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Content

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# ARCHITECTURAL APPROACH TO NOISE CONTROL IN BROADCASTING STUDIOS

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## ABSTRACT

*The evolution of broadcasting technology in the past few years has modified the design criteria for the current broadcasting studio design. Consequently, this has led to greater acoustical challenges in designing an acoustically ideal studio, sound stage, control room or listening room. The intrusion of sound that interferes with or detracts from the desired production output within the broadcasting studio has become a major concern to those in the broadcasting industry as well as a necessity for control by those in building industry especially architects. This paper focuses on the various sources of noise that are detrimental to smooth studio production. It highlights both internal and external sources of noise, common mistakes in design and construction of broadcasting studio with principle and the effect of airborne sound insulation and control of structure borne sound transmission in broadcasting studios. It proffered architectural application for solution to noise problems. Recommendations were given with conclusion that the best (and often the only) place to effectively control noise is at its source and that once noise has radiated throughout a building, its control will require large amount of design ingenuity, technology, and money.*

***Keywords: Architectural approach, noise, control, broadcasting studios, acoustics.***

## INTRODUCTION

The task of architecturally achieving acoustical privacy is becoming more and more important. One of the major problems facing architects in the field of acoustics according to Snyder and Catanese (1979) is the difficulty of understanding the behaviour and the control of unwanted sound. Architects must therefore understand behaviour of sound if they are to successfully control and manipulate it. This is a primary concern, for the great majority of acoustical problems are the results of unwanted, uncontrolled sound. Noise is one of the most difficult terms to define. It could be argued that the easiest way to classify noise and all sounds would be in terms of their structure and order. The factors influencing this classification would primarily be intensity, frequency, and generation (continuous versus random) patterns. In this case the most structured sounds would be music, and the list structured sounds would be noise. Speech patterns would rest somewhere between the two extremes. The simplest way therefore to define noise is any intrusive sound that interferes with or detracts from the desire auditory task (Snyder and Catanese, 1979). Noise control therefore involves keeping out unwanted sounds that might interfere with the auditory tasks to be performed. In broadcasting studios, the basic requirements are perfect sound proofing and variable reverberation time, due to variable pitch and frequency of sound to be produced there Punmia (1987). Broadcasting studios need to be constantly maintain as artificial spaces should stay clear of any external sound. All considerations for studio design and construction should therefore be geared towards this goal and have to be duly respected for its efficient and effective functioning. It is thus necessary to examine the undesirable source of background noise radiating into the broadcasting studio with the purpose of proffering architectural solution to controlling it.

## IDENTIFICATION OF NOISE SOURCES INTO BROADCASTING STUDIO

The background noise in a broadcasting studio is made up of energy generated outside the studio and also partly of energy generated internally. They are identified as

### External Noise Sources

The common background noise originated from outside are those form traffic, railways, aircraft, industries, people and animals. The sound level of the total traffic flow could affect the studio as well as the sociological, physiological and economic sense of the workers.

### Internal Noise Sources

Internal noise is produced by a wider variety of services and their control is often left to the designers of these services. Practical experience has shown that the cost of amendment in a faulty service installation could be twice more expensive than providing a correct design at the initial stage (Oladimeji, 1994). Internal noise has the possibility of emanating from three different sources namely: mechanical services, electrical services and the activities of the people within the station.

**Noise from Mechanical Services**

Ventilation and plumbing system constitute the potential sources of noise from the mechanical services. Fans are invariably the major source of noise in any ventilation system and will determine the eventual noise level in the studio and how much attenuation is required to meet specific criteria. Plumbing work is another source of noise from mechanized services. Other examples of mechanical equipment which contribute to the overall noise problem are lifts machines, refrigeration plant, compressors, air-cooled condensers etc. All these equipments may give rise to structure-borne or air borne noise into building even if it is mounted externally.

