

Overview

1. What is resilience? The basics
2. Hazard and risk analysis
3. Resiliency planning for local governments



1

What is Resilience?



Community Definitions of Resilience

“Community resilience is a measure of the sustained ability of a community to utilize available resources to respond to, withstand, and recover from adverse situations.”

— CommunitySolutions.org

“The ability to respond to crises in ways that strengthen community bonds, resources, and the community’s capacity to cope.”

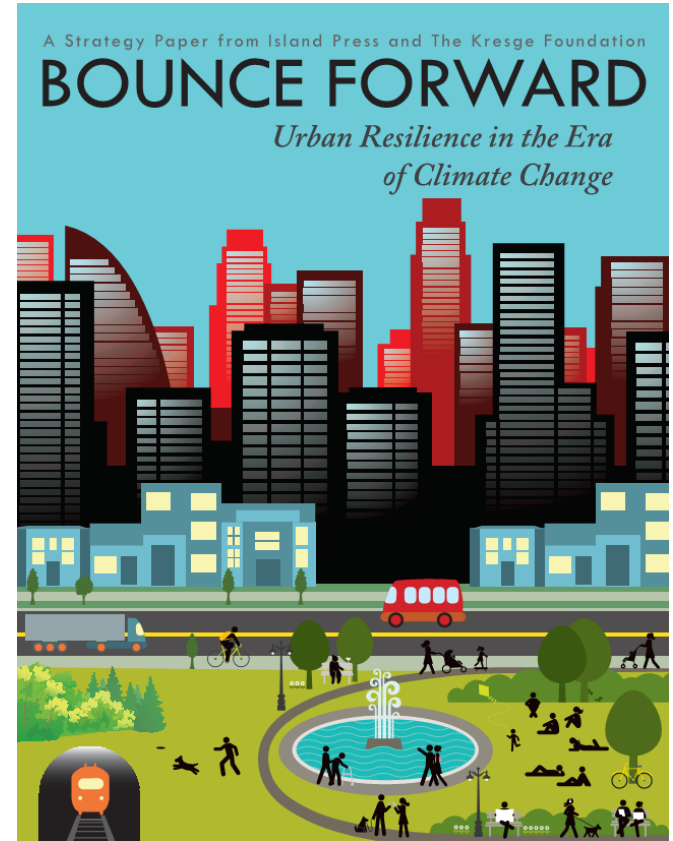
— Chenoweth, 2001

“The investment of resources in the community... creates an upward spiral of increasing community ability to respond effectively to change, that is, it creates community resilience.”

— Magis, 2010

Community Definitions of Resilience

“We define urban resilience as the capacity of a community to anticipate, plan for, and mitigate the risks—and seize the opportunities—associated with environmental and social change.”





Resilient Design

+ *Resilience* - the capacity to adapt to changing conditions and to maintain or regain functionality and vitality in the face of stress or disturbance. It is the capacity to bounce back after a disturbance or interruption

— The Resilient Design Institute (RDI)

Physical, social & economic challenges

Shocks

- Earthquakes
- Fires
- Floods
- Hurricanes
- Tornadoes
- Mass casualty event

Stresses

- High unemployment
- Overtaxed or inefficient public services
- Violence
- Chronic shortages
- Socio-economic disparity
- Resource disparity

Military Resiliency

+ *Resilience* means the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

— DODD 4715.12 Climate Change Adaptation and Resiliency

+ “Energy resilience” is the ability to prepare for and recover from energy disruptions that impact mission assurance on military installations.

— DODI 4170.11

+ *All key factors:*

- + *Does the infrastructure satisfy a specific requirement or series of requirements?*
- + *How well does the infrastructure satisfy those requirements?*
- + *Does the infrastructure have redundancy built-in?*
- + *Is the infrastructure in good enough condition to operate throughout the foreseeable future of the mission?*
- + *Is the infrastructure capable of withstanding current and future hazards/threats?*



DoD DIRECTIVE 4715.21

CLIMATE CHANGE ADAPTATION AND RESILIENCE

Originating Component: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics

Effective: January 14, 2018

Releasability: Cleared for public release. Available on the DoD Intranet. Website at <http://www.dtic.mil/doddirectives>.

