Using Seismic Design Specifications to Help Teach Introductory Physics

Frederick J. Thomas, Professor of Physics (retired), Sinclair Community College and President, Learning with Math Machines, Inc., Freeland, MI
Robert A. Chaney, Professor of Mathematics, Sinclair Community College, Dayton, OH
Richard Tseng, Ph.D. PE, Semi-retired as Chief Geotechnical Engineer with Bowser-Morner, Inc., Dayton, OH

Do you know the engineering specifications for your school's Maximum Considered Earthquake ???

The specified horizontal acceleration is *never* zero.

Overview

When teaching basic physics concepts and methods, it helps to incorporate examples that::

1. Show applications of physics outside the physics classroom,
2. Are related to students' current environment, and
3. Stimulate further questions.

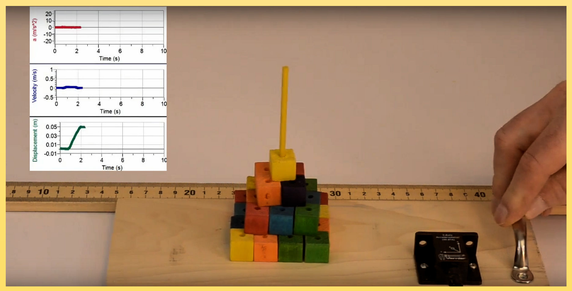
Whether in areas with relatively high earthquake hazard (such as Provo, Utah) or an area with relatively low hazard, structural engineers are required by law and ethics to ensure that major buildings can withstand a clearly defined "Maximum Considered Earthquake." Knowing the specifications for your school can help deepen students' understanding of many physics topics, including acceleration, vectors, wave propagation, resonance, material properties and more.

Maximum Considered Earthquake (MCE)

The MCE is usually the worst possible seismic event with a 2% probability of occurring during an expected 50-year lifetime of a building, dam, bridge or other structure. The key specification for the MCE is ***peak horizontal ground acceleration, PGA,***

Most schools and conference buildings are Risk Category III, for which the engineering goal is to avoid catastrophic collapse during the MCE. Category IV structures (hospitals, water treatment facilities, etc.) require far more detailed seismic designs which aim to ensure the building can resume operation soon after the earthquake.

Hands-On Activities



Simple shake tables with data collection software can let your students replicate your (or someone else's) Maximum Considered Earthquake..

Topics beyond PGA

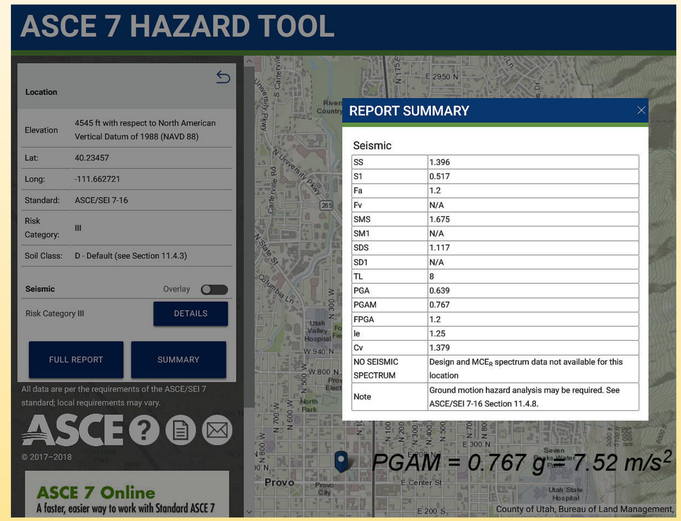
Resonance: Engineering specifications provide data about frequency-dependent risks.

Wave Propagation: Near-surface variations in wave velocity can greatly effect the seismic hazard. (MPGA vs PGA in the report at right.)

Terminal Velocity: Some soils "liquefy" during earthquakes.

Friction:: Earthquake-induced landslides.

Modelling: How the US Geological Survey and ASCE set the seismic specifications.



Properties of Materials: Why unreinforced masonry structures are especially dangerous.

Additional Information

The Physics of Destructive Earthquakes by Thomas, Chaney & Tseng, IOP Concise Physics / Morgan & Claypool, 2018.

Detailed MCE data for the US is available without cost at https://hazards.atcouncil.org/

The Global Seismic Hazard Assessment Program, GSHAP, provides estimates of PGA values for every on-shore location on earth.

Scan me

Notes

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