

Upper Darby High School Auditorium

ROOM ACOUSTICS REPORT – REVISION 1

August 1, 2025



PREPARED FOR
Doug Aldinger, PE, LEED AP
Sr. Development Engineer
SiteLogIQ



PREPARED BY
Maeve Cantwell
Associate Consultant

Scott Hulteen
Associate Principal
Metropolitan Acoustics

August 1, 2025

Doug Aldinger, PE, LEED AP
Sr. Development Engineer
SiteLogIQ
3300 North 3rd Street
Harrisburg, PA 17110

Re: Upper Darby High School Auditorium
Room Acoustics Report – Revision 1

Dear Mr. Aldinger:

Metropolitan Acoustics has completed a room acoustics analysis for the Upper Darby High School Auditorium in Drexel Hill, PA. The auditorium was renovated recently, including replacing seats and floor finishes, removing suspended plywood baffles, painting the walls, and adding a larger sound booth. It is our understanding that the current auditorium has problems with speech intelligibility during spoken word performances. This report addresses room acoustics in the current auditorium compared to the pre-renovation condition.

The information in this report is intended to be used as a guide for architectural and engineering disciplines so appropriate acoustical performance can be achieved. These recommendations are based on drawings of the pre-renovation and current auditorium, a site survey conducted in the pre-renovation space on May 18, 2023, and a site survey conducted in the current space on May 28, 2025.

For the readers' convenience, [blue text](#) indicates an external link. Please let us know if you have any questions regarding this information.

Best regards,

metropolitan acoustics, llc



Scott Hulteen
Associate Principal
s.hulteen@metro-acoustics.com
MA#230227.AS1



Maeve Cantwell
Associate Consultant
m.cantwell@metro-acoustics.com

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ACOUSTIC TERMINOLOGY

Reflection

A reflection is the redirection of sound energy. Reflected sound can be either beneficial or detrimental to room acoustics depending on the magnitude, direction, arrival time, and the intended function of the room under design. For example, reflective surfaces can be used to project sound toward the audience in the rear of a lecture hall, and lateral reflections can enhance the sense of envelopment in a performance venue. On the other hand, reflections from a hard ceiling can degrade speech privacy in an open office, and reflections from a nearby surface in a crowded room can lead to excessive sound buildup.

Echoes

An echo is a reflection of direct sound that is discernible above reverberant decay in a room. There are several types of echoes including flutter echoes, slap echoes, and focusing. Flutter echoes are repeated reflections typically between hard, parallel surfaces. A slap echo is an excessively delayed reflection from a surface back to the source location. Focusing is a type of echo caused by concave surfaces that converges sound energy to a single point. Creep echo is also caused by concave surfaces where a series of reflections along the curvature is clearly audible on the opposite side.

Reverberation

Reverberation is the persistence of reflected sound after direct sound is produced. The reverberation time (RT), which is defined as the time it takes a sound to decay 60 decibels, is frequency-dependent, where some frequencies decay faster than others depending on the finishes in a room. The RT is proportional to the volume of a room and inversely proportional to the amount of acoustically absorptive materials.

Unless otherwise noted, when a reverberation time is reported as a single number, it is the mid-frequency time: the average of the 500 and 1000 Hz octave bands.

Noise Reduction Coefficient (NRC)

A common way to present the sound absorption properties of a material is the noise reduction coefficient (NRC), where 0 is completely reflective and 1 is completely absorptive. It is the arithmetic mean of the absorption of a material in the octave band center frequencies from 250 to 2000 Hz. For example, NRC 0.70 means that the material will absorb approximately 70% of the sound between 250 and 2000 Hz that is incident upon its surface.

PRE-RENOVATION CONDITIONS

During a site survey conducted on May 18, 2023, the following finishes were observed in the auditorium:

- Ceiling: metal deck, suspended plywood baffles
- Walls: unpainted acoustic CMU, gypsum board (GWB), unpainted CMU
- Floor: carpet, wood stage
- Seating:
 - Lower center seating section: fabric upholstered seats
 - Upper center and wing seating sections: vinyl covered seats

Figure 1 through Figure 3 show the pre-renovation conditions in the auditorium, including the plywood baffles and unpainted acoustic CMU.

