SOUND TREATED ROOM IN A SPEECH AND HEARING CLINIC

S. S. MURTHY AND K. T. JACOB

Introduction

Aucostic environment plays an important role in the field of Audiology and Speech Pathology especially in conducting hearing acuity tests. A suitable aucostic environment is required to carry out free-field tests especially for children and for recording the speech samples of patients with defective speech before, during and after therapy. For the above test requirements, the Speech and Hearing Clinic should be provided with a satisfactory sound treated room.

Characteristics of a Sound Treated Room in a Speech and Hearing Clinic

If the audiometric tests are conducted without considering the ambient noise conditions inside and outside the room there is every possibility of getting audiograms that are not valid due to the masking effect of the ambient noise in the test environment. Also, for comparing audiograms taken at different places, it is essential to know about the acoustical conditions under which the tests were conducted.

The American Standards Association (1961) has specified the maximum ambient noise levels that can be tolerated in a sound treated room, where the audiometric tests are being carried out. The following table gives the ASA values for the sound treated room in a Speech and Hearing clinic.

TABLE 1

Maximum allowable SPLs for no masking above the zero hearing level setting of a standard audiometer (dB ref: 0.0002 dynes/cm²)

Frequency setting **Hz**	***Octave*** *band in Hz*	**SPL in dB** *(ref:* **0.0002** *dyms/cm²)*
125	**75 — 150**	**40**
250	**150 — 300**	**40**
500	300 — **600**	**40**
1000	**600 — 1200**	**40**
2000	**1200 — 2400**	**47**
4000	**2400 — 4800**	**57**
8000	**4800 — 9600**	**67**

Mr S. S. Murthy is Lecturer in Electronics at the A.I.I.S.H.
Mr K. T. Jacob is an Internee.

Besides the above requirements the sound treated room should be sufficiently spacious with good ventilation and diffused lighting for the comfort of the patient. These measures will avoid physical fatigue of the patient and thus will ensure good co-operation from the patient which is essential for valid hearing measurements.

Designing of Sound Treated Rooms: To achieve the above qualities for a sound treated room in a Speech and Hearing Centre, the following points maybe considered independently.

Orientation: Generally a sound treated room will be constructed in an ordinary room of a building. This particular room should be selected in such a way that it is away from heavy traffic or any other noise source in the vicinity.

Size: It is preferable to have a room of the size of 10'x8'x8' for conducting all the tests. A smaller dimension may be chosen for pure tone and speech audiometry (except free-field tests). The dimension may be changed in terms of the user's requirements. In addition to the sound treated room a control room of proper dimension should be provided.

Walk: In a moderate ambient noise level a single brick wall with two sides cement mortar plaster is adequate. Total thickness of the wall may be 9 or 10 inches. In case of excessive ambient noise level, it is advisable to have double walls of single brick in lengthwise construction separated by an air gap of 3-4". The air gap between the two walls should go deep into the floor at least by 12 inches which provides considerable isolation of the inner floor from outer one.

Ceiling: The ceiling of a sound treated room must be of higher density materials such as reinforced cement concrete. For double wall construction, the outer wall should carry the concrete slab and the inner walls should support the false ceiling. The space between the concrete roof and false ceiling may be filled with sound absorbing materials.

It is advisable to have a false ceiling with a sound absorbing material in the control room to reduce the reverberation and this in turn will facilitate live speech audiometry.

Floor: Floors may be covered with coir matting and carpets.

Doors: It is preferable to have double doors fixed in such a way that one **opens** into the room and the other opens outwards. Each door may be made up of teakwood frame covered with teak wood planks bearing an air gap between the planks. The air gap may be filled with sound absorbing materials such as glass wool or fine river sand. A thick rubber lining along the edges of the doors will be an added advantage to avoid leakage of sound waves.

Observation Window: In case of single wall construction an obseravtion window of 24"X18" maybe sufficient. This should be provided with two layers

of ¼" glass sheets separated by maximum available air gap. Two separate windows of the same size mentioned above should be provided in case of double wall construction. It is an advantage to line the edges of the glass sheets with suitable sound absorbing material such as sponge or glass wool. From the acoustic point of view and also from that of visibility, one of the glass sheets should be tilted a little inward.

Internal Acoustical Treatment: It is important that the ceiling and all the four walls of the room should be treated acoustically. For this purpose one inch thick compressed fibre glass wool plus an air gap of one inch, with a facing of acoustic tiles should be fixed on all the walls and ceiling.

Ventilation: Indirect lighting may be provided by suitable means to make it pleasant. Air conditioning could be made by suitable ducting system. It is essential that the AC Plant should be installed away from the sound treated room and the ducting should be designed properly to keep the noise level to a minimum. An alternative is to have a suitable room air cooler in the control room. This may be operated as frequently as desirable keeping the door between control and test rooms open.

Electrical connections: The connections between the instruments in the control and test rooms are made through suitable jacks and adaptors. Pipes or holes should not be used for this purpose.

