

SOME UNUSUAL ENTERTAINMENT NOISE PROBLEMS

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INTRODUCTION

For many of us, entertainment is usually divided into three distinct categories:

- Concert halls - for classical and popular music
- Theatres - for drama and touring road shows
- Stadia and arena - for sporting events and mass assemblies

Nowadays, the lines which differentiate various forms of entertainment, including recreation and even leisure, are melding. Entertainment is now commonly found in theme parks, hotels, malls and retail establishments, and even the streets. And with this societal shift of our definition of entertainment - and where we do it - comes noise problems for those of us working as acoustical consultants.

This paper will present a series of very interesting and unusual acoustical projects associated with entertainment noise. Four projects are located in Las Vegas, Nevada; one is in the San Francisco Bay Area; and one is in Orlando, Florida. Exterior noise problems include a large water feature during the day which becomes an erupting volcano in the evening; a sound reinforced performance between an English and Pirate ship; an amphitheatre in a major urban area; and an "island of entertainment" with multiple venues. Interior noise problems include a hydraulic rigging system for a showroom; and a Roman themed retail complex with animatronic shows and large domed ceilings.

CIRQUE du SOLEIL

The Cirque du Soleil is a modern day "circus" which has become a very popular form of entertainment. The Cirque travels throughout the world typically setting up a temporary tent structure in each city in which it performs.

In Las Vegas, the owners of the new Treasure Island Hotel built a permanent theater facility, in the form of a tent, for the Cirque. Just prior to its opening we were called in because of an unusually loud noise which was audible throughout the theater.

The noise was associated with the rigging system, which was driven by hydraulics instead of manually or electrically. In order to minimize the travel distance and pressure of the hydraulic fluid, it was decided by the original designers to locate the four large hydraulic pumps in a separate room near the rigging lines. This located it approximately 70 ft. in the stageloft. While the excessive noise was generally considered to be associated with the hydraulic pumping system, there had already been a lot of attention and money, in the form of extensive wall constructions, utilized in an attempt to control noise prior to our being brought into the project. Since the audible noise was not a result of deficient sound isolation at the equipment room, this seemingly logical approach was costly, frustrating, and ineffective.

My first introduction to the problem was a bit disconcerting. I was brought into the theater and sat in one of the theater seats to listen to the noise. The sound I heard was relatively high in frequency. The strange part was that I could not locate the source of the noise as I would have expected with a high frequency noise source.

As I was toured through the facility and walked the rigging grid I became deeply concerned. I saw individual hydraulic lines from the main pumping room feeding out to smaller motors which controlled separate rigged theatrical components. It was then that I became concerned realizing that the high frequency noise that I couldn't focus on was the sound of the whole rigging grid ringing! Initially I thought that every hydraulic line and every connection to the grid might have to be vibration isolated. Further investigation revealed that the noise was created by cavitation in the hydraulic fluid lines. Tuned in-line acoustic filters could be provided in the four main lines immediately downstream from the four pumps in the equipment room. Four special filters were designed and installed at a cost of approximately \$12,000. The noise was reduced substantially enough that we were not called again to return after the installation.

THE FORUM SHOPS AT CAESARS PALACE

Retail is not a building type in which we do a lot of work. So the day I received a very large set of architectural drawings for the Forum Shops at Caesars Palace, a large extensive retail complex in Las Vegas, I did not understand what we were supposed to do with them.....until I got to the section drawings. It was there that I began to realize what the problem was. The shape of the ceilings were all domes or barrel vaults. Caesars Palace is a large casino in Las Vegas with an all Roman theme. These retail shops were also to have a Roman theme. There were to be Roman streets where modern day tourists would shop. They would have terrazzo floors, stone facades of Roman villas, and a barrel vault ceiling, onto which was painted many exquisite looking clouds, stars, and the sky. At the intersection of streets, the barrel vaults met and created a huge domed ceiling, also with clouds, stars, and sky. (Note: during construction I had an opportunity to measure the reverberation time of the space within the dome: $RT_{mid} = 18$ seconds)

At the intersection of the streets, there was always a focal element. At one major location was an enormous fountain of Zeus with a cascading water feature; at another location was a series of slot machines; and at other locations animatronic figures which became major entertainment attractions a few times an hour. People would gather and observe a laser and music show and a pre programmed animatronic display of a Roman story.

The answer to the question "Do we think these shapes or finishes would create any acoustical problems?" was easy: "yes"! The real problem was what to do about it. Treating the barrel vaults and much of the ceiling with a sound absorbing treatment was rejected because there was a very sophisticated lighting system along the edge of the ceiling which could change the light by computer to create any time of the day or night within the retail complex; and once the painting of the clouds and stars began, it was like a recreation of one of Michelangelo's famous ceiling paintings. To change it was out of the question. Some of the domes, such as above the slot machines, were treated with a spray on application of sound absorbing cellulous fiber.

At the animatronic features, it was a real challenge to find suitable areas to provide sound absorbing materials and to suggest changes in the audio system to improve intelligibility and clarity of the spoken word. The loudspeakers were originally conceived by the animatronics designers and were placed in many locations, often within the animatronic figure for realism.

