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Williamson County Justice System
Vibration Study

Prepared for

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Williamson County Justice System Vibration Study

1. Introduction

At the request of Gresham Smith, a vibration study was performed for the Williamson County Justice System project in Franklin, Tennessee.

This project includes the following buildings:

- WCJ Special Operations Division
- Williamson County Adult Detention Center
- WCJ Juvenile Justice Center
- Williamson County Sheriff's Office Gun Range and Impound Lot

There are also several existing buildings on site with concrete masonry and brick cladding.

Blasting operations at two nearby quarries cause perceptible vibrations at the project site. The nearest blasting is approximately 500 ft to the north of the Adult Detention Center.

The primary purpose of this study is to determine whether blasting causes ground-borne vibrations that might damage the buildings in this project. A secondary purpose is to comment on the likelihood that blasting vibrations might damage the existing buildings.

2. Vibration Limit

Blasting inevitably causes ground-borne vibrations. When it is performed in the vicinity of a building, these vibrations might damage plaster or drywall partitions and ceilings, cladding, or structural components. Plaster and drywall are much more delicate than cladding or structural components, so plaster and drywall are the primary focus of the published limits.

Plaster and Drywall: In the US, most limits on ground-borne vibrations due to blasting are based on the U.S. Bureau of Mines (USBM, Siskind et al. 1980) report *Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting*. Its Figure B-1 provides peak particle velocity (PPV) limits in in./sec. units for structures with plaster or drywall. A slightly modified version of the USBM limit for drywall appears in the Tennessee Code Title 68, *Safety and Environmental Protection 68-105-104* Figure A – it is the applicable limit on this project. These limits are plotted in Figure 2.1.

Cladding and Structural Components: Johnson and Hanson (2015) summarized results of their study of the USBM report mentioned above. They stated that minor damage such as hairline cracking of masonry "typically appeared at approximately 4 to 5 in./sec. and was never observed at below 1.0 in./sec." They also stated that major damage such as cracking of foundations or bearing walls typically did not occur below 5 in./sec. The values in this paragraph are not official limits but provide references for assessing the likelihood of damage. The writer is not aware of PPV limits for structural steel or precast concrete, which is planned for some of the buildings in this project. However, those components are less delicate than masonry, so damage is not expected below 5 in./sec.

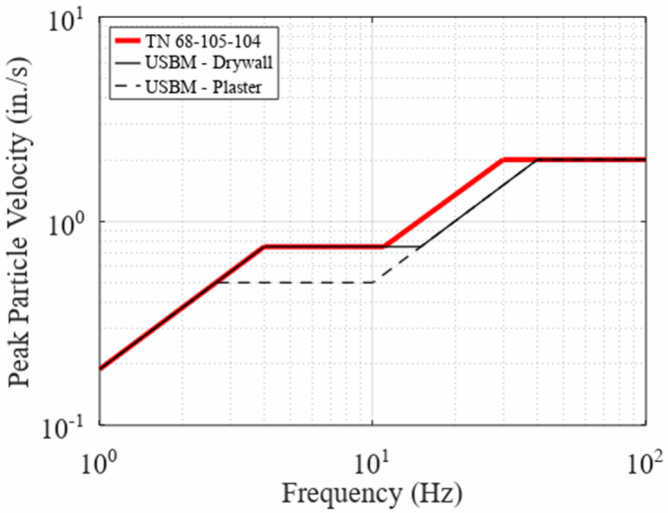

Figure 2.1: Vibration Limits

3. Measured Peak Particle Velocities and Evaluation

Vibration measurement records by Vibra-Tech were provided for use in this study. It is assumed that these represent high-end PPVs for blasting at the two nearby quarries. It is also assumed that these PPVs were measured close to the property line with the current project. The maximum PPVs from each measurement are summarized in Table 3.1.

Vibration measurement records were also provided by TTL in their detailed report dated 2/20/2025. Their geophone vibration sensor was placed just outside the northwest corner of the Adult Detention Center, shown in Figure 3.1. This is the project location nearest to the adjacent quarries. Vibrations were monitored for three weeks. During that time, PPVs due to eight blasts were recorded. These are summarized in Table 3.2.

The PPVs from Vibra-Tech and TTL are plotted in Figure 3.2. The maximum measured PPV, 0.342 in./sec., is significantly below the limit. Therefore, ground-borne vibrations due to blasting should not damage the drywall partitions or ceilings in the current project.

The maximum PPV is far below the reference values for cladding and structural components listed in Section 2 – the minimum of which was 1.0 in./sec. Therefore, ground-borne vibrations are not expected to damage masonry walls and brick cladding in the existing building or steel framing or precast concrete in the new buildings.