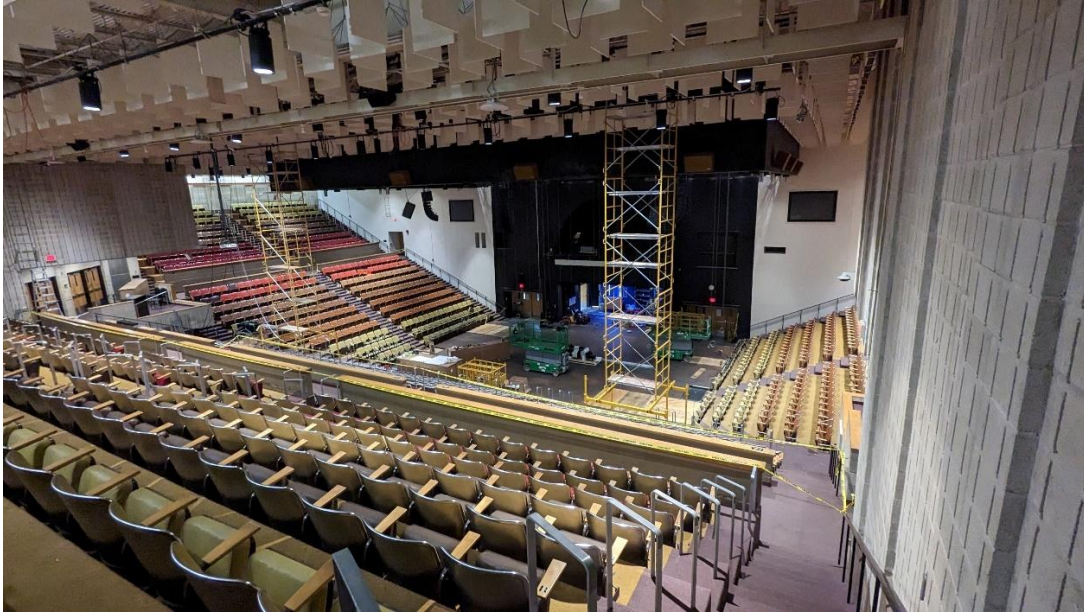


Figure 1. Pre-renovation conditions in auditorium



Figure 2. Pre-renovation unpainted acoustic CMU

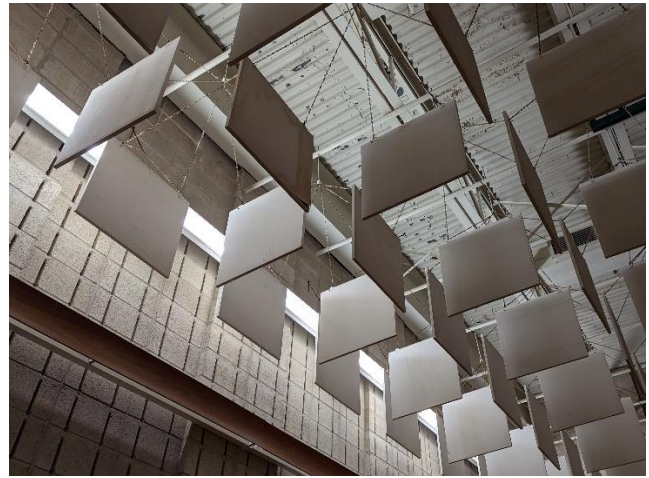


Figure 3. Pre-renovation plywood baffles

CURRENT CONDITIONS

During a site visit on May 28, 2025, the following finishes were observed in the auditorium:

- Ceiling: painted metal deck
- Walls: painted acoustic CMU, GWB, painted CMU
- Floor: carpet in walkways, vinyl plank under seats, wood stage
- Seating: fabric-covered upholstered theater seats

As part of the renovations, the first row of seats by the stage was removed, as well as some of the seats in the last row of the lower seating sections. Additionally, the last row of seats in the upper middle section was removed to construct a larger sound and light booth.

