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A `Geo-Logical' Review of the Upcoming Movie `San Andreas'

Don't Believe Everything You've Seen in the Trailers, CGS Scientist Says

By Rick Wilson, California Geological Survey Senior Engineering Geologist

Set to an eerie version of the tune "California Dreaming," the trailers for the movie "San Andreas" show a massive earthquake that causes a huge chasm to form on the earth's surface and an enormous tsunami crashing into San Francisco.

This is the latest movie to portray those hazards in the fantastic extreme, joining the likes of "Poseidon Adventure" (1972 and 2006), "Earthquake" (1974), "Superman" (1978), "A View to a Kill" (1985), "Escape from L.A." (1996), "2012" (2012), and most recently "Pompeii" (2014).

As a movie fan, I'm excited to see the incredible action sequences and special effects. As a scientist, the word "unbelievable" better describes the portrayal of the earthquake, tsunami, and other geological events in the movie. However, as over-the-top as it might be, the pending release of "San Andreas" on May 29 does provide a good platform to discuss the many myths about earthquakes and tsunamis, while also describing what a real earthquake on the San Andreas Fault or a real tsunami can do in California, and what you can do to survive.

And, after all, doesn't it seem appropriate for a geologist to review a movie starring "The Rock" (aka Dwayne Johnson)?

Based on the trailers, "San Andreas" will provide fantastic visual effects, spine-tingling suspense, and super-heroic deeds, as any legitimate summer sci-fi blockbuster movie should. It uses natural disasters as its underlying threats, relying on our experience with recent real disasters -- like the March 11, 2011 Great Eastern Japan Earthquake and Tsunami and the recent magnitude 7.8 earthquake in Nepal -- to help get our attention. As someone who has witnessed the impacts of real earthquakes and tsunamis first-hand, I know these events can injure or kill tens to hundreds of thousands of people and cause devastating, long-term impacts to whole communities. However, the movie also relies on a number of earthquake and tsunami urban legends exaggerated by Hollywood to make squeamishly tense situations even more intense. Just from the trailers, I recognize three significant events that transform a science-based fictional concept into a mostly fictional realm:

- During an earthquake, the ground opens up into a huge rift.
- Tall buildings crumble and collapse during the earthquake.
- A tsunami crests over the top of the Golden Gate Bridge.

Will a huge rift in the ground open during a large earthquake on the San Andreas Fault? No. The San Andreas

Fault Zone forms the boundary between two tectonic plates that are moving in a lateral (side-to-side) motion past one another. The east side of the fault is moving south and the west side is moving north. When the plates grind past one another suddenly, the rapid overcoming of the plate friction is what causes the earthquake. If a chasm or rift were created by the pulling apart of the plates, there would be no friction and, thus, no earthquake.

Although the ground is not likely to open up as shown in the movie, a large earthquake on the San Andreas could potentially cause significant damage to highly populated areas in California. Large earthquakes on the fault have approached magnitude 8.0 in the years 1857 and 1906. Recent studies indicate there is about a 7 percent chance of an earthquake of similar magnitude happening again in the next 30 years. This same study indicates that there is nearly a 100 percent chance that an event similar to the magnitude 6.9 Loma Prieta Earthquake of 1989 or the magnitude 6.7 Northridge Earthquake of 1994 will occur somewhere in California in the next 30 years. In other words, it is not a matter of if a large earthquake will hit California again, it is just a matter of when and where. You should know what to do before, during, and after the earthquake. The websites at the end of this article are a good starting point.

Will tall buildings collapse during a large earthquake? Although any building could sustain damage during an earthquake, it is highly unlikely that tall buildings will collapse as shown in the movie trailer. California has one of the most stringent building codes in the world. Most tall, unreinforced-masonry buildings -- the type most susceptible to collapse damage during an earthquake -- have been retrofitted or replaced by steel-structure building designs.

A good test of these tall buildings came during the aforementioned 2011 earthquake in Japan. Although tall buildings from Sendai to Tokyo swayed during this magnitude 9.0 quake -- which they are engineered to do -- they did not collapse (see video [here](#)). If you are in one of these large buildings during an earthquake, watch out for falling objects, stay away from the windows, and don't use the elevators. Know what to do during an earthquake by reviewing the earthquake and evacuation plans for the building.

Can a tsunami several hundred feet high hit the California coast? Unless a huge asteroid hits off the coast, there is no chance of a tsunami higher than the Golden Gate Bridge occurring along our coast. Also, because the San Andreas Fault moves laterally and not vertically, it will not uplift the sea floor and cause a significant tsunami near San Francisco. In fact, California is fortunate that the extreme tsunami threat is relatively low to moderate (10 to 30 feet high) in southern and central California, areas with low-lying topography and large populations. The region north of Cape Mendocino has the highest tsunami hazard, potentially up to 50-60 feet. In this area, the San Andreas Fault plate boundary transitions into a different plate boundary called the Cascadia Subduction Zone where exceptionally large earthquakes may trigger tsunamis similar to the 2011 Japanese event.

Although the tsunami hazard might not be as depicted in the movie, people who live, work, or visit the coast should still be aware of the potential danger. It is important to know if you are within a tsunami hazard zone

So, sit back and enjoy the movie "San Andreas" realizing that many of the things you will see are more highly exaggerated science fiction than science fact. It is important to remind ourselves of the death and destruction caused by real earthquakes and tsunamis, and to have compassion for the people in those areas like Nepal that are still being directly impacted. Although real earthquakes and tsunamis can be very scary and damaging, if you understand the facts about these hazards in California and know what to do before, during, and after the earthquake or tsunami, you can survive and be the hero in your own life story.

Earthquake hazard and preparedness information:

CGS earthquake hazards information:

http://www.consrv.ca.gov/cgs/geologic_hazards/earthquakes/Pages/index.aspx

California Governor's Office of Emergency Services (CalOES) earthquake preparedness information:

<http://www.caloes.ca.gov/for-individuals-families/earthquake-preparedness>

CalOES My Hazard webpage: <http://myhazards.calema.ca.gov/>

CGS Earthquake Mythology – or, don't believe everything you hear:
http://www.conservation.ca.gov/index/earthquakes/Pages/qh_earthquakes_myths.aspx

Tsunami hazard and preparedness information:

CGS tsunami hazards information: <http://www.tsunami.ca.gov/>

Official tsunami hazard maps for California:
http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/Inundation_Maps/Pages/Statewide_Maps.aspx

CalOES tsunami preparedness information: <http://www.caloes.ca.gov/For-Individuals-Families/Tsunami-Preparedness>

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