HGC ENGINEERING
NOISE | VIBRATION | ACOUSTICS

Howe Gastmeier Chapnik Limited
2000 Argentia Road, Plaza One, Suite 203
Mississauga, Ontario, Canada L5N 1P7
t: 905.826.4044

August 15, 2024

Paul F. Ziegler, C.E.T.
Triton Engineering Services Limited
The Old Post - 39 Elora Street South, Units 7, 8 & 9
P.O. Box 159, Harriston, ON N0G 1Z0 Via Email: pziegler@tritoneng.on.ca

Reference: Elora Salt Barn Acoustical Study (DRAFT)

Dear Paul,

As requested, and with the benefit of our site visit, acoustical measurements, discussions with yourself and Wellington County Staff and a review of the architectural drawings, HGC Engineering has studied the acoustical conditions in the Elora Salt Dome in Elora ON regarding a proposed replacement of the lower wood walls with new footings and poured concrete. We are pleased to provide the following report.

The Salt Barn is used to store sand and salt for use during winter months. It is of an uninsulated construction with open eaves; an asphalt pavement floor; lower walls of 4 by 6 inch horizontal pressure treated dimensional pine wood boards; upper end walls of vertical dimensional tongue in groove or shiplap lumber and an interior roof sheeting (chipboard) with exterior metal roofing. A large (~70 square meter) sliding barn door is located on an end wall to allow equipment movement.

During the summer months the barn is cleaned and used as a concert venue with occupancy of 500 for various musical activities on a large portable stage. Events range from popular music with full amplification to choral and symphonic events which also use some degree of sound reinforcement. It is understood the users of the space consider the acoustics of the space to be satisfactory for those events. There were no serious acoustical defects noted during the visit such as flutter echo, slap echo or sound focussing. The barn door is understood to be partially closed to leave an approximately 2 to 3 m gap during concert events.

The lower 8 foot high wooden walls are in poor condition due to exposure to dampness and salt, and significant gaps are visible between most of the horizontal wood boards increasing, their acoustical absorption. County personnel wish to understand the acoustical ramifications of the proposed replacement of the lower wooden walls with poured concrete.

Shape and Interior Volume
An inspection of the architectural drawings estimated the physical volume of the space to be ~ 8,400 cubic meters.

This results in a volume per occupant ratio of ~17 which is high for spaces with multipurpose facility. Such a large volume in an insulated mechanically ventilated building with standard building materials would result in excessive levels of reverberation and unsatisfactory acoustical conditions for amplified speech and most musical activities except perhaps cathedral organ recital.

In this case, consideration that the acoustical conditions are currently satisfactory leads to speculation that the bare weathered interior wood surfaces and the heavily worn asphalt floor are providing more sound absorption than would be expected from finishes in insulated and mechanically ventilated music venues. This was confirmed in the measurements and analysis reported below.

Reverberation Criteria

Reverberation is the tendency of sound to linger as it is reflected off the room surfaces. High levels of reverberation degrade speech intelligibility as our ears and auditory system have evolved to listen for the sound arriving directly from the source and early sound reflections to give us cues about our surrounding environment and understand direct speech. Reverberant sound arrives too late to be useful, and if there is too much reverberation, it confuses our auditory system and masks speech syllables and rapid musical passages. High levels of reverberation also interfere with inter-musician audibility, sound recording and the functionality and intelligibility of sound systems.

Reverberation is described in terms of *Reverberation Time* (RT), which is the time in seconds required for sound to decay by 60 decibels after the sound source has stopped. RT values are measured in six octave frequency bands from 125 Hz (low frequency or bass) to 4000 Hz (high frequency or treble).

An RT in the range of 1.5 to 2.5 seconds is favoured for choral performance and symphonic or organ music. An RT in the range of 1.0 to 2.0 seconds is generally appropriate for a multipurpose facility and an RT below 1 second is considered to represent a well-controlled acoustical environment, favouring speech intelligibility and popular music with individually amplified electronic instruments and drum kits, although may be considered “dead sounding” for a choral or symphonic music. An RT below 0.6 seconds is more typical of a broadcast or recording studio where the technicians fully control the recorded sound and add electronic reverberation or other effects as appropriate.

In this case considering the requirement for multipurpose activities with reasonable intelligibility for reinforced speech and the reinforced popular, choral or symphonic activities we recommend the reverberation target be in the range of 1.0 to 2.5 seconds in the mid-frequency (500 Hz) octave band. The recommended range is shown in the attached Figure 1. An RT exceeding 2.5 seconds in the mid to upper frequency bands can cause difficulties in the functioning of sound reinforcement systems.

Absorption for Reverberation Control

In general, reverberation is controlled by applying acoustically soft surface materials such as sound absorbing ceiling tiles, panels made of fibreglass or mineral wool or other porous materials which absorb much of the sound rather than reflecting it back into the space. In this case from the measurements below it appears that the bare weathered walls and ceiling and worn rough asphalt are providing sufficient reverberation control on their own.

