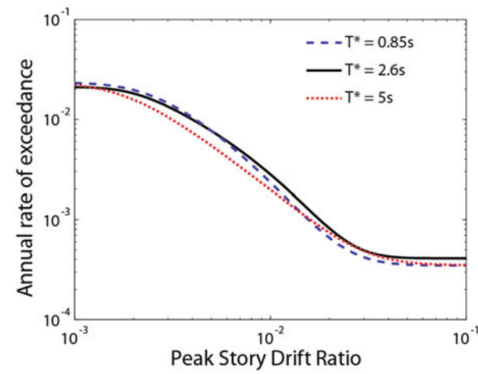
DOI	https://doi.org/10.1007/978-94-017-8875-5_28
Title	Ground motion selection for Performance-Based Engineering: Effect of Target Spectrum and Conditioning Period
	Background
Why this paper? How'd you find it?	My research involves **Performance-Based Earthquake Engineering (PBEE)** calculations, so this paper was highly relevant reading material. I decided to bring it to the Club's attention because it involves a discussion on ground motion selection, which is a procedure many others may utilize for their research, irrespective of whether it involves PBEE.
Study Objective	The study claims, and aims to demonstrate, that annualized PBEE loss results *are insensitive* to the conditioning period of the target **Conditional Spectra (CS)**.That is, even if a structure is sensitive to some period T*, and the CSs are conditioned on some other T, PBEE application would lead to the same rates of exceedance of losses. They claim that this is true when CSs are utilized to define hazard levels and select ground motions, implying that other ground motion selection approaches do not have that benefit.
Intended gaps to fill	The authors present the question of what conditioning period to use to generate target CS as an unresolved question. Indeed, relying on a single conditioning period can discourage the use of CS, since most structures are sensitive to multiple periods --which in fact shift as the structure accumulates damage during an earthquake--, or losses may have to be estimated while the period of the structure might be unknown in certain situations. So what would happen if an analyst specified a "best guess" value for the conditioning period, and how sensitive would the PBEE results be to it? This is the question that this paper is trying to answer.
Authors	Jack W. Baker(1)[Corresponding Author], Ting Lin(2), Curt B. Haselton(3).
Affiliations	(1) Dept. of CEE at Stanfort, John A. Blume Earthquake Engineering Center. Boo! (2) Dept. of Civil, Construction and Env. Eng., Marquette University (3) Dept. of Civil Engineering, California State University
Funding Source	The work is supported by the NHERP Consultants Joint Venture (Contract SB134107CQ0019), project ATC-82 of Earthquake Structural Engineering Research.
Journal / Field	The paper is part of a book (which is actually your typical collection of research papers organized by subject areas), edited by Matej Fishinger, part of the book series titled "Geotechnical, Geological and Earthquake Engineering." So we now got promoted to a book club!
Date	2014
Historical Context	Just like today, at the time of publication of that paper, many competing methodologies existed for the generation of target response spectra for the purposes of ground motion selection, some rudimentary, and some more sophisticated. On the more sophisticated end at the time, there was the **Uniform Hazard Spectrum (UHS)**, which was constructed to have equal hazard (equal rate of exceedance) for all periods. In 2006, Jack Baker and Allin Cornell introduced the Conditional Mean Spectrum, which was a recognition that a single ground motion record occurring at a site will not have the shape of the UHS (similar how the PGAs observed after a single earthquake rupture do not look like the hazard map of a broad region). In a series of publications, it was more clearly defined and extended to also include the conditional probability distribution at other periods, instead of just focusing on the the mean. At the time of publication of the subject paper, the effects of different ground motion selection schemes on risk assessments was not very clear.
Relationship to SEMM	SEMM-related research often involves ground motion selection. Sometimes even PBEE!
	Methods
Given:	Given a site and an agreed upon way to characterize the seismic hazard for probabilistic seismic hazard analysis calculations,
Find:	find the sensitivity of PBEE calculations on the conditioning period of the CS involved in ground motion selection.
Experimental Design	- find a hazard curve for T' - split it into hazard levels and construct CS for each of them conditioned on T'. - Show that a structure sensitive to T* != T' will still have the same rates of occurrence of (EDP > y) for all y's of interest, as if the whole procedure was done conditioned on T*. - Repeat the procedure for some other T' to demonstrate the generality of the observation.
Test Subjects	The paper involves the assessment of a 20-story reinforced concrete building, but it also contains elements that are more abstract and do not rely on a particular structure.
	Results
Baseline for comparison	It is shown that for the 20-story RC building, the annual rates of exceedance obtained via PBEE utilizing the CS targets are insensitive to the conditioning period (Fig. 28.4). In an attempt to explain this, it is demonstrated that a back-calculation of the hazard curve from some other period, using the ground motion data obtained for the target period, results in a good approximation of the PSHA-obtained hazard curve for that other period (Fig. 28.5).
Metric for comparison	There is no quantifiable metric used to assert that the results are close, other than plotting them all together and visually inspecting them.
Difference from baseline	The goal is to show that they are the same. They are not exactly the same, but it can be argued that they are close enough for the purposes of PBEE.
	Conclusions
Authors'	If the goal of the calculations is to obtain annual rates of exceedance of something, the conditioning period *does not matter*. They write "one should be able to obtain an accurate result using ***any*** conditioning period."
Yours	I find the conclusion too broad considering what was actually done in the paper. While Fig. 28.4 shows a reasonable match for the rates of exceedance of story drift, it has been shown that story drift is the least sensitive EDP to the conditioning period to begin with. What about floor accelerations? What about peak ground acceleration? Would we still get a reasonable match? The paper implies that we would, but I have doubts. Still, I acknowledge that by capturing the complete distribution of spectral accelerations for all periods, CS offer a better representation of a target hazard level than most other target spectrum generation approaches. I have confirmed that reproducing Fig. 28.5 with a ground motion set coming from UHS target spectra results in a worse hazard curve reconstruction.
Applications	Ground motion selection, performance-based engineering, risk evaluations.

