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Stage acoustics for amplified music

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ABSTRACT

It is sometimes expected by acoustic designers that open monitor speakers and in-ear monitoring in itself will provide pop and rock musicians with enough early sound to feel comfortable and communicate well on stage. This could lead the designer to create a fairly anechoic stage environment, ideal for sound engineers tasked with making a "clean mix" with little "bleed" from one instrument into other instruments' mics, and avoiding acoustic feedback in PA and monitor system. However, it seems that diffusive lateral surfaces on stage help the musicians communicate far better and further achieve a sense of being *with* their audience with a better chance of creating a *social unity*. Such a design meets the needs of both musicians and sound engineers. Regarding halls where both unamplified and amplified music is presented, it appears that the same ratio between Early and Late Support should be achieved in both the un-dampened and dampened state of the hall. To achieve this, the stage environment should be dampened as much, and in the same frequency bands, as the audience area itself.

Keywords: *Stage acoustics, amplified music*

1. INTRODUCTION

Amplified music acoustics has not undergone as much research as acoustics favorable for unamplified, classical music. The only two studies that this author is aware of, where musicians and sound engineers have been asked to rate actual halls for pop and rock music, are both by the author [1, 2] from 2010 and 2018. These two investigations were looking into overall recommendations for suitable RT values for the hall as such, with regards to hall volume and to frequency. They did not have the scope of studying stage acoustics more specifically. Although measurements in these studies actually were made on stage, in accordance with the standard, and parameters like Definition and Clarity were captured, these numbers, when correlated with ratings by musicians, only reveal that clarity on stage is important. A study of the importance of Early and Late Support would need measurements of G, and a study of lateral energy also takes specialized measurement equipment. And such measurements would need to be correlated with results from detailed questionnaires about stage acoustics. That was beyond the scope of the two mentioned investigations by the author at the time and would possibly have blurred the questionnaires and thereby the chance of reaching the important findings that were acquired in that research. However, in [1] musicians were encouraged to leave general comments on insights from their many concert experiences in the questionnaire. From these, and from the authors' own 1200 concerts, as well as from actual results in the two studies, it is possible to acquire some information about suitable acoustics on stage for amplified music. At least for a well substantiated hypothesis. Hence, this article is based on partly qualitative and partly quantitative data.

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2. QUANTITATIVE DATA

In [1] overall RT values as a function of hall volume were defined from studying 20 halls and 500 hall ratings from 33 musicians and sound engineers. It was proven, that halls with significantly longer RT in the 63-250 bands were the least well-liked. A high C80 at LF was found to be an important factor for a quality hall. Further, out of the 20 halls, the sound engineers preferred the deadest hall, which also had a dead stage environment across all frequencies. This hall ranked only no. 10 according to musicians.

Notably, in [1] the respondents were also asked various general questions, and to the question whether electro acoustic monitoring (in-ear, opens speakers etc.) could help mitigate unfavorable acoustics, the average answer was "*somewhat*". The most alienating sensation a pop/rock musician can encounter, is a rather dead stage with a far more reverberant audience area, leading the musician to hear the loud level music stemming from another place than where he/she creates it. Not even a combination of various types of monitors will mask the loud reverberant bass sound. This is probably due to the fact that bass sound enters even sound-attenuating earphones as well as to bone-conduction. The bone-conducted reverberant sound is btw. attempted mitigated by drummers, by use of a so called "butt kicker" mounted to the drum seat.

In [2], two halls were compared; the two halls had the same RT at 63 and 125 Hz and roughly the same volume. One hall had porous absorbers in the entire ceiling, the other plate absorbers in the ceiling and thus the two halls had very different RT characteristics from 250 Hz and up. The hall with longer RT at mid- and hi-frequencies was the absolute winner among musicians, while sound engineers did not have a preference. Further, since RT in both halls was rising quite drastically towards frequencies below 125 Hz, and since 250 Hz was not particularly controlled in the hall without porous absorption, and since the preferred hall got top ratings and is considered one of the best in Denmark, it was substantiated, that the 125 Hz band is the most important to control in terms of RT in pop/rock venues. The two halls in [2] have similar stage geometry: *not* a tiny enclosure, but full width and with the same acoustical treatment in stage area as in audience area.

Hence, [2] leaves with a strong hint, that HF reverberation is important for pop/rock musicians. And since, according to musicians as mentioned, the acoustic response on stage should not differ from the that in the audience area, stage environment must be somewhat HF reflective.

