Photo Credit:
Courtesy of the National Information Service for Earthquake Engineering
“Soft Story” Collapse: 1994

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The 1994 Northridge Earthquake:
Impacts, Outcomes, and Next Steps
“Soft Story” Collapse: 1994

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“Soft Story” Sidesway: 1994

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The 1994 Northridge Earthquake: Impacts, Outcomes, and Next Steps
“Soft Story” Sidesway: 2011

Photo Credit: Tony Court & Marko Schotanus

The 1994 Northridge Earthquake: Impacts, Outcomes, and Next Steps
“Soft Story” Sidesway: 2011

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The 1994 Northridge Earthquake: Impacts, Outcomes, and Next Steps
San Francisco program

- Wood frame construction (Type V)
- Pre-1978
- 5+ residential units
- 3+ stories
Retrofit Program Timeline

Compliance Deadline by Building Tier

<table>
<thead>
<tr>
<th>YEARS</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier I</td>
<td>I Permit</td>
<td>II Permit</td>
<td>III Permit</td>
<td>IV Permit</td>
<td>I Completion</td>
<td>II Completion</td>
<td>III Completion</td>
</tr>
<tr>
<td>Tier II</td>
<td>I, II, III, IV Submission: Screening Form</td>
<td>Optional Evaluation Form</td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

- Tier I: Group A, E, R-2.1, R-3.1, R-4 Occ.
- Tier II: 15+ residential units
- Tier III: All other buildings
- Tier IV: Group B or M Occ. + liquefaction
Financing

• Private sector financing
  – Menu of financing options

• Public sector financing
  – Discontiguous Mello-Roos districts

• Retrofit cost can be passed through to tenants over 20 year period
Ingredients for success

• Champion
• Research and education
• Technical criteria
• Financing
RESEARCH EDUCATION
Research and education

SAN FRANCISCO BUILDING INVENTORY

(FROM: Earthquake Safety for Soft-Story Buildings, ATC 52-3A)

The 1994 Northridge Earthquake: Impacts, Outcomes, and Next Steps
Research and Education

Collect data

- Door bells
- Stories
- Construction type
- % Open
Research and Education

SAN FRANCISCO INDEX BUILDINGS
(FROM: Earthquake Safety for Soft-Story Buildings, ATC 52-3A)

The 1994 Northridge Earthquake:
Impacts, Outcomes, and Next Steps
Research and Education

(FROM: Earthquake Safety for Soft-Story Buildings, ATC 52-3A)

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Research and education

Here Today—Here Tomorrow: The Road to Earthquake Resilience in San Francisco
A Community Action Plan for Seismic Safety

ATC 5252

ATC Applied Technology Council

Prepared for
San Francisco Department of Building Inspection
under the Community Action Plan for Seismic Safety (CAPSS) Project

The 1994 Northridge Earthquake: Impacts, Outcomes, and Next Steps
TECHNICAL CRITERIA
Technical Criteria

• City of Fremont, Ordinance No. 2363.
• 1998 Los Angeles Building Code, Chapter 93
• International Existing Building Code, Appendix Chapter A4
Technical Criteria

• Three ways to satisfy the ordinance:
  – IEBC A4
  – ASCE 41-13
  – FEMA P-807

• SEAONC Special Projects Initiative
Technical Criteria

**Bldg 2 P807 Push Over Curve (N-S Direction)**

The 1994 Northridge Earthquake: Impacts, Outcomes, and Next Steps

(FROM: SEAONC SPI, by Jonathan Buckalew)
Accomplishments

- Engineering criteria for retrofit design
- Various jurisdictions adopted legislation
  - Los Angeles
  - Santa Monica
  - Fremont
  - Berkeley
  - Alameda
  - Oakland
  - San Francisco
Needs

• Continue improving the technical knowledge base
  – Consolidating criteria
  – Testing of archaic materials
  – Understanding true performance

• Provide incentives and set requirements for local jurisdictions
Questions?

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