Earthquake Engineering Research Institute
Utah Chapter

Summer 2015 Newsletter

President's Message
By Brent Maxfield
EERI Utah Chapter President

In the May 2015 issue of SEAU News (The newsletter of the Structural Engineers Association of Utah), I wrote an article titled, "*Seismic Communication: Let's get on the Same Page*." In this article I proposed a common message that structural engineers should use to communicate with others about seismic risks. In this article I presented 14 talking points. I will repeat these talking points here. The article is included in its entirety later in this newsletter.

Talking Point #1:

Engineers design for a specific ground motion shaking intensity, not a specific earthquake. (Avoid the use of "earthquake" in your discussions unless it is "the ground motion caused by an earthquake.")

Talking Point #2:

Engineers design to a code-mandated ground motion shaking intensity level that is not caused by a specific magnitude earthquake, but could be caused by different magnitudes of earthquakes.

Talking Point #3:

The "Maximum Considered Earthquake" (MCER) ground motion shaking intensity is not the largest possible shaking intensity. It is the largest shaking intensity that the code requires to be considered.

Talking Point #4:

Engineers use the following terms to describe building performance: "Immediate Occupancy" means that the building can be used following some cleanup and that it can be occupied during repairs. "Life Safety" means that the building will have significant structural damage, but it has extra strength and stiffness to resist aftershocks. It also means that nonstructural components stay attached to the building. "Collapse Prevention" means that the building has been pushed to the limits of its strength and stiffness and is on the verge of collapse. Nonstructural components may be dislodged causing localized deaths from falling debris.

Talking Point #5:

The code acknowledges that 10% of the buildings that experience the MCER shaking intensity could collapse.

Talking Point #6:

When discussing building performance, two things must always be discussed: 1) The ground motion shaking intensity, and 2) The expected building performance at that shaking intensity. For a typical house or building, the code performance expectations are "Collapse Prevention" at the MCER and, "Life Safety" at the 2/3 MCER shaking intensities. For hospitals, it is "Immediate Occupancy" at the 2/3 MCER, and "Life Safety" at the MCER shaking intensities. Note that hospitals may not be operational if they experience the MCER shaking intensity.

Talking Point #7:

It is impossible to predict the exact ground motion shaking intensity from a magnitude 7 earthquake on the Wasatch fault. Seismologists can only provide a median predicted ground motion and a standard deviation. The median provides a 50% likelihood and the median + 1 standard deviation provides an 84% likelihood that the actual ground motion will be less than these amounts

Talking Point #8:

The code ground motion shaking intensity levels along the Wasatch Front are based on a very low probability of a magnitude 7 earthquake on the Wasatch fault (about 1/1250 per year).

Talking Point #9:

Some segments of the Wasatch fault have built up enough stress to break at any time (tomorrow or many years from now). The code does not consider this increased risk of earthquake. If it did, the code-mandated ground motion shaking intensities along the Wasatch Front would be considerably larger.

Talking Point #10:

In parts of California, the MCER is set at the 84th percentile shaking intensity of a nearby fault. In Utah this is not a requirement. In other words, the code does not require that buildings be designed to resist the higher shaking intensities that could be caused by a magnitude 7 earthquake on the Wasatch fault.

Talking Point #11:

If a magnitude 7 earthquake happened on the Wasatch fault, there is about a 50% likelihood that, for some buildings, the MCER shaking intensity would be exceeded. Remember that the code allows building collapse to begin occurring at the MCER.

Talking Point #12:

Understand how the MCER and 2/3 MCER Design shaking intensities relate to the shaking intensities that can be caused by a magnitude 7 on the Wasatch fault. Engineers can provide the likelihood that the actual ground motion will be less than the MCER and the likelihood that the actual ground motion will be less than 2/3 MCER.

Talking Point #13:

A building owner can choose to consider shaking intensity levels above the code and then decide upon a level of confidence he/she wants for the "Immediate Occupancy", "Life Safety", and "Collapse Prevention" performance states for a magnitude 7 earthquake on the Wasatch Fault.

Talking Point #14:

The 2012 International Building Code (IBC) lowered ground motions by about 18%. This results in weaker buildings and will result in more collapsed buildings when the Wasatch fault moves.

In a nutshell, the building code may not be protecting the residents along the Wasatch Fault as well as they think that it is protecting them. New buildings may be significantly damaged or collapsed when the Wasatch fault moves.