Table 3.1: Summary of Maximum PPVs – Vibra-Tech

Date	Time	Longitudinal		Transverse		Vertical	
		Freq. (Hz)	PPV (in./s)	Freq. (Hz)	PPV (in./s)	Freq. (Hz)	PPV (in./s)
8/6/2019	14:45:20	41.7	0.330	26.3	0.175	50.0	0.185
8/8/2019	11:30:06	50.0	0.138	45.5	0.0980	55.6	0.0780
8/22/2019	13:00:48	55.6	0.263	62.5	0.103	71.4	0.133
9/19/2019	11:30:42	20.0	0.235	25.0	0.238	55.6	0.170
3/11/2021	11:59:18	26.9	0.279	21.3	0.326	34.1	0.208
3/31/2021	9:58:29	23.3	0.177	25.6	0.186	23.3	0.207

Figure 3.1: Vibration Sensor Location – TTL

Table 3.2: Summary of Maximum PPVs – TTL

Date	Time	Longitudinal (N-S)		Transverse (E-W)		Vertical	
		Freq. (Hz)	PPV (in./s)	Freq. (Hz)	PPV (in./s)	Freq. (Hz)	PPV (in./s)
1/27/2025	15:57:21	78.8	0.0413	53.9	0.0354	85.3	0.0881
2/3/2025	13:58:10	46.5	0.276	46.5	0.149	85.3	0.159
2/3/2025	14:02:21	51.2	0.318	48.8	0.342	85.3	0.248
2/4/2025	15:58:24	41.0	0.0227	53.9	0.0236	93.1	0.0462
2/7/2025	15:55:20	51.2	0.0208	53.9	0.0133	78.8	0.0164
2/10/2025	15:55:34	44.5	0.0177	93.1	0.0106	85.3	0.0180
2/11/2025	13:07:20	56.9	0.0267	78.8	0.0205	93.1	0.0195
2/13/2025	15:18:13	60.2	0.0227	60.2	0.0289	85.3	0.0338

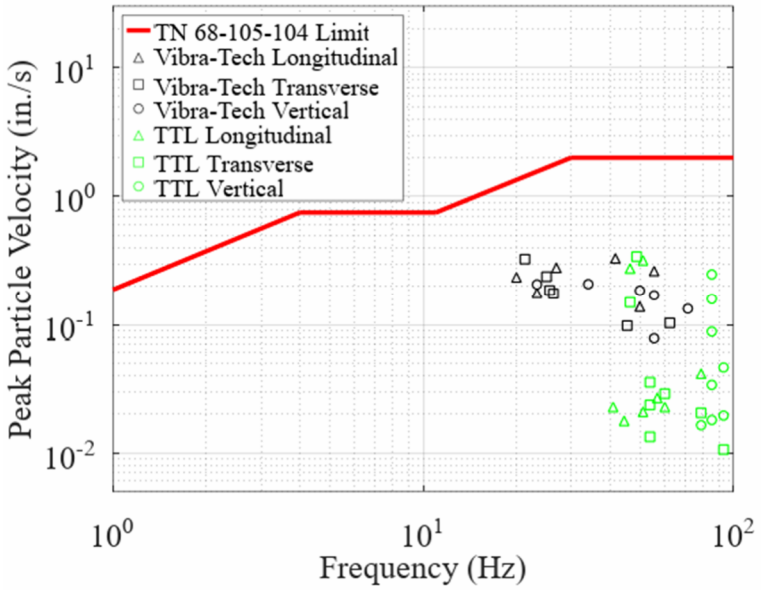

Figure 3.2: Summary of Measured PPVs vs Limit

4. Summary and Conclusions

A vibration study was performed for the Williamson County Justice System project, which is in the design phase. The concern is that blasting in nearby quarries might cause ground-borne vibrations that damage the buildings in this project.

The applicable limit for this project is from Tennessee Code Title 68, Safety and Environmental Protection 68-105-104 Figure A, which is reproduced herein. It is similar to the widely used U.S. Bureau of Mines limit for structures with drywall.

Vibration measurements from Vibra-Tech and TTL were provided for use in this study. The measured peak particle velocities (PPVs) were far below the limit. Thus, ground-borne vibrations due to blasting should not cause damage to the drywall partitions or ceilings.

The measured PPVs were far below reference values for damage to cladding and structural components. Thus, ground-borne vibrations due to blasting are not expected to damage brick walls, masonry walls, steel framing, and other structural components in the existing buildings and new buildings.

In summary, vibrations due to blasting in the quarries are not expected to cause damage to the buildings in this project or the existing buildings on the site.

Thank you for including our services in your project. If you have any questions, please contact me.

Submitted by:

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References

Johnson, A.P. and Hannen, W.R. (2015), "Vibration Limits for Historical Buildings and Art Collections," *Journal of Preservation Technology*, 46(2-3), 66-74.

Siskind, D.E., Stagg, M.S., Kopp, J.W., Dowding, C.H. (1980), *Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting*, Report of Investigations 8507, US Bureau of Mines.