**Noise from Electrical Services**

It is obvious that in order to eliminate the noise that may be detrimental to broadcasting production, great care must be taken. Some electrical equipment that are potential sources of noise include fluorescent lighting, general fittings, studio clocks, and standby diesel generators.

**Noise from People**

Corridor floors, which are often hard, will transmit impact noise from shoes. People also generate noise as they talk which could affect studios when located near offices and other public functions.

## ACCEPTABLE NOISE LEVELS IN BROADCASTING STUDIOS

In every building, there is an acceptable noise level that can be tolerated by the users. Knudsen and Harris (1950) referred to the acceptable noise level in a building as the highest level of noise within a building that neither disturbs its occupants nor impairs its acoustics. It is therefore useful for architects to be acquainted with the range of average noise levels that are acceptable in broadcasting studios before embarking on its design. The acceptable noise levels is specified in terms of Noise Criterion (NC) level and are useful in calculating the sound-insulation requirements of walls, partitions, and ventilation ducts under typical noise conditions. Broadcasting studios have low noise levels and a room acoustic that is pleasant to work in without adding undue coloration to the sound that reaches microphones. Traditionally, recording and broadcast studios were recommended to follow the Noise Criterion (NC) 15-20 curves while television studios have NC 25 curve. However, recent studies have questioned the appropriateness of these recommendations considering the recent advance in recording technology (Cohen and Fielder, 1992).

**Radio Studios**

Radio Studios are among the most critical of all acoustic environments requiring very low noise levels and a high standard of acoustic isolation. In the past, this was achieved by burying the studios in the centers of large, purpose-designed buildings. The modern trend now is to bring studios more into the public eye, with studios visible to the public through large areas of glass. Often these studios are installed in existing building that will not take the weight of traditional heavy sound-insulating constructions. Achieving the same acoustic standards in lightweight buildings with large areas of glass is an acoustic challenge that architects have to meet.

**Television Studios**

Television Studios are generally much more tolerant of noise. They do still require relatively high standards of isolation and the difficulty tends to be co-ordination of acoustic design with the very large amounts of technical and lighting equipment involved. The purposes of Television (TV) Studios and its location within building have significant effects on acoustical design. The use of boom microphones requires that the studios have both an NC rating of 25 or lower and the absence of intrusive noise from building services and occupant activity. This is particularly an acute issue in a multi-tenant commercial building and in fact, presents the greatest acoustical challenges (Lindsey, 2004).

### News Studios

In contrast, a news/sports/weather studios featuring anchors and reporters using lapel microphones is much less sensitive to intrusive noise. Sound separation can be adequately addressed using conventional construction. NC 30-35 is acceptable in this application.

## COMMON MISTAKES IN DESIGN AND CONSTRUCTION OF BROADCASTING STUDIO

There are a number of common mistakes in designing and constructing broadcast facilities. Mechanical, Electrical and Plumbing (MEP) equipment are often located adjacent to studios without careful thought to noise control. MEP services are frequently allocated inadequate space, making noise more prominent and leading to noisier conditions in directly adjacent spaces. Or a dining room is located near the studio, but without properly treating it for acoustical control of impact noise. The heavy concentration of computers in TV equipment rooms creates an additional source of noise from the large volume of Heating Ventilation and Airconditioning (HVAC) equipment required to cool it, yet for operational reasons these are sometimes located close to control rooms and studios rather than separated, perhaps, by a video control room. Corridors around the TV studios are used to carry typical traffic around the facility, and storage rooms are paced nearby, rather than isolating these sources of activity –related intrusive noise. Likewise, lack of effective construction management can defeat an otherwise effective acoustical design. For example, an electrical contractor may lay cable conduit in a straight line, even though it was designed to be run offset in wall cavity space. Another contractor may knock a hole in the wall rather than cutting it, leaving debris in the wall cavity that bridges the sound isolation. Another contractor may adjust the layout of MEP equipment to suit "efficient" or fast installation, adding elbows or shortening ducts, or locating it dangerously close to outlets. The result often is the generation of noise that will be difficult to trace to the source and attenuate.