Approved by: Robert D. Work, Deputy Secretary of Defense

Purpose: In accordance with the direction in Executive Order 13813, this document establishes policy and assigns responsibilities to provide the DoD with the resources necessary to assess and manage risks associated with the impacts of climate change. This directive delivers preparation, clear requirements, and coordinated planning by the DoD to:

- Facilitate federal, state, local, tribal, private sector, and nonprofit sector efforts to improve climate preparedness and resilience, and to implement the 2014 DoD Climate Change Adaptation Roadmap.
- Help safeguard U.S. security, infrastructure, environment, and natural resources.
- Provide for the continuity of DoD operations, services, and programs.



Military Resilience Key Topics

- + *What does resilience mean to Air Force Civil Engineers?*
 - + *Types of resilience (~~personnel/individual~~ versus infrastructure)*
 - + *Resilience defined: how does the Air Force view/treat infrastructure resilience?*
 - + *From the Installation level to the Department of Defense (DoD) level: what does each tier care about?*
 - + *Focusing on the root requirement: what's the threat and how do we manage risk?*
 - + *Building resilience: Planning to Execution*



Military Infrastructure Resilience

- + *Mission Dependency Index (MDI) aka what's most important?*
- + *Facility Condition Index (FCI) aka how's it all holding up?*
- + *Resource management (people, money, stuff) aka how to we solve the problems?*
 - + *Planning (30 year span) -> Programming (5 year span) -> Budgeting (1-year span) -> Execution (current-year span)*
- + *Root requirement:*
 - + *The mission!*
 - + *But also:*
 - + *Known threats/hazards and vulnerabilities: Natural, man-made, as assessed against historical data and current intelligence; take into account dependency on other organizations, climate change*
 - + *Applicable national/state/county/local codes and standards*
 - + *DoD and Air Force Policy*



1

How about some examples?

Discussion

1. How is resiliency addressed in your case study? How is it defined?
2. What actions are described to increase resiliency? If none, what actions can you think of or suggest?

Can't do it all? Provide a "life boat"

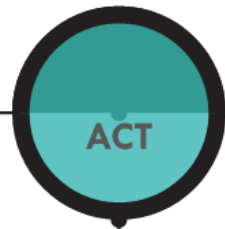
“Create community facilities (resilience hubs) that can serve as gathering places during emergencies and interruptions in services, and outfit such facilities with access to key services, including water, electricity for charging cell phones, etc. Such capabilities could be integrated into schools and other existing community facilities.”

-- Resilient Design Strategies, RDI



2

Resiliency: First Steps



<p><i>Resilience of what?</i></p> <ul style="list-style-type: none">• What do we need?• What do we value? <p><i>Resilience to what?</i></p> <ul style="list-style-type: none">• Hazards• Environmental/ social changes <p><i>Resilience for whom?</i></p> <ul style="list-style-type: none">• Who is vulnerable?• Who decides?	<p><i>Is it:</i></p> <ul style="list-style-type: none">• Diverse?• Redundant?• Modular? <p><i>Does it have:</i></p> <ul style="list-style-type: none">• Tight feedbacks? <p><i>Does it promote:</i></p> <ul style="list-style-type: none">• Social capital?• Agency?• Equity?• Inclusiveness?• Innovation?	<p><i>Persist</i></p> <ul style="list-style-type: none">• Protect/restore system in current form. <p><i>Adapt</i></p> <ul style="list-style-type: none">• Modify system to increase resilience. <p><i>Transform</i></p> <ul style="list-style-type: none">• Replace with more resilient system.
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15.3.1 WARMING AND HEAT STRESS

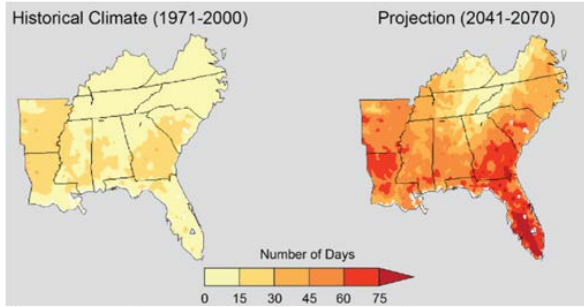


Figure 2. Projected average number of days per year with maximum temperatures above 95 degrees F for 2041-2070 compared to 1971-2000, assuming emissions continue to grow (Carter et al., 2014).

