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Modular, Shippable Acoustic Treatments for High-End Mastering Rooms: A Case Study with Adam Ayan

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ABSTRACT

In high-resolution mastering environments, achieving optimal room acoustics has traditionally relied on built-in architectural solutions—false walls and permanently installed broadband treatments requiring quite a bit of space inside the room and careful systemic design. This paper presents an alternative approach using high-performance modular acoustic devices deployed in a distributed, spaced configuration. Focusing on the mastering studio of Grammy Award-winning engineer Adam Ayan, we explore the use of 10" thick modular panels—absorbers, membrane bass traps, and hybrid diffusers—to achieve mastering-grade acoustic response with minimal architectural modification.

Ayan, formerly of Gateway Mastering, began using these devices in freestanding configurations in a temporary untreated space after Gateway's closure. Despite the lack of traditional wall treatment, he maintained the sonic accuracy and consistency required for mastering Grammy-winning work. Upon moving into his permanent facility, the same modular devices were integrated into the new room. The room was designed to replicate the room at Gateway, with a shell very close to the old room's dimensions. Measurements in the new room with this treatment strategy shows that the resulting decay time and modal behavior exceeds the performance of the prior Gateway room.

This paper explores Ayan's success with this approach which offers not only performance benefits, but logistical advantages: treatments are built offsite, shipped as discrete units, and deployed without the permanence or cost of custom architectural builds. This case supports a broader design model for scalable, high-performance room acoustics—one that accommodates evolving spaces without compromising sound quality.

1 Introduction

The craft of mastering in professional audio production has always demanded the highest performance listening environments. Even more so than mixing, a mastering engineer needs an accurate, trustworthy monitoring system to do this intricate, detailed work unimpeded. This trustworthy relationship between the engineer and the monitoring environment consists of several factors. One is the choice of speakers and the engineer's history with them. Many mastering engineers also have specific preferences for gear behind the speakers (amplifiers, converters, cables, analog gear, etc) that are part of this environment. Acoustics, or the ways in which the room colors the sound heard, is also an enormous influence. Without a good treatment strategy to deal with these colorations and distortions, the engineer will struggle to get reliable work done in the space.

Historically, achieving world-class acoustics has meant an architectural acoustics approach, with careful design and bespoke treatments constructed on-site as part of the room's design. Often the visible walls and ceilings inside the finished room are false walls, concealing very thick acoustic treatments behind them. There are several benefits to this approach, and efficacy is at the top of the list. A detailed design, with the ability to use whatever space is needed to achieve the desired results, along with careful construction can deliver wonderful results. However, it also locks you in that one design and configuration. Sometimes the needs of the room change over time or we want to integrate new workflows (growing from 2-channel to Atmos would be one example). A permanent build can make it challenging to do when the room needs to be modified.

One way around this limitation is to use modular acoustic treatments that can be added inside the finished room. When such devices are mounted individually in the room, it allows for easier modification down the road, since each device can be moved or relocated as needed. If they are small enough, it also means the devices can be manufactured offsite and shipped. But the devices still must be large & thick enough to provide the desired effect in the room. With acoustic treatments, thickness correlates closely with performance at lower frequencies. That is certainly the case with broadband absorption, and in many types of diffusion a thicker depth means performance at lower and lower frequencies.

In 2023, Grammy-winning mastering engineer Adam Ayan found himself in exactly this dilemma, the need for both a new studio, and a temporary place to work while the new studio was being sorted out. He had been working at Gateway mastering in Portland Maine for more than 20 years, but Gateway was closing down with Bob Ludwig's retirement. Ayan not only needed a longterm place to house Ayan Mastering, his permanent home, but also a temporary space he could continue to work with while Ayan Mastering was being built in Portland, Maine. Ayan teamed with us at GIK Acoustics as an early adopter of a new product, generically called the Sound Block, that delivers a high-end mastering room using this modular concept of manufacturing.

This paper will give a detailed overview of Ayan's transition from Gateway Mastering after its closure, through his temporary workspace, and into his new permanent home at Ayan Mastering. Throughout the process, Ayan continued to deliver the high-end quality his career has been built on. It will include a detailed analysis of the challenges, how the modular concept was deployed at each stage, along with test data showing the performance in Ayan Mastering exceeds what he had gotten used to at the Gateway Mastering facility.

2 The Modular Concept

The core of the modular concept for us is the Sound Block. These devices are about 2' square, and about 10" thick (59x59x26cm). These dimensions can be shipped in normal boxes without overage charges or freight shipments, which solves one big challenge with thick acoustic treatments. They can be manufactured offsite to exacting standards and then shipped to the end user for installation.

