StEER STRUCTURAL EXTREME EVENTS RECONNAISSANCE	**EVENT BRIEFING**		
	Event:	15 May 2020, Nevada, Mw 6.5 Earthquake	
	Region:	USA	
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Key Lessons

- This 6.5 earthquake was felt across a wide area including the states of Nevada, California and Utah; however, because the epicenter and the area of strong shaking were in a remote, uninhabited region, there were no injuries or fatalities and only minor infrastructure damage.
- There was no structural damage experienced by buildings, including several historical landmark structures in Tonopah and Goldfield around 60 km away from the epicenter. Although this epicentral distance is relatively large, damage may have occurred had there been any ground motion amplification due to local site conditions or structural vulnerability.
- This large magnitude earthquake still provided three potential lessons to the general public and the earthquake engineering and science communities:
  - First, it is a reminder of the potential of major earthquakes in the US, similar to the Mw 6.5 Idaho earthquake that recently occurred on March 31, 2020, and the need to increase public awareness, especially considering the conflicting consequences related to the ongoing COVID-19 pandemic.
  - Second, the recorded ground motions in this earthquake demonstrated a unique nature characterized by a very shallow depth and a strike slip fault with a fault plane close to vertical that has potential usage for design purposes.
  - Third, the data recorded in terms of instrumented structures, including buildings and bridges, can be used for structural health monitoring and model updating purposes.

Introduction

On May 15, 2020, at approximately 4:03 AM local time, a magnitude 6.5 earthquake, with a depth of 2.8 km, struck 56 km W of Tonopah, Nevada. The epicenter of the earthquake had coordinates of 38.159°N, 117.875°W. This Event Briefing, an abbreviated StEER response mechanism, concisely summarizes the event and any key lessons that can be learned or reemphasized from the event. Objectives of this Event Briefing are: 1) to provide details of the 15 May 2020 Mw 6.5 Nevada Earthquake, 2) to describe damage to buildings and transportation and industrial infrastructure, as well as disruption to the community in terms of life and economic losses, and 3) to list key lessons learned, particularly within the COVID-19 context.

Figure 1. Epicenter of the Mw 6.5 Nevada earthquake (USGS, 2020)

Hazard Description

This magnitude 6.5 earthquake, with epicenter of 38.159°N, 117.875°W and depth of 2.8 km, struck 56 km W of Tonopah, Nevada, close to the California border, as shown in Figure 1 (USGS, 2020). The earthquake was followed by several aftershocks, including a magnitude 4.9 and a magnitude 5.1 that occurred less than an hour after the mainshock of the earthquake (Tripathy-Lang, 2020).

This earthquake occurred on a strike-slip fault in the shallow crust of the North American plate, within the Walker Lane, an active zone of seismicity roughly aligned with the California-Nevada border. Tectonically, the Walker Lane accommodates up to 25% of the North America-Pacific Plate motion, with the remainder mostly taking place on the San Andreas fault system (USGS, 2020). USGS preliminary focal mechanism solutions for the event indicate that slip likely occurred on a nearly vertical, steeply dipping fault striking either east-west (left-lateral) or north-south (right-lateral) (USGS, 2020; Tripathy-Lang, 2020).

Historically, more than 20 Mw 5+ earthquakes have occurred within 100 km of this event over the past 50 years, mostly to the west and south. Two Mw 6+ events took place around the same region, one of them being a Mw 6.5 earthquake 40 km to the northwest in January 1934, and the other being a Mw 6.8 event 50 km to the north in December 1932. Both of these earthquakes caused severe ground shaking and consequences (MMI VIII); the 1932 earthquake is documented to have caused damage in the sparsely populated surrounding region (USGS, 2020).

USGS ShakeMap (Fig. 2) indicates that Peak Ground Acceleration (PGA) was around 0.4g near the epicenter. However, shaking levels at all populated areas were smaller than 0.06g. The maximum intensity estimated by ShakeMap is VIII, mainly around the epicentral region, not affecting any infrastructure or people, while the intensity around the populated regions is V or less, consistent with the observed minor damage (USGS, 2020).