4.15.4.1 SEISMIC ACTIVITY

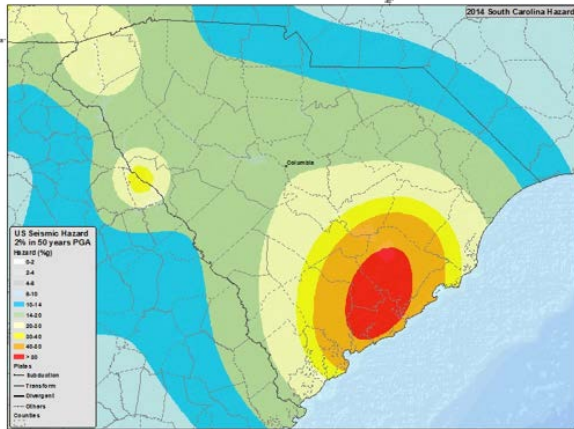


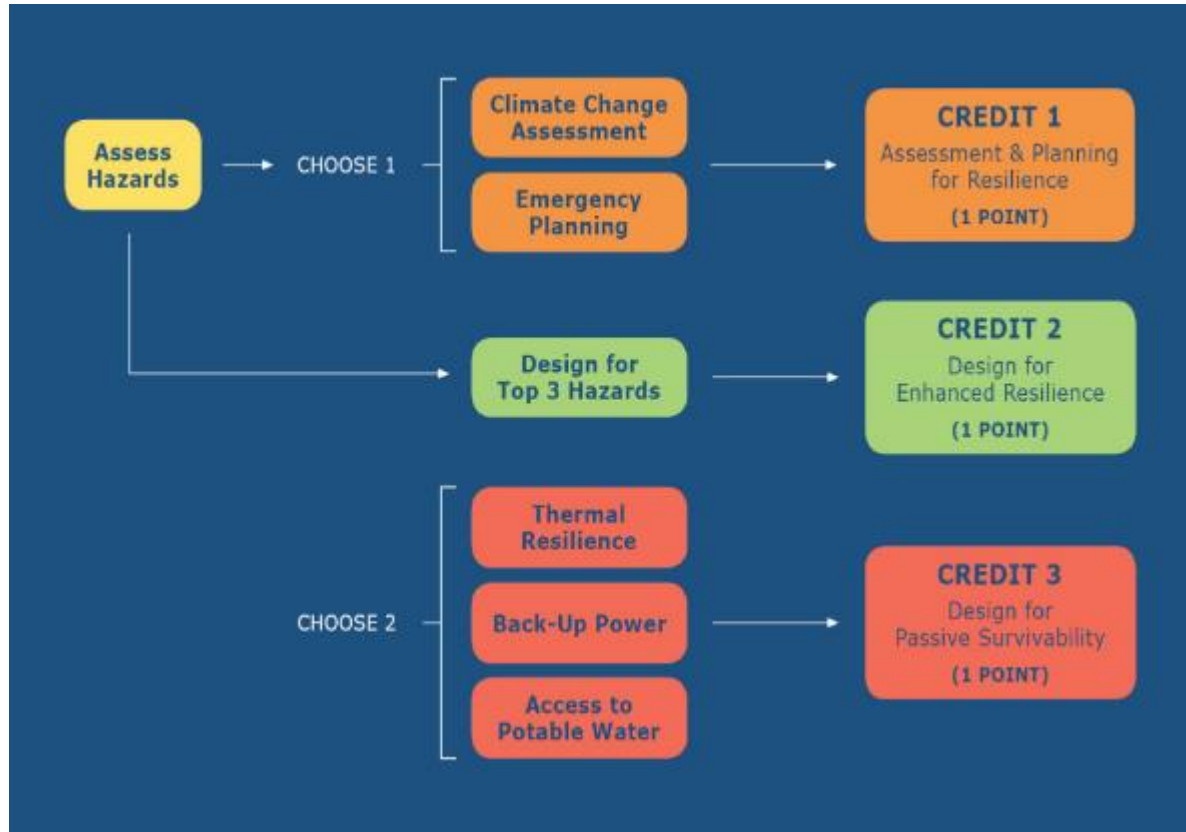
Figure 3. USGS map of earthquake hazard, expressed as the risk of exceeding a set of ground motions. McEntire JNGB lies in an area of moderate risk (green), with very high risk (red) to the east near Charleston.

