



SSA Acoustics LLP
 7409 Greenwood Ave N, Suite A
 Seattle, WA 98103
 Office: (206) 839-0819

TO: Gus Wallerstedt, Quileute Tribal School
FROM: Steve Hedback, SSA Acoustic, LLP
DATE: June 30, 2023
SUBJECT: Quileute Tribal School Gymnasium – Acoustical Treatment Recommendations

This report details the results of the reverberation time analysis at the Quileute Tribal School located at 12181 La Push Road in La Push, WA. The purpose of the testing was to document the performances of the reverberation time within the gymnasium and open office space and provide recommendations for addressing the buildup of noise within the space.

DESIGN CRITERIA

There are multiple standards that provide recommended criteria for the reverberation time within gymnasiums including LEED, Washington State Sustainable Schools Program (WSSP), International Green Construction Code (IgCC), and ANSI / ASA S12.60 Part 4: Acoustic Standards for Physical Education Teaching Environments. There are various criteria for these with IgCC being the least stringent and ANSI / ASA S12.60 Part 4 having the most detail and the most stringent. These criteria are generally broken down further for gymnasiums based on the volume of the room. The following table presents a summary of the design criteria options for a gymnasium with a volume of approximately 219,000 cubic feet:

Table 1: Recommended Design Reverberation Time – Gymnasiums

Standard	Reverberation Time at Octave Band Center Frequency		
	500 Hz	1000 Hz	2000 Hz
IgCC	2.0 s	2.0 s	2.0 s
WSSP IEQ 4.0 (Minimum)	2.0 s	2.0 s	2.0 s
WSSP IEQ 4.1 (Preferred)	1.5 s	1.5 s	1.5 s
LEED	1.5 s	1.5 s	1.5 s
ANSI S12.60 Part 4	1.2 s	1.2 s	1.2 s

The standards generally recommend 2.0 seconds or 1.5 seconds reverberation times within gymnasiums with 2.0 seconds being a minimum and 1.5 seconds being preferred. ANSI S12.60 Part 4 takes a more detailed approach noting that at 1.2 seconds with adequately low background noise levels, at least 85% of sentences will be understood correctly with raised voices within a radius of 36 feet from the speaker.

LEED and IgCC provide criteria for open plan offices as follows:

Table 2: Recommended Design Reverberation Time – Open Plan Offices

Standard	Reverberation Time at Octave Band Center Frequency		
	500 Hz	1000 Hz	2000 Hz
IgCC	0.6 s	0.6 s	0.6 s
LEED	0.8 s	0.8 s	0.8 s

TEST RESULTS

The gymnasium contains a volume of approximately 219,000 cubic feet. The open office area contains a volume of approximately 13,000 cubic feet. The following are the existing flooring, ceiling finish, wall finishes, and furniture type:

Table 3: Current Finishes – Gymnasium

Surface:	Finishes in Gymnasium:	Finishes in Open Office:
Ceiling	Exposed Wood	Exposed Wood
Floor	Hardwood Floors	Carpet
Walls	Primarily Painted G.W.B.	Painted G.W.B. and Windows
Furniture	Benches on One Wall	Various Desks and Shelving

The following table presents the measured reverberation time within the space:

Table 4: Measured Reverberation Time - Gymnasium

	Reverberation Time at Octave Band Center Frequency						Overall Equivalent
	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	
Gymnasium	2.8 s	4.6 s	5.7 s	6.0 s	4.8 s	3.1 s	5.3 s
Open Office	1.3 s	1.5 s	1.7 s	1.4 s	1.2 s	1.1 s	1.5 s

Both spaces exceed the recommended design criteria in each of the spaces with the gymnasium tripling the least stringent of the recommended design criteria.

RECOMMENDATIONS

For each of the spaces we are providing recommendations to meet each of the criteria. Additionally, within the gymnasium we are providing recommendations to meet each of the criteria for adding some baffles within the ceiling as well as only wall treatments within the gymnasium. We recommend treating the ceiling and walls of the gymnasium; however, we understand that the aesthetic of the ceiling is an important design consideration in the current state.

