

Diffuse Reflections

The Newsletter for Progressive Acoustics Research

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Introducing the SIAP[®] MK III processor and control panel.

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Hummingbird Center

“We are hard put to convey to you how successful we consider SIAP[®] to be and how profoundly it has ameliorated, one could virtually say eliminated, the historic acoustical problems of the Beaumont, converting it into one of the best theaters for the spoken word of all the thirty some Broadway theaters in New York City.”

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DIFFUSE NEWS



Dr. Peter D'Antonio
President/CEO

The Future is CHAOS[™]!

Architectural acoustic projects are often chaotic, because small changes in the initial conditions produce unpredictable results. We believe a Collaborative Holistic Acoustical Optimization System is the future of our

industry. The following components comprise CHAOS[™].

- Creation- the Arcousthetic[™] design team creates the architectural, acoustic and aesthetic concept
- Holistication- emphasis is placed on the interdependence of the parts to the whole- the gestalt
- Adaptation- SIAP[®] electronic architecture allows adaptation to changing acoustical needs and provides variable acoustics, without infringing on the architecture
- Optimization- by combining BEM technology with efficient search engines, RPG offers multi-dimensional shape optimization of the passive boundary surfaces
- Simulation/Auralization- RPG's Disc Project and co-funded EPSRC research grant are developing scattering coefficients to improve the accuracy of geometrical modeling and auralization programs, like RayNoise[®], so a design can be evaluated before it is built.

RPG ONLINE

In an attempt to keep the consulting community up to date on our research and products, we have created RPG ONLINE. We invite you to visit our web site at www.rpginc.com. Our Acoustical Palette Logo assists navigation through the site. **About** describes RPG's philosophy, history and personnel; **Products** contains product data and brochures; **Applications** provides design suggestions; **Project Profiles** offers a pictorial of RPG installations; **Customer Support** lists worldwide dealers/distributors for our products; **News** presents current developments, and the **RPG University** is a developing

educational concept containing an Acoustics Laboratory, Classroom, Library of our publications and software, and Conference Center containing PowerPoint presentations. All information can be downloaded in zip or pdf format to instantly access current developments at RPG.

PRODUCTS

SIAP[®]

Adaptability to changing acoustical needs will become commonplace in the near future as more and more demands are placed on a multi-purpose performance venue. RPG is proud to offer what we think is the most powerful electronic enhancement system available called SIAP[®]. Call or download a copy of our white paper entitled the "History of Electronic Architecture" by Wim Prinssen, founder of SIAP[®], and Dr. Peter D'Antonio. The first US installation of SIAP[®] in the Vivian Beaumont Theater at Lincoln Center is now complete.

Bernard Gersten, Executive Producer of Lincoln Center Theaters, offered the following testimonial. "We are hard put to convey to you how successful we consider SIAP[®] to be and how profoundly it has ameliorated, one could virtually say eliminated, the historic acoustical problems of the Beaumont, converting it into one of the best theaters for the spoken word of all the thirty some Broadway theaters in New York City".

ROOM OPTIMIZER[™]

A demo version of the RoomOptimizer[™] can be downloaded from our web site. Experience how this combination of image model and multi-dimensional minimization techniques can automatically determine the best locations for loudspeakers, listener and acoustical materials in a rectangular room.



Research & Development

HUMMINGBIRD CENTRE

In this case study we describe the first installation of a custom optimized diffusor that was developed as part of our Collaborative Holistic Acoustical Optimization System (CHAOS™). The O'Keefe Center in Toronto provided a reasonable venue for reinforced contemporary programs, but a poor environment for opera, ballet and non-rock musicals that relied on the acoustics of the hall. Therefore, a proposal was made to install an electronic enhancement system (see Project Profile). The design team determined that a significant number of passive diffusing elements were required to mitigate the slap echo from the rear wall back to the stage and side to side reflections generated by the enhancement speakers. The diffusors needed to integrate into the existing decor and also house and conceal the enhancement speakers. As part of the CHAOS™ program, RPG was asked to provide an optimized shape to solve these problems.