Fig. 28.4 Risk assessment results showing annual rates of exceedance for various Peak Story Drift Ratios, obtained using hazard curves and ground motions with three different conditioning periods



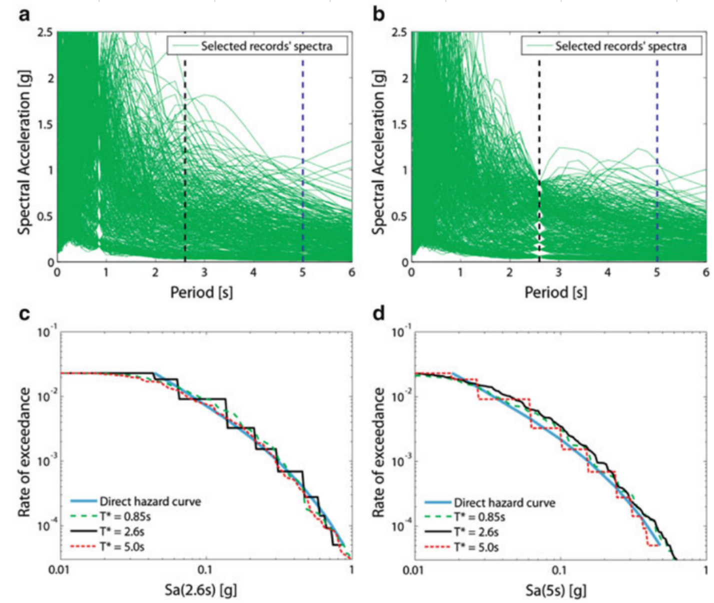


Fig. 28.5 (**a**) Response spectra of ground motions selected using $T^* = 0.85$ s. (**b**) Response spectra of ground motions selected using $T^* = 2.6$ s. (**c**) Rate of $Sa(2.6\text{ s}) > y$ implied by each of the selected ground motion sets, plus the original ground motion hazard curve for reference. (**d**) Rate of $Sa(5\text{ s}) > y$ implied by each of the selected ground motion sets, plus the original ground motion hazard curve for reference