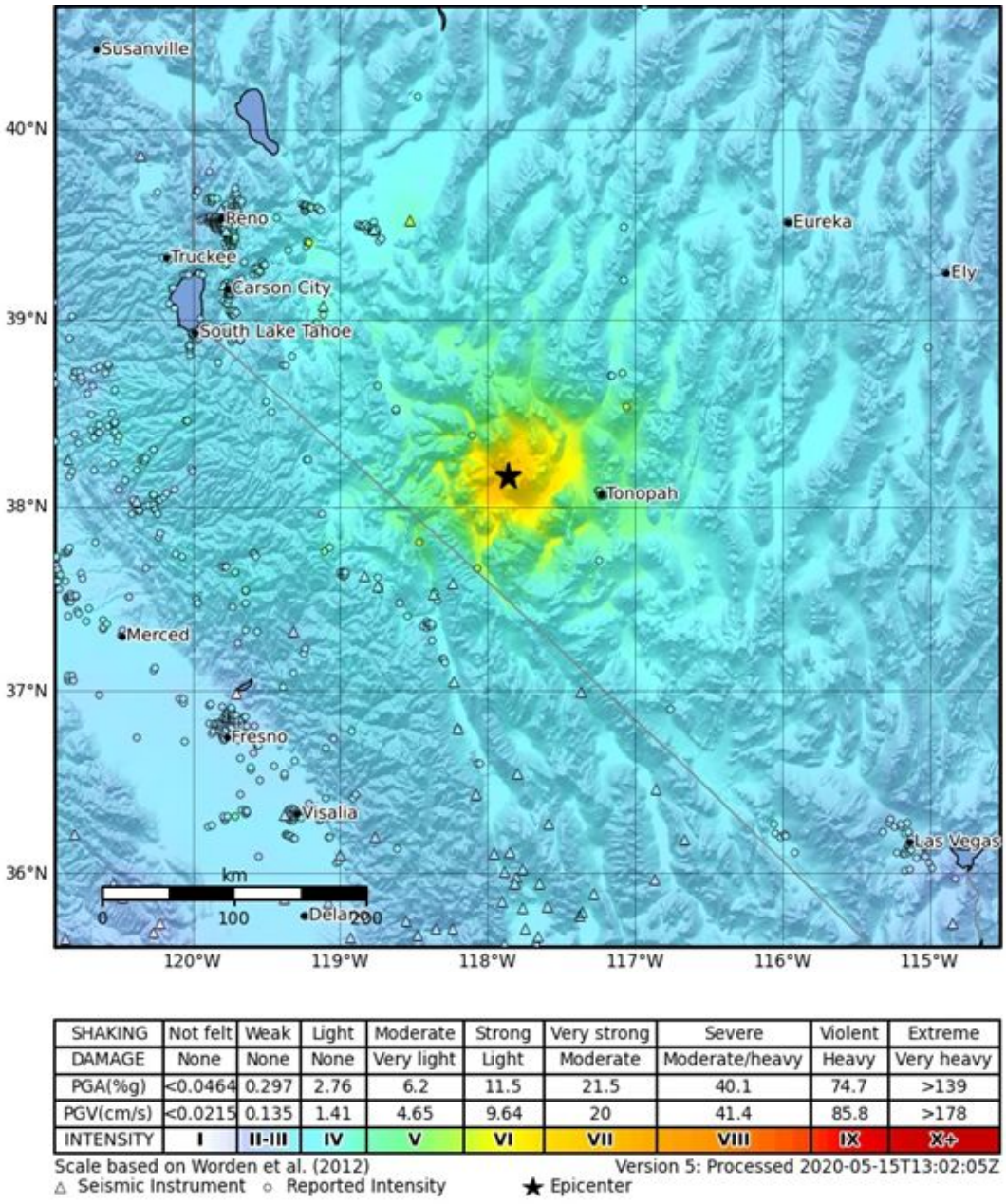

Figure 2. PGA and intensity estimate from ShakeMap (USGS, 2020)

Damage to Structures

The most significant damage observed during this earthquake was pavement damage to a half-mile section of U.S. Highway 95, between Las Vegas and Reno (Fig. 3), which was closed after the earthquake, but reopened 10 hours later (Ritter, 2020).

Figure 3. Pavement damage on U.S. Highway 95 between Las Vegas & Reno (Ritter, 2020)

There was no structural damage to buildings, including several historical landmark structures in Tonopah and Goldfield around 60 km away from the epicenter. It is noted that although this epicentral distance is relatively large, had there been any ground motion amplification due to local site conditions or structural vulnerablity, damage could have been experienced. There was minor nonstructural damage including broken storefront glass and items knocked off shelves, along with stress cracks on the asphalt of streets, loose hanging signs, and minor lifting of sidewalks (Ritter, 2020).

This large magnitude earthquake, which did not lead to any injuries or fatalities and only caused minor damage provided three potential lessons to the general public and the earthquake engineering and science communities. First, it is a reminder of the potential of major earthquakes in the U.S. and the needed increase of public awareness, especially considering the ongoing COVID-19 pandemic. Second, the recorded ground motions in this earthquake had a unique nature characterized by a very shallow depth and a strike slip fault with a fault plane close to vertical, which could potentially be used for design purposes. Third, the seismic activity was recorded by several instrumented structures, including buildings (CESMD, 2020) and bridges (Quakelogic, 2020), the data from which can be used for structural health monitoring and model updating purposes.

Resilience Aspects and Effects on Community

Particularly because of the very shallow nature of the earthquake (depth of 2.8 km), this earthquake was felt across a wide region: from Las Vegas, about 280 kilometers to the southeast of the epicenter, all the way to the San Francisco Bay Area, about 450 kilometers to the epicenter's west

(Tripathy-Lang, 2020). Although shaking was felt across a large area, as mentioned earlier, levels of shaking were too small to cause significant damage, injuries or fatalities. The USGS “Did you Feel It?” program documented low levels of shaking in populated areas based on 22,000 voluntary self-reports (Fig. 4).

