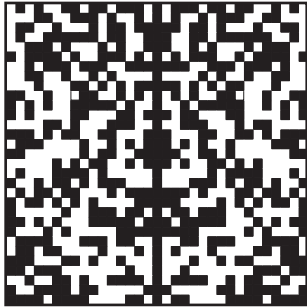# DiffuseReflections

**The Newsletter for Progressive Acoustics Research**

**Introducing the BAD™ Diffusor: The first flat Binary Amplitude Diffusor.**

## IN THIS ISSUE

> **"Acousticians are frequently asked to perform miracles, between chair rail and door jam in a flat, thin surface treatment. We are proud to announce your magic wand - the Binary Amplitude Diffusor (It's BAD™)."**

## DIFFUSE NEWS

**Dr. Peter D'Antonio**
**President/CEO**

Intelligent shape optimization is proving to be one of the most powerful AcousticTools® that we have offered the consulting community. To optimally use this AcousticTool®, we have developed the **C**ollaborative **A**coustical **O**ptimization **S**ystem (CAOS™), to synergetically interact with the consultants. The acoustical consultant is our liaison to the project and CAOS™ provides the optimized shapes to satisfy the architecture, the acoustics and the aesthetics for a holistic Arcousthetic™ solution to the design problem. We are currently collaborating on numerous interesting and challenging projects with acousticians around the world. We invite you to explore the power of this new technology.

## RPG APPOINTS NEW COO

We are proud to announce the appointment of John H. Groth as our new Chief Operating Officer. John began his RPG career as production manager, in 1992. His business acuity and Cornell MBA degree allowed him to quickly assimilate the role of Comptroller. Today, John manages the the day-to-day operations and financial aspects of RPG. He also has coached women's rowing at Princeton, Cornell and FIT. He and his wife Lois have two children, Kyle and Jennifer. You can e-mail him at jgroth@rpginc.com.

## NEW PRODUCTS

RPG is bursting at its acoustic seams with new technology. In this issue, we highlight the Room Optimizer™ program and the new zero-depth, flat BAD™ Diffusor.

## RPGSOFT'S ROOM OPTIMIZER™

Room Optimizer™ is RPG's first "expert system" to assist acousticians with the design of critical listening rooms. It is also the first software release of our RPGSoft division. Version 1.0 automatically determines the optimum positions for listener, loudspeakers, and acoustical surface treatment in rectangular rooms. The sum of the weighted variances of the spectra derived from the windowed 65 ms impulse response and the entire 15th-order impulse response is used as a cost factor in an iterative optimization cycle. A robust search engine intelligently explores all possible solutions, while satisfying user imposed symmetry and displacement constraints. Additional features are planned for future releases.

## BAD™ IS GOOD!

Acousticians are frequently asked to perform miracles, between chair rail and door jam in a flat, thin surface treatment. We are proud to announce your magic wand: the **B**inary **A**mplitude **D**iffusor (It's BAD™). On the outside it looks like a conventional absorptive fabric wrapped panel. When you lift the hood on this turbocharged panel, you see the industry's first patented 2-dimensional binary amplitude grating. By mapping "0" for absorption and "1" for reflection, this combination of "resorptive" areas provides diffusion in a flat variable impedance panel up to 9 KHz. Now you can economically control reflections, without creating a "dead" space.

## NEW ACOUSTIC DEMONSTRATION DISC

RPG is offering an Acoustic Demo Disc to help acousticians demonstrate the importance of acoustic treatment. The CD was recorded by Tom Jung of DMP® using the latest 20 bit recording technology. Call for a free copy.