In addition, the building code is focused on preserving lives, and not preventing major economic loss. The recently published report, ***Scenario for a Magnitude 7.0 Earthquake on the Wasatch Fault – Salt Lake City Segment*** (See article in this Newsletter) estimates over $30 Billion dollars of economic loss. One way to reduce this loss is to design buildings to be more robust, thus reducing the cost of repairs following an earthquake. Building owners should consider building their buildings with a focus on reducing repair cost rather than on just preventing building collapse.

During the next year, the EERI Utah Chapter will begin discussions with many different groups with a focus on planning for a faster and less expensive recovery following a Wasatch Fault earthquake. The ability and speed of recovery is sometimes referred to as resiliency. To become a more resilient community and state will take planning and commitment by many different government and non-government organizations. We hope that you will participate in these discussions.

This issue of the Newsletter contains information about the referenced Scenario report. It also summarizes the lecture by Dr. Robert Olshansky, the 2015 EERI Distinguished Lecturer that was held on July 21st. Dr. The lecture by Dr. Olshansky was a kick-off for our discussions of resiliency. He discussed the relationship between earthquakes and time and then emphasized the need for pre-disaster planning. It was a stimulating discussion.

The EERI Utah Chapter is committed to reducing the risk of earthquakes in Utah. We encourage your participation with us. Please visit our website at http://utah.eeri.org.

Utah Chapter of EERI Completes Earthquake Scenario Report

By Bob Carey – EERI Utah Chapter Board Member

The EERI Utah Chapter, in cooperation with FEMA, has completed an earthquake scenario report for the greater Wasatch Front region. A publication of this detail has never been created for Utah. The Utah Chapter hopes that the report will "catalyze public and private actions that will increase pre-disaster resiliency through earthquake preparedness – being prepared to withstand, to respond and to recover." The report was presented by the Chapter to the Utah Seismic Safety Commission (USSC) at their quarterly meeting at the end of July.

The report uses results developed by the Utah Division of Emergency Management from their ongoing work with the HAZUS loss-estimation software. The scenario is for a magnitude 7.0 earthquake on the Salt Lake City segment of the Wasatch fault.

Estimated aggregated losses, for the 12 most northern Utah counties, illustrate the severity of this event. The human impact of the report focuses on the HAZUS results in terms of deaths, injuries, and sheltering needs. The HAZUS results also emphasize the huge economic impact showing the loss from structural, nonstructural (i.e. walls, ceilings, cladding, and HVAC), building contents, and inventory damage in addition to the cost of lost wages, lost rental income, and relocation. The reports lists the estimated lifeline losses and also provides time estimates for recovery for selected utilities. In addition, the report presents estimates on the number of building inspectors that will be needed to perform building safety evaluations, and it estimates the amount of debris generated that must be hauled away.

The scenario report concludes with a call to action, providing nine recommendations to the USSC. These recommendations provide the Commission with a direction forward that includes consensus building of stakeholders, advocates for pre-disaster planning and mitigation, and encourages the ongoing study of geologic hazards along with the continued monitoring of seismic activity, and finishes with the need for disaster resiliency planning.

The Chapter would like to thank the Scenario Subcommittee for their volunteered time and hard work on the report. Subcommittee members include Kris Pankow, Chair, Barry Welliver, Walter Arabasz, Pete McDonough, Josh Groeneveld, Leslie Youd, Gary Christenson, Steve Bowman, Sheryl Peterson, Brent Maxfield, and Bob Carey.

The report will be presented to Governor Herbert and the members of the state legislature and provided to jurisdictions along the Wasatch Front. It is available for download from the EERI Utah Chapeter website http://utah.eeri.org.

2015 EERI Distinguished Lecture – *Cities, Earthquakes, and Time*
Presented by Dr. Robert Olshansky, July 21, 2015

On Tuesday, July 21st, Dr. Robert Olshansky presented the 2015 EERI Distinguished Lecture to a diverse audience of engineers, geoscientists, planners, architects, emergency planners, and building owners. The title of the lecture was *Cities, Earthquakes, and Time*. Dr. Olshansky pointed out that unlike many other disasters, earthquakes occur without warning and occur at a small instance of time. Even though they occur in a brief instance of time, the time spent preparing for and recovering from earthquakes occurs over a very long period of time.

