**Central Campus**
**Acoustical Findings Report for Worship Center**

We greatly appreciate of the opportunity to discover the proposed factors and goals of the proposed renovations of the Newhope Sanctuary. That discovery process has led to in-depth acoustical studies and this findings report. The report is intentionally framed to connect the technical results to predicted real world experiences.
This report applies a (6) point protocol to large room acoustical analysis through (4) perspectives. Each point is in itself the tip of more detailed concerns that may lie beneath.
**Clarity:** which encompasses frequency response through speech intelligibility
**Envelopment:** the listener should feel bathed in sound from all sides while being able to identify origin. The acoustical aspects of this point are all too frequently downplayed given advances in PA technology.
**Freedom from Echo:** reflections must blend together smoothly
**Reverberation:** the manner that sound decays in the space must have an appropriate loudness relative to the original sound, a pleasing rate of decay & be consistent with the function of the space.
**Performer satisfaction:** the stage must be free from distracting echoes while providing a group sense between performers. Again, given advances in personal monitor technology, the acoustical aspects of this point are too frequently disregarded.
**Freedom from Noise:** the noise level of the space: the general ambient background, specific acute noise bursts & mechanical system noise must be sufficiently quiet.

It's now important to consider that acoustics are truly directional...you have a source and you have a listener. Where these elements are located within a space has great importance to the acoustical surroundings. In this regard, we put thought and consideration to each of the above through the following four perspectives:

**First:** the PA to the Room. This a primary evaluation starting point. The RT60 (decay time study) has bearing in that the decay time should be matched to the rooms volume, unique factors and style of worship. Discrete reflections issues are then to be closely reviewed for a total understanding.
**Second:** the Pastor to the Room. It is a common experience that the pastor hears a delayed reflection from the rear surfaces (or balcony facade) that hampers the ability to deliver a sermon.
**Third:** the Praise Band/Choir to the Room. The worship platform must accommodate the singers and musicians ability to perform. Monitoring systems are part of this, but the stage itself is an often overlooked component (resonant coloration). The energy of the singers/musicians must get to the room in a manner consistent with the overall sound reproduction system.
**Fourth:** the Congregation to the Room. Consistent with the style of worship, the acoustic energy created by the congregation should have a sense of envelopment where strong and weak singers feel tied together and the sound is "glorious" within the room. Too "dry" a room and the weak singers become meek...too "wet" a room and the clarity of the words is lost.

**FINDINGS**

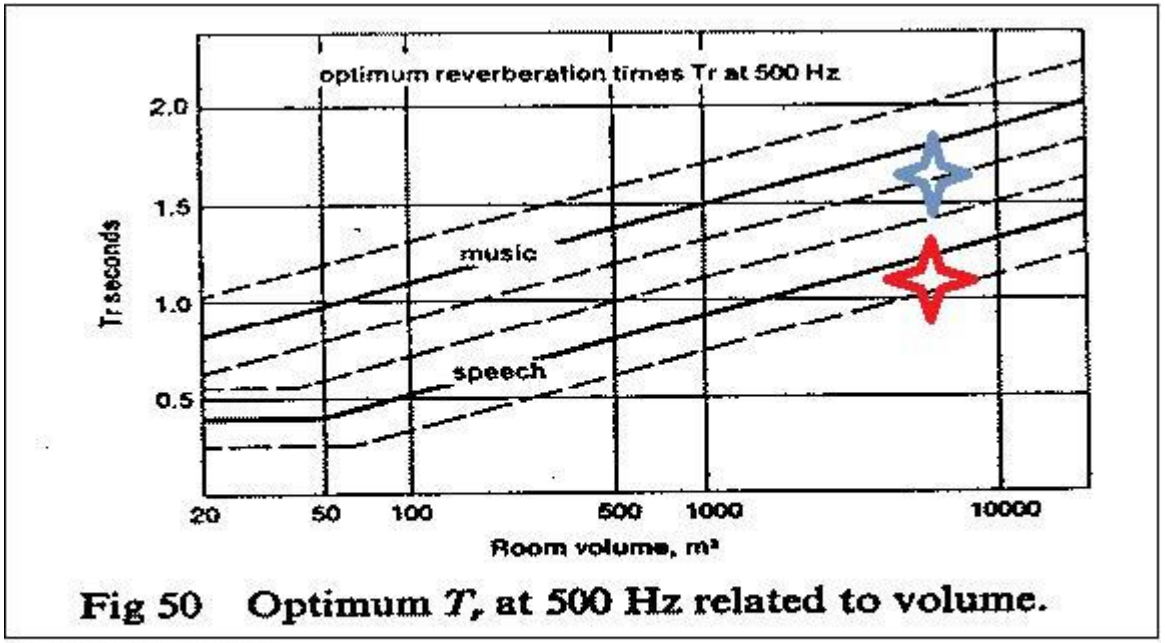



Fig 50 Optimum $T_r$ at 500 Hz related to volume.

Figure 50 of DES 51

as designed w/ seats

after proposed treatments

*Figure 1*

**Comments Figure 1: the very first acoustical qualifier in a room of this size and function is the decay time of the midrange: "Is it appropriate for the function?". In this case, the function is cutting edge contemporary worship with heavy praise band presentation. The calculated room volume is ~8,300 cu. Meters. The target RT60 for this function that allows optimal use of the sound reproduction system while retaining a natural space for humans is 1.2seconds (at 500Hz). The graph above shows this. It also shows that the room as designed by architectural prints, with seats, is near a totally functional result. This is very important to grasp early on in this report as it is now a driving factor: simply, we need to get control of the space acoustically so that to the very best ability within the factors, every seat can have a quality experience and that the service intents will reach the congregation.**

RT60: time, in seconds it takes for sound to decay -60dB at 500Hz

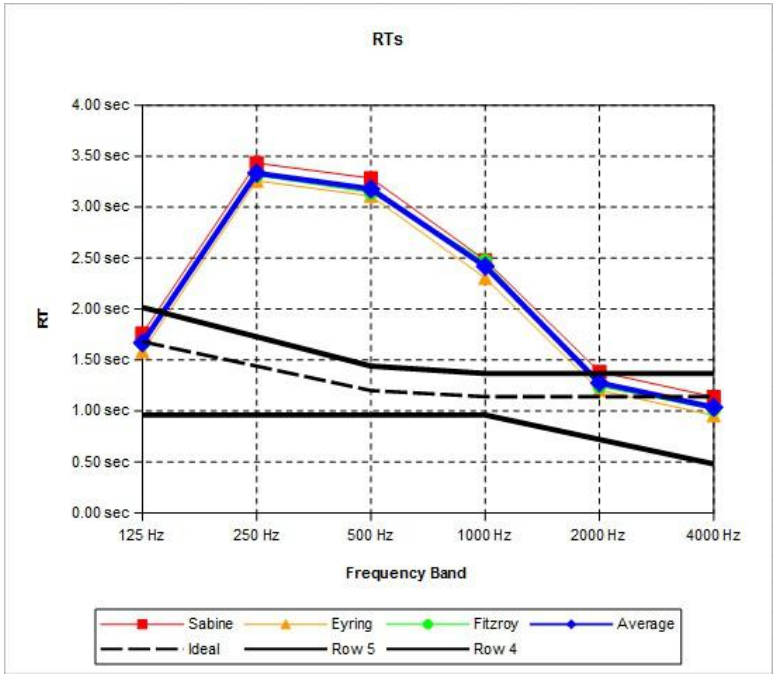



*Figure 2*

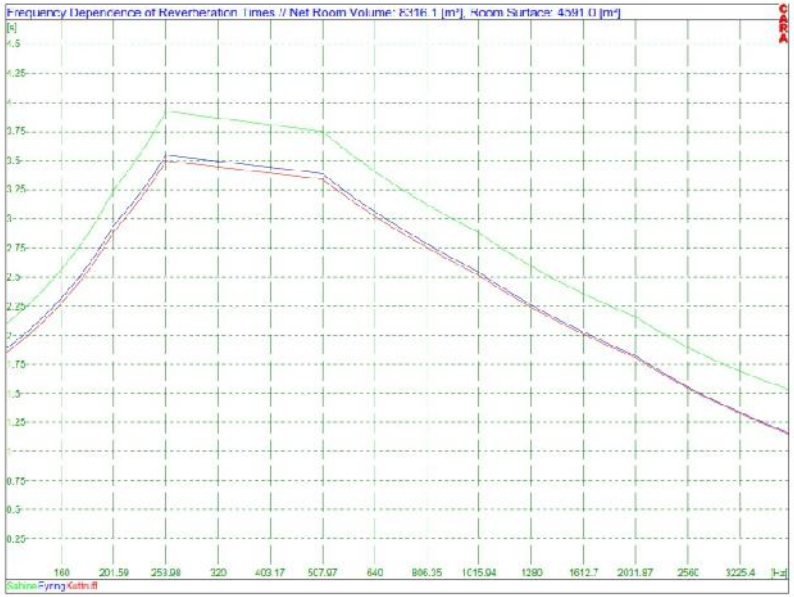



*Figure 3*

**Figures 2 and 3 are decay time studies of the room as drawn with the carpet on the floor, with the curtain as backdrop of stage (note, this curtain is very helpful acoustically and is an anchor of the whole room response), but with NO seats or people. Figure two is from a moderate level program in terms of ability to input high level details. Figure three is generated from the primary acoustical analysis/modeling program that allows very high level details (from structure to geometry to finishes). The immediate take away is that the similarity of the curves and the two programs affirms the process and the results...these studies are acoustically on point.**

