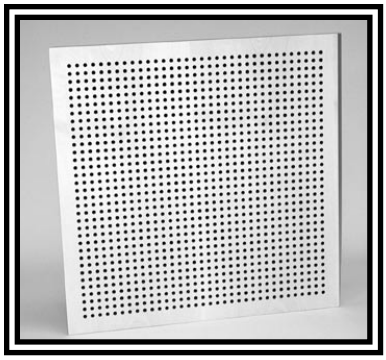
Diffuse Reflections

The Newsletter for Progressive Acoustics Research **Volume 8, Issue 1, 2001**



TopTiles™

RPG® announces a new series of Topakustik® and Topperfo® 2'x2' (shown above) and 2'x4' lay-in wood panels.

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"It was an honor addressing the NCAC members and I appreciate all of the kind words about the contributions RPG has tried to make to our industry. I can only reiterate what I have said many times, that none of this progress could have been achieved without the support of the acoustical community. We look forward to continued growth and progress."

For up to the minute information, we invite you to visit RPG's acclaimed web site: http://www.rpginc.com.

DIFFUSE NEWS

Dr. Peter D'Antonio
President and CEO

Everything Acoustic!

Happy 40th Anniversary NCAC (1962-2002)

I wanted to thank the NCAC for the invitation to address the general membership meeting in Ft. Lauderdale, FL on the evolution of diffusion performance metrics and the future direction of architectural acoustic surface treatments. It was an honor addressing the NCAC members and appreciate all of the kind words about the contributions RPG has tried to make to our industry. I can only reiterate what I have said many times, that none of this progress could have been achieved without the support of the acoustical community. We look forward to continued growth and progress. ***Please send your comments to pdantonio@rpginc.com.***

This Old House

At some time or another, all of us have watched This Old House (www.thisoldhouse.org). The Emmy Award winning This Old House is television's premier home improvement series. The show that unlocked America's passion for home improvement, celebrates its 22nd anniversary season on PBS this year. This Old House's mission is to demystify the home improvement process and to celebrate the fusion of old world craftsmanship and modern technology. Each season features two renovation projects. Project One traditionally consists of eighteen or so episodes and is filmed in Massachusetts. Project Two is taped in a different region of the country to highlight the variety of American architectural styles and renovation issues. Project One this year is The Manchester House, owned by Janet and David McCue.

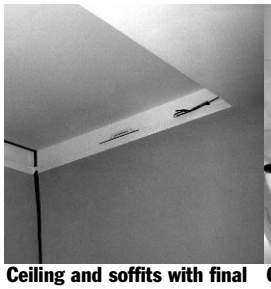
RPG was brought into this renovation by John Storyk of WSDG, Highland, NY who is responsible for the home theater design in the living room. The room will be used for both viewing movies and live piano recital. Storyk selected BASWA®phon to treat the existing flat ceiling and focusing upper side wall areas. Skylines® were chosen to create diffusion in the performance area ceiling. The installation of BASWA®phon is now complete and will be presented in a series of programs 2113, 2117 and 2119. Please consult local stations for airing times. You can also consult the Material Resources Directory on their website and **This Old House** magazine for further details and pictures.

Partial gluing of the pre-coated scored panels

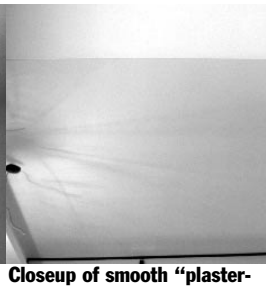
Curved soffit fully covered with pre-coated panels

Application of seam fill to cover joints between panels

Application of base coat after seam fill is sanded



Ceiling and soffits with final top coat applied



Closeup of smooth "plaster-like" finish on ceiling

Research & Development

DIFFUSE REFLECTIONS & RT60

Reverberation time, diffuse reflection, Sabine, and computerized prediction - Part I