MIRAGE HOTEL WATER FEATURE

The Mirage Hotel is one of the newest and most unique hotels in Las Vegas, or anywhere else for that matter. Outside of this 1000 room hotel is a beautifully landscaped water feature approximately 40 ft. high which cascades into many reflecting pools and extends the whole city block.

Our firm was contacted by the legal department of the Mirage Hotel with an interest in developing a noise ordinance for Las Vegas. Well, that was interesting enough. What I didn't realize at the time was that the Mirage water feature turns into an exploding volcano, and it was hoped that this water feature/volcano would fall within any noise ordinance that would be developed! A trip to Las Vegas to make acoustical measurements revealed that the volcano, which erupts every 15 minutes after dark, measured 90 dBA at the sidewalk where hundreds of interested and excited people gather to observe this free entertainment. Much time and effort was spent documenting the sound levels from the volcano in order to be able to make a public presentation before the City Council. It helps to understand what makes Las Vegas tick. Anything that attracts people and brings tourists to the City is welcomed. The Mirage water feature/volcano certainly does that.

Although a neighboring hotel had complained to the City Council that the noise from the volcano kept their guests from sleeping, the City Council elected to approve the volcano with its water cannons, water and fire jets, and sophisticated outdoor audio system with extensive subwoofers built into the grounds.

TREASURE ISLAND HOTEL

As a result of the success of the erupting volcano in front of the Mirage Hotel, the owners decided to continue their theme of free outdoor entertainment. They designed and built a new hotel called Treasure Island on the adjacent property. This time they included a large (full city block) lagoon in front of the hotel. In the lagoon is a full sized British Frigate and Pirate ship. The two ships engage in a mock battle, with amplified name calling, cannon blasts and explosions galore. There is much action involving Pirates and Brits getting shot, falling into the water, and generally creating a realistic mood of battle. Unbeknownst to us, this event was well into the planning stage at the time we were contacted regarding the noise ordinance for Las Vegas. The planners were obviously well aware of the potential concern for noise impact since this event, which occurs once an hour in the evening, occurs on the hotel property but outdoors and alongside the public sidewalk. It is free, very popular,

and draws many hundreds of spectators for each performance. In order to prepare for this, a mock up of the audio portion of the performance was recreated in a remote vacant property on the outskirts of town. When the gain structure was set for what was subjectively considered the correct levels, the measured sound levels, in general, were in the range of 75 to 90 dBA with cannon blasts in excess of 105 dBA. All performers wear ear protection. And since it draws people to the City, it is considered a major success.

SHORELINE AMPHITHEATRE

Approximately 40 miles south of San Francisco, on the edge of San Francisco Bay, in the City of Mountain View, a 10,000 seat outdoor amphitheatre has been constructed which plays to full capacity audiences for a variety of popular entertainers throughout the year. For being so close to a major urban area, the site of this amphitheatre is about as ideal as you can expect, with the Bay stretching many miles immediately to the east, behind the stage of the amphitheatre, and a lot of either industrial properties or mudlands to the north and south. To the west is a major freeway and the Cities of Mountain View and Palo Alto.

During the planning stages for this amphitheatre, we were able to set up a flatbed truck with a huge battery of amplifiers and loudspeakers at the site to playback audio tape recordings to simulate a real musical event. Acoustical measurements were made throughout the surrounding communities and even across the Bay.

Due to the unique meteorological conditions of the San Francisco Bay area, and the weather inversions that can occur there, there are times when sound from the actual performance at the amphitheatre cannot be heard in Mountain View, but can be heard in the more distant City of Palo Alto. The audibility of the "disturbing" sound is so slight that it cannot be measured on a sound level meter, nor can it be identified from traffic noise of the freeway when tape recorded and reduced via acoustic instrumentation.

Extensive studies have been made by a number of consultants representing each City and the amphitheatre venue. Obviously there is no easy solution to "solve" a community noise situation such as this. Some of the more imaginative solutions that have been proposed have included:

- * Constructing a 90 ft. high masonry wall at the rear of the amphitheatre
- * Using giant helium filled balloons above the stage to diffract the low frequency sound waves
- * Deploying helicopters to break up the inversion during periods of inversion conditions when the amphitheatre is in use.

THEME PARK

At a major theme park in Florida, a new project involving a performing arts building, and a series of other less critical building occupancies was proposed in close proximity to a cluster of outdoor evening performance venues, and a number of other unusual but noisy activities including tourist buses and helicopters, fireworks, and thunderstorms which include heavy rains, thunder, and lightening. A series of acoustical measurements were made to obtain a sound source design level from which to determine the degree of sound isolation to be provided for the exterior envelopes of the buildings under consideration.

Throughout the design process, the Project Manager had always asked to keep the technical information simple so that he could understand it. In fact, his most memorable phrase was always: "tell me on a scale of 1 to 10". When it came time to provide a technical basis for evaluating a series of five alternative roof constructions, a simple matrix was developed from which we were able to technically provide a comparative analysis and graphically provide the Project Manager with a 1 to 10 rating scheme.