

Introduction

- ♪ Musicians are at a higher risk for noise induced hearing loss on the basis of their age (2,3)
- ♪ Acoustic shields offer a beneficial role in reducing noise exposure to musicians by blocking sound waves which are generated behind a musician
- ♪ In the previous study, it was determined that diffraction from the walls in a non-orchestral setting was likely a significant factor in the low attenuation values measured (1)
- ♪ This study was conducted at the orchestra pit of the **Four Seasons Centre for the Performing Arts** in Toronto (Figure 1)
- ♪ Professional musicians were asked to play excerpts from Act 1 of Tchikovsky's Swan Lake using either a **flute, trombone or trumpet** to provide coverage for low, medium and high portion of the sound spectrum
- ♪ To compare results with the previous study, same shields were used to measure attenuation: Manhasset and Wenger (Figure 2 and 3 respectively)



Objective
To obtain the attenuation values for Manhasset and Wenger Shields, and assess their effectiveness in reducing noise exposure to orchestral musicians
Figure 1: Orchestra Pit at the Four Seasons Centre for the Performing Arts

Methodology

- ♪ 2 dosimeters were placed on both shields: one in front of the shield facing towards the musician and the other behind, difference between the two would give attenuation values (shown in table 1)
- ♪ After reaching consensus to run the trial, two experimenters simultaneously turned on their designated dosimeters (2 on each shield) and nonverbally signaled the musician to play their instrument (one at a time)
- ♪ Measurements were simultaneously collected from the two shields via dosimeters, which were located at an angle of 45° and a distance of 1m from the musician
- ♪ Measurements were also manually recorded in notebook for later reference and comparison
- ♪ A total of 6 trials were conducted, 2 for each instrument: Trumpet, Flute and Trombone
- ♪ After conducting the experiment, data was obtained electronically from the dosimeters and analyzed

Results

Trials:	Instruments:	Shield		Attenuation*	Average Attenuation	Standard Deviation
		Front	Back			
		Manhasset				
1	Trumpet	103.5	92.8	10.7	10.4	0.4
	Flute	91.9	82.8	9.1		
	Trombone	93.5	85.9	7.6		
2	Trumpet	103.2	93.1	10.1		
	Flute	90.7	83.6	7.1		
	Trombone	96.1	85.6	10.5		
		Wenger				
1	Trumpet	101.2	95	6.2	5.9	0.4
	Flute	90	83	7		
	Trombone	95.3	89.3	6		
2	Trumpet	99.5	93.9	5.6		
	Flute	90.3	85.9	5		
	Trombone	96.2	89.2	7		

Note: Attenuation = Leq Front - Leq Back, dBA

Table 1: Attenuation measurements obtained from the experiment



Figure 2: Manhasset Shield



Figure 3: Wenger Shield

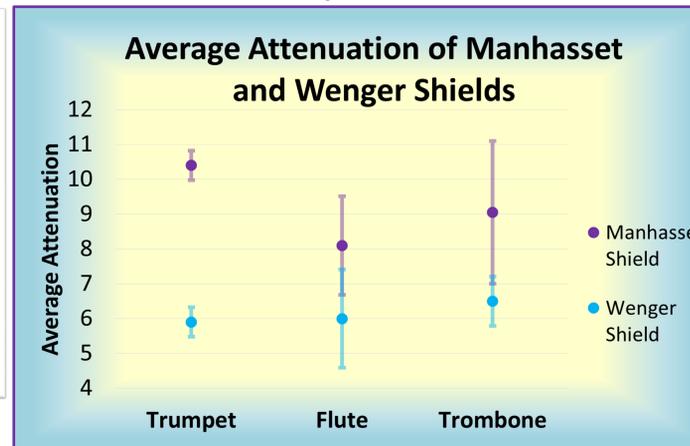


Figure 4: Chart depicting the average attenuation values of Manhasset and Wenger shields

Discussion

- ♪ Manhasset shields outperformed Wenger shields as attenuation values obtained for it were larger as shown by figure 4
- ♪ Manhasset's larger surface area is likely the reason for its larger attenuation values
- ♪ Manhasset shield seems significantly better able to reduce noise exposure from instruments playing at higher sound spectrum than Wenger (trumpet versus flute)
- ♪ Measured attenuations are larger than previous study, supporting the earlier assertion regarding diffraction from the walls
- ♪ These attenuation values may be smaller in real live orchestra, as multiple instruments will be playing simultaneously and sound may be penetrating from multiple sites
- ♪ Both shields are able to reduce noise level, but their average attenuation is less than 10 dBA

Conclusion

- # Attenuation values measured for both shields are neither satisfactory nor significant in reducing noise being able to reach musician's ears.
- # Manhasset's overall performance is better than Wenger's
- # Future Recommendation: Conduct a spectral analysis with a particular focus on frequency measurements to assess the effectiveness of the shields in reducing high frequency exposure

Acknowledgements

The researchers would like to thank **Leslie Ailt** (principal flute), **Richard Sandals** (principal trumpet) and **David Pell** (bass trombone), members of the **National Ballet of Canada Orchestra** for playing their instruments for the trials. The researchers would like to thank **Lydia Hamata** from Ryerson University for helping collect data

References

- Behar, A., Luo, Y., Mosher, S., & Abdoli-Eramaki, M. (2017). SOUND ATTENUATION OF ACOUSTIC SHIELDS. *Canadian Acoustics*, 45(3), 150-151.
- Jansen, E. J. M., Helleman, H. W., Dreschler, W. A., & de Laat, J. A. P. M. (2009). Noise induced hearing loss and other hearing complaints among musicians of symphony orchestras. *International archives of occupational and environmental health*, 82(2), 153-164.
- Schmidt, J. H., Pedersen, E. R., Paarup, H. M., Christensen-Dalsgaard, J., Andersen, T., Poulsen, T., & Baelum, J. (2014). Hearing loss in relation to sound exposure of professional symphony orchestra musicians. *Ear and hearing*, 35(4), 448-460.