RPG is frequently asked what the effect diffuse reflections have on reverberation time. Since acousticians are used to using Sabine, Eyring, Fitzroy and Arau-Puchades to calculate reverberation time using absorption coefficients, it is natural to wonder if there is a modification to these equations that can incorporate diffusion. The short answer is that all of the above mentioned equations already assume a totally diffuse sound field, so the real question is "How does one calculate reverberation time correctly when the sound field is not diffuse or mixing?" One answer to this lies in the use of computer prediction programs, which properly take into account diffusion. One of the initial findings of round robin experiments comparing experimental measurements with computer predictions was the absolute need to include diffuse reflections. Today, diffuse reflections are attempting to be modeled in commercial programs. CATT® Acoustics has been on the forefront in diffusion modeling and so we have asked the creator of CATT® Acoustics, Bengt-Inge Dalenback, to write a tutorial that we have published on our website. RPG has been doing its part to experimentally measure and theoretically predict the diffusion coefficient. Also there have been significant advances in the standardization of a method to measure the random incidence scattering coefficients, specifically to be used by the computer modeling programs. Therefore, with these data close at hand, I encourage all acousticians to read this tutorial to advance the accuracy of the computer prediction of reverberation time and the other objective parameters.

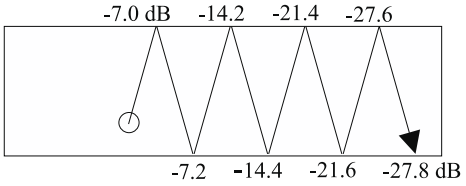
Introduction

This is the first part of a continuing discussion about reverberation time estimation with special emphasis on the effects of diffuse reflection in computerized prediction (CP) in relation to classical Sabine methods. The purpose of this presentation is to discuss problems, pitfalls and techniques regarding reverberation time (RT) prediction. We will also provide examples from idealized as well as actual rooms encountered in consulting practice. Reverberation time is far from the only measure a CP program can estimate and many further types of analysis are possible. However, the RT is a good starting point, since it remains a central parameter in all applications of room acoustics and most acousticians would agree that an appropriate RT is a necessary, if not a sufficient condition, for good room acoustics. All CP examples shown are created using CATT®-Acoustic v7.2.

Effect of diffuse reflection on the RT?

Diffuse reflection basically affects the RT in two ways, both in the decreasing direction:
1 Diffuse reflection forces surfaces to be more evenly utilized
2. Diffusors may introduce absorption of their own

By redirecting the reflected sound in many directions, diffuse reflection will let room surfaces be hit by sound in a more uniform manner and absorbing surfaces will be better utilized. It thus prevents cases where the sound field e.g. becomes predominantly horizontal, such as with hard parallel walls where a ceiling absorber does not have any major effect on the late decay. Clear examples of such cases are swimming and sports halls that often are rectangular and where the absorption for practical reasons is placed mainly in the ceiling and perhaps on upper walls. Another example is a reverberation chamber, where the placement of an absorber (to be measured) on the floor, requires the use of diffusing elements to give a good estimate of the random incidence absorption coefficient. Signs of the non-diffuse field in such rooms are double-sloped or otherwise non-linear (when expressed in dB) decay curves. This non-linearity is created because the sound in some direction (often the vertical) is quickly absorbed giving a fast initial decay (both due to the higher average absorption in the vertical direction and because vertical reflections occur more frequently - the height is often the smallest dimension). In contrast, the horizontal sound lingers, since it is reflected between hard surfaces (and is also reflected less often), and thereby gives a slow late decay.



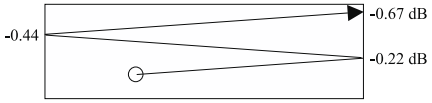


Figure I- Schematic illustration of vertically and horizontally reflected sound in a rectangular room with a ceiling absorber (alpha = 0.80) and hard walls and floor (alpha = 0.05) assuming no diffuse reflection. Reflection traces are those occurring within the same time period (i.e. total length of rays are roughly equal). Numbers indicated are the remaining relative levels after each reflection (for example, 10 log(1-0.80) = -7.0 dB and 10 log(1-0.05) = -0.22 dB).

The figure illustrates that during the same time period - a vertical ray is attenuated by almost 30 dB due to absorption, while the horizontal ray - in comparison - is hardly attenuated at all. With double-sloped decays the whole concept of an RT becomes ambiguous, especially if the knee of the decay is located inside the -5 to -35 dB span commonly used to evaluate RT (T-30). Next we will examine the effects on the RT for scattering coefficients from 0 to 0.99 using an idealized rectangular room with an absorbing floor.

