



Reverberant Noise in a Multi-Purpose Room

A local senior citizens' center was experiencing significant problems with their multi-purpose room. Specifically, the seniors were complaining about difficulties communicating within the room. The conditions were so reverberant that speech was unintelligible and the music was "muddy". This rendered the room virtually unusable for its intended use as a lecture and dance hall, theater, exercise room, and social center.

Problems with the Original Design

The multi-use room was designed with a spacious wooden floor, a stage, and a vaulted wooden ceiling in the shape of a large pyramid. The 12' high walls were covered with gypsum wallboard. While beautiful to look at, this design had a number of problems from an acoustical standpoint. The expanse of hard surfaces reflected any sound in the room. This was exacerbated by the large parallel walls. Finally, the pyramidal ceiling focused sound into the center of the room. Extensive testing indicated that reverberation times in the room ranged from 1.5 to 3.0 seconds. (Reverberation time is the time it takes a sound signal to decay by 60 dB. The decay results from sound absorption by the materials in the room.)

Design Goals

There are no standards for acceptable reverberation times in multi-purpose rooms. Because of their nature the rooms must satisfy different needs. For effective speech communication a reverberation time of about 0.5 seconds is appropriate. However, for music a "live" room with a reverberation time of about 1 second is better. Thus to satisfy all the needs of a multi-use room, a reverberation time of 0.5 to 1.0 seconds is an appropriate design goal.

Mitigation

The operators of the senior center had several constraints regarding changes that could be made to the room. Specifically, no materials could cover the floor or the wooden ceiling. These were serious constraints since effective noise control is best achieved by tackling all of the reflective surfaces within the room.

Nevertheless, recommendations were provided for introducing large amounts of sound absorptive material into the room. The effectiveness of the material was maximized by mounting and positioning it properly on the walls. Some of the material was hung in a way that absorbed sound and broke up the focusing effect of the pyramidal ceiling.

The Results

Within the constraints imposed by the operators, analysis indicated that the additional materials would reduce the reverberation times to acceptable levels. Due to budgetary constraints, not all of the recommended material was added to the room immediately. However, the resulting improvements were noticeable. As funding became available, the ultimate goal of using the room for the multiple purposes for which it was intended — without challenges to communication — was met with only modest design change.

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