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INDEPENDENT LOCAL RADIO DESIGN

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1. INTRODUCTION

In the UK, Independent Local Radio (ILR) stations are run by consortia (usually local) which operate under licence form the Independent Broadcasting Authority (IBA). When the availability of such a licence occurs, several consortia compete by submitting proposals covering programming, financing, staffing, background research, studio plans and the methods by which they intend to achieve the IBA standards.

A public meeting held in the locality of the proposed station is followed by a two-stage selection process by the IBA which results in the nomination of the successful consortium. This nomination marks the start of an intensive programme of work, involving many disciplines, to design, build and commision the station. Accompanying this is a publicity campaign which names the opening day.

2. OVERALL DESIGN CONSIDERATIONS

2.1 Stations are not allowed to commence broadcasting until the completed studios have been tested and passed by the IBA. Meeting the IBA Code of Practice for acoustics is the most critical aspect of the design. All other design factors are overshadowed by this requirement and should give way to it.

The other factors that must be considered are: choice of site, client's cost targets, programme for studio construction, degree of innovation, function and aesthetics.

2.2 Choice of Site

Undoubtedly the choice of site is the second most important aspect to be considered at the design phase as it affects the acoustic design in every direct manner.

Experience has shown that in order to construct a cost effective radio station within the IBA criteria and with a short construction period the following are desirable:

- Low external noise level (aircraft, trains, major roads, etc.)
- Studios on ground or lowest floor of building (new or existing)
- Good access for builders and end users
- Floor to ceiling height in studio areas no less than 4.0 m

2.3 Client cost targets

Because of the acoustic restraints, the cost of building Independent Local Radio stations is high. This can be in the region of £1000/m² gross for the technical and acoustically sensitive areas. The cost must be met from local voluntary subscription (with some help from local financial institutions such as banks) which invariably means that money for the project is very tight. Thus the design team is faced with the necessity of designing a set of sophisticated studios on a low budget.

2.4 Construction programme

This again tends to be dictated by financial requirements as there can be no revenue until the station is on air. The highest revenue period is the two months before Christmas so that, irrespective of when they start, most stations wish to commence broadcasting at the end of October. This puts additional pressure on the design team.

2.5 Degree of innovation

With pressures on time, money, and standards, it would be forgivable to remain with well tried safe formulae to ensure passing the Code of Practice tests, but such an approach would allow the design of stations to stagnate and may limit the choice of sites. However, it is obvious that 'experimentation' on the part of the consultants carries the risk of acoustic failure. This would be very damaging to the client and is, therefore, equally unacceptable. The correct course of action in the writers' opinion is to carefully measure the acoustic performance for each of station designed, and base future designs on the knowledge gained.

2.6 (a) Function

The day to day running of radio stations dictates that the studios and control rooms be placed adjacent to one another; to facilitate ease of running with a relatively small staff, and to give flexibility. This, of course, makes the acoustic consultant's work even more difficult than it might be.

(b) Accommodation

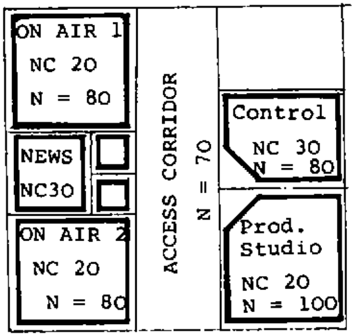
There are variations in the number of studios each station has. However, the most common technical facilities are noted below:

1.	On-air self operated studio	15-25 m²
2.	Back up or No.2 on-air studio	15-25 m²
3.	News booth	6-10 m²
4.	Production studio	25-40 m²
5.	Production control room	15-20 m²
6.	Racks room	10-15 m²

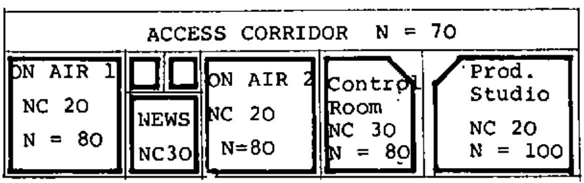
The smallest station currently in use has two 'on-air' studios, a news booth, and a racks area. In some of the earlier stations a master control room was also included, but this is no longer found to be economic.

