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Resilient Everyday Infrastructure

William R. Morrish

When a tsunami, hurricane, or earthquake strikes a metropolitan area, wind surges or tremors may immediately strip away the veneer of everyday life, exposing the illusory stability of its civil infrastructure. Uncovered in moments may be the fragility of local life-support systems for water supply, waste disposal, flood control, telecommunications, public health, governance, and personal mobility, to name just a few.

These weaknesses are usually matters of public record long before disaster strikes. But the decision to tackle the tough political and financial issues involved in making necessary upgrades is routinely deferred to "another day." In the grim aftermath of disaster, however, responders may discover that the day of reckoning has arrived. On top of the chaos and hardship of the disaster itself, a city may face multiple system failures intensified by prior neglect. Urgent rebuilding demands will thereafter also have to compete with long-overdue infrastructure reconstruction.

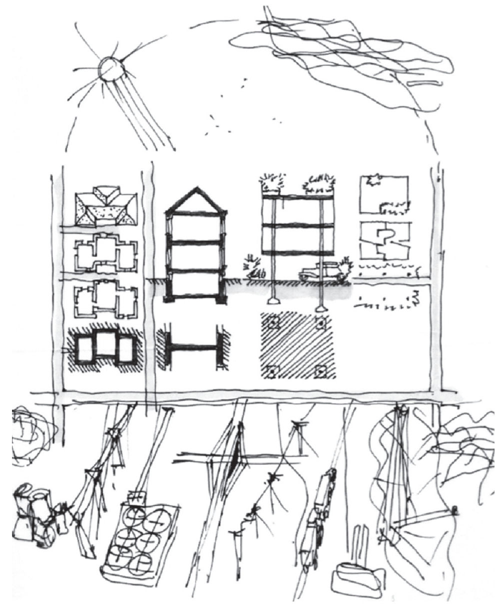
We take for granted that our cities are rooted on solid economic foundations and supported by benevolent environments, yet many float on conditions as fragile and uncertain as those in New Orleans or Los Angeles. They may not have abundant blue water nearby to remind them of their vulnerability, but the basic circumstances are often the same—faltering infrastructure, aging or diminishing population, waning tax base, severe weather events, declining resources, and the growing realization that time is not on their side. Cities that neglect the care of their basic economic and ecological footings set themselves up for the kind of sudden and traumatic change witnessed in the aftermath of Hurricane Katrina, in 2005.

Resilience

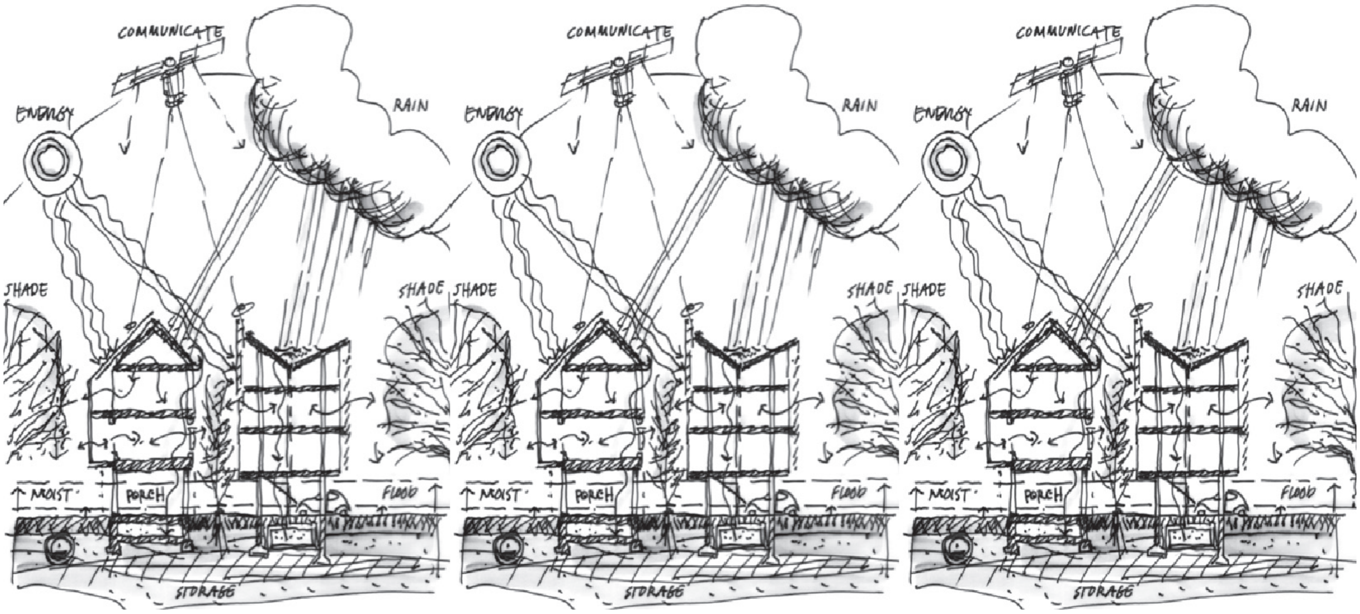
The traditional approach to infrastructure vulnerability and recovery has been to harden defenses and focus recovery on the repair of big public works. For me, however, a more strategic approach is the concept of "resilience." What is needed is a distributed infrastructure that enables citizens to operate independently, sustain themselves during service disruptions, and assist the recharge of larger systems upon return to normal conditions. This way, citizens may become better "first responders" to crisis, as well as more active and effective agents in long-term recovery. They may also make incremental individual investments in a collective effort to realign their urban landscape to new conditions brought on by global climate change.

