Earthquake Hazard Class Mapping by Parcel in Las Vegas Valley

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Large scale earthquake parcel classification mapping for increasing public safety and enhancing planning and development within Clark County, NV

Clark County and the City of Henderson, Nevada have completed the Nation’s first-of-its-kind effort to map earthquake hazard class systematically through an entire urban area. The map will be used in development and disaster response planning, in addition to its direct use for building code implementation and enforcement.

IBC 2006 Section 1613.5.5 states that: “The rock categories, Site Classes A and B, shall not be used if there is more than 10 feet (3048 mm) of soil between the rock surface and the bottom of the spread footing or mat foundation.” Therefore, Clark County designates areas classified as Site Class B according to velocity alone as “C-”, and we follow their convention here.

Optim, via subcontracts from Clark County, the City of Henderson, and the Nevada System of Higher Education (NSHE), measured shallow shear-velocities throughout approximately 600 square miles of Clark County and the City of Henderson.

Parcel Map coverage of 36 mi² map books by Clark County (red) and the City of Henderson (green), totaling 600 mi² of urban and urbanizing area.

Parcel Map Enables Nevada ShakeZoning

Above: Map showing the IBC seismic zoning results of the Earthquake Parcel Mapping projects sponsored by Clark County and the City of Henderson. The method of kriging was used to produce this map from the measured values. The IBC “D” zone is blue; the IBC “C” zone is green; and the proposed IBC “C” zone is red.

The measured Parcel Map shows a clearly definable C+ to C boundary on the west side of the Valley. The C to D boundary is much more complex. Using the parcel map in compounding shaking in the Valley for scenario earthquakes is crucial for obtaining realistic predictions of ground motions.

Types of Microtremor

Noise recordings were then processed and analyzed using the refraction microtremor (ReMi) method and a single shear wave velocity profile was determined for each seismic array. These profiles were then used to calculate Vs30 (or Vs100) the average shear wave velocities down to 100 feet per IBC 2006 section 16-41. Once these were determined, the information was concreted with the GIS spatial data into a single Geographical Information Systems (GIS) seismic database which was used to model Vs100 across Clark County.

Examples of Typical Profiles

Paradigm Microtremor (Louie, 2001) examples from left to right for typical sites having velocities in the NEHRP class range D (left), C, (middle), and D (right) with an inversion due to the presence of calciche. Upper plots show the profile image along with modeled dispersion. Lower plots show Vs(z).

Recorded ambient microtremor data are first transformed into the frequency-slowness domain. The dispersion curve is then picked and modeled to obtain a 1D shear wave velocity profile (C).


Blind Tests of Parcel Map

Different:
- Equipment & Field crew
- Dispersion interpreter
- Vs(z) modeller

Match to Map Values:
- 6 of 93 blind tests >10% off
- 13.55% maximum difference
- 0.26% bias of average
- 4.92% RMS difference

Parcel Map Vs30-m Affects Earthquake Scenario Results at 8.1-0.5 Hz