(c) Layout

While many layouts have been used in the past, they broadly fall into two categories - rectangular and linear - as shown below.



R E C T A N G U L A R   L A Y O U T



L I N E A R   L A Y O U T

The choice is usually dictated by the area available for building. Clearly the rectangular layout is preferable as it uses the corridor to isolate the production studio whose maximum noise level output has been assessed at N = 100 (refer to section 3.4) from the other NC 20 areas.

2.7 Aesthetics

Aesthetic quality will always remain a matter of opinion, but it is certainly true that most people will react favourably to the 'appropriateness' of a space where a particular function or task is to be carried out. A radio studio has a well defined function and clearly the acoustic quality of the space is a major part of its aesthetics.

3. ACOUSTIC DESIGN CONSIDERATIONS

3.1 General

There are few occasions when an acoustician has to face a task comparable with the design of an ILR station. Within a short period he has to design a technically and acoustically complex building with a detailed acoustic specification, and to be right first time.

When the building is complete he usually has little or no time to make any adjustments and will see each specified acoustical parameter measured in detail by an independent third party days before an unalterable opening date. The IBA Code of Practice dominates the acoustic design of ILR stations and the comments below refer mainly to the problems of meeting those requirements; Reverberation times, background noise, and insulation are the main aspects.

3.2 Reverberation Time

The reverberation time (RT) characteristics to be achieved in studios and control rooms are clearly defined by the IBA. There are four main requirements:

a) The maximum RT in any octave band from 250 Hz to 8 kHz is about 0.3 s, depending upon the volume, for typically sized rooms.
b) The RT's in adjacent octave bands in this region must not differ by more than 10%.
c) The maximum RT in 1/3 octave bands from 63 Hz to 160 Hz is specified as a percentage of the RT in the 250 Hz octave band.
d) The decay slopes must be constant for at least the first 30 dB, and there must be no noticeable colouration or flutter.

A typical production or on-air studio has a floor area of about 15-25 m^2, a ceiling height of about 3.5 m, a volume of about 50-90 m^3 and internal surface area of the order of 80-120 m^2. There are several limitations which must be faced at the start: the floor, which comprises about 25% of the total internal area, must be covered with carpet and will thus have little low frequency absorption. Windows, doors and other essentially reflecting area may occupy another 10 m^2 or more. In many cases almost all the remaining available internal surface area will be covered with acoustic finishes. These are a significant part of total building budget and must therefore be designed with a view to minimising the cost whilst being sure that the IBA criteria are met.

Since acoustic wall treatment results in lost floor space, it is desirable that its depth should be minimised. It is worth noting that in studios of 25 m^2 floor area, 200 mm depth of wall treatment loses about 15% of the useable floor area. In addition, the cost of acoustic treatment depends greatly upon its depth, and it is thus important that detailed attention is paid at the design stage to reducing the area and depth of acoustic treatment to the minimum.

In practice a depth of 200 mm, including any timber grounds and any fabric or other finish, is the absolute maximum.

It is not possible to provide sufficient absorption in brick and concrete studios using only broad band absorption of the depth indicated. Consequently highly efficient resonant bass absorbers must be used. The high absorption coefficent required combined with the depth limitation means that it is difficult to construct an absorber with a peak absorption below 100 Hz. Introducing enough absorption of this type to meet the requirements at 63 Hz often results in a trough in the RT characteristics somewhere between 100 Hz and 250 Hz.

For many years, perforated hardboard-faced absorbers were used to provide the principle bass absorption, but were often found to cause a dip in the RT curve in the 250 Hz octave band, indicating an absorption peak at a frequency much higher than laboratory measurments had shown. The introduction of a new IBA code of practice which specified the maximum low frequency RT's in terms of the RT in the 250 Hz band meant that this type of treatment became more difficult to use successfully. A combination of panel absorbers and perforated face absorbers can provide a satisfactory solution.