Gymnasium Treatments with Ceiling Treatment – 2.0 Seconds (IgCC / WSSP Minimum)

We recommend installing ceiling treatments consisting of baffles as well as wall treatments as follows:

Baffles:

- Install absorptive baffles hung vertically the length of the gymnasium.
- There should be 5 rows located halfway between each sprinkler head (approximately 12'-0" on center).
- The panels should be 4'-0" tall.
- The panels should extend from beam to beam.
- The panels should be selected to have an NRC of at least 0.95.
 - We recommend 2" thick polyester absorption panels.
- This would consist of 2000 square feet of material.

Wall Panels:

- Install absorptive material onto the upper walls of the gymnasium.
- The absorptive material should be as evenly spaced as possible and located on at least two walls with two walls that share a corner.
- The absorptive material should be selected to have an NRC of at least 0.95.
- The overall coverage of material should be at least 800 square feet of material.

This would consist of an overall coverage of 2,800 square feet of material.

Gymnasium Treatments with Ceiling Treatment – 1.5 Seconds (LEED / WSSP Preferred)

We recommend installing ceiling treatments consisting of baffles as well as wall treatments as follows:

Baffles:

- Install absorptive baffles hung vertically the length of the gymnasium.
- There should be 5 rows located halfway between each sprinkler head (approximately 12'-0" on center).
- The panels should be 4'-0" tall.
- The panels should extend from beam to beam.
- The panels should be selected to have an NRC of at least 0.95.
 - We recommend 2" thick polyester absorption panels.
- This would consist of 2000 square feet of material.

Wall Panels:

- Install absorptive material onto the upper walls of the gymnasium.
- The absorptive material should be as evenly spaced as possible and located on at least two walls with two walls that share a corner.
- The absorptive material should be selected to have an NRC of at least 0.95.
- The overall coverage of material should be at least 2,425 square feet of material.

This would consist of an overall coverage of 4,425 square feet of material.

Gymnasium Treatments with Ceiling Treatment – 1.2 Seconds (ANSI S12.60 Part 4)

We recommend installing ceiling treatments consisting of baffles as well as wall treatments as follows:

Baffles:

- Install absorptive baffles hung vertically the length of the gymnasium.
- There should be 5 rows located halfway between each sprinkler head (approximately 12'-0" on center).
- The panels should be 4'-0" tall.
- The panels should extend from beam to beam.
- The panels should be selected to have an NRC of at least 0.95.
 - We recommend 2" thick polyester absorption panels.
- This would consist of 2000 square feet of material.

Wall Panels:

- Install absorptive material onto the upper walls of the gymnasium.
- The absorptive material should be as evenly spaced as possible and located on at least two walls with two walls that share a corner.
- The absorptive material should be selected to have an NRC of at least 0.95.
- The overall coverage of material should be at least 3,825 square feet of material.

This would consist of an overall coverage of 5,825 square feet of material.

Gymnasium Treatments without Ceiling Treatment – 2.0 Seconds (IgCC / WSSP Minimum)

We recommend installing absorptive material to the upper walls of the gymnasium as follows:

Wall Panels:

- Install absorptive material onto the upper walls of the gymnasium.
- The absorptive material should be as evenly spaced as possible and located on at least two walls with two walls that share a corner.
- The absorptive material should be selected to have an NRC of at least 0.95.
- The overall coverage of material should be at least 3,550 square feet of material.

This would consist of an overall coverage of 3,550 square feet of material.

Gymnasium Treatments without Ceiling Treatment – 1.5 Seconds (LEED / WSSP Preferred)

We recommend installing absorptive material to the upper walls of the gymnasium as follows:

Wall Panels:

- Install absorptive material onto the upper walls of the gymnasium.
- The absorptive material should be as evenly spaced as possible and located on at least two walls with two walls that share a corner.
- The absorptive material should be selected to have an NRC of at least 0.95.
- The overall coverage of material should be at least 5,375 square feet of material.

This would consist of an overall coverage of 5,375 square feet of material.

Gymnasium Treatments without Ceiling Treatment – 1.2 Seconds (ANSI S12.60 Part 4)

We recommend installing absorptive material to the upper walls of the gymnasium as follows:

Wall Panels:

- Install absorptive material onto the upper walls of the gymnasium.
- The absorptive material should be as evenly spaced as possible and located on at least two walls with two walls that share a corner.
- The absorptive material should be selected to have an NRC of at least 0.95.
- The overall coverage of material should be at least 7,095 square feet of material.

