ACHIEVING GREAT CONCERT SOUND – LESSONS FROM THE TRENCHES

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1 INTRODUCTION

This paper examines some of the many factors that conspire to either produce or prevent great concert sound for amplified events in music halls from about 800 seats to 2500 seats.

Some stages in the development of music and music halls over the last 100 years are light-heartedly reviewed to try to develop a brief for the Music Hall. What should it be?

Then these is a focus on two main types of factors that contribute to success or failure in achieving the brief – perhaps for the time-being the last frontiers to be crossed to make Great Concert Sound possible. These are:

- those acoustics and psychoacoustics issues affecting low frequencies, and
- the struggle to achieve common ground and real cooperation between the stakeholders in the music production itself.

There, of course, are even different views on what constitutes Great Concert Sound, depending upon the music type, and the audience member's expectations.

If Great Concert Sound is the accurate conveyance of the content of the music itself and the quality and sound detail of the instruments and voices, then this is only accomplished when each element comes together, either through strategy or accident. Is this ideal contradictory to a feeling of energy and excitement? Does it set itself against the live music experience of room and audience?

The goal of this paper is to improve the protagonist's awareness of some of the issues that might be involved, in the hope that increased cooperation and sharing of knowledge might lead to more consistent and enjoyable results.

The author is, himself, hungry to learn more and achieve more and is convinced that those involved must respect one another and share their way of undertaking the work. We must seek a common language, or at least struggle to find agreed interpretations that permit a common understanding of what is required for success. The goal then is to discipline the problems, expose the strengths and leave more events having achieved the thrill of musical satisfaction.

2 HALLS FOR MUSIC

2.1 The Background

Probably since music began to be played, there have been all kinds of musical styles. Somewhere in the history of music, rich, wealthy, powerful and important people set apart some styles of music and built rooms for them. Other musics continued unabated in ad-hoc venues of all sorts, apparently without loss of pleasure for either the players or their audiences.

However, as democratization and the spread of wealth extended power more widely, and the people's money began to be used to build the buildings for music, the buildings were required to support more than just elitist styles and include traditional and popular music as well.

In parallel with these developments, the rooms got bigger, orchestras and bands got larger and their instruments grew more powerful. The pitch of music rose over two centuries to increase musical impact. Instrument makers did well in the business of either modifying or replacing the instruments of earlier generations with louder models. New instruments, with more carrying power – such as the saxophone – were invented, all to serve larger and more demanding audiences. Eventually some sense prevailed and at least the rise in musical pitch was largely abated – though not internationally agreed until the 1950s. Even today, it is inching upward again.

Though voice teachers managed, to some extent, to help lift the human voice against the rising tide of instrumental vigor, it non-the-less became more difficult for singers to keep up against the onslaught. Acousticians were invented and entered the fray, using their black arts to somehow remix the sound in the room more in favour of the weaker instruments – such as the voice.

Somewhere along the way, the microphone, mixer, amplifier and loudspeaker were invented, making it possible particularly for vocalists to entertain more listeners simultaneously – thus increasing their status and income. Microphones leaked over the border onto the musical instruments. Those prone to unwanted feedback had their vibrating bodies deleted and their musical vibrations collected before even entering the air. Over time the amplifiers and loudspeakers became more powerful, enabling the music not only to tickle the ears and make the feet jump, but indeed to vibrate parts of the body directly. The ultimate goal here, considering the typical age of the listeners, takes little imagining. A little later, even the listener's clothing began to flap.

But this is a tale of music halls. Music has been called the "opiate of the people". To provide this opiate in a democratically acceptable way, all brands are required to be distributed fairly. Let the people decide! Since most towns of small and average size cannot afford more than one specialized music hall, the hall itself had to become a hall for all musics. Is one musical type superior to others? As a player myself and a person unable to stay in a box, I would have to conclude that no, there are no superior musics. But, there are certainly better concerts and worse, whatever the musical type.

Meanwhile in this stream of development, the unamplified musical group failed to develop further in loudness or size. Some players wished to retain control of the destiny of their sound and generate it directly by their own efforts. Others were perhaps rhythmically challenged and wished to follow a stick to keep time rather than take note of abdominal vibrations. Interestingly, there were now two lots of rich and powerful people – each supporting different musical styles. Those who won their money by commerce and sometimes by dubious practices frequently became benefactors for the individuals wishing to control their own sound. These continue to contribute large amounts of money and effort to help ensure that "classical" music is provided with new homes. Most of those who won their money by playing to larger audiences kept it, and promoted more events to increase its value. And many finally came back to the smaller venues they originated from play in smaller venues as their ability to draw large audiences began to wane. Thank goodness for that, since those audiences of old friends often provide the income necessary to stabilize the hall financially.

The role of acoustician continued to develop, aided by increasing demands for fresh air, transportation vehicles and buildings where listeners could choose between amplified or unamplified performances in two different rooms on the same night. Also beer continues to flow, but the strength of the barman waned as county life diminished, so more and more noisy pumps were likely to have to be found and re-mounted to keep background noise under control.