Our experience confirms that the prediction of RT's below 250 Hz in these small studios, using laboratory measured absorption coefficients and conventional formulae, is extremely unreliable. We have found that the use of the measured performance results from other similarly sized studios provides the only way of predicting the reverberation times sufficiently accurately for the design of ILR stations.

Resonances in air conditioning ducts feeding the room and vibration resonances in inadequately damped duct walls can both result in problems due to the re-radiation of stored energy. Both are difficult to predict except on the basis of experience.

3.3 Background Noise

Background noise level criteria are specified in terms of the NC value. The background noise level in all on-air facilities from all normal sources must be below NC 20; in control rooms without 'on-air' capability and announcer booths with a microphone distance not exceeding 300 mm, NC 30 is permitted.

Air conditioning is the major internal noise source to be taken into account. Fan noise is dealt with using normal duct attenuators, but air flow generated noise remains as the most critical factor particularly in NC 20 areas. Air flow noise is extremely dependent upon duct air speeds, but lowering airspeeds is achieved only by increasing the duct size and hence the cost.

3.4 Insulation

The IBA specifies the level difference to be achieved between areas by specifying the source noise to be assumed and the background noise criterion in each area. The source noise is specified by the IBA octave band sound pressure level spectrum with the parameter N. This spectrum is flat from 63 Hz to 500 Hz at N dB and falls off by 2 dB/octave from 500 Hz to 8 kHz. The insulation needed for some combinations is shown in Table 1.

Table 1. Octave band level differences corresponding to a noise source with the spectrum defined by the IBA parameter, N, and a received noise level defined by NC curves

Source spectrum (N)	Received noise level (NC)	Octave band centre frequency (Hz) 63	125	250	500	1000	2000	4000	8000
100	20	49	60	67	74	76	77	77	76
100	30	43	52	59	65	67	67	66	65
80	20	29	40	47	54	56	57	57	56
70	30	13	22	29	35	37	37	36	35

It is obviously sensible when planning the layout of the station to avoid locating areas with high source levels adjacent to those with low background noise criteria. However, the space available and client's requirements can sometimes dictate otherwise. In the station for Red Rose Radio, it was necessary to place the production studio next to an on-air studio with the result that sound insulation better than the highest requirement shown above was needed.

Box-in-box structures are frequently needed to meet the insulation requirements with the inner structure supported by the outer with a resilient material. This can be done with varying degrees of sophistication; from the use of rockwool or fibreglass layers to the use of metal springs or rubber pads. Rubber pads are often considerably more expensive than fibrous layers but offer a better, more reliable and more predictable performance. The decision on which to use may depend not only upon acoustic requirements, such a case occurred in the design of the County Sound station and is described later in this paper.

As a general rule double wall structures (often structurally isolated) can deal with all but the two highest requirements in Table 1. A triple masonry wall structure may be needed to provide the insulation necessary between N = 100 and NC 20-30 areas.

Simply achieving these levels of insulation may not be sufficient; part of the IBA's test is the checking of background noise levels with heavy footfalls in an adjacent area. This test is not defined, but may include running with heavy footfalls if this is felt appropriate. In one case, a suspended timber floor covered with carpet generated such high levels of low frequency noise in such a test that background noise criteria in an adjacent masonary box-in-box studio floated on rubber pads were exceeded. Whether this problem was due to airborne noise or to vibration remains undetermined, although measurements indicated that airborne sound was a feasible culprit. It has been our policy to avoid the use of suspended timber floors within 2 m of studios areas, and elsewhere if possible.