Resilient **planning** starts with site analysis

- “Before beginning actual design of an Area Development Plan, planners will conduct a thorough analysis of the existing conditions...” -- UFC 2-100-01
- What are your risks, present and future?
 - Conduct a Hazard Assessment (see tool)
 - Rank hazards by risk
- If possible, model using future climatic conditions rather than past
- Identify risks likely within the lifecycle of planned facilities

LEED Pilot Resiliency Credits

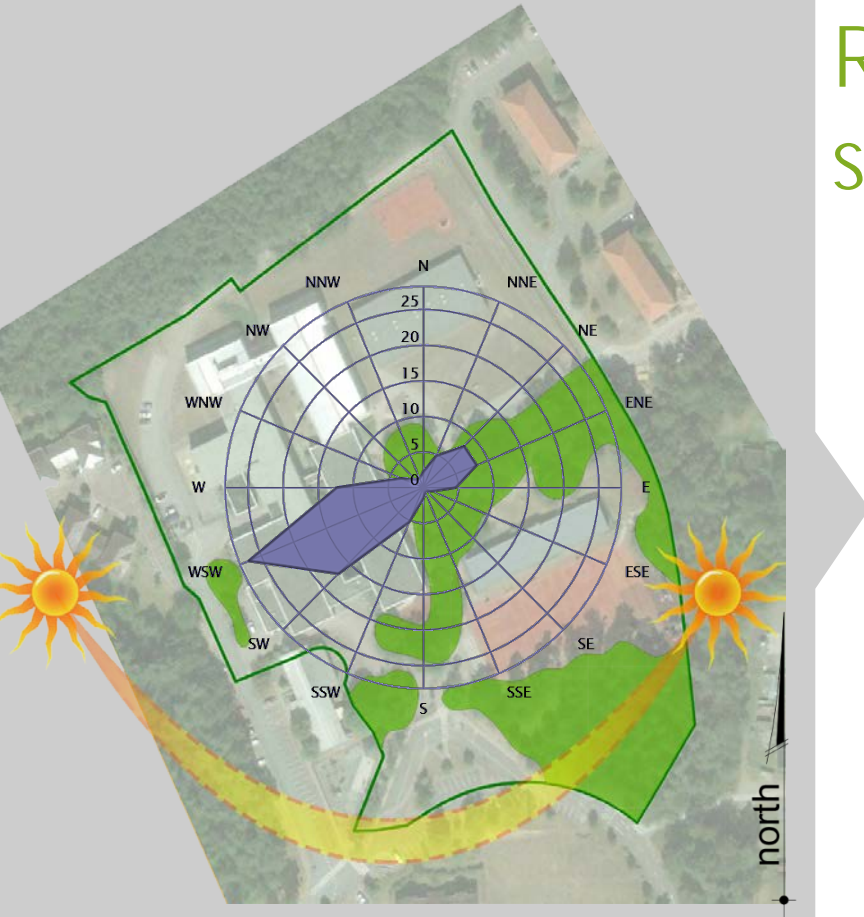
- Assessment and Planning for Resilience (IPpc98)
- Design for Enhanced Resilience (IPpc99)
- Passive Survivability and Functionality During Emergencies (IPpc100)