## CONCEPT OF NOISE CONTROL

The principal objective of noise control is to shield the occupants of a room from noises generated outside the space. This involves keeping out unwanted sounds that might interfere with the auditory tasks to be performed. According to Snyder and Catanese (1979), the best (and often the only) place to effectively control noise is at its source. Wherever and whenever possible, noise should be isolated and control at its point of origin. Architects must therefore recognize and define potential sources of noise and understand as well as appreciate the paths that noise may take through a building in order to achieve the goal of effective noise control. Basically, there are two major sources of noise (and sound in general) into a building. The first is through the air, and the second is through the structure of a building.

### Airborne Noise Control/Sound Insulation

Glifford (1972) defined airborne sound transmission as the transfer of sound from one point to another, the sound been generated in the air at the first point and received in the air at the second. Airborne noise will enter a space through any opening it is afforded, regardless of the size, shape, or location of the opening. Among the more common openings are HVAC ducts, cracks around doors, windows, or partitions, and electrical outlets. Consequently, the attainment of any degree of airborne noise control must begin with the effective blocking of these openings. Architecturally, Oladimeji (1994) suggested that airborne sound can be first controlled at the planning stage by isolating the area concerned to achieve natural attenuation and the use of building and landscape as barriers. He also suggested practical design aids which include design of partitions, roofs, doors and windows. Natural attenuation of sound can be achieved when studios are located away from noise sources. Obstacles or barriers in form of screens are more effective if placed near the source or observer, as attenuation is greater if sound rays have to bend through large angles to get to the observer, in this case, the studios.

### Structure Borne Noise Control/Insulation

Structure borne sound transmission refers to the transmission of sound from a vibrating body in contact with the structure of the building. This is by far the most difficult to control. This is due in part to the speed with which sound travels through solids. Impulsive sounds exciting the solid structure of a building are propagated with little attenuation, and thus affect quiet areas far from the source of sound. Once sound has entered a structure, the only way to block it path is literally to break the structure. In broadcasting studios where a high degree of sound insulation is required, it is necessary to take precautions to ensure that there is no significant sound transmission via the supporting structures of the studios. Therefore, the only effective way of controlling structure – borne noise here is to isolate the source and prevent its initial entry into the structure. Retinger (1988) highlighted the degree of such sound isolation that can be attained to be dependent upon three factors such as the mass of the enclosing walls, ceiling and floor, air tight sealing of all penetrations for doors, windows, cables and air ducts and physical separation from the enclosing structure.

## BASIC PRINCIPLES OF NOISE CONTROL

To protect the building from the external noise sources, ensure that the building designed is not nuisance to people in buildings and spaces nearby, and to control the amount of noise generated within the building, Croome (1982) suggested the following principles:

i. Locate noisy areas away from critical areas.
ii. Select plant and equipment carefully considering the noise implication.
iii. Use building materials and structure suitable for control of penetration.
iv. Use control equipment where necessary only after the above issues have been exhausted.

The background noise levels appropriate to broadcasting studios and other technical areas are very low compared with external noise level due to traffic and other everyday activities and also programmes in neighbouring studio. Therefore, it cannot be over stressed that the exclusion of external sounds requires methods and materials completely different from those for damping internally generated sound and reverberation, and that the two processes are largely independently of each other.