Air conditioning ductwork causes major penetrations in the sound insulating structure around studios and control rooms, bringing with them the danger of sound transmission by break-in through the duct walls or by 'cross-talk' through grilles. Cross-talk is normally dealt with by the use of duct attenuators and break-in through the duct walls by lagging the duct externally with a heavy material. Duct lagging is very expensive and causes difficulties in the building programme, particularly those sections in the void above a box-in-box studio which have to be done when both inner and outer ceilings are in place with perhaps only 1 m height for the lagger to work in.

Recent experience has shown that sound insulating lagging can be eliminated throughout most of the building by the use of appropriate silencers located where wall penetrations occur. Indeed, in one recent station, lightweight flexible ducting was successfully used in this void, eliminating even the need to provide the normal duct supports and special flexible sections normally needed with rigid ducts, and resulting in a very considerable cost saving.

There is no doubt that the acoustician's biggest headache is that of site supervision. This can only be successfully done in conjunction with an Architect who is made to fully appreciate the importance of seemingly small details. No matter how good the design, the performance achieved depends critically upon how well the detailed drawings have been observed. This is far more difficult in practice than it sounds. It is made more difficult by short building programmes where a contractor might be under great pressure to ignore what may appear to him to be trivial comments from the acoustician.

4. CASE STUDIES

4.1 Red Rose Radio - St. Paul's Church, Preston

It takes a lot of courage on the part of a client to make the decision to tackle the complete renovation of a wholly derelict church, and a lot of hard work on the part of the Architects, Acoustic Consultants and Engineers to make it successful within the client's cost budget.

The renovation and adaptation of St. Paul's Church in Preston has worked well. Partly because a valuable piece of history has been well preserved, and partly because the building has become a sophisticated and technologically advanced radio station without loss of character.

The design of a radio station is complicated technically, even more so when the all important internal isolated structure of the studios has to be designed around 'must be preserved' neo-gothic columns. The overall planning solution reached was simple, although somewhat complicated in execution. The studios were designed into the central body of the church in a linear pattern, the technical facilities were placed in one side aisle and the news room area in the other. The main offices occupy the space created by a concrete slab spanning the entire width of the church above the studios and ancillary areas. This slab also provided the much needed structural stability to the columns and outer walls.

Acoustically, the station was a success as the rigid set of standards laid down by the IBA covering reverberation time, insulation, airconditioning noise, etc., were achieved with only very minor adjustments.

4.2 County Sound - The Friary Centre, Guildford

There are two rules in choosing a site for a Local Radio Station: the first is to select one with as little background noise as possible, and the second is to choose a site where the considerable structural weight of the studios can be economically handled.

On top of the Friary shopping complex in the centre of Guildford, beside a bus station was far from ideal. However, our client's reasons were irrefutable: they were financial, and was also the reason for the very tight time scale.

In order to minimize the weight and meet the tight programme, a 'kit of parts technique' was adopted for the offices, using tubular steel and curtain walling. All this was fabricated off site while the studios, which had to be constructed of wholly floated brick and concrete boxes, were built in situ. In addition, self finished materials were used wherever possible to further reduce the programme time.

The studios were placed centrally on the rectangular site, and surrounded by the pre-fabricated lightweight envelope. The junction between the two comprises continuous pitched glazing, which provides light and ventilation.

The studios and control rooms were all constructed as resiliently supported box-in-box structures. Rubber pads were chosen for this task for two reasons: a) to sufficiently attenuate vibration in the structure from the large plant rooms located nearby in the Friary Centre roof; and b) because the studio boxes had to be supported on beams, for structural reasons.

Large areas of the floor had to be constructed as a suspended timber structure for weight and cost reasons. The footfall noise identified in section 3.4 was reduced satisfactorily by the use of two 25 mm chipboard sheets with a damping interlayer.

Radio studios usually have a dim closed-in feeling. At Guildford, with the extensive use of glazing, it has been possible to achieve a clear, open and pleasant working environment.

It is fair to say that the amount of glazing in the studios is, to our knowledge, unprecedented and required detailed investigation during the acoustic design process.

All the IBA tests were passed at the first attempt.