In this finer-grained approach to infrastructure, every new urban structure or landscape modification becomes an opportunity to add to system capacity and reduce external impacts. In a volatile world of changing climate, with the potential for cascading infrastructure failure, investment in this kind of sustainable, distributed capacity will have substantial returns for communities. Not the least of the benefits will be the ability of businesses to rebound more quickly after disaster and stay competitive in the global marketplace; the costs of being shut down for more than a few days or weeks can be tremendous.

A more reflexive urban infrastructure would build reciprocal relationships between the center, branches, and ends of all of its respective systems. As an example, heating and cooling systems in state-of-the-art green office buildings now include thousands of small sensors embedded in the skin of the building. During the day, as the sun tracks across the sky, readouts from these sensors allow a central computer to make continuous small adjustments in internal temperature and airflow. The recognition that a building is not just a box but also a mosaic of changing thermal sub-surfaces has yielded new design approaches that lower energy costs and increase the productivity and well-being of its inhabitants. Every component—from lighting to plumbing—may provide a vital link in a network that supports energy efficiency, alternative forms of power supply, water conservation, public safety, and the specific needs of individual tenants.



The infrastructure systems that support such buildings—indeed, the entire human-made landscape—should serve multiple goals. Besides their functional values, these systems can become cultural utilities and civilizing amenities to strengthen neighborhoods, create new jobs, and improve the health of local ecological systems.



Such "domestic-based" infrastructure design, however, will require that natural ecological processes be integrated into the "structural" systems of everyday economic and social transaction. This will mean the end of infrastructure systems designed on the premise that "one size fits all," with the user waiting at the end of the line for services.

Public-sector agencies and private utilities will need to reach across proprietary service-district boundaries to calculate baselines and combined strategies. Power companies and urban water-supply companies will need to balance their demands for local water supplies with other critical needs. Among these needs are support of healthy neighborhood streams and protection of the urban tree canopy, which helps to reduce heat-island effects and to lower power demands. Power companies will also need to work with transportation agencies to reduce traffic congestion and air pollution; we cannot refresh our work places with open windows and local breezes if the air outside is increasingly polluted.

Integration

When buildings, landscapes, and cities begin to incorporate natural systems into design and operation, the effect will be cumulative. Eventually, all may even operate as capillaries in an infrastructure network that provides water, air, energy, communication, transportation, and waste services at minimum cost to the environment.

Here is an example of what could have been: after hurricane-force winds stripped the roofs off many Gulf Coast homes, in 2005, instead of simply replacing them in the customary hipped forms using asphalt shingles, architects could have made them energy generators. Angled toward the sun, these roofs could have been equipped with solar-voltaic shingles or solar water-heating systems. In New Orleans, a citywide application of this idea might already be helping residents reduce energy bills. It might also be seen as a way to provide back-up power at times of emergency, reduce overall metropolitan energy demand, and jump-start an emerging green industry with enormous job potential.

When end-of-the-line users become "generators" we will be in a much better position to support overall energy supply needs and build a safer, more comprehensive and redundant civic infrastructure.

Opposite: Users at the end of the line. The traditional view is that home and gardens are users of infrastructure, demanding more and contributing less.
Above: Resilient and redundant neighborhoods.