Enhancing Community Resilience: a U.S. Perspective

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Community Resilience and Critical Infrastructure

Resilience are Societal Imperatives

The term *resilience* refers to the ability to *prepare for* and *adapt to* changing conditions and *withstand* and *recover rapidly* from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.*

*President Policy Directive 21 - Critical Infrastructure Security and Resilience February 12, 2013*
Resilience Components and Timelines

Figure 3. Resilience

PREPARE
- Withstand
- Respond
- Adapt
- RECOVER

PRE-CALCULATED
- Housing
- Develop permanent housing solutions
- Infrastructure
- Rebuild infrastructure to meet future community needs
- Business
- Implement economic revitalization strategies
- Facilitate funding to business rebuilding
- Emotional/Psychological
- Follow-up for ongoing counseling, behavioral health, and case management services
- Public Health and Health Care
- Reestablishment of disrupted health care facilities
- Mitigation Activities
- Implement mitigation strategies

POST-CALCULATED
- Recovery
- Workforce development
- Infrastructure
- Rebuild infrastructure to meet future community needs
- Business
- Implement economic revitalization strategies
- Facilitate funding to business rebuilding
- Emotional/Psychological
- Follow-up for ongoing counseling, behavioral health, and case management services
- Public Health and Health Care
- Reestablishment of disrupted health care facilities
- Mitigation Activities
- Implement mitigation strategies

PREPAREDNESS
- Ongoing
- Pre-disaster recovery planning
- Mitigation planning and implementation
- Community capacity- and resilience-building
- Conducting disaster preparedness exercises
- Partnership building
- Articulating protocols in disaster plans for services to meet the emotional and health care needs of adults and children

SHORT-TERM RECOVERY
- Examples include:
  - Mass Care/Sheltering
  - Provide integrated mass care and emergency services
  - Debris
  - Clear primary transportation routes
  - Business
  - Establish temporary or interim infrastructure to support business reopenings
  - Reestablish cash flow
  - Emotional/Psychological
  - Identify adults and children who benefit from counseling or behavioral health services and begin treatment
  - Public Health and Health Care
  - Provide emergency and temporary medical care and establish appropriate surveillance protocols
  - Mitigation Activities
  - Assess and understand risks and vulnerabilities

INTERMEDIATE RECOVERY
- Examples include:
  - Housing
  - Provide accessible interim housing solutions
  - Debris/Infrastructure
  - Initiate debris removal
  - Plan immediate infrastructure repair and restoration
  - Business
  - Support reestablishment of businesses where appropriate
  - Support the establishment of business recovery one-stop centers
  - Emotional/Psychological
  - Engage support networks for ongoing care
  - Public Health and Health Care
  - Ensure continuity of care through temporary facilities
  - Mitigation Activities
  - Inform community members of opportunities to build back stronger

LONG-TERM RECOVERY
- Examples include:
  - Housing
  - Develop permanent housing solutions
  - Infrastructure
  - Rebuild infrastructure to meet future community needs
  - Business
  - Implement economic revitalization strategies
  - Facilitate funding to business rebuilding
  - Emotional/Psychological
  - Follow-up for ongoing counseling, behavioral health, and case management services
  - Public Health and Health Care
  - Reestablishment of disrupted health care facilities
  - Mitigation Activities
  - Implement mitigation strategies

National Response Framework (NRF)

National Disaster Recovery Framework (NDRF)
Why Community Resilience?

- All communities face potential disruption from natural, technological, and human-caused hazards.
- Disasters take a high toll in lives, livelihoods, and quality of life that can be reduced by better managing disaster risks.
- Planning and implementing prioritized measures can strengthen resilience and improve a community’s ability to continue or restore vital services in a more timely way – and to build back better.
- The built environment exists to serve a social function (e.g., a hospital provides healthcare services). Therefore, social and economic needs and functions should drive the goals for performance of buildings and physical infrastructure.
- New tools and guidance are needed to measure resilience and plan and implement measures to enhance resilience.
Community Resilience - a Tale of Two Cities
Case Study I: Public Sector Resilience – Hurricane Sandy
New York Metropolitan Transportation Authority

1. Moved Trains to high ground and shelter

2. Provided incentive for workforce to stay on the job
Case Study II: Public Sector Resilience – Hurricane Sandy
New Jersey Transit

345 Trains damaged by flooding at the Meadowlands Maintenance Complex & Hoboken Yard totaling $120 million
Strategies

• Planning/Assessment/Risk Characterization
• Building Regulations
• Community Guidance
• Economic Incentives
Planning and Assessment

**Buildings**
Individual structures, including equipment and contents that house people and support social institutions

**Building Clusters**
A set of buildings that serve a common function such as housing, healthcare, retail, etc.

**Physical and Social Systems**
Physical networks and structures that support social institutions, including transportation, energy, communications, water and waste water systems.

**Dependencies**
Internal and External, Time, Space, Source
Event Characterization

- **Routine** – Hazard level is below the expected (design) level and occurs more frequently. Resilient buildings and infrastructure systems should remain fully functional and not experience any significant damage that would disrupt social or economic functions in the community.

- **Expected** – Design hazard level, where the design level is often based on codes. The design hazard level may be greater than the minimum required by codes, or may be based on other criteria. Buildings and infrastructure systems should remain functional at a level sufficient to support the response and recovery of the community as defined by the performance levels. This level is based on the design criteria normally used for buildings.