Resources for site assessment and hazard analysis

- Climate change modeling: US Global Change Research Program's National Climate Assessment
 - <https://www.globalchange.gov/>
- UM Graham Sustainability Institute Cities Climate Series Great Lakes Fact Sheets
 - Includes Dayton, Toledo and Columbus (among others)
 - <http://graham.umich.edu/emopps/products/cities-climate-factsheets>
- County/Local Emergency Response Plans
- The LEED Resiliency Prerequisite contains an excellent list of resources for all hazards at <https://www.usgbc.org/credits/assessmentresilience>

Resilient **design** starts with site analysis and planning



Landstuhl Elementary School site analysis

- What are your assets?
 - Solar, wind, soil characterization
 - Water/hydrology and energy flows
- Knowing risks, present and future, locate critical systems to withstand extremes

Resources for site analysis

- GIS – County, City, Regional
 - Floodplains, wetlands, water bodies
 - Socioeconomics
 - Green spaces, parks
 - Transit
- Wind rose:
 - US: <https://www.wcc.nrcs.usda.gov/climate/windrose.html>
- Incident solar radiation, wind, geothermal (and others) analysis: National Renewable Energy Lab
 - PVWatts: <https://pvwatts.nrel.gov/>
 - Renewable Resources Data Center: <https://www.nrel.gov/grid/solar-resource/renewable-resource-data.html>

PROGRAM	DESCRIPTION
US Climate Resilience Toolkit	Climate resilience toolkit of tools, resources and case studies from all across the U.S. federal government in one easy-to-use location.
Community Resilience System (CRS) and Campus Resilience Enhancement System (CaRES)	Two FEMA funded initiatives of the Community and Regional Resiliency Institute
FORTIFIED*	Residential and business programs to reduce damage from specific natural hazards
Open For Business-EZ	Business continuity tool to re-open quickly post-event
RELi* Rating Guidelines for Resilient Design and Construction"	Resiliency Action List + Credit Catalog, dubbed "LEED for Resiliency," provides a comprehensive listing of resilient design criteria
REDi	Resilience-based Earthquake Design Initiative
LEED Resiliency Pilot Credits	Planning and design tools for building projects (IPpc98, 99 and 100)
U.S. Resiliency Council	Offers a Building Rating System for three performance measures—Safety, Damage expressed as repair cost and Recovery expressed as time to regain basic function
100 Resilient Cities Network	Find cities pursuing resiliency; share project and grant ideas
Climate Resilience Evaluation & Awareness Tool (CREAT)	Part of the US Climate Resilience Toolkit for owners and operators of drinking and wastewater utilities.
Building Resilience Against Climate Effects (BRACE)	Identify and prepare for the health effects of climate change

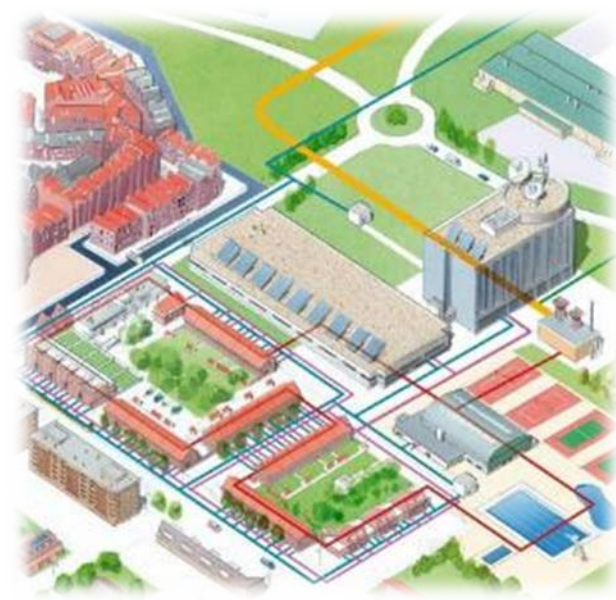
Resilient Design Strategies

Infrastructure

- + Transportation – multi-modal
- + Communication – multi-modal as well
- + Energy – distributed power; smart/micro-grids; local
- + Water – distributed storage and treatment
- + Grid-tied, district systems

