Issue 4.1.1 Balancing Precision and Uncertainty

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Background

• Since the 1997 NEHRP Provisions, the precision of the design values mapped have increased from single-digit values to 2 or 3 digits.

• The maps used zones or course parsing of the base accelerations and adjustment values such as $C_a$ of $C_v$. 
Background

• This resulted in values being applied over large regions of geography and a perceived stability to the seismic design community

• The uncertainty of the design values was on the order of 50%, and the less precise design values portrayed this to the design community
Background
Background

• The design community understood that the design values we approximate values and there was a reasonable probability that when an earthquake occurred, there was a good probability that the site would experience a larger acceleration than determined following the design provisions.
Background

• Since 1997, the hazard functions have changed with improved science, such as improved locations of faults and their size, and improved attenuation functions.

• These improvements in knowledge have also been reported with higher precision, even though the uncertainty remains in the range of 50%.
Background

• Computer technology has also contributed to the increase in precision. The ability to parse the range of design values into contours, and integrate the risk of collapse probability into the design values relatively easily, has provided a mechanism that allows the presentation to give the illusion of improved accuracy by reporting more precise values.
Background
Background

• Many in the design design community now think that the seismic hazard is more accurate than it is

• The uncertainty has a significant range, and the quantification of the uncertainty is problematic in many regions of the country due to the lack of data
Background

- Small changes in the science (e.g., changes in the attenuation functions) can cause significant changes in the final design values without real improvements in the uncertainty.

- The design values have begun to yoyo up and down with each cycle of the hazard maps and the design community is beginning to lose confidence in the design values.
Background

Design Spectra for Santa Barbara, CA 2003-2009
Charge for Committee

• Under this task, the Project 17 Committee should seek to develop engineering interpretation of the computed values based on science that can be portrayed as design values having precision appropriate to the uncertainty associated with their calculation, potentially allowing for increased stability of the values in future map editions. This can be accomplished through a return to the use of zones, through plotting of contours on a coarser gradation, or other means.
Decisions for Coordination

• The committee will coordinate with the committee working on Issue 4.2.1 Acceptable Risk

• If the mapping is to continue to incorporate the risk of collapse instead of uniform hazard, the level of risk must be considered in the precision and uncertainty of the hazard
Options Being Considered

• Consider developing a zone map similar to the IRC map, but with more zones

• Investigate an initial trial at quantifying the uncertainty

• Investigate the sensitivity of design values to changes in underlying hazard functions
Options Being Considered

• Consideration of jurisdictional boundaries

• Consideration of effect of using multiple periods to define the design spectra

• Consideration of a two methods
  – Zones
  – Current
  – (3rd Option such as redefine SDC?)
Proposed IRC Zone Map
Issues with Zonation

• Zones end up with a step function at boundaries

• How many zones would be reasonable?
  – More zones mean more likelihood of significant changes from cycle to cycle
  – Fewer zones means penalizing more buildings by requiring designs be for higher accelerations
Investigate Quantifying Uncertainty

- This is problematic for lack of data
  - Eastern vs Western Regions

- Issues in hazard functions that are difficult to quantify

- The sensitivity to changes to some parts of Hazard functions is unknown
Multi-Period Spectra

• Will moving to multiple-periods for developing design spectra result in multiple zone maps?
  – Currently the IRC is based only on the 0.2 second map

  – Will this result in a change in the definition of Seismic Design Category?
    • This is one option that this committee will consider
Questions/Discussion