UWI
Seismic Research Centre

Insights into Earthquake Engineering

Omari Graham, S.R.C.

At the S.R.C. We….

1. Monitor Earthquakes, volcanoes and tsunamis.

2. Develop hazard maps for contributing territories.

3. Assist in public education about the hazards we study.

Earthquake Safety

Earthquake Drill!!!

Watch video at the following link
http://www.youtube.com/watch?v=yI9QcSLShMc

Quick Tips on Earthquake Safety

During an earthquake…

- REMAIN CALM. DO NOT PANIC.
- If inside, stay inside. If outside, stay outside. Do not run outside during an earthquake.

JUST REMEMBER… D.C.H!!!!

Drop Cover Hold on!

During an Earthquake…

- Stay away from glass windows, mirrors and pictures.
- Protect your head and face by going under a strong desk, bed or other piece of furniture.
- Be sure to hold on to the furniture and stay alert.

During an Earthquake…

If outside, stay outside away from glass buildings, electricity poles and bridges.

If in a vehicle, do not stop on or under a bridge.

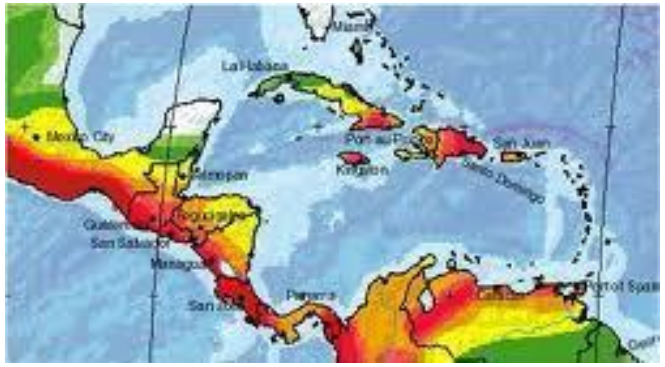
If trapped under debris...

- Do not light a match.
- Do not move about or kick up dust.
- Cover your mouth with a handkerchief or clothing.
- Tap on a pipe or wall so rescuers can locate you. Use a whistle if one is available. Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust.

EARTHQUAKE ENGINEERING

Earthquake Engineering
What? Who? Why? Huh….

What - **Earthquake engineering seeks to estimate the consequences of earthquakes and to mitigate these consequences.**[1]



Who – **This field is multidisciplinary, requiring: seismologists, structural and geotechnical engineers, architects, urban planners, information technologists and social scientists.**

Why – **A properly designed and built structure can save your life. Earthquakes don't kill people…. CRUMBLING BUILDINGS DO!!!!!**

HUH….

Port-au-Prince, Haiti, 2010.

Every Building has an Address

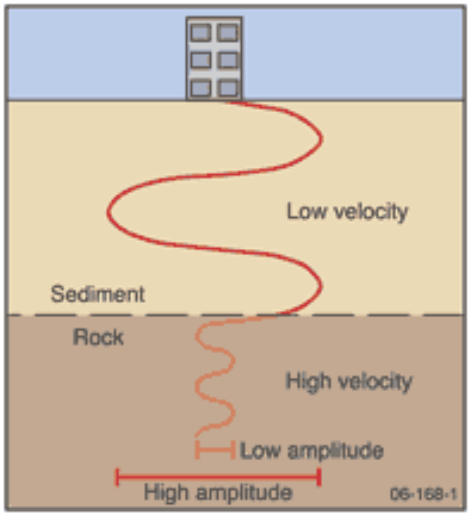
Local conditions upon which buildings are constructed can significantly alter the amplitude of ground motions.

Geology, topography and the non-linearity of soil are some of the factors that influence the amplitude and frequency of seismic wave.

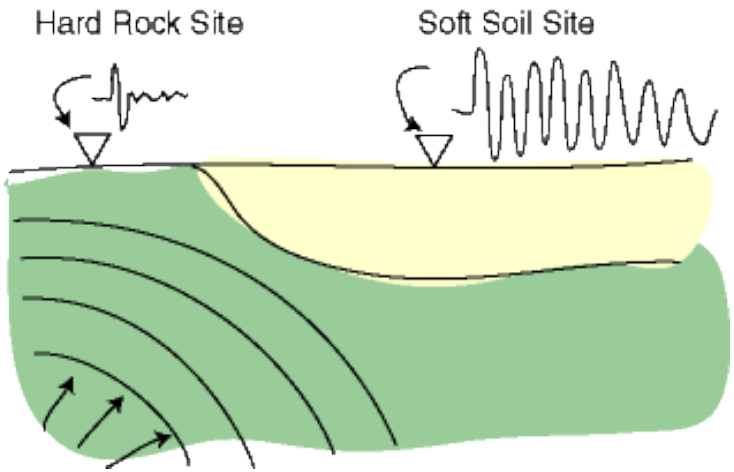
Collectively these factors are called SITE EFFECTS!