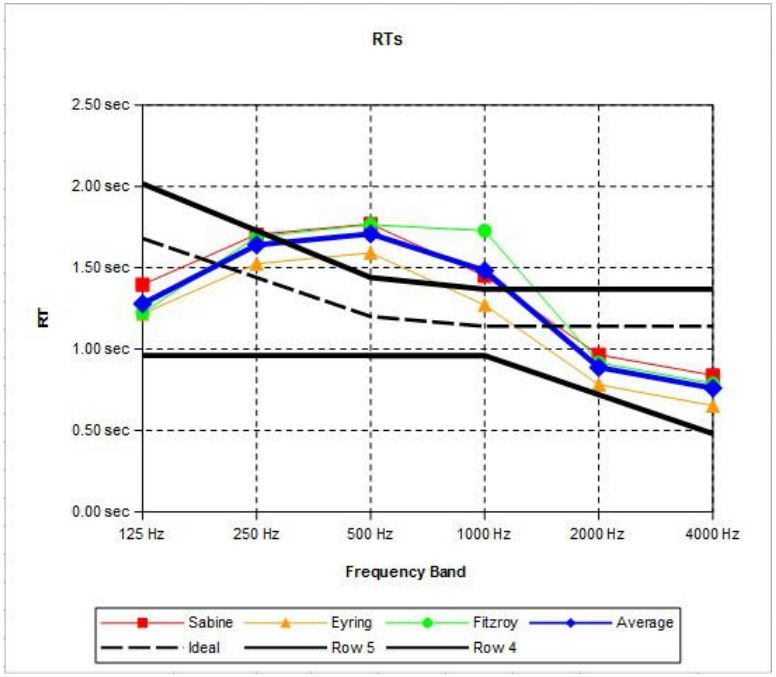



*Figure 4*

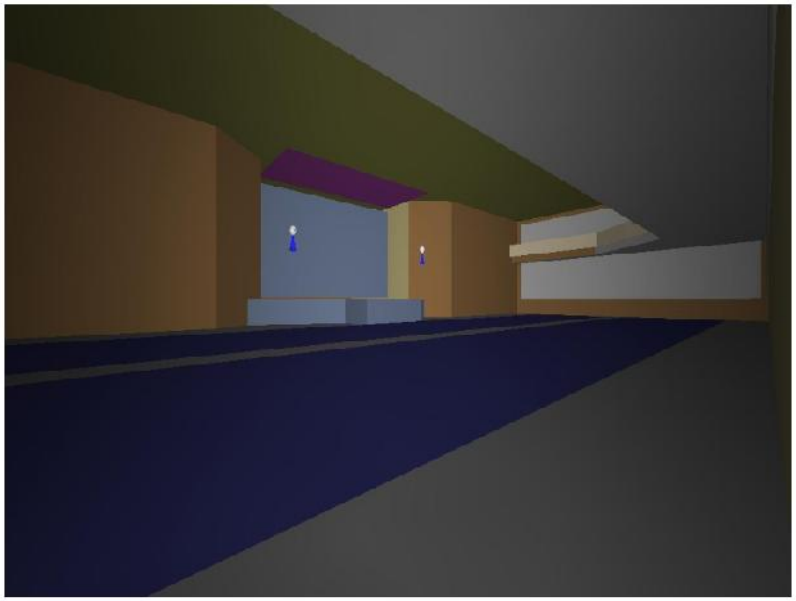


*Figure 5*

**Figure 4 shows the results after adding the ~1,300 padded seats. Figure 5 shows a view inside the primary acoustical model. In this model, each color represents a surface type that has been specifically assigned. You'll note a pair of floating speakers (9' AFF) that are omnidirectional full range sources to excite the room for acoustical studies.**

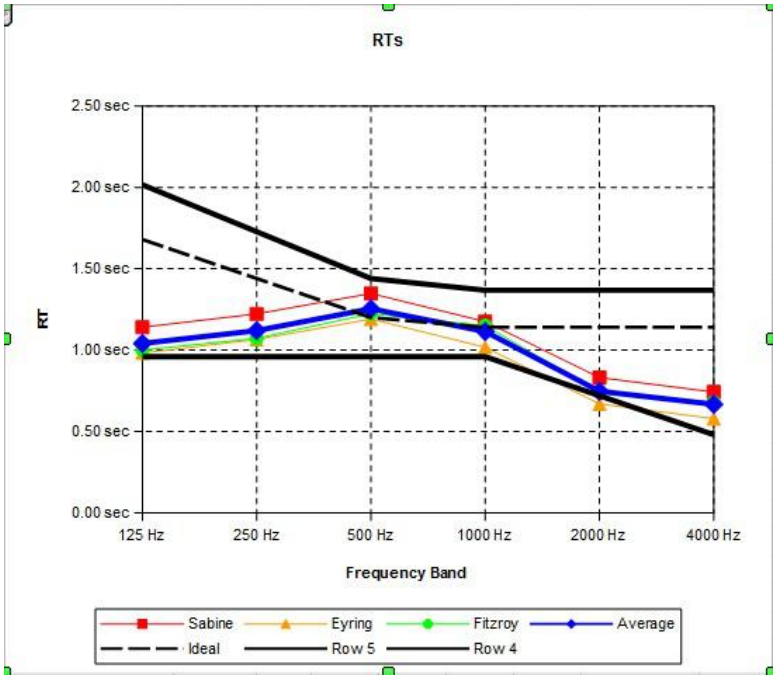



*Figure 6*

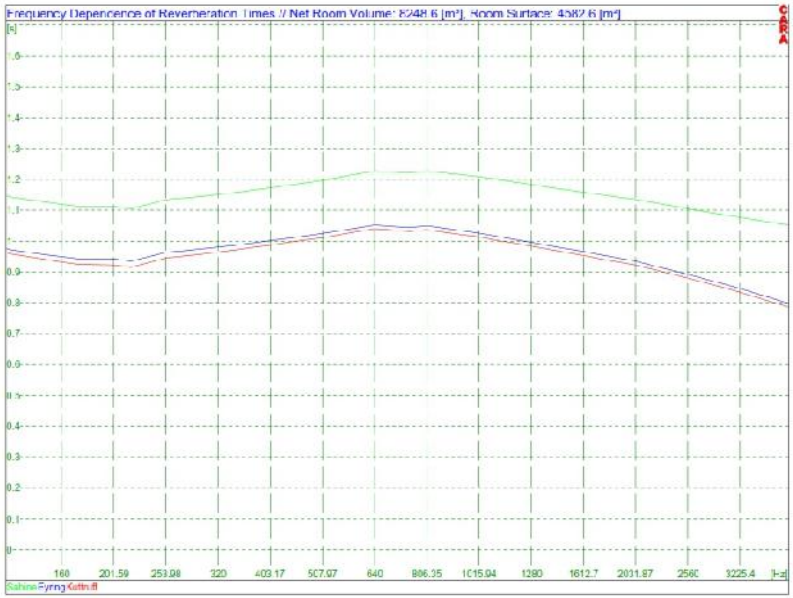


*Figure 7*

**Figures 6 and 7 are after the treatment solutions are added= ~1.0 to 1.2 seconds. We see great consistency between the two modeling programs. Now is an ideal time to point out the multiple curves on these RT graphs. They are different acoustical algorithms (Sabine, Fitzroy, Eyring, Kutruff) and each algorithm has slightly different calculation engines within and responds more accurately to certain types of room compared to it's peers. In this specific case, it is not so important which curves is most appropriate; the importance is seeing how spectrally consistent the curves are which indicates that the predictions are highly related to real world results.**

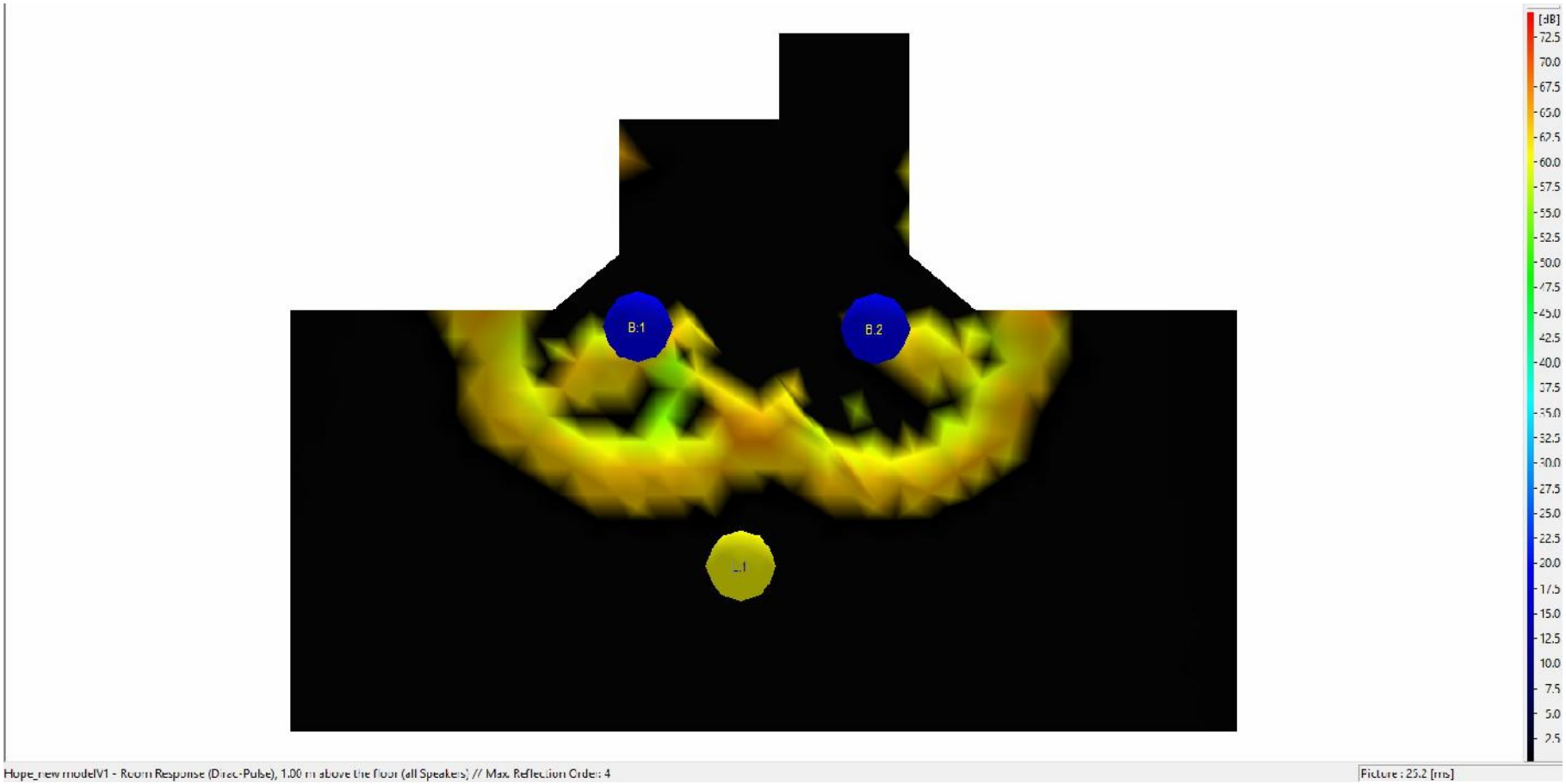



*Figure 8*

**Figure 8 is the first graph that shows how the room is responding. This and the following studies are with the treatments. You can reference Figure 5 for a visualization 'inside' the acoustical model.**

**This specific study shows a plan view of the space 25 milliseconds after sound leaves the speakers. We see the formation of a propagation pattern. The two BLUE circles are the speakers and yellow circle is our randomly placed listener...actually the listener is placed in a central location with purpose...mid congregation just left of center aisle (a seat most would hope to be excellent).**