Dr. Olshansky is a professor and head of the Department of Urban Planning at the University of Illinois at Urbana-Champaign. His research focuses on disaster recovery. He has studied the aftermath of many disasters including Hurricane Catrina, Super Storm Sandy, tsunamis in the Indian Ocean and Japan, and earthquakes in Japan, China, Haiti, California, and other locations. In this lecture Dr. Olshansky shared some of his observations of what worked and did not work as these areas tried to recover from the disasters that struck these regions. He offered four observations.

1. **Earthquakes occur without warning**. Even though they occur in a brief instance of time, the time spent recovering from an earthquake could take years or even decades. He mentioned that after the response comes the economic damage when businesses shut down, people lose their jobs, and the rebuilding starts. He discussed that cities are complex systems of social and economic networks.
2. **Even though it takes only an instant to break, it takes a long time to fix**. One tendency to avoid is the desire to hastily rebuild. Rebuilding should not be a race. He said that rebuilding should take a long time because of the complex interactions within a community and the need to consider important aspects of urban life. He strongly encouraged openness in government and the involvement of community residents. If residents are involved and understand the process, they will be much more willing for the process to take a long time. Do not use number of housing units restored as an indicator of progress to recovery.
3. **Earthquakes repeat themselves**. Think about the earthquake after the next one. The rebuilding process must account for another earthquake. Codes and policies do not have this long-term view. They tend to focus only on the upcoming earthquake and only to get people out of the building safely. He strongly encouraged changing focus to a long-term view that would ensure continuity of basic operations. If the rebuilding process must consider another earthquake, it would make more sense to plan now for the earthquake after the next one. This long-term focus requires a change in current policy.
4. **Rethink traditional structural standards**. Current structural standards do not consider the aftermath once people are safely out of a building. The current code focus of life safety increases the economic loss following an earthquake and lengthens the recovery process.

Dr. Olshansky then recommended four policy discussions related to:

1. Mitigation
2. Post-earthquake recovery and setting mechanisms in place prior to an earthquake
3. Policies based on the earthquake following the next one
4. Policies considering the complex social and economic network within a city

The meeting concluded with an excellent question and answer session.

EERI Student Design Competition at the EERI Annual Meeting in Boston
By Jamison Fox
EERI BYU Student Chapter

The BYU Seismic Design Team had a busy month in March. The final rush to finish the structural model was a lot of fun for everyone involved, but not as much fun as the competition in Boston! We packed the model into a homemade crate, crossed our fingers and said a prayer for gentle freight workers, and shipped it off to Boston. Thankfully, it made the trip in one piece.

We arrived safely ourselves, despite the overnight red eye that arrived in Boston just after 6:00 am. After a few minor repairs, we were ready for the competition.

There were a total of 38 schools that participated in the seismic design competition. Each school had worked hard on their structural models, and it made for stiff competition. BYU has historically performed well, and we hoped to maintain that tradition. The tower was loaded with weights and shaken with three different ground motions on a shake table. A link to a video of our tower under the final ground motion can be found here: https://onedrive.live.com/redir?resid=AEFA547C1552719A!86324&authkey=!ABgmXAuISMIVIJ4&ithint=video%2cmp4. As you can see, we didn't perform as well as we'd hoped. Due to the failure of the load bearing floors, our structure was considered failed and we did not place in the competition.

While nobody likes to lose, there is a lot to learn from failure (no structural pun intended). Several back of the envelope ideas have already been floated for next year, and the team is applying lessons learned.

The BYU student chapter of EERI wants to express our deep gratitude to the EERI Utah Chapter for your support in this experience. We become better students and future professionals from our annual participation in this competition, and it would not be possible without your contribution. We look forward to working with you in the future leading up to the competition next year, and we especially look forward to sending a picture of a trophy this time next year!

