

Earthquakes and Cascading Failures:

How can our understanding of the risk of cascading failures be used to help build resilience?

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*2012 EERI Annual Meeting and
National Earthquake conference*



Basis



The Resilient City:

*Defining what San Francisco needs from its
seismic mitigation policies*

Before the Disaster, Response, Recovery

Now being incorporated in *Resilient SF*



Earthquakes and Cascading Failures

Participants

Urban Planners:	Laurie Johnson, George Williams
City Officials:	Laurence Kornfield, Hanson Tom, Debra Walker
Public Policy Makers:	Sarah Karlinsky, Laura Samant, Tom Tobin
Engineers:	Chris Barkley, David Bonowitz, Joe Maffei, Jack Moehle, Robert Pekelnicky, Chris Poland
Labor:	Michael Theriault
Developers:	John Paxton, Ross Asselstine
Economist:	Jessica Zenk
Contractor:	Jes Penderson
PG&E:	Kent Ferre
Seismologists	Jack Boatwright, avid Schwartz

Cascading Failures

- A failure in a system of interconnected parts that triggers failure of successive parts
- Occurs in systems with single points of failure, insufficient redundancy, or a lack of real time monitoring
- Also occurs when systems are highly interdependent
- Mitigate with redundancy and factors of safety

Community Resilience

- A Resilient Community can take “the Punch” of an event and through preparedness and the impromptu and innovative response of those affected, recover quickly.
- Goal is to save the people, their neighborhoods, their cultural heritage and their local economy.
- Not about individual buildings, it is about an integrated system of critical infrastructure

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Earthquake Resilient Communities

Requires a Holistic Approach

- Physical resilience is the foundation
- Human resilience is the engine
- Address the social needs
- Integrated with urban design
- Organized to overcome institutional and governance constraints
- Identifies financial resources including incentives

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Cascading Failures and Resilience

Critical Interdependencies

- Stable governance with an ability to maintain order and direct recovery
- A work force willing to stay and recover
- Sufficient usable physical infrastructure
- Readily available financing

Governance

Core functions of government

- Provide vision and leadership for recovery and rebuilding
- Restoring public facilities and services
- Provide resources and information

Why is it different than business as usual?

- Time compression
- Scale
- Tension between rebuilding quickly and deliberately

Governance

Issues encountered during recovery

- Transition from the emergency to recovery
- Budgeting and planning decisions
- Code is not applicable for reconstruction
- Land use planning priorities
- Inefficient incorporation of NGO's

Opportunity to for a better new normal will be lost, again, without preplanning

Governance

Need to do

- Plan and prepare for response and recovery
- Set a clear vision for rebuilding
- Define what will be rebuilt differently
- Change the rules
- Exercise recovery

Human Resilience

Knowing what will happen, how to respond, deciding to “tip-in” and support recovery

- Understand the earthquake potential
- Understand what will happen to their homes, neighborhoods, jobs, and businesses
- Develop shelter-in-place programs and plans that include neighborhood support centers (Safe enough to stay)

Human Resilience

- Have personal plans to respond immediately and support the community
- Fully utilize social media and new technologies
- Support plans for long term recovery
- Be supported by an organized governance structure that is focused on restoring community culture, economic vitality, and a better new normal.

Sufficient Infrastructure

Performance Goals

Phase	Time	Condition of the built environment
I	Weeks	Support initial response and staging for reconstruction
II	Months	Workforce housing restored – Workforce ready to work Ongoing social needs have been met
III	Years	Support reconstruction

Mitigation

Transparent Performance Measures for Buildings

Category	Performance Standard
Category A	Safe and operational: Essential facilities such as hospitals and emergency operations centers
Category B	Safe and usable during repair: “shelter-in-place” residential buildings and buildings needed for emergency operations
Category C	Safe and usable after repair: Facilities needed to restore the economy
Category D	Safe but not repairable: Minimum needed to save lives
Category E	Unsafe – partial or complete collapse: damage that will lead to casualties

