Community Disaster Resilience

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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). 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.
NIST Community Resilience Program

**Stakeholder Engagement***
- Community Resilience Planning Guide
- Community Resilience Panel
- Community Resilience Implementation Guideline

**Research**
- Community Resilience Systems Model
- Community Resilience Assessment Methodology
- Economics-based Decision Support Tool

**Center of Excellence**
- Integrated, multi-scale modeling
- Database Architecture
- Pilot Studies

*Stakeholder Engagement component is called out in the President’s Climate Action Plan*
Community Resilience Planning Guide

• The target audience for the Guide is local government as a “logical convener.”

• The term “community” refers to a place that:
  – Is designated by geographical boundaries
  – Functions under the jurisdiction of a governance structure, such as a town, city, or county.

• Each community has its own identity based on its location, history, leadership, and available resources.

• Some systems (e.g., electric power) often extend beyond the boundaries of the community.
Planning Guide Overview

- The Guide helps communities:
  - Organize effectively to address resilience risks, goals, and priorities.
  - Determine customized long-term resilience goals.
  - Develop short- and long-term plans for buildings and infrastructure systems to achieve resilience goals.
  - Prioritize improvements to the built environment based on their role in supporting social institutions and economic functions during recovery.
  - Address infrastructure dependencies and cascading effects of system failures.
Guide Outline

**Volume 1 - Methodology**
- Executive Summary
- Ch 1. Introduction
- Ch 2-6. Methodology and Planning Steps
- Ch 7. Future Directions
- **Appendix**: Planning Example – Riverbend, USA

**Volume 2 - Reference**
- Executive Summary
- Ch 9. Social Community
- Ch 10. Dependencies and Cascading Effects
- Ch 11. Buildings
- Ch 12. Transportation Systems
- Ch 13. Energy Systems
- Ch 14. Communications Systems
- Ch 15. Water & Wastewater Systems
- Ch. 16 Community Resilience Metrics
Planning Steps for Community Resilience

1. Form a collaborative planning team
2. Understand the situation
   – Social Dimensions
   – Built Environment
3. Determine goals and objectives
4. Plan development
5. Plan preparation, review, and approval
6. Plan implementation and maintenance
Step 1. Form a Collaborative Planning Team

**Public**
- Elected Officials
- Local Government
- Community Members

**Private**
- Business and Services
  - Banking, Health care
  - Utilities
  - Media
- Organizations
  - NGOs (VOAD, Relief)

**Representation of All Interests**
Step 2. Understand the Situation

Characterize the Social Dimensions

– Community members
  • Present and future needs
  • Demographics and economic indicators
  • Social Capital/Social Vulnerabilities

– Social institutions
  • Social functions
  • Gaps in capacity
  • Dependencies on other institutions

– Community metrics
Characterize the Built Environment

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.

Infrastructure 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

Characterize
Location, number, construction, demands and use, etc.
Link Social Dimensions and Built Environment

Some rely more on the built environment

Emergency Rooms

Industrial Plants

Identify how services are supported

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

Some functions change

Schools → Shelters
Step 3. Determine Goals and Objectives

Establish Long Term Community Goals

- Long term goals to improve the community can guide the prioritization and implementation process.
  - Improve reliability of infrastructure systems
  - Enhance community functions
  - Reduce travel time impacts to residents and businesses
  - Revitalize an existing blighted area
- Community resilience is achieved over time
  - Resilience can be achieved with resources for current maintenance and capital improvements
Establish Desired Performance Goals for the Built Environment

• Performance goals are independent of hazard events.
  – Community functions are needed during recovery, such as acute health care, 911 call centers, emergency response
  – Consider role of a facility or system that impacts others outside the community.

• Define goals in terms of ‘time needed to restore functionality’.

• Use goals to help prioritize repair and reconstruction efforts.

• Goals may suggest criteria for new construction and retrofit of existing construction.
Recovery of the Built Environment

Organize around restoring functionality over time

When is each system needed for recovery?

- **PREPAREDNESS**: Ongoing
- **SHORT-TERM**: Days/Weeks
- **INTERMEDIATE**: Weeks/Months
- **LONG-TERM**: Months/Years

Size & Scope of Disaster and Recovery Efforts
Determine and Characterize Hazards

• Identify prevalent hazards
  • Wind, Earthquake, Inundation
  • Fire, Snow, Rain
  • Human-caused or Technological

• Evaluate 3 hazard levels
  • Routine Level expected to occur frequently
  • Expected Level used to design buildings
  • Extreme Maximum considered possible
Anticipated Performance of Existing Built Environment

- Anticipated performance (restoration of function) during recovery depends
  - Damage level - Condition and capacity of structural and nonstructural systems
  - Recovery time - Materials, equipment, and labor needed for restoration
  - Dependencies on other systems that may be damaged
### Example Summary Resilience Matrix

#### Critical Facilities

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Recovery Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Days</td>
</tr>
<tr>
<td>Buildings</td>
<td>90%</td>
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<tr>
<td>Transportation</td>
<td>90%</td>
</tr>
<tr>
<td>Energy</td>
<td>90%</td>
</tr>
<tr>
<td>Water</td>
<td>90%</td>
</tr>
<tr>
<td>Wastewater</td>
<td>90%</td>
</tr>
<tr>
<td>Communication</td>
<td>90%</td>
</tr>
</tbody>
</table>

