4pAAb6. A study of a real world transmission loss chamber and the Kinetics UniBrace-L technology.

Eric W. McGowan*, Scott Hulteen and Dominique J. Cheenne

*Corresponding author’s address: eric.mcgowan@loop.colum.edu

This study performed at Columbia College Chicago (CCC) had two purposes: The first was to test the functionality of the recently-developed real-world transmission loss (RWTL) chamber, while the second was to evaluate the performance of the Kinetics UniBrace-L product on a double wall construction assembly. CCC’s RWTL chamber is designed to illustrate issues that have influence when testing partitions in the field. It is smaller in volume than a certified STC chamber, which results in modal effects on both sides of the chamber. Numerous microphone positions are available and are used to display the modal effects of the rooms and to determine an average sound pressure level in both spaces during testing. Absorption values are also substantially different between the sending and the receiving spaces (each side can be switched as either sending or receiving room) and diffuse-field conditions are not achieved in either side of the chamber. As such, the RWTL chamber will typically yield a lower STC value than a certified STC Chamber and will also yield lower values than what may be experienced when performing a test that would follow the standard ASTM E-336 or associated procedures.
Introduction

The purpose of this study was to determine the performance capabilities of the UniBrace Single L technology designed by Kinetic’s Noise Control. It was made known that no Sound Transmission Class (STC) testing had been done on the UniBrace-L product, though it had been designed to provide bracing without any decrease in transmission loss. The Real-World Transmission Loss (RWTL) chamber at Columbia College Chicago is capable of finding such information, and provided a unique opportunity to obtain results in a different fashion than in an industry STC testing facility or field STC test. A testing specimen was designed and constructed to fit within the RWTL chamber and to provide results containing useful information regarding the performance of the product. The construction and the testing were entirely carried out using the resources located within Columbia College Chicago’s Audio Arts and Acoustic’s facilities with the help of both faculty and staff of the college and employees at Kinetics Noise Control.

Methods and Procedure

The chamber housed in the 33 E. Congress building at Columbia College Chicago is not a certified Sound Transmission Class chamber; rather it is Real-World Transmission Loss, or RWTL chamber. One significant difference is the size of the two rooms housed in the chamber. Columbia’s RWTL room is smaller in volume than a certified STC chamber, which results in modal effects on both sides of the chamber. Numerous microphone positions are available and are used to display the modal effects of the rooms and to determine an average sound pressure level of both spaces. Along with the small volume, diffuse-field conditions are not achieved in either side of the chamber. As a result, the RWTL Chamber will yield a lower STC value than a certified STC Chamber. This provides a “worst case” scenario that is very useful for real world application.

The RWTL chamber is composed of a “send” and a “receive” room that are connected by a 50x50 inch opening housed within a three inch thick steel frame. The send room houses two QSC K8 powered speakers that produce the test signal. Both of the speakers are suspended from Kinetic’s Muta 1-35 hangers at a height of fifty-two inches from the floor. Speaker A is hung facing the northwest corner of the room, while Speaker B is nineteen inches away from and facing the center of the opening that joins the two rooms. The send room contains four omnidirectional Behringer ECM-8000 measurement microphones that are used to measure sound pressure levels. The Microphone positions were chosen in a manner that would produce the best possible coverage of the space. The receive room is connected to the send room by the test window frame. Similar to the send room, it houses four omnidirectional Behringer ECM-8000 measurement microphones. These microphone positions were also chosen to cover the space in a way that would yield the best total coverage. A figure showing the microphone and speaker positions can be found on the last page of this report.

