
PORTLAND'S UNREINFORCED MASONRY SEISMIC RETROFIT PROJECT

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In late 2014, the City of Portland set up a taskforce intended to expedite the seismic retrofitting of unreinforced masonry (“URM”) buildings in Portland.¹

There is a one in three (37 percent) probability of Portland experiencing a massive (magnitude 8.7 to 9.2) subduction earthquake (the “Big One”) in the next 50 years,² although the epicenter will likely be at least 100 kilometers distant along the Cascade Subduction Zone. Because of proximity, a large (M 6.5) crustal quake on the

¹ A URM building is defined by the City of Portland as a building with at least one masonry bearing wall containing little or no reinforcement.

² “Anticipating the Next Mega Quake” CBS NEWS, 3/6/2016 quoting Prof. Chris Goldfinger, OSU Paleo Seismologist and leading researcher on the Cascade Subduction Zone.

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Portland Hills fault, although much more localized, might be as damaging to the inner west side of Portland.

URM buildings are vulnerable to a high level of damage or collapse in a large magnitude earthquake,³ and they can suffer parapet wall damage and wall/floor separation even in a moderate magnitude earthquake.⁴ The City's some 1,800 URM buildings⁵ include some of the City's most historically significant structures, and provide cultural character, moderate-rate housing for 8,000 to 10,000 people and incubator office and creative commercial space for thousands more.

Fortunately, it is technically feasible to seismically retrofit a URM.⁶ However, is it cost effective to do so? Whether as an individual owner or as public policy (risk management)? The City anticipated this question and is relying on a 1995 analysis prepared for the City by Geologist Ken Goettel (the "Goettel Study") which found that retrofitting URMs sufficiently to allow occupants to survive a quake and to exit a building (Life/Safety standard) will cost less than the benefits in terms of lives saved and economic losses avoided in an earthquake, i.e. the upgrade cost will be less than the public (including owner) benefits which result in terms of lives saved and economic losses avoided in an earthquake.⁷ Unfortunately the Goettel Study is so dated in methodology and data that it is not a reliable basis for the conclusion in 2016, that seismic retrofitting of a URM building in Portland to Life/Safety standards is cost beneficial.⁸

³ URMs are vulnerable to earthquakes because (a) brick, cinderblocks, etc. tend to shear and crack under the lateral and uplift forces of an earthquake; (b) most URMs in Portland were constructed at least 80 years ago and typically their mortar has not been well maintained; (c) non-structural elements like parapet walls, chimneys and building ornamentation abound and are prone to falling off in a quake and injuring fleeing residents and bystanders; (d) floor and roof joists typically rest in but are not attached to notches of bearing walls; (e) floor and roof diaphragms are often overly flexible, such that in a quake the floors deflect and joists pull free causing floors to collapse ("pancake"); and (f) bearing walls typically lack steel or other reinforcement and therefore are not resistant to lateral loads such that they sometimes collapse.

⁴ Written comments to Author from Amit Kumar, SE, PE, Senior Structural Engineer, Portland Bureau of Development Services, March 28, 2016.

⁵ Unreinforced Masonry Database published by Michael R. Hagerty, SE, then Chief Engineer, Office of Planning, April 23, 2001.

⁶ In Los Angeles, that City's mandatory URM upgrading program was tested in the 1994 Northridge Earthquake (M 6.7), and the retrofitted buildings performed well and far better than un-upgraded URMs. See FEMA Publication P-774, Unreinforced Masonry Buildings and Earthquakes (2009). In the 2003 San Simeon quake (M. 6.5): "[Of the] 53 unreinforced masonry buildings in Paso Robles...none of the nine URM buildings that had been retrofitted experienced major damage. Many of the others were damaged so extensively that they were subsequently demolished."

⁷ K. Goettel & G. Horner, Earthquake Risk Analysis, Final Report to the City of Portland, Vol. One (1995); see also FEMA Publication-156, Typical Cost for Seismic Rehabilitation of Existing Buildings (1994).

⁸ Conversation on April 6, 2016, between the Author and Goettel.

In contrast to the public benefit analysis of Goettel, the typical URM building owner would analyze a major expenditure like a seismic upgrade on a more limited “money invested, money repaid” (“Payback”) basis. Looking at seismic upgrading on a Payback basis, URM Life/Safety upgrades in Portland are currently at best marginally cost effective as upgrading will take in the range of 20 to 25 years to payback the owner’s investment through higher rents and lower expenses (in particular, less costly earthquake insurance and a lower cost of mortgage funds).

