Climate Change Adaptation through Building Design Criteria[1]

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Public discourse relative to climate change on a worldwide basis, but specially here in the United States, has been clouded by ideology, politics and the incapability of some industry and business sectors to shift their focus from the immediate bottom line to long term actions, solutions and benefits.

This "noise" that has surrounded the issue of climate change in the United States has made it very difficult for stakeholders from all sectors, but especially for homeowners and residents of communities across the land, to understand what climate change means to them, what consequences they may face in the future, and what solutions may be available to reduce the potential for damage from the impact of climate change.

As a result of this the general public and professionals in a wide range of fields have, by and large, remained until quite recently uninvolved in what is one of the most critical issues confronting humankind today. However recent actions by international and American institutions, such as the IPCC, the National Council for Science and the Environment (NCSE), the Nobel Foundation, the Academy of Motion Pictures Arts & Sciences, and various states have finally began to turn the tide succeeding in engaging the general public that now demands more information, knowledge and solutions.

While this is undoubtedly a significant and positive development, we must realize that effective solutions to existing and future problems caused by climate change must be implemented by policy-makers and private sector professionals who must be ***educated*** and ***informed***, with the support of engaged and knowledgeable citizens who will demand specific and timely actions.

Toward that objective it is critically important to emphasize the role the scientific research and educational communities can play as the gatherers of data, investigators, and eventual transferors of knowledge to those charged with implementing solutions.

To contribute to such a role the scientific research community must also look beyond the focus on emissions and mitigation of global warming to the practical issue of how the built-environment will be impacted by the consequences of climate change.

Owners of buildings expect them to last for the next 75 years. There are thousands of buildings in urban centers throughout the country that have already exceeded 60 - 75 years of service.

This expectation of longevity of service rests on design criteria based on the past and given statistical annual probabilities that certain levels of impacts may be exceeded.

This approach to building design may render most structures incapable to perform effectively under the impact of future hazards. This is particularly true for buildings in coastal regions in a world where some hazards will be exacerbated by climate change.

For example, say a building is designed today to resist a storm surge estimated at 10 feet above ground net of wave action. But sea level may rise 2 feet while this building is still in service. As a result total future loads acting on the structure from hydrodynamic pressure and wave action may be 150% - 200% higher than those used in the original design criteria. It is clear that the risk of future catastrophic damage to this building is extremely high.

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To adapt our buildings to such potential for damage resulting from climate change we must base our building design criteria on what may happen 75 - 100 years from now. Building codes must reflect this paradigm now.

Toward that objective building design and construction professionals and planers, but especially those professional associations involved in building and infrastructure design, and in community planning, such as the American Society of Civil Engineers (ASCE) and the American Institute of Architects (AIA), and Regional Planning Councils must become proactive players in this arena for critically needed change. In addition, academic institutions must adapt their curricula on the fields of architecture, city planning, environmental design, engineering and other disciplines in order to graduate professionals that will have the knowledge to confront the challenges that climate change will continue to pose for our built environment. .

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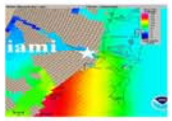
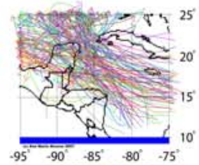
TODAY WE USE HISTORICAL DATA AND ANNUAL PROBABILITY OF EXCEEDANCE FOR:

* PRECIPITATION
* TEMPERATURE
* FLOOD LEVELS
* STORM SURGE
* WIND SPEED

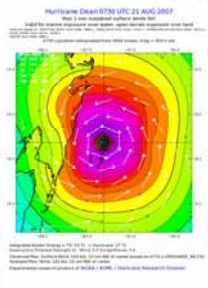
TO CHARACTERIZE THE IMPACT OF HAZARDS ON OUR BUILDINGS AND ESTABLISH MINIMUM BUILDING DESIGN CRITERIA.



STORM SURGE



TROPICAL CYCLONE FREQUENCY



WIND VELOCITY

Natural Hazards have ***Damage Components***, which include the following:

* Wind Velocity Pressure
* Hydrodynamic Pressure
* Hydrostatic Pressure
* Wave Impact
* Flying Debris Impact
* Water Borne Debris Impact
* Extreme Rain

Damage Components apply forces [*loads*] to buildings.

The interaction of damage components with buildings, and the effect of loads they generate are reflected in ***Design Standards*** such as the ASCE 7 that establishes ***Minimum Design Loads for Buildings and Other Structures.***

Such ***Design Criteria*** are part of the Building Codes used to design buildings we expect will have a minimum service life of 75-100 years.

Climate Change will modify and/or exacerbate all of the factors listed above, during the projected service life of a new building.

Sea-level rise will lead to higher, faster-flowing storm surges that penetrate farther inland.

Deeper waters will lead to higher wave action atop storm surge.

Faster flowing surge will result in faster water-borne debris.

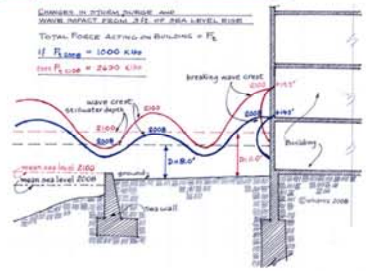
Warmer more humid atmosphere will increase precipitation.

Consequences of these changes, during the service life of the new building will lead to:

* Higher hydrodynamic pressure
* Higher wave impact
* Higher floating debris impact
* Higher wind-velocity pressure
* Higher flying debris impact
* Increased precipitation loads

In Summary buildings will suffer much higher loads than they were designed for, based on current design criteria!

Higher Potential for Damage:



A building is designed today to resist a total force from Surge and Wave action F_{t2008} = 1000 Klbs, but by 2100 the building may sustain a 163% higher total force F_{t2100} as a result of storm surge and wave action exacerbated by 3 ft in sea level rise driven by global warming.

Conclusion: to adapt buildings to climate change, design criteria must be based on projected future events not on historical data.

Recommendations:

♣ Conduct vulnerability assessment to characterize future impacts caused by climate change.

♣ Use future impact characterization to establish new building design criteria.

♣ Develop new standard for minimum loads for buildings and other structures to be incorporated into model building codes.

♣ Conduct applied research to identify effective design and construction methods to adapt buildings to climate change.

♣ Inform and educate building design and construction professionals on new design paradigm.