Institute of Acoustics

HOLLYWOOD NIGHTCLUB, ROMFORD - A CASE STUDY IN ENTERTAINMENT NOISE CONTROL

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INTRODUCTION

Hollywood, on Sunset Boulevard, Romford is operated by the Essex based entertainment organisation, Urban Leisure Limited. As a green-field project Hollywood is unique in that by far the greater majority of discotheque venues utilise existing, often decaying buildings, typically disused cinemas, dance halls etc. No less unique is that in Urban Leisure we have an operator who from the outset was alert to the need for environmental noise control, noise exposure and interior acoustic considerations to be addressed at an early stage and to be properly monitored and controlled throughout the project. Consequently an acoustics consultant was appointed to the design team at an early stage and although the design of the basic building structure had by then been finalised and construction already under way on site, it was nevertheless still possible for the substance and cladding of the walls and roof of the building to be changed. The brief included full responsibility for all aspects of environmental noise control, the interior acoustics of the building, supervision of the sound system installation and liaison with the local authority.

THE SITE - ENVIRONMENTAL CONSIDERATIONS

The site is bounded on the north side of Romford Station, to the west by the River Rom and an industrial estate, and to the east by a new do-it-yourself supermarket and a new London Transport bus terminal, the latter developments being part of a new Romford Center development of which the Hollywood building forms part. At first inspection therefore the site does not seem particularly sensitive even though the southern boundary is formed by a rear service road to a council housing estate. Also there is a residential development beyond the industrial estate on the other side of the river. Fig 1 shows the general site arrangement.

Notwithstanding the location the London Borough of Havering Environmental Health department were insistent that as the client would be seeking late operating and liquor licenses the noise containment proposals should be designed to ensure no material increase in the existing ambient noise levels in the locality, particularly at the southern boundary of the car park adjoining the local authority housing. Surprisingly a nocturnal noise survey carried out at 0200hrs in April 1986 produced an L90 ambient noise level of 35dB(A) and it was agreed that NR35 at the car park boundary would be the design target.

THE DoE CODE OF PRACTICE FOR NOISE LEVELS IN DISCOTHEQUES

Hollywood is also unique in that it is believed to be the very first new building project to be affected by the new DoE Code, the Code itself having only been published in April 1986 and was in the hands of a particularly astute member of the Havering Environmental Health noise control team virtually on the day of publication. Following a public meeting at which provisions of the Code were endorsed by a team of officers from the London Borough of Havering it was the stated intention that the requirements of this Code would be enforced as a condition of planning and licensing. Subsequently however, following the publication of a condemnatory paper (1) in which a number of provisions of the Code are shown to be unworkable, it was agreed that whilst the spirit and the exposure level recommendations of the Code would be applied, the monitoring and sound level control requirements would be relaxed subject to the alternative proposals proving effective.

NOISE CONTAINMENT

Fig 2 shows the general interior layout proposals of the first and second floor levels. Apart from the main entrance foyer the ground floor is given over entirely to car parking leaving the discotheque operations center on the first floor with surrounding balconies and bars and a private club room on the second. The architects had already had the presence of mind to group the administration offices, clockroom facilities etc around the south east corner of the building thus to an extent screening the council housing estate from the noisiest area of activity on and around the dance floor. Taking the 102dB LAeq (5 minute) maximum dance floor SPL as required by the DoE Code of Practice as a "hotspot" at the center of the dance floor a sound contour map (Fig 3) was prepared in order to provide an indication of the likely distribution of sound within the building. From this it became clear that Inverse Square Law attenuation over the relatively small distances involved would be insufficient to provide the 85dB LAeq (5 minutes) "rest areas" also required by the Code at the bars and perimeter lounge seating and in any event, levels made in excess of this level in these locations would not have been acceptable to the client. This first stumbling block was overcome by the use of a "surround" type of loudspeaker installation in which a number of individual loudspeaker systems, each providing tightly controlled dispersion were deployed around the perimeter of the dance floor, with coverage away from the dance floor confined to far field or off axis energy. In order to accelerate the rate of attenuation the areas underneath the second floor balcony overhang were made high absorbant using a combination of suspended acoustic ceilings, thickly carpeted timber on joist flooring and luxurious upholstered furnishings to provide the predicted sound contour values given in (Fig 3), thus complying with the DoE Code of Practice and meeting the client's operating requirements.