In contrast, retrofitting an older apartment building with in-unit washer dryers might have a five-year Payback. Also, the 20 to 25 year Payback assumes that the building owner has or can borrow sufficient funds to pay seismic retrofit cost of (say) \$35 to \$45 a square foot, a doubtful assumption for those URM owners who have significant debt relative to the value of their buildings.

Focusing to the public benefit analysis used by Goettel, he concluded that:⁹

- For buildings of any construction type (including URM) on rock sites, the earthquake death risk was very low. So arguably no seismic upgrading of URM buildings in rock soils need occur;
- For URM and precast concrete buildings on firm soils, the earthquake death risk is about 2 times higher than an acceptable level; and
- For buildings of any of the most vulnerable building types (including URM), on soft soils, the earthquake death risk is 2 to 6 times higher than an acceptable level.

Assuming *arguendo* that a Life/Safety seismic retrofit of most URM buildings is called for in Portland, what progress has been made in retrofit efforts?

CURRENT UPGRADE SYSTEM AND ALTERNATIVES

Title 24.85 of the Portland City Code adopted in 1995, and modified in 2004, gives a building owner an alternative to compliance with the seismic rehabilitation requirements of the Oregon Structural Specialty Code. Under current Title 24.85, seismic upgrades to an existing building are required only when the owner activates a “passive trigger,” for instance (1) when the owner changes the occupancy or use¹⁰, or (2) when the owner undertakes a major renovation which exceeds a specific cost

⁹ Goettel considers two main kinds of benefits: (a) life safety benefits which are the dollar value of avoided casualties and (b) non-life safety benefits which are the value of avoided or reduced economic damages and losses, specifically building damages, contents damages, displacement costs, business income losses, rental income losses, and loss of non-profit services. Using this approach Goettel concluded that the benefits of a seismic rehabilitation of a URM building outweigh the costs, unless occupancy is less than one person per 1,000 sq. ft. or unless the building is built on solid rock and hence will suffer little damage.

¹⁰ Resulting in more than 33 percent of the building’s changing to a higher seismic hazard classification or resulting in an increased occupant load of more than 149 people.

threshold, etc. Also, roof upgrades, in particular parapet wall bracing, is required or (3) when more than 50 percent of the roof is re-roofed within five years.

Contrast with Mandatory System. The City’s Bureau of Development Services (“BDS”) estimates that in the 20 years since Title 24.85 was adopted less than 20 percent of the identified URMs in Portland have been seismically upgraded or demolished.¹¹ Portland’s slow rate of URM upgrading is consistent with the data on those California cities that, in response to that state’s Unreinforced Masonry Building Law (1986)¹², elected to employ a voluntary system, establishing retrofit standards and only requiring owners to evaluate the seismic risks in their buildings rather than mandating the owners to make seismic upgrades of URMs. These voluntary programs were only 19 percent effective at achieving compliance, while California cities which chose to mandate seismic upgrades of URMs had an overall compliance rate of 81 percent as of 2003.¹³

RECOMMENDATION OF PORTLAND TO ADOPT A MANDATORY SYSTEM

The City, desiring to keep its citizens safe and to increase post-quake resilience, and encouraged by Goettel’s conclusion that the seismic upgrading of URMs to a Life/Safety standard is cost effective and BDS’s finding that URMs are not being seismically upgraded quickly with a voluntary compliance system, set up the URM Seismic Retrofit Project (“Taskforce”).

The initial step was to appoint a Retrofit Standards Committee to determine what upgrades should be made to what URM buildings in what timeframes. After deliberation, the Standards Committee recommended the City modify Title 24.85 Seismic Design Standards for Existing Buildings, to mandate some level of seismic upgrade for all URMs, except one and two family dwellings, with the degree of upgrade depending on occupancy load, the use or function of the building, building height and size. (Notable in their absence from the matrix were soil stability and/or liquefaction risk.) The Committee also recommended closing loopholes in Title 24.85, including that which allows owners to avoid parapet wall bracing by replacing a roof incrementally over more than five years. As modified, bracing would be required if a roof is replaced within 15 years.

¹¹ This conclusion was corroborated by a 2015 BDS pilot study of 147 presumed URM buildings. In three areas of the City (E. Burnside, S.E. Foster Road and Chinatown) the study found that of 147 buildings, 13 had been demolished and 13 had received some upgrading, but only 4 had received a full upgrade (at best an 18 percent compliance rate).