Furthermore, there is a lot of flexibility in the details of how Sound Blocks can be implemented. They can be mounted individually, as we did on the ceiling in Ayan's studio. Or, they can be "stacked" in a freestanding configuration, 4' (2 units), 6' (3 units), or 8' (4 units) tall.

Lastly, there are several performance options deployable within the modular concept. Each individual block can be a broadband absorber, supplying approximately equal amounts of bass and treble absorption. Or, they can have them built with a membrane device that enhances bass absorption and reduces midrange and treble absorption. They can also have an internal (under the fabric) or external

(veneer finished, recessed) plate covering on the front, which transforms the device into a hybrid, binary diffusor/absorber. We used all these types of Sound Blocks as the primary treatment strategy, deployed throughout most of the room.

There are also performance benefits to a spaced, distributed configuration of treatments. Let's take a theoretical look at two of them. First, in general for most consistent sound, we want the treatments used to be more or less evenly spread throughout the room. This is completely true in general environments, though for high performance environments there are also other strategies that may necessitate different placements, but in general we should opt for even distribution.

There also appears to be a leverageable impedance drop whenever sound transitions from one medium to another, ie, from absorbent material to air, and air to absorbent material. By spacing the absorption to create more of these transition points from medium to medium, it appears to increase low frequency absorption efficiency. This is one area of further study and experimentation we have going forward.

In addition to the Sound Blocks, there were 2 other products used in the final design, both among the largest devices we can ship: very thick, 41 x 41 x 120cm | 16.2 x 16.2 x 47.2in corner bass traps (GIK's Soffit Corner Bass Traps) and the 50 x 117 x 16cm | 19.7x45.9x6.22in 7-root diffuser (GIK's Q7D). Figure 1 shows a design rendering using these devices in various configurations used in the room.



Figure 1. A design rendering of Ayan Mastering, showing Soffit Bass Traps in the front corners and dozens of Sound Blocks in freestanding configurations along the walls, and mounted on the ceiling. These are also a mixture of absorptive and binary diffusive.

We will take a closer look at the specifics of this design later. But you will notice quite a few freestanding “stacks” of Sound Blocks. These, along with quite a few stackable thick corner bass traps, were deployed immediately in Adam's temporary workspace. They were then moved to the permanent Ayan Mastering space when it was ready.

You will also notice on the ceiling panels that there is a bit of space (10cm | 4”) between each device on the ceiling. This space between the panels works aesthetically and also seems to add the spaced configuration benefits discussed above.

The design goals for Ayan Mastering were to equal or exceed the performance at Gateway Mastering, while also providing higher performance in terms of isolation. These two facts point to extensive use of thick devices like these for the treatment strategy. Bass trapping is always important and a significant space investment inside the room, but keeping more low frequency energy trapped inside the room makes this need even greater.

Both of these objectives with Ayan Mastering were met. We were able to not just preserve Ayan's trustworthy monitoring environment essential to his work, but to surpass what he was used to, in a modular way that was affordable, and flexible for future adaptations or upgrades.

3 Ayan Mastering – Design Details

There were a few things we knew about the room going in, apart from how tight it was going to be in terms of stopping sound:

- The dimensions of the room were going to be very similar to Ayan's previous room at Gateway, at 15'4" x 20' x 10'. We knew the modal frequencies here might stack up across those dimensions (two even multiples with harmonically related modal frequencies), but were confident both in the bass trapping strategy to overcome it and with Ayan's familiarity and predisposition to the modal signature of these dimensions.
- There are two load-bearing posts in the rear of the room that cannot be relocated.
- We wanted to leverage the modular, freestanding concept in the front half of the room. We relocated the existing stacks from Adam's temporary space, and added significantly more in the final design. This maximizes flexibility both for initial speaker

placement fine-tuning and for future upgrades or modifications.

- In general, Ayan was comfortable with quite a lot of absorption in the front half of the room to minimize early reflection activity, with more diffusion deployed in the rear of the room to keep things balanced.

The Sound Block configuration reflects these philosophies. The units in the front half of the room on the side walls, and directly above the engineer and the desk on the ceiling, are fully absorptive to get rid of all the early reflections. Remaining Sound Blocks in the rear of the room and on the ceiling away from the desk are diffusive.

We used thick full range broadband absorption in the corners with stackable, square, thick devices. There are 2 Soffits stacked in each front corner. For the rear corners, there was space behind the posts for 2 stacks, so we went with that for increased performance and making a great use of that space, making the posts “blend in” far more than they would otherwise.

There is also a row of diffusers in the middle of the rear wall above and behind the sofa. All Sound Blocks above, below, and around them on the rear wall have the diffusive plates on them as well. Figures 2 and 3 show renderings of the treatment designs.

