Resilience and Sustainability of Infrastructure and Communities

INSS-GT, June 9, 2016

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Resilience

National Institute of Standards and Technology (NIST)

Community Resilience Planning Guide for Buildings and Infrastructure Systems
<http://www.nist.gov/el/resilience/guide.cfm>

Presidential Policy Directive-21 (2013) defines resilience as “the ability to prepare for and adapt to changing conditions and to withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.”
Sustainability

Policy Statement 418 definition:
The American Society of Civil Engineers (ASCE) defines sustainability as a set of economic, environmental and social conditions in which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely, without degrading the quantity, quality or the availability of natural, economic and social resources.
The Five Capitals of Sustainability
All to be Sustained/Restored

1. Natural (environment)
2. Human (part of social)
3. Social (part of social)
4. Produced (part of economic)
5. Financial (part of economic)

<https://www.forumforthefuture.org/project/five-capitalsoverview>
Relating Resilience and Sustainability

Environmental

Social

Economic
Infrastructure Systems
Resilient and Sustainable, Individually and Collectively, for Stakeholders Served and Affected

- Buildings of all types
- Communications
- Energy Generation and Distribution
- Industrial Facilities
- Transportation of all modes
- Waste Management
- Water Resources
Role of Emergency Management

- Preparedness
- Response
- Recovery
Adapting Infrastructure to a Changing Climate

The report “Adapting Infrastructure and Civil Engineering Practice to a Changing Climate” prepared by the Committee on Adaptation to a Changing Climate (CACC) of the American Society of Civil Engineers is available for free download at

http://dx.doi.org/10.1061/9780784479193
The Challenge

Climate science observations and models strongly indicate that our engineered facilities and systems should adapt to changing climate, weather and extreme events.......but climate science does not yet provide an adequate basis for the needed practices.
Observed Climate Change Extremes

Percent Change in Very Heavy Precipitation*
(1958 to 2011)

* defined as the heaviest 1% of all daily events

Dilemma for Engineering Planning and Design

• Planning and design of new infrastructure should account for the climate of the future

• Designs and plans as well as institutions, regulations, and standards will need to be updated and made adaptable to accommodate a range of future climate conditions

• There is great uncertainty about potential future climate/weather/extremes
Summary

Climate is changing but there is significant uncertainty regarding the magnitude of the change over the design life of the systems and elements of our built environment. It will be difficult to reliably estimate the change that will occur over several decades, long after the infrastructure is built and the financing and governance have been established.

Engineering designs, plans, and institutions and regulations will need to be adaptable for a range of future conditions (conditions of climate, weather and extreme events, as well as changing demands for infrastructure).