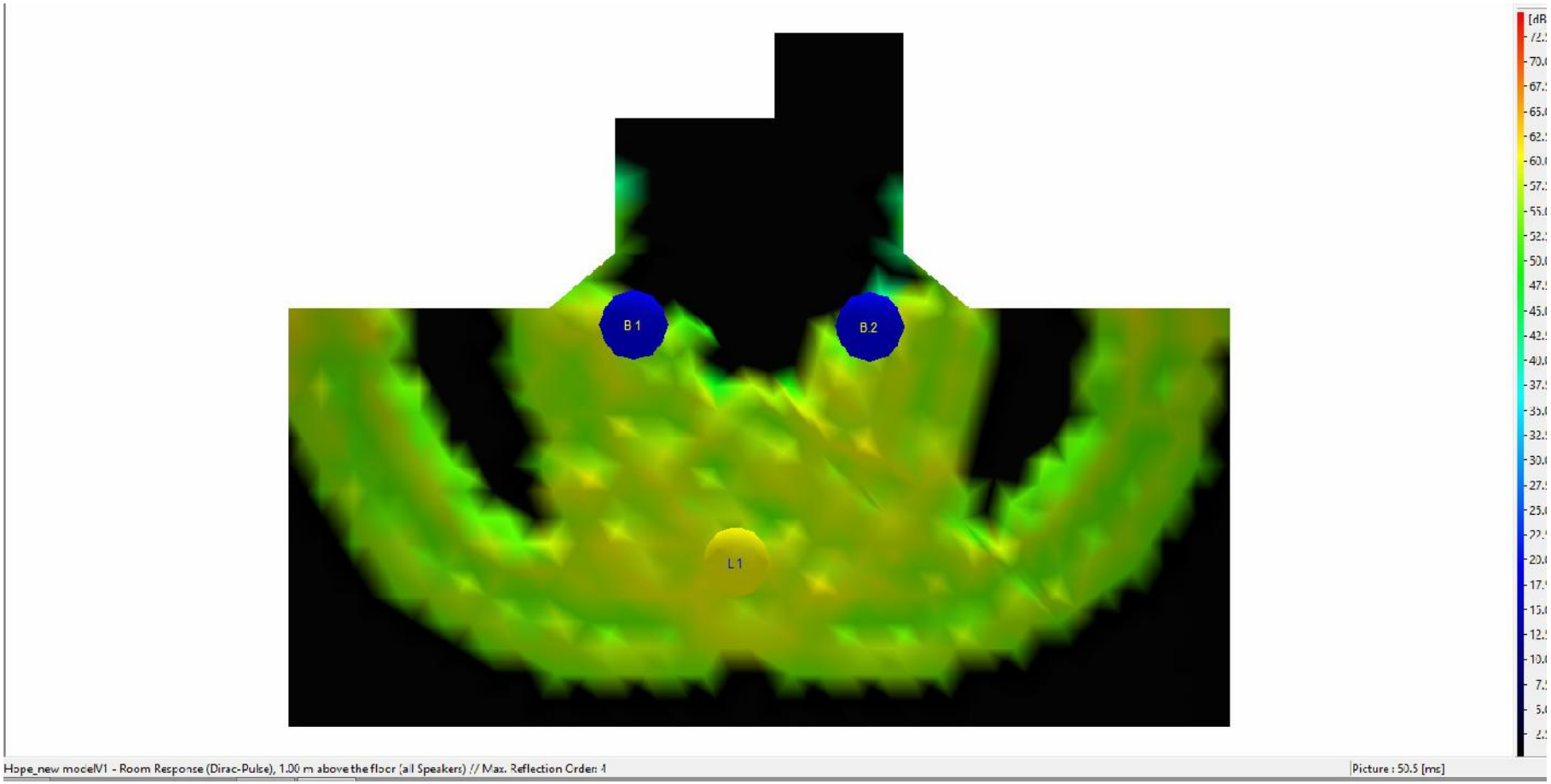



*Figure 9*

**Figure nine is the second in a sequence of 3D energy over time studies in 25ms intervals. This study is at 50ms and shows how the sound energy has reached our listener and the balcony facade but not the rear wall (or all of sidewalls).**

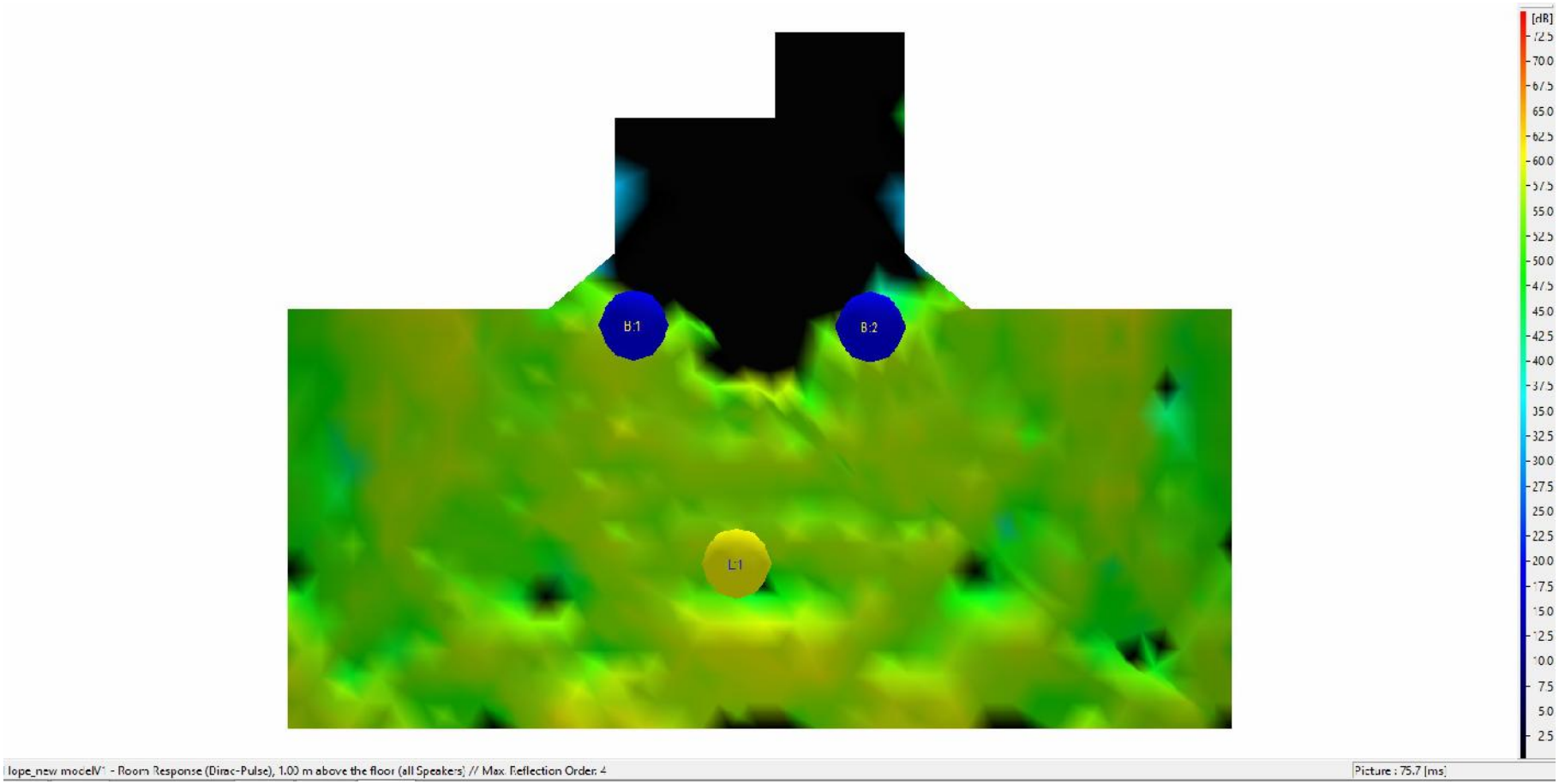



*Figure 10*

**Figure 10 is at 75ms and sound has reached every surface in the space and the return energy is just about to our listener. What I can clearly comment on from professional experience is that this space excites effortlessly and evenly...a very positive factor.**

Technical Note: sound energy within the first ~80ms in a space of this size and function is generally considered positive to clarity and envelopment. Discrete reflections after ~80ms typical are detrimental and cause confusing echoes.

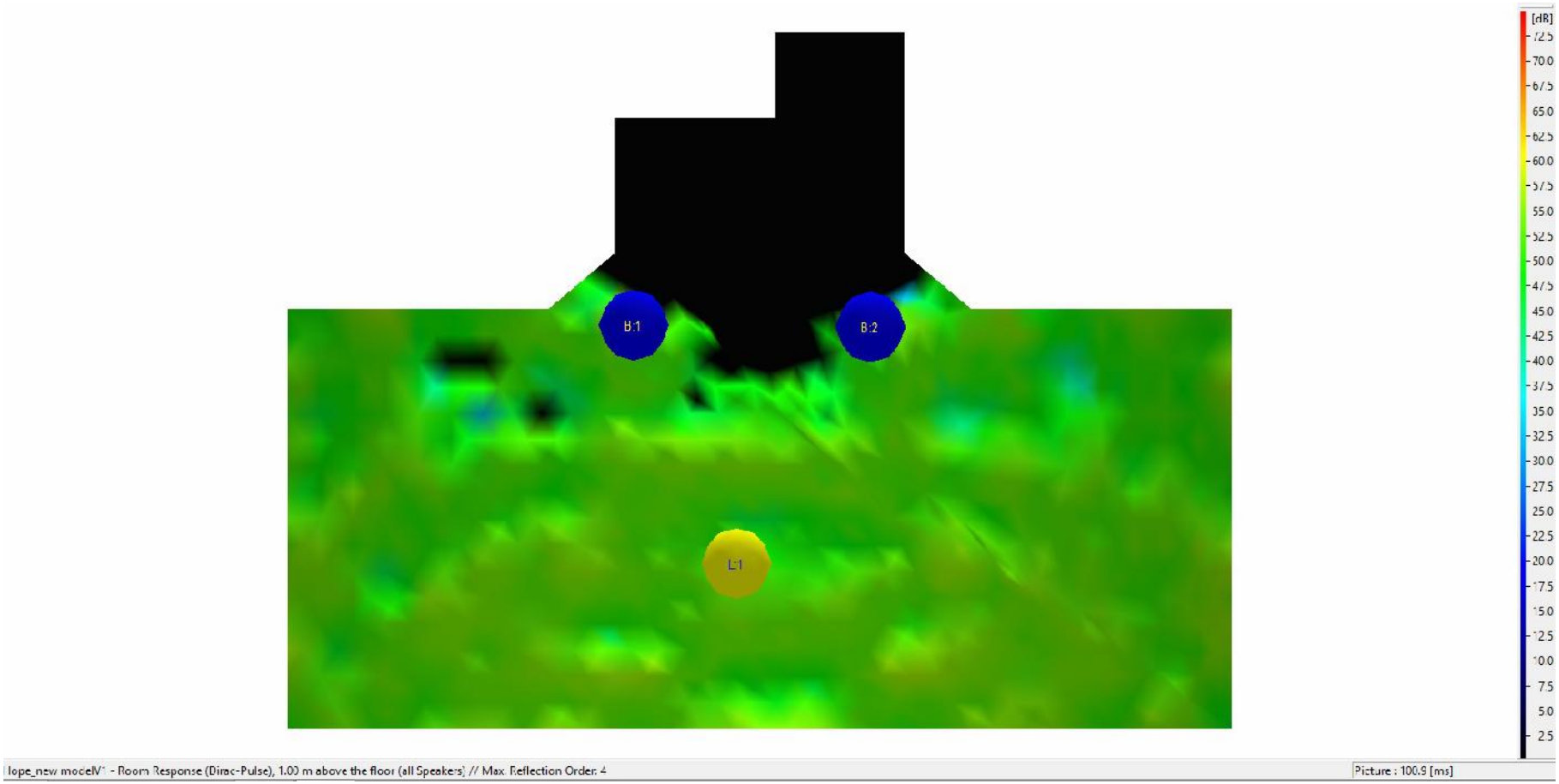



*Figure 11*

**Here our tour arrives at 100ms, Figure 11. VERY smooth decay pattern and we are ~-15dB to -20dB below the amplitude of the sound leaving the speakers. This bodes very well that the treatments will allow a quality speaker and speaker design to produce exceptional sound quality throughout the congregation.**

