

# April 14, 2014 Memorandum: from Ken Goettel to David Gonzalez and Seth Thomas

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### Memorandum

**TO:** David Gonzalez and Seth Thomas  
**FROM:** Kenneth A. Goettel  
**RE:** Seattle BCA Comparisons  
**DATE:** April 14, 2014

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I took another look at the BCA report.

First, the building value used seems to be very low. Here is the calculation from data in the report. For damage and loss estimates, the proper metric (per FEMA) is the building replacement value. My semi-informed guess is that the building replacement value (the cost to build a new current code building of the same size and level of amenity as the existing building) would be at least \$200/sf. FEMA also allows consideration of the historical value by allowing use of a reproduction value to recreate the significant architectural features of a building. So the reproduction value would be even higher. Using a more realistic value would raise the BCR by a factor of more than 2 and perhaps up to 3.

Retrofit Costs	\$808	million
Retrofit Costs	\$40	per SF
Building Value	\$1,902	million
Building/SF	\$94	per SF

Second, the damage percentages shown for the Seattle Fault scenario are grossly discordant with the USGS Shakemap ground motions and the HAZUS PGA fragility curves for a Pre-Code URM. Per page 45 of the BCA Report, building damage for the Seattle Fault M6.7 scenario is \$512 million, 26.9% of the stated building value.

Per the maps in the report, most of the URMs are in the downtown core, for which the USGS Shakemap shows color-coded ground motions in the very dark orange to red zones, which is at least 34-65 %g PGA and probably into the 65+ %g PGA range.

HAZUS Pre-Code URM fragility curves for low rise have 0.26 g and 0.38 g for the extensive and complete damage states, respectively. With 0.21 g and 0.38g for mid rise URMs. Given these data, at least 50% of the buildings would be in the complete damage state with roughly 75% being in the extensive or higher damage state, with very few in the slight damage state.

However, the table on page 78 for the Seattle 6.7 scenario has the following percentages of structural damage

None: 18%  
Slight: 23%  
Moderate: 14%  
Extensive 22%  
Complete 22%

These results are grossly discordant with the Pre-Code HAZUS PGA fragility curves.

This suggest strongly that the report calculations did not properly get the Degenkolb fragility curves into the HAZUS runs.

Note also, that with a reasonable demolition damage threshold, many (most or all) URMs with extensive structural damage (50% or so) would be a complete economic loss. More accurate damages may be several times (~3 or so) higher than the results in the BCA Report

With only the above factors, a more accurate BCR would be approaching 10x higher than the reported BCR. With a proper analysis, including the full range of damaging earthquakes and other refinements a BCR above 1 is within the realm of possibility.

See: shakemaps of M6.7 and 7.2 Seattle Fault scenarios. The BCA report only considered the M6.7.