The next problem was whether the proposed building shell would provide the necessary transmission loss characteristics to reduce an SPL of 85dB(A), with energy levels in the low frequency 1/3rd octave bands predicted to reach 100dB to the required NR35 external level. The proposed construction was to be dense concrete block having a specific density of 1350 Kg/cu.m and using the standard Mass Law calculation:-

$$R = 14.5\ (\log m) + 10\text{dB(A)}$$

the likely transmission loss figure worked out at 44dB(A). However, laboratory testing carried out by AIRO for the Autoclaved Aerated Concrete Productions Association (2) showed that in practice this type of material performs rather better than the standard Mass Law predictions might suggest, the following variation to the standard formual having been derived by Airo from the tests carried out:-

$$R = 21.6 (\log m) - 1.2dB(A)$$

This relation is shown plotted in Fig 4 and produced a predicted value for R at 49dB(A).

Using 1/3rd octave data taken from the AIRO report, Table 1 shows the spectral relationship between the anticipated 85dB(A) SPL at the containing walls, the predicted "R" value of the wall, and the target NR35 residual noise level outside the building, and clearly identifies a shortfall in noise containment performance.

Having identified the problem at a sufficiently early stage in the building programme, a secondary partition in the form of a damped membrane absorber was introduced at first and second floor levels to screen the blockwork from airborne incident energy thus significantly increasing its R value - especially at low frequencies. This comprises a 13mm plasterboard/12mm softboard sandwich carried on decoupled 100 x 50mm timber studwork framing with 120mm high density, semi-rigid mineral wool slab in the cavity as shown in Fig 5.

Based on behavioural testing of lightweight sandwich partition constructions carried out by British Gypsum (3)(4) and BBC Engineering (5), as well as on our own considerable experience in the application of this form of partition, the expected performance of the complete structure is given in Table 2. To further illustrate the order of improvement to be obtained by this method the curve of Fig 6 is taken from the British Gypsum investigation. Clearly, there is very little likelihood of the 35dB(A) environmental target SPL being exceeded, even should perimeter SPL rise well above the target 85dB(A) level.

Although considered less of a problem due to the reduced volume levels at the second floor balcony level and the absence of any high powered lourspeaker apparatus at this level, the roof cladding received similar attention and again, was expected to result in no more than 35dB(A) SPL external to the site.

Lobbies

In all instances where considered necessary, acoustically damped lobbies with two sets of doors were provided at appropriate accesses to each stair core. The performance of these lobbies has not been calculated but follows tried and tested methods and materials with predictable effectiveness.

Mechanical Services

Having effectively dealt with the building enclosure it was critical to ensure that the effort was not amortised by other trades - in particular by the creation of large air intake and/or extraction ducts linking the club interior to the outside environment. Further the Local Authority Environmental noise criteria was to include plant noise and close liaison with the heating and ventilation contractor and the brewery refridgeration contractors over the design, placement of enclosure of mechanical plant and duct and pipe routing was therefore necessary to contain these elements within the NR35 criteria.

Fig 7 shows the results of the measures implemented and it can be seen that a good correlation exists between the predicted and actual noise containment performance of the building. Also, airborne noise from the roof top air extraction grills and plant, and from the brewery compressors mounted at ceiling level in the ground floor car park, was not audible above ambient noises even at 0200hrs. The relatively low level of residual bass throb of between 50 and 100Hz as shown in Fig 7 is not audible at the car park boundary adjacent to the housing.

SOUND LEVEL REGULATION

Apart from the volume restrictions imposed by the DoE Code of Practice it will be clear that the extent to which the external noise level target will be met is directly related to the internal volume criteria upon which the noise containment predictions are based. It is therefore desireable that some form of volume regulatory apparatus be provided. The major problem however in any regulatory situation is that those responsble for the operation of the discotheque will always claim that any limit level imposed is inadequate and whenever attendance numbers start to fall off, insufficient volume will always end up the scapegoat, often resulting in acrimony between the venue management, the disc jockeys and the sound system installer. Recognising that straightforward volume limiting rarely provides a satisfactory solution to the problem an alternative approach was sought. Coincidently the Practice had recently been approached over a project to develop an entirely new concept in sound system hardware to address this very problem whereby system equalisation is constantly automatically adjusted for varying volume levels in accordance with the characteristic equal loudness contours of the human auditory system. The development of this device is the subject of a following but connected paper (6) and provides a psychological alternative of switching the sound system off when over the desired maximum volume levels are exceeded. The Inflexor, in prototype form was used at Hollywood and this, in association with sophisticated dynamic range compression and precise room equalisation, resulted in a perceived sound quality which provided all the drive and excitement necessary from a sophisticated up-market discotheque/nightclub but within the restrictions imposed by architectural cost considerations and by the requirements of the DoE Code of Practice.

