inter·noise 96
25th Anniversary Congress – Liverpool

INCE: 66.2

CONTROL AND MANAGEMENT OF OUTDOOR CONCERT SOUND – A REVIEW OF EXPERIENCE IN NORTH AMERICA

W J Cavanaugh (1) & R G Cann (2)

(1) Cavanaugh Tocci Associates Inc, 327F Boston Post Road, Sudbury, MA 01776, USA, (2) Grozier Technical Systems, Brookline, MA, USA

INTRODUCTION

Over the past dozen years, the authors have been involved in assessing the impact of outdoor concert sound on residential communities surrounding concert amphitheatres and in developing acoustical controls to minimize unfavorable community response while at the same time permitting adequate sound levels in the audiences at the venues themselves. For some venues, our involvement extended from prior to the construction where critical acoustical decisions (e.g., orientation of venue loudspeakers away from residential areas, etc.) were possible, and where effective community relations policies and procedures could be developed with venue neighbors. For other venues our involvement was "after the fact", where hostile community relations had already developed, and some even to the point of legal action with court mandated acoustical controls and monitoring to be implemented. In all of these, our experience overwhelmingly suggests that resolution of problems involves the adoption of concert sound level limits at the venue itself and, most importantly, the continuous control and active management of concert sound output to achieve acceptable concert sound levels in the community and, where established, satisfy local noise ordinances. Furthermore, because the concert artists' rights are constitutionally protected in the United States, these limits at the venue must be voluntary. In other words, a "limiter" may not be directly integrated with the concert sound amplification system. Nor for that matter can local enforcement officials "pull the plug" on an ongoing concert at a facility should a local ordinance limit be exceeded in the offended community. Hence, a continuously operated concert sound monitoring system represents a practical and effective solution to encourage "real time" adherence to voluntary venue limits, and

to secure accurate recording and archival storage of concert sound level data for review by local authorities and for further development of acoustical controls. This paper reviews experience with concert sound management systems throughout the United States which have been used with generally satisfactory results.

OUTDOOR CONCERT SOUND.... THE BASIC PROBLEM

Outdoor concert sound, particularly amplified popular rock music, varies widely in level as well as in frequency content and temporal characteristics. When concert sound propagates to adjacent residential areas (usually several hundred meters or more from the facility), intermittent concert levels in the community approximate those of other intermittent environmental sounds (traffic, aircraft, industrial sources, etc.). In other words, the "unwanted" concert sound levels are essentially immersed in a relatively complex system of other intermittent sounds and sometimes even "masked" by these other community sounds. Therefore, unattended monitoring of community sounds is difficult, if not impossible, if one is attempting to show conformance with local noise ordinance limits. Furthermore, meteorological factors affecting sound propagation (wind and temperature effects, etc.) make the repeatable monitoring of venue music sound in the community extremely difficult.

RECOMMENDED CONCERT SOUND SOURCE LIMITS

Sound source limits at a concert venue must represent a compromise between the artistic needs of the performing artist and audience, and the needs of the adjacent neighbors who generally regard even the slightest audibility of concert sound as "unwanted" sound or noise. Our experience with numerous venues over the past decade has indicated that the maximum concert sound levels indicated in Table 1 are feasible and can permit compatable relations between the concert venue and the adjacent communities. (See References {1}, {2}, {3}, & {4}).

Table 1. Recommended Maximum Concert Sound Levels

Monitoring Location	1 Second Leq (in dBA)
A) Neighbors greater than about 800 meters	
Concert Mix	105
Rear Lawn	95
B) Neighbors less than 600 meters	
Concert Mix	100
Rear Lawn	90

These recommended limits are generally given in "A" scale frequency weighting since most community noise ordinance limits are so expressed. However, increasing concern has been voiced by communities surrounding outdoor concert venues with respect to low frequency music sound. Accordingly, recent concert sound management systems have incorporated "C" scale frequency weighted monitoring channels. Tentatively, C-weighted limits that are 10 decibels greater than the recommended A-weighted limits of Table 1, have been used for such systems.

PROJECTED CONCERT SOUND LEVELS IN COMMUNITIES

Due to the largely "contaminated" nature of typical community noise environments (i.e. where music sound levels are the same order of magnitude as other intermittant environmental sounds, etc.), direct, unattended monitoring within an adjacent community is difficult, if not impossible to accomplish. On the other hand, "real time" concert sound levels at community locations can be estimated by estimating or measuring spreading and sound propogation losses, including meterological effects. Thus an effectively managed concert venue can take appropriate" corrective action" while a concert is in progress if predetermined communtiy limits are likely to be exceeded. For example, on an evening when strong winds are blowing from the direction of the venue towards the community, venue concert level limits can be lowered accordingly. Conformance with these adjusted limits in the community can be confirmed by "spot check" sound measurements, which can be integrated with the overall management system, as is currently done at some venues.