The New Sound Treated Rooms in AIISH

Keeping the above ASA Specifications in view, two rooms are constructed in the Institute. The new sound treated rooms are located in a big hall on the ground floor of the Institute building. The maximum ambient noise level around the locality is about 60-65 dB on the C-scale of the Sound Level Meter (GR Type 1551-C).

The two rooms are of internal dimensions 5½'x5'x7' and a corridor of dimensions I6'x3½'x7' is provided as a common control room.

These rooms are provided with double walls of *4½"* thickness with plaster on the outer side. The ceiling is provided with I8 gauge tin sheets fixed on wooden raftors. Sand of 3" thickness is placed on the tin sheets. An air gap of 3" is kept between the two walls. The floor of the inner room is isolated by 3" gap from the external floor to a depth of one foot to prevent structure borne sounds such as those from foot steps, vehicles, etc. The inner ceiling consists of randomly perforated acoustic tiles fixed on a wooden frame work 12" down the external ceiling. All the walls of the rooms, including the central rooms, are acoustically treated by fixing the randomly perforated acoustic tiles on wooden frames.

The pbservation window is of the size 18"x12". It is provided with two glass sheets of ¼" thickness supported by teak wood frames. The inner glass sheet is tilted slightly outward for good visibility and to reduce the mass volume resonances.

The edges of **the** glass sheets are lined with glass wool to prevent the leakage of sound waves.

The rooms are provided with double doors on separate wooden frames. The dimensions of the doors are 2' - 3" x 6' consisting of two plywood planks of I/8" thick fixed on teak wood frames. The air gap between the planks is filled with fibre glass. A thick rubber lining is provided along the edges of the door to ensure effective closing of the door on the frame without any air gap.

Two Air Conditioners of I½ tons are provided in the control room to keep the rooms with fresh and cooled air. Incandescent bulbs in white domes are fixed to give soft lighting.

The floors are covered with coir matting and thick carpet.

Pre-fabricated Audiometric Booth: On an experimental basis, a pre-fabricated booth was constructed with internal dimensions of 3'x3'x4½'. This is a room in a room situation with common floor. The outer room is made up of five dealwood planks fixed to iron angulars. The inner room consists of perforated acoustic tiles fixed on wooden frame work. The annular separation between the inner and outer rooms is filled with fibre glass and acoustic tiles. The door is of single wedge design of 8" thickness made up of two hard-board planks of l/8"thickness fixed on a wooden frame. The annular separation between the two planks is filled with paper chips. The observation window is provided with double glass of 1/6" thickness separated by a distance of 6". The edges of the walls towards the door side are lined with glass wool and cotton cloth to achieve effective closing of the door without any air gap.

Results

The ambient noise level measurements in all the newly constructed rooms are made by using sound Level Meter—GR type 155I-C and Octave Bond Analyzer-GR type I558-A. The average Sound Pressure Level outside the rooms is 65 dB on C-Scale of the Sound Level Meter. Table II gives the values of SPL inside the rooms in octave bands.

TABLE II

Octave Band in Hz	*ASA Specified SPLs ref:* 0.0002 dynes/cms²	*Room No. I*	*SPLs in dB ref:* 0.0002 dynes/cm² *Room No. II*
75 — 150	**40** dB	38	**42**
150 — 300	40 dB	34	**29**
300 — 600	40 dB	26	**20**
600 — 1200	40 dB	16	**12**
1200 — 2400	47 dB	13	**12**
2400 — 4800	57 dB	14	**13**
4800 — 9600	67 dB	14	**13**

From the above table it is clear that the design of the new audiometric rooms satisfies the ASA Specifications. To reduce the cost of the construction the rooms are provided with ceiling made up of I8 gauge tin sheets and 3'' thick riversand instead of expensive RCC slab. Two window air coolers are provided instead of costly ducting system on separate central air conditioning plant. The approximate cost of the rooms is Rs 5000 excluding air conditioning units.

The pre-fabricated audiometric booth, mentioned above gave satisfactory results. The attenuator characteristics of this booth is I8 dB on C-scale of the Sound Level Meter. This booth was successfully used in 1967 Mysore Medical Exhibition for carrying out screening tests. The limitation of this booth is that the subject is not able to sit inside for a long period because of the lack of air circulation. This may be further improved by providing a ducting system. The approximate cost of this booth is Rs 500.

Conclusion

A sound treated room in a new Speech and Hearing centre can be constructed with minimum expenditure by considering the points discussed above. It is thought that a single brick construction of I0" thickness with cement plaster is adequate and the internal acoustic treatment can be made with glass wool and acoustic tiles. This type of construction can give satisfactory results for an ambient noise level of 65 dB. The room may be provided with ceiling made up of tin sheets and riversand instead of with costly RCC slab. It is hoped that this paper would provide with sufficient information to construct an inexpensive and satisfactory Sound Treated Room.

REFERENCE

A.S.A. (1961) *American Standard Criteria for Background Noise in Audiometer Rooms, S 3.1—1961.* Quoted from Snow, W. B. (1966) Audiometric Test Environment, pp. 97-107 in Glorig, A. (Ed.) *Audiometry: Principles and Practices:* Baltimore: The Williams & Wilkins Company.