## ARCHITECTURAL METHODS AND MATERIALS FOR EXCLUDING NOISE

The acoustical requirements of an NC 25 live-audience studio in a multi-tenant building generally are best met using room-within-a-room construction. A floating six-inch concrete floor is supported by springs with a two-inch air space between it and the building slab. The springs provide vibration isolation, preventing transmission of sound from the building slab, while the air space increases air borne sound transmission loss. The studio's walls are built on top of this floating slab and attached to its ceiling, which is suspended from the building slab above by sound isolation hangers. Specialty doors with acoustical values similar to the double walls must be installed to accommodate people and sets. These include doors often up to 10 feet high and eight feet wide, and are very heavy, requiring special goalpost framing made of structural steels tubes with isolated male/female restraints at the top of the structure. Specialty products are manufactured for floating floors, acoustic doors, acoustic windows, floating wall restraints and supports, enabling construction without field-built items. Use of prefabricated materials enables better quality control and reduces errors while speeding construction. Similarly, drywall construction is preferable to concrete block construction for ease and cost of construction as well as acoustical control. In fact, several layers of drywall with air spaces between yields better acoustical control with far less weight than masonry construction. Often the most sensitive room is the voice-over room, which must be very quiet (i.e. NC 15-20) and free of intrusive noise. Typically, these are to be designed as floating rooms measuring six feet by six feet, with all surfaces finished with sound-absorbing material to create a "dead room" that avoids coloration of voice. For the formal NC 25 studio, the ideal is a box that is free from contact with the base building except through acoustical elements. The need to run utilities (air supply and returns, cables etc) into the room compromises this idea requiring additional acoustical controls. This is particularly true of the air handling systems, which needs large sheet metal ducts for supply and return air. Meeting the NC 25 requirement of a formal TV studios usually requires an air handling system dedicated to that studio, a separate system dedicated to serve areas such as technical areas, audio and video control rooms, editing rooms, and master control rooms. And another system is needed to serve the offices. This enables the systems to be run at full capacity only as needed, saving money on operation. Good noise control starts with effective design at the core of the system. Low-frequency noise can be problem in contemporary buildings, which utilize variable air volume systems and smaller floor fan rooms. Because noise is generated by sound radiating from HVAC equipment, proper selection and positioning of this equipment in machine rooms is essential for effective noise control. Careful orientation of the fan units with respect to the main supply ducts optimizes acoustic conditions. Theoretically, equipment in a machine room can be positioned in any configuration and supply ducts can run in several different ways. In practice, however, machine rooms and plenum space have shrunk in size as rental space has become more valuable, placing constraints on the installation. Still, optimal positioning and cost-effective source noise control can be achieved. Careful orchestration of the mechanical system with the architectural design is essential to achieving acoustic goals.

## ARCHITECTURAL DESIGN APPLICATION

The control of noise in broadcasting studios is as much a matter of awareness as one of action (Parkin, *et al.*, 1979). Many problems arise because noise is considered only when it occurs, rather than in advance. However, experience has led to increasing effort in the building industry to anticipate and control noise by design. Noise in broadcasting studios can be avoided by making intelligent decisions in architectural design through the following:

### Site Selection

The problem of noise in broadcasting studio is best controlled by the architect through a careful selection of site for the building he designs. The architects who appreciate the importance of noise control will advice in the selection of site making use of the available data from noise survey or have surveys made of the proposed site.

### Building Layout

The location of a building on its site requires a careful consideration. To avoid external sources of noise into broadcasting studio as mentioned earlier, the functions in the broadcasting building facing the streets should be designed to house those activities that can tolerate the greatest amount of noise. While the functions that require the quietest conditions such as the studios, control room etc should be reserved for the quietest environment. Natural attenuation of sound will thus be achieved when this is done.

### Landscaping

Architects can use dense planting to attenuate noises to levels that will facilitate the provision of adequate noise insulation for the studios. Landscaping can serve as a surface barrier facing the source of noise by using proper landscaping elements whose surface is absorptive such as grassy, turf, dense vines, hedges or trees with dense foliage which can act as sound absorber and reflectors in whose over-all noise reduction may amount to as much as 8 or 10 db.

### Special Construction Technologies

Special construction technologies such as floating floors, floating walls and ceiling can be specified by the architects and provided in studios or technical areas where the possibility of structure borne noise sources exists. They can be employed to limit structure – borne vibrations from plant being transmitted. Basically, there idea is to allow one part of the building to remain stationary and hence quiet whilst other parts move or vibrate under the influence of structure borne noises. In framed buildings constructed in either concrete or steel, it is essential to float studios and technical areas resiliently of the building.