TOP TILES™

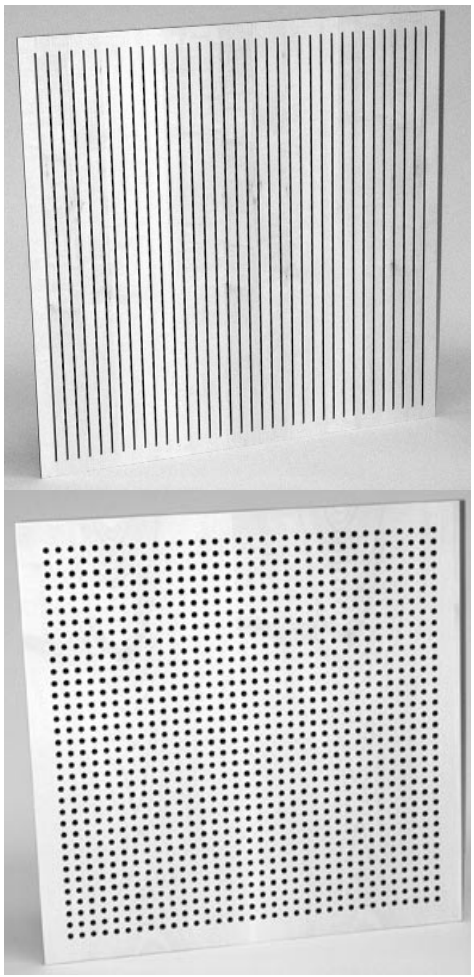


Figure 1. Top- Topakustik® 2'x2' ceiling tile, available in 6/2M, 9/2M and 13/3 M. Bottom- Topperfo® 2'x2' ceiling tile available in 16/16/8. Both available in standard melamine Maple. Any other wood veneer, color or melamine finish are available as a custom order

The Topakustik®/Topperfo® absorptive wood system offers a very wide range of possibilities. In DRV7I4 we illustrated how easy it is to install Topakustik® planks on walls and ceilings. We also described how to cover an existing T-bar ceiling with Topakustik® planks using a special clip that attaches to the bottom of the 15/16" T-bar. The existing absorptive ceiling tiles can remain as an absorptive backing or removed and replaced with fiber-

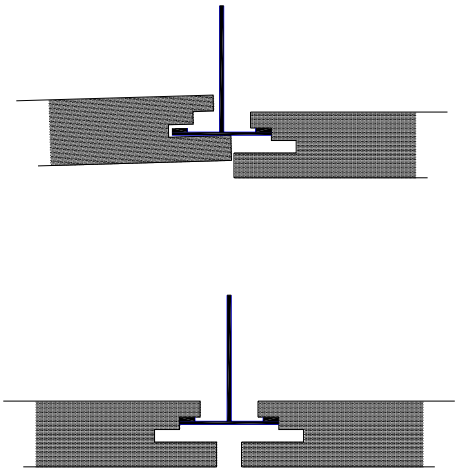


Figure 2. The Topakustik® and Topperfo® ceiling tiles provide partial concealment of the 15/16" T-bar offering a handsome and simple lay-in ceiling treatment.. Installation sequence, Top Tile™ perimeter detail and tile spacing is illustrated

glass or other type of porous absorptive panels.

For new applications and renovations that require a removable lay-in tile, RPG offers Top Tiles™, both in the Topakustik® and Topperfo® design. With Top Tiles you simply insert the panel into a 15/16" T-bar grid. The unique edge profile allows the panels to be inserted and

Figure 3. Example installation of Topakustik® Top Tile™ ceiling tile

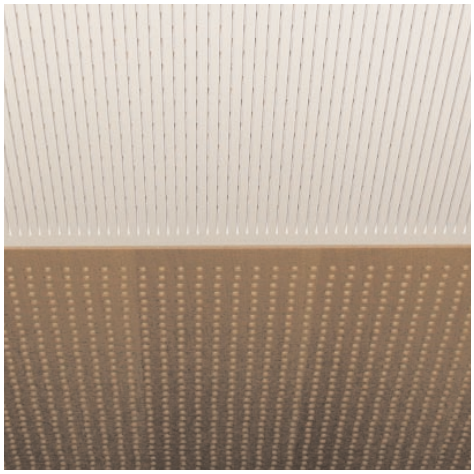


Figure 4. View of a Topakustik® Top Tile™ (upper) and a Topperfo® Top Tile™ (lower) in a T-bar grid

