

What's Shakin'? The Assessment of Vibrations in an Urban Environment.

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Summary

Vibrations in urban environments come from many sources; traffic, construction activities, and blasting. The human response to these vibrations is often ambiguous and are often measured by the impact to items in households or an individual (ie. shaking glass of water or dishes, cracks in walls or foundations). We use multiple 3-component geophones and accelerometers in multiple rooms in a building to assess peak particle velocity (ppv) and analyze the dataset to determine how vibration from an seismic source changes in a building. Results of the surveys suggest solutions and preventative measures to reduce vibration to acceptable levels.

Theory / Method / Workflow

Anticipated construction activities prompted vibration monitoring of nearby buildings to determine exposure limits for the buildings and its inhabitants (ISO 91.120.25, 13.160). Vibration monitors are placed along the foundations, and several locations on each floor of the buildings as well as near to the source location to correlate the seismic event to nearby buildings. Analysis of each component of each geophone is conducted simultaneously to determine ppv experienced at each geophone. Based on the results, mitigation measures are suggested.

Results, Observations, Conclusions

Peak particle velocity changes throughout a building. Contrary to anticipated results, the foundation of the buildings did not experience the highest ppv. The highest ppv's are experienced in the intermediate floors between the foundation and top of the building; specifically, in the center of the floors (Figure 1-1). Depending on the anticipated duration or frequency of the seismic source reduction of amplitude, mitigation measures included engineered barriers, compacted soil between the source location and buildings, and simply modifying the duration, frequency, and/or size of the source.

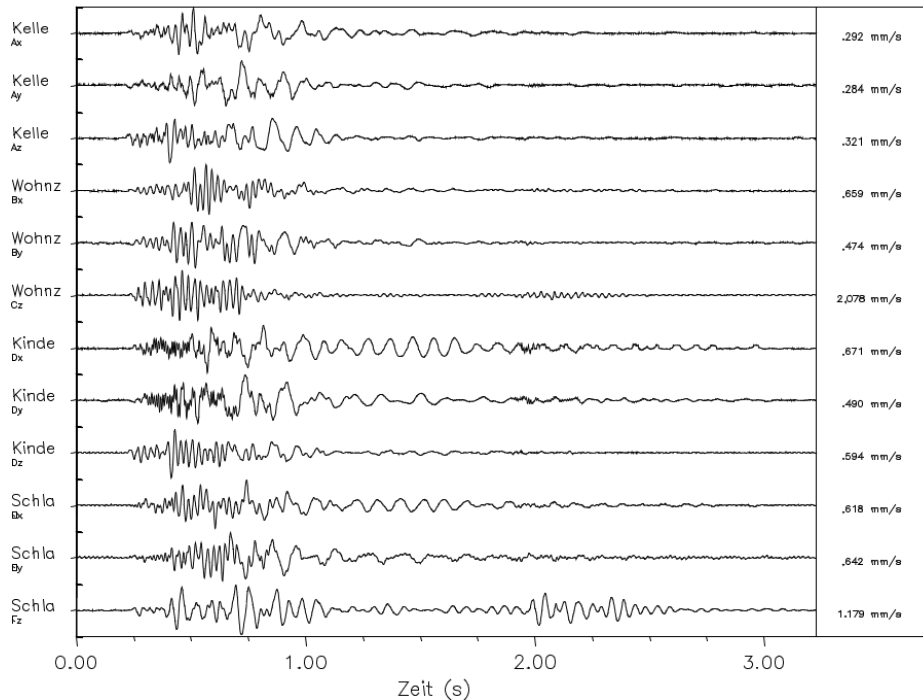


Figure Error! No text of specified style in document.-1: Vibration response of four 3 component geophones placed at various locations in a residential building.

Novel/Additive Information

Empirical evaluation of vibrations is important to determine the potential of damage to buildings. However, applying empirical measurements and standards to vibrations for people is difficult as the perception of vibrations are subjective to individuals. Field surveys have been conducted to determine exposure-response relationships to determine acceptable vibration criteria.

Vibration standards change depending on country, province, and sometimes city. Canada currently has no standards in place to monitor vibrations, but has put the onus on each municipality to decide standards.

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References

- ISO 91.120.25 – Vibrations, Shock and Vibration Measurements
- ISO 13.160 – Vibrations and Shock with Respect to Human Beings
- DIN 4150 – Vibrations in Buildings
- BS6472 -Guide to evaluation of human exposure to vibration in buildings