Q & A for Improving Performance of Buildings in Very High-Seismic Regions (P-2343), April 3, 2024

#	Question	Answer
1	What was the typical depth of the ground motions plotted?	The records of the two (Far-Field and Near-Field) sets of FEMA P695 ground motions used for nonlinear response history (IDA) analyses of the FEMA P-2343
2	What are the research topics needed regarding: 1- Short period building collapse; and 2- Improving Performance of Buildings in Very High-	Please refer to Chapter 7 of FEMA P-2343, which recommends topics for future study (i.e., Section 7.4). The FEMA P-2139-1 report of a prior study of short-period building collapse performance also includes recommendations for future study.
3	Are there any projections for the building of Resiliency Buildings?	Not directly; although avoiding collapse would be essential for a resilient building.
4	The depth of the epicenter.	Key properties, including various defintions of fault distance of the individual records of the Far-Field and Near-Field record sets of FEMA P-695 are provided in
5	Will a subsequent study incorporate the lessons learned from yesterday's Taiwan earthquake.	No such studies are planned.
6	Will the results affect how seismic load is prescribed in ASCE 7 in the future?	Most likely. Issue Team No. 4 (IT-4) of the Building Seismic Safety Council (BSSC) Provisions Update Committe (PUC will be reviewing the findings and recommendations of FEMA P-2343 and will be developing proposals for the 2026 NEHRP Provisions and ASCE 7-28, as deemed appropriate.
7	How to obtain eSDOF properties in p18 of the slide (for example He and We)?	See Appendix E of FEMA P-2343 for concepts and formulas
8	Slide and 18 and 19: what's the difference between a "backbone curve" and "pushover curve"? I noticed both names are used to name basically similar plots.	A "pushover curve" refers to the force-deflection plot of response to a static monotonic "push" of the nonlinear analytical model of the building archetype (see Chapter 6 of FEMA P-695). A "backbone curve" refers to the force-deflection plot of the envelop of cyclic-loading response of the nonlinear analytical model of the building archetype (e.g., see FEMA P-795). The backbone curve is essentially the same as the pushover curve for nonlinear models that do not degrade during repeated cycles of loading.

9	Is there any sensitivity assessment to evaluate the effect of 44 records used in performance evaluation? Because the mentioned set of ground motion records show unique ability to cause collapse. Is it possible that the use of these records result in biased outcomes?	Yes. The collapse performance of selected archetype models (MFD Wood archetypes) evaluated using both Far-Field and Near-Field record sets showed an approximate 1.30 increase in model strength of 3-story, 4-story and 5-story MFD wood archetypes would be requited to achieve comparable collapse performance of models evaluated using the Near-Field record set.
10	Any details about the non-structural wall connectivity (connection with the building)?	Yes. See Chapter 4 of FEMA P-2343 and related prior studies of wood archetype models (i.e., FEMA P-2139-2)
11	What will the report say about joints and connection criteria?	See Chapter 4 of FEMA P-2343 for modeling of wood archetype models and Chapter 5 of P-2343 for modeling of non-wood archetypes.
12	What damping ratio/method was used and why? Did you do a sensitivity analysis on the ACMR (or other performance) regarding this assumption?	See Chapter 4 of FEMA P-2343 for modeling of wood archetype models (e.g., 1% damping added to that explicitly modeled by hysteretic properties) and Appendix C of FEMA P-2139-2 for sensitivity of collapse results of wood archetypes to damping (added to the hysteretic model). Damping of the eSDOF models of non-wood archetypes is due entirely to the nonlinear hysteretic properties of these models (i.e., no added damping).
13	Was there consideration of improper ductile detailing as the other possible root cause of past observed collapse rather than an underestimate of building design strength? After all building design STRENGTH, will this control seismic behavior in a MODERATE Earthquake? Whereas proper DUCTILITY & DETAILING will control seismic behavior under the	No. The archetype models of four SFRSs studied by FEMA P-2343 tacitly assumed that ductile detailing requirements of ASCE 7-22 (i.e., large nonlinear displacement capacity). Past U.S. earthquake performance of these four SFRSs does not include events with ground motions above the VHS boundary of the FEMA P-2343, the focus of the study.
14	Did you do any tests for light gage metal studs and how did they compare?	No.
15	Was soil-structure interaction included in the models?	No. However, SSI was investigated in the prior studies of short-period building (i.e., see FEMA P-2139 series) and found to not significantly influence collapse