3. QUALITATIVE DATA

In [1] musicians and sound engineers were encouraged to leave general comments on insights from their many concert experiences within the questionnaire form. In this context, especially two musicians' inputs can be of value.

One very experienced guitarist states: "In general, I prefer to play in halls *with* "klang" (meaning: a considerable amount of reverberation). However, the reverberation must not occur below approx. 300 Hz." His last statement is very precise, and turned out to be articulating the core result that the entire investigation led to, when doing statistics on all 500 datapoints: low RT at LF is preferred. Further, his first statement was statistically substantiated in [2] averaged for many musicians. What he says is further directly understandable for an acoustician, and it qualifies this musician to an extent where it seems reasonable to listen to his other statements: "Playing in a very dampened hall makes one very reliant on the monitor situation while in a more reflective hall, one can always navigate even if the monitor situation is not optimal. In a very dampened hall, I would need all instruments in the monitor, which I would otherwise prefer to use uniquely to hear the singer's voice." Further: "Decisive is of course the *sound-level* of the reverberant sound that comes back on stage from the hall. *The monitor speaker must be able to play at least as loud as the returned reverberant sound*." The brilliant guitarist probably fails to take into account that there are two factors influencing what he conceives as the monitor speaker sound level: that of the speaker itself *as well as* the early reflected sound from the stage environment. As acousticians we know this to, at least probably, be true. And thus, his statements are in perfect alignment with the author's experiences (more detailed written in [3] as well as with [4]. This information can in simple writing be interpreted as follows: *the early sound must be at least as loud as the late sound returning from the hall.* This also aligns with the previously mentioned second musician's statement: "Playing in a very dead hall feels like *hitting a pillow*, it feels like I cannot reach the audience". He continues: "The worst stages are the "*closed*" ones, encountered in e.g., "Rytmeposten" and "Sønderborghus". Those two stages were of course part of the investigations in [1], and they had a common trait: they were far deader than the audience area from which they were acoustically detached. It is the experience of the author, that given the choice, some sound engineers would like to "fix acoustics" by deadening just the stage environment as much as possible (there are a few examples in Denmark). However, as just substantiated, this is in contradiction with the preference of musicians. What

PA sound engineers are looking to obtain, is creating a "clean mix" for the PA loudspeaker system, where little "bleeding" from one instrument into other instruments' open microphones occurs.

4. DEBATE

There is some discrepancy between the preference of musicians and that of sound engineers. Most professional sound engineers have incredible ears and skills, artists in their own right, and can cope with almost all sorts of stage acoustic situations. It is the view of the author, that since the acoustic discrepancy is relatively small, priority (if needed) should probably be given to the musicians' needs, since great music is what the audience (who, by buying tickets, made the event possible) has come to hear – not uniquely great sound. Musicians have a bigger chance of making great music if they feel great on stage. And with a fantastic, expressive concert, everyone is content afterwards.

Further, it appears that the same *notion* as encountered in classical music hall design, where there needs to be a subtle ratio between level of early and late sound as encountered by the musician, is also true for amplified music, despite monitors, as mentioned in [3] but without the substantiation of this paper. This is often expressed in terms of the Support parameter [5], ST_{early} and ST_{late}.

So which frequencies do we need to reflect on the amplified music stage? According to [1, 2] and the statements above, quite the same RT curve should be encountered on stage as in the audience area, possible with slightly stronger sound level from early reflections. Depending on room and stage design, to avoid any possibility for too long RT at LF some of the stage environment can be made LF absorptive. But as seen, we should not strive for a very MF and HF dampened environment. To accommodate musicians' need for ease-of-ensemble, while at the same time lower specular reflections that would make the sound engineers' job harder, it seems natural to *diffuse* the stage environment. This decreases the sound level of early reflections while at the same time spreading reflections around to all musicians in the environment. And possibly, as for the geometry, the acoustician could narrow a bit the stage, or provide the possibility of employing mobile, diffusive reflectors on the stage to be used for smaller ensembles.

In multipurpose halls, where RT must be variable to accommodate for both amplified and un-amplified music performances, logically the stage acoustics should provide as much variability as encountered in the audience area. Otherwise, the same ratio of early to late sound on stage cannot be obtained for the different genres of music.

5. REFERENCES

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