Photo 1 – BYU Seismic Design Team

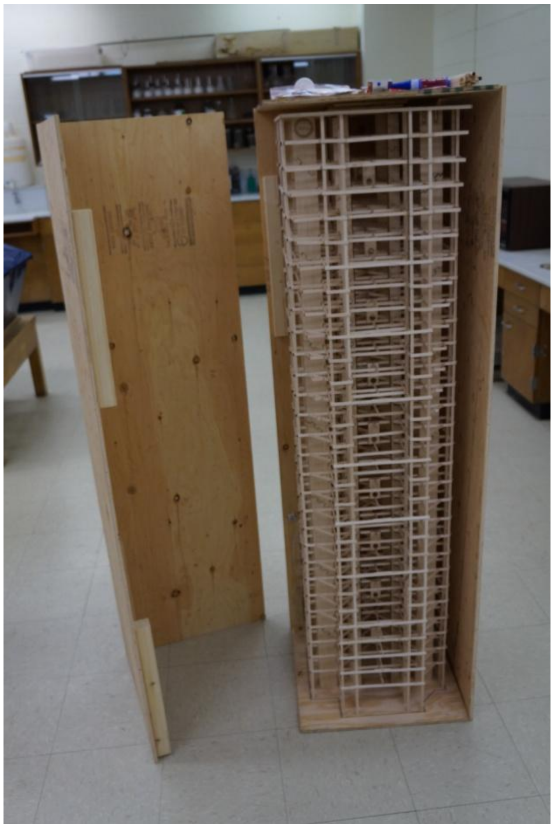

Photo 2: Structure Boxed and Ready!

Photo 3: Loaded Structure at Competition

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Helpful Earthquake Engineering Links:

Earthquake Engineering Research Institute (EERI) - Utah	http://utah.eeri.org
National EERI	http://www.eeri.org
Structural Engineering Association of Utah (SEAU)	http://www.seau.org
American Society of Civil Engineers (ASCE) – Utah	http://www.sections.asce.org/utah/
ASCE GEO-Institute	http://www.asce.org/geo/
American Council of Engineering Companies (ACEC) - Utah	http://www.acecutah.org
Seismological Society of America (SSA)	http://www.seismosoc.org
Southern California Earthquake Center (SCEC)	http://www.scec.org
Utah Seismic Safety Commission (USSC)	http://ussc.utah.gov
Utah Geological Survey (UGS)	www.geology.utah.gov/utahgeo/hazards/index.htm
University of Utah Seismology and Active Tectonics Research Group	http://www.uusatrg.utah.edu
Utah Division of Occupational and Professional Licensure (DOPL)	http://www.dopl.utah.gov
United States Geological Society (USGS)	http://earthquake.usgs.gov/
Be Ready Utah	http://www.utah.gov/beready/
Utah ShakeOut Website:	http://www.shakeout.org/utah/
Homebuyer's Guide to Earthquake Hazards in Utah	http://geology.utah.gov/online/pdf/pi-38.pdf

EERI Utah Chapter is seeking articles and announcements for upcoming newsletter editions. Please forward submissions to be considered by the Utah Chapter leadership to Chris Garris at garrisct@pbworld.com.

The following article is reprinted from the May 2015 issue of SEAU News.

Seismic Communication
Let's Get on the Same Page

By
Brent Maxfield, SE

Don't ever tell a client along the Wasatch Front that you designed his/her building to resist a magnitude 7 earthquake. I know that is an easy answer, but it is not accurate and is misleading.

One of the reasons that the public is so confused about seismic design, is that we as engineers don't communicate the same message. There are many times when we communicate the wrong message. The goal of this article is to help us as practicing engineers in Utah to understand some basic seismic issues and to propose a common message that we all use to communicate with clients.

Earthquakes vs Ground Motion

The code writers didn't do us any favors by using terms such as "Maximum Considered Earthquake" (MCE) and "Design Earthquake" (Sometimes referred to as the Design Basis Earthquake or "DBE"). Using these terms implies that we are designing for a specific magnitude earthquake and that this earthquake will generate a specific level of ground motion. This is not accurate. Both of these terms do not refer to a specific earthquake; they refer to a specific ground motion shaking intensity, which is given as an acceleration. The code writers should have used the terms, "Maximum Considered Ground Motion" and "Design Ground Motion."

Talking Point #1:
Engineers design for a specific ground motion shaking intensity, not a specific earthquake. (Avoid the use of "earthquake" in your discussions unless it is "the ground motion caused by an earthquake.")

Talking Point #2:
Engineers design to a code-mandated ground motion shaking intensity level that is not caused by a specific magnitude earthquake, but could be caused by different magnitudes of earthquakes.

For example, the MCE_R ground motion shaking intensity along the Wasatch Fault could be caused by a magnitude 6 earthquake. If we are lucky, a magnitude 7.5 earthquake may not cause the MCE_R ground motion. In a magnitude 7 earthquake, the MCE_R could be exceeded in some areas and not in others. Do not tell a client that their building is designed to resist a specific magnitude of earthquake.