#### Desired Performance

- Buildings: 90% in Days 1-3
- Transportation: 90% in Days 1-3
- Energy: 90% in Days 1-3
- Water: 90% in Days 1-3
- Wastewater: 90% in Days 1-3
- Communication: 90% in Days 1-3

#### Anticipated Performance

- Buildings: X in Days 1-3
- Transportation: X in Days 1-3
- Energy: X in Days 1-3
- Water: X in Days 1-3
- Wastewater: X in Days 1-3
- Communication: X in Days 1-3
Step 4. Plan Development
Evaluate Gaps and Identify Solutions

- Prioritize gaps
  - Long-term community goals
  - Social needs during recovery
- Identify alternative solutions
  - Multiple stages
  - Temporary and permanent
  - Administrative
  - Construction

- Flood plain management
  - Reduce threat: relocate, elevate
- Wind and seismic preparedness
  - Strengthen: retrofit, redundancy
- Recovery Plans
  - Mutual aid agreements
  - Improvement plans

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<tr>
<td>Critical Facilities</td>
<td>Days 0 Days 1 Days 1-3 Weeks 1-4 Weeks 5-8 Weeks 9-12 Months 4 Months 4-24 Months 24+</td>
</tr>
<tr>
<td>Buildings</td>
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Prioritize Solutions and Develop Implementation Strategy

• Select solutions for prioritized performance gaps
  – Determine how alternative solutions can be combined to meet community goals.
  – Consider collaborative projects.

• Develop implementation strategies
  – Quantify benefits of impact on public safety and social needs.
  – Evaluate economic impacts on community costs and savings.
  – Consider short- and long-term benefits versus costs.

• Determine preferred implementation strategy

2013 Mandatory Soft Story Retrofit program for all older, wood-framed, multi-family buildings ensures the safety and resilience of San Francisco.

North Texas 2050 plan integrates land use, natural resources, transportation, housing, water and wastewater infrastructure, parks and open spaces.
Step 5. Plan Preparation, Review, and Approval

Plan Approval

- Document proposed implementation strategy and supporting assessments and solutions.
- Share with all stakeholders and community members
  - Public Meetings, review and comment period.
- Finalize and approve community plan.
Step 6. Plan Implementation and Maintenance

Implementation
- Formally adopt community plan to guide local government and agencies
- Identify and obtain resources to implement solutions
- Track and *communicate progress* to stakeholders

Plan Maintenance
- Review strategy and solutions on a regular basis
- Modify or update as needed
Next Steps

• Public Comment and Version 1.0
  – Update Guide based on comments with planned release in September 2015

• Community Resilience Panel
  – Focus on identifying gaps in practice and knowledge
  – Inform the development of Implementation Guidelines to help users of the Guide.
  – First meeting planned for Fall 2015

• Support Use of the Guide
  – Developing a plan to work with pilot communities implementing the Guide
  – Plan to develop training tools and user forum to support implementation
  – Collect data on implementation of resilience planning to inform future versions of the Guide and other products.
Research Plans

- Develop a methodology to assess resilience at the community-scale based on community functions, supported by buildings and infrastructure systems and time required for those systems to recover after disruption.
- Develop first-generation, science-based tools to assess resilience at the community scale.
- Develop a first-generation economic analysis tool to facilitate cost-effective resource allocations that minimize the economic burden of disasters on communities.
- Economic analysis tools, combined with the resilience assessment tools, will provide decision makers at the community/regional level a means to evaluate alternate investment decisions.
Community Resilience Center of Excellence

- Awarded to 10 institution team led by Colorado State University.
- $4M/year program funded through a cooperative agreement.
- Objectives are to:
  - Develop an integrated, multi-scale, computational modeling environment to accelerate development of systems-level models to enable new standards and tools for enhancing Community Resilience
  - Foster the development of data architectures and data management tools to enable disaster resilience planning for emergency and decision-making officials, code and standards professionals, engineering design experts, and researchers.
  - Conduct studies to validate resilience data architectures, data management tools, and models for a variety of hazard events including:
    - Tornado, hurricane, earthquake, flood, Wildland-Urban Interface (WUI)
    - Effects of climate change, and effects of aging infrastructure
Concluding Remarks

- Improving resilience does not have to be prohibitively expensive.
- Measures to improve resilience can be implemented over many years and as part of long-term community development plans.
- The Guide will help communities with prioritizing buildings and infrastructure and with planning to improve resilience.
- Implementation Guidelines will provide guidance in the form of standards, codes, and best practices, to implement resilience measures.
- Resilience assessment tools and economics-based decision support tools will aid communities in identifying needs and prioritizing actions.
NIST Contact

Website:
http://www.nist.gov/el/building_materials/resilience/

Guide:
http://www.nist.gov/el/building_materials/resilience/guide.cfm

Or google “NIST Resilience Planning Guide”

General E-mail: resilience@nist.gov
Questions?