**RPG** ®

## STAGE CANOPY STUDY

We begin a two part presentation on a new approach to design and evaluate stage canopies. This case study is a result of our CAOS™ interaction with a leading acoustical consulting firm. The boundary element method offers acousticians the most accurate way to predict and evaluate the performance of a stage canopy. RPG has combined this approach with a search engine to also determine the optimum surface shape. We will describe the optimization of a stage canopy, illustrated in Fig. 1. It consists of an array of similar elements lying on the arc of a large circle whose radius is variable. The elements extend across the full width of the stage and are spaced for
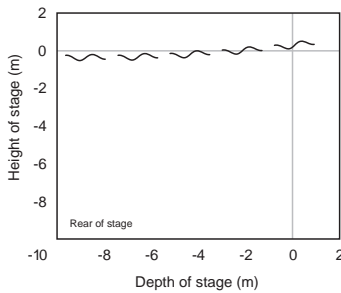


**Fig 1. Location of stage canopy elements on a large convex arc above the stage.**

lighting or to access the volume above the canopy. To illustrate the improvement optimization affords, we will compare the optimized "S" shape, with traditional arcs of 5' and 10' radius of curvature, a wedge or elbow shape, and a flat panel shown in Fig. 2.

## OPTIMIZATION PARAMETERS

To evaluate the effectiveness of the thousands of surface shapes considered in the iterative optimization, we have defined a cost parameter, which is the average standard deviation (referred to as Diffusion) in dB
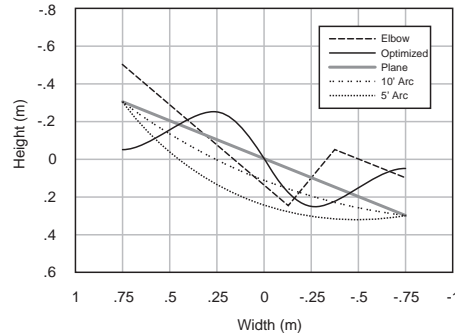


**Fig 2. Illustration of the various canopy element shapes evaluated in the optimization.**

of the scattered pressure at the receivers, from all of the sources on stage. It is evaluated at 1/3-octave center frequencies over the desired bandwidth.

## RESULTS

In Fig. 3, we show the scattered pressure using flat canopy elements from a source in the center of the stage at 2 kHz. Notice the specular hump in the center of the stage and how irregular the coverage is from the front to the rear of the stage. The ideal coverage plot would be essentially flat with a low standard deviation. To find an optimum curved shape, the curve optimizer program searches for the best combination of a specified number of harmonic sinusoids (e.g. 4). The result is the "S" shaped profile in Fig. 2. The more uniform coverage offered by this shape is shown in Fig. 4. In Fig. 5, we compare the average standard deviation from all of the sources, to all of the receivers, for all of the canopy shapes examined, as a function of frequency. It can be seen that the optimized canopy offers a lower standard deviation than any of the conventional shapes. In Vol. 3, Issue 4, we will discuss an approach to optimally distribute the energy created on stage, between stage and audience.
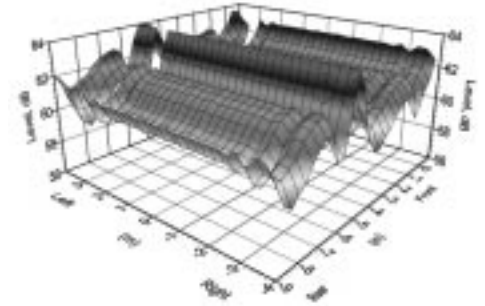


**Fig 3. 2 kHz scattered pressure from flat canopy elements at all receiver locations. The source is located in the center of the stage.**
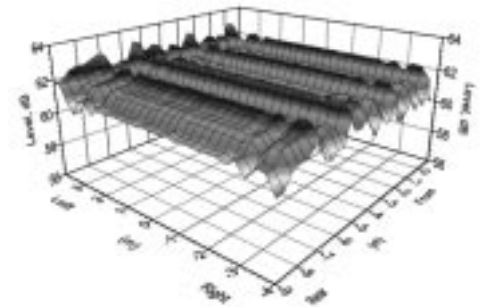