Talking Point #3:
The "Maximum Considered Earthquake" (MCER) ground motion shaking intensity is not the largest possible shaking intensity. It is the largest shaking intensity that the code requires to be considered.

Code Performance Objectives

It is critical that building owners understand the objectives of the building code: "Life Safety" for 2/3 MCER and "Collapse Prevention" for the MCER. This understanding must include the expected level of structural and nonstructural damage that could occur with each performance state.

The term "Life Safety" has a specific code and engineering connotation, meaning that the building has reserve capacity to resist aftershocks. It also means that the nonstructural components are still attached and do not fall. What building owner wouldn't want their building to be life safe during an earthquake, meaning that everyone can get out of the building safely and no one is killed. The term "Life Safety" has a two very different connotations. A building owner may say he/she wants "Life Safety" when "Collapse Prevention" would be an acceptable performance state.

Rather than only using the engineering terms "Immediate Occupancy", "Life Safety", and "Collapse Prevention" let's be descriptive so that owners have a better understanding of performance.

Talking Point #4:

Engineers use the following terms to describe building performance: "Immediate Occupancy" means that the building can be used following some cleanup and that it can be occupied during repairs. "Life Safety" means that the building will have significant structural damage, but it has extra strength and stiffness to resist aftershocks. It also means that nonstructural components stay attached to the building. "Collapse Prevention" means that the building has been pushed to the limits of its strength and stiffness and is on the verge of collapse. Nonstructural components may be dislodged causing localized deaths from falling debris.

Talking Point #5:

The code acknowledges that 10% of the buildings that experience the MCER shaking intensity could collapse.

It is also important to understand what the importance factor does. It modifies the performance state at the DBE and MCER shaking intensities. An importance factor of 1.5 is intended to give a hospital an "Immediate Occupancy" performance state for the 2/3 MCER "Design" ground motion, not the MCER. If the hospital experiences the MCER ground motion it could only be "Life Safe" with the need to be evacuated. I will talk more about hospitals later.

Talking Point #6:

When discussing building performance, two things must always be discussed: 1) The ground motion shaking intensity, and 2) The expected building performance at that shaking intensity. For a typical house or building, the code performance expectations are "Collapse Prevention" at the MCER and, "Life Safety" at the 2/3 MCER shaking intensities. For hospitals, it is "Immediate Occupancy" at the 2/3 MCER, and "Life Safety" at the MCER shaking intensities. Note that hospitals may not be operational if they experience the MCER shaking intensity.

Ground Motions from a Magnitude 7 Earthquake

Will a magnitude 7 earthquake along the Wasatch fault generate low ground motions, or will it generate very high ground motions? No one knows. It is like predicting whether a specific kernel in a bag of popcorn will pop before a certain time. There is an element of chance. Seismologists can only predict a median ground motion and the standard deviation from a specific magnitude earthquake.

Talking Point #7:

It is impossible to predict the exact ground motion shaking intensity from a magnitude 7 earthquake on the Wasatch fault. Seismologists can only provide a median predicted ground motion and a standard deviation. The median provides a 50% likelihood and the median + 1 standard deviation provides an 84% likelihood that the actual ground motion will be less than these amounts.

Wasatch Front vs. California

The Wasatch Front has one very major fault and several other significantly smaller faults. The Wasatch fault is the only source of very large shaking intensities. Because the Wasatch fault only moves about once every 1250 years or so, it greatly lowers the code-mandated ground motion shaking intensity. The code uses the smaller of the 84th percentile deterministic ground motion (What happens when the Wasatch fault moves?) and the probabilistic ground motion. (Which takes the deterministic and adds the "What is the likelihood that it will happen?" aspect).

If the Wasatch fault moved more often, the code-mandated ground motion shaking intensities along the Wasatch Front would be considerably higher than current code. The code assumes that there is about a 1/1250 likelihood in any year that the Wasatch fault will move – regardless of how long it has been since the last movement. If the code considered the time since the last movement, the code-mandated shaking intensity along portions of the Wasatch Front would be considerably higher. (If a magnitude 7 earthquake occurs on average every 1250 years, then the 1/2500 year ground motion [2% in 50 year] would be the median predicted ground motion for the magnitude 7 earthquake [1/1250 * 50/100 = 1/2500 Assuming only one source of hazard])

California has many faults. Each fault adds to the seismic hazard level. This causes a very high probabilistic ground motion shaking intensity. In these areas, the code allows a lower MCER to be based on the largest 84th percentile deterministic ground motion from a nearby fault. In other words, California considers the scenario of an actual earthquake occurring. In Utah, this is not a requirement. If it was a requirement, and if the MCER were based on the 84th percentile deterministic ground motion then the Ss MCER code values near the Wasatch fault could be in the range of 2.5 to 3.0. This is almost twice the current Ss code values.