¹² Section 8875 et seq. of California’s Government Code (CA, 1986) required local governments to inventory URMs, establish a loss reduction program to their own specifications and report progress to the State.

¹³ “Status of URM Building Law,” 2003 Report to the Legislature of the Seismic Safety Commission at page 8. Note that cities with voluntary programs without any incentives had only a 12 percent compliance rate.

The Standards Committee divided commercial URM buildings into five classes.¹⁴ Private owners will typically find their buildings falling into Classes 3, 4 and 5.

- Class 3, taller (4 or more stories) or high occupancy (300 or more) structures or large apartments (100 or more units) (estimate 188 buildings) would be retrofitted to Life/Safety standards.
- Class 4, lower buildings (1-3 stories) with fewer (10-300) occupants (estimate 736 to 800 buildings of which 650 would require upgrading) would be retrofitted either to Life/ Safety or less stringent “Bolts Plus” standards.¹⁵
- Class 5, one or two stories, low risk occupancy (usually 10 or fewer) (estimate 700 buildings) are given ten years to brace parapets and if needed to attach exterior and bearing walls to floors and roof. Wall bracing will only be required if the building is deemed a collapse risk.

Exemptions. If a building is of masonry construction but had significant¹⁶ reinforcement throughout dating from its construction, it is not a URM and as a result would not be subject to the City’s proposed mandatory seismic upgrade requirements. Also, previously retrofitted URM buildings would be excluded from the new mandatory upgrade requirements (“Grandfathered”).¹⁷

What is A Life/Safety Retrofit? A Life/Safety retrofit is designed to ensure that building occupants survive a quake and can exit the building.¹⁸

¹⁴ Class 1 consists of hospitals and emergency facilities (estimate 10 buildings). These need to be upgraded so they will be ready for “Immediate Occupancy” after a quake. Class 2, schools and public assembly facilities (estimated to be more than 40 buildings). These need to be upgraded beyond Life/ Safety, to the “Damage Control Standard.”

¹⁵ “Bolts Plus” is a standard developed in San Francisco that allows the owner to forego strengthening of exterior walls as required to achieve Life/Safety because the building has characteristics generally shown to provide improved seismic performance and increased safety from collapse, specifically if the height to thickness ratio of the walls is sufficient and the building qualifies as “rugged.”

¹⁶ *Albeit* less than would be required in a new building by current Code.

¹⁷ The Grandfathered buildings: (a) Buildings in URM Classes 3, 4 and 5 that have undergone a “full seismic upgrade to ASCE 31 or 41 (or equivalent) standards”; (b) Buildings that have been fully upgraded to Seismic Zone 3 standards under the Oregon Structural Specialty Code; and (c) Buildings with a currently approved Phased Seismic Agreement with the City for a full seismic upgrade as long as the Building remains in the same or “lower” URM Class.

¹⁸ Life/Safety status often entails (a) strengthening the floor and roof diaphragms, as needed, (b) attaching most floor and roof joists to the exterior or load bearing walls, (c) tying back and bracing parapet walls, ornamentation, and reinforcing chimneys, (d) reinforcing bay windows, entrance canopies and skylights, (e) bringing masonry and mortar into a well maintained condition, using a flexible mortar, (f) securing the load bearing walls to the footings or foundation, and (g) reinforcing the exterior and load bearing walls to survive substantial lateral force.

Retrofit Timeline. For the typical three or four story URM apartment building, whether URM Class 3 or 4, the Retrofit Standards Committee proposes that the owner will be given three years from notification that the City classifies his/her building as a URM to complete an ASCE 41 seismic assessment, 10 years to brace parapets and tie the roof to the walls and 25 years or (if a hardship is demonstrated) 30 years to complete all mandatory upgrades.¹⁹ Note that as originally proposed the timeframes were significantly less favorable to owners.²⁰

A retrofit to Life/Safety standards is not a guaranty that building damage can be readily repaired, much less that the building can be immediately occupied after a large quake. If it is a high priority to an owner either to avoid major damage or to retain rental income, then the owner may determine to retrofit to (say) the Class 2 standard (“Damage Control”). Note, the City will encourage Class 3 and 4 buildings to upgrade beyond Life/Safety through incentives, but will not require such additional upgrades.

