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THE TIVOLI THEATRE

BY

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THE TIVOLI THEATRE

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The Tivoli Theatre in Downers Grove, Illinois, is one of those older, privately-owned single screen houses with a full stage and some 1,100 seats. Designing and installing a sound system presented no special problems: three stage speakers, a surround array, amplifiers, the usual. The difference here is that no sound system had ever sounded very good in that theatre, due to substantial acoustical problems.

The sound we hear in a theatre is a mix of direct sound, which arrives first, and reverberation. Reverberation is simply a lot of echoes of the direct sound bouncing around the room. Sooner or later these reflections die out as the sound is absorbed by the things it hits and by the air.

A concert hall is designed to have a relatively long reverberation time: 1.6 to 2.2 seconds. Orchestras sound dry without this. In movie theatres, however, where speech intelligibility is important, long reverberation times are dialogue killers.

In a good concert hall, the frequencies we hear decay fairly evenly. In a theatre we also want the sound to decay evenly, just faster. This is not always easy to do. As we all know, sound absorbing materials are available. They are generally placed on the walls and the ceiling. These materials are usually designed to absorb the higher frequencies. Absorbing bass is more involved.

The trouble at the Tivoli was that the bass echoed around the room so long that people couldn't understand the dialogue, particularly from deeper male voices. Several attempts had been made to solve the problem: different speakers, equalization, and so on, all had been unsuccessful. In fact, the attempts to use equalization showed a lack of understanding of the nature of the difficulty and of the equalizers themselves. One speaker manufacturer's representative had suggested the worst possible approach and installed a very wide dispersion speaker system. This made things so much worse that patrons were walking out of the theatre.

The owner of the theatre, Willis Johnson, was very unhappy, to say the least. His customers were leaving, he was losing money and neither he nor his dealer could find the help he needed. When he called me, I immediately told him that I didn't know the

solution either, but that I knew someone who would. We called Bolt, Beranek and Newman, a world famous team of acoustical engineers headquartered in Cambridge, Massachusetts.

What they were able to do was determine which frequencies were not dying off fast enough, the surfaces those frequencies were bouncing off and the proper acoustical treatment to install. This was just the help that Johnson and his technician, Jim Reed of Abbott Theatrical Equipment Co., were looking for.

BB&N found that, sure enough, the reverberation time was two seconds in the 500 hertz octave band, two seconds in the 250 hertz band, and a whopping three and a half seconds in the 125 hertz band. Male chest tones occur in the 250 hertz area. Very little dialogue occurs in the 125 hertz area. Ideally, BB&N likes to see a reverberation time of one second or less in a theatre of this size. The Tivoli clearly needed a reduction in its reverberation times, especially in the 250 and 125 hertz bands.

Reflections are another matter. The most offensive surface in a room such as this is the rear wall. This is for two reasons: this wall directly faces the screen, as well as being the farthest away from the screen's speakers. As we get closer to the screen the reflection from the back wall arrives later and later. Finally, we cannot make out the words from the direct sound because of the reflected sound from the wall behind us. Unless the reflection arrives at a relatively low level, dialog intelligibility is impaired.

Bolt Beranek and Newman suggested that the rear and side walls of the Tivoli be covered by a very heavy velour curtain, on the order of 16 ounces per square yard of fabric, with about six inches of air space behind it. The curtain was to be hung with a 75 to 100 percent fullness, or about two feet of material for every linear foot of wall.

To be sure, diagnosing a problem like this takes sophisticated equipment, but sound engineering is also an art. When asked what was the most important tool for a job like this, BB&N engineer Larry Philbrick pointed to his ears. At the Tivoli it was engineer Carl Rosenberg's experienced ears that did part of the job, along with such tools as an Acoustilog 232A reverberation time analyzer and a sound pressure level meter. The consulting fee was well under \$1,000, and the first stage of the recommended treatment was a modest \$3,000.

Problems as severe as those at the Tivoli cannot always be totally corrected. The goal here was speech intelligibility and, if possible, natural sound. BB&N felt that treating the side and rear walls would be ideal,. Since cost is always a factor, a first step of treating only

the rear wall and subjectively evaluating the results made sense as well.

You can stand in the middle of the Tivoli, clap your hands and hear a lot of flutter echoes off the side walls. While this may seem likely to cause trouble, actually it not all that important after all. This is because there is no sound source midway between the side walls when a film is playing. The flutter echo from side to side is actually more of a curiosity than a real acoustical problem.

The low frequency absorption could be placed anywhere in the room. Placing the first curtain across the rear wall afforded a reduction of the rear wall's reflection as well.

After treating the rear wall we felt that the room sounded good enough to leave the sides alone, and to install a good sound system. A Dolby CP-50 was installed for stereo films and a Kintek mono enhancement system for monophonic films. These are fed into three BGW 750-C power amplifiers which drive three Klipsch TCM-3 speakers behind the screen, and 11 Klipsch TH-SR surround speakers in an Allen Sound Array™.

The attempts to solve the problems of the Tivoli with different speakers and with equalization failed because simply turning down the bass would not have reduced the reverberation time in the room, but would merely have reduced the bass coming out of the speakers, resulting in a thin sound. We did some experimenting just to see what would happen through the use of equalization, and found that, as expected, equalizing the system more than the slight amount we do in other theatres made the sound worse, not better, without improving intelligibility.

The results at the Tivoli are satisfactory, though not perfect. It can still be an effort to understand the sound track of a poorly recorded film. Good recordings, however, now sound excellent in this room, and people have noticed the difference. They have stopped complaining and walking out. Now Willis Johnson is getting compliments.

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