Project Objective and Scope

Examine the earthquake performance of San Francisco’s tall buildings and develop recommendations to address building code requirements, policies and practices for the design of new buildings, assessment and retrofit of existing buildings, and post-earthquake inspection and response to promote the earthquake resilience of San Francisco

- Project initiated August 2017
- Summary Recommendations released October 4, 2018
- Final Report released January 2019
  http://onesanfrancisco.org/resilient-sf
- Compiled by experts pulled from the Applied Technology Council
- Under the direction of City Administrator, DEM, DBI, SFPUC, and Chief Resilience Officer
Motivation

- Growth in residential uses in the area
- Unique challenges associated with high-rises
- Economic impact
- 2011-2040 CAPSS Work-plan
  - Plans and programs for all buildings
  - Mandatory evaluation, retrofit
  - Enhance building performance standards
- ResilientSF
- Feasibility varies for some building subsets
  - Tall buildings
  - Similarly complex or recovery-critical buildings
Database of Tall Buildings

156 Tall Buildings (Over 240 ft)

Building footprint data from DataSF.org
# Building Stock: Districts 3 & 6

## Occupancy
- Hotels, Visitor Services
- Mixed Uses (With Residential)
- Residential
- Medical
- Mixed Uses (Without Residential)
- Office (Management, Information, Professional Services)
- Retail, Entertainment
- Cultural, Institutional, Educational
- Industrial (Production, Distribution, Repair)
- Unknown/Vacant

## San Francisco Districts

### Table: Office vs. Residential

<table>
<thead>
<tr>
<th></th>
<th>Office</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td># Bldg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 240 ft</td>
<td>86</td>
<td>29</td>
</tr>
<tr>
<td>All</td>
<td>749</td>
<td>3,949</td>
</tr>
<tr>
<td>Percentage</td>
<td>11%</td>
<td>1%</td>
</tr>
<tr>
<td>Sq.Ft</td>
<td>40M</td>
<td>20M</td>
</tr>
<tr>
<td></td>
<td>70M</td>
<td>50M</td>
</tr>
</tbody>
</table>

### Map

The map shows the distribution of buildings in Districts 3 and 6, categorized by occupancy type.
Occupancies

- 55% office; 22% residential; 24% mixed/hotel
- Older buildings are mostly offices (Steel moment frames)
- Newer buildings (south of Market) tend to be residential (Concrete shear wall systems)

<table>
<thead>
<tr>
<th>Year</th>
<th>CIE</th>
<th>Hotel</th>
<th>MixRes</th>
<th>Mixed</th>
<th>Office</th>
<th>Res</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1960</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>1960s</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>1970s</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>1980s</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>1990s</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>2000s</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>&gt;2010</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>
Building Structural Systems

- The newer buildings (south of Market) tend to be concrete shear wall systems.
- Older buildings are predominantly steel moment frame systems.
Building Foundations

Factors of Influence

1. Depth to rock
2. Soil Type/Stiffness
   - Marine Deposits
   - Colma Sands
   - Old Bay Clay
3. Building Height/Weight
4. Number of Basement Levels
5. Slope/Proximity to Shoreline
6. Adjacent/Underlying Structures
7. Ground Water Level

Plus, construction technologies, logistics and economics
Downtown Recovery Plan

Compiled from tax assessor and building footprint data available at DataSF.org

The map shows the distribution of building heights in the study area. The graph illustrates the percentage of buildings built in different years, with the highest concentration in the 1940s and 1950s.
## Summary Recommendations & Next Steps

A table showing recommended actions and their timeframes (short-term, mid-term, long-term). The table includes:

1. **Actions for Reducing Seismic Risk Prior to Earthquakes – New Buildings**
   - **1A. Develop Regulations to Address Foundation and Geotechnical Issues**
     - Training and checklist: **X**
   - **1B. Establish Performance-Based Seismic Design Standards**

2. **Actions for Reducing Seismic Risk Prior to Earthquakes – Existing Buildings**
   - **2A. Enforce the Repair Provisions of the San Francisco Existing Building Code with Respect to Loma Prieta Damage**
     - **X**
   - **2B. Amend the San Francisco Existing Building Code**
     - Alteration triggers: **X**
   - **2C. Require Minimum Levels of Earthquake Insurance to Ensure Recovery**
   - **2D. Increase Local Water Supply for Automatic Fire Suppression Systems in Tall Buildings**
     - **X**

### Mayor’s Executive Directive
- Conduct community outreach to inform City stakeholders about the Tall Buildings Safety Strategy.
- Develop additional regulations to address **geotechnical issues**.
- Explore adopting **higher seismic design standards**.
# Summary Recommendations & Next Steps

## Mayor’s Executive Directive

- Update the policies and procedures for implementing the **State’s Safety Assessment Program** and clarify department roles and responsibilities for post-earthquake emergency response and safety inspection.

- Establish a **Disaster Recovery Taskforce** that will develop a recovery framework and a comprehensive recovery plan for the Financial District and adjacent neighborhoods.

- Provide information and knowledge sharing with other cities facing similar seismic challenges that are home to tall buildings.

### Recommended Action

<table>
<thead>
<tr>
<th>Recommended Action</th>
<th>Short-Term</th>
<th>Mid-Term</th>
<th>Long-Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Actions for Reducing Seismic Risk Following Earthquakes</td>
<td></td>
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</tr>
<tr>
<td><strong>3A. Develop New Policies and Procedures for implementing the State’s Safety Assessment Program</strong></td>
<td>X</td>
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<tr>
<td><strong>3B. Extend and Improve the Building Occupancy Resumption Program</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Conduct simulation-based training</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Update procedures</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Extend program</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3C. Clarify and Update Roles and Responsibilities Associated with Post-Earthquake Emergency Response and Safety Inspection</strong></td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td><strong>3D. Update and Amend the San Francisco Existing Building Code</strong></td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td><strong>3E. Update Administrative Bulletin 099 and Clarify its Application to Tall Concrete Structural Systems</strong></td>
<td>X</td>
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<tr>
<td><strong>3F. Develop a New Administrative Bulletin for Post-earthquake Inspection and Evaluation of Welded Steel Moment Frames</strong></td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td><strong>3G. Create Protocols and Procedures for Establishing Cordon Around Damaged Buildings</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3H. Require Existing Buildings to File Recovery Plans</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Actions to Improve the City’s Understanding of its Tall Building Seismic Risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4A. Maintain and Expand the Database of Tall Buildings</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4B. Develop a Comprehensive Recovery Plan for the Financial District and Adjacent Neighborhoods</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Thank You!

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