But, the whole truth is not yet out. Even the unamplified musicians required more assistance from the acoustician than just helping to get a balance between them. Somehow the room itself was a part of the musician's individual and corporate sound quality – its timbre. So, yet another art emerged in the acoustician's world – the means of keeping the room's assistance going as rooms got bigger. Ways were needed to keep the musician's limited power intact. Shapes, locations, consrtuctions and distances of surfaces were found to need detailed planning in designing the music hall if those unamplified musics were to keep their vigour going.

Over in the amplified music world, just the opposite was the case. Yes, fresh air and beer at the right temperatures were desirable features. As was the ability to keep out the awful sound of the symphony orchestra during a rock event. But, other than those requirements, a room without walls would be ideal – for the same reflections that create delight for the orchestral listener caused sawblades to cut through the heads of rock audiences. Ah, but there is an advantage to those reflective walls - a savings on amplifiers and loudspeakers while still permitting the audience to "feel the force". So emerged a new and special type of rock music hall. Numerous grand old cinemas, having been defeated to the point of death by television, were stripped of all internal acoustic treatment, most of the seats were removed, and then large sound systems were installed. Power to the people! Often, it has to be said, not much else to the people, but power certainly. Pelvic vibrations were even more optimized, nights out became even more fully satisfied, money and favours exchanged hands. Most, if not all, were happy with the transactions achieved. For this highly satisfactory musical experience, acousticians had only one role – that of preventing neighbours from achieving the same satisfaction at home as those who attended the event. This event should not be experienced for free!

2.2 The Brief

So – where is the Multipurpose Music Hall now? The only specialist hall in town caters for power rock events by big-name groups. Our music hall is a hall for all other musics. The best of the "classical" performers in the world can be expected to use it with many sizes of ensemble. So can the best of niche-market amplified groups such as roots, traditional, folk and contemporary mixed music events. Jazz players might play there now that the once preferred smoky haunts are being freed from their familiar visual and respiratory haze. Dancers of the more esoteric styles will dance upon its stage. Three tenors (but not the ones you thought) will deliver opera without the exhaustion of acting at the same time. Also attracted will be up and coming local rock bands not yet able to command a larger venue. And finally, we can expect names famous to middle and older age music lovers, whose star is fading, even though their music might be better than ever.

Probably the majority of musicians and a significant part of their audiences do fall into those seeking nuance as much as energy. Their energy is delivered through stagemanship, detail, contrasting sound levels, beautiful chords and amazing timbral subtlety rather than sheer sound power. The ability to create and convey a convincing and heartfelt musical detail and deliver it to the listener is king. Players are encouraged to play and listeners to really listen.

2.3 The Delivery

If we accept the premise that each of these musics is equal to the others, then a lot of wormy cans are opened during both the design of the hall and in the interaction between those putting on the events themselves.

The remainder of this paper poses some questions, cites some ideas for development or disposal, and generally attempts to let the worms out of the can so that we can try inducing them to behave as we intend rather than vice versa.

Whether your role is as a musician, an architect, a sound designer, an acoustician, an event manager, a hire company director, a house or stage monitor mix engineer, or anyone else involved in this process from beginning to end – you have either a positive or negative role to play in delivering Great Concert Sound. Let's talk together and see what we can achieve that will help bring in our audiences so that our preferred music can be kept live and alive.

3 GETTING THE SOUND ACROSS – PHYSICS, ACOUSTICS AND PSYCHOACOUSTICS

There are lots of books, papers and magazine articles covering these topics. It is not possible in this short paper to address even a fraction of the issues. We will concentrate on what we see as the last frontiers in this generation – the steps for exploration toward the goal of achieving Great Concert Sound.

This section assumes that the client will require a "world class concert hall". This so far usually implies that the room finishes and geometry of the hall will be designed to deliver this, rather than an electro-acoustically based solution. We expect this to remain the case for most halls for some time to come, though for clients in smaller towns and with proportionally smaller budgets, the latter will be the right solution from time to time.

For the purposes of this paper, we assume the "natural world class concert hall" as the starting point.

3.1 Reverberation, Absorption, and Reflection Control

A requirement for our hall will therefore be a narrow range of fairly lively reverberation criteria, probably with a rising RT in the lowest octaves. Typically, around 1.8 to 2.0 seconds mid-band.

Walls, balcony fronts and other surfaces will be arranged to return early reflections from the musicians on stage to each other and to the audience.

Flat surfaces will often do for this (by this we don't mean that they are not curved, but rather that the surface might be smooth). Over the last 10 to 15 years many architects have preferred very simple visual surfaces with little modulation on them.

On the other hand, some of the most famous halls included a lot of architectural detail at all physical scales. These range from statues, highly ornate wall mouldings, architraves, etc. the provide substantial diffusion within the hall.

Recent experiences in both smoother and more articulated halls indicate that diffusion greatly improves the amplified sound experience, softening the edges of the sound, reducing comb-filter effects and allowing more comfort at high sound pressure levels. But there have been some questions as to whether the room character has been diminished, and the level of early reflections reduced – taking something away from the experience of unamplified performances.

