



HPS-4000®

HIGH PERFORMANCE STEREO

Sound IS the Experience !™

**LOW CEILINGS
MAKE BAD THEATRES**

BY

JOHN F. ALLEN

HIGH PERFORMANCE STEREO™



HPS-4000®

HIGH PERFORMANCE STEREO

FIRST IN DIGITAL STEREO

This article was written by John F. Allen and originally published in BOXOFFICE MAGAZINE. Unauthorized duplication or publication without the written consent of both John F. Allen and BOXOFFICE MAGAZINE is prohibited.

HIGH PERFORMANCE STEREO™

NEWTON, MA 02459 USA • TEL: 1-617-244-1757

HPS® and HPS-4000® are registered trademarks of John F. Allen

LOW CEILINGS MAKE BAD THEATRES

**BY
JOHN F. ALLEN**

The shift towards theatres with stadium seating has been a welcome one for anyone who, like myself, has always disliked watching movies through the heads of other people. Better sight-lines, however, can often come at a cost in sound quality, especially if the ceiling height in the back of the theatre is allowed to get too low.

In the past, theatres with standard sloped floors would typically have a ceiling height at the rear of the auditorium of around 19 to 24 feet. Consider a conventional theatre that is 80 feet long, 45 feet wide, 20 feet high at the back and has a floor that slopes from back to front a total of 4 feet. Such a theatre would have a total volume of about 79,200 cubic feet.

If such a theatre was refitted with a stadium seating configuration, the ceiling height at the back of the house could well be reduced from 20 feet to 10 feet, sometimes even less. Better for sight-lines? Of course. Better for sound? Well, it depends. If you like good bass, there may be a surprise. The volume of the theatre is now about 23 percent less than it used to be. Assuming that the boundaries of the theatre before and after the stadium conversion are in the same place and acoustically unchanged, the reduced volume of the room will reduce the reverberation time. A lower reverberation time means that the room is more acoustically dead. One well known consequence of acoustically dead rooms is poor bass. It is also quite possible that one will find that the bass in the back rows will be excessive while normal elsewhere throughout the theatre. In other words, the bass coverage is less uniform.

The effect on bass quality and uniformity is also influenced by other factors. So it can often be hard to predict what will happen to bass when ceiling heights are reduced below say 15 feet. However one thing is certain, the volume of a room matters when acoustics are involved.

Another certainty is that the surround coverage and performance will be impacted by a low ceiling. Surround speakers must be mounted high enough above the audience to provide good coverage around the room. If they are too low, people will localize to the

speaker closest to them. Imagine a surround speaker that is just two feet from someone's head. This extreme example makes this problem easy to understand. At some point as that surround speaker is raised, along with the others, the listener hears them as a non-localized wall of sound, rather than individual speakers. If the ceiling height is too low to prevent the speakers from being installed high enough for this to happen, two things will be needed: The first is more surround speakers. This is because they will need to be spaced closer together to avoid single speaker localization. The second is additional electronic delays and another amplifier. This is needed to help correct the problem of localization to the specific groups of surround speakers for those not seated along the center line of the theatre -- in other words, most of the audience.

The wider the dispersion characteristics of the surround speakers themselves, the more pronounced these problems will be in theatres with low ceilings. This is due to the need for speakers with wider coverage angles to be placed higher on the walls to achieve good coverage.

All told, a ceiling that is too low and prevents the surround speakers from being placed at their ideal height, will add at least four speakers to the surround array and cost around \$4,000.00 more, including the electronics. Of course, one immediately sees that the cost of raising the height of the building to provide higher ceilings will cost far more than \$4,000.00. But the same can also be said for raising the height of a building to allow for a taller screen. However it is equally important for acoustic reasons as well to have a room of adequate height.

Below is a table of recommended minimum ceiling heights that we provide to clients designing theatres intended to be equipped with our surround speakers. To simplify matters, the ceiling heights are correlated with just the width of the auditorium. In truth, accurately determining needed ceiling heights in stadium theatres is far more complicated than that and is beyond the scope of this article. But these figures are given here to illustrate the issue. When considering these numbers one must note that most surround speakers have wider dispersion patterns than ours and therefore would ideally need minimum ceiling heights at the back to be even greater. There is no magic number for surround speaker dispersion, only proper placement of surround speakers with any given coverage angles. Note also that as the width of the theatre increases the minimum recommended ceiling height as a percentage of the width decreases. This is helpful when trying to minimize construction costs. Ideal ceiling height is not necessarily a linear function of any other dimension, but a combination of many things including common sense.

Theatre Width	Minimum Recommended Ceiling Height	Height as Percentage of Width
30 feet	12 feet	40%
35 feet	12 feet 7 inches	36%
40 feet	13 feet 7 inches	34%
45 feet	14 feet 5 inches	32%
50 feet	15 feet 8 inches	31%
55 feet	16 feet 7 inches	30%
60 feet	17 feet 6 inches	29%
65 feet	18 feet 6 inches	28%
70 feet	19 feet 6 inches	28%

Table 1.

Another feature that has crept into some recent theatre designs is a ceiling that is not only too low, but also slanted upwards from the back of the auditorium to the front. This appears to be been done for cosmetic reasons only as there is plenty of wasted space above these sloped ceilings that would allow them to remain level. This can result in ceiling heights as low as 8 feet (low enough to spoil the acoustics of a living room) and is an especially bad idea for all the reasons already mentioned here, plus one more: Such a ceiling increases the amount of reflections from the screen speakers that land on the audience. These reflections are not only stronger but earlier as well and are the last thing we want in a movie theatre. Coming at us from above, such reflections, if strong enough, will reduce the stereo effect and could very well undermine dialog intelligibility in scenes with lots of sound. We have all heard what people have often called the “tunnel effect” when referring to the sound in long narrow theatres. The same principles are involved when the room lacks sufficient ceiling height.

The bad news created by low ceilings doesn’t end with acoustic problems. Projection ports that are too low allow patrons to stand on seats and block the picture. If the ceilings are really low, people can even walk right through the image.

Figure 1 shows a large stadium theatre. The ceiling is just high enough to eliminate the need for additional surround speakers and delays. The fixed roof height of the building allows the ceiling heights in the smaller theatres will be quite generous. This means that these smaller theatres will have larger volumes and the acoustic benefits that go along with the added space.



Figure 1.
Pacific Theatre's Victoria Ward #7 in Honolulu.

In conclusion, low ceilings in movie theatres should be avoided whenever possible as they create a host of acoustic, sound system and even projection problems that all have a negative impact on the overall presentation.

© Copyright 2004, John F. Allen. All Rights Reserved.

*John F. Allen is the founder and president of High Performance Stereo in Newton, Mass. In addition, he serves as the sound director of the Boston Ballet. He is also the inventor of the HPS-4000® motion picture sound system and in 1984 was the first to bring digital sound to the cinema. John Allen can be reached by E-mail at johnfallen@hps4000.com. Mr. Allen's 24 year series of articles written for **BOXOFFICE** are available for download at <http://www.hps4000.com>.*