16	It seems the American community is invested in increasing the lateral strength of the structural systems to maintain constant their probability of collapse for VHS regions. Has the possibility of reducing the allowable drift in the structural systems for VHS regions been considered as an alternative?	Possibly. There is a separate on-going FEMA/ATC study that is investigating drift limits (also a topic of consideration by the PUC of the 2026 NEHRP Provisions). The effects of drift limits on the over-strength of the archetype models was considered in the subject study (e.g., see Chapter 2 of FEMA P-2343).
17	It seems to me the presentation is based on the U.S. environment. How adaptable is this research to other continents like Africa with little research into seismic risk assessment?	Limited, mainly due to differences in the types of structural systems. However, the collapse trends of FEMA P-2343 showing an increase in collapse probability with the level of earthquake ground motions is generically applicable to all structures that have significant nonlinear displacement capacity at incipient collapse.
18	Will torsion affect the accuracy of capacity spectrum method? Is there a way to account for the effect of torsion in the pushover curve using a method that is simpler than the multi-modal pushover?	No. Provided the pushover (backbone) curve is derived from a push on a 3-D model of the SFRS archetype that accounts for rotation in plan.
19	Please elaborate further on increasing collapse probability on softer soil which is related to shape of spectra.	See spectrum shape example, Appendix G of FEMA P-2343.
20	Should ductility factor R be a function of the building period T?	Not necessarily.

21	Do you think future Seismic Hazard Maps will include values for R, Omega, and I factors?	No. Seismic hazard maps, developed by earth scientists at the USGS, quantify the ground motions referenced by Chapter 11 of ASCE 7-22; whereas, the R, Omega and I factors are design parameters of Chapter 12 of ASCE 7 developed by earthquake engineers of seismic code committees (e.g., BSSC PUC).
22	The ASCE 7 fragility curve targets 10% probability of collapse at MCEr for RCII buildings. The same fragility curve shows a 45% probability of collapse if the building experiences twice the MCEr. Based on the P2343 study, will the collapse risk be greater than 45% at twice the MCEr? (The twice MCEr could occur in Salt Lake City.)	Yes, if the there is a 10% probability of collapse for MCEr ground motions, then there will be a larger probability of collapse for twice MCEr ground motions (even if the SFRS is designed for twice MCEr ground motions). However, (1) from actual earthquake experinece, most SFRSs are expected to have much less than a 10% probability of collapse for MCEr ground motions (i.e., perform better than the 10% target reliability of ASCE 7-22 for RC II designs) and (2) MCEr ground motions of ASCE 7-22 (e.g., Site Class D) are about 2 times those of VHS boundary at longer response periods (e.g., see Figure 6-1 of FEMA P-2343), such that new buildings designed to ASCE 7-22 are inherently stronger than those designed to ASCE 7-05/10 (i.e., the VHS boundary of FEMA P-2343/SDC Dmax of FEMA P695).
23	How predictable are earthquakes today?	Seismic hazard maps developed by the USGS provide a reliable basis for MCEr ground motions in VHS regions.
24	It seems that depth is an influencing factor in collapse probability as is type(s) of base soil, i.e., liquefaction, bedrock, etc. How much do these two qualifications	Soil type significantly influences the frequency content (response spectrum shape) of the ground motions, which is very important to collapse performance). Depth of the epicenter has little of no influence on collapse performance (unless
25	On slide 22, which flavor of the DR is being plotted? Is this the median drift ratio at collapse?	The horizontal DR axis of the collapse surface represents a range of hypothetical valus of the median drift ratio at incipient collapse, including those determined from curves of IDA results, as well as those that might be considered appropriate by seismic code committees for establishing values of seismic design parameters.
26	What software was used for this study?	See Chapter 4 of FEMA P-2343 for wood archetype models and Chapter 5 of FEMA P-2343 for non-wood archetype models
27	On the light frame wood you mention drywall and stucco as non-structural, was the exterior of the	See Chapter 4 of FEMA P-2343 (and FEMA P--2139-2)