SOUND SYSTEM

The client's brief having included supervision of the sound system installation, a basic scheme as shown in Fog 8 was prepared. In essence, the system comprised a large, 5000 watt main dance floor system employing a total of 10No bass loudspeaker enclosures recessed into the perimeter upstand of the dance floor well with 5No separate mid/high frequency directional enclosures, again distributed around the perimeter of the dance floor and attached to the second floor balcony edge. This arrangement provided the desired 102dB(A) "hotspot" at the centre of the dance floor falling to 98/100dB(A) at the perimeter. The mid/high systems were carefully angled to ensure that the 85dB(A) SPL at the building perimeter was not exceeded. In addition to the main system, separate line source arrays were provided at each of the massive moving multi-screen video pods, and an independent ambience system, comprising flat diaphram ceiling tile loudspeaker units, to provide fill to the perimeter areas. A further independent system was provided to relay classic radio comedy, ie "Hancock's Half Hour", "The Goons", etc into the toilet and clockroom areas. Sophisticated mixing facilities enabled live stage shows, discotheque turntables, tape, compact disc, video playback and three satellite video channels to be routed in virtually any likely combination to any section of the loudspeaker system with automatic voice-over and music shutdown in the event of a fire or other emergency.

Once the sound system budget had been approved and a contractor appointed Shuttlesound introduced several alterations to the type of equipment being provided although the actual concepts and basic structure of the system remained unaffected. The system was set-up and commissioned by the acoustics consultant in conjunction with Shuttlesound's engineers.

Operational experience has demonstrated that using the Inflexor dynamic equalisation device, in combination with careful setting up of the compressor/ limiters and the room equalisers, the CEL206 sound level limiter (employed only as a backstop protection device) has not been activated except under test conditions.

CONCLUSIONS

It has been shown that given the opportunity, the resources and the will it is possible to provide high energy discotheque and live music entertainment in a residential location without recourse to unduly expensive and elaborate forms of construction provided that the extent and nature of the problem be addressed is fully understood and that common sense precautions are taken at the outset. The achievement of the objective relies entirely upon the close collaboration between all parties involved in the design team, especially the Project Management , architects, the interior design consultants, all the contractors involved and in particular the client who at the end of the day has to foot the bill! In this context the co-operation of Messrs Tarmac Construction, Stanley Keen Architects, Bulldog Design, Lynn & Jones Shopfitters, Shuttlesound, West One Air Conditioning, Courage Limited and Urban Leisure Limited is acknowledged in bringing about a satisfactory conslusion to this project.

References

(1) Dibble K, Implications of the Noise Advisory Council Code of Practice on Sound Levels in Discotheques, Proc IOA Vol 8, PT 6, 1986.

(2) Jones A J, "Laboratory Study of the Sound Insulation of Single Lead Aerated Concrete Blockwork Walls", AIRO report No L/1763/A, 1985 February.

(3) Jones P E, British Gypsum Research and Development, Internal Product Application Evaluation Test Reports 1981/5. Work not published.

(4) Jones P E, "Improving Inadequate Sound Insulation Between Houses", Noise and Vibration Control Journal, 1981 November.

(5) Rose K A, Mears D J, et al, "Guide to Acoustic Practice" BBC Engineering Architectural and Civil Engineering dept, 1980 February, revised and expanded 1986 October.

(6) Duncan B, Dynamic Loudness Correction, Proc IOA Vol 9 1987.

1/3 Oct:	100	125	160	200	250	315	400	500	630	800	1KHz
85dB(A):	97	95	94	92	91	90	89	87	86	85	84dB
35dB(A):	56	52	50	48	45	43	41	40	38	36	35dB
Difference:	41	43	44	44	46	47	48	47	48	49	49dB
Attenuation:	34	37	38	38	38	39	44	46	48	51	54dB
Ref 35dB(A)	+7	+6	+6	+6	+8	+8	+4	+1	0	-2	--5dB

