A Real Estate, Land Use and Construction Law Update

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Sendai Isn't Unique: Is the Pacific Northwest Next?

Sendai, Japan, has just experienced a horrific subduction earthquake and tsunami arising from its proximity to the so-called "Japan Trench." Some geologists think that Seattle and Portland have a 10 to 14 percent chance of experiencing a similar M 9.0 subduction earthquake in the next 50 years because of their proximity to the so-called "Cascadia Subduction Zone." Such an earthquake would have a catastrophic effect on the Washington and Oregon Coast (compounded by a tsunami) and would cause major damage along the I-5 Corridor, destroying infrastructure and many buildings.

Un-reinforced masonry ("URM"), and surprisingly, pre-1994 high-rise buildings are especially at risk. There are an estimated 3,500 URM buildings in greater Portland and Seattle and an estimated 240 older high-rise buildings. Buildings such as these constitute a substantial component of the housing and commercial spaces, and contribute to the historic and cultural fabric of the respective cities.

Total preparedness is impossible, but just as individual homeowners can reduce their risk by planning, so too can the owners of at-risk buildings. Given the number and importance of such buildings to the two cities, the communities need to be persuaded to encourage seismic upgrading.

The March 11 Sendai Earthquake (M 9.0), tsunami and nuclear meltdown has hopefully impressed most people with the enormous power and destructiveness of a major subduction zone earthquake (i.e., a quake where one tectonic plate moves forcibly under another).

Initial calculations have found that the epicenter of the quake was 32 km (19.9 miles) down and 129 km (80 miles) away from the City of Sendai. The Sendai Quake resulted from thrust faulting on or near the Japan Trench Subduction Zone ("JTSZ"), the plate boundary between the Pacific and North America plates.[1] In the vicinity of the epicenter, the Pacific plate moves westwards and under the North America plate (and Japan) at a rate of 8.3 meters (27.4 feet) every 100 years.

According to the U.S. Geological Service, the JTSZ has generated nine seismic events of magnitude seven or greater in the last 38 years.[2] Moreover, large offshore earthquakes also occurred in the JTSZ in 1611, 1896 and 1933. Each produced devastating tsunami waves on the

[1] See Japan Sendai Earthquake Data Portal, Harvard University http://cegrp.cga.harvard.edu/japan
[2] USGS, Earthquake Hazards Program, http://earthquake.usgs.gov/

Sanriku coast of Pacific Northeast Japan. That coastline is particularly vulnerable to tsunami waves because it has many deep coastal bays that amplify tsunami waves.

About 20 years ago in the Pacific Northwest, geologists discovered a history of massive, if infrequent, subduction zone quakes in the Cascadia Subduction Zone ("CSZ"), the 800-mile-long intersection of the small Juan de Fuca plate with the same North America plate off the British Columbia, Washington, Oregon and Northern California Coasts. In fact, a quake of approximately M 9.0, the same magnitude as the March 11 Sendai Quake, occurred on January 26, 1700.[3] Moreover, historically there have been 19 similar (M 8.7 to 9.2, full fault) and 18 lower magnitude and more localized (M 8.0 to 8.5, partial fault) CSZ quakes in the last 10,000 years (average: one per 263 years).[4]

Geologists recently estimated that there is about a 10 to 14 percent chance of a M 9.0 quake occurring off the Oregon/Washington Coast in the next 50 years and a 37 percent chance of a more limited M 8.0 to M 8.5 quake on the Southern Oregon coast.[5]

Since the Juan de Fuca plate moves eastward under the North America plate at a rate of four meters (13 feet) every 100 years (about one half the rate of the movement in the JTSZ), approximately 40 feet of movement has potentially been stored up since 1700. Geologists estimate that in a typical M 9.0 CSZ quake some 20 meters (62 feet) of plate movement occurs.[6] Release of that much stored energy, if it occurs in the typical four-minute timeframe, would initiate a tsunami that could flatten many of the low-lying structures on the Oregon and Washington Coast, and would send out long duration (1 second or longer) ground waves for several minutes. Such a quake would produce as much energy as the entire U.S. consumes *in a month*. Modeling indicates such shock waves would severely damage a substantial percentage of the buildings, homes, highway and railroad bridges, roadways, water, gas, sewer and electric lines in Seattle, Portland and points north, south and in between, on the I-5 Corridor.[7]