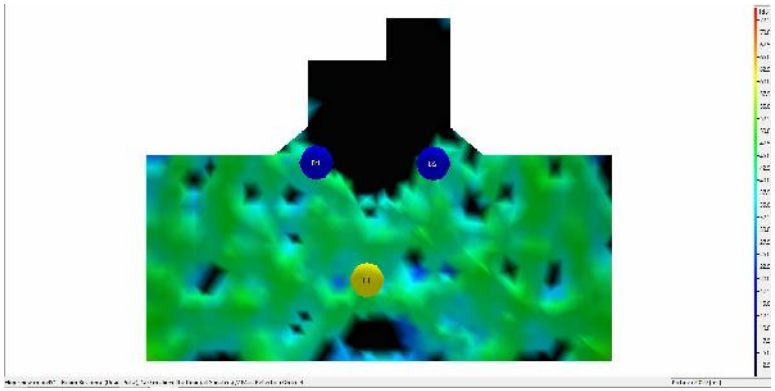


*Figure 12*

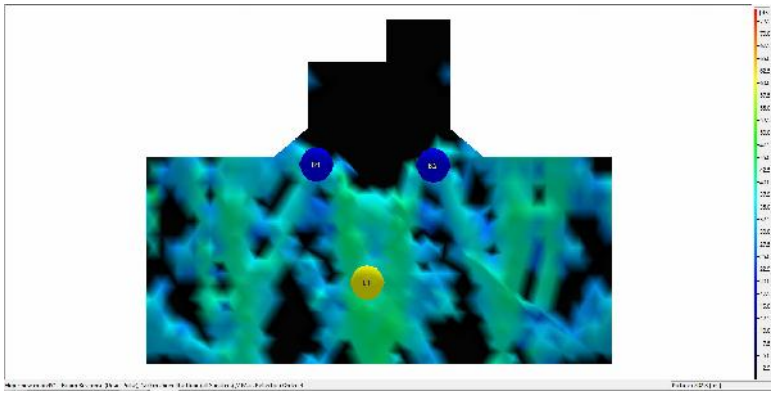


*Figure 13*

**Figures 12 and 13 finish the energy over time 3D tour with snapshots at 200ms and 300ms. The data shows even reflection patterns and a very smooth decay rate.**

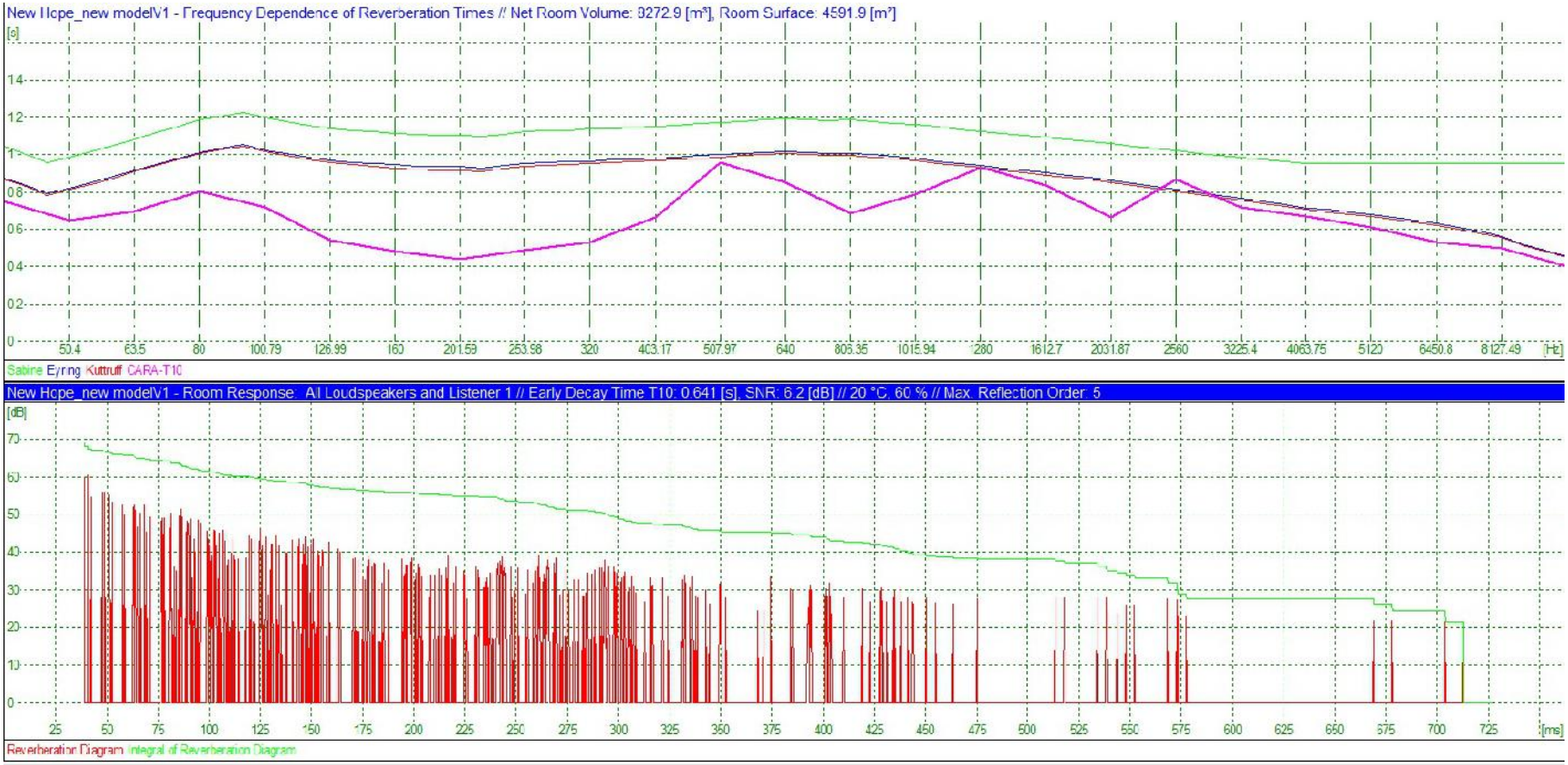



*Figure 14*

**Going deeper into the technical studies, Figure 14 is a combination graph of the treated room. The upper portion shows the same decay across the spectrum with a new curve (the heavy pink). This is called T-10 (energy from -5dB to -15dB below direct sound level). It shows to be not smooth in the 500Hz to 2KHz range. The T10 should be very smooth and not in excess of the main RT60 curves. The cause is the ceiling. As our decay time is already in the desired range, we cannot address this with absorption. We need a diffusion tool that will smooth out the midrange energy without robbing the energy from the space. This will be shared in the pages to follow.**

**The lower portion of Figure 14 shows a 2D Energy Time Curve with a Schroeder decay curve. These are excellent: dense reflections, smooth decay, nice energy below 80ms and no singularly discrete and loud reflections after.**

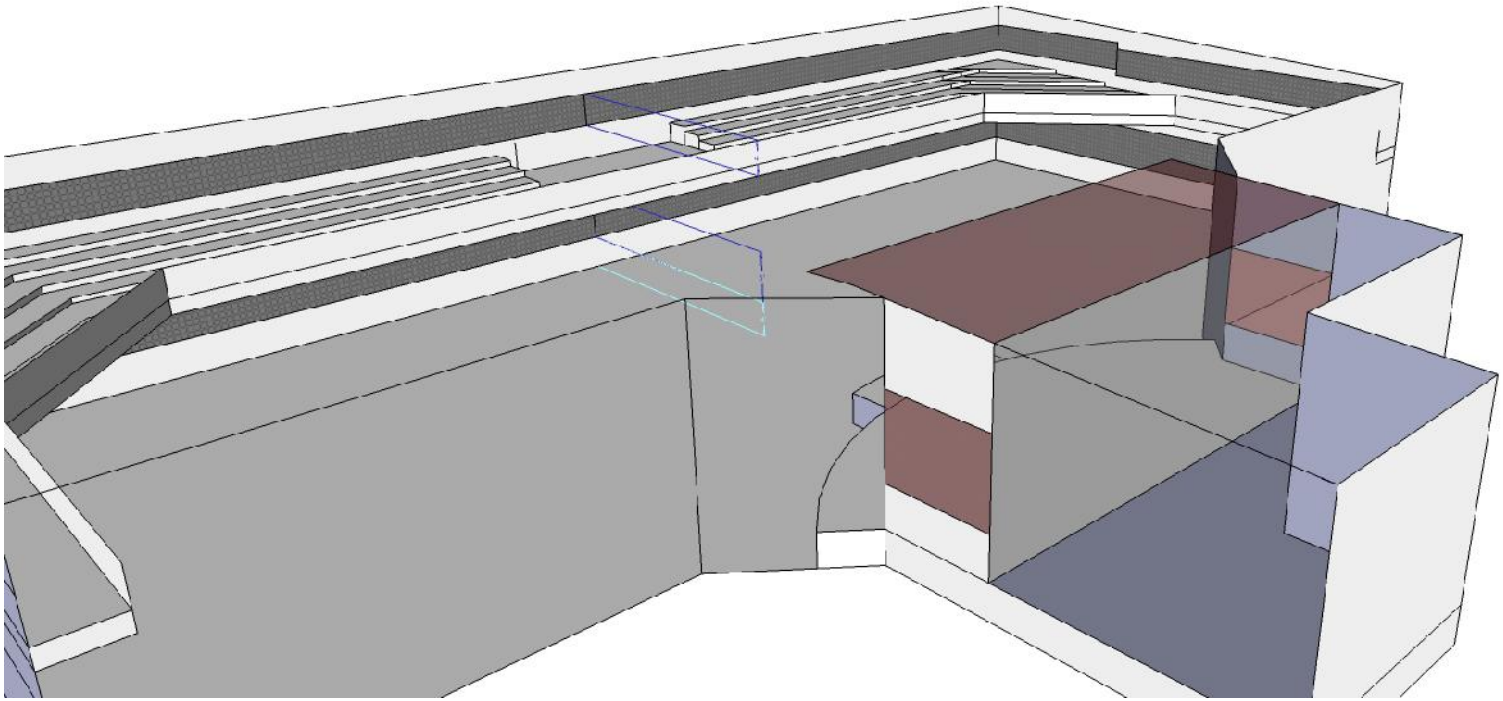
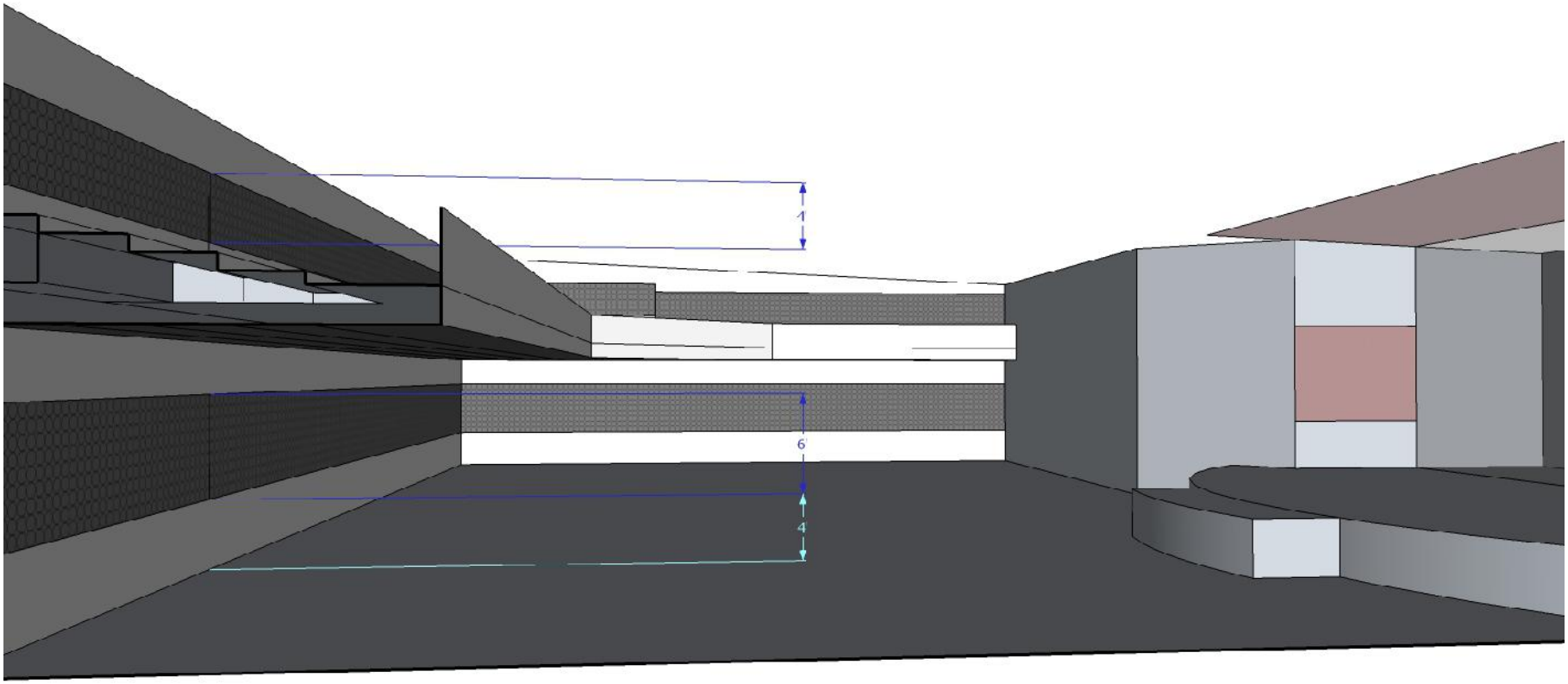