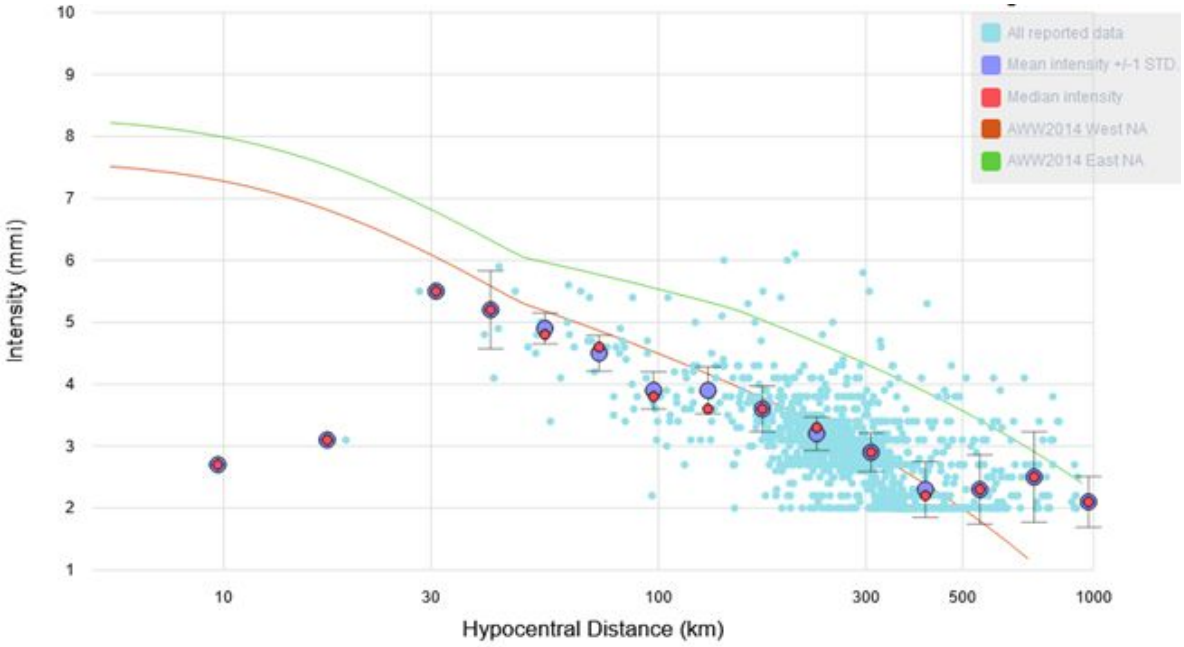

Figure 4. Variation of the felt intensity with hypocentral distance from the USGS “Did you Feel It?” responses (USGS, 2020)

Regarding the consequences of the earthquake, USGS PAGER tool estimated that the fatalities are expected to be less than 1 (which is indeed the case for this event), between 1 and 10, and between 10 and 100, with probabilities of 65%, 30%, and 4%, respectively (Fig. 5, left). Regarding economic losses, this USGS tool also estimated with 100% certainty that such loss would be under $1 million (Fig. 5, right).

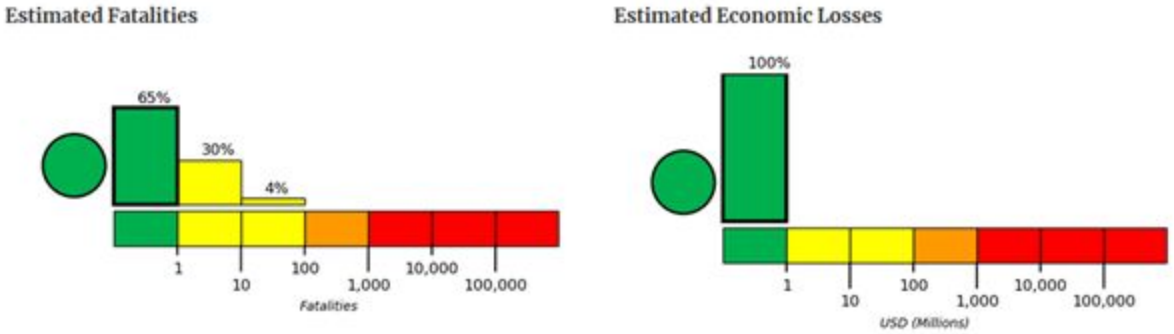

Figure 5. USGS PAGER loss estimates: fatalities (left) and economic losses (right) (USGS, 2020)

Still, this event is another reminder of the potential of major earthquakes taking place in the U.S. Similar to the Mw 6.5 Idaho earthquake (Gunay et al., 2020), had the earthquake occurred closer to populous areas with this shallow depth, there could have been severe consequences, and these, combined with the ongoing COVID-19 pandemic, could have introduced additional stresses on the affected population along with potential economic challenges. A potential complication in that case would be due to the normal practice of placing displaced people in mass evacuation centers, where the social distancing requirements would not be possible (Gross, 2020).

StEER Response Strategy

StEER's present response to this earthquake will consist only of this Event Briefing, compiling information from various websites, news channels and USGS. The briefing does not include detailed field investigations. This briefing was released under StEER's current COVID-19 level-down response (StEER, 2020) and would not warrant further response given the minor structural impacts.

References

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