OPTIMIZATION PARAMETERS

The original concept was a truncated triangle, 1.5 m (L) x 0.3 m (H) x 0.3 m (D), that would fit into the recesses of the theater's existing side walls. The loudspeakers would be located in a majority of the flattened apexes. Taking this as a design motif, we let the shape optimizer search for the best profile. Two source locations were considered. On stage sources would address the rear wall reflection problems and side wall sources would address the flutter

between side walls. Iterative multi-dimensional optimization requires a metric or parameter that is minimized or optimized. We have found the standard deviation of the sound pressure to be a good indicator of uniform scattering. Thus the combined stan-

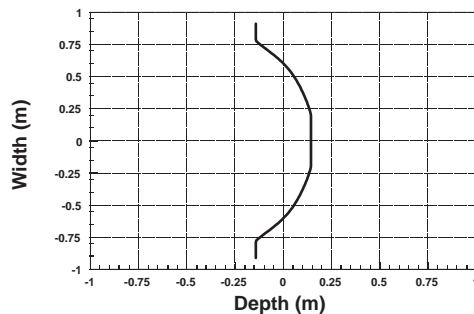


Fig. 1. Optimized diffusor profile, including flat speaker baffle.

dard deviation (Diffusion, dB) of the 1/3-octave scattered pressures at all of the receivers from all of the sources is evaluated for each trial surface profile. A

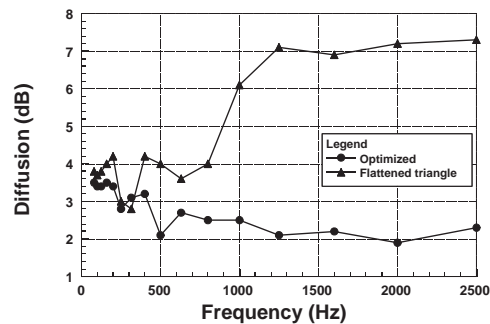


Fig. 2. Comparison of diffusion response between a truncated triangle and the optimum shape.

constrained multi-dimensional analysis was used to maintain the flattened front profile that housed the

enhancement speakers, while allowing the sides to assume the ideal shape. Constraints are often necessary in optimization algorithms so that the result conforms to aesthetic, ergonomic or physical requirements dictated by the project. The program accomplishes this efficiently by progressively penalizing surface points that deviate from the desired topology. This penalty weighting approach encourages the program to look for shapes that conform to the desired topology. The goal was to provide uniform backscattered sound pressure levels across the audience and stage areas, from 100 - 3000 Hz.

RESULTS

The optimum shape profile is shown in Figure 1. In Figure 2 we compare the Diffusion in dB versus frequency, for the initial truncated triangle and the optimum constrained curve, for the side wall source condition. An ideal Diffusion parameter would be zero. The improvement in uniform scattering over a broad specified frequency range is apparent.

The shape optimizer outputs a DXF file directly to a CAD/CAM system that allows fabrication of the mold master. Several rubber molds were made and 320 diffusors were cast in fiber-reinforced gypsum. FRG is an ideal material because it is low-cost, moldable and non-combustible. The optimized diffusors were upholstered in textile at the site to blend in with the aesthetics. This shape provided an architectural, acoustic and aesthetic (Arcousthetic™) solution to the problem.