4 Performance Data

With these design details in mind, let’s take a look at the performance data. I prefer spectrograms for a thorough overview of what a room sounds like, in one rendering of the data. We can discern not only frequency behavior by color, but also decay times as well as the Peak Energy Time curve. Some details are obscured in black & white renderings of the graph, but enough information remains evident for it to still be useful. Spectrograms give us quite a bit more information about what the room sounds like than a simple response graph ever could.



Figure 2. Overhead rendering for Ayan Mastering. Ceiling treatments not shown for clarity.

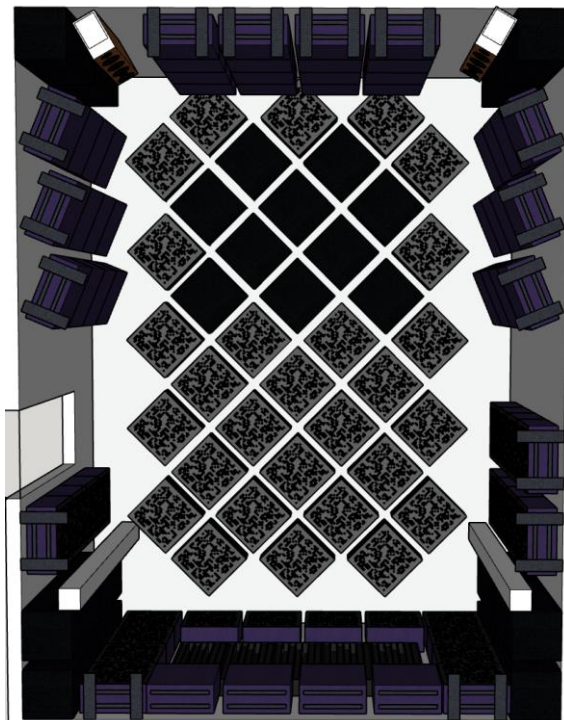


Figure 3. Ceiling Detail rendering, as seen up through the transparent floor. Note the position of absorptive Sound Blocks in the early reflection zone.

We'll begin with a spectrogram reading of the empty room in Figure 4.

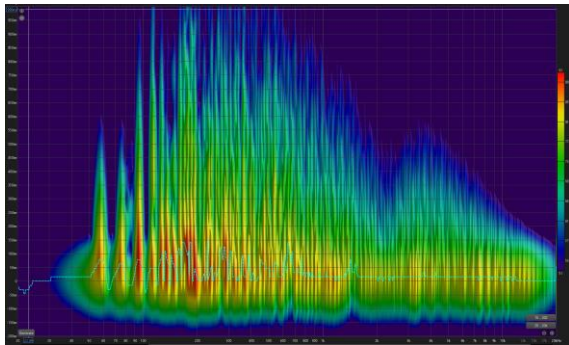


Figure 4. Spectrogram of the empty Ayan Mastering room shell, pre treatment.

There are a few things to notice about this data. First, the room is extremely tight – not much sound is escaping the room so the decay times are longer than usual for a room of this size, including several longer than 1 second. All the traditional problems of room acoustics are made worse when we increase isolation performance to this level, particularly in the bass range. The need for increased bass performance is even greater than normal in tight rooms.

Another thing to notice is that the speakers used in this initial test did not have much output below 50Hz, so some sub-bass region problems are not apparent in this data rendering. In addition to being different speakers from the final build, the temporary test speakers were not in the same position as the main speakers were in the final build, so it's far from a perfect comparison isolating only one variable. However the before & after results are radically different enough that they still convey a fair representation of what the room sounds like under both conditions, with and without treatment.

The challenges here are twofold. One is to get some semblance of consistency with uniformly shorter decay times throughout the midrange and treble, to reduce reverb and increase clarity and accuracy. Another important step is to get all the bass resonances under control, again so that they are decaying in a more uniform way. We'd also like to see a more consistent Peak Energy Time as depicted in the graph. These time-based artifacts are quite audible in most rooms and are the primary culprit for boomy, inaccurate, "one note" bass response that see in untreated rooms.

Once all the treatments were deployed, the speakers were placed precisely, and things were sounding fantastic by ear, Figure 5 shows us the same spectrogram of the finished studio.

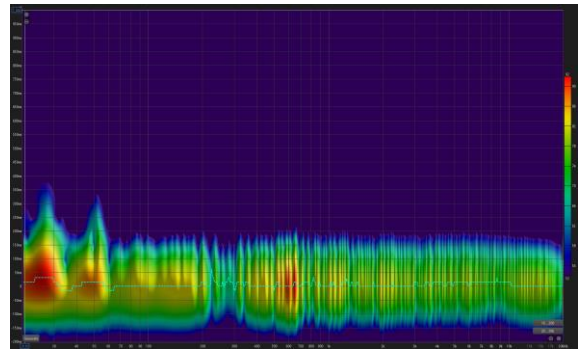


Figure 5. Spectrogram of the treated, finished Ayan Mastering studio at launch.