The risk of a massive CSZ quake, coupled with the vulnerability of Pacific Northwest coastal areas to a 30-foot or greater tsunami present a challenge to the Oregon/Washington Coast and the I-5 Corridor. Especially vulnerable to damage or collapse in a M 9.0 quake are URM buildings and seismically out-of-date high-rise (over 115 feet) buildings ("Old HR").

Besides the magnitude of the earthquake, the severity of structural damage to a building in an earthquake is a factor of: (1) the depth and horizontal distance away from the quake's epicenter; (2) the site's soil conditions (loose and wet being bad); (3) the slope of adjacent hillsides; (4) the

[3] Brian F. Atwater, David Yamaguchi, et al., The Orphan Tsunami of 1700: Japanese Clues to a Parent Earthquake in North America, USGS and University of Washington Press (December 30, 2005) at 96.

[4] C. Goldfinger, C. H. Nelson, et al., "*Holocene Earthquake Records from the Cascadia Subduction Zone*…," 31 Annual Review of Earth and Planetary Sciences, at pp.555-577 (May, 2003); Cascadia Region Earthquake Workgroup ("CREW") 2005, "*Cascadia Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario*," Oregon Dept. of Geology and Mineral Industries ("DOGAMI")(May 2005).

[5] Joe Rohas-Burke, "*Quake Study Asks When, Not If,*" Oregonian (April 21, 2010); Tom Banse, "Sleeping Giant Overdue…," National Public Radio ("NPR") Web page Apr. 21, 2010

[6] Atwater, Yamaguchi supra n. 3 at 98.

[7] Cascadia Region Earthquake Workgroup ("CREW") 2005, "*Cascadia Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario*," Oregon Dept. of Geology and Mineral Industries ("DOGAMI") (May 2005).

building's type of construction (URM, Old HR, to name a few); (5) the building's state of repair and degree of seismic upgrading; and (6) the proximity of other earthquake-vulnerable buildings liable to collapse on the subject building.

The "distance from epicenter" factor would favor the eastern parts of Oregon and Washington in a CSZ quake, as these areas are several hundred miles removed from the Coast. While the maximum ground motion generated by a M 9.0 CSZ quake on the Coast is estimated to be 150[8], the ground motion in Portland is estimated to be about 90 (60 percent of the Coast's), and in Central Oregon a much lower 35 (23 percent of the Coast's).

The "type of construction" and "state of repair/degree of upgrading" factors are crucial in predicting the damage likely to be suffered by a structure in a subduction zone quake. Wood-frame structures are generally less vulnerable to quake damage, as long as they are attached to their foundations (however, they are more vulnerable to a tsunami). High-rise buildings, long-span bridges and aqueducts readily sway if exposed to long waves at periods of one second or more, and such waves can create a damaging resonance between the ground and the long/tall structures above.[9] This might cause an old high-rise building that would be unscathed in a more typical quake to suffer substantial damage.[10] URM buildings are especially vulnerable to earthquake damage.

An inventory of high-rise buildings in the Pacific Northwest disclose that 66 percent, that is 743 of the 1,131 tall buildings (12 stories or higher) along the I-5 Corridor, predate the mid-1990s building code changes which upgraded the seismic risk of much of Oregon and Washington to Zone 3 and imposed more stringent structural performance standards.

- Vancouver, B.C. (634 total HR/ 381 or 60 percent predate 1995);
- Seattle, Wash. (225 total HR/ 156 or 69 percent predate);
- Portland, Ore. (127 total HR/ 84 or 66 percent predate);
- Salem, Ore. (24 HR/ 20 or 83 percent predate); and
- Eugene, Ore. (25 HR/ 20 or 88 percent predate).