Amplification

- Shaking is generally larger and tends to last longer in soft sediments!



- Seismic Wave Velocity decreases in soft soils! This increases the amplitude and period of a wave!!!



Resonance

- Resonance refers to the tendency of a mechanical system to absorb more energy when the frequency of its oscillation matches the system's natural frequency of vibration (its resonant frequency) that it does at other frequencies.

- The ratio of building period and site period should be as large as possible. A small ratio raises the possibility of resonance and collapse.

Topography

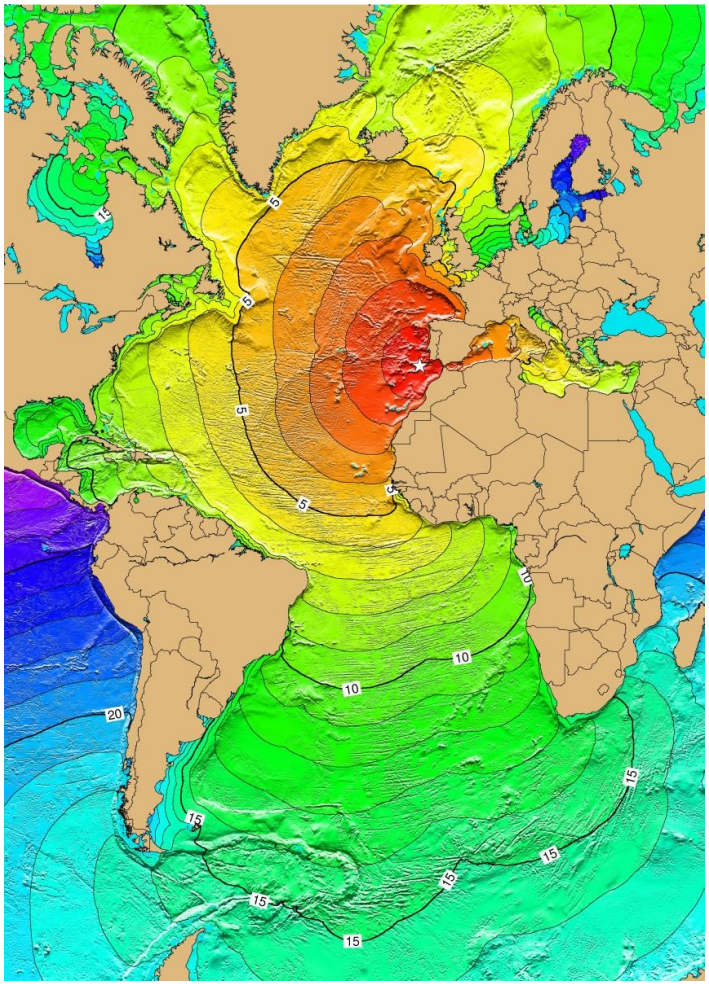
The steeper the angle of a ridge... The more amplification is to be expected!!!