Figure 4 through Figure 6 show the current conditions in the auditorium.

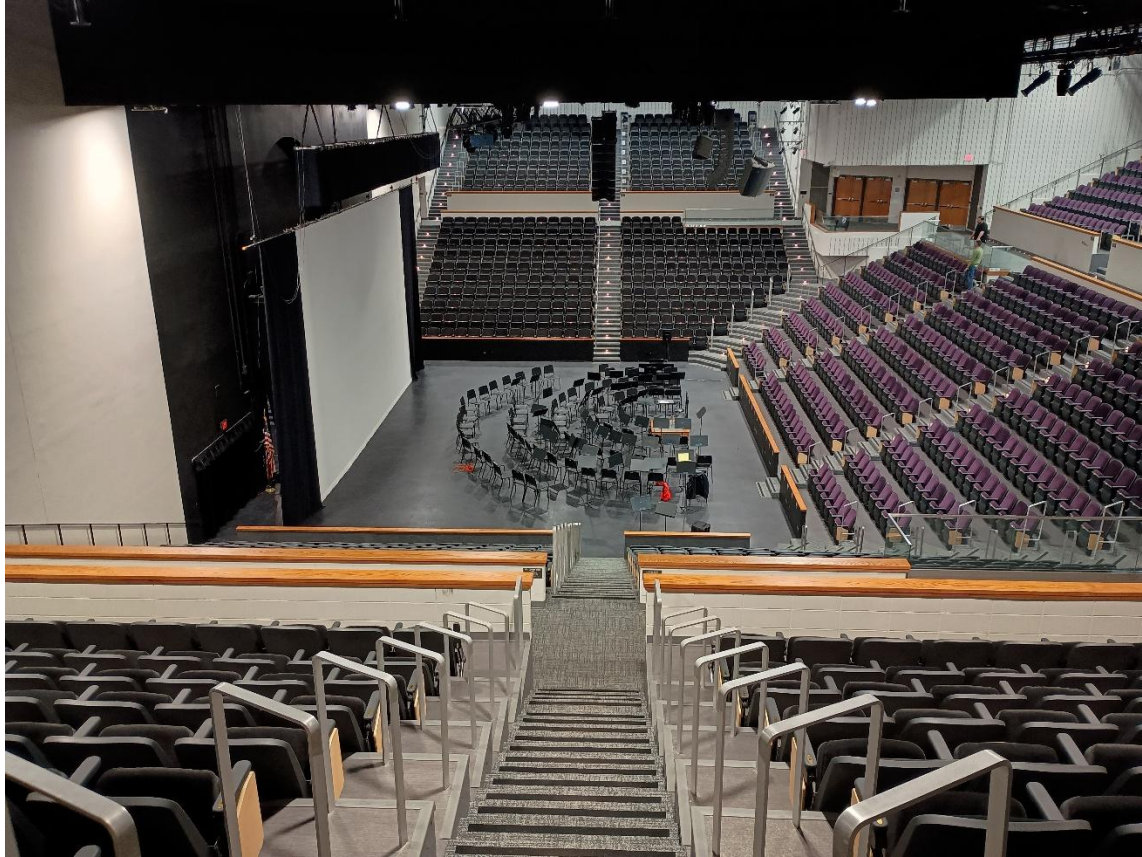


Figure 4. Current conditions in auditorium



Figure 5. Current painted acoustic CMU



Figure 6. Current heavily upholstered seats

TEST PROCEDURES AND RESULTS

RTs were measured in octave bands from 125 to 4,000 Hz using an NTi Audio XL2 Sound Level Meter, which meets ANSI S1.4 criteria for a Type 1 sound level meter. Interrupted amplified broadband noise generated by an NTi MR-PRO and emitted by a JBL PRX710 loudspeaker was used as the sound source. Measurements were conducted at multiple locations throughout the space, which was unoccupied at the time of testing. Table 1 and Figure 7 below show the results of the RT test in the current space compared to the pre-renovation condition.