### Isolation of Circulation Areas in Design

Circulation areas such as staircases and ramps should be designed such that they are not connected in anyway to a structure enclosing a studio or a technical area unless adequate precautions have been taken to eliminate any interference caused by structure borne noise or vibration from footsteps or other impact noise sources. This problem can be generally overcome by the provision of cavity walls and resilient materials within the construction or simply by the provision of an absorbent covering e.g. carpet or underfelt, to be the surface of the staircase or ramp.

### Geometrical Shape

The geometrical shape of a room plays a primary role in sound control. The success or otherwise of the requirement is first centered on the shape because once a mistake is made it is difficult to manipulate. The behaviour of sound varies in the shape such as ellipse, circle, rectangles, squares, polygon, trapeziums etc. In conventional design of broadcasting studios, the rectangle has been mostly used. This is owning to easy construction and interiors manipulation achieve the desired diffusion.

### Improvement to the Sound Insulation of Existing Structures

This generally necessitates the introduction of a lightweight ceiling suspended below the existing ceiling. The lightweight structure should be formed either in Camden construction or in pre-plastered channel reinforced wood-wool slabs, and if they are fixed to the existing ceiling in any way then resilient hangers must be used.

## SUMMARY AND CONCLUSION

The goal of a quite, intrusion-free-broadcasting studio can be achieved cost-effectively only through close cooperation between the design/engineer, acoustical engineers and construction manager at every step from the earlier planning phase through the completion of construction. More often than not, the best (and often only) place to effectively control noise is at its source but if noise is allowed to radiate throughout the building, its control will require large amounts of design ingenuity, technology and money. Though, the technology exists to solve many noise problems in broadcasting studio design provided that the costs can be met to implement the noise-control solutions. While acoustical problems can be remedied, it is infinitely more effective when good acoustics are properly designed into broadcasting studio project.

## RECOMMENDATIONS

In practical design approach for sound control in a broadcasting station, it is highly recommended that the following steps should be taken:

i. There should be a noise survey of the proposed site and environment by the architect and acoustic engineer in order to determine how much sound insulation must be incorporated in a building.

ii. Potential noise sources should be located and defined specifically in terms of their anticipated intensities. This should be done at the planning stage so as to avoid the expenses of insulation from a completed structure.

iii. Acoustical engineers should be proactive members of the design team and should be utilized from the planning stages of the project. They should likewise work with the architect, designer and/or mechanical engineer from the earliest stage to present design alternatives that ensure precise acoustical performance and acute vibration control.

iv. An acoustical consultant should be retained where possible during construction for supervision of the installation of acoustical plaster, plastic absorbents, or other materials whose absorptivity is dependent on the manner of application.

v. Holes or any openings through partitions, ceilings, or floors should be caulked or sealed. Sound leaks of any kind will significantly reduce the effectiveness of the noise isolation barrier.

vi. Doors and windows in the partitions should exhibits high STC ratings to maintain high performance.

vii. Electric outlets thru-the-wall cabinets, etc., should not be placed back-to-back in order to prevent potential excessive transmission of noise.

viii. Masonry walls should be plastered or sealed with a hard coating.

ix. Acoustical treatment and absorptive finishes may be used in noisy rooms to reduce the reverberation and overall noise within these rooms.

x. All floating floors, partitions, and ceilings should be constructed with care. Construction errors such as rigid ties, fastener short-circuiting, improper floor re-enforcing etc., can create a sound flanking conduit and should be avoided.

xi. The inspection of the finished building should include tests to determine whether the required sound insulation, sound absorption, and the other acoustical properties have been satisfactorily attained.

xii. Maintenance instructions should be left in writing with the building engineer/manager indicating how the acoustical materials can be cleaned and which furnishings in the building must be retained to maintain good acoustics.

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