**Fig 4. 2 kHz scattered pressure from optimized canopy elements at all receiver locations. The source is in the center of the stage.**
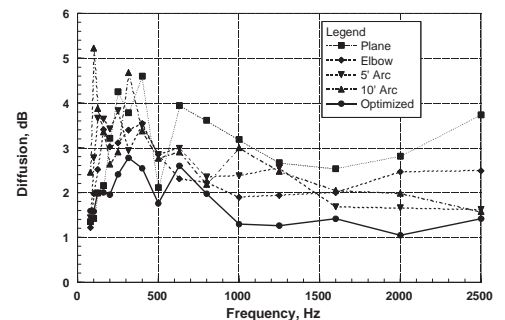


**Fig 5. Comparison of the average standard deviation (Diffusion, dB) as a function of frequency for all of the shapes examined.**

## CONFERENCE ROOM

As with other small rooms, the Conference Room can pose a significant challenge to the Acoustical Consultant. The requirements for good speech intelligibility, audio/visual reproduction, as well as the possibility of Tele/Video Conferencing, require certain acoustical conditions that may not have previously been a consideration for this type of space. It is with these considerations in mind that we provide the following suggestions for acoustical treatment using RPG Diffusor System's products.

The traditional solution may be to cover as much of the available surface area with an absorptive material. This is not an incorrect method of treatment, but it does cut down on the amount of natural acoustic gain in the room by absorbing all reflections from the room boundaries. The extensive use of absorptive treatment could pose a problem in a larger conference room. As the distance from the speaker to the listener increases, the sound decreases by 6dB every time you double the distance (inverse square law). Without the added diffuse reflections from the room boundaries, the amount of energy received by a listener may be reduced beyond the point of intelligibility.

In our example, we use two-dimensional Omniffusors™ in the ceiling, Flutterfree® on the sidewalls, and Diffractals® on the rear wall opposite the main speakers and audio/visual equipment. These products help reduce discrete reflections that may interfere with intelligibility and gain before feedback, while distributing the energy evenly across the width and depth of the room. This approach helps alleviate acoustical problems in these spaces, such as flutter echo, while providing improved acoustical conditions over traditional absorptive panels.
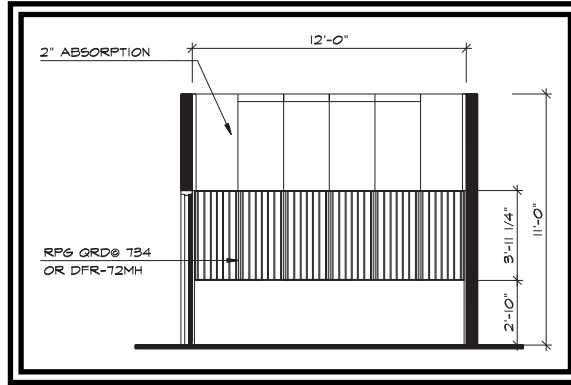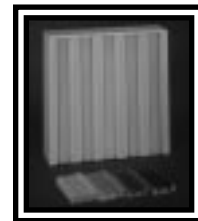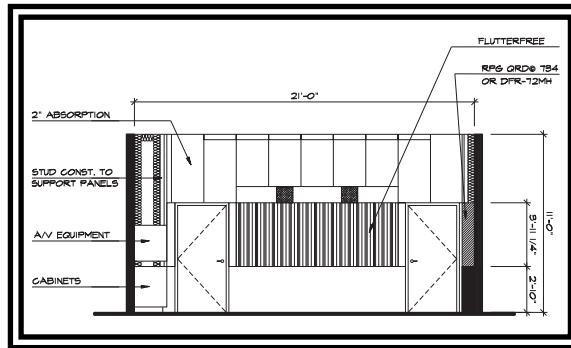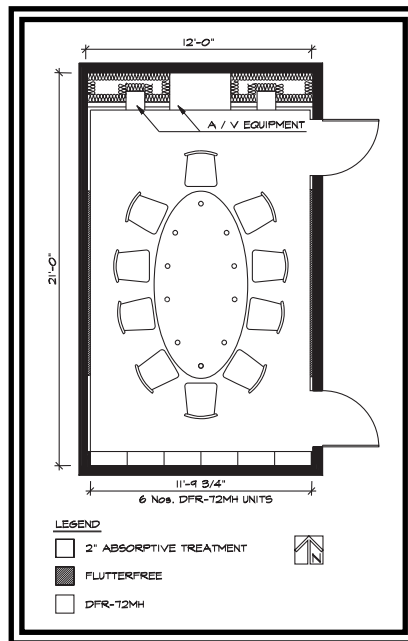