28	It seems that the overstrength factors currently recommended by ASCE 7 are too low, right? Particularly for wood? But it is not really an issue because of the strength of non-SFRS elements?	Yes, noting that there is an important difference between the actual overstrength (Omega) of the SFRS archetype models of the FEMA P-2343 report and overstrength (Omega_sub_O) of ASCE 7-22, where, in general, ASCE 7-22 overstrength required for design (Section 12.4.3.1) is intended to be an upper-bound on actual overstrength (excluding nonstructural finishes typical of wood light-frame SFRS).
29	I would like to know which parameters have an effect on collapse surface?	All of them.
30	A key takeaway seems to be that buildings with more drift capacity have better resistance to collapse. In other studies, I have read that to limit nonstructural damage using stronger/stiffer systems to limit drift is best for repair costs especially in lower-level earthquakes. Sometimes strength/stiffness and ductility can be at odds with each other.	Strength/stiffness and ductility are both beneficial to collapse performance and not at odds, unless one precludes the other, which is generally not the case. However, stronger/stiffer structures will increase acceleration demand and the likelihood of shaking damage to non-structural components sensitive to acceleration.
31	Is there an ideal design methodology or structural system that could limit damage in small earthquakes and also prevent collapse in large EQs?	Maybe, collapse (not damage) is the focus of FEMA P-2343 evauation of collapse trends.
32	How do we improve the seismic resistance of existing constructed buildings?	Seismically retrofit the building (e.g., ASCE 41)
33	Does this study consider structure ductility factor affect and for increasing strength just properties	I do not understand the question
34	Ductility assumptions should correspond to the intensity of Seismicity.	The displacement capacity (ductility assumptions) of archetype models is inherent to the nonlinear hysteretic modeling of the SFRS of interest, which is

35	Is torsion considered in FEMA P-2012?	Yes (but not in the models of steel SMFs of that study, which where used as the basis of the steel SMF archetype models of FEMA P-2343)
36	Were the wood structures the same as coupled concrete wall structures modeled using Opensees	No. See Chapters 4 and 5 of FEMA P-2343
37	Are there special considerations for non-structural components?	Yes, in determining SFRS archetype model overstrength (e.g., wood models)
38	What is the factor that defines the habitability of a building after an earthquake?	Interesting and important question, but not relevant to FEMA P-2343 study of collapse trends in regions of VHS
39	How do I enhance the seismic performance of old existing buildings in medium to high seismicity zones that do not have any ductile detailing in any member?	Add strength/stiffness (or seismically isolate) to reduce displacement demand on low-ductility members (e.g., seismically retrofit the building using ASCE 41)
40	How do we enforce the building codes effectively, and how to identify what projects will have this new form as a requirement?	Interesting and important question, but not relevant to FEMA P-2343 study of collapse trends in regions of VHS
41	How to integrate multihazard and multirisk analysis in to the singular solution. Performance Based seismic design?	Interesting and important question, but not relevant to FEMA P-2343 study of collapse trends in regions of VHS
42	I specifically work in residential buildings but not sure if this webinar will apply to that - I didn't see that it stated if it was for commercial or residential.	FEMA P-2343 evaluates the collapse performance of wood archetypes of commercial (COM) buildings and multi-family dwelling (MFD) residences. Single-family dwelling (SFD) residences where previously studied (see FEMA P2139-2)

43	I've been on the TMS402 Building Code for masonry buildings for several cycles. I want to learn more about the other issues with buildings in seismic zones other than just the masonry.	Collapse evaluations of FEMA P-2343 focus on regions of VHS, but VHS collapse trends are generic to all SFRSs
44	Let us know the performance of traditional houses in high seismic regions such as Indian Himalaya.	Collapse evaluations of FEMA P-2343 are limited to SFRS common to US construction.
45	Are the findings applicable to Puerto Rico?	Collapse trends and findings of FEMA P-2343 are applicable to the VHS regions of Puerto Rico
46	The Salk Institute has a unique structure. Since its construction, has it been evaluated for performance in a seismic event?	No. Specific buildings are not the subject of the FEMA P-2343 report