Mitigation

Transparent Performance Measures for Lifelines

Transportation, Power, Water, Sewer, Communication

Category	Performance Standard
Category I	Resume 100% service within days
Category II	Resume 90% service within weeks 100% within months
Category III	Resume 90% service within weeks 100% within years

Target States of Recovery for Buildings & Infrastructure

Phase	Time Frame	Focus of Attention
I	Weeks	Initial response and staging for reconstruction
		<p><i>EOC's, City Buildings, Hospitals, Police and Fire Stations, Shelters</i></p>  <p>San Francisco General Hospital</p> <p><i>Building Category A: "Safe and Operational"</i> <i>Life Line Category I: "Resume essential service in days"</i></p>

Target States of Recovery for Buildings & Infrastructure

Phase	Time Frame	Focus of Attention
II	Months	Workforce housing restored – ongoing social needs met

*Residential structures,
Schools,
Community retail centers,
Doctors offices*



*Building Category B: “Safe and usable while being repaired”
Life Line Category II: “Resume 100% workforce service within weeks”*

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Target States of Recovery for Buildings & Infrastructure

Phase	Time Frame	Focus of Attention
III	years	Long term reconstruction

*Industrial Buildings
Commercial buildings
Historic buildings*



*Building Category C: “Safe and usable after repair”
Life Line Category III: “Resume 100% commercial service within years” with priority given to key industries*

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Finance

Very little recovery can happen without money.

- Outside financial resources are vital
- Government is generous but limited.
- NGO's have significant resources
- Business will invest and exercise civic leadership
- Insurance is outstanding when available
- Personal savings is growing
- Banks and other investors will jump in

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21st Century Goals 100th Anniversary Commemoration



2006 San Francisco

Develop a Culture of Preparedness

1. Know your Seismic risk
2. Prepare to be self sufficient
3. Plan to care for the vulnerable
4. Prepare to respond

Invest in Reducing Losses

5. Mitigate collapse hazard buildings
6. Retrofit essential facilities
7. Retrofit vulnerable infrastructure

Ensure Resiliency in Recovery

8. Plan for displaced households
9. Plan for financing reconstruction
10. Governments plan for recovery

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National Earthquake Hazards Reduction Program

Vision :

A nation that is earthquake-resilient in public safety, economic strength, and national security

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National Earthquake Hazards Reduction Program

2010 Advisory Committee on Earthquake Hazards Reduction

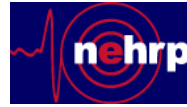
Walter Arabasz
Jon Bray
Jim Harris
Mike Lindell
Chris Poland (Chair)
Anne vonWeller
Brent Woodworth

Jim Beavers
Richard Eisner
John Hooper
Tom O'Rourke
Susan Tubbesing
Yumei Wang
Jack Moehle

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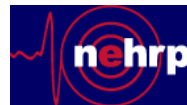
Bicentennial Statement Related to the 200th Anniversary of the New Madrid Earthquake



Major earthquakes will continue to occur -
Thanks to those that work tirelessly toward
resilience

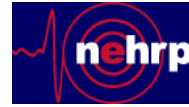
1. Use the bicentennial to spark collaboration and inaugurate new programs
2. Develop a plan to achieve earthquake resilience
3. Base plans on a clear and defensible statement of current risk and targeted resilience goals

Bicentennial Statement Related to the 200th Anniversary of the New Madrid Earthquake



4. Adopt and enforce the latest building codes
5. Base disaster plans on both likely and worse case scenarios
6. Demonstrate cost effective implementation of building codes
7. Motivate owners, architects, engineers, and contractors to build differently.

Bicentennial Statement Related to the 200th Anniversary of the New Madrid Earthquake



Establish a dialogue among community members on what constitutes acceptable levels of risk and appropriate technologies for reducing risk.

Earthquake professionals nationwide are urged to cooperate, collaborate, determine the best path toward mitigation and speak with a common voice.



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Thank you!

For more information

- SPUR Resilient Cities Initiative
www.spur.org
- ACEHR/NEHRP Reports
www.nehrp.gov
- Chris D. Poland
cpoland@degenkolb.com



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