Proposed Financial Assistance. The Retrofit Standards Committee’s report was presented to the Support (or aka Incentives) Committee which commenced work in June 2015; the author served on that Committee. That Committee eventually had two charges, namely: (1) to determine the cost of a typical seismic upgrade and (2) to make recommendations as to appropriate financial assistance to owners to make an upgrade economically feasible.

As to the cost of a seismic retrofit, BDS had developed some retrofit costs, relying on an updating of the same 20 year old FEMA study used by Goettel.²¹ Surprisingly, the resultant numbers adjusted for inflation were fairly consistent with the hard costs of some current Portland seismic retrofit projects. Seismic upgrade hard costs (ignoring soft costs like tenant relocation, rent loss, debt service, etc.) to bring a typical URM to Life/Safety standards were estimated to be \$35 to \$40 a gross square

¹⁹ Deadlines as follows:

- Step 1. An ASCE 41 seismic assessment and geotechnical report, if in a high liquefaction zone, is to be completed within three years of notification from the City that it believes the owner’s building is a URM;
- Step 2. Parapet, cornice, and chimney bracing and wall to roof attachment are to be completed within 10 years of notification;
- Step 3. All bearing and exterior walls to floor joist attachments and wall strengthening within 20 years; and
- Step 4. Full retrofit within 25 years (or within 30 on a showing of hardship).

²⁰ The draft proposal of the City first proposed to the Retrofit Standards Committee would have imposed a higher standard of retrofitting, a much shorter timeframe for compliance (15 years) and no hardship extension. The final upgrade proposal from Retrofit Standards reduced the required standard of upgrading to Bolts Plus for some buildings with characteristics generally shown to provide improved seismic performance and increased safety from collapse, lengthened the time to come into compliance for most buildings to 25 years, proposed a five-year hardship extension and strongly recommended financial assistance to owners.

²¹ see FEMA Publication 156. Typical Costs for Seismic Rehabilitation of Existing Buildings, Second Edition (1994).

foot, or for a 40,000 square foot Class 3 building, \$1.4 million to \$1.6 million. The cost to bring a URM to the higher Damage Control standard were estimated to be \$44 to \$51 a square foot and the cost to bring a URM to the even higher “Immediate Occupancy” standard was \$63 to \$74. Total cost including soft costs is typically the hard cost plus \$30 a square foot.

Regarding financial assistance to owners, the committee recommended various proposals, including a state tax credit for a percentage of seismic expenditures, a property tax abatement or assessment freeze, a grant to cover initial expenses, possible low interest loans and allowing owners of non-historic buildings to sell their excess FAR.²² The City, in the 2015 Legislature, did manage to get SB 85 passed, allowing local jurisdictions to use the proceeds of general revenue bonds to make seismic retrofit loans. The Committee spent time discussing both affordable housing and historic properties. The tax credit and property tax freeze do not help affordable housing as typically the developer is a non-profit. Historic properties already have access to the federal historic tax credit and a property tax assessment freeze.

WHAT LIES AHEAD?

In early 2016, the work of the Standards and Support Committees was given to the Seismic Policy Committee to consider and balance all these issues and develop a final set of recommendations to City Council by early summer 2016. Council intends to adopt a final package of regulatory changes for URMs over the summer.

So what could all this mean to a URM building owner? Prospective owner? Lender? or Insurer?

Effect on Individual Building Values. If and when the City mandates URM retrofitting, lenders, buyers and insurers of apartments and commercial buildings will

²² A grant program to pay some of the cost of a seismic retrofit, such as the cost of an ASCE 41 seismic analysis and upgrade plan; a low interest loan program possibly through private lenders and/or SBA utilizing revenue bond funds, such loans to supplement private loans so as to achieve a low, blended rate construction/mini-perm loan; a fund to provide credit enhancement for privately financed retrofits; a fund to be used to buy-down the interest rate on seismic retrofit loans; a permit fee reduction on seismic work; a broader FAR transfer program, expanded so any URM building, not just an historic building, could sell its excess FAR; a broader “no piggy backing” stricture aimed in particular to prevent Water Bureau impositions at the time of a seismic permit application; a 25 percent state seismic upgrade tax credit, allowing the owner a saving of Oregon income taxes equal to one quarter of seismic upgrade expenditures once the work is completed (similar to bill SB 565 introduced by Restore Oregon in the 2015 session); a property tax abatement, once a seismic upgrade has been completed, running for (say) 10 years such that the assessed value of the property cannot increase; a LEED-like rating system showcasing completion of seismic upgrades, either the new program administered by the US Resiliency Council or a similar one sponsored by the City; an incentive to owners who comply ahead of time (early adopt); and a BDS fast track for seismic permits and an ombudsman or concierge to assist in the approval process, and post disaster expedited permit issuance to support recovery, waiver of non-conforming use limitations on rebuilding, etc.

likely want to know the seismic condition of any Portland URM buildings with which they are dealing. This, in turn, will create an incentive for URM owners to have a structural engineer prepare an ASCE 41-13 seismic assessment of their buildings.

