

ACOUSTICS OF LINCOLN HALL THEATER

BY

F. R. WATSON

University of Illinois, Urbana.

The acoustical properties of an auditorium may be prescribed at the present time with certainty of success. The pioneer work of Wallace Sabine in 1900 set forth fundamental principles that have served for guidance in the adjustment of thousands of rooms.

While Sabine's principles have given generally satisfactory results, there have been occasional complaints, particularly from musicians. Also a number of scientists have been endeavoring to prescribe conditions that will give "optimum," or perfect, acoustics.

Some recent publications have set forth new ideas that furnish possibilities for improving acoustic effects. For instance, one investigation shows that the sound reflected from the walls of a room does not increase the loudness as much as commonly assumed. He shows that while the sound passing directly from a speaker to an auditor may have 10,000 units of intensity, and the reflected sound added to this may give a total of 30,000 units, an apparent three fold increase—really the loudness is increased from 40 decibels for the direct sound to only 45 decibels when the reflected sound is added. (The loudness in decibels is obtained by multiplying the logarithm of the intensity by 10).

This rather surprising result immediately suggests the possibility of omitting the reflected sound, particularly when it is remembered that the reflected sounds are responsible for the chief acoustic defects in the room,—the echoes, blurring of speech and excessive reverberation. Omitting the reflecting walls would give an open air theater, which has always been noted for having good acoustics, even as long ago as the time of the Greek Theater. In this connection, Knudsen found that speech was much better understood outdoors than in the best indoor theater.

One other conclusion drawn from these recent studies is that a word in a speech is blurred when the sound reflected from the walls joins with the direct sound so as to produce a distortion. If the reflected sound comes one-tenth of a second later than the direct sound, it can be demonstrated that the vowels and consonants of the two sounds are mixed so as to produce a blurring.

If, however, the reflected sound comes only one-twentieth of a second or less after the direct sound, the word is beneficially strengthened. This means that reflecting walls should not be further distant than about 25 feet from the speaker if distortion is to be avoided.

A further advantage in having the reflecting walls nearby allows the speaker to "hear himself," so that he immediately is assured that his utterances are being heard; and also, he can adjust his performance until it sounds best.

Two conclusions are to be drawn from these investigations: first, for the perfect generation of sound, there should be reflecting surface near the speaker; and, second, for comfortable listening, the reflection about the auditors should be reduced to approximate an out door theater.

An opportunity to incorporate these two conditions in an auditorium was afforded in the construction of the Lincoln Hall Theater at the University of Illinois, because of the co-operation of Supervising Architect, James M. White. The theater is not large, having approximately 800 seats, and is intended to be used principally for lectures, but a stage house allows opportunity for theatricals. When used for lectures the stage is shut off, with the lecturer on a platform in front of the stage curtain. Plane walls, placed diagonally at either side of the lecturer, reflect sound to the audience and allow the lecturer to hear himself. The absorption in the auditorium is furnished by leather upholstered seats and by a highly effective material on the ceiling. The stage house is deadened by a number of heavy velour curtains that are intended primarily for decorative and lighting effects. Also, a huge plastered cyclorama at the rear of the stage acts as a reflecting surface, by which the actors may hear themselves.

The outcome of the acoustics justifies the experiment. A general satisfaction prevails regarding the ease of hearing, not only for lectures but also for theatricals. The actors also find the conditions acceptable for plays. The theater gives opportunity for further experiments, and it is expected that the results should be instructive in the design of future auditoriums.