The equipment used in the test is shown in Figure 1. As Figure 1 displays, a stimulus was sent from the SpectraPLUS software to a speaker processor. It was then processed to only include frequencies in the testing range. From the speaker processor, the stimulus was sent to the two speakers in the send room of the RWTL chamber. Four microphones in the send room measured the output from the speakers, and four additional microphones in the receive room measured the level of the stimulus after passing through the test specimen. The data was then recorded and processed in a Microsoft Excel spreadsheet.
The test specimen was constructed inside of a testing frame, made from 2x12 Glulam beams, built by the engineers at Columbia College Chicago. To eliminate any rigid contact between the frame and the walls to be built, the inside of the frame was lined with two strips of closed-cell Neoprene. The double wall frame portion of the specimen was then constructed with fabricated 2x4’s, made from multi-ply birch, and also constructed by the Columbia engineers. Two layers of 5/8” drywall were used to cover both outward facing sides of the walls. Due to the fact that only the front side of the specimen needed to have the capability of being removed, the back two layers of drywall were attached both with screws and glue to the wood frame. To ensure that the back wall was completely void of rigid contact with the frame, QuietSeal Acoustical Sealant was used to fill the gap between the two. As implied before, the front layers of drywall needed to be able to be removed so that the different testing materials could be implemented within the specimen. To achieve this, the two layers were glued together and only attached to the frame with screws. Two handles were also installed to allow for easier removal of the drywall. Finally, two strips of removable closed-cell foam rope were used to fill the gap between the wall and the test frame.

As shown in Figures 2 and 3, there are several differences between the original drawings of the test specimen and the one that was eventually built and used for testing. In Figure 3, the two 2x4 studs in each wall were aligned. During construction, it was determined that these studs needed to be staggered in order to be able to implement the
UniBrace-L product into the specimen. Due to the fact that the outermost studs on each wall needed to be aligned for construction, a piece of 2x4 was used on each side to create a staggering effect and allow for the UniBrace-L units to be mounted. In addition to these changes, the locations of the plywood bracings were changed in order to make certain that there was no overlapping or other interference with holes drilled to attach the UniBrace-L units. Concerning the extra measures taken to isolate the frame from the walls, the QuietSeal and closed-cell foam rope were used in place of the putty that was originally planned to be used.

FIGURE 2. Final Design for Test Specimen

FIGURE 3. Original Design for Test Specimen
Before each round of testing, all microphones were calibrated to 94 dB at 1 kHz to provide maximum accuracy for each test. After calibration the test specimen was secured within the wall and the door to the chamber was shut. The Excel software was then run and 110 dB of pink noise was played for sixty seconds at each position. The pink noise was band limited from 100 Hz to 10 kHz to reduce vibrational and modal problems that might have occurred when sending lower frequencies outside of our testing range at such high levels. The software averaged the recorded levels from each of the four microphones in both the “send” and “receive” rooms which was then processed using equations found in the ASTM E-90 standard to produce the transmission loss number. To take possible modal differences at each position into account, the maximum and minimum recorded values were plugged into an Alf-Warnock transmission loss calculator in order to produce a complete range of values. Each test and subsequent calculation was conducted twice to confirm that consistent results were obtained.

This testing procedure was used a total of six times to gather the required data. The first and second tests contained no bracing between the two walls and were conducted using R-19 and R-13 fiberglass insulation respectively. The third and fourth tests implemented the rigid plywood bracing and also used R-19 and R-13 respectively. The final two tests were conducted using the UniBrace-L technology with the same insulation as all previous tests.

**Results**

![Comparison of Minimum, Maximum and Average STC with each Bracing Method](image)

**FIGURE 4.** Comparison of Minimum, Maximum and Average STC with each Bracing Method
As seen in Figure 4 and Figure 5, the results of no bracing, or “air,” along with the UniBrace-L bracing tests produced similar results. The maximum STC for no bracing was 57 dB with a minimum of 48 dB, while the UniBrace-L produced a maximum of 57 dB and a minimum of 49 dB. The average STC of both tests was 53 dB, indicating that for the purpose of this testing they performed equally. The plywood bracing produced the lowest numbers, with a maximum STC of 53 dB, a minimum or 38 dB and an average of 46 dB.

Omitted from these figures is the comparison of the difference between tests with R-19 fiberglass insulation and the R-13 insulation. Although testing was completed in full with each type, there were no noticeable differences to provide useful data.

**Conclusion**

As shown in the results, when using the UniBrace Single L product to brace the double-wall test specimen, an average STC of 53 dB over all four microphone positions was measured. This matched the result of the testing done without any bracing, meaning the product indeed provides bracing without any decrease in transmission loss. It should be kept in mind that these tests were conducted in a Real-World Transmission Loss chamber and not under perfect laboratory STC conditions. Real-world and worst case scenarios were reproduced while still giving usable results that could accurately gauge the performance of the UniBrace-L. If it is desired to obtain more industry-standard results from this technology for a more detailed specification, the next step in the process would be invest in measuring the products in a true STC laboratory environment.