*Figure 15*

**Figure 15 is the first visualization of the solution. It is done in 3D using SketchUp. The SU model and DWG views are available upon request. The solution has FIVE areas of focus.**

**1) the heavy theatrical grade curtain at back of stage must remain**
**2) The vertical side and rear wall areas are to be treated with a specific absorption panel. This is shown in gray banding.**
**3) The ceiling above the worship platform and the sidewalls are to be absorptive with 2" fabric covered acoustical panels similar to (or exactly like, meaning re-purpose) existing panels owned by Newhope. This is shown in red.**
**4) the ceiling above the congregation is to be evenly diffused.**

**5) the ceiling under the balcony is to be specifically absorbed.**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6
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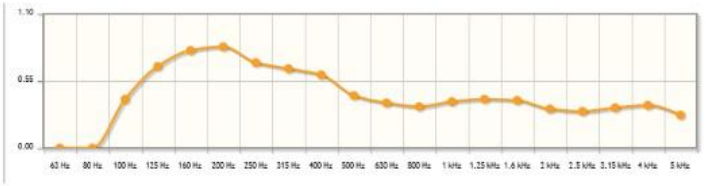
## UniSquare BC T15LV VW Wenge

Vicoustic
Innovative Acoustic Solutions

Designed for large areas, this The UniSquare aims to leverage an existing and accessible technology by maximizing its potential at an acoustic and aesthetic level. Besides the advantages of using a typical false ceiling structure, placing Basotect® foam ensures the best sound absorption and provides an enormous added value to the Unisquare BC.

Taking advantage of an incleasingly demanding industrial segment, Vicoustic has launched a innovative acoustic panel for false ceilings. Combining the standard clip-in system, with Vicoustic's know-how in design and performance, the new Unisquare BC allows you to easily and quickly install a High End panel to a conventional suspended ceiling.

**Graph**




**Main Info**

Ref: B01212
EAN13: 5600301858802
HS-Code: 44101110
Dimensions: 595.0 x 595.0 x 10.0 mm
Scratch Resistance: No
Washable: No

*This is the preferred tool for vertical sidewall acoustical control. Because of it's specific absorption coefficient pattern that exactly matches the needs of THIS space, we are able to place a proper quantity of treatments resulting in the most consistent experience possible spatially without drying the room. Note: an alternate product is the Golterman and Sabo (G&S) LFA-V2 panel that has similar response.*

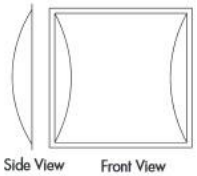
# CEILING SOUND DIFFUSERS (CD)

ACOUSTICS
Golterman & Sabo

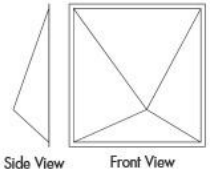
When installed in a ceiling grid system or hung independently, G&S Acoustics' Ceiling Sound Diffusers use their shape to **reflect sound evenly in a room.** Ceiling diffusers improve sound quality by disrupting standing sound waves that occur between parallel surfaces such as ceilings and floors.

Using our ceiling diffusers allows you to "tune" the ceiling to enhance desired frequencies and absorb unwanted frequencies, especially low frequencies.

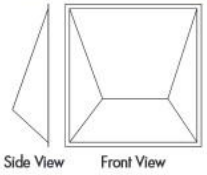
### BARREL DIFFUSER - BCD




### PYRAMIDAL DIFFUSER - PCD




### WEDGE DIFFUSER - WCD




### SOUND ABSORPTION

**CD** - Standard Ceiling Diffuser

| Hz | 125 | 250 | 500 | 1000 | 2000 | 4000 | N.R.C. |
|---|---|---|---|---|---|---|---|
| CD | .19 | .16 | .11 | .09 | .09 | .15 | .10 |

**CORE**
CD: 0.125 Thermoformed co-polymer (recyclable), N.R.C. = .10
CDA: Add 1-1/2", 1-1/2 pcf fiberglass backing, N.R.C. = .35
CDL: Add additional stiffener, N.R.C. = .05

**SHAPES**
Pyramid (PCD), Barrel (BCD), Wedge (WCD)

**SIZES**
2'x2', 2'x4' and 4'x4'

**MOUNTING**
Lay-in ceiling grid system
Custom mounting available

**FINISH**
Textured white,
Fabric (Guilford 2100 only)

**FLAMMABILITY**
All components have a Class "A" rating per ASTM E84

*This is the preferred tool for ceiling diffusion. Ours would be 2'x4'x8" version and they can be painted black to disappear.*

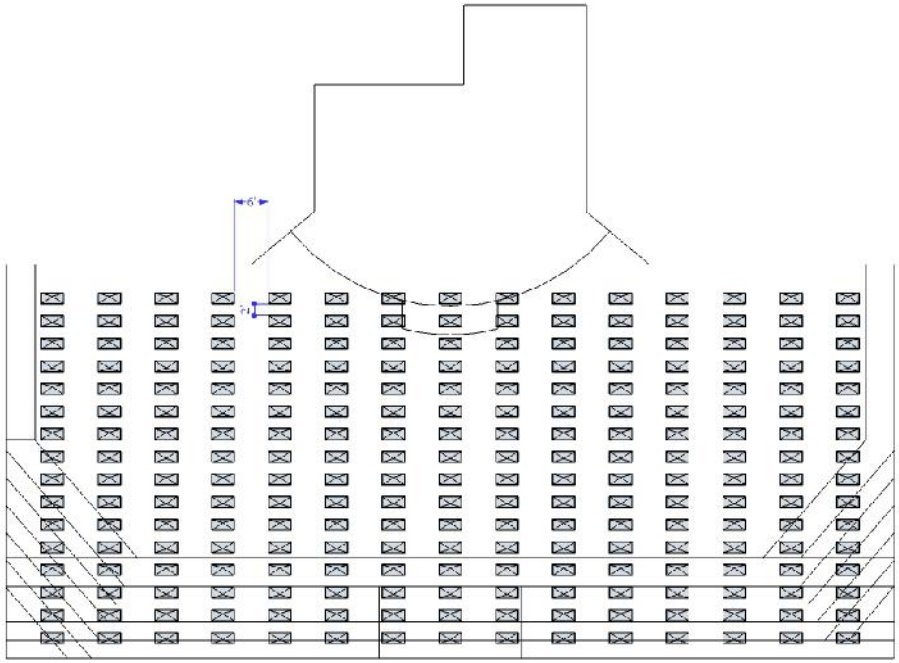
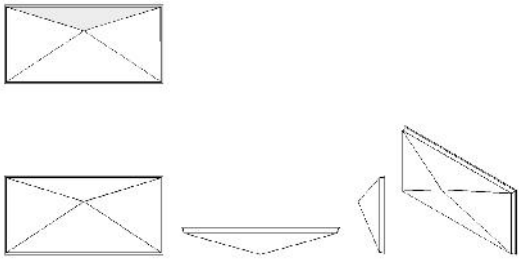


*Figure 17*



**Figures 17 shows the starting layout specification for ceiling diffusors (this is 240 units). Figure 18 shows various views of the product. The specification is to retain 200 units (as closely as possible) after review with RCP.**