Talking Point #8:

The code ground motion shaking intensity levels along the Wasatch Front are based on a very low probability of a magnitude 7 earthquake on the Wasatch fault (about 1/1250 per year).

Talking Point #9:

Some segments of the Wasatch fault have built up enough stress to break at any time (tomorrow or many years from now). The code does not consider this increased risk of earthquake. If it did, the code-mandated ground motion shaking intensities along the Wasatch Front would be considerably larger.

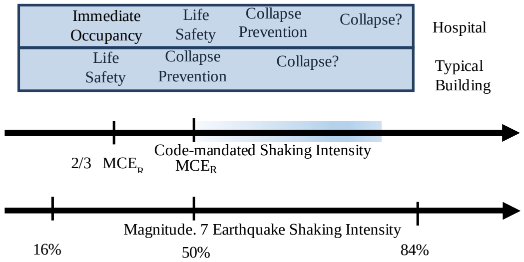
Talking Point #10:

In parts of California, the MCER is set at the 84th percentile shaking intensity of a nearby fault. In Utah this is not a requirement. In other words, the code does not require that buildings be designed to resist the higher shaking intensities that could be caused by a magnitude 7 earthquake on the Wasatch fault.

Building Performance in a Magnitude 7 Earthquake

You now know that the MCER shaking intensity in Utah is based on a very low probability of an earthquake on the Wasatch fault. You also know that the shaking intensity would be almost twice the current code values at the 84th percentile predicted ground motion. Unfortunately, because there is so much uncertainty, the 84th percentile ground motion along the Wasatch fault is very large.

An important question to get answered is: "How does the code MCER ground motion relate to the range of ground motions from a magnitude 7 earthquake on the Wasatch fault?" In my experience, the MCER ground motion will be about equal to or less than the median ground motion from a magnitude 7 earthquake. (This will vary depending on the period of interest. It could be as low as 40% or slightly above 50%) The 2/3 MCER or DBE ground motion shaking intensity will be considerably lower than the median shaking intensity from a magnitude 7 earthquake. In other words, if a building is designed to be "Life Safe" after the 2/3 MCER shaking intensity, if a magnitude 7 earthquake happens along the Wasatch Fault, you could only have about a 30%-40% confidence that the shaking intensity would be less than this. You would only have a 50% confidence that the shaking intensity would be less than what would give you "Collapse Prevention." Saying it a different way – for some building periods, there is a 50% likelihood that a magnitude 7 on the Wasatch fault will push the building beyond "Collapse Prevention." RED FLAG! See Figure 1.



Obviously every location is different and you would need to get an expert to help understand how the code MCE_R and 2/3 MCE_R shaking intensity relate to various earthquakes at a specific location. The Pacific Earthquake Engineering Research Center (PEER) (http://peer.berkeley.edu/ngawest2/databases/) has generated a MS Excel spreadsheet that calculates the predicted median and standard deviation ground motion from various magnitude earthquakes. Note that the values from this spread sheet must be multiplied by 1.2 to 1.3 to get the code-required "maximum direction" (RotD100) ground motions. The USGS also provides an estimate of the 84^{th} percentile deterministic shaking intensity at a site. Use "2009 NEHRP" as the Design Code Reference Document at http://earthquake.usgs.gov/designmaps/us/application.php and select the "View Detailed Report."

Talking Point #11:

If a magnitude 7 earthquake happened on the Wasatch fault, there is about a 50% likelihood that, for some buildings, the MCER shaking intensity would be exceeded. Remember that the code allows building collapse to begin occurring at the MCER.

Talking Point #12:

Understand how the MCER and 2/3 MCER Design shaking intensities relate to the shaking intensities that can be caused by a magnitude 7 on the Wasatch fault. Engineers can provide the likelihood that the actual ground motion will be less than the MCER and the likelihood that the actual ground motion will be less than 2/3 MCER.