Table 1. Measured Reverberation Times (seconds) Upper Darby High School Auditorium							
Condition	Octave Band Center Frequency						Mid-Frequency Average
	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	
Pre-Renovation	2.22	1.74	1.65	1.48	1.25	1.02	1.57
Current	2.06	1.69	1.66	2.09	2.05	1.74	1.88

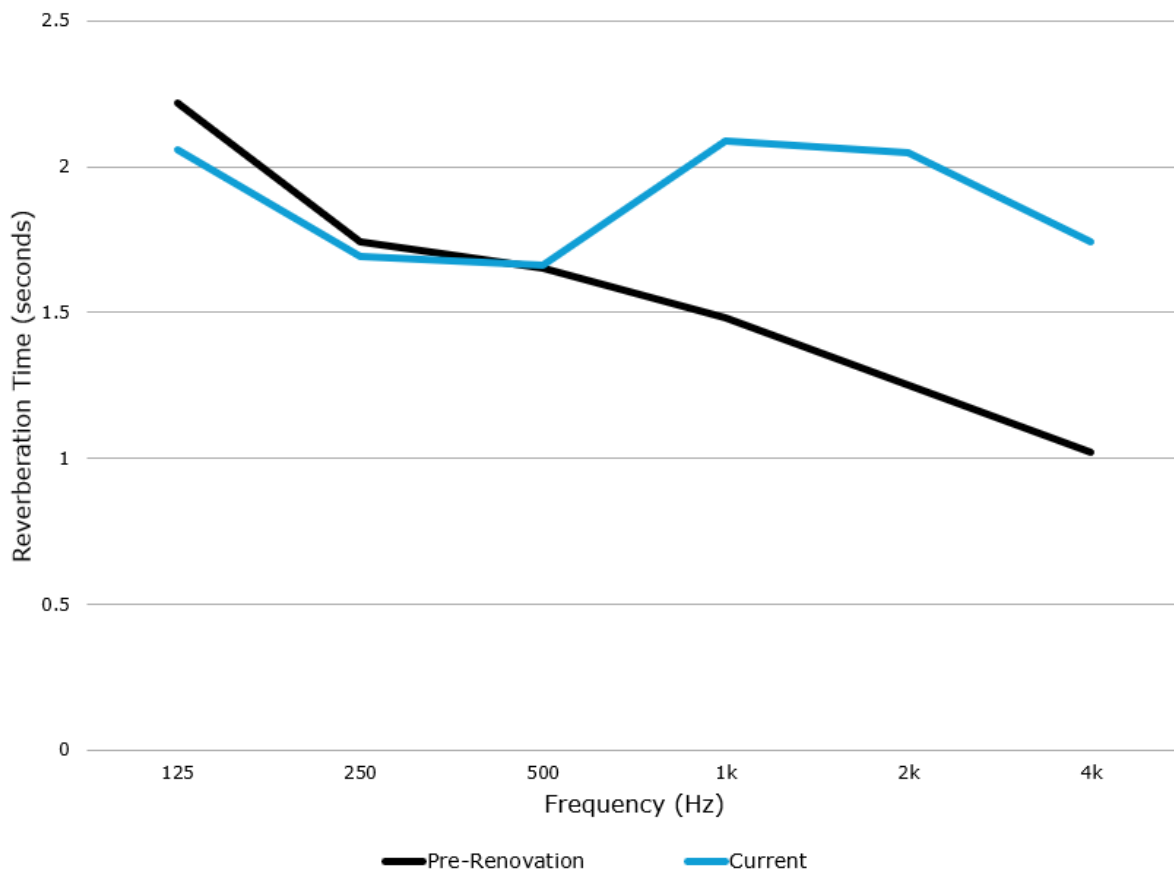


Figure 7: Comparison of pre-renovation (black) and current (blue) measured RTs

OBSERVATIONS AND DISCUSSION

As shown in the table and figure above, the RT in the auditorium did not change much in the low to mid frequencies (500 Hz and below) after renovation. However, the current RT in the high frequencies (1,000 Hz and above) is higher than the pre-renovation condition by 0.6-0.8 seconds.

