

| # | Question | Answered live | Response |
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| 1 | By the current Guidance for Practice in Structural Engineers in California (and Oregon, Washington, west coast) is it needed to undergo the Independent Structural Review of Design of this type of structures? | | Not usually. Most retrofits are reviewed through standard processes by building officials. |
| 2 | Has the software been revised at all since 2012? I believe it used to have a default demand built in; is that still the case? | Y | The software has had only minor revisions. There are user input settings for the hazard and POC. |
| 3 | Mr Mar is calling vertical elements diaphragms rather than shearwalls? | | Diaphragms are horizontal elements and shearwalls are vertical elements. |
| 4 | how much more complicated and realistic would be to model the entire building as actual 3D walls and floors with their corresponding spring properties to have a more realistic response and results ??? | | A more detailed analysis would be significantly more complicated, because of the large number of walls in this typology. The wall material backbones were calibrated to experimental data, which would need to be done for 3D element types as well, and thus there is likely minor consequence to precision. It is noted there is often great uncertainty as well, since the walls are typically non-structural, non-engineered, and poorly documented. As a consequence, there was a focus on a large number of sensitivity studies to understand how these differences may affect collapse risk and related conclusions. |
| 5 | In the "soft side open" model, if the parking area is only 20% of the building length, why is it considered "open" at all? I agree this is a common configuration, but the terminology is unfortunate because there actually ARE buildings with highly open stories and openings on the short side: Are such buildings captured by the 807-1 prototypes? | | I believe the question refers to short-side open models. It is included as a SWOF building because it is often seen as such by building departments, and mandatory screening programs. |
| 6 | Based on shown hysteresis of diaphragm, are we allowed to design it as energy dissipating elements? Or is it preferable to keep it elastic? | | The non-linear behavior of the existing walls is recognized, and utilized in the capacity of the FEMA P-807 retrofits. The non-linear capacity of new elements (plywood walls and moment frames) is also recognized. However, the guidelines are not able to treat walls as traditional energy dissipating elements. |
| 7 | At slide 26: Would it be reasonable to suggest that the soft story failure is primarily due to the torsional irregularity, which would be present in both axes? | | The failures are often a mix of translational and torsional effects. |
| 8 | What software did you use to perform to perform analysis (IDA)...? | | OpenSees |
| 9 | Can you kindly provide the FEMA P695 material? | | FEMA P-695 may be downloaded from the "Downloadable" tab here: https://store.atcouncil.org/index.php?dispatch=products.view&product_id=210 |
| 10 | Could you please show the buildings once more! | | A recording of the webinar will be made available. |
| 11 | Which failure Mode are we addressing in the soft story ordinance. Is it just where we have the open side or are you asking to also mitigate the brittle failure too. Thank you | | FEMA P-807 looks at weakness, in both the X and Y directions. There is a direct accounting of torsional unbalance and brittleness. The Line retrofits are based on the appearance vulnerability of the open front. The study showed that the Line approach was inadequate. |
| 12 | What movement is the %drift based on | | The sidesway drifts are in the X and Y directions. Torsion makes them both worse. |
| 13 | Did you find any real world examples of collapses (or red-tagable damage) caused primarily by diaphragm deficiency? (That is, without already having a major soft, weak, or torsional wall configuration.) | | Great question. We did not find any instances where the diaphragm obviously triggered collapse. Walls seem to be the drivers of collapse. However, the data is sparse. |
| 14 | On the test what was the brittle diaphragm that was tested. | | The brittle diaphragm is derived from tests of a diagonally sheathed test. The changes are based on judgement and intended to understand the sensitivity of such parameters. |
| 15 | Did post EQ surveys corroborate with the IDA study in terms of types of failure? | | Yes. Sort of. Both X and Y direction earthquake failures were observed. The IDA results also showed X and Y failures. |

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| 16 | Do you think that the "cruciform location configuration" of the diaphragms have been the major cause of the way of failure (where the "weak story" is not that pronounced as reason for failure)? | | We do not think that the cruciform configuration of the model is a contributor to the collapse rates. The diaphragm is represented as a line, but it is a shear spring, and flexural modes are neglected. |