SOME EXAMPLES OF MANAGEMENT SYSTEMS

Table 2 indicates the essential elements of concert sound management systems installed in eleven locations throughout the United States. Because of varying local requirements at each concert venue, each system must be tailored for the particular locale. Figure 1 represents a schematic diagram of a typical management system containing basic elements common to all of the systems of Table 2. All of these systems were designed, programmed, and installed by Grozier Technical Systems on the basis of design specifications prepared by acoustical consultants for the particular venues. Systems such as that for Great Woods in Mansfield, Massachusetts have been successfully operating for over ten concert seasons. The Hollywood Bowl system is in its' second concert season and replaced several property line direct monitoring systems which had not proven satisfactory over the years. Experience has clearly

shown general community acceptance of such continuously operated management systems by both local authorities as well as the residential neighbors themselves.

TABLE 2. U.S. CONCERT SOUND LEVEL MANAGEMENT SYSTEMS

Venue	Sound Limit Monitoring Location(s)	Mics	Limit Criteria	Limit Level	Limit Period	Management System Configuration
Hollywood Bowl (CA)	Rear hill-top property line, Mix	3 2	1 mic dBA Leq	>75 >81 >86 >89	10 min 5 min 2 min zero	$ fine prediction software. Closed circuit TV display.
Fiddlers Green (CO)	Outside walled enclosure, perimeter	5	4 mic avg dBA Leq	70	15 min	Average levels calculated for the propagation loss to the community.
Desert Sky (AZ)	Property line perimeter	4	Each mic dBA Leq	80	1 min	Limit level set at measuring mics at parking lot edge.
Walnut Creek (NC)	Rear lawn Mix	1 1	Each mic dBA Leq	95 105	1 sec	2 independent systems, with online download capability.
Lake Compounce (CT)	Rear lawn Mix	1 1	Each mic dBA Leq	95 105	5 sec	Graphical printing of sound levels,
Great Wood (MA)	Rear lawn Mix	1 1	Each mic dBA Leq	95 105	5 sec	Graphical printing of sound levels, segregated crowd noise. Weather station
Chastain Park (GA)	Rear of seating	3	Each mic dBA Leq	90	1 sec	House/Road loudspeaker in-concert sound balancing system. Weather station
Bogey Inn (OH)	Adjacent residences	1	dBA	60	1 sec	Limit projected from a microphone location 40 feet from musicians
Sundance Square (TX)	Adjacent condos	1	dBC	70	1 sec	Limit projected from a microphone location 40 feet from musicians
Polaris (OH)	Rear lawn Mix	2 1	Each Mic dBA Leq	90 100	1 sec	Graphical printing of sound levels. Segregated crowd noise. Weather station
New World (IL)	Rear lawn Mix	2 1	Each Mic dBA Leq	95 105	1 sec	Graphical printing of sound levels. Projected levels to two community locations. Weather station. Video data display.

CONCLUSIONS

All the usual passive acoustical controls for outdoor concert venues are essential (facility and loudspeaker orientation away from sensitive communities, maximum shielding by the concert stage enclosing structures, sound walls, etc.) to minimize propagation of concert sound to the venue neighbors. However, experience with a number of venues in the US suggests that facilities which adopt voluntarily limits on concert sound at the source, and continuously monitor those levels such that management intervention is possible, have a high probability of achieving compatable relationships with their neighbors. "Non Acoustical" measures such as establishing and maintaining good community relations programs (e.g. community workshops to explain and communicate ongoing or proposed concert sound control programs, preferential hiring of local residents for seasonal work, free community uses of the facility, etc.) are also important aspects of an effective concert sound management system. Concert sound, like so many of environmental sounds, simply cannot be made "inaudible" even at great distances. However, concert sound can be effectively controlled, in a comprehensive "management" sense such that outdoor concert venues can be good neighbors.

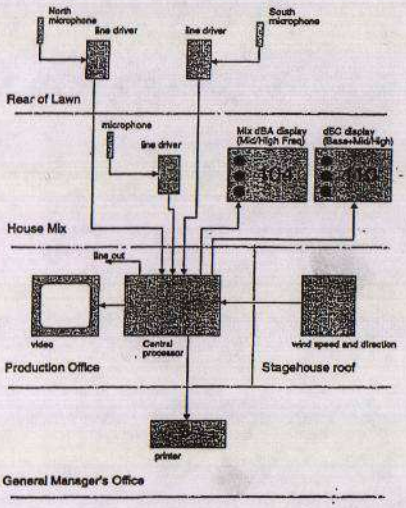

FIGURE 1. A Simplified Functional Diagram of a Typical Concert Sound Management System

REFERENCES
PROCEEDINGS:

[1].'Residential Neighbors And Outdoor Concert Facilities; Are They Compatible? A Case Study Of The Great Woods Center For The Performing Arts; W.J. Cavanaugh And B. Montgomery; Proceedings INTER-NOISE 89, p. 767-771.

[2] 'Controlling Concert Sound Level Emissions; the Design and Development of In-House Sound Level Management Systems'; R.G. Cann; Proceedings INTER-NOISE 89, p. 763-766.

[3] 'Evaluating the Severity of Community Response at Outdoor Concert Sites: A Model that Seems to Work;' W.J. Cavanaugh, proceedings INTER-NOISE 95, p. 797-800.

[4] 'Concert Sound Management - A Decade of Practical Experience'; R.G. Cann; Proceedings INTER-NOISE 95, p. 801-804.