Buildings

- + Extremely efficient
- + Local power and water, with local control
- + Include storage – thermal, water, power
- + Passive heating/cooling & ventilation
 - + Orientation
 - + Operable windows



Resilient Building Design Strategies

- + Extremely efficient
- + Local power and water, with local control
- + Include storage – thermal, water, power
- + Passive heating/cooling & ventilation
 - + Orientation
 - + Operable windows

PASSIVE SURVIVABILITY refers to a building's ability to maintain critical life-support functions and conditions for its occupants during extended periods of absence of power, heating fuel, and/or water.

THERMAL RESILIENCE is one dimension of passive survivability, and refers to a building's ability to maintain liveable temperatures in the event of a power outage or disruption in fuel supply for prolonged periods of time.



Components of Resilient Buildings

- **Extreme efficiency**

- Passive heating, cooling, daylighting and thermal comfort features
- Efficient equipment/processes
- Vernacular design

- **Generation**

- Renewable energy
- Rainwater harvesting

- **Placemaking**

- Design for social cohesion
- Multi-modal access

- **Storage**

- Batteries and/or flywheel
- Water tanks (elevated)
- Ice storage

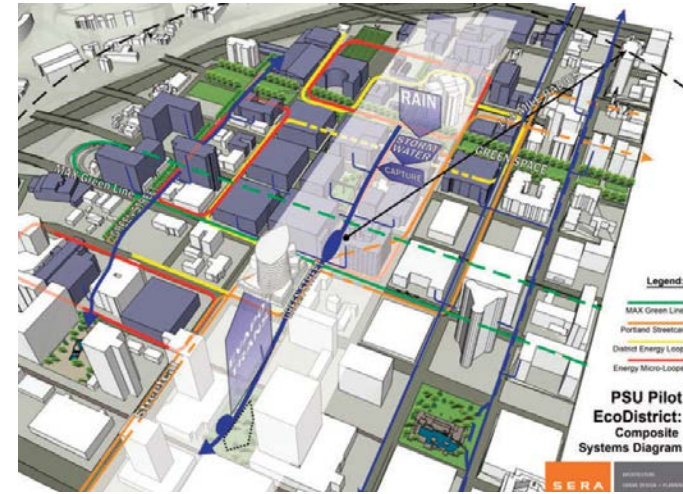
- **Control & Intelligence**

- Building automation; “smart” building systems (must be cybersecure)
- Microgrid - automatic transfer switches, synchronizers, intelligent power controllers
- Fiber optic and/or wireless communication

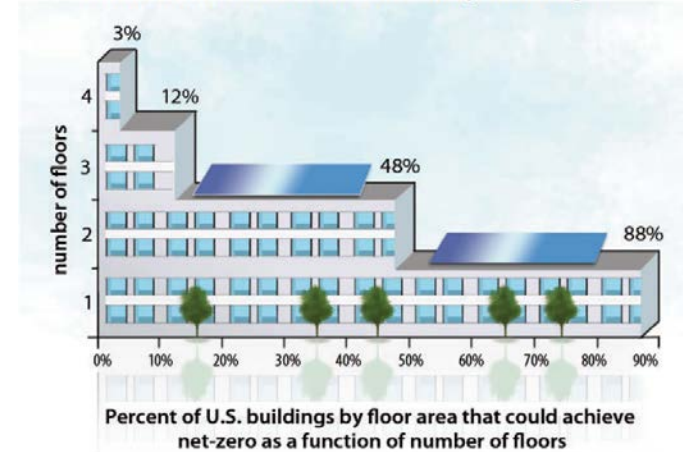
Resilient Design Strategies

...are often most (or *only*) effective at a community, district or campus scale

- District Energy systems
- Storage
- Low Impact Development
- Microgrid(s)
- Net-zero energy or water



Limits to Net-Zero for Multi-Story Buildings





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Resiliency for Local Government

Thank you

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