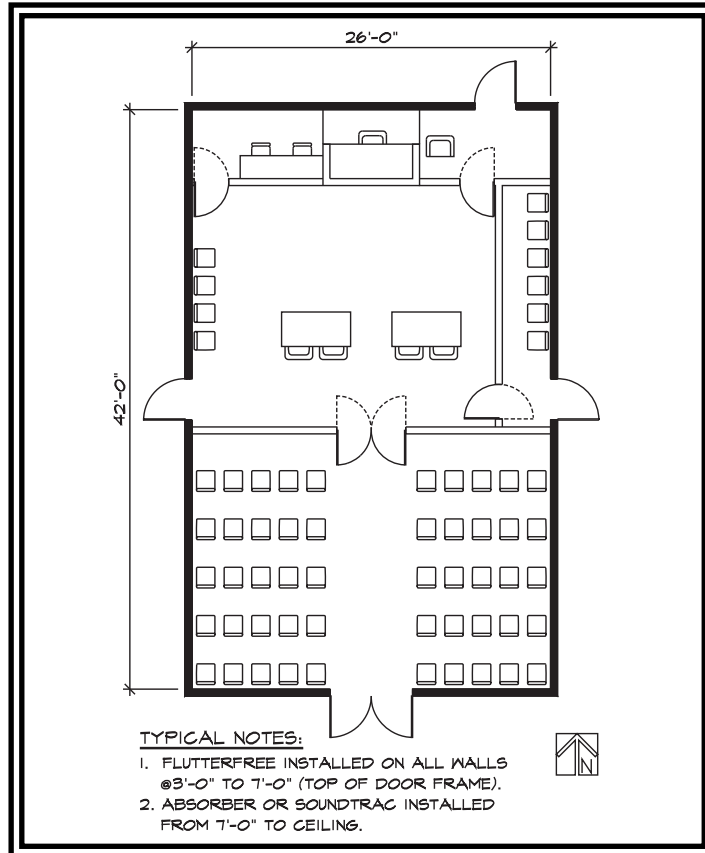
Diffuse Applications

COURTROOM

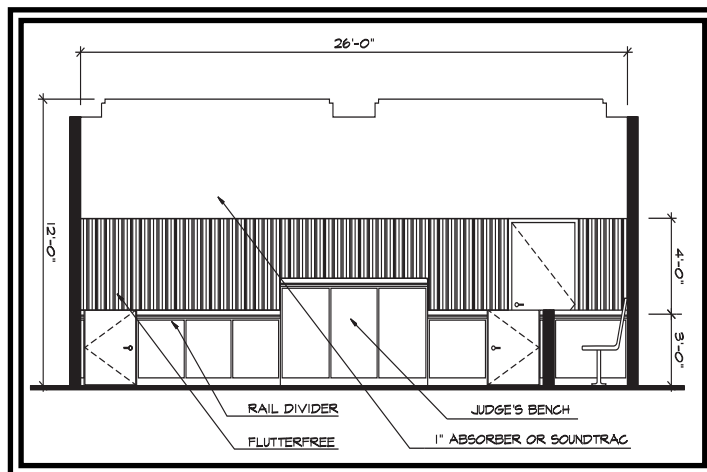
We have been fortunate to be able to work with several acoustical consulting firms regarding specific applications for our products. This issue's application profile is a result of one such request. Courtrooms share some of the same criteria as a large conference room with the added responsibility of minimizing extraneous spectator gallery noise from interfering with the courtroom proceedings.

We suggest a departure from the typical application of absorptive treatment on the majority of the interior surfaces of the room. Absorptive treatment is effective in lowering the ambient noise level in the room, but it also reduces the ability of critical members of the trial from hearing one another. The RPG approach combines a variety of interior finish materials that provide absorption, reflection, and diffusion to yield a more balanced acoustical environment.

In order to insure that all active parties of the trial can hear one another, we employ diffusive elements on the ceiling and wall surfaces in the front half of the courtroom to distribute energy evenly across the Judge's Bench, Witness Stand, Prosecution, Defendant, and Jury. FRG Omniffusors[®] are suggested for the ceiling. Flutterfree[®] or RPG's first cost-effective flat binary amplitude diffuser, the BAD[™] Diffusor, are suggested for the wall surfaces. Absorptive material, in the form of RPG's Absorber panels or SoundTrac[®] stretch fabric system, are suggested above the audience gallery to lessen the impact of noise generated by spectators. BAD[™] panels can be applied to the wall surfaces. This approach insures that extraneous noise is kept to a minimum and that critical testimony can be heard by all of the participants in the trial.



Plan View



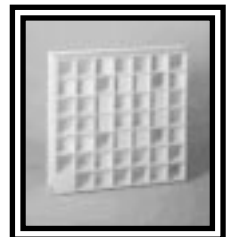
North Wall Elevation



FlutterFree[®]



BAD[™] Diffusor



FRG Omniffusor[™]



SoundTrac[®]

Project Profile: Hummingbird Centre



Overall view of side wall integrated diffusers, audience seating and ceiling.

Close-up of optimized diffusers in basket-weave curving wall



CLIENT

"Solution of acoustic deficiencies at the Hummingbird Centre in Toronto required a team to address all aspects of the work. A proposal to install an electronic enhancement system led to four areas of work- system design, acoustic analysis, architectural/visual acceptability and structural engineering for system support. Neil Muncy & Associates and Steve Barbar of LARES[®] Associates were responsible for system design; John O'Keefe of Aercoustics Engineering Ltd., performed acoustic analysis; Tom Payne of Kuwabara Payne McKenna Blumberg Architects provided the design concept for integration of the electro-acoustic system into the existing wood-paneled wall; Yolles Patnership were the structural engineers; and Richard Smerdon of Theatre Consulting Group designed the methods of installation. Installation was carried out by the theatre's own staff. Acoustical testing indicated that the LARES[®] system alone could not correct all of the problems and that a substantial amount of passive diffusion was required. O'Keefe indicated, 'Our scale model study suggested that we could not eliminate the side wall echo with stepped diffusers. The optimized curved diffuser design gave us the extra few dB we needed to solve the problem.' The parameters of performance and architectural requirements were established and RPG developed a diffuser to meet these needs. They were custom fabricated to specific dimensions dictated by the existing wall panels and included features to facilitate site installation. Approximately half of the diffusers incorporate enhancement speakers in a way that makes them unnoticeable to the audience. The architect's design follows a distribution pattern producing a 'fabric weave' on the wood walls that blends as a natural part of the auditorium decoration. Both the acoustic and architectural requirements have been well served".



PRODUCT



OptiCurve™