- **Extreme** – Hazard level is above the expected (design) level. Some hazards refer to the maximum considered event, which is based on the historic record. Extreme events may also include long-term changes in hazards anticipated due to climate change. However, this hazard level might not be the largest possible hazard level that can be envisioned, but rather one that the community believes is credible. Critical facilities and infrastructure systems should remain at least minimally functional at this level. Other buildings and infrastructure systems should perform at a level that protects the occupants though they may need to be rescued. In addition, emergency response plans should be developed for scenarios based on this hazard level.
Link Social Dimensions and Built Environment

Some rely more on the built-environment

- Services provided to meet needs
- Dependency on other services and systems
- Dependency on built environment
- Consequences of loss

Some functions change

Emergency Rooms
Industrial Plants

Schools → Shelters
The Role of Regulation

FIRE EVENTS AND REGULATORY RESPONSE IN NEW YORK (1776-2000)

MAJOR FIRE EVENTS IN NEW YORK CITY

1776
1815
1835
1845
1860
1913
1975
1998
1970-1990

1776 - FIRE IN NEW YORK CITY
1815 - MANHATTAN FIRE
1835 - BROOKLYN FIRE
1845 - FIRE IN NEW YORK CITY
1860 - FIRE IN NEW YORK CITY
1913 - FIRE IN NEW YORK CITY
1975 - FIRE IN NEW YORK CITY
1998 - FIRE IN NEW YORK CITY
1970-1990 - FIRE IN NEW YORK CITY

BUILDING CODE RESPONSE
The Role of Regulation

A Tale of Two Cities:
The Paso Robles and Bam earthquakes of December 2003

- Paso Robles, Calif.
  - Population: 30,000
  - December 23, 2003
  - 6.5 Richter
  - 2 died
  - 46 buildings damaged
  - Buildings were code compliant
  - Designed and built by qualified professionals

- Bam, Iran
  - Population: 40,000
  - December 23, 2003
  - 6.5 Richter
  - Over 30,000 died
  - 85 percent of the city destroyed
  - Buildings were not code compliant
  - Informal buildings
U.S. Resilience Regulatory Resources

• NFPA 1600
  “Standard on Disaster/Emergency Management & Business Continuity Programs”

• FPRF, 2015
  “Guidance on Incorporating Resiliency Concepts into Codes and Standards”
The built environment exists to serve a social function (e.g., a hospital provides healthcare). Therefore, social and economic needs and functions should drive the goals for performance of buildings and physical infrastructure.

Practical, flexible methodology to better set priorities and allocate resources to reduce risks and to build back better.
Planning Steps for Community Resilience

**SIX-STEP GUIDE TO PLANNING FOR COMMUNITY RESILIENCE**

1. **FORM A COLLABORATIVE PLANNING TEAM**
   - Identify leader
   - Identify team members
   - Identify key stakeholders

2. **UNDERSTAND THE SITUATION**
   - **Social Dimensions**
     - Characterize social functions & dependencies
     - Identify support by built environment
     - Identify key contacts
   - **Built Environment**
     - Identify and characterize built environment
     - Identify key contacts
     - Identify existing community plans
   - **Link Social Functions & Built Environment**
     - Define clusters

3. **DETERMINE GOALS & OBJECTIVES**
   - Establish long-term community goals
   - Establish performance goals
   - Define community hazards
   - Determine anticipated performance
   - Summarize results

4. **PLAN DEVELOPMENT**
   - Evaluate gaps
   - Identify solutions
   - Develop implementation strategy

5. **PLAN PREPARATION, REVIEW, AND APPROVAL**
   - Document plan and strategy
   - Obtain feedback and approval
   - Finalize and approve plan

6. **PLAN IMPLEMENTATION AND MAINTENANCE**
   - Execute approved solutions
   - Evaluate and update
   - Modify strategy as needed
## Example Summary Resilience Matrix

### Infrastructure Recovery Time

<table>
<thead>
<tr>
<th>Critical Facilities</th>
<th>Recovery Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>Buildings</strong></td>
<td>90%</td>
</tr>
<tr>
<td><strong>Transportation</strong></td>
<td>90%</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>90%</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Wastewater</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Desired Performance

- **Buildings**: 90% recovery within 1 day
- **Transportation**: 90% recovery within 1 day
- **Energy**: 90% recovery within 1 day
- **Water**: 90% recovery within 1 day
- **Wastewater**: 90% recovery within 1 day
- **Communication**: 90% recovery within 1 day

### Anticipated Performance

- **Buildings**: X (not recoverable within stated time frames)
- **Transportation**: X (not recoverable within stated time frames)
- **Energy**: X (not recoverable within stated time frames)
- **Water**: X (not recoverable within stated time frames)
- **Wastewater**: X (not recoverable within stated time frames)
- **Communication**: X (not recoverable within stated time frames)

### Superstorm Sandy

Photos of infrastructure damage and recovery efforts following Superstorm Sandy.
Challenges

Changing design considerations from life safety-driven to functionality-driven

- Determining how to define and measure the functionality of buildings and infrastructure systems – including structural and nonstructural components
Challenges (cont’d)

Stochastic nature of hazards and typical decision maker’s understanding of risk
Fully capturing interdependencies amongst systems and prioritize for competing objectives
Examples of Interdependency Challenges

• Refineries and pipelines need electricity to operate.

• Vehicles for repairing electrical distribution lines need a reliable supply of gasoline or diesel fuels.

• Transportation conveyances are required to move fuel to commercial and residential users.

• Transportation conveyances require fuel to operate.

• Gas stations require electricity to operate pumps and telecommunications to support credit/debit card purchases.
Challenges (cont’d)

Communication between the many disciplines – physical systems and their services, social services, economics – methods, vocabulary, input and output data

- Social scientists working at individual/neighborhood level working with economists at the regional/aggregate levels;
- time and frequency of data (annual versus monthly)
The abiding strategy of our parents’ generation was ‘containment’ of communism in order to be free.

The abiding strategy of our generation has to be ‘resilience.’ We will only be free to live the lives we want if we make our cities, country and planet more resilient.”

Questions?

Thank You