2:36

K7. New sound reinforcement system for the Kentucky Fair and Exposition Center. John V. Fricke and Robert C. Coffeen (Coffeen, Anderson and Associates, 5400 West 61st Place, Misson, KS 66205)

Freedom Hall, an 18 000 seat coliseum, which houses the University of Louisville Cardinals basketball team, the National Quarterhouse Championship Show, and many concerts received a new sound reinforcement system consisting of fourteen distributed loudspeaker clusters and three stage location clusters. The stage location clusters provide a time delay base for the remaining distributed clusters. The presentation examines the "distributed cluster" concept of providing a better sound reinforcement system for large audience spaces.

TUESDAY, 7 JUNE 1977 KELLER ROOM 405, 2:00 P.M.

Session L. (Poster Session) Architectural Acoustics II.

M. David Egan, Chairman

College of Architecture, Clemson University, Clemson, South Carolina 29631

Poster Papers

L1. Design, development, and field testing of a stable sound source for privacy testing between dwelling spaces according to ASTM Recommended Practise 597. Kenneth E. Barron, P. Eng., and Marcel T. Rivard (Barron and Associates, Consulting Acoustical Engineers, Vancouver, B.C., Canada V5Z 3K5).

The new ASTM Recommended Practise 597 for testing of privacy between dwelling spaces requires an accurate, calibrated, and stable sound source employing specially shaped *source* and *absorption* frequency spectra. This paper describes the sound source, its circuitry, electrical and acoustical performance as well as field experience during testing sessions. In addition to providing the special spectra, the remote, radio-controlled source provides several other spectra and functions frequently used by persons involved in acoustical testing.

L2. Recent field testing experience of privacy between dwellings using ASTM Recommended Practise 597. Kenneth E. Barron, P. Eng., and Gordon D. Hall (Barron and Associates, Consulting Acoustical Engineers, Vancouver, B.C., Canada V5Z 3K5)

Some recent experience with field testing of privacy between dwelling units using the method of the new ASTM Recommended Practise 597 is reported and the effects of airborne flanking paths on the ratings obtained is discussed. The results of the testing experience indicate that the single number rating provided by this new test method is approximately two points less than the Noise Insulation Class Rating (NIC) obtained by grading 1/3-octave-band noise reduction measurements according to ASTM 413. It is suggested that this new single number rating obtained from *A*-weighted sound pressure level differences utilizing the specially shaped source and absorption test spectra be called the *Privacy Index*.

L3. Prediction of the sound diffracted around barriers in large rooms using an extension of Maekawa's approach. R.A. Johnson, C.J. Hurst, and L.D. Mitchell [Westvaco, Covington Research Center, Covington, VA 24426 (RAJ), and Department of Mechanical Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061]

A computer program has been developed for the prediction of sound pressure levels in large, irregular rooms utilizing a geometric acoustics approach. Experiments indicated that the program gave good predictive accuracy when receiver positions were in the line of sight of the sound source. However, the accuracy was poor when the receiver was out of the line of sight. The present discussion reports on the further development of the program to include diffraction effects using an extension of Maekawa's approach for thin screens and right-angle wedges. The program is capable of finding all valid diffracted rays which undergo three or fewer reflections before diffraction and three or fewer reflections after diffraction. Limited experimental work indicates good predictive accuracy.

L4. Acoustical solutions for SSA Headquarters. Ron Moulder (Owens-Corning Fiberglas Corporation, Granville OH 43023) and D.A. Harris (Owens-Corning Fiberglas Corporation, Toledo, OH 43600)

Speech privacy between closed-plan and open-plan work situations is the goal of the new Social Security Administration (SSA) Headquarters complex in Baltimore. Approximately 1.1 million square feet of office building is being procured by the U.S. General Services Administration (GSA) using the "Systems Approach." A key element is the "Performance Specification for Office Buildings" which establishes detailed criteria for the "in systems" portion of the building including structure, HVAC, Electrical Distribution, Finished Floor, Luminaries, Finished Ceiling and Space Dividers. The successful system offeror demonstrated system compliance in a technical proposal before submitting an installed and lifecycle cost bid. American Bridge, Wolf and Munier, and Owens-Corning Fiberglas, in joint venture, submitted the low bid. Prototype tests recently completed demonstrate full compliance. Since acoustical attributes affect each subsystem, the criteria includes reference to the PBS C.1 and C.2 test procedures among others. A summary of the procurement process, testing criteria, development parameters and solutions will be available.

L5. Computer-aided, interactive design routine for the prediction of sound levels in irregularly shaped factory spaces. J.M. Blanding (Union Carbide Corp., P.O. Box 8361, S. Charleston, WV 25303), L.D. Mitchell and C.J. Hurst (Department of Mechanical Engineering, Virginia Polytechnic Institute and State University, Randolph Hall, Blacksburg, VA 24061)

An interactive computer algorithm is presented which utilizes modified room acoustics theory to predict dBA sound pressure levels in regularly- and irregularly-shaped factory

spaces. Irregularly positioned and nonuniform room absorptions are treated. The user-oriented algorithm, suited to remote interactive terminal operation, employs a conversational format to facilitate input of room dimensions, of absorption data, and of locations and noise levels of machinery. A redesign feature is included which employs three options. These allow the user to change sound source data and acoustic treatments in the process of finding the most economical accomodation of OSHA regulations during any phase of the factory design or redesign. [Work supported by NSF.]

