Sound Advice

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FACTORS IN ACOUSTICAL PERFORMANCE OF GYPSUM WALLS

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The acoustical performance of a gypsum wall system is dependent upon

1. The total weight of the gypsum used.
2. The isolation of the two sides of the wall from one another
3. The size of the air space between the two sides
4. The sound absorption material in the cavity
5. The thickness of individual layers of gypsum used
6. Vibration damping of the gypsum.

Total weight is a most important factor, especially at low frequencies. Other factors being equal, the blockage increases about 5 to 6 dB for each doubling of weight.

Structural isolation between the two sides greatly increases performance. Walls with gypsum attached to each side of a single wood or heavy gauge steel stud perform poorly because of direct transmission through the stud. Minimal improvement is achieved from addition of sound absorptive material in the cavity because of this direct transmission through the studs. A light gauge steel stud is more flexible and leads to significant improvement. Further improvement is achieved using resilient channels to create spring-like point connections between the two sides. However, the resilient channel must be a good design and the gypsum must be properly installed on it with screws that are not too long. Resilient isolation clips supporting hat channel do not carry that risk, provide even better isolation with fewer points of contact and also increase the air space. A fibrous board sometimes called a "sound deadening board" between the gypsum and studs provides some isolation but is shorted by screws through it to the studs. The best performance is achieved with two sets of studs on separate base plates isolated from the floor or with a discontinuous floor to minimize connections between the walls.

The air space between the two sides creates a resonance frequency at which the wall will be weak, and increases isolation above that frequency. If this air space is too small the resonance will be in a frequency region of much sound. Resilient channel should never be installed between two layers of gypsum leaving a half–inch air space. Gypsum should not be installed in the middle of a wall creating more than cavity unless absolutely necessary for other reasons. This will improve blockage at higher frequencies but hurt it at low frequencies. Never build two complete walls with gypsum on each side of studs and place them with a small air space between. Such a wall will test only slightly better than a single wall because of poor performance at low frequencies. It will be better with the gypsum in the middle removed and much better if that gypsum is moved to the outside of the wall.

For the sound absorption in the cavity the most important factor is thickness. Most of the benefit is provided by filling half the space with absorption but more absorption to fill the space without being packed does help. A more dense material helps a little, but the improvement is within the measurement accuracy so that it is not always apparent.

A weakness will occur at a higher frequency called the coincidence frequency that is dependent on the thickness of the gypsum layers. This can be controlled by using layers of gypsum of different thicknesses, at least a ¼ inch difference in thickness. Thin layers of gypsum are also sometimes sold as a "sound deadening board." A soft damping glue between the layers also reduces this effect. Wallboard with thin layers of gypsum and a soft glue moves the coincidence frequency above the frequency range normally tested and damps it. This damping also helps isolate the outer surface from the stud and damp vibration transmitted to that surface through screws.