If the ASCE 41 indicates a need for major upgrades, one might assume that, as with hazards disclosed by an environmental Phase One, the owner may be asked to commit to perform the prescribed seismic upgrading work prior to a purchase or loan closing or at least obtain bids for such work and potentially escrow funds to pay for it.

Unless or until cured, identified seismic deficiencies may arguably reduce the building's value. For instance, assume a 4-story, 48 unit URM apartment building of 40,000 square feet, with a seismic retrofit cost of \$35 a gross square foot, or \$1.4 million. One could argue that the building's value would be reduced by a 50 to 90 percent of said cost until the retrofit was substantially completed.²³

Financial Impact on City's Housing Stock. Of the some 1,800 URM's in Portland, by the Author's count about 200 of these are multistory apartment buildings. There are about another 95 historic apartments which are not URM's, as they have some seismic reinforcing, but less than needed to meet the Life/Safety standard, seismic reinforcing. Together, these nearly 300 apartment buildings, totaling approximately 6.0 million square feet, are worth something like \$650 million.²⁴

Of course some URM buildings will end up being demolished, but even 200 apartment buildings averaging 20,500 square feet each would cost at a minimum \$103 million to upgrade to a Bolts Plus standard (\$25 a square foot) and \$185 million to upgrade to a Life/Safety standard (\$45 a square foot) all in 2016 Dollars. That is a lot of money, but the alternative of losing 300 apartment buildings valued at \$650 million and averaging 30 units each (9,000 units), as well as the cultural impact of their loss, would be devastating to the housing inventory and aesthetics of the City, costing upwards of \$1 Billion to replace the units alone, ignoring the aesthetic loss, the deaths and injuries and the loss of productivity.

CONCLUSION

Obviously it is essential that any mandatory URM retrofit program adopted by the City be flexible in its impositions on URM owners and include substantial financial help to the owners so the Payback is positive. Still, given the credible and peer-reviewed science indicating an impending "Big One," it is likely that an owner of a Class 3 or 4 URM building not situated on rock or firm soil will eventually have to do one of the following: (1) seismically upgrade; (2) sell to or joint venture with

²³ Why not 100 percent of the cost? Because some buyers will not take the earthquake threat seriously.

²⁴ According to the Multnomah County Assessor they were worth \$579.1 million in 2010 Dollars (or \$96.50 per square foot). So assuming 3 percent appreciation annually they are worth something like \$651.8 million in 2015 Dollars (or \$108.60 per square foot).

someone who can afford to and will seismically upgrade; or (3) demolish the building.

Lenders and Insurers. Lenders and insurance companies, especially given the wide dissemination among opinion leaders of The New Yorker Magazine article by Kathryn Schulz entitled “The Really Big One,”²⁵ may, absent seismic upgrading, in the future become more hesitant respectively to loan on URM buildings or to insure them against earthquakes.

The lenders and insurers on URM buildings may in future want to see an ASCE 41 report on each. If a lender determines to make a loan on a URM, he/she may modify the loan terms to lower their risk and increase the return.²⁶ Insurers will have similar goals and adjustments.²⁷

URM owners who want to weigh in and express their views should follow City Council agendas and the project website:
<http://www.portlandoregon.gov/pbem/66418>. ■

²⁵ June 28, 2015.

²⁶ Lower the allowed loan to value ratio and insist upon greater debt coverage, a shorter amortization and term, and a higher interest rate. Also lenders making loans collateralized by URM apartments will likely want the owners; (b) to carry earthquake insurance; (c) to complete a seismic upgrade; and/or (d) to be personally liable on the loan and have a net worth well in excess of the loan.

²⁷ Insurance companies will likely (a) require an ASCE 41 seismic analysis on any URM buildings to be insured, (b) reduce the amount and scope of earthquake coverage on Portland URM, (c) increase the premiums, (d) increase the deductible, and potentially (e) require the seismic upgrades to be commenced.