Table 1: Relationship between 85dB(A) & 35dB(A) and Blockwork Only Enclosure

1/3 Oct:	100	125	160	200	250	315	400	500	630	800	1KHz
85dB(A):	97	95	94	92	91	90	89	87	86	85	84dB
35dB(A):	56	52	50	48	45	43	41	40	38	36	35dB
Difference:	41	43	44	44	46	47	48	47	48	49	49dB
Attenuation:	44	49	50	48	50	53	59	61	63	66	66dB
Ref 35dB(A):	-3	-6	-6	-4	-4	-6	-11	-14	-15	-17	-17dB

Table 2: Relationship between 85(A) & 35(A) and Blockwork Enclosure with Sandwich Lining

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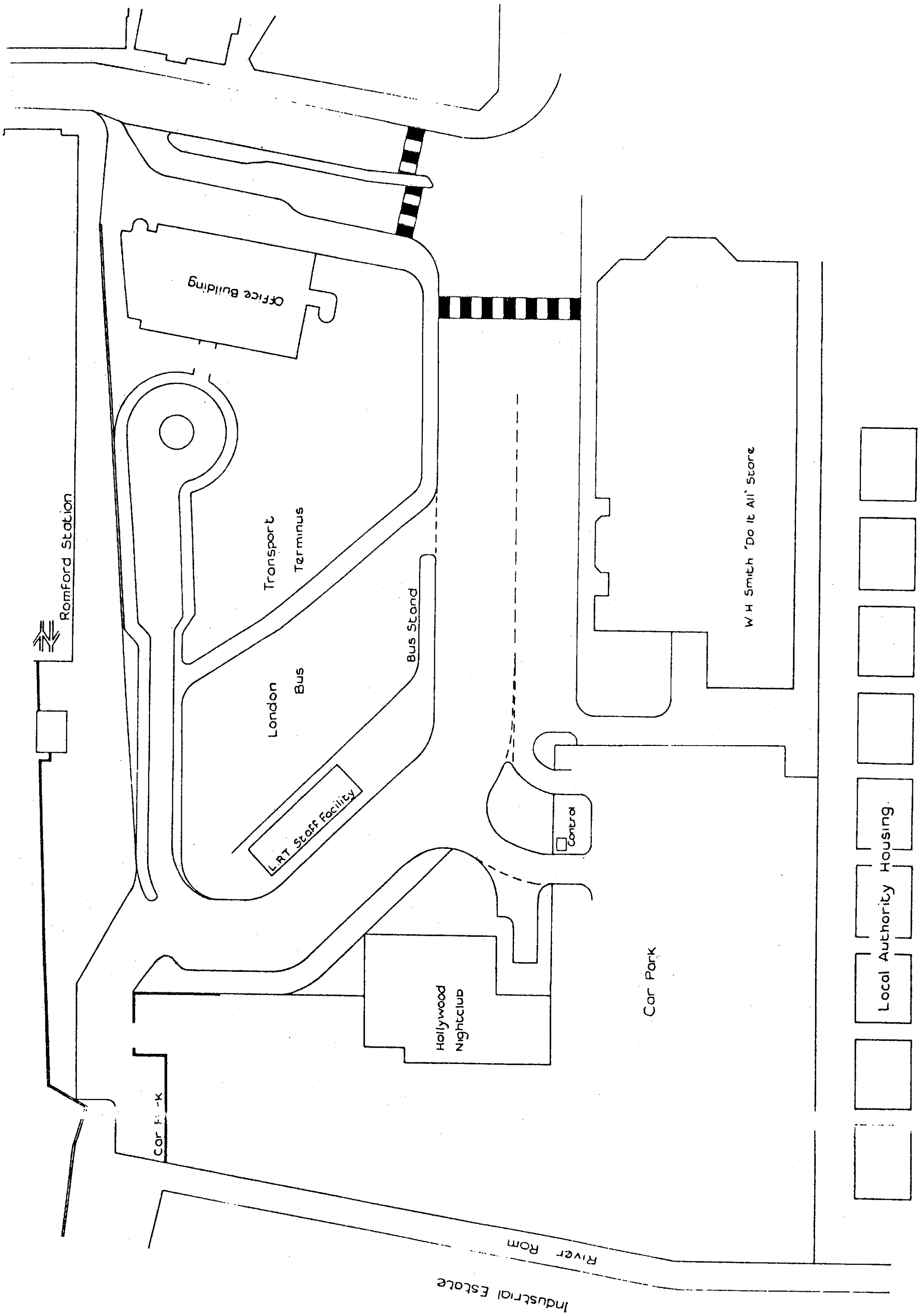