While conducting our measurements, we assessed the space for unusual reflections or echoes but did not observe anything that could be causing the elevated RT in the high frequencies. Based on our conversations with Upper Darby HS staff while on site, we understand that the acoustics in the current space are appropriate

for unamplified musical performances but amplified spoken word performances such as plays and assemblies have poor speech intelligibility. The sound system was not changed as part of the renovation.

Due to the volume of the space, the acoustic properties of a large surface area would need to have changed to observe such an increase in high-frequency reverberation time. The large areas that were modified during renovation were the removal of the suspended plywood baffles, the replacement of all of the seats, and the painting of the acoustic CMU. Each is discussed below.

Plywood Baffles

The baffles suspended from the ceiling in the pre-renovation condition were composed of plywood. Plywood does not provide much, if any, acoustical absorption in the high frequencies where the increased reverberation was observed. We do not believe the removal of the baffles caused the change in reverberation.

New Seats

In auditoria, upholstered seats typically provide the largest area of broadband acoustical absorption. Spaces with fully upholstered seats avoid large differences in reverberation times caused by varying levels of occupants because the seat cushions mimic the acoustic characteristics of a person sitting in the seat.

The fabric used for the new seats is Designtex Samba. We understand this fabric has a Crypton fluid barrier coating and backing, which could prevent high frequency sound from being absorbed by the seat cushions. Unfortunately, Designtex does not have acoustic test data available for this fabric; therefore, we cannot determine the acoustic impact of the fluid barrier. In our experience, we have observed that fabrics with a backing are less acoustically transparent than fabrics without a backing, with the greatest drop in performance seen in the high frequencies; therefore, this fluid barrier coating and backing could play a role in increased high frequency reverberation.

Acoustic CMU

During the design process, we discussed the painting of the acoustic CMU with the acoustic CMU manufacturer. We were informed that painting the acoustic CMU should not affect the acoustic performance, as long as the slots in the acoustic CMU are not painted over or filled in. Unpainted acoustic test data was not available for the specific type of acoustic CMU used in the auditorium; however, we reviewed acoustic test data of a similar acoustic CMU product that was both painted and unpainted, which confirmed what we were told by the manufacturer.

After reengaging with the manufacturer post renovation, we were informed that the test data provided for painted acoustic CMU uses a single light coat of spray-applied paint. It was conveyed to us that using several layers of rolled-on latex paint, as was done in this auditorium, could lower the acoustic absorption provided by the CMU. While the slots were not covered or painted over, we believe that the painting may have affected the ability of sound to pass through the CMU and into the absorptive cavities.

In conclusion, we believe that a combination of the painting of the acoustic CMU and the fabric selection for the seating has caused the increase in high frequency reverberation.

RECOMMENDATIONS

Regardless of the cause of the excessive high frequency reverberation, additional high frequency absorption needs to be added back to the space to lower the high frequency RT.

Unamplified musical performances benefit from higher RT, which is why the directors of the band and choir indicate that the acoustics in the new space are desirable. A lower RT is needed for speech intelligibility, which is why performances centered around amplified speech may suffer in the new space. Since the space is used for both unamplified musical performances and amplified performance based around speech, a compromise is needed for the reverberation time. We recommend a mid-frequency RT design goal of 1.6

seconds. To achieve this design goal, add 4000 SF of 1/2" fabric-wrapped fiberglass acoustical panels such as [G&S AP](#). We recommend locating these panels on the walls of the sound booth as well as the stage wall, as shown in Figure 8 and Figure 9.