***Deeper into construction and LF response***

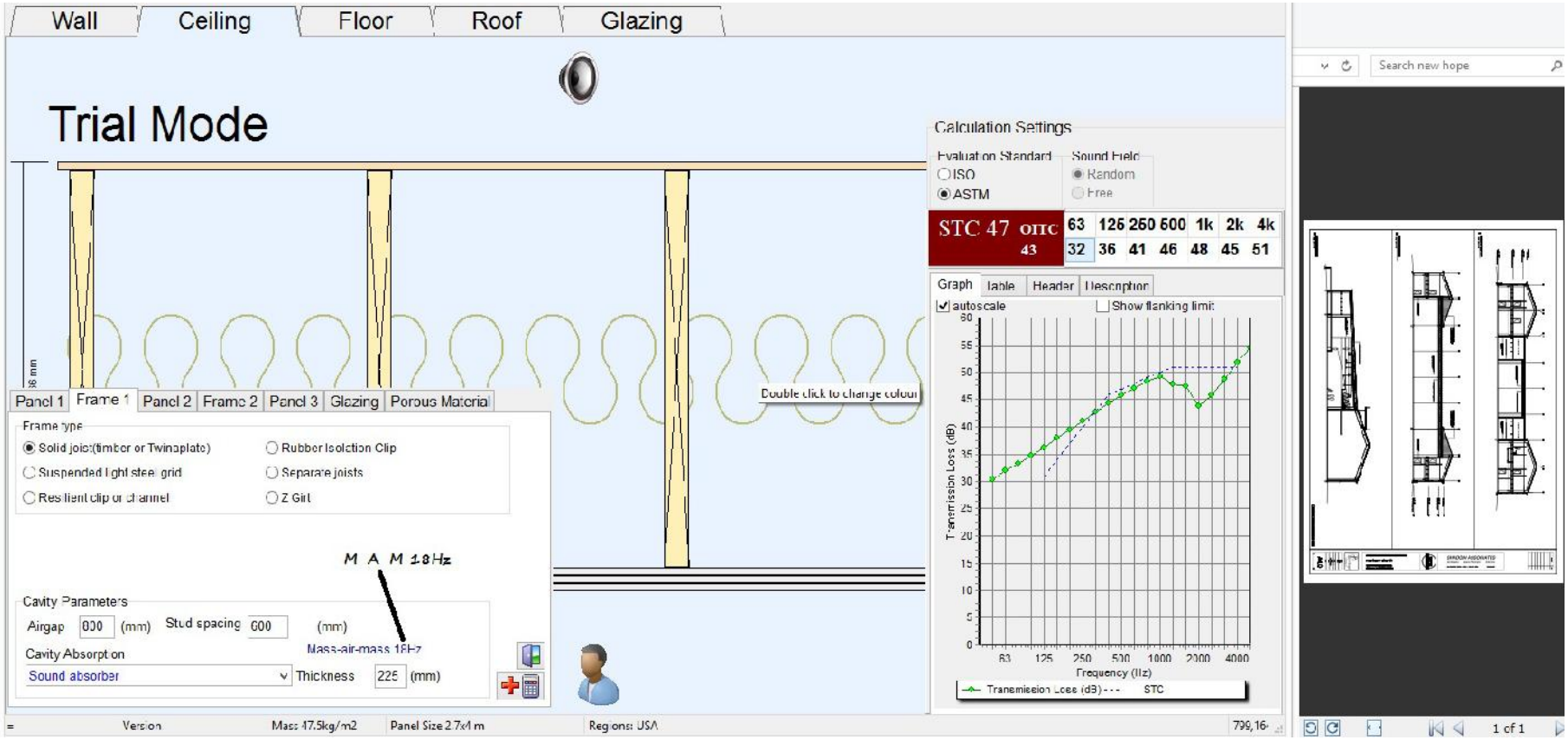



*Figure 19*

**It is known that the addition of multiple drywall veneers is likely to dramatically change the low frequency (LF) response in the worship space. Specific studies were performed that allowed more precise surface characteristics within the high-level acoustical modeling program. Figure 19 is one such study. It is exposing the M-A-M (mass-air-mass resonance of the triple layers of 5/8" type X drywall with ~24" ceiling joists and plywood/steel upper layers. The resulting M-A-M is 18Hz. That means that 18Hz will be very efficiently absorbed. Corresponding studies were done for all wall systems and proper data used for specific surfaces in the acoustical model.**

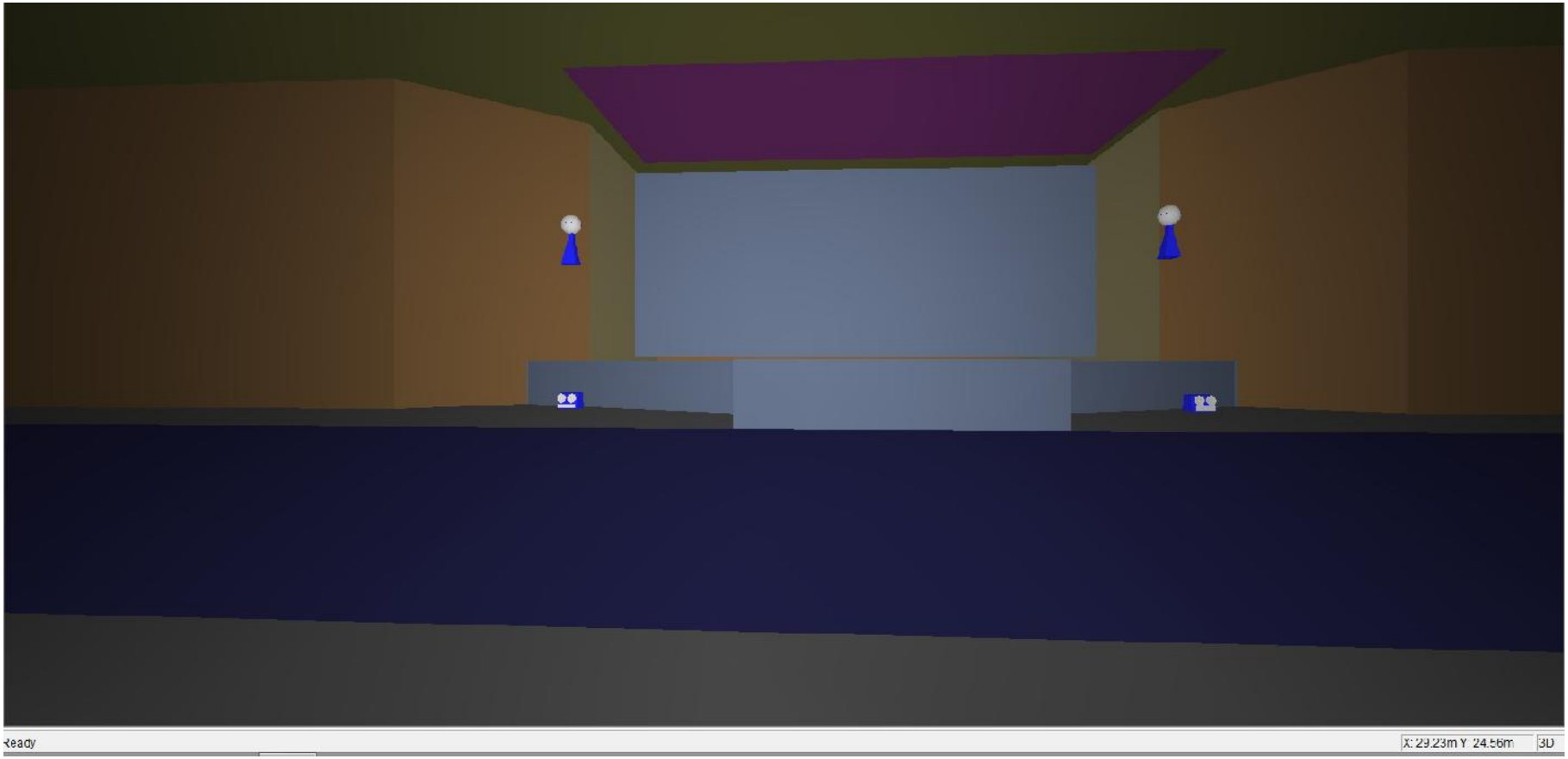



*Figure 20*

***Figure 20 shows a new view inside the acoustical model after adding two subwoofers.***

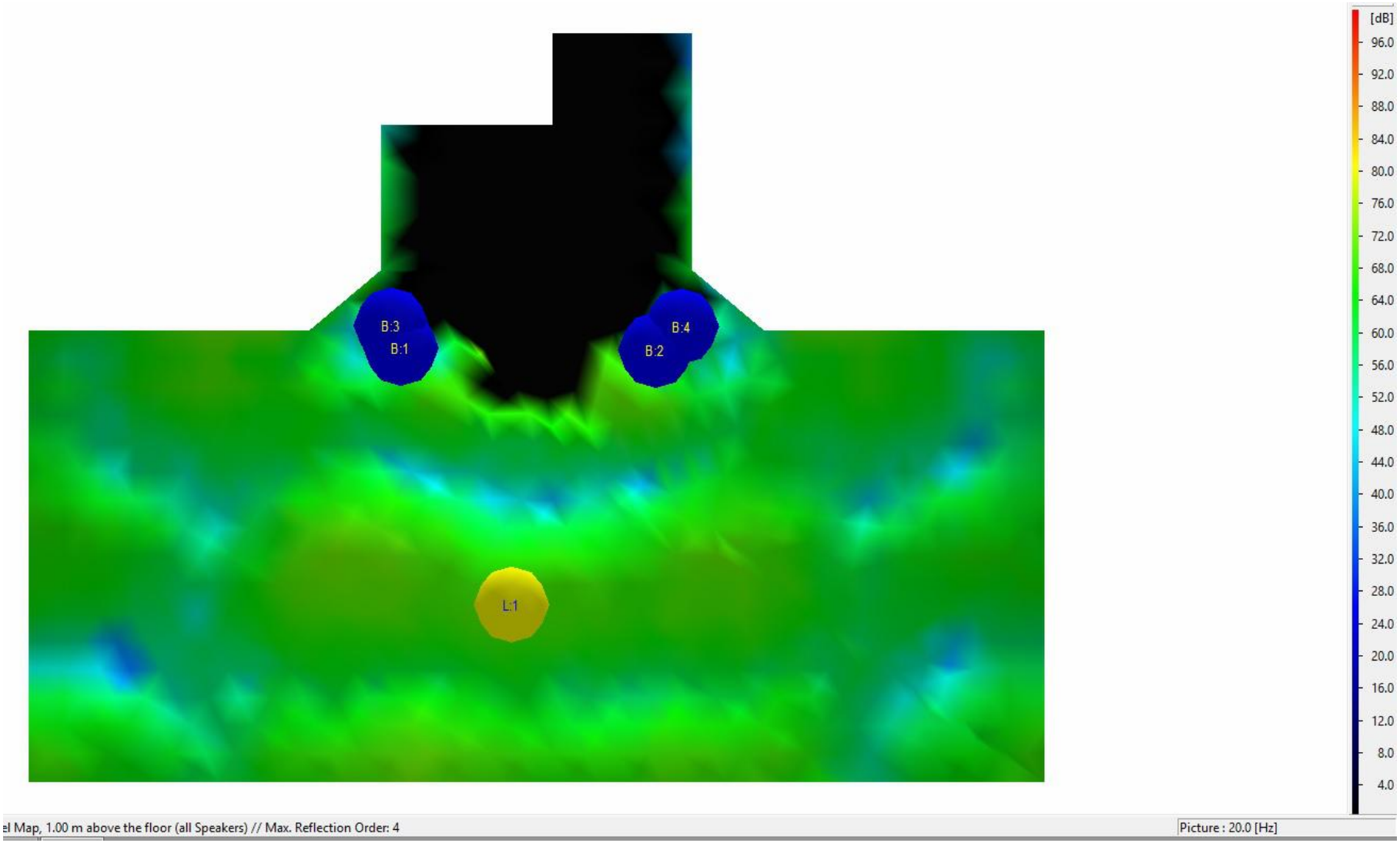



*Figure 21*

**Figure 21 shows a 3D frequency study at 20Hz. Note how even the smooth the energy is. That is the direct benefit of the ceiling system.**