SITE PLAN

Fig 1

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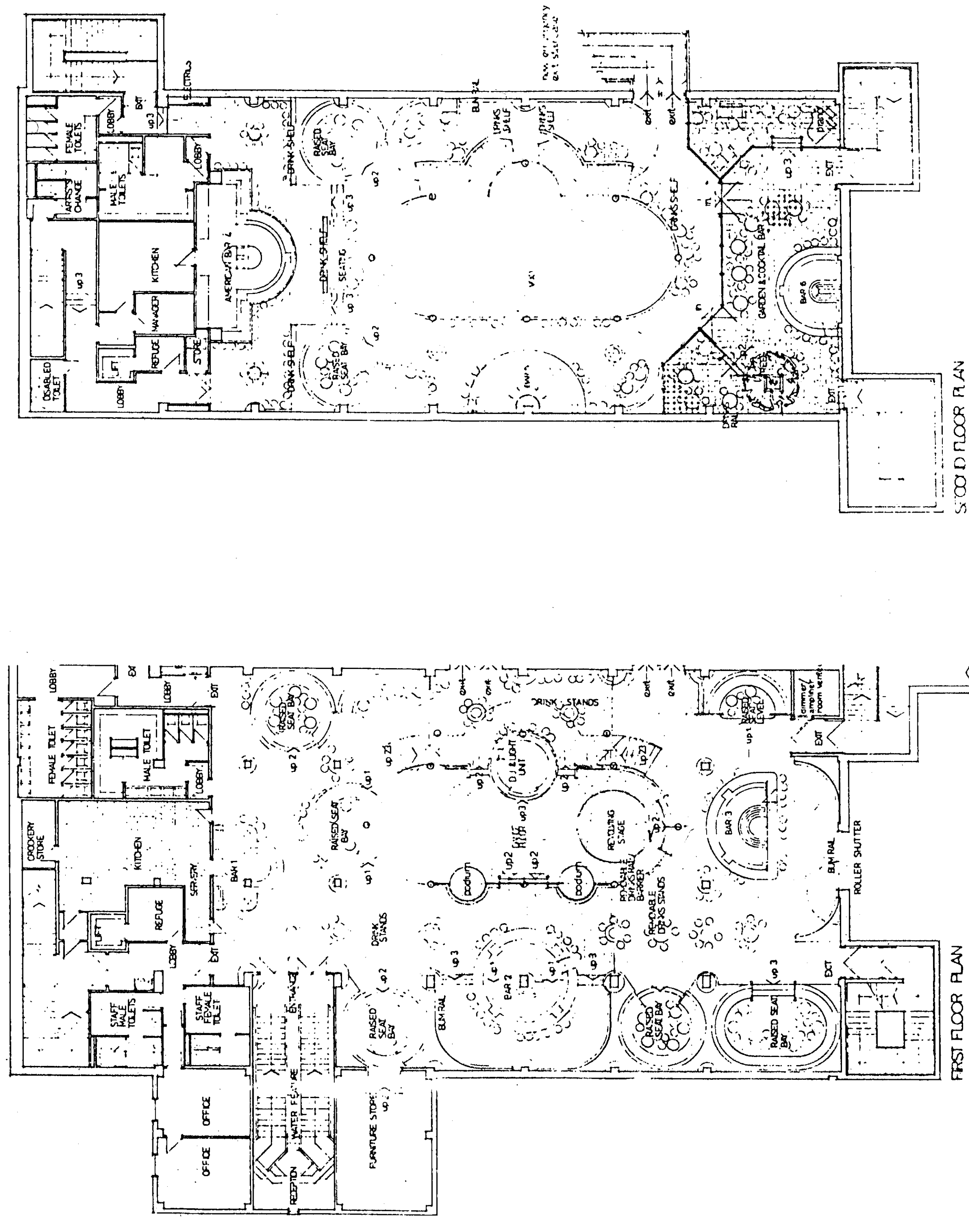