Displacement amplification = 2/v

*where v is the est. angle of the crest of a triangular shaped hill. i.e. vπ

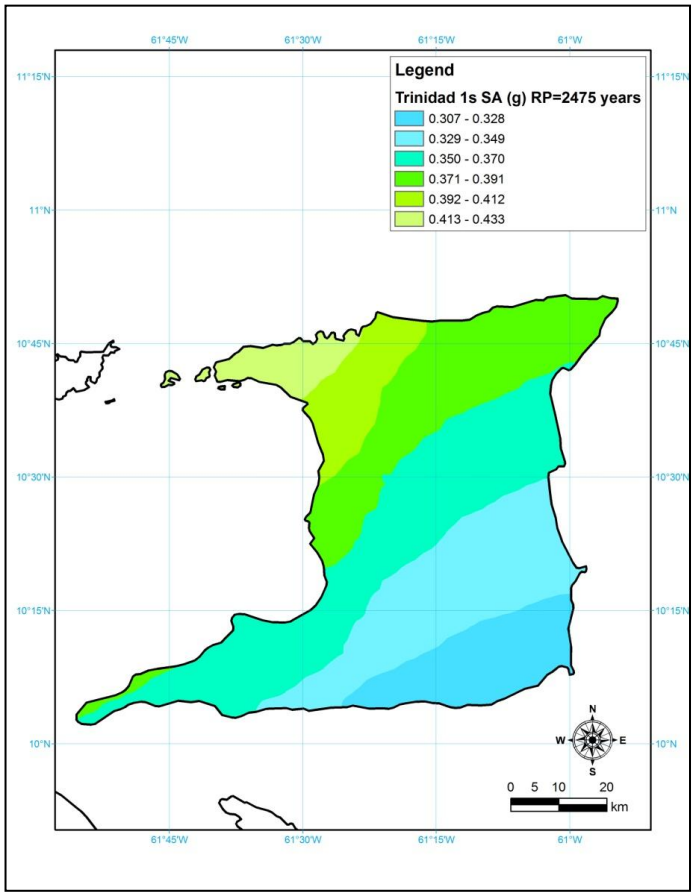
Distance

- Seismic Waves tend to be attenuated as they travel outward from the Epicentre.
- Energy is dissipated as the wave travels through the earth.
- Therefore in most cases the further a location is from the epicentre, the less ground shaking it will experience!!!