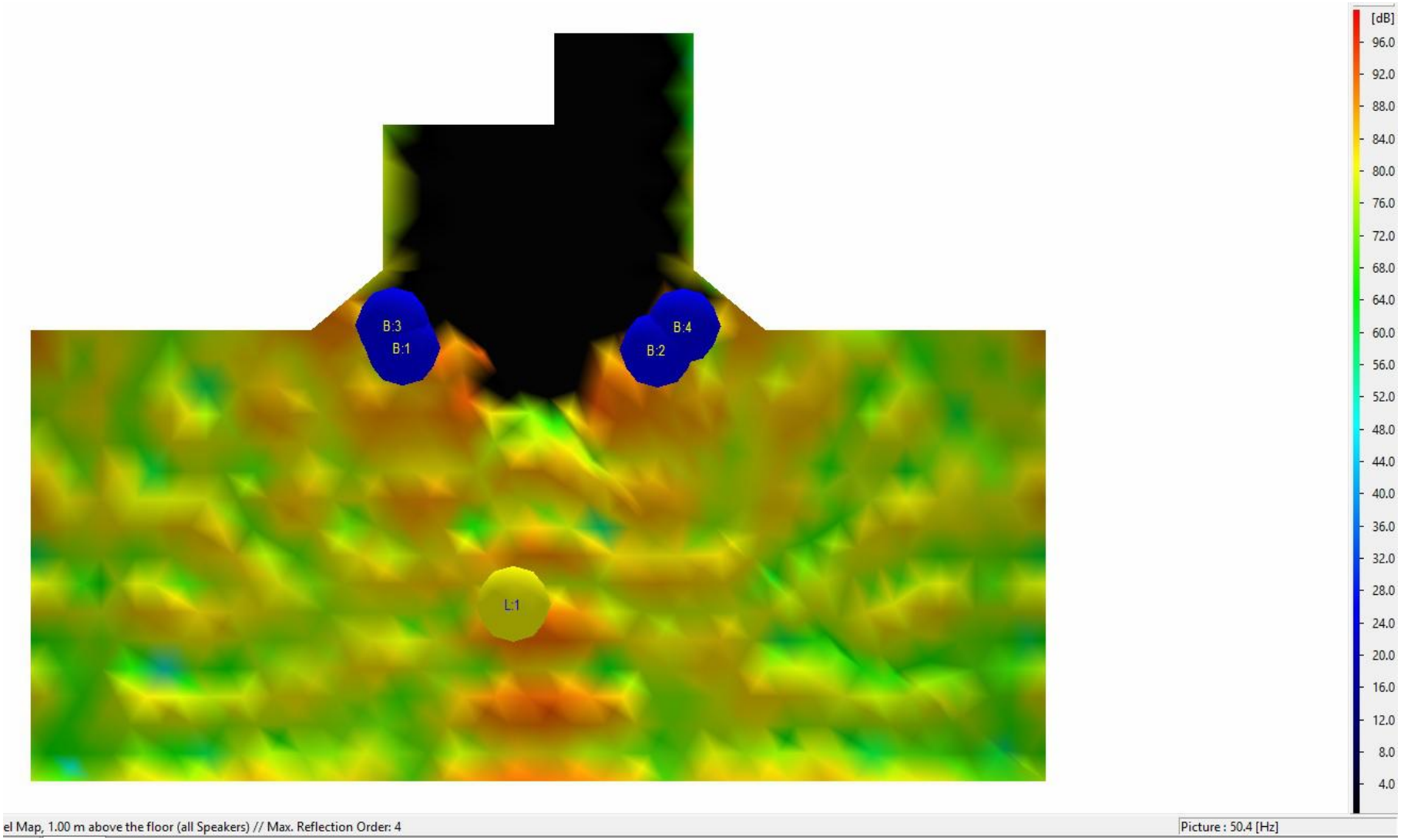



*Figure 22*

**Figure 22 shows the greatest area of LF concern from the studies: ~50Hz to 60Hz. This range shows modal resonance patterns that are strong. This is mentioned for the awareness of the speaker installer to have in mind during subwoofer/system commissioning. This is a very addressable concern and well within standard situations.**

**WHAT ABOUT UNDER THE BALCONY???**

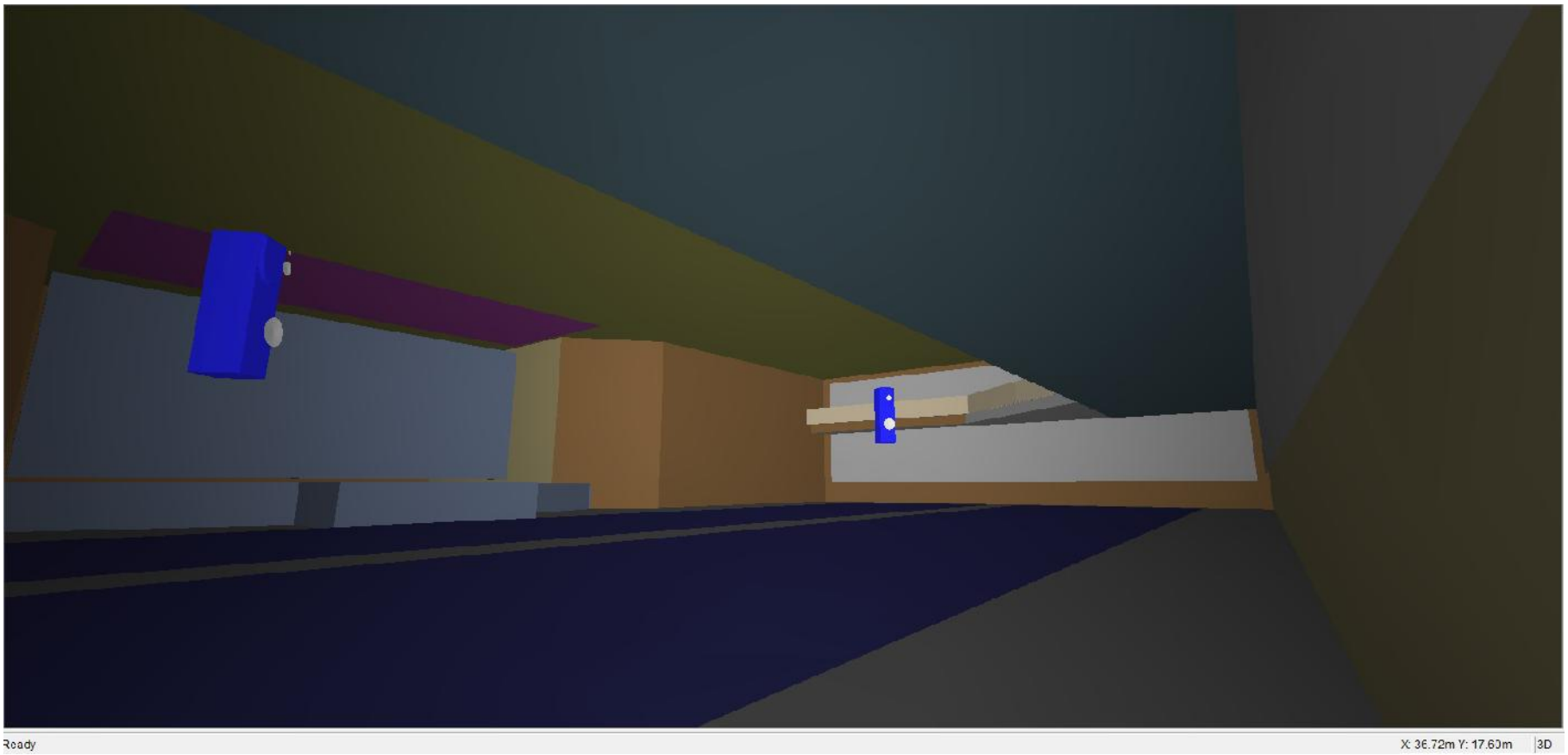



*Figure 23*

**Specific studies were done to see what the acoustic conditions are under the balcony. Keep in mind, we do not want to affect the overall room by solving any discrete concerns...*use the right tool for the job*. Point source speakers were placed firing into the seating area under the balcony. This speaker has a very smooth off-axis response similar to the specified speakers.**

**Note about the balcony facade. Luckily NO treatments can be shown to be helpful on the balcony facade (rare occurrence). This is do the height 13' AFF, the relation of balcony to stage and the slight angle of balcony facade per architectural section drawings!!***The next page shows the preferred solution for the ceiling under the balcony (remember we have the ceiling diffusors above the balcony). This is a fire rate acoustical carpet- may be substituted for one of similar specs (fire and absorption).*

The ceiling of the under-balcony should be treated with ceiling tiles which have an NRC rating of .05

(If under-balcony ceiling is a hard surface, such as drywall, it should be covered with the following material)

home product formats colour/design installations environment technical news

Acousticord®

technical

maintenance

spot removal guidelines

installation

home » technical

## technical

**Acousticord** is made from carded fibres formed into a continuous corrugation and bonded with PVC or Latex to a hessian backing.

**Materials/Pile Composition** 80% goat hair /15% nylon / 5% viscose

**Warranties** Wear guarantee and a lifetime anti-ravel/non-zipper guarantee

**Product Dimensions**

| | |
|---|---|
| Width: | 2m (6 foot 7 inches) |
| Length: | 25 yards approx (20.5M) |
| Thickness: | .2 in (5.1 mm) |
| Weight: | 60 oz per square yard |

**Construction**
Fusion Bonded

**Fire Testing**

| | |
|---|---|
| Flame Spread & Smoke Density: | ASTM E-84 Tunnel Test Class A |
| Flammability: | NFPA 701 Test 1 Passed |

