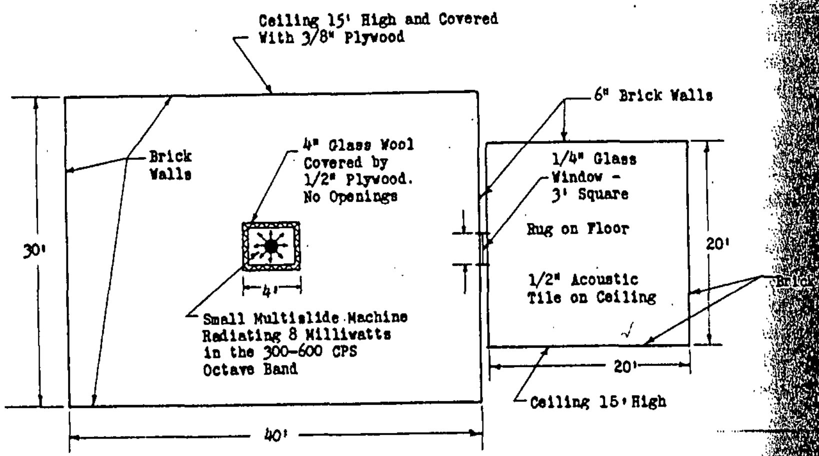
average distance from the center of the room to the wall is $r_0 = \sqrt{6 \times 16/4\pi} =$ 2.75 feet. Figure 14 indicates that the difference between the sound pressure at the surface of the sphere ($r/r_0 = 0.28/2.75 = 0.1$) and the wall is about 20 db. Thus, the level at the wall is 110 db — 20 db = 90 db.

The transmission loss through the plywood partition will be about 19 db (Figure 18) since $^1/_2$-inch thick plywood has a surface density of about 1.5 lb. per



Plan of the Two Rooms Discussed in the Practical Example

Figure 21. Plan of the two rooms discussed in the practical example.

square foot (Table 4). In order to evaluate the noise reduction from the inside to the outside of this enclosure Figure 20, which requires a knowledge of S_w/S and $\bar{\alpha}$ for the large room, must be used.

The radiating area is $S_w = 5 \times 4$ ft. $\times$ 4 ft. = 80 sq. ft., since it is assumed that the sixth side of the enclosure lies on the floor and does not radiate sound into the room. The total surface area of the large room is:

$$S = (30 \text{ ft.} + 40 \text{ ft.} + 30 \text{ ft.} + 40 \text{ ft.})\ 15 \text{ ft.} + (30 \text{ ft.} \times 40 \text{ ft.}) + (30 \text{ ft.} \times 40 \text{ ft.}) = 4500 \text{ sq. ft.}$$

Thus, $S_w/S = 0.018$. As indicated in equation 5, the average absorption coefficient may be calculated as follows:

$$\begin{aligned}
\alpha_{\text{ceiling}}\ S_{\text{ceiling}} &= 0.12 \times 30 \text{ ft.} \times 40 \text{ ft.} = 144\\
\alpha_{\text{walls}}\ S_{\text{walls}} &= 0.03 \times 140 \text{ ft.} \times 15 \text{ ft.} = 63\\
\alpha_{\text{floor}}\ S_{\text{floor}} &= 0.03 \times 30 \text{ ft.} \times 40 \text{ ft.} = 36\\
\hline
\bar{\alpha}S &= 243
\end{aligned}$$

Here it has been assumed that the floor is concrete with an absorption coefficient equal to brick. Thus, $\bar{\alpha} = 243/4500 = 0.054$. The correction to be added to the transmission loss is approximately 2 db yielding a noise reduction of 21 db. The sound pressure level, therefore, drops from 90 db to 69 db. However, as pointed out in Section II. J, the dashed portions of the curves in Figure 20 indicate that the sound pressure may fall off as one moves away from the radiating partition. Figure 14 can be used to calculate the sound pressure level in the remainder of the room as follows.

Since the enclosure rests on the floor, the cubical source is best replaced by a hypothetical one, hemispherical in shape and of equal surface area. The radius of this hemisphere will be $r = \sqrt{80/2\pi} = 3.6$ ft. The average distance from the center of the room to the walls is $r_0 = \sqrt{4500/4\pi} = 19$ ft. Figure 14 shows that in a room with $\bar{\alpha} = 0.054$ the sound pressure level at $r/r_0 = 3.6/19 = 0.19$ is about 1 db greater than the level near the walls. Because of this very reverberant condition the sound pressure level at the partition separating the two rooms is 68 db, just 1 db less than that at the outside of the enclosure.

This partition is a 6-inch brick wall with a $^1/_4$-inch glass window occupying 9 square feet of the total area of 300 square feet. The transmission loss of the brick is about 47 db (Figure 18) based on a surface density of 66 lb. per square foot (Table 4). The transmission loss of the $^1/_4$-inch glass window is about 25 db. Since the transmission loss of the window is 22 db less than that of the wall and since the fraction of the wall occupied by the window is $9/300 = 0.03$, the transmission loss of the composite partition (Figure 19) is about 7 db less than that of the brick wall, or 40 db. In order to compute the noise reduction through this partition, we need to know the area ratio, $S_w/S = 300/2000 = 0.15$, and the average absorption coefficient, $\bar{\alpha}$:

$$\begin{aligned}
\alpha_{\text{ceiling}}\ S_{\text{ceiling}} &= 0.5 \times 20 \text{ ft.} \times 20 \text{ ft.} = 200\\
\alpha_{\text{walls}}\ S_{\text{walls}} &= 0.03 \times 80 \text{ ft.} \times 15 \text{ ft.} = 36\\
\alpha_{\text{floor}}\ S_{\text{floor}} &= 0.25 \times 20 \text{ ft.} \times 20 \text{ ft.} = 100\\
\hline
\bar{\alpha}S &= 336
\end{aligned}$$

Thus $\bar{\alpha} = 336/2000 = 0.17$, and no correction need be added to the transmission loss (Figure 20). The noise reduction is, therefore, 40 db and the sound pressure level that exists in the room at the right in the 300 to 600 c.p.s. band is 68 db — 40 db = 28 db. A similar analysis should be performed in each of the seven other octave bands.

This example and the charts used to compute the result demonstrate some of the fundamental properties of the transmission of sound. An understanding of these properties should be of help in intelligently assessing most common noise problems. The transmission of sound through solid materials,[11] through acoustical

[11] C. E. Crede, *Vibration and Shock Isolation.* Wiley, New York, 1951.