

GUIDLINES FOR CREATING DISASTER-RESILIENT COMMUNITIES



Chris D. Poland, SE, FSEAOC, NAE

Degenkolb Engineers, San Francisco CA

SUMMARY:

Communities are healthy, vibrant, and sustainable when they are well governed and growing by driving economic development while also protecting their cultural heritage. Success, in part, depends on a healthy built environment that is rooted in contemporary urban planning, sustainability and disaster resilience. Disaster-resilient communities must have credible disaster response plans that assure the ability to govern and provide flexibility for people to do what is needed to recover quickly. The people understand what has happened and work together to shelter-in-place. Power, water, and communication networks begin operating again shortly after a disaster, and within weeks people are living normally at home, are able to travel as needed, and have resumed a fairly normal routine. The return to a “new” normal begins quickly, in a planned manner, and is achieved within a few years. Reconstruction financing plans and construction standards need to be in place before the emergency. For the past 6 years, the San Francisco Planning and Urban Research Association (SPUR) have been developing policy recommendations for the City of San Francisco related to transforming the City into a disaster resilient community. The resulting guidelines and recommendations are available for application to communities worldwide regardless of size or location.

Keywords: Earthquake Engineering, Disaster Resilience, Public Policy, Recovery, Design Criteria

1. INTRODUCTION

Multiple occurrences of devastating earthquakes worldwide in the last few years have clearly shown how serious the earthquake threat is and how devastating it can be to a community’s safety and recovery. It is clear that the centuries-long practice of ignoring the effects of major earthquakes or just working to make the built environment “safe” is not sufficient to avoid a catastrophe. Communities, cities, states, and nations need to be disaster resilient; that is, safe and able to quickly recover – and it is not simply a matter of building everything better. Building better is only one piece of the puzzle that includes a host of “soft” and “hard” resilience activities related to mitigation, preparedness, response, and recovery.

Communities are healthy, vibrant, and sustainable when they are well governed and growing by driving economic development while also protecting their cultural heritage. Success, in part, depends on a healthy built environment that is properly designed and constructed, rooted in contemporary urban planning, sustainability, and disaster resilience. Disaster-resilient communities must have credible disaster response plans that assure the ability to govern and provide flexibility for people to do what is needed to recover quickly. The people understand what has happened and work together to shelter-in-place. Power, water, and communication networks begin operating again shortly after a disaster, and within weeks people are living normally at home, are able to travel as needed, and have resumed a fairly normal routine. The return to a “new” normal begins quickly, in a planned manner, and is achieved within a few years.

The San Francisco Planning and Urban Research Association (SPUR) initiated a Disaster Planning Program in 2005 that includes a Resilient City Initiative that is chaired by the author. SPUR is a 100 year old public policy think tank that promotes good planning and good governance throughout the San Francisco Bay Area (SPUR.org). The ongoing SPUR Resilient City Initiative defines resiliency in a holistic and deterministic manner based on what the city needs from its governance, its people, its buildings, and its lifelines to support response, recovery, and rebuilding. It is an ongoing effort that has produced multiple public policy papers that include guidelines on what is needed.

Defining a disaster-resilient city requires a broad holistic view. The resilience of the built environment stands as the foundation, but alone it is insufficient. Human resilience is the engine of recovery. Resilient communities must be able to deal quickly with the social needs of their disadvantaged and disenfranchised people. Before the event, recovery plans must be in place that are fully integrated with contemporary urban planning and that seek to create a better new normal. Community recovery must be led by a transitional governance structure that can overcome traditional institutional constraints while orchestrating the deployment of financial resources.

Recovering from a natural disaster is a unique and complex experience for each community. It depends on the size and nature of the disaster and the effect it has on the spirit and physical security of the people. Recovery is a system of interconnected activities that must function effectively and harmoniously to avoid having the disaster cascade into a catastrophe. There are four critical interdependencies that fundamentally direct the recovery process and allow the disaster to remain manageable. First is a stable governance structure with an ability to maintain order and direct recovery; second is a work force that is willing to stay and recover; third is the availability of sufficient financing; and fourth is a sufficient and usable physical infrastructure.