| 17 | Thank you for the very informative webinar. How the stiffness of the nonlinear elements is calculated? | | The stiffnesses were based on test results. |
| 18 | Do you have any data on how many of LA's 10,000+ mandatory SWOF retrofits used P-807? | | We do not have data for this. However, we think the number is low, compared to the 75% building code approach in Los Angeles. |
| 19 | How much more would it have cost to design to 2/3 SMS like new buildings? How much would that have saved in the long run? | | This depends. If the upper structure is strong, the building is capable of supporting a stronger ground floor retrofit. In this case the cost difference would be a slight to moderate increase. When the upper floors are weak, there is a physical limit to ground floor retrofits. Thus, the higher performance triggers the need to work in the upper floors. This would be significantly more expensive. P-807 establishes the upper limit of capacity. |
| 20 | Some Cities do not consider using the inverted Column as a favorable design to mitigate the soft story buildings! what do you think? | | I think a well-designed inverted column frame performs well. It can be more reliable than welded frame. It needs a compact section, and a strong grade beam, to force the plastic hinge to the column. |
| 21 | Considering damages observed in diaphragm of studied wood buildings, I wonder if you have any recommendation to include diaphragms in FEMA P58 performance analysis which typically ignore these components? Additionally, do you have any suggestions for component fragility and consequence function for diaphragm needed for P58 analysis? | | I don't think we understand enough about diaphragms and their damagability. However, retrofits seem to mitigate very weak diaphragms, with respect to safety, given the strengthening of vertical elements on the ground level reduces the need for large loads to travel through the diaphragm to other vertical elements. |
| 22 | Very useful comparison of Line (LA) and Story (P-807) retrofits. Did you do any comparisons with CEBC Chapter A4 retrofits? Since that is also a full-story approach, is it fair to think an A4 retrofit is closer to the 807 retrofit than the Line retrofit? | | There are references to A4 and FEMA P-807 comparison studies in the report. |
| 23 | What minimum concrete foundation sizes should be used in order for the embedded cantilever column retrofit be effective? | | Please look at the design example in new document. |
| 24 | Please post a link to the Weak Story Tool software. Does it run on a Mac? (Also, please clarify that the analysis results and plots shown are not from the WST, right?) | Y | The Weak Story Tool is available for download here: https://www.atcouncil.org/fema-p-807-product-support |
| 25 | How is soil condition factored when retrofitting? | Y | The frame should be capacity designed, including keeping the soil pressures within the strenght limits. |
| 26 | Is there an age range of buildings where we can expect LBD? | | I don't understand what LBD is, but perhaps this is referring to the "lower bound diaphragm" strength that we discussed in the presentation (we used different nomenclature). In our investigation of existing materials, we found a range of conditions for the existing diaphragms, and the document encourages engineers to perform a site visit to observe given the wide variability. That said, in many cases it is expected that the floors serve as sheathing for these vintages, and the worst-case strength and ductility would be expected where carpet was used as flooring over straight board sheathing. FEMA P-807 does not have an age range for materials, and custom materials can be used. |
| 27 | Oh, and 10% rather than 20% collapse probability. | | The studies were base on a 20% POC, at 0.5Sms in downtown LA. Other criteria could be used for FEMA P-807. |
| 28 | What POE represent this spectral acceleration 1g? | | The studies were base on 0.5Sms in downtown LA. Other criteria could be used for FEMA P-807. |
| 29 | Excellent finding: retrofit of the vertical elements fixes diaphragm issues. So does this mean it's not necessary to do (expensive, disruptive) destructive investigation of the existing diaphragm? | | The document encourages some level of site observation be performed for the engineer to understand the conditions of the existing building and properly evaluate the related deficiencies, particularly for evaluation. That said, the studies generally showed a substantial improvement where retrofit was performed, and the sensitivity was greatly diminished. |
| 30 | Very insightful presentatoin! This is a question for David. Could you please reiterate how the hysteresis curves are obtained and validated for the walls and diaphragms including the reduction considered to account for the deteriorations? Thanks! | Y | The walls and diaphragms are based on cyclic tests. The material were new. The considerations for deterioration beyond ranges of subassembly test data were based on judgement. |