First, decay times are dramatically more consistent and uniform across the frequency spectrum. That's immediately apparent. But there are other things to observe in this data.

There's a lot of energy at 28Hz. It's too bad we didn't have test data from the untreated room in this frequency range, I expect it was a lot worse inside the room than what the temporary test speakers were able to excite (little output under 50Hz). I attribute this to how tight the room is, in terms of keeping the sound from escaping the room, exacerbating the problems as previously discussed.

There's also a resonance, actually two, around 50Hz. These correspond to calculated modal resonances, ie, the 1-0-0 axial mode is 28Hz, and both the 0-0-1 and 2-0-0 axial modes are 56Hz. The 1-1-0 tangential mode is also 46Hz. These are all quite evident in the spectrogram.

Above there, from about 60Hz all the way up to 200Hz, both response and decay times are much more consistent throughout the rest of the bass range, and the Peak Energy Time through that range is ruler flat! This range is critical to mastering; most recorded music has a lot of energy from 60-200Hz, from bass and kick drum fundamentals for a lot of a songs, to fundamentals for many instruments and human voices. Having a response this flat in that critical range makes it much easier to discern problems and solutions to getting the low end right for release.

Let's compare this response to what Ayan was used to in his room at Gateway, shown in Figure 6.

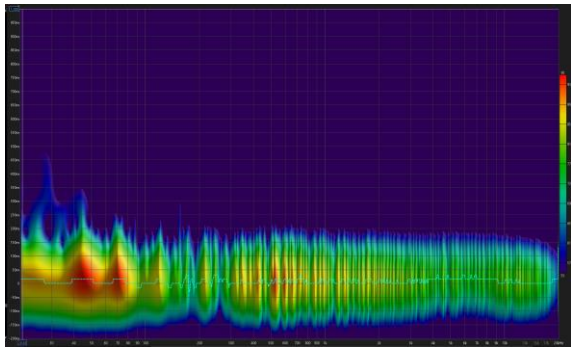


Figure 6. Spectrogram of Ayan's previous room at Gateway Mastering.

The room at Gateway was, as a reminder, built to very similar dimensions, so the modal resonances are consistent to a degree. Both rooms show the 45-55Hz resonances. However, the old Gateway room shows another peak at 70Hz that is absent in the treated Ayan Mastering room. I attribute this to the abundance of thick bass traps in the new room. The 10" thick Sound Blocks are quite effective at 70Hz. Even the 45-55Hz issues are significantly improved in the new room over the old room, despite the increased isolation performance letting less bass energy escape the room. In this context, the sonic results of the new room are even more impressive.

One last, important comment about the final bass response. The results in Figure 5 are shown with NO tuned pressure bass traps deployed whatsoever. These are the devices we'd normally bring to bear in this scenario, to get these last bass resonances calmed down even more. We left space in various pressure zones (in the wall/ceiling corners, especially in the front of the room) to add these pressure devices if desired. But because these resonant modal frequencies are familiar to Ayan, he's somewhat internalized and normalized the sound of them to his listening experience. The performance, even at these deep bass frequencies, is already far exceeding what he had in the old room, and he's not sure he wants to tame these resonances down even more. But if he decides to do it, we can implement more pressure devices to get results that are even flatter and more consistent than what's already there.

5 Conclusion

Adam Ayan's journey from Gateway Mastering, through a temporary workspace, to Ayan Mastering deploying the modular treatment strategy concept is not a performance compromise compared to

traditional architectural acoustics builds. The modular approach is instead a new path to world-class performance. By combining the depth and broadband performance of large-format, bespoke treatments with the adaptability of movable, shippable modules, this approach delivers both technical excellence and long-term flexibility.



Figure 7. Adam Ayan in his new studio, Ayan Mastering, in Portland, Maine.

As Ayan himself, shown in Figure 7, summed up his experience with the modular approach,

"If you go down this road and do it this way, as opposed to building things into walls that may or may not work, and you have to take out or get into heavy construction to fix or modify, the beauty of this is that you can move it around. You can also do it in phases, and always add to it down the road based on the design consultation from GIK. I am really thrilled with the way this room turned out. I feel like in terms of bang for the buck we far exceeded the goals. We ended up with a room that's better than rooms that I've worked in, and I've worked in what were considered the best rooms on the planet for a long, long time. Those old rooms are now unfortunately gone but we've improved upon it with this build."

As professional audio continues to expand into remote, mobile, and evolving spaces, modular systems like the Sound Blocks stand out as a practical foundation for mastering, mixing, and broadcast rooms that demand uncompromising accuracy and future-ready design.