

# The Problems with PMLs

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## ABSTRACT

Probable Maximum Loss (PML), Scenario Expected Loss (SEL), Scenario Upper Loss (SUL) earthquake damage estimates are being indiscriminately developed, used, and abused by the engineering profession and by the parties who commission and utilize PMLs. Owners may pressure engineers to obtain specific PML, SEL, and SUL values that they desire to meet insurance or lending requirements, and engineers often capitulate. Engineers use “black box” software and obtain either the desired values or values that are not representative of the actual structure. Black box software, which can “produce” PMLs at a small fraction of the cost required to actually understand the seismic behavior of the structure, has lowered the bar. Engineers who do not provide the desired values at a very low price tend to get cut out of the process. Meanwhile, the insurance companies and lending institutions, as third parties, blindly rely on the PML, SEL, and SUL values obtained by building owners to set insurance rates for the buildings in question or as the basis for deciding whether to issue financing -- setting up a clear conflict of interest on the part of the owners and the engineers. In some cases, building owners even appear to be using the PML, SEL, and SUL values to determine the policy limits for the property casualty insurance that they purchase, never realizing that the values are not appropriate for such a decision for an individual building.

The authors examine the multitude of problems inherent in the PML, SEL, and SUL procedures being used by most of the profession. A few simple case studies are presented to show how the PML process is being misused; then the authors propose a different, more logical way of determining the PML, SEL, and SUL for a building and demonstrate through a number of examples how these more reliable and defensible PML, SEL, and SUL values can be determined, as described below.

A seismic analysis consisting of a lateral pushover of the building is performed to estimate the seismic capacity of the actual building and to predict damage patterns associated with increasing levels of lateral load. Different scenario earthquakes are used (e.g. the 475-year earthquake and the 2475-year earthquake) to assess locations and quantities of damage under different levels of ground shaking. Once the physical damage patterns are predicted, estimates regarding the cost to repair the predicted structural and nonstructural damage are generated and compared to the replacement cost of the building. For typical damage such as cracking and spalling, engineers experienced in repairing existing structures may be able to generate reasonably accurate cost estimates, but other more unusual damage may require the use of a cost estimator. All of this analysis is done using actual data from the building (as opposed to generic data about the type of building as is typically done with black-box software). The building’s performance during prior earthquakes is also used to cross-check the predictions with reality.

Examples are used to show how the process works. Limitations and caveats for owners are also presented.