http://www.resilientdesign.org/the-resilient-design-principles/

What Is Resilience and Resilient Design?

By Alex Wilson

Resilience **is 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 of some sort.**

At various levels —individuals, households, communities, and regions — through resilience we can maintain livable conditions in the event of natural disasters, loss of power, or other interruptions in normally available services.

Relative to climate change, resilience involves adaptation to the wide range of regional and localized impacts that are expected with a warming planet: more intense storms, greater precipitation, coastal and valley flooding, longer and more severe droughts in some areas, wildfires, melting permafrost, warmer temperatures, and power outages.

Resilient design **is the intentional design of buildings, landscapes, communities, and regions in response to these vulnerabilities.** As used by the Resilient Design Institute, resilient design focuses on practical, on-the-ground solutions.

The Resilient Design Principles

1 **Resilience transcends scales.** Strategies to address resilience apply at scales of individual buildings, communities, and larger regional and ecosystem scales; they also apply at different time scales—from immediate to long-term.

2 **Resilient systems provide for basic human needs.** These include potable water, sanitation, energy, livable conditions (temperature and humidity), lighting, safe air, occupant health, and food; these should be equitably distributed.

3 **Diverse and redundant systems are inherently more resilient.** More diverse communities, ecosystems, economies, and social systems are better able to respond to

interruptions or change, making them inherently more resilient. While sometimes in conflict with efficiency and green building priorities, *redundant* systems for such needs as electricity, water, and transportation, improve resilience.

4 **Simple, passive, and flexible systems are more resilient.** Passive or manual-override systems are more resilient than complex solutions that can break down and require ongoing maintenance. Flexible solutions are able to adapt to changing conditions both in the short- and long-term.

5 **Durability strengthens resilience.** Strategies that increase durability enhance resilience. Durability involves not only building practices, but also building design (beautiful buildings will be maintained and last longer), infrastructure, and ecosystems.

6 **Locally available, renewable, or reclaimed resources are more resilient**. Reliance on abundant local resources, such as solar energy, annually replenished groundwater, and local food provides greater resilience than dependence on nonrenewable resources or resources from far away.

7 **Resilience anticipates interruptions and a dynamic future.** Adaptation to a changing climate with higher temperatures, more intense storms, sea level rise, flooding, drought, and wildfire is a growing necessity, while non-climate-related natural disasters, such as earthquakes and solar flares, and anthropogenic actions like terrorism and cyberterrorism, also call for resilient design. Responding to change is an opportunity for a wide range of system improvements.

8 **Find and promote resilience in nature.** Natural systems have evolved to achieve resilience; we can enhance resilience by relying on and applying lessons from nature. Strategies that protect the natural environment enhance resilience for all living systems

9 **Social equity and community contribute to resilience.** Strong, culturally diverse communities in which people know, respect, and care for each other will fare better

during times of stress or disturbance. Social aspects of resilience can be as important as physical responses.

10 **Resilience is not absolute.** Recognize that incremental steps can be taken and that *total resilience* in the face of all situations is not possible. Implement what is feasible in the short term and work to achieve greater resilience in stages.

Achieving Resilience at the Building Scale

- Design and construct (or renovate) buildings to handle severe storms, flooding, wildfire, and other impacts that are expected to result from a warming climate.
- Locate critical systems to withstand flooding and extreme weather events.
- Model design solutions based on future climatic conditions as much as possible, rather than relying on past data.
- Create buildings that will maintain livable conditions in the event of extended loss of power or heating fuel through energy load reductions and reliance on passive heating and cooling strategies (passive survivability).
- Create durable buildings using such features as rainscreen details, windows that can withstand hurricane winds, and interior finish materials that can dry out if they get wet and not require replacement.
- Create beautiful buildings that will be loved and maintained.
- Reduce dependence on complex building controls and systems. Provide manual overrides in case of malfunction or temporary power outages.
- Optimize the use of on-site renewable energy.
- Carry out water conservation practices and rely on annually replenished water resources, including, potentially, harvested rainwater, as the primary or back-up water supply.
- Provide redundant water supplies or water storage for use during emergencies. For deep-well pumps, provide either stand-alone solar electricity or hand pumping options where possible. Where there is no option for on-site water, consider water storage that can gravity-feed to building.

- Consider an option for human waste disposal in the event of non-operating municipal wastewater system. This could include composting toilets and waterless urinals.
- Use locally available products and skill-sets.
- Specify products and materials that will not offgas or leach hazardous substances in the event of flooding or fire damage.
- Rely on *vernacular design* practices that were prevalent before the advent of air conditioning and central heating. Combine these design strategies with modern materials to optimize resilient design.
- Provide redundant electric systems with at least minimal back-up power capacity, such as a fuel-fired electric generator (with adequate fuel storage) or a solar-electric system with islanding capability.
- Maintain on-premises, non-perishable food supply that could provide residents with adequate staples for a 3-to 6-month period. Non-perishable foods include canned goods; dehydrated foods (dried fruits, vegetables, meats in sealed bags); dried beans, grains, and rice; flours and cornmeal; salt; and vegetable oils. Some such foods may be stored in a freezer for long shelf-life, but they will remain relatively durable out of a freezer. Most foods should be stored in sealed glass jars for protection against insects and rodents.

Achieving Resilience at the Community Scale

- Build or facilitate social structures that strengthen the fabric of community. This could include community gathering places, dog parks where residents get to know their neighbors, central mailbox locations, and community bulletin-boards with rideshare notices and other postings. The Japanese “Koban” may provide a useful model.

- Design communities to minimize dependency on transportation fuels sourced from far away; provide for human-powered transportation options to access key services.
- Deliver food security through reliance on local or regional food systems and strategies for long-term, low-energy food storage. Work to achieve the potential for 50% reliance on local food production, as follows: within 10 miles of communities up to 10,000 residents; within 25 miles of communities from 10,000 to 100,000 residents; within 50 miles of cities from 100,000 to 1 million residents; and within 100 miles of cities larger than 1 million residents.
- Design vegetated roofs and rainwater bioswales to reduce the urban heat island effect and manage stormwater.
- Design and build (or rebuild) physical infrastructure, such as culverts, storm sewers, roadways, and bridges, to handle increased stormwater flows.
- Rely on natural, biological erosion-control solutions that will grow stronger over time.
- 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.
- Work to ensure the resiliency of cell phone towers so that communications can be maintained during times of emergency. Educate residents about the benefits of texting rather than calling during emergencies to use less bandwidth.
- Consider potential extreme weather events and climate change in determining locations of critical facilities and systems.
- Foster strong community education programs that will build greater understanding of energy, water, and other natural resource systems as well as the functioning of buildings and community infrastructure. Build such capacity into public education systems.

Achieving Resilience at the Regional and Ecosystem Scales

- Adopt policies that recognize and value *ecosystems services* and protect or restore the capacity to rely on those services (e.g., water filtration, protective buffers at coastlines, natural erosion-control along streams and rivers, healthy forests that purify and replenish air).
- Maintain and protect aquifers—prohibit withdrawals that exceed recharge on an annual basis and provide strict regulations to protect against contamination.
- Develop or strengthen regional transportation networks that can serve to transport not only people, but also food and other critical needs and that can function during times of emergency.
- Develop regional, renewable power-generation systems to ensure a more stable, distributed electrical grid. Pursue community ownership of utility-scale renewable power systems to garner regional support, s has been done very successfully in Germany and Belgium with energy co-ops.
- Work to achieve a more diverse regional economy.
- Foster greater reliance on regionally manufactured goods, perhaps through preferential sales tax strategies or other incentives.