**South Wall Elevation**



**East Wall Elevation**
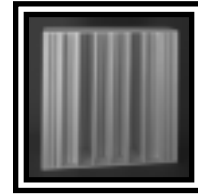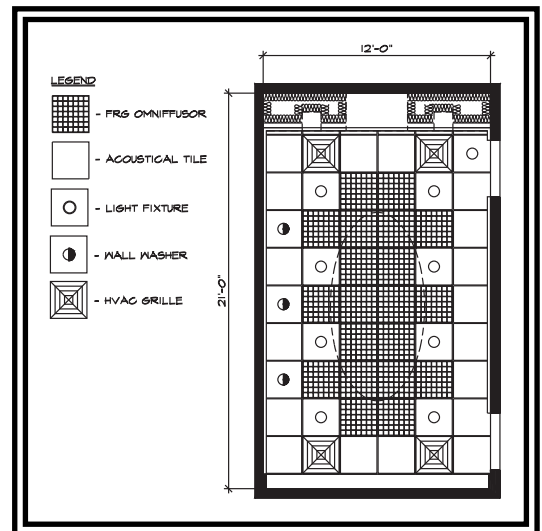


**Plan**



**Diffractal®**
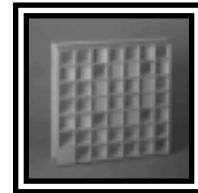


**FRG Omniffusor™**



**Flutterfree®**



**Reflected Ceiling Plan**

# Project Profile: Roeselare's Cultural Center



## ARCHITECT

The Cultural Center De Spil and the adjacent Academy of Music are built around an amphitheatre-style courtyard in Roeselare, Belgium. The original design did not incorporate an orchestra shell as part of the hall. Later on, when the owner requested that an orchestra shell be part of the design, RPG VAMPS® was specified. "The custom-made, zebrano-wood Diffractals®, with faux aluminum dividers, marvelously blend with the hall's dark red hues and also add a surprising touch of warmth and comfort."

## CONSULTANT

Acoustic Consultant Luk Van Daele used RPG Diffractals® all along the side walls and on the rear wall of the balcony to provide optimal sound coverage for the 850 seat audience. "RPG QRD® 734 Diffusors were used in the Orchestra pit to clarify and heighten the sense of ensemble. The fully rigged, mobile RPG VAMPS® can be adjusted according to the size and composition of the orchestra. Musicians and public are unanimously enthusiastic about the extraordinary acoustical impact on stage and within the hall."
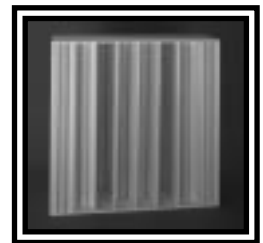
## CLIENT

"The City of Roeselare's Cultural Center De Spil sought an acoustically excellent 850-seat multi-purpose hall that would be able to welcome a variety of performances, including drama, opera, band and orchestra. Flexibility and adaptability are therefore the key words for this hall and RPG products have played a great part in achieving this goal. Additional flexibility is obtained by opening or closing the balcony level, which changes the hall's seating capacity from 500-600 up to 750-850."



## PRODUCTS



**QRD® 734**



**Diffractal®**