**Electrostatic Propensity**
AATCC Test Method 134 Under 2.0 KV at 20% R,H., 70°F Passed

**Acoustical Rating**
ASTM C-423-66-.15 NRC One-third Octave Bands

**Center Frequency**
HZ 125 250 500 1000 2000 4000

**Absorption Coefficients**
.03 .07 .10 .24 .46 .52

**Color Fastness**

| | |
|---|---|
| Light AATCC16: | 4 |

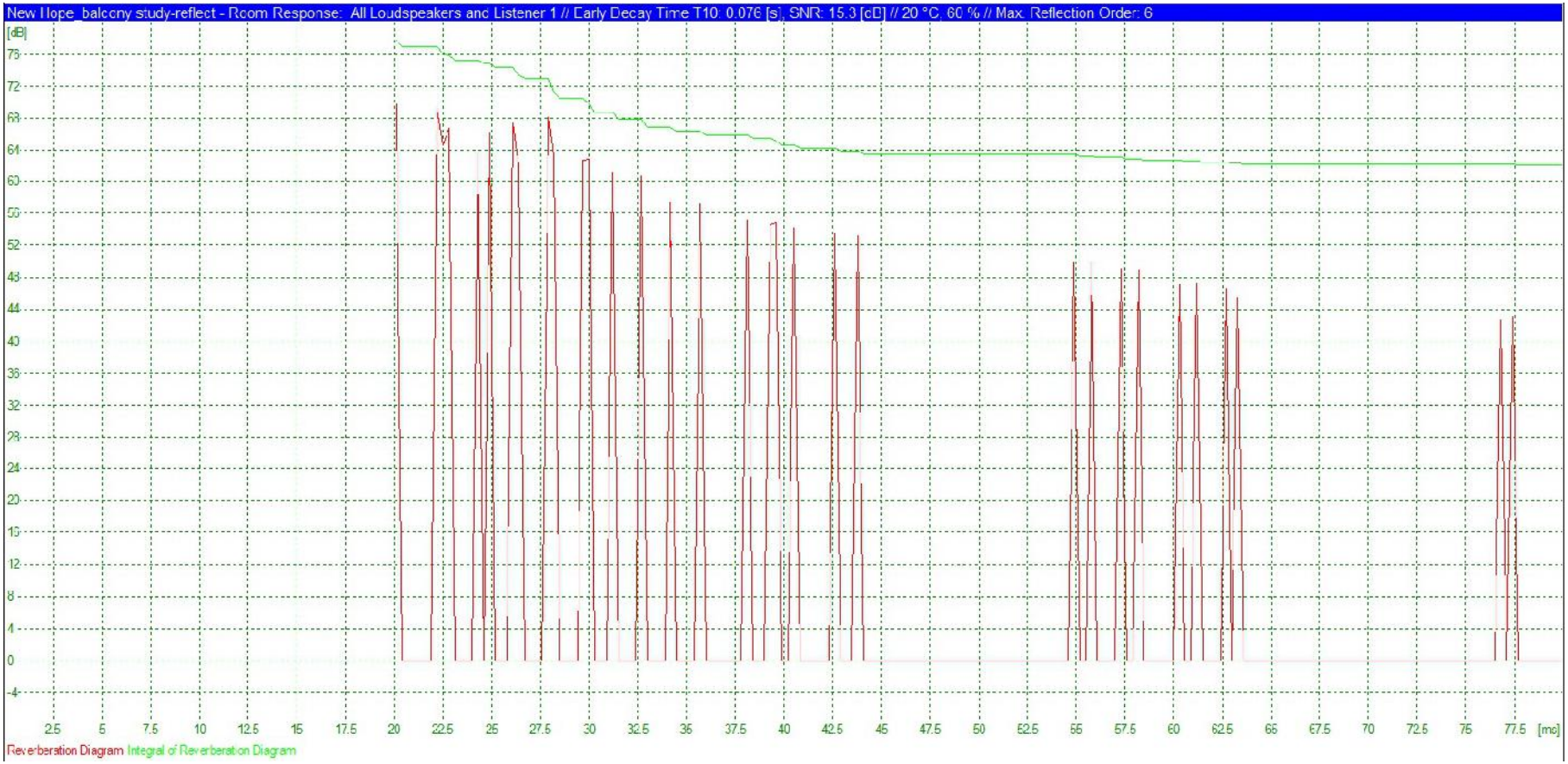



*Figure 24*

**Figure 24 shows the energy time curve of the response below the balcony with the ceiling hard concrete. Overall not bad...hmmm**

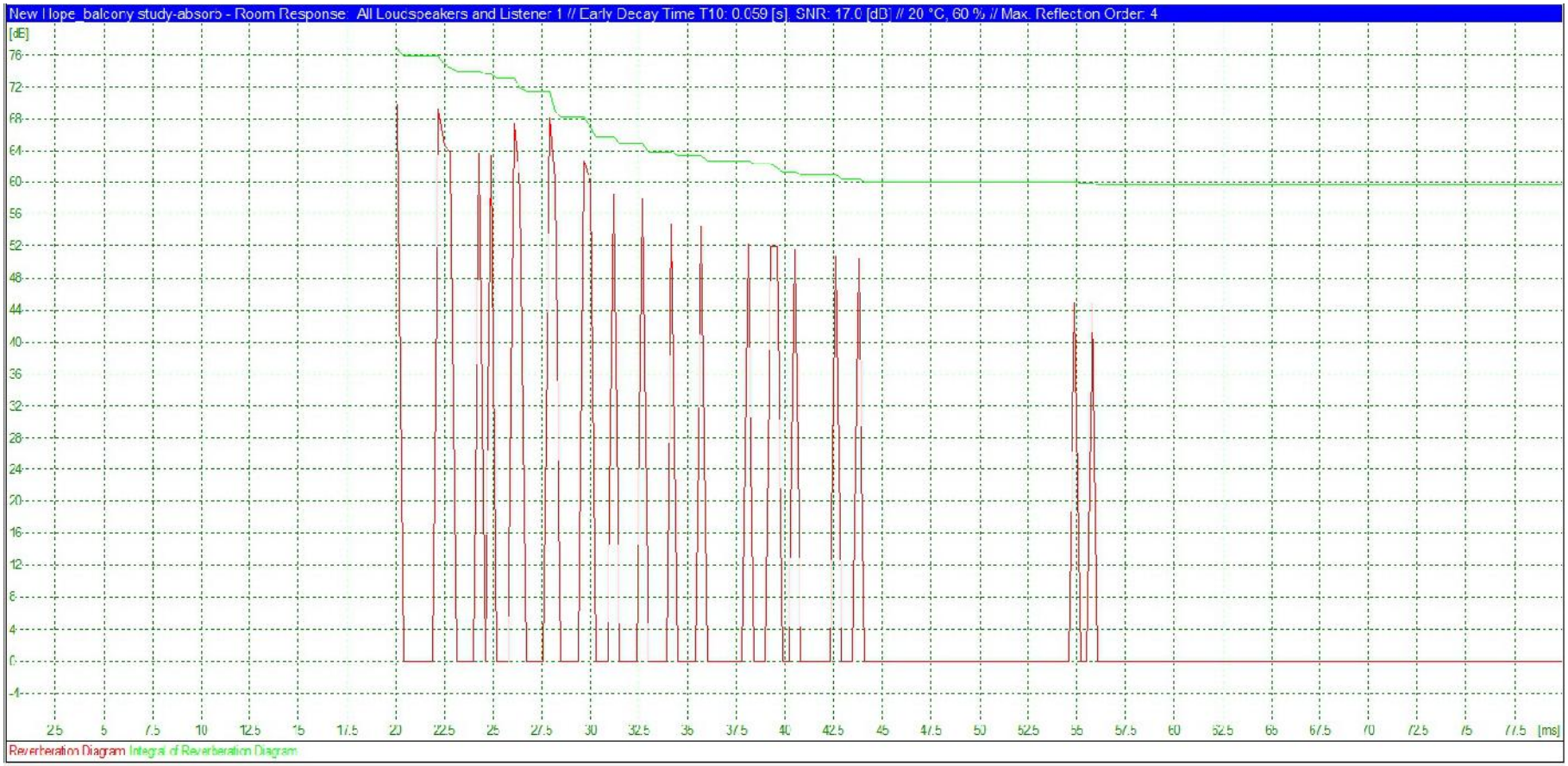



*Figure 25*

**Figure 25 shows the same study but with the acoustical carpet on the underside of the balcony. What this directly implies is greater clarity at this specific location and as a result all seats below the balcony would enjoy enhanced clarity. The specifications of the acoustical carpet are addressing this issue without changing the overall room response: win-win.**

***ACOUSTICAL TREATMENT OVERVIEW AND SUMMARY***

**Vertical walls: ~2,500 sq ft of Vicoustic UniSquareBC. Note, this company is just increasing its' US presence. They have fire rating data for the EU but none for US...we will have to see on this aspect. Remember, the alternate is G&S LFA-V2 panel. Sizing TBD after architectural and budget reviews.**

**Ceiling above stage: ~ 1,000 sq ft of 2" fabric covered acoustical panels. To cover the zone above the stage proper and each sidewall (from 4' AFF to 12' AFF).**

**Ceiling Diffusion: to be ~1,600 sq ft of offset pyramid diffusor, 2'x4'x8". 200 units or close, reference G&S cut sheet.**

**Under balcony acoustically rated carpet: ~3,000 sq ft of product with similar acoustic specifications as the Acousticord shown and must be fire rated for this horizontal/in-room application.**

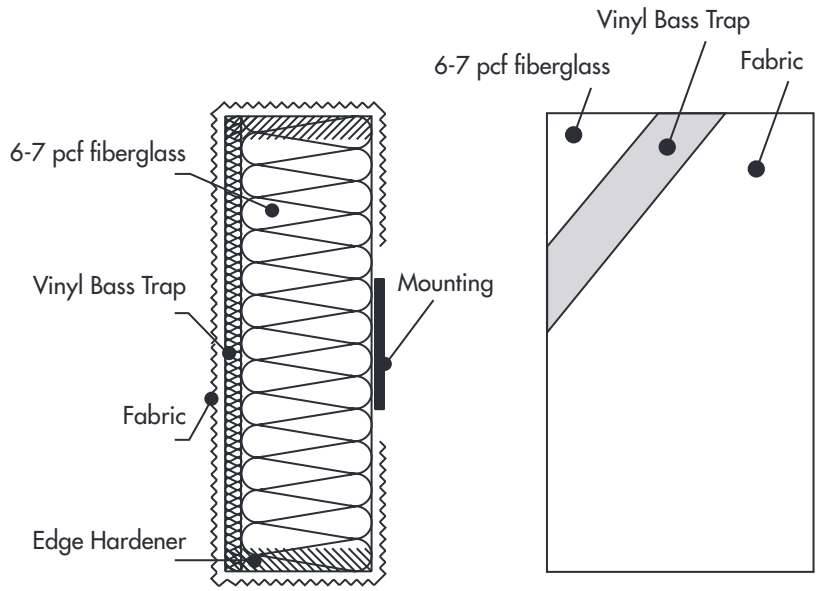
***In summary, the combination of these treatments will result in an exceptional space for worship and for worship in this specific contemporary style. The word exceptional is not an idol choice but an accurate one.***

# Low Frequency Absorber (LFA-V2)

G&S Acoustics' LFA-V2 wall panels are **excellent low-frequency, sound-absorbing panels.** LFA-V2 panels are covered in your choice of fabrics and may be used in conjunction with our other fabric-covered, sound-absorbing products.

Our LFA-V2 panels are designed for areas that require sound absorption in the low-to-middle frequencies while preserving higher-frequency sound. Choose LFA-V2 panels for places such as band rooms and performance halls.

## Core Section




## Sound Absorption

| Hz | 125 | 250 | 500 | 1000 | 2000 | 4000 | N.R.C. |
|---|---|---|---|---|---|---|---|
| LFA-V2 | .66 | .87 | .82 | .47 | .18 | .18 | .60 |

Note: NRC test results based on our standard acoustically transparent fabric. Results may vary with other fabrics.

### Core
Facing: Vinyl Bass Trap
Backing: 6-7 pcf fiberglass, 2" thick

### Sizes
Custom sizes and shapes up to 4'x12'

### Mounting
Adhesive, impaling clips, two-part Z-clips

### Finish
Fabric

### Edges
Square, beveled, radiused
Chemically hardened

### Flammability
All components have a Class "A" rating per ASTM E84

*Controlling Sound Beautifully*

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