GENERAL LAYOUT

Fig. 2

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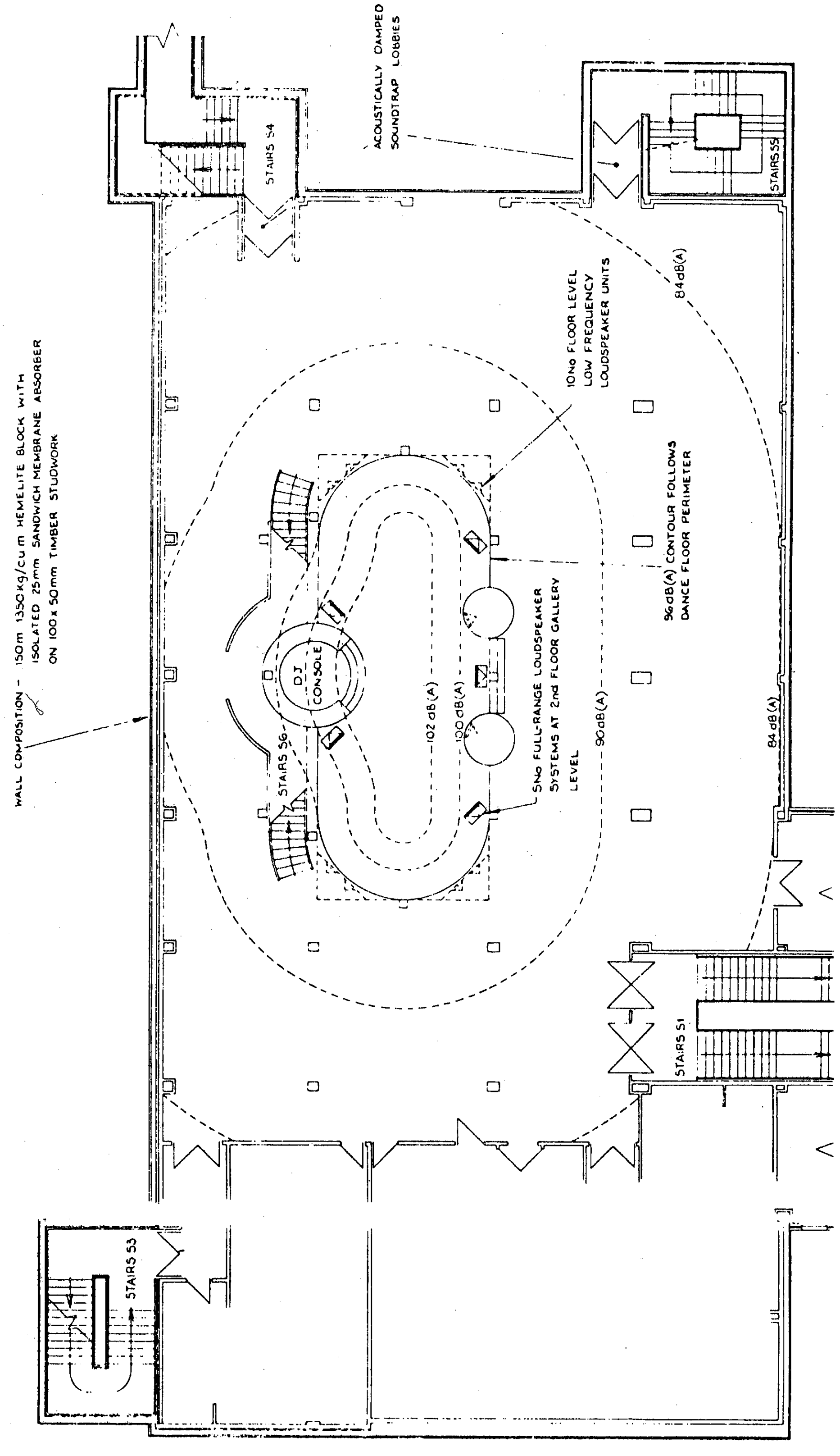