Should we now look in more detail at which surfaces particularly affect the room when it is delivering each type of musical event to see if we can optimise it more precisely for both? Can we make diffusion variable, as we do mid-range reverberation levels?

In most recent halls, there is indeed variable absorption, accomplished mostly by exposing absorptive materials at the will of the concert manager. This does a good job over a range of frequencies and when combined with diffusion seems to produce a very nice hall for amplified music.

But, at the lowest frequencies, say below 150 Hz, there is rarely either diffusion or absorption. The room remains the same for all music types. We will examine a little further below whether this is important. Should we be investigating means to produce low frequency diffusion in an architecturally acceptable and cost effective manner? Should we be trying to introduce variability in reverberation at the lowest frequencies?

3.2 Perception of Detail at Low Frequencies

Having had the benefit on occasion of sitting at the house mix position during indoor festival events, it became very clear through the day that the sound system in use ranged in quality from exceptionally good to quite poor as the performing group and the house and stage mix engineers changed. Bear in mind that the sound system itself, and the available processing for it where not changed – only adjusted by the engineer himself (and sometimes sneakily returned to its nominal setting by the sound rental company between performances).

The difference in quality to my ears was clear at all frequencies, but as a bass player, even more pronounced at lower frequencies

One particular system used a cardioid bass configuration, and it was established by listening on stage that this did indeed develop much less bass at the musician position on stage that would a conventional system. It had an optional infra-sub that could be used pointed toward the audience. Further bass and low bass cabinets were available for optional use by the musicians – under control of the stage monitor mix engineer.

In one performance an amplified double bass delivered a stunningly detailed sound, full of personality and lots of notes (when needed). You could have gone into a music shop with 20 basses, tried them out, and found this particular bass by identifying its particular "sound" from what was heard at the mix position through the sound system.

Two bands later, another player using an electric bass, played a million notes and was obviously hearing (or pretending to hear) this on stage. He was in ecstasy. In the audience, the sound of wobbly jelly was heard and that even seemed to obscure what little could be felt from the kick drum. Note was taken that the rack of 1/3 octave graphics had gone from slight corrections to a sea of needles. Sound levels were also higher, but not startlingly so.

Had there been only one band to listen to on this sound system, one would have concluded that it was not worth the wood used to make the cabinets. In the other, you would take it home to use as hi-fi.

Following this, and also other experiences comparing the speech intelligibility of male and female voices, some study was made and some questions asked. These are still ongoing for investigation:

- It seems that there is serious upward masking from lower frequencies, with a more pronounced effect than mid- and high-frequencies. This is not really apparent in the STI matrix (but at least masking is now considered in the most recent proposals). This would imply that control of low frequency reverberation would have a positive effect on concert sound, with similar benefits from diffusion. Also that changing the usually heard frequency / amplitude ratios could undermine quality. And finally that we should be trying to achieve direct sound spectra and sound power spectra that are the same – so that reverberation energy spectra match, rather than exceed those of direct sound. Ie, we need a truly constant Q loudspeaker. Contemporary line array systems with "cardioid" bass are coming closer to achieving that.

- Masking seems to worsen with rising amplitude. We know this is true, yet take little notice of it when trying to assess clarity. There is work from the 1950's showing what happens. How can we provide for this to achieve better sound and still maintain "impact" at lower frequencies? Can we make a trouser flapping transient wave that tracks the kick drum, while eliminating most of the harmonics that would mask the aural experience?

- Musical timbre can be lost due to masking and equalization. Further study reveals that it is not only the overtone series, but also bandpass shaped "formats" that define the character of a family of instruments and of an individual instrument. Use of graphic equalizers almost

always produces serious ripples in the frequency response that can counteract these formats and smother the real sound of the instrument being amplified? This is a further reason for examining the user interface on parametric equalizers so that we can achieve the simplicity of control of the graphic together with the smooth response of the parametric.

4 THE STAKEHOLDERS

There is a lot to say about this and it is alluded to above. But, being a paper on Great Concert Sound, you will have to buy the CD of the conference if you want to get the full detail.

5 ACKNOWLEDGEMENTS

I am grateful to the enormous number of people who have influenced by life experience and knowledge so far. There is still a lot to learn. Many of you are at the conference. Don Davis and Pat Brown are others. My current colleagues Glenn Leembruggen in Sydney, Kurt Graffy in San Francisco and Rob Harris in Winchester get special mention.

Thanks also to industry practitioners, musicians and mix engineers who have dared to try to talk about what they do, what they want and try to explain why. Lurking in here is the important information needed to achieve Great Concert Sound together. Others – please join us. We need to keep the improvements going.

Many, many books have influenced these ideas. When some of the issues are resolved further, it will be appropriate to give more detailed credit. Thanks to all who bother to share what they know, so that all of our work is improved.

Finally, my clients. Both exciting and exasperating, you are the reason that Great Concert Sound will ever be possible. If you did not build buildings and run them, where would music be? Thank you, thank you, thank you.