This would consist of an overall coverage of 7,095 square feet of material.

Open Office Treatments – 0.8 Seconds (LEED)

We recommend installing absorptive material to the upper walls of the open office as follows:

Wall Panels:

- Install absorptive material onto the upper walls of the gymnasium.
- The absorptive material should be as evenly spaced as possible and located on at least two walls with two walls that share a corner.
- The absorptive material should be selected to have an NRC of at least 0.95.
- The overall coverage of material should be at least 415 square feet of material.

This would consist of an overall coverage of 415 square feet of material.

Open Office Treatments – 0.6 Seconds (IgCC)

We recommend installing absorptive material to the upper walls of the open office as follows:

Wall Panels:

- Install absorptive material onto the upper walls of the gymnasium.
- The absorptive material should be as evenly spaced as possible and located on at least two walls with two walls that share a corner.
- The absorptive material should be selected to have an NRC of at least 0.95.
- The overall coverage of material should be at least 660 square feet of material.

This would consist of an overall coverage of 660 square feet of material.

This concludes our assessment and recommendations for the gymnasium and open office areas of the Quileute tribal school. Please let us know if you have any questions about materials or would like assistance in reaching out to product representatives.

For your information, baffle systems, descriptors, measurement methodology, equipment used, local suppliers, product information, and example photos are contained in the following pages.

This report has been prepared for the titled project or named part thereof and should not be used in whole or part and relied upon for any other project without the written authorization of SSA Acoustics, LLP. SSA Acoustics, LLP accepts no responsibility or liability for the consequences of this document if it is used for a purpose other than that for which it was commissioned. Persons wishing to use or rely upon this report for other purposes must seek written authority to do so from the owner of this report and/or SSA Acoustics, LLP and agree to indemnify SSA Acoustics, LLP for any and all resulting loss or damage. SSA Acoustics, LLP accepts no responsibility or liability for this document to any other party other than the person by whom it was commissioned. The findings and opinions expressed are relevant to the dates of the works and should not be relied upon to represent conditions at substantially later dates. Opinions included therein are based on information gathered during the study and from our experience. If additional information becomes available which may affect our comments, conclusions or recommendations SSA Acoustics, LLP reserves the right to review the information, reassess any new potential concerns and modify our opinions accordingly.

DESCRIPTORS

To better understand this report, we present a brief overview regarding sound and vibration properties, descriptors and terms.

Interior noise is often measured as an A-weighted sound level in units of decibels, symbolized as dBA. The A-weighting is a specific weighting filter in a sound level meter that corresponds approximately to the sensitivity of human hearing at the various frequencies.

Sound levels vary significantly, depending on location and activities. People normally experience sound levels between about 30 and 90 dBA, depending on their activity. For example, a nearby noisy vehicle, radio, or power tool may produce 90 dBA; normal conversation is about 55 to 65 dBA; and a bedroom or quiet office is about 30 to 40 dBA.

Absorption coefficient α - The absorption coefficient α describes the fraction of the sound energy that a material absorbs within a frequency band. Theoretically, it can vary from 0 (no sound energy absorbed) to 1 (perfect absorption with all incident sound energy absorbed). The testing methods and analysis follow the ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

Noise Reduction Coefficient (NRC) The effectiveness of a sound absorbing material can be expressed by its absorption coefficient α and a noise reduction coefficient NRC. The absorption coefficient α describes the fraction of the sound energy that a material absorbs within a frequency band. Theoretically, it can vary from 0 (no sound energy absorbed) to 1.0 (perfect absorption with all incident sound energy absorbed). The NRC is the arithmetic average of the sound absorption coefficients at 250, 500, 1000 and 2000 Hz for a specific material and mounting condition. This is the speech frequency range and represents the perceived performance of the material.

Reverberation Time - The reverberation time of a space is defined as the time required for the sound level to decay 60 dB. The decay of 60 dB corresponds to a noise level that is relatively loud that diminishes to a noise level that is barely audible. The testing methods and analysis follow the ASTM E2235 Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Test Methods.