FIRST FLOOR SOUND CONTOUR MAP

Fig. 3

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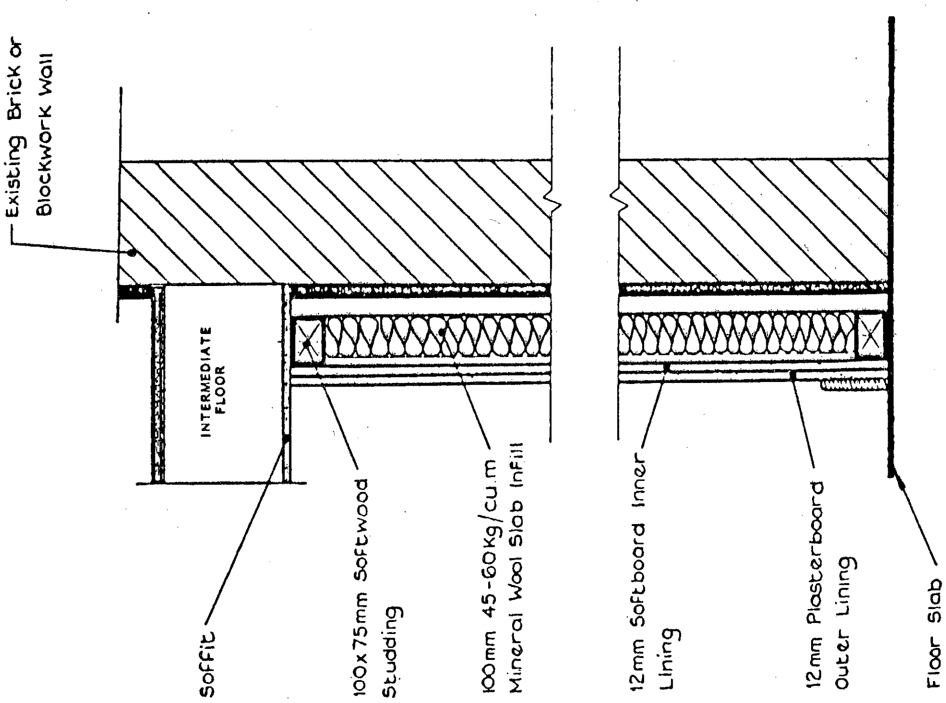

Fig 5 Damped Membrane Dry Lining Construction

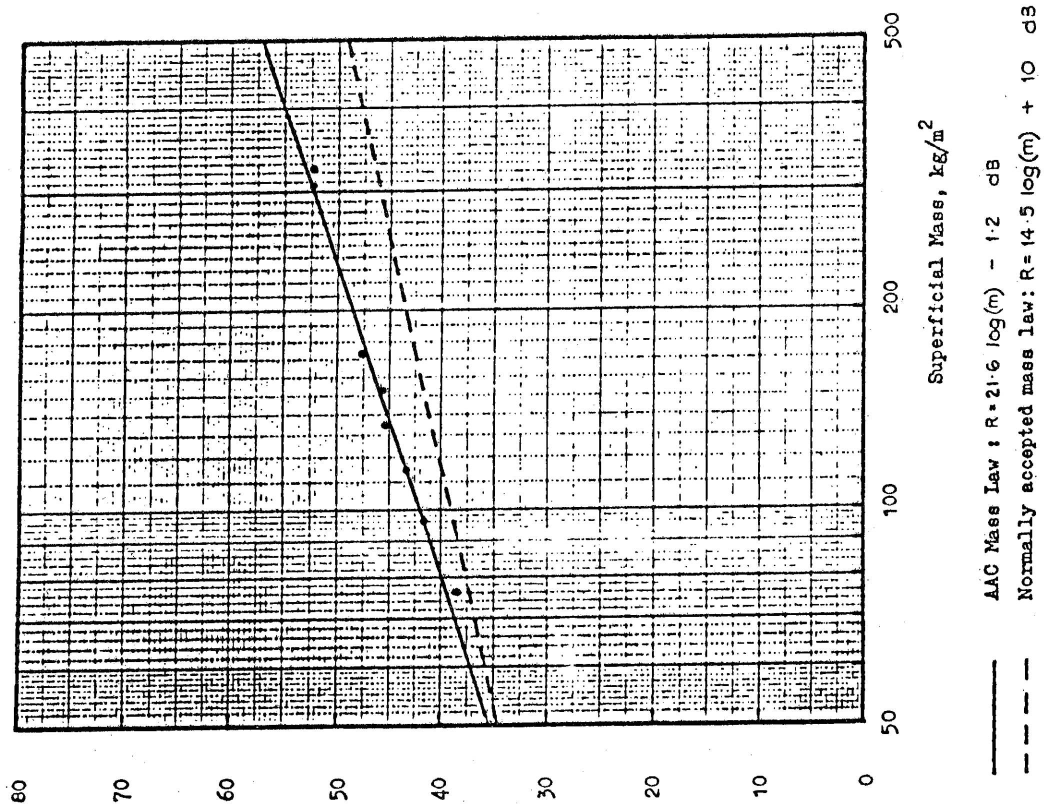

Fig 4 Relationship Between Standard Mass Law & that derived for Lightweight Aerated Concrete Block Partitions (2)