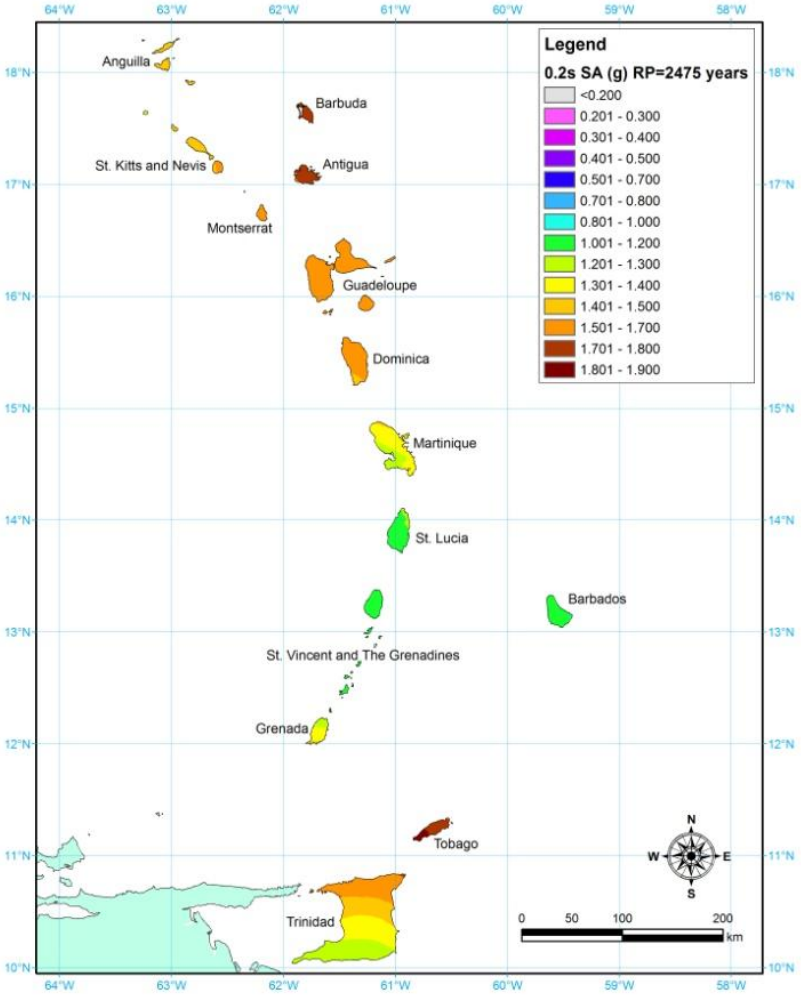


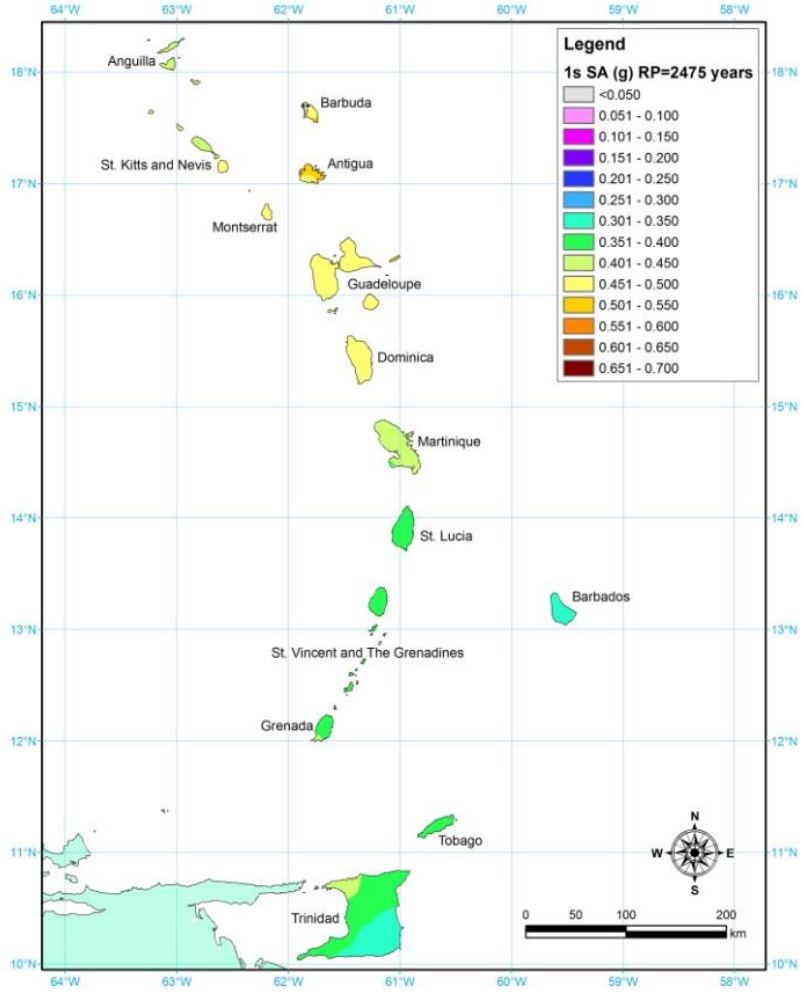
Hazard Maps

- Here are the SRC we produce Seismic Hazard Maps.
- These depict using contours the amount of ground acceleration expected at different points within a land mass.
- The acceleration is measured in g.



Seismic Hazard Maps of the Caribbean





Three Popular Techniques

Reinforcement

Base Isolation

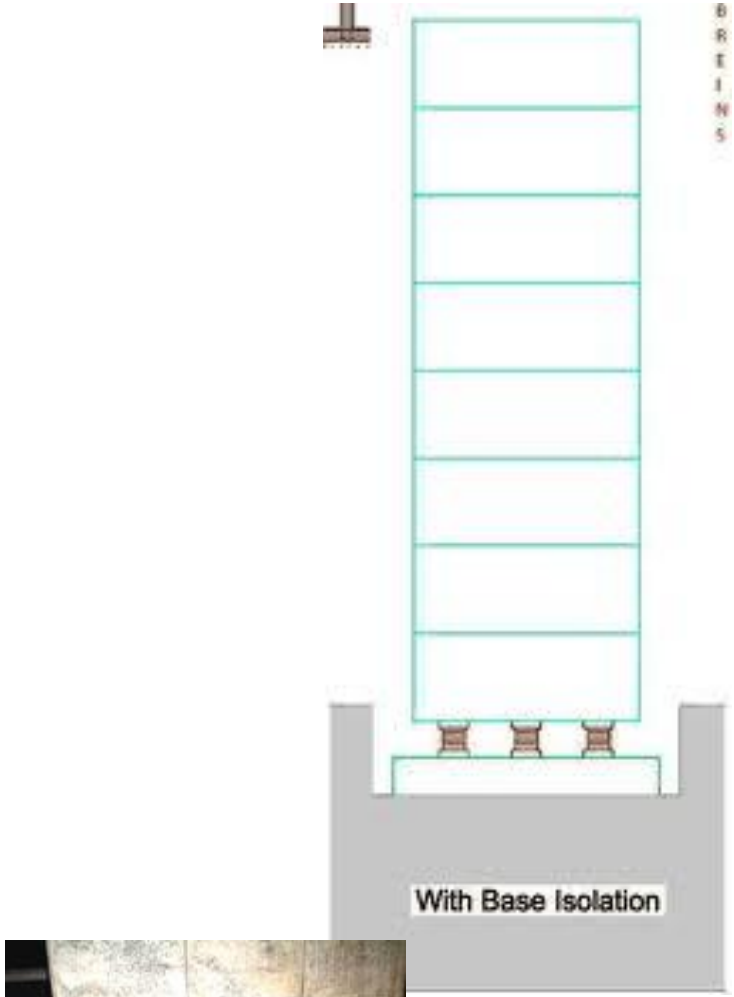
Bracing

Reinforcement

- Reinforced concrete has within it a steel lattice or grid.
- This technique increases the stiffness of a structure!
- Reinforcement reduces displacement during excitation!