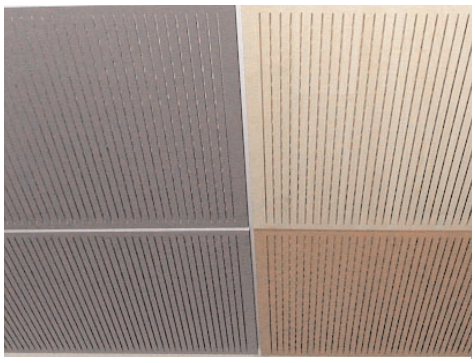


Figure 5. View of the intersection of four Topakustik® Top Tiles™. Tiles on the left are finished in a metallic finish and the tiles on the right are Maple (upper) and Beech (lower)

locked in place. The unique edge profile provides partial concealment of the T-bar, so that the system has a concealed grid appearance without the problems associated with special key tiles. Removing the tiles for servicing is as simple as with a tegular or flush mounting. Top Tiles are available in 2'x2' and 2'x4' sizes. If required on 2' x 4' Top Tiles™ an "L" shaped aluminum insert may be inserted along the 4' dimension to prevent sagging. Top Tiles™ are 5/8" thick and are supplied with a black non-woven matt on the rear surface to conceal and prevent any potential dust from the field-applied absorptive backing from entering the room below.

Project Profile: Hit Factory Criteria Studios


View of the typical Diffractal® rear wall in all of the Control Rooms

View of the Skyline® ceiling in Studio A

CONSULTANT

Hit Factory Criteria Studios, Miami, FL

Founded in 1958 by Mac Emmerman, the history books credit Criteria with a phenomenal catalogue of special performances. The complete list reads like the proverbial 'Who's Who' of popular music including James Brown, Aretha Franklin, The Eagles, Eric Clapton, Bob Seeger, Aerosmith, REM, Celine Dion, Julio Iglesias, Gloria and Emilio Estefan and, of course, the Bee Gees.

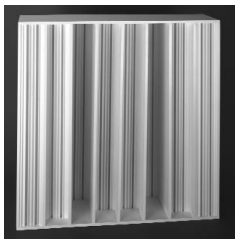
Attracted by its reputation, high ceilings, the growing Latin music market and Miami's gateway to Latin America, The Hit Factory acquired Criteria and completely refurbished the existing facility. The design team consisted of The Hit Factory Inc., New York (project management); White Mark Ltd., Suffolk, England (acoustical and technical design consultants and technical installation), WML/AKA/Procter & Wang Architects, New York (furniture, interior and design consultants); Oakwood Construction (specialist studio construction).

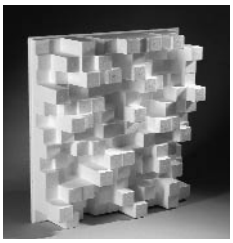
"The studio design was a major and unique challenge", comments David Bell Managing Director of White Mark, Ltd. "The history and character of the complex together with the need for integration with the New York Hit Factory presented both problems and opportunities. Significant technical advances were required in the isolation performance, the electrical, technical and mechanical systems. Interior design coordination involving much loved historic studio features, the local Miami vernacular and the company corporate style was vital."

Bell continued, "To provide uniform coverage and accurate monitoring, RPG Diffractals® were used on the rear wall of all of the new Control Rooms at Criteria. To provide a uniform diffuse sound field in Studio A the entire ceiling was treated with RPG Skyline® omnidirectional diffusors, whilst careful creation of live areas throughout the complex utilised RPG Diffractals® in many of the booths and smaller live rooms. Our experience has indicated that RPG products are well documented and consistently provide the desired acoustical performance our projects require. This is true of studios ranging from post production for television and radio to full film dubbing facilities and from recording facilities aimed at pre-production to full film scoring stages. We have installed RPG products in countries as diverse as Iceland, mainland Europe, the UK and the USA with full confidence that they will do exactly what is specified."

Commenting on the renovation as opposed to a new ground up facility, Troy Germano, Hit Factory New York, indicated, "I think the end result is that the studios are even better than they otherwise would have been. The result is certainly impressive. All the rooms display a character missing from most modern rooms and retain essential elements of the studio that has produced so many classic recordings." Despite the renovation, veteran producers and musicians feel that the magic is still there! For more information consult the RPG website and Studio Sound Magazine April 2000.

PRODUCTS


Diffractal®


Skyline®

RPG DIFFUSOR SYSTEMS, INC., 651-C COMMERCE DRIVE, UPPER MARLBORO, MD 20774, PHONE: (301) 249-0044, FAX: (301) 249-3912, E-MAIL: INFO@RPGINC.COM, INTERNET: WWW.RPGINC.COM