0.4 - 0.6S dependent on the number of screens used. The majority of the Beatles recordings were made under these conditions and twenty years later the studio remains virtually unchanged.

The largest studio, No.1, (98 x 56 x 40ft) has experienced many changes in its acoustics. Originally it contained a fixed stage at one end and a Compton Organ on one of the long walls. Within the first twelve months, several changes had been made to the acoustic treatment and the external consultants were blamed because they did not produce the optimum RT/frequency characteristic which they had guaranteed. This optimum characteristic, specified at that time, for this studio, had a mid-frequency RT of 1.5S rising to 2.5S at 100 Hertz. Considerable trouble was experienced at that time designing suitable RT measuring equipment and it was very difficult to obtain consistent results. With the merger of the Gramophone Company and Columbia Graphophone Company at this time there were two groups of EMI experts and the external acoustic consultants involved in resolving the problems. It appears that initially the RT was measured using a single frequency but within a year a warble tone signal became the established method.

Rockwool was used as the absorbing material and this was fixed only on the ceiling but there were also large areas of Insulwood Board. Within a month of the opening one-third of the Rockwool was removed. During 1933 all the horizontally placed building board and the remaining Rockwool were removed and

areas of felt and Cabots quilt were introduced. The resulting RT characteristic was now close to their target and it was stated that records made then were regarded as very satisfactory and an improvement on any orchestral recording that had previously been made.

During 1938/39, however, the Commercial and Artistic Departments requested a considerably increased RT but with the reduction in the number of staff in the Recording Department and further problems with the RT measuring equipment, it was decided to remove only a small amount of absorption for fear of spoiling the tone of the studio. Kingsway Hall and Queens Hall were available for recording large orchestras at this time. When using Kingsway Hall, the amplifier characteristics were modified to improve the tone and the placing of instruments was critical.

By the late 1950's, the studio had been made more reverberant and had an RT of 2.0S between 200 and 4,000 Hertz, decreasing below 200 Hertz. For the larger orchestras and choirs Kingsway Hall or the Town Halls at Watford and Walthamstow were usually used and outside the London area, Southampton Guildhall and the Salle Wagram in Paris were popular. All these halls were larger than No.1 studio and with the exception of Walthamstow Town Hall, were more reverberant than No.1 studio and they all had an RT characteristic which decreased below about 200 Hertz but none of them had a constant reverberation time between 1,000 and 4,000 Hertz which was characteristic of No.1 studio at that time.

In the early 1960's the fixed stage and Compton Organ were removed from No.1 studio to provide maximum floor area and volume and it was decided in 1964 to design an Ambiophony system to enhance the RT. One hundred high quality loudspeakers, distributed on the four walls and ceiling, were fed from six time delayed replay channels and feed back was used in each channel to provide intermediate delays. The system proved difficult to quickly set up and some recording engineers became rather too ambitious but a few very successful recordings were made. Eventually, however, it was decided to abandon the system and attempt to increase the RT and match the characteristic of the halls which were popular for recording and produce a studio which could cater for a range of repertoire from solo piano to orchestra and choir.

The excessive RT between 1,000 and 4,000 Hertz was removed by installing on the ceiling, a large area of quilted vinyl comprising a layer of one-eighth inch polyurethane foam sandwiched between two plastic films. Laboratory tests with high frequency membrane absorbers had shown that it was possible to achieve the desired frequency/absorption characteristic but the cost of fabricating a large area was rather high and commercially available material, although slightly inferior, was used.

The next stage was to remove all the absorbing material and diffusers, with the exception of the recently installed high frequency membrane absorber, and cover half of the wall area with half-inch thick wood panels covered on both sides with a plastic laminate. These panels were fixed to the existing wall battens and provided a large area of rather inefficient low frequency absorber.

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The lower part of the walls were clad with wood panels in contact with the brick. The mid-frequency RT increased to 3.0S but proved to be too high for the volume and selective narrow band fibrous and membrane absorbers were designed to operate between about 200 Hertz and 800 Hertz and gradually the mid-frequency RT was reduced to 2.3S.

According to the majority of the users, the studio is now regarded as having good to very good acoustics and I do not think that any significant changes will be made in the future.

In 1980 a small Pop studio, with control room and matching mastering room, was constructed and in 1984 it is proposed to construct an entirely new control room for No.1 studio and the existing No.1 control room will be extended and acoustically treated as a Pop studio.

The new No.1 control room will be external to the main studio block and, although essentially for classical usage, must be acceptable for film music and Pop monitoring.

The tape machines etc., because of their high inherent noise levels and physical dimensions, will not be in the listening area but in an adjacent room and, hopefully, we may be fortunate in finding a loudspeaker and power amplifier which has the approval of classical, film and Pop recording engineers and producers.

In conclusion I should like to express my thanks to the Manager of Abbey Road Studio for his permission to give this paper and to him and members of his staff for supplying some of the material.