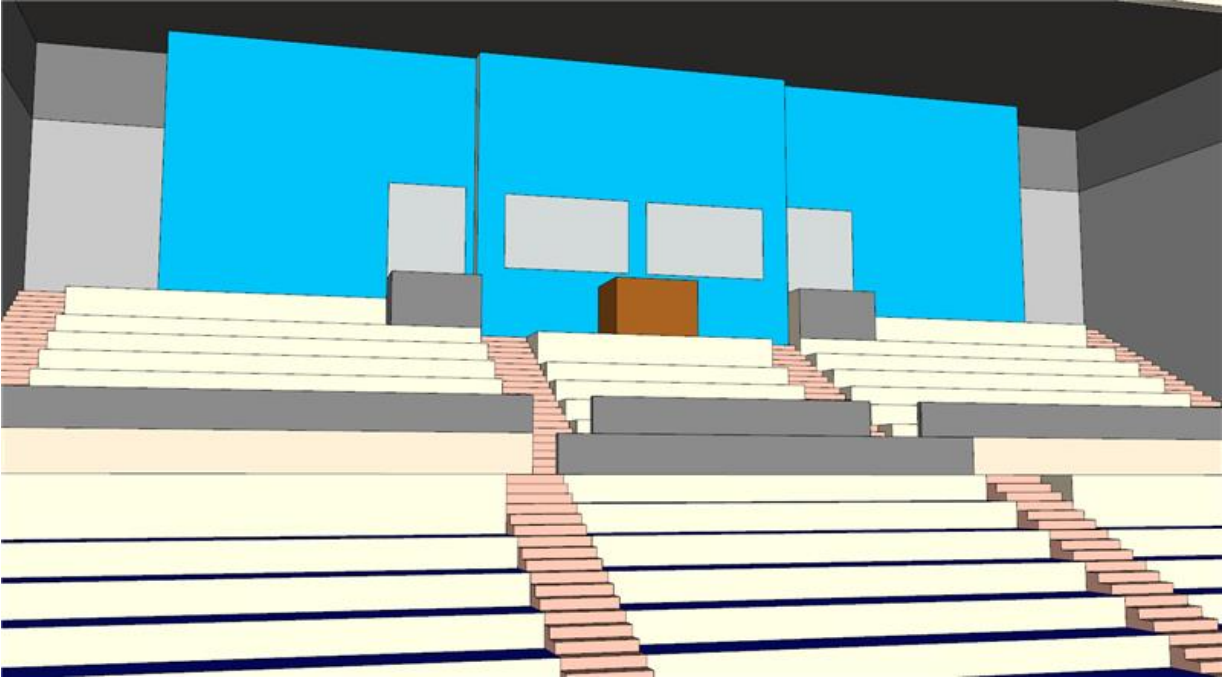


Figure 8: Available sound booth wall acoustic panel locations

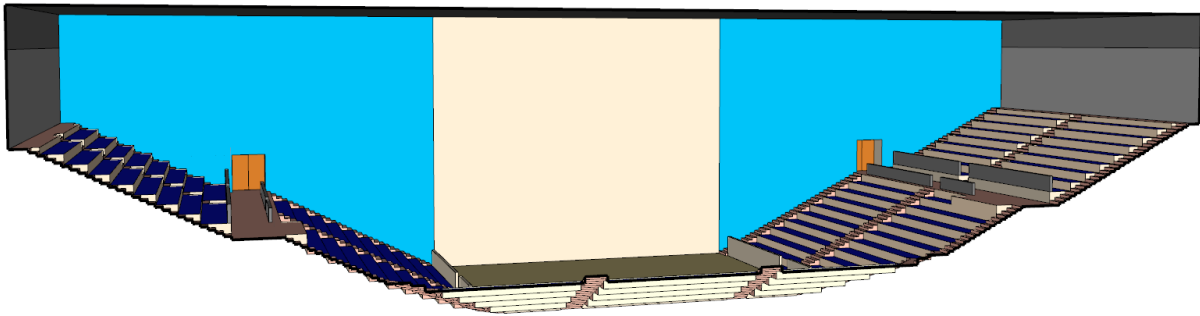


Figure 9: Available stage wall acoustic panel locations