Applying Seismic Hazard Information in Local and Regional Urban Planning

USGS-ATC NSHM Workshop
September 22, 2015
Governmental Authority for Planning in the U.S.

- Most power resides with States
  - States can plan and regulate land use, if they want to.
  - States have laws that enable cities to conduct their affairs, including planning.
  - So cities’ planning laws depend on the state they are in.

- Federal government
  - Provides funding, policy guidance and technical assistance
  - Regulates air and water quality
  - Regulates the banking system (i.e. NFIP-flood hazard trigger in mortgage lending)
Policy Pathways for Hazard Information

- Planning Policies
  - Comprehensive Plan (Land Use and Hazards/Safety Elements)
  - Specific/Area Plans
  - Hazard Mitigation Plan
  - Emergency/Evacuation Plans
- Development Regulations
  - Zoning and zoning overlay districts
  - Subdivision regulations
  - Geologic/hazard site investigations
  - Hazard-specific setbacks and regulations
  - Environmental impact review
  - Grading ordinances and site development controls
  - Deed restrictions
- Land and Property Acquisition
  - Acquisition of undeveloped land
  - Acquisition or transfer of development rights
  - Acquisition of damaged properties
  - Land readjustment / relocation of buildings
- Building Standards
  - Building codes
  - Hazard-specific provisions
  - Retrofit requirements
- Critical Infrastructure and Public Facilities Policies
  - Design and construction standards
  - Locational restrictions
  - Capital improvement programs
- Taxation and Fiscal Policies
  - Impact fees
  - Assessment districts (i.e. GHADs)
  - Tax breaks/incentives
- Information Dissemination
  - Real estate disclosures
  - Professional education/certification
  - Public information/warnings

### Types of Local and Regional Planners

<table>
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<tr>
<th>Urban / Land Use Planning</th>
<th>Capital Facilities/Transportation Planning</th>
<th>Emergency Planning</th>
<th>Resiliency Planning</th>
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<tr>
<td>• General or comprehensive plans</td>
<td>• Capital improvement plans</td>
<td>• Emergency response plans (earthquake annex)</td>
<td>• Risk and hazard assessment</td>
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<td>• Natural hazards/safety elements and plans</td>
<td>• Specific infrastructure/transportation planning</td>
<td>• Evacuation plans</td>
<td>• Resilience and vulnerability reduction strategy development</td>
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<tr>
<td>• Housing plans</td>
<td>• Capital facilities and infrastructure siting/development</td>
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<td>• Land use zoning</td>
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Town of Portola Valley, CA:
Example of robust and effective integration of “locally meaningful” seismic hazard information in public policy

- Comprehensive planning (Land use and hazards elements)
- Zoning and zoning overlay districts
- Subdivision and development regulations
  - Geologic Safety Committee
  - Geologic/hazard site investigations
  - Environmental impact review
  - Hazard-specific setbacks and regulations
  - Grading and site development controls
- Acquisition or transfer of development rights
- Building standards (building codes, hazard-specific provisions)
- Critical infrastructure and public facilities (design and construction standards, locational restrictions, and capital improvement programs)
- Real estate transfer – hazard disclosure
Average parcel slope → Land use density
States requiring local comprehensive plans (2009)

Coastal State Building Code Effectiveness Rating

(Insurance Institute for Business & Home Safety (IBHS), August 2013)
California Statewide Mandates for Seismic, Wildfire, and Flood Hazard Identification

(My Hazard, California Office of Emergency Services)
California State Seismic Hazard Mapping Act
(Public Resources Code Section 2690-2699.6)

- “.. a statewide seismic hazard mapping and technical advisory program to assist cities and counties in fulfilling their responsibilities for protecting the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure and other seismic hazards caused by earthquakes.”

- CGS established 4 technical advisory groups and their recommendations are contained in CGS, Special Publication 118, Recommended Criteria for Delineating Seismic Hazard Zones in California (1992; revised 2004)
  - “The purpose of the Seismic Hazard Mapping Act is to identify where special provisions, beyond those contained in the UBC, are necessary to ensure public safety. This need has not been recognized for the hazard of ground shaking. Design provisions contained in the UBC are believed to be representative of current knowledge and capability in earthquake-resistant design.”
  - Further recommends investigating the development and utility for land-use planning purposes of informational maps that identify areas of soft-soil and/or basin structure or topography which may enhance ground shaking or where an aggregate of such adverse conditions within near-source zones might occur.
Considerable Variability in Hazard Mapping/Assessment Across the U.S.

- Hazard knowledge and ability to “map it” varies by peril: earthquake (faulting, liquefaction, landslide, strong shaking), flooding (riverine, dam/levee failure, storm surge, sea level rise), wildfire, landslides/debris flows, hurricane-force winds, tornadoes, hail, ice, subsidence, man-made, etc.

- Variations in mapping approach and accounting of uncertainty (inventory/identification, hazard/susceptibility, probabilistic, risk)

- Variations in mapping scales (regional to site-specific)

- Variations in legislative/policy controls: national, state, and local mandates requiring specific action versus informational or advisory only
1. Form a collaborative planning team
2. Understand the situation (Social Dimensions and Built Environment)
3. Determine goals and objectives (Determine and characterize hazards (wind, earthquake, inundation, fire, snow, rain, human-caused or technological) for 3 hazard levels (routine, expected, extreme))
4. Plan development
5. Plan preparation, review, and approval
6. Plan implementation and maintenance
“Building Local Capacity and Accelerating Progress: Resilience from the Bottom Up”

(Disaster Resilience: A National Imperative, National Academies 2012)

- Organizing communities, neighborhood, and families to prepare for disasters
- Communicating risks, connecting community networks, and promoting a culture of resilience
- Engaging the whole community in disaster policy making and planning
- Linking public and private infrastructure performance and interests to resilience goals
- Improving public and private infrastructure and essential services (such as health and education)
- Adopting and enforcing building codes and standards appropriate to existing hazards
- Adopting sound land-use planning practices
Challenge: Expand the hazards/risk discussion as part of building design, construction and (re)development; consider Fit, Form and Function

- Where (more precisely) to build?
- What to build?
- How to build?
- Also, think about who ultimately owns the (retained) risk (multiple successions of owners and occupants) and how to ensure their awareness and preparedness

Property Rights Valuation ≠ Hazard-Risk Ownership/Retention
Challenge: Account for uncertainty and risk of “delusional precision” in hazards characterization and risk management

Research Investigations 

Probabilistic Hazard Assessment
Consensus-based, periodic synthesis

Catastrophe Risk Models
Building Codes
Infrastructure Design
Land Use Planning
Evacuation Maps
Response Exercises
Warnings/Forecasts

Derivative Products (updated periodically)

Comprehensive Risk Management
Correlated Uncertainty

Distribution map of occurrence probabilities of ground motions equal to or larger than JMA seismic intensity 6 Lower, occurring within 30 years from the present (start date: Jan. 1st 2008)

Challenge: Enable “locally meaningful” characterizations of seismic hazards information in an increasingly multi-hazards policy environment.
Almost half of the U.S. population—150 million people—reside in portions of 42 states at risk of experiencing a damaging earthquake within the next 50 years. Sixteen of those states are at very high risk.

Thank you!

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