URM buildings are vulnerable to quake damage because: (1) they typically have load-bearing walls of inadequate strength to resist horizontal ("shear") forces; (2) their walls lack flexibility or "ductility;" (3) the buildings' heavy weight creates enormous momentum once in motion; (4) their lack of structural connections throughout can hasten disintegration; (5) the weakness of the buildings' roof and floor diaphragms make them susceptible to deflection; (6) such URM buildings tend to have parapets, cornices, chimneys and stone ornamentation, which are prone to breaking off in a quake; and (7) older URM buildings were typically designed without reference to seismic forces.[11]

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[8] Maximum considered earthquake ground motion, of 0.2 sec spectral response acceleration (5 percent of critical damping), site class B. Figure 1613.5 (1), 2007 Oregon Structural Specialty Code p. 408. See also http://eqhazmaps.usgs.gov/

[9] Atwater, Yamaguchi supra n. 3 at 104.

[10] CREW, "*M9.0 Earthquake Scenario*," supra n. 4 at 2.

[11] FEMA Publication 774, Unreinforced Masonry Buildings and Earthquakes…" at 10 through 14, 33 (October, 2009); D. W. Look, AIA, T. Wong, PE, and S.R. Augustus, et al, "*The Seismic Retrofit of Historic Buildings*," 41 Preservation Briefs, National Park Service (October 1997).

Portland URM Inventory: In 2001, the City of Portland inventoried its URM buildings and identified approximately 1600 URM's in the city,[12] which include among others:

- Two-hundred apartment buildings (including condo conversions) totaling over 3.8 million square feet, and 5,200 units worth conservatively over $350 million (at $67,300 a unit); and
- Schools (49), hotels/motels (38), churches (49), restaurants (85), auto repair (61), office buildings (186), child care, medical and nursing homes (26), assembly halls and theaters (43), stores-general (119), commercial buildings-general (352), warehouses and storage (198), government/public buildings (6), and general industrial (95).

Clearly, URM buildings are a key component of "close in" rental housing and commercial space in Portland. In addition, they contribute to Portland's historic fabric, making an aesthetic and architectural contribution to the city.

Seattle Inventory: In 2007, Seattle conducted a URM building inventory,[13] which identified:

- Eight-hundred and fifty to 1,000 URM's in the City of Seattle; and
- Two-thousand and two-hundred URM's in King, Pierce and Snohomish Counties.

Again, URM buildings are an important component of housing and commercial space in Seattle, and as evidenced by the Pioneer Square area, important to Seattle's historic identity.

As mentioned above, starting in about 1994, changes to the Uniform Building Code ("UBC") upgraded earthquake risk for Western Oregon and Washington and the performance standards for buildings. Seismic Zone 3 (high hazard) was extended to Western Oregon and Washington, and coastal areas were reclassified Seismic Zone 4 (highest hazard).[14] With the coming of the 2006 International Building Code (reflected in the 2007 Oregon Structural Specialty Code), there was a slight shift in approach to seismic risk analysis. In addition to geographic location and construction type, the site's "maximum considered earthquake ground motion," and its soil profile were to be considered.

Currently, neither Seattle nor Portland mandate the seismic upgrading of seismically-challenged buildings unless (for example) the owner is undertaking substantial alterations, making a change of occupancy to a more people-intensive use, or the building suffers major damage or is deemed dangerous.[15]

It is expected that that there will be increasing pressure from casualty insurers, mortgage lenders and local government to try and force owners of URM buildings and older high-rise buildings in the Pacific Northwest to seismically reinforce and/or upgrade their buildings. The challenge

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[12] Michael R. Hagerty SE, Chief Engineer, Editor, Office of Planning and Development Review, City of Portland, Unreinforced Masonry Data Base (April 23, 2001).
[13] Reid/Middleton for City of Seattle Dept. of Planning and Development, Unreinforced Masonry Building Seismic Hazards Study (December, 2007).
[14] Note that a structure in Zone 4 must be 33 percent more seismically resistant than a structure in Zone 3.
[15] Portland Seismic Regulations, City Code, Chapter 24.85; Seattle Building Code, Section 3404.

