

April 14, 2014 Memorandum: from Seth Thomas to URM Policy Committee

To: Seattle URM Advisory Committee
From: Seth Thomas, P.E.
Job No.: n/a
Date: April 14, 2014
Re: Seattle URM Cost Benefit Study

The analysis and documentation in the March 13th, "Seattle Unreinforced Masonry Retrofit Policy: Benefit Cost Analysis" appears to have several errors/omissions. I have highlighted several areas that either more documentation is required or revisions in the analysis should be made to improve the accuracy of the overall study.

Hazard: While the 3 agreed upon scenarios do represent the 3 major earthquake sources for the Seattle area I don't think the hazard probability is accurately represented

- Variability in ground motions including epistemic uncertainties are not accounted for when using "shakemap" scenarios – this is why USGS models the faults using these uncertainties (most of the hazard comes from the +0.5-2s events – something I did not know until I worked on the risk assessment stuff at Degenkolb)
- It is not clear how soil properties are being accounted for relating to the pga for each scenario – Task 4: Table one lumps buildings into "Stable Soil" and "Liquefaction Zone" which is a gross simplification that is unclear and could (depending on what they did) be non-conservative. The usgs vs30 database should be used to scale GM's for each location.
- Not clear how liquefaction is handled – even if buildings are in soils that are at risk of being liquefied it takes a big enough event to trigger the liquefaction.

Fragility Curves:

- It is not clear what they used since Task 3: Figure 1 is a mocked up fragility curve with no units – the report should show exactly what Degenkolb sent them (probably an appendix) so that there can be proper review.
- It is also not clear how the fragility curves are applied – this is where I think the key mistake was made. You take the input PGA at your site determine where you are on the capacity curve to get a spectral acceleration and drift (based on your building type, i.e. URM-2 or BoltsPlus-2). Once you have these values they can be applied to the structural and non-structural fragility curves.

Building inventory: It is not clear what the building inventory used was.

- The full building inventory with address, Lat/Long, size and SF should be included in the appendix

Building & Retrofit costs

- It is not clear how were building contents valued – what was the loss rate estimated at (i.e. for a complete damage state what was the % loss of contents)
- What % of structural and non-structural value was lost for each damage state? This should be clearly stated as it directly affects the costs
- Buildings last a lot longer than 30years – these buildings are a prime example as most of them have been around for at least 50 already. A much longer building life should be used
- I talked to a few local engineers here in Portland and the retrofit costs seem to be a little off
 - For a full ASCE 41 retrofit the consensus seems to be about 40-50 dol/sq ft
 - Talking to people about a prescriptive bolts plus (which admittedly none of the people I talked to had been apart of) was around 20-30 dollars/sq ft with lower costs possible for larger square footages (economy of scale)

While some of these items are fairly minor there are a few items that are big issues are in the hazard and fragility curve items. I have worked on risk assessment projects for almost two years now and have a very detailed understanding of how USGS creates the probabilistic seismic maps and the methodology of HAZUS. In addition while at Degenkolb Engineers I was responsible for developing the capacity and fragility curves and I believe these are being misused as the damage rates seem very low (especially for the Seattle Fault event).

Thanks,

Seth Thomas, P.E.