HAZUS Overview

- HAZUS is a nationally-applicable methodology developed by FEMA to estimate potential losses from earthquakes, hurricanes, and floods
  - **Input**: Soil maps, ground shaking maps, building inventory maps, building structural data, building occupancy data, building economic data
  - **Output**: *Estimated* economic impact, building damage, and casualties

- It is a **relative risk model**, and **helps prioritize** mitigation efforts, emergency preparedness, and response and recovery planning

**MITIGATION**
- Prioritize seismic retrofits of existing facilities
- Support development of local hazard mitigation plans
- Support development of hazard-resistant building codes & land use planning activities

**EMERGENCY PREPAREDNESS**
- Create scenarios for use in developing emergency response plans (e.g., temporary housing, debris removal, etc.) and for emergency response exercises

**RESPONSE & RECOVERY**
- Assess the need for post-disaster damage assessment
- Support response planning for critical transportation outages
- Recovery planning
HAZUS Recap of previous analyses in San Francisco

- HAZUS for earthquakes in San Francisco was first conducted in 2012
  - The initial run included 82 high-priority buildