GG339-14

Appendix R (New)

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Add new text as follows:

APPENDIX R
RESILIENT DESIGN AND CONSTRUCTION

The provisions in this appendix are not mandatory unless specifically mandated under Section 302 Jurisdictional Requirements. If indicated, the provisions of this appendix are intended to be used in conjunction with the requirements of the International Building Code and requires design strategies that reduce the environmental impact of the building due to repair and retrofit resulting from hazard events including fires, earthquakes, hurricanes, tornadoes, floods, hail, snow and other natural or man-made hazards.

R101.1 Purpose. Improve public safety and disaster resilience by designing the project building to resist hazards above the minimum requirements in the International Building Code including fire, snow, wind, floods, earthquake, hail and other natural or man-made hazards to reduce the environmental impacts associated with extracting, processing, transporting and installing materials for repairing, replacing and/or retrofitting a building after a disaster. The requirements for this section shall be performed in accordance with Section R101.2.

R101.2 Requirements. Demonstrate reduced environmental impacts from disaster resilient design for natural and man- made hazards through whole-building life cycle assessment of the project building. To meet the requirement, two building designs shall be completed, a reference building and project building, and life cycle assessment performed on each building. The reference building shall be designed to the minimum requirements of this code and the minimum loads and hazards of the International Building Code and the project building shall be designed to a higher level of loads and hazards. Taking into account the probability of the buildings being subjected to project building loads and hazards over a 75-year life of the buildings, estimate damage to the buildings and the environmental impact of repairing, replacing and retrofitting the buildings and include these impacts in the life cycle assessment.

1. The life cycle assessment shall demonstrate that the building project achieves not less than a 5-percent improvement in environmental performance for global warming potential and at least two of the following impact measures, as compared to a reference design of similar usable floor area, function, materials and configuration that meets the minimum requirements of this code and the requirements of the *International Building Code*.
   - 1.1. Acidification potential.
   - 1.2. Eutrophication potential.
   - 1.3. Ozone depletion potential.
   - 1.4. Smog potential.
   - 1.5. Depletion of non-renewable energy resources.
   - 1.6. Depletion of non-renewable material resources.
   - 1.7. Use of renewable material resource.
   - 1.8. Use of renewable primary energy.
   - 1.9. Consumption of freshwater.
   - 1.10. Hazardous waste.
   - 1.11. Non-hazardous waste.
   - 1.12. Impact(s) and potential impact(s) on biodiversity.

1.13. Toxicity related to human health, the environment or both.

2. The reference and project buildings shall utilize the same life cycle assessment tool.
3. The life cycle assessment tool shall be *approved* by the code *official*.
4. Building operational energy shall be included.
5. Building process loads shall be permitted to be included.
6. Maintenance and replacement schedules and actions for components shall be included in the assessment.
7. The full life cycle, from resource extraction to demolition and disposal, including but not limited to, onsite construction, maintenance and replacement, relocation and reconfiguration, and material and product embodied acquisition, process and transportation energy, shall be assessed.
8. The complete building envelope, structural elements, inclusive of footings and foundations, and interior walls, floors and ceilings, including interior and exterior finishes, shall be assessed to the extent that data are available for the materials being analyzed in the selected life cycle assessment tool.
9. The life cycle assessment shall conform to the requirements of ISO 14044.

Reason: The consequences of natural disasters have become increasingly real, personal and devastating. In 2012, there were 11 natural disasters costing $1 billion or more in damage, making 2012 the second highest year with billion-dollar disasters[i]. Early season tornadoes, the widespread and intense drought that covered at least 60 percent of the contiguous U.S. and Hurricane Sandy are expected to go down in history as the most costly weather-related disasters in U.S. history. Now, with the world's attention on the Philippines after Typhoon Haiyan, communities must rethink the way we build to meet the challenge of natural or man-made disasters.

Globally, insurers lost at least $108 billion on disasters in 2011 and $77 billion in 2012[ii]. Reinsurer Swiss Re Ltd. said that 2011 was the second-worst year in the insurance industry's history. Only 2005, with Hurricane Katrina and other major storms, were more costly [iii]. However, most of the increased disaster losses cannot be attributed to an increased occurrence of hazards but with changes in population migration and wealth. Frequency of major US hurricane landfalls has remained constant in the last 60 years[iv], and the trend of strong to violent tornadoes (F3+) has, in fact, decreased since 1954[v]. So what cause is attributed to the increase in losses?

In the last several decades, population in the United States has increased and migrated toward the coasts, concentrating along the earthquake-prone Pacific coast and the hurricane-prone Atlantic and Gulf coasts. Over 60% of the U.S. population lives within 50 miles of one of its coasts (including the Great Lakes)[vi]. At the same time, wealth and the value of their possessions have increased substantially. For example, while California's Los Angeles County accounts for only 2.5% and Florida's Dale County account for only 14% of their respective states land area, yet they contain 30% of their state's property value[vii]. These changes in concentration of population and property values are significant contributors to the increased property losses from natural hazards. Moreover, many elements of our aged infrastructure are highly vulnerable to breakdowns that can be triggered by relatively minor events[viii].

Disasters result not as much from the destructive agent itself but from the way in which communities are (or are not) prepared. Disasters happen when the natural systems are encroached upon by human development. There is no such thing as a natural disaster. The extent of disruption caused by a disaster is greatly influenced by the degree to which society chooses be fortified for the event.

Buildings, when designed to minimum code requirements, are intended to experience controlled damage and provide minimum life safety. Therefore even if the building must be demolished or significantly repaired after a major earthquake, hurricane, tornado, fire or flood, it has met the intent of the code. For projects in high-risk areas, this minimal level of performance results in significant additional material impacts following a major natural or man-made event.

The term 'sustainability' usually describes some aspect of maintaining our resources from the environment to the quality of life, over time. It can also refer to the ability to tolerate—and overcome—degradation of natural environmental services, diminished productivity and reduced quality of life inflicted by human's relationships to the planet and each other.

Critical infrastructures and other essential services have enabled societies to thrive and grow and become increasingly interconnected and interdependent from the local to global levels. As a society, we have placed a great deal of emphasis on recycling rates and carbon footprints. It is ironic that we are surprisingly willing to invest considerable amounts of upfront capital for a building that achieves a modest savings in energy efficiency, yet be we are completely satisfied if the structure meets only the code minimum requirements for seismic or wind load and is significantly damaged during these events.

A sustainable building should be designed to sustain minimal damage due to natural disasters such as hurricanes, tornadoes, earthquakes, flooding and fire. Otherwise, the environmental, economic and societal burden of our built environment could be overwhelming. A building that requires frequent repair and maintenance or complete replacement after disasters would result in unnecessary cost, from both private and public sources, and environmental burdens including the energy, waste and emissions due to disposal, repair and replacement.

It doesn't make sense to design a modern building, commercial or residential, to meet the green code requirements that could be easily destroyed as a result of a hurricane, earthquake or other force of nature. That would mean that all of the green technology and strategies used in the building would go to the landfill. What is the point of installing low flush toilets in a home to conserve water if it ends up in a landfill after a tornado blows through? Therefore, this proposal provides a performance pathway to demonstrate the environmental impact reduction through resilient design and construction. To meet the requirements of this section, the two designs shall be documented in separate life cycle assessment models, and the material quantities of the structural and non-structural materials over the 60-year building life shall be compared. The assessment shall demonstrate a reduction in life cycle impacts over the buildings lifetime including the impacts of repair and replacement.

This section is similar to section 303.1 of this code on Whole Building Life Cycle Assessment except in this case the design is increased over and above the minimum requirements of the IgCC and the IBC such that the project building will resist minimum design loads and other requirements with lower damage than it would otherwise experience during a natural or man-made event.

It is apparent that there needs to be significant shift in how we address natural disasters, moving away from the traditional focus on response and recovery toward emphasis on resiliency, that is, preventive actions to reduce the effects of a natural hazard. The goal of this requirement is to protect the building and its contents in addition to protecting the occupants, resulting in improved performance over the building life reducing environmental, societal and economic burdens of the building.

Bibliography:

[i]National Oceanic and Atmospheric Administration (NOAA) National Climate Data Center. 2011. http://www.ncdc.noaa.gov/billions. Accessed October 2013

[ii]Masters, J. 2011. “2011’s Billion-Dollar Disasters: Is climate Change to Blame?” Weatherwise, March-April 2012, http://www.weatherwise.org/Archives/Back%20Issues/2012/MarchApril%202012/dollar-dis asters-full.html.

[iii]Swiss Re website. News Release, 27 March 2013, Zurich. http://www.swissre.com/media/news_releases/nr_20130327_sigma_natcat_2012.html. Accessed October 2013

[iv]Weinkle, J., et. al. July 2012. “Historical Global Tropical Cyclone Landfalls” http://sciencepolicy.colorado.edu/admin/publication_files/2012.04.pdf

[v]National Oceanic and Atmospheric Administration (NOAA) National Climate Data Center. 2013. “U.S. Tornado Climatology”, http://www.ncdc.noaa.gov/oa/climate/severeweather/tornadoes.html. Updated May 17, 2013

[vi]Congressional Research Service Report (CRSR). 1997. Oceans & Coastal Resources: A Briefing Book, CRSR 97-588 ENR. http://www.cnie.org/NLE/CRSreports/BriefingBooks/Oceans. Accessed November 13, 2012. [vii]Guin, J. and Saxena, V. 2002. “Extreme Losses from Natural Disasters - Earthquakes, Tropical Cyclones and Extratropical Cyclones”, Applied Insurance Research Inc. http://www.air-worldwide.com/_public/NewsData/000208/Extreme_Losses.pdf

[viii]Masters, J. 2011. “2011’s Billion-Dollar Disasters: Is climate Change to Blame?” Weatherwise, March-April 2012, http://www.weatherwise.org/Archives/Back%20Issues/2012/MarchApril%202012/dollar-dis asters-full.html. Accessed October, 2013.

Cost Impact: Will increase the cost of construction. WIll have an impact on initial cost in material selection and design. However, will have a positive cost impact resulting from improved performance over the building life.

GG339-14 : APPENDIX R (NEW)-PENG958