Talking Point #13:

A building owner can choose to consider shaking intensity levels above the code and then decide upon a level of confidence he/she wants for the "Immediate Occupancy", "Life Safety", and "Collapse Prevention" performance states for a magnitude 7 earthquake on the Wasatch Fault.

Risk-Targeted MCE_R

For the 2012 International Building Code (IBC), the code writers felt that the MCE using a 2% in 50 year ground motion across the country (Uniform Hazard) did not give the same risk of building collapse across the country. They switched from a "Uniform Hazard" shaking intensity (MCE) to a "Uniform Risk" shaking intensity (MCE_R). This shaking intensity is set so that across the country there is a 1% chance of building collapse in 50 years (1/5000 per year). This change has the effect of lowering the code-mandated shaking intensity along the Wasatch Front by about 18%.

In essence, the code writers said that Utah was not going to experience enough collapsed buildings compared to the rest of the country, so they lowered the code-mandated ground motions. This was not because they felt that a magnitude 7 earthquake would cause lower ground motions. It was to increase the number of collapsed buildings to be consistent with the rest of the country.

Think about this new code objective of 1/5000 risk of collapse in any year. If any specific segment of the Wasatch fault moves on average about every 1250 years, when the Wasatch fault moves, there could be about ¼ (1/5000*1250) of the new code-designed buildings collapse. That is not likely, but it gives a sense of the code expectation.

Talking Point #14:

The 2012 International Building Code (IBC) lowered ground motions by about 18%. This results in weaker buildings and will result in more collapsed buildings when the Wasatch fault moves.

My Opinion

The Wasatch Front is in a unique position. The long recurrence interval puts the code design ground motions very low compared to what could happen if the Wasatch fault moved. The code assumes that the movement of the Wasatch fault is a random (time independent) event. The movement of the Wasatch fault is not a random event. Seismologists have observed a regular occurrence of earthquakes on each of the major segments of the Wasatch fault. The Brigham City segment is past due and the Salt Lake City segment is approaching its recurrence interval. (See *Putting Down Roots in Earthquake Country*, page 7.)

There are numerous efforts both private and government to prepare for the “Big One.” We are constantly being told to prepare. If we as a community along the Wasatch Front want to be prepared, why are new buildings not being designed to safely resist the potential ground motions from a magnitude 7 earthquake on the Wasatch fault? Shouldn’t we be like parts of California, where they must design to “Collapse Prevention” for the 84th percentile shaking intensity of the controlling fault?

It is my opinion that the current IBC MCE_R shaking intensity level is significantly too low. The switch to the Risk-Targeted ground motions has made the situation even worse (by reducing shaking intensities by 18%). Some new buildings could be a collapse risk if they experience shaking intensities above the median predicted shaking intensities from a magnitude 7 on the Wasatch fault.

I believe that ground motions caused from a magnitude 7 earthquake on the Wasatch fault must be explicitly considered and the code shaking intensities should be increased. Exactly where to set these shaking intensities must be a matter of healthy public debate, weighing the associated costs and the risks. Building codes have focused solely on preventing loss of life. If you consider the staggering economic loss that will occur in a magnitude 7 earthquake, the debate must also consider limiting economic loss and the cost to society if buildings are allowed to be heavily damaged. The debate must consider how quickly the State of Utah can recover and return to (a new) normal. This is sometimes referred to as resiliency. A small investment in stronger buildings will pay big dividends in repair and recovery time and cost.

I recommend that there be dual design criteria. One for the “planned-for” event that will limit economic damage, and one for the extreme event, that will focus on preventing building collapse.

Are we expecting hospitals to be operational after a magnitude 7 earthquake? I believe that the community expectation is, “yes”. The current code does not require this. The code objective is “Immediate Occupancy” at 2/3 MCE shaking intensity. There is only about a 30% - 40% likelihood that the actual ground motions will be less than this level. I believe that essential facilities should be designed to consider the higher ground motions that a magnitude 7 on the Wasatch fault could cause.

I challenge the structural engineers of SEAU to become more conversant in these topics. We have a responsibility to our clients and building owners to clearly present to them what the code writers have deemed an acceptable risk. We then need to present them with the information that will allow them to accept the code risk or to make other informed risk decisions. We need to help the communities along the Wasatch Front be better prepared for the “Big One” by giving them structures that are better able to resist the potentially higher ground motions that can be caused by it.