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| 31 | I'm not quite sure how to phrase this question, but I'll give it my best. What is the "mindset" of the public, if they even know, that living in a 3 story, certain configuration of building is not as safe as one would want to be? | | The statement refers to a person who does not have a structural engineering background, and who is not aware of seismic vulnerabilities. |
| 32 | Has the margin of collapse were calculated for each retrofit options? does any of the option give benefit over other one. The CMR might be an important issue given the low drift capacity of different architypes. | | Collapse margin ratios were not calculated. |
| 33 | If you have a 3 story building to retrofit and you place a steel frame only up to the second floor and you used typical plywood shear wall from 2nd to roof is this a good recommendation? | | A multiple level retrofit is potentially better than a story retrofit. It is also usually more expensive and disruptive. |
| 34 | David Mar: Thank you for your work, but I'm wondering: Three (seemingly unconservative?) assumptions were made: 1. The building archetypes are free-standing. This is different from my memory of most of these buildings. 1a. The adjacent buildings do not influence the response of the generic buildings used in the analytical studies (e.g., corner buildings in the Marina District, San Francisco, 1989). 2. The connections of the superstructures to the foundations do not fail. 3. The foundations do not fail. 3a. The soils do not fail (from liquefaction, other). How do these assumptions affect the analytical results and the recommendations for retrofit? Thank you. | Y | Item 1 and 1a - is true. Mid-block buildings are considered to be safer. But this is difficult to charecterize. 2 and 3, and 3a. New elements need good foundation designs and good loadpaths. Existing walls should be checked for deterioration. If there are soil failure issues, these need to be addressed as well. |
| 35 | introducing a row of retrofit only in front and not back invites torsion. | | I agree with this observation. FEMA P-807 addressed the story capacity, including the effects of torsion. |
| 36 | Thank you FEMA and ATC. Huge amount of hardwork has gone into these studies and providing insights from studies helps practicing engineers to understand the complex analysis. Standardising retrofit details would help further. | Y | Thanks for the feedback. |
| 37 | It seems obvious that if the closed wall is not retrofitted, the stucco+drywall (short side), will introduce torsion, triggering a higher probability of collapse. What do you think it would happen if all the walls, but the open side is retrofitted to even take the torsion generated by the soft side (you may include the wing walls also)? Many times this is the most expensive side to retrofit for the extra foundation work needed. | | We promote the use of FEMA P-807 because it addresses the whole story capacity, including the effects of torsion. Imbalances could be captured, and mitigated. |
| 38 | I'm not quite sure how to phrase this question, but I'll give it my best. What is the "mindset" of the public, if they even know, that living in a 3 story, certain configuration of building is not as safe as one would want to be? | | The statement refers to a person who does not have a structural engineering background, and who is not aware of seismic vulnerabilities. |
| 39 | The targeted POC or probability of failures are for what risk category (with reference to table 1.5-2 ASCE)? | | The studies were base on a 20% POC, at 0.5Sms in downtown LA. Other criteria could be used for FEMA P-807. |
| 40 | was there study regarding the interstory displacements which could controbute to a level of architectural damages making certain retrofit scheme undesirable. | | Story retrofits are primarily focused on safety, and rely on a lot of damage to finishes. Other more expensive retrofits would be needed to reduce damage. |
| 41 | How does the earthquake directionality affects the collapse patterns? Alos connected building in a row - or what would be row effect in the collapse pattern. | | The FEMA P-695 analyses have two EQ directions. But they are far field records. The analyses show complex interations from both directions. |
| 42 | Does the 807-1 report represent FEMA recommendations? Is FEMA really advising cities NOT to bother retrofitting LSO buildings? (I hope not.) | | The FEMA P-807-1 report promotes retrofits, based on the findings of the analyses. |
| 43 | the Line Retrofit using cantilevered columns has lateral stiffness both in-plane and out-of-plane. This why I prefer using Structural Tubes/Square columns. The out-of-plane stiffness will add to the orthogonal direction. Was this considered in the models? | | This was not considered in the models. However, it was recognized as a detailing consideration. |
| 44 | How did you determine the stiffness and non-linear properties of both the walls and diaphragms? | | These are from tests. |