L6. Performing arts building for a small liberal arts college. W.J. Cavanaugh (Cavanaugh Tocci Associates, Natick, MA 01760)

The Michael and Margaret McCarthy Arts Center on the campus of St. Michael's College, Winooski, VT, was occupied and in use for the fall semester of 1975. Its 400-seat theater, 300-seat recital hall, faculty offices, studios, classrooms, individual and group rehearsal rooms serve the performing arts needs of this 1400 student campus. The building was long in the planning stages and several original proposals for the building were discarded primarily for budget reasons. The design and construction of the building in just under 12 calendar Pizzagalli Construction Company undertook the complete design and construction of the building in just under 12 calendar months. This paper reviews the acoustical design considerations and the solutions to the myriad room acoustics, sound isolation, and building noise control problems inherent in a building of this type. Measurements of background ambient noise levels, room-to-room noise reduction, and reverberation times in the completed spaces are given and compared with the design objectives and generally accepted criteria.

L7. Music building for a small liberal arts college. Howard F. Kingsbury, P.E. (1983 Park Forest Avenue, State College, PA 16801)

Lebanon Valley College, Annville, PA has had a strong music program for many years. Recently it felt the need for new facilities to complement the program. The new building was occupied in the fall of 1975. It contains a 400-seat recital hall, band room, organ-choral room, faculty offices and studios, classrooms, and individual and group practice rooms. The building was designed by Bogar and Bink, Lemoyne, PA. The acoustical consultant was engaged early in the planning process. This made possible a high degree of interaction between the architect and consultant throughout the planning, design, and construction process. This paper reviews the acoustical design considerations and solutions to the many room acoustics, sound isolation, and mechanical system noise control problems typical of a music building. Measured data on ambient noise and room-to-room noise reduction will be shown, in comparison with the design criteria. One unusual feature of the recital hall is the methodology of varying easily the hall reverberation time for small and large group performances. Measured reverberation times versus calculated will be shown.

TUESDAY, 7 JUNE 1977 KELLER ROOM 115, 2:00 P.M.

Session M. Noise I: Aeroacoustics and Industrial Noise

Gerhard Reethof, Chairman

The Noise Control Laboratory, The Pennsylvania State University
University Park, Pennsylvania 16802

Contributed Papers

2:00

M1. Modeling of pressure spectra in a turbulent shear flow. Paul Beuther and William K. George, Jr. (Department of Mechanical Engineering, SUNY at Buffalo, Buffalo, NY 14214), and Roger E.A. Arndt (St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, MN 55414)

Models of turbulent—turbulent and turbulent—shear contributions to pressure spectra in a turbulent shear flow are developed. The spectral model for the turbulent—shear contribution is obtained by directly Fourier transforming the integral solution to Poisson's equation for an isotropic, homogeneous, constant mean shear flow. The turbulent—turbulent model is found in a similar manner with the addition of a quasinormal fourth-order-moment closure approximation. It is found that the turbulent—turbulent contribution is dominant in the high-wavenumber region and possesses a $k^{-7/3}$ inertial subrange. The shear contribution is dominant in the low-wavenumber region where it increases as k^2 for the large scales and rolls off as $k^{-11/3}$ for scales smaller than the energy containing eddies. Both spectra are related to the type of model chosen for the velocity field; by choosing various spectral forms, it is possible to compute the mean-square pressure of the flow. These results are compared to models for the mean-square pressure developed by Kraichnan, as well as with our own experimental data taken in a 12-in.-round jet and that of several other investigators.

2:15

M2. Scintillations of sound propagating through the turbulent atmosphere. Robert H. Gonter (University Computing Center, University of Massachusetts, Amherst, MA 01003)

During the Haswell Experiment sponsored by NOAA's WPL in March 1974, sound propagating from a source on a 150-m tower was received on the ground at slant range of 188 and 333 m. Recordings were made using a tetrahedral array 1 m on a side at frequencies of 500 and 1000 Hz. Using time delays between three pairs of microphones, direction cosines were computed for a plane wave arriving at the array. The cosines indicate that the direction of the sound reaching the array fluctuates several degrees in direction during medium turbulence at 188-m distance. Computed sound source direction misses the actual source direction by about 12° in the vertical and 5° horizontal at 188 m for both 500 and 1000 Hz. At 333 m, noise and loss of signal prevented computing reliable source direction.

2:30

M3. Azimuthal decomposition of the power spectral density of subsonic jet noise. K. Yamamoto and R.E.A. Arndt (Department of Aerospace Engineering, The Pennsylvania State University, University Park, PA 16802)