facing these owners is that a standard seismic retrofit is costly (e.g., for a URM building a retrofit will in many cases approach 20 percent of the value of that building),[16] but there are few tax or other governmental incentives except in those instances when the 20 percent Federal historic tax credit applies.[17] Moreover, a retrofit adds little to the cash flow of the building, aside from marginally lowering earthquake insurance premiums and mortgage interest rates, resulting in at best the recovery of the investment over a 20-25 year amortization.

Given the large number and the economic, historic and architectural importance of URM and old high-rise buildings in Portland and Seattle, it is incumbent upon knowledgeable owners, architects, preservationists, structural engineers and governmental officials to educate other owners and our state legislators of the earthquake threat to these buildings. It is also important for all to work collaboratively to reduce impediments and increase incentives for seismically upgrading such buildings.

Based on the above, here are suggestions for owners of URM and old high-rise buildings:

> 1. Consult a structural engineer and commission a Seismic Risk Assessment of your building, or if concerned with liability, obtain a verbal report only;
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> 2. Find out if your building has been identified by either the City of Seattle or the City of Portland in their inventories as a URM or otherwise seismically deficient;
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> 3. Review commercial leases to determine what ability you as the owner/landlord have to pass on voluntary or required seismic upgrade costs to tenants, and if you do not have this right, attempt to add this type of provision in future leases; and
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> 4. Find out what governmental incentives, if any, are available for the seismic upgrading. If your building is historic, there is a possible federal 20 percent historic tax credit (versus a possible 10 percent tax credit for non-historic commercial buildings) and a possible charitable deduction for a facade donation.[18] In Oregon, for historic buildings, there is a possible 10-year property tax assessment freeze, which is possibly renewable for a second 10 years.[19]

In addition, here are some steps you can take for individual preparedness at home and work.

> 1. Obtain earthquake insurance with a maximum 10 percent deductible for your house and other buildings;
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> 2. Obtain flood/tsunami insurance for any low-lying beach house or waterfront property;

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[16] See FEMA 156 and 157, Typical Costs for Seismic Rehabilitation of Existing Buildings, Vols. 1 and 2 (Washington D.C. 1994, 1995).

[17] IRC Section 47 and Regulations 26 CFR 1.48-12. See also, M. Primoli, IRS for National Park Service, "*Tax Aspects of Historic Preservation Tax Incentives - Frequently Asked Questions*" (October, 2000), available at the NPS/National Register Website.

[18] www.preservationnation.org/resources/legal-resources/easements/easement-incentive-renew.html

[19] ORS 358.475 et seq.

3. Look at the FEMA/USGS maps of your locale and determine if you are in a seismically threatened area, have a deficient soil type and/or are in the 100-year flood plain;

4. Have your wood-frame house and buildings retrofitted to secure the structures to their foundations;

5. Secure water heaters, chimneys, cabinets and any parapet walls at your residence and in other buildings;

6. Know how to turn off your gas line and have a tool to do so, and know how to turn off the water line and electricity;

7. Store in an accessible place: several weeks of food, water, flashlights, batteries for same, basic tools, bedding, warm clothes, a tarp, fire starter, an emergency radio, even a small electrical generator to charge and/or operate essential appliances and cell phones, possibly $1,000 in cash, a first aid kit and a month of your prescriptions if you have a medical condition;

8. Determine if your office or apartment building meets Zone 3 or even Zone 4 seismic codes;

9. Encourage your state legislators to vote in favor of allocating money for school and public building seismic upgrades, and to vote in favor of granting state tax incentives for seismic upgrades (i.e., tax credits and property tax abatements);

10. For those living in Portland, encourage the city to arrange for some emergency vehicle storage on each side of the Willamette River; and

11. Support earthquake awareness training at the workplace.

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