| 45 | What does the FEMA BCA tool say about the benefit of retrofitting SWOF buildings of different sizes, ages, and configurations? | | I have not used the FEMA BCA toolkit. |

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| 46 | In order to compute the shear collected and transferred to the lateral load bearing elements, how do you model the connectors and fasteners in the seismic analysis? | | The design examples recommend capacity design, based on the plastic strength of the frame. |
| 47 | Do you have a link for an ATC webinar for Manufactured Homes as it relates to earthquakes? | | Not that I know of. |
| 48 | thank you for the webinar..i wanna ask a question to mr david.. what the maximum displacement limit that occurs a timber building collapses, seen from the height of the building based on FEMA? Thank you | | Most buildings are collapsing at around 5% drift, when unretrofitted. |
| 49 | Since you did not study A4 retrofits, do these recommendations apply to them? Or should they be understood as recommendations for implementation of P-807? | Y | We think that A4 retrofits would similar results to P-807 retrofits. |
| 50 | how many buildings have been retrofitted using P-807 methodology? | | We do not have data for this. However, we think the number is low, compared to Line and A4 retrofits. |
| 51 | Do you have waterproofing detail to go with that collector screwed to the outside face of the building? (This is a sarcastic question. It's a bad detail.) | | I decline to respond. |
| 52 | Would most of the buildings collapse in Turkey 2023 earthquake be due to open front 3+ story even though the diaphragm is likely to be reinforced concrete? | | I believe that the collapses in Turkey are primarily attributed to a lack of strength, combined with brittleness, and story mechanism. |
| 53 | That's what I've found over time. Additionally, how "we" got away with so many things when looking back at load bearing/paths, I'm astonished it was common practice. | | This question is unclear. |
| 54 | Has any firm used artificial intelligence techniques to retrofit weak story buildings? | | Not that I know of. |
| 55 | Thanks, David. I have heard that concern raised, but always as a concern, never accompanied by quantitative evidence: no fraction of buildings where that's a real issue, no quantification that proves that in those cases, upper stories collapse with unacceptable probability. | | This question is unclear, however collapse probability would depend on a number of variables as discussed in the webinar. |
| 56 | It's normally hard to get 100% fixity on the foundation. Any SSI effect to be considered | | The foundations are capacity designed. There is SSI flexibility, but the frame yielding can still occur. |
| 57 | In bracing requirements the detail 4.4.1 is all wrong. Those nails or small diameter screws through the often 100 year old oak planks will just split the flooring. What kind of doofus concept it that? And are there any builders with hundreds of jobs out here who can detail better, easier, more cost effective methods to capture floor diaphragms? /// And where is the attention to detail or CONDITION | | I decline to respond. |
| 58 | Simpson Strong Frame is another way to retrofit weak story. It is steel moment frame with fuse designed to yield. It might simpler to meet continuous load path requirement. | | We like the Simpson Strong Frame as a viable solution in addition to other options discussed in the webinar. |
| 59 | how do you consider the orthotropic properties of the wood? | | These were considered through the physical testing of the wall and diaphragm assemblies. |
| 60 | Have you or do you plan on assessment of age of materials further work? | | There are not currently any plans for additional material investigations. |
| 61 | How many models/cases were run for this reporting? The summary recommendation wraps up a lot of this. | | There were around 120 versions of the models run. |
| 62 | When I did wood design we used the top plate as the collector. All you would need to do is provide additional nailing/screwing from the sole plate to the rim and clip the rim to the top plate with addition nailing at the top plate joints. That would remove the issue of disturbing the stucco on the exterior. | | Your approach sound reasonable. |
| 63 | Any insights on why the Short Opening failed in the long (Y direction)? Torsion or just a blunt lack of strength? | Y | The primary reason is a lack of strength and brittle materials. |

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| 64 | Do you need secondary blocking to assure the load path from the existing joist to the line of new lateral resisting system? | | Most likely. |
| 65 | Do you have any recommendations on how to develop an inventory of buildings in a community with weak first stories? | | Many cities have conducted visual surveys, followed by mailed notifications to have an engineering report performed. |
| 66 | A4 has been amended to allow a cap on first story strength to avoid upper story problems. Glad to hear you are fans of A4. ;-) | | This is an encouraging improvement. |