Replacing some of the lower walls with smooth poured concrete is expected to increase the reverberation in the space to some degree, as illustrated in the measurements and analysis below.

Measurements Analysis and Recommendations
The site was visited in July and August to conduct measurements and gain an understanding of the space. Reverberation was measured in Octave Frequency Bands and the results are presented in Figure 1. These results indicate mid-band (500 Hz) RTs slightly exceeding 3 seconds when the space is empty and just over 2 seconds when the space is outfitted with concert furnishings (stage, curtains, undeployed seating, admission tables etc.) but unoccupied. The RT will decrease further with occupancy, but our analysis is conducted under unoccupied conditions to represent the worst case of low occupancy events.

An acoustical computer model was constructed of the barn calibrated with the measurement results. It was then used to investigate the expected change in reverberation by replacing the lower walls with concrete walls of various heights. The analysis as shown in Figure 2 suggests the following:

1. The installation of a 4 foot concrete wall would result in a minor, although largely imperceptible change in the acoustical conditions.

2. The installation of a 6 or 8 foot wall would result in a more significant change in the acoustical conditions and be more noticeable, considering that the height of the wall would be above ear level of most standing patrons.

3. If a 6 foot wall is required for operational purposes, its reflective acoustical characteristics could be modified by providing it with a rough surface or a surface which included some relief such as one inch deep slotted recesses or other patterned finishes with 1 to 2 inch relief to promote the diffusion of sound rather than more glaring lateral reflections.

4. If an 8 foot wall concrete wall is required operationally, and should concerns be raised by concert participants, the use of 4 foot high sound absorbing stage curtains suspended from the top of the wall over approximately ½ of its extent could be considered. Another option could be the use of more natural and architecturally compatible materials such as hay bales, subject to fire code considerations.

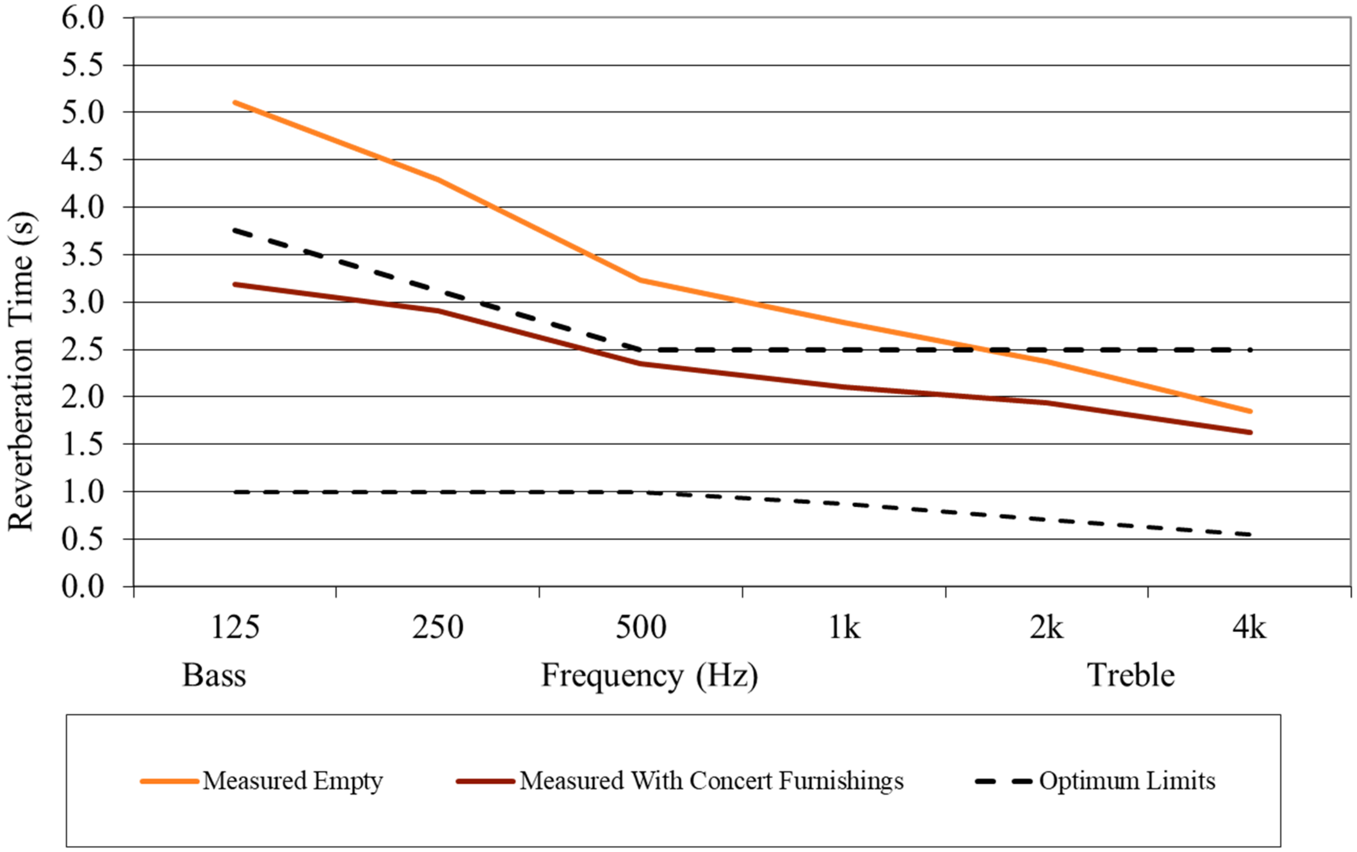
Thank you for the opportunity to provide this information. We trust it is sufficient for the present purposes.