Base Isolation

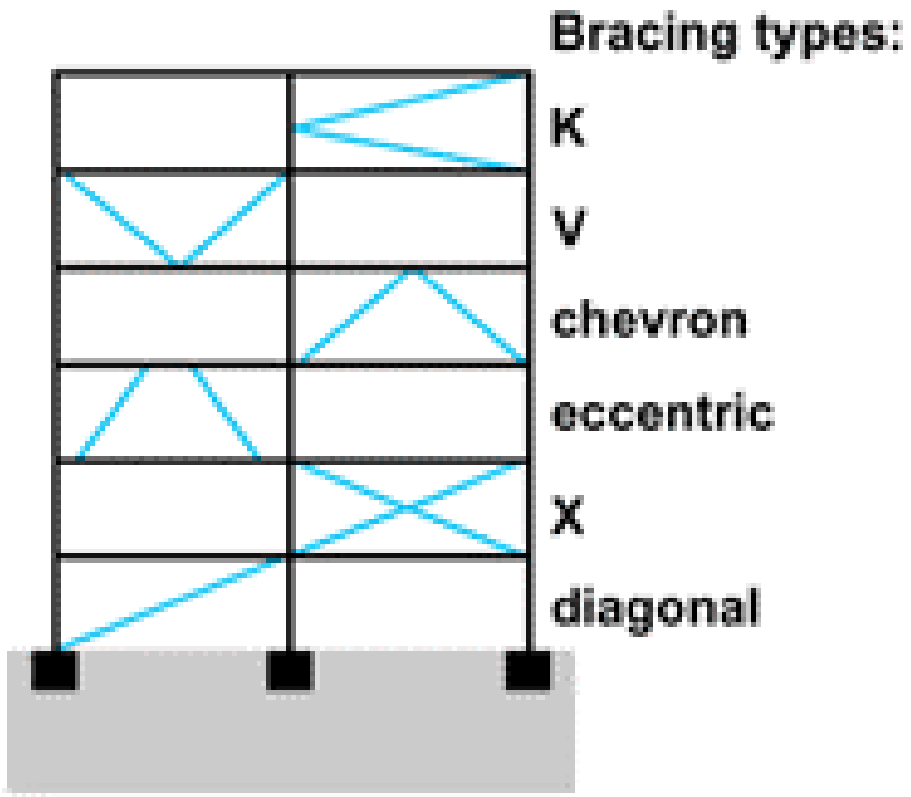
- Separates a building's superstructure from its substructure!
- The upper section of the building is spared the brunt of the ground motion.
- This technique does not offer protection against vertical motion!



Bracing

- Bracing adds stiffness to framed buildings.
- Helps to reduce displacement due to lateral forces!
- Bracing places increased strain on columns... these may in turn need strengthening!

Examples of bracing

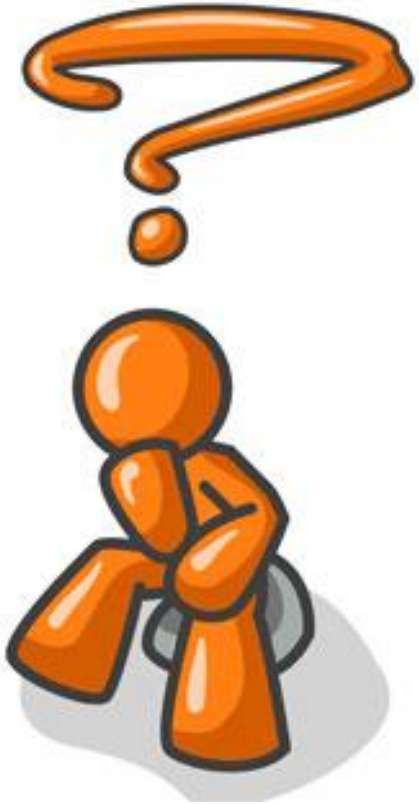


Make a Quake!!!

Click link below

http://tlc.discovery.com/convergence/quakes/interactives/makeaquake.html

Questions???



References

[1]Elnashai, A. S. and Di Sarno, L. - Fundamentals of Earthquake Engineering, 2008.