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A CASE STUDY IN ENTERTAINMENT NOISE CONTROL

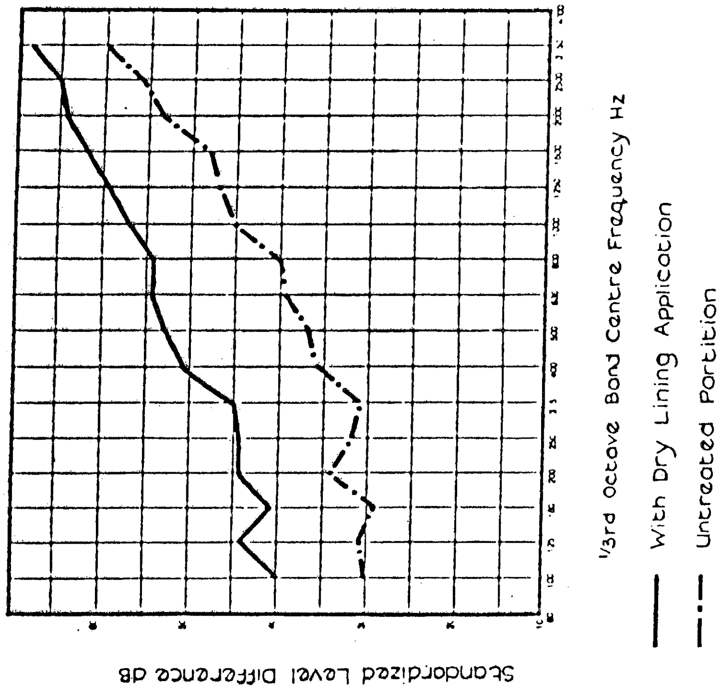
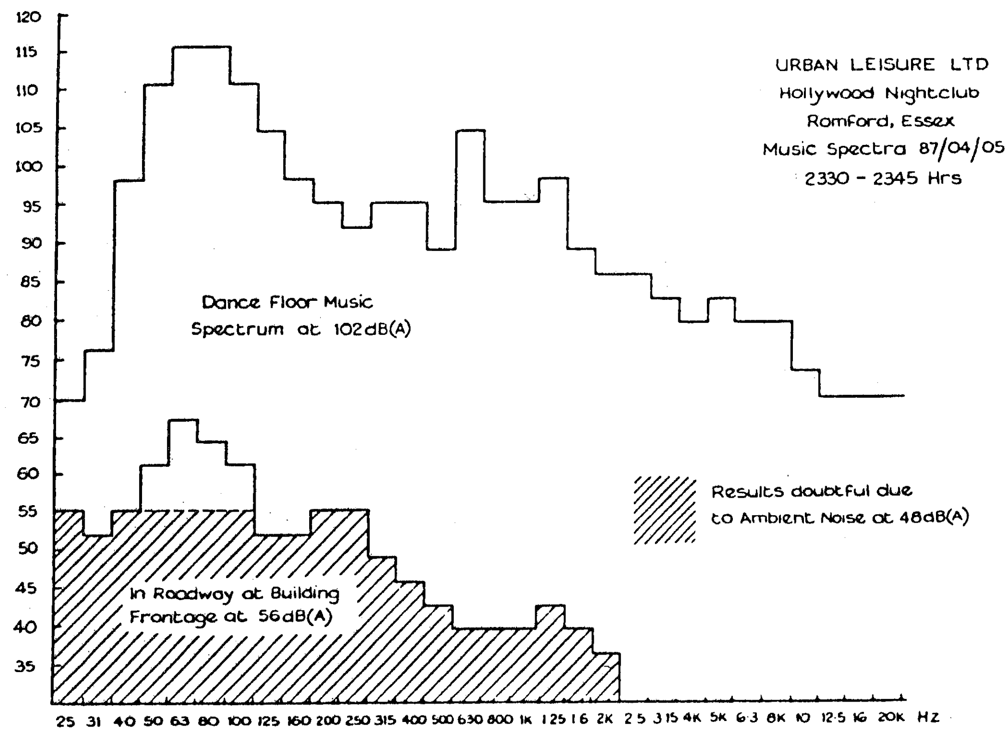


Fig. 6 Improvement in Sound Insulation Performance of Typical Untreated Blockwall due to Application of Damped Membrane Lining (3,4)



	25	31	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1K	1.25	1.6	2K	2.5	3.15	4K	5K	6.3	8K	10	12.5	16	20K
SRI	15	25	43	50	48	51	50	52	46	40	37	46	50	47	65	56	56	56	49	50										

1/3rd OCTAVE CENTRE FREQUENCIES

Fig. 7 DISCO MUSIC SPECTRA & TRANSMISSION LOSS CHARACTERISTICS

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