Yours truly,
Howe Gastmeier Chapnik Limited

DRAFT

Bill Gastmeier, MASc, PEng
Principal

Figure 1
Elora Salt Barn Reverberation Measurements



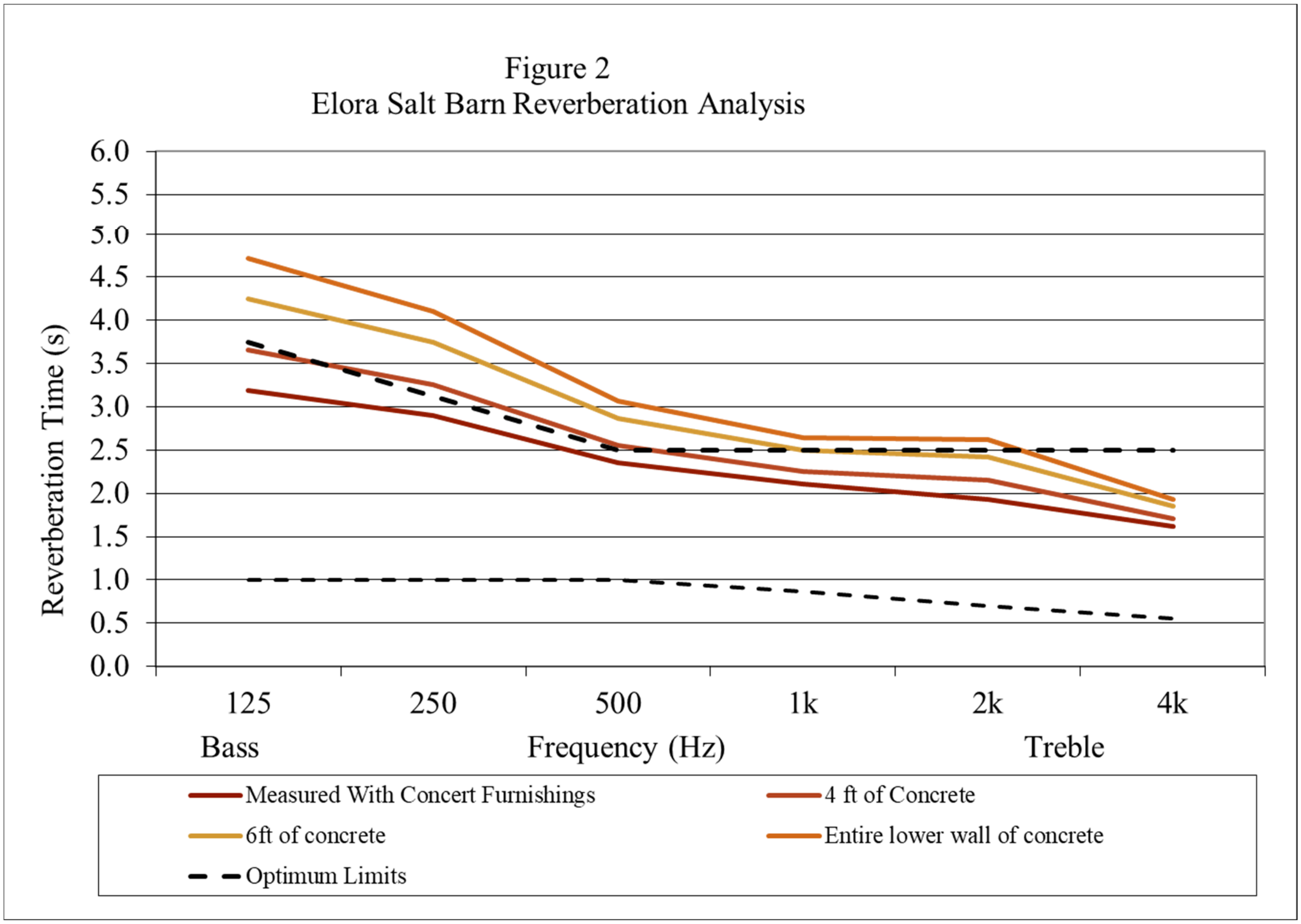


Figure 2
Elora Salt Barn Reverberation Analysis
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Reverberation Time (s)
125
250
500
1k
2k
4k
Bass
Frequency (Hz)
Treble
Measured With Concert Furnishings
4 ft of Concrete
6ft of concrete
Entire lower wall of concrete
Optimum Limits