2. GOVERNANCE

After a natural disaster occurs, government needs to provide vision and leadership for recovery and rebuilding. Their public facilities and services need to be restored in a timely manner and there needs to be a continuous flow of credible and accurate information that will lead to informed decisions. It will not be business as usual. The extent of damage and the demands for information related to services and reconstruction will compress the usual decision-making process from weeks to minutes. Instead of dealing with a handful of buildings and systems at a time, they will be considering nearly all of the buildings and systems. The pressure to rebuild from an anxious population will play against the opportunity to build back deliberately and better. (Olshansky 2010)

After the initial response period, natural disasters deliver a unique set of issues during the recovery process. The emergency response is handled out of the emergency operations center where decisions can be made quickly and without regard to cost or public input. Within a few weeks, the region settles into the recovery process that needs to consider public input, but also needs to respect the fast pace required to achieve the new normal. It appears that a transitional form of governance is needed that allows for thoughtful consideration while exercising an appropriate amount of streamlining in process. A well balanced subset of the usual governing body needs to convene and have the authority to implement the pre-set plans.

Pre-set plans need to be developed that recognize the potential opportunities that reconstruction provides. These need to be thoughtfully outlined pre-event so that rational decisions can be made. Government needs to plan for the recovery period with the same diligence applied to the initial response by setting a clear vision for rebuilding. At the forefront is the need to develop reconstruction codes and standards for damaged buildings that include rebuilding in areas affected by liquefaction, landslide and faulting. SPUR is currently working on policy recommendations related to governance immediately after the event that extends through the recovery period. Also under development are recommendations related to land use planning before and after a major event.

3. PEOPLE AND WORKFORCE

Communities exist because of the people and the people are the engine that will drive the recovery. Past events have shown that early in the post-event period, people decide whether they will “tip-in” and help rebuild, or “tip-out” and permanently relocate. In order to assure that a critical mass of the workforce stays, the damage and disruption that occurs must be expected and short-term recovery must appear to be possible (Ahlers 2009). There needs to be a clear understanding on the part of the people about the earthquake potential and what is going to happen to their homes, neighborhoods, jobs and businesses. This understanding must be built on a new level of transparent information available about the performance expectations for the built environment and a clear understanding of what it will take to repair damage.

For the workforce to be able to settle into the new normal of recovery, they need to be able to return to their homes and reconnect to their neighborhoods within a few weeks. For this to be possible, shelter-in-place programs appear to be the best solution, and they should become a cornerstone of temporary and interim housing plans. SPUR recently completed a study of what is needed to create neighborhoods in San Francisco where it will be “safe enough to stay” (SPUR *Urbanist* 2012). Two key attributes are (1) buildings that are safe enough to reoccupy after the event and (2) neighborhood support centers staffed and outfitted to cover daily needs. People need to be able to effectively camp out in or near their homes as repairs are made and services restored.

Resilience is also a personal responsibility. People need to develop and maintain personal response plans based on a clear and accurate understanding of what can happen. Government needs to recognize and utilize social media and new technologies to deliver the continuous, common voice messages that will build confidence. People need to understand and support long-term recovery and reconstruction plans along with the transitional governance structure enabling quick decision making in support of restoring community culture, economic vitality, and achieving a new normal.

4. FINANCING

Financing the recovery is the third element of critical infrastructure that needs to be readily available post event. Because of the amount of reconstruction that is necessary, outside financial resources are vital. Government funding will underwrite the response and stabilization of a region, but recovery demands additional resources. In addition to personal savings and insurance, recent events have underscored the significant resources available from the NGO community, though to be best utilized, they need to be coordinated with the recovery programs. Banks and other investors will enter the recovery when financially viable opportunities are present. In addition, business will also invest in recovery beyond their own facilities as an exercise of civic leadership. Organizations like the US Chamber’s Business Civic Leadership Center work to organize those efforts.

Funding for relief and response often arrive quickly and can be distributed efficiently. Funds for permanent reconstruction are the opposite. Often, the “red tape” associated with long term funding is the source of delay rather than the lack of funds. Traditional bureaucracies are poorly suited for a streamlined recovery process. To be altered, the transitional form of governance needs to have the ability to disburse moneys in a streamlined manner without requiring excessive tracking and oversight. Pre-planning, development of reconstruction standards, and a method to direct the funding that arrives from non-government organizations will greatly accelerate the availability of money for reconstruction.

5. INFRASTRUCTURE

Creating a sufficient and usable physical infrastructure requires proper design and construction standards and mitigation programs for the existing structures and systems that do not meet these resilience standards. Current design and construction standards used in California are close, but need augmentation. Included in SPUR's initial work on Disaster Planning has been a focus on defining public policy that will set proper design and construction standards for San Francisco.

The SPUR recommendations encompass the performance and recovery of an integrated system of critical infrastructure. It is not just about the performance of individual buildings. SPUR addresses the physical infrastructure needed during the three phases of response and recovery in the same manner used by San Francisco's emergency planners, recognizing that there is time to repair most buildings and systems before they are actually needed. In the first phase, the weeklong response and rescue period, only the emergency response centers are needed. The second phase of recovery focuses on restoring the neighborhoods within 30 to 60 days so that the workforce can be reestablished, their communities restored, and people are able to return to a normal lifestyle and back to work. Special consideration must be given to the needs of the economically and physically challenged populations. The third phase of recovery covers the repair and reconstruction of the affected area. SPUR has published a guideline that defines a framework for achieving resiliency and includes specific recommendations for policies and programs needed in San Francisco. It includes the hazard levels to plan around and performance goals for all elements of the critical infrastructure. (SPUR *Urbanist* 2009).

Hazard Levels

Setting resilience goals requires the combination of a defined level of shaking and a transparent performance goal. To be effective and understood, today's probabilistic definitions need to be translated into equivalent scenario events for effective public policy decision making. For that purpose, SPUR defined three scenario events for San Francisco that included an "expected" earthquake – one that could reasonably be expected to occur during the useful life of the structure or system - along with extreme and routine events. The expected earthquake is defined for use in design and evaluation. The extreme earthquake - the largest earthquake that could reasonably be expected to occur on a nearby fault - is intended to be used as the basis for response planning. The routine earthquake – the event that will likely occur routinely during the life of a building – is intended to verify the service level performance of buildings. That is the level of earthquake a building or system can endure without damage or interruption in its operational ability.

For buildings in San Francisco, SPUR has defined the following:

Routine	Magnitude 5.5,	70% probability of exceedance in 50 years
Expected	Magnitude 7.2,	10% probability of exceedance in 50 years
Extreme	Magnitude 7.9,	2% probability of exceedance in 50 years

For lifeline systems such as major bridges, levees, or utility systems, the useful life of the systems is much longer. The expected earthquake for lifelines should represent a ground motion with a much lower probability than defined for buildings, perhaps even as high as the extreme event.

The current move from this safety focus to resilience needs to be supported by a complete set of transparent performance goals that declare what is needed from both the lifeline systems and the buildings to facilitate recovery. This does not imply that all facilities and systems need to be designed or upgraded to a level that would make them damage-proof and fully operational after an extreme event. Rather, the intent is to identify what elements of the built environment are needed for effective response and rapid recovery. The traditional definitions of design requirements in terms of use, occupancy, material, and structural system need to be expanded to recognize when they are needed in the recovery process. Buildings and systems need to be designed and constructed so they are available, after repaired, when needed.

SPUR chose to define performance goals in terms of the following five performance categories for buildings, three performance categories for lifeline systems, and a matrix format as the metric for defining and tracking the state of resilience.

Performance Categories for Buildings

- Category A: *Safe and Operational.*
- Category B: *Safe and usable during repair.*
- Category C: *Safe and usable after repair.*
- Category D: *Safe but not repairable.*
- Category E: *Unsafe: Partial or complete collapse.*

Performance Categories for Lifelines

- Category I Resume 100 percent of service levels within four hours.
- Category II Resume 90 percent service within 72 hours, 95 percent within 30 days, 100 percent within four months.
- Category III Resume 90 percent of service within 72 hours, 95 percent within 30 days, 100 percent within three years.

SPUR distilled these goals into the resilience matrix, shown in Figure 1, which indicates both the goals and the estimated current condition of the city's infrastructure.

6. SUMMARY

Creating Disaster-Resilient Communities is not only possible, it is in process within San Francisco – encouraged by the recommendations of the San Francisco Planning and Urban Research Association (SPUR). The needed tools and procedures exist and are continually being refined. Achieving resiliency requires a new holistic approach with a broad view. The resilience of the built environment stands as the foundation, but alone is insufficient. Human resilience is the engine of recovery. Resilient communities must be able to remain organized and orderly immediately after the event. They need to be able to quickly initiate an orderly response and immediately initiate preparations for recovery that includes a shelter-in-place environment for the workforce and deals with the social needs of their disadvantaged and disenfranchised people. Before the event, recovery plans must be in place that are fully integrated with contemporary urban planning, seek to create a better new normal, and have a financing mechanism in mind. Community recovery must be led by a transitional governance structure that can overcome traditional institutional constraints while orchestrating a fast paced recovery.

The successful application that is in process in San Francisco includes recommendations on new governance structures, shelter-in-place programs, modifications to current building codes, development of mandatory rehabilitation programs surrounding residential occupancies, alignment of lifeline systems around common performance objectives, and development of community support for the needed policies. Having the whole picture defined in recognizable terms is facilitating the progress of the initiative.

7. ILLUSTRATION

TARGET STATES OF RECOVERY FOR SAN FRANCISCO'S BUILDING AND INFRASTRUCTURE									
INFRASTRUCTURE CLUSTER FACILITIES	Event Occurs	Phase 1 Hours			Phase 2 Days		Phase 3 Months		
		4	24	72	30	60	4	36	36+
CRITICAL RESPONSE FACILITIES AND SUPPORT SYSTEMS									
Hospitals									X
Police and fire stations			X						
Emergency operations center	X								
Related utilities						X			
Roads and ports for emergency				X					
CalTrain for emergency traffic					X				
Airport for emergency traffic				X					
EMERGENCY HOUSING AND SUPPORT SYSTEMS									
95% residence shelter-in-place									X
Emergency Responder Housing			X						
Public shelters							X		
90% Related Utilities								X	
90% roads, port facilities, and public transit							X		
90% Muni and BART Capacity						X			
HOUSING AND NEIGHBORHOOD INFRASTRUCTURE									
Essential city service facilities							X		
Schools							X		
Medical provider offices								X	
90% neighborhood retail services									X
95% of all utilities								X	
90% roads and highways						X			
90% transit						X			
90% railroads							X		
Airport for commercial traffic						X			
95% transit							X		
COMMUNITY RECOVERY									
All residences repaired, replaced or relocated									X
95% neighborhood retail businesses open								X	
50% offices and workplaces open									X
Non-emergency city service facilities									
All businesses open									X
100% utilities									X
100% highway and roads									X
100% transit									X

The "x"s in the chart to the right indicate SPUR's best educated guesses about current standards for recovery times. The shaded areas represent the goals – targets based on clearly stated performance measures (see next page) – for recovery times for the city's buildings and lifelines. The gaps between "x"s and shaded boxes represent how far we are from meeting resiliency targets.

TARGET STATES OF RECOVERY

Performance Measure	Description of usability after expected event
BUILDINGS	
	Category A: Safe and operational
	Category B: 100% restored in 4 hours
	Category C: 100% restored in 4 months
	Category D: 100% restored in 3 years
	Expected current status

Figure 1. Target States of Recovery for buildings and Infrastructure

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