EARTHQUAKE WAVES

Units 22, Dr. John P. Cise, Professor of Physics, Austin Com. College, Austin, Texas, USA jpcise@austincc.edu & New York Times June 19, 2018 by Thomas Fuller, Dedicated to Stephen McLandrich,Earthquake Engineer

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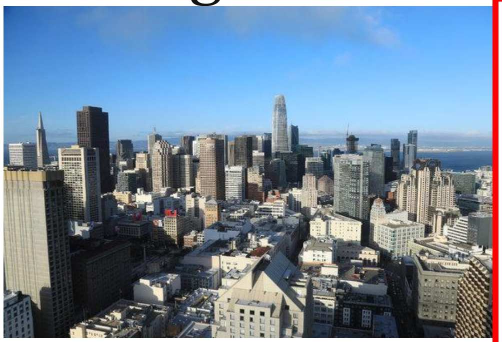
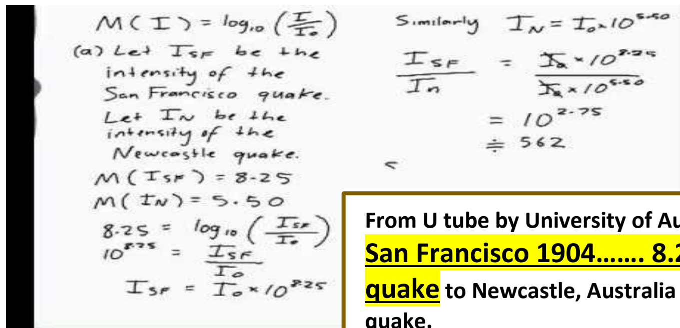
Writing About Earthquakes, and Feeling One





From U tube by University of Australia comparing San Francisco 1904……. 8.25 richter scale quake to Newcastle, Australia 5.5 richter scale quake.

The view from the Cityscape Lounge atop the Hilton San Francisco. It was around 7:30 p.m. on a Monday in May and I was sitting in my 12th-floor office in San Francisco, writing an article about how some high-rise buildings are more vulnerable to earthquakes than others. Then the building jolted and rattled like a train lurching out of a station. It was a **mini earthquake, a 3.7 magnitude centered across the San Francisco Bay.** And it had uncanny timing, because the article I was writing had already crossed from the professional into the personal.A list of potentially vulnerable buildings published in the appendix of a report put out in April by the U.S. Geological Survey had a familiar address on it: the San Francisco bureau of The New York Times. As I was looking up the magnitude of the earthquake on the U.S.G.S. site, my 6-year-old daughter called from our home across the Bay. “Dad! We had an earthquake! We had an earthquake!” she yelled excitedly over the phone. “It was like a giant stepped on the house!”As a correspondent in Asia, I had covered the Nepal earthquake of 2015 and experienced a number of aftershocks. But this the first earthquake that I had felt since moving to the San Francisco Bay Area two years ago. It caused no damage, but I was surprised at how strongly even such a seismic blip could jolt a building. The article I was researching, which was published last week, involved a particular class of buildings constructed before the Northridge earthquake in 1994, when a critical flaw was discovered in the connections between columns and beams. Northridge was a humbling experience for engineers who realized that a welding and connection technique that had been used for three decades made steel-frame buildings more likely to collapse. A recent study co-authored by Gregory Deierlein, a Stanford University earthquake engineering expert who is a seismic advisor to the city of San Francisco, found that a typical building with the flaw had roughly a 50 percent chance of collapse with ground shaking similar to the 1906 San Francisco earthquake. (The buildings are not thought to be vulnerable to lower intensity earthquakes.) The probabilities of collapse are calculated by using complex computer models that engineers agree are far from perfect. Engineers often say we won’t know how accurate those models are until the buildings actually go through an earthquake.I had spoken to only a handful of my San Francisco bureau colleagues about our building’s seismic vulnerabilities. So on the day before the article was published last week, I sent a note to 20 or so reporters and editors in the bureau to alert them both to the issue and the story about it.

Richter Scale:regina.com: The Indian Ocean Earthquake that struck the coast of Indonesia in 2004 was registered as a 9.0 magnitude earthquake. Magnitude is a measurement of the energy released from an earthquake and is measured on a Richter scale, usually with a reading between 2 and 9. Earthquakes of magnitude 8.0 or greater are very rare and can completely destroy anything near the epicenter. The Richter scale measurements are logarithmic base 10, which means that an earthquake of magnitude 9.0 would be 10 times as strong as an earthquake of magnitude 8.0. Similarly, an earthquake of magnitude 9.0 would be 104 times as powerful as an earthquake that measured 5.0. Using the distance from the S-P interval time and the maximum amplitude, both of which are recorded on a seismograph, experts can use the base 10 logarithms to find the magnitude of the earthquake. The Richter scale is based on a standard measurement: an earthquake that can be felt 100km away with amplitude of 1mm is given a magnitude measurement of 3.0. This is the base measurement and all other measurements of magnitude are made to this reference. As a result, an earthquake that is 100km away, but has an amplitude measurement of 10mm would measure 4.0.

INTRODUCTION: Object of this application is to compare the author’s experienced mini quake(B) of 3.7 Richter scale to the 1904 San Francisco quake of 8.25 Richter scale using the same methodology as in the San Fran. vs. Newcastle quakes in the upper right graphic where it was found the SF quake was 562 times higher in intensity compared to the Newcastle quake.

QUESTION: Use the same methodology as in SF vs Newcastle quake to compare intensity of the author’s 3.7 quake to the SF quake of 8.25. HINT: $M(I_B)$ = magnitude of intensity at Bay = $3.7 = \log_{10}(I_B/I_O)$, $M(I_{SF}) = 8.25 = \log_{10}(I_{SF}/I_o)$. Follow same algebraic steps as above.

ANSWER: $I_B = 10^{-5.05} I_{SF}$, $I_B = 0.000009\, I_{SF}$, SHOW ALL ALGEBRAIC STEPS TO YOUR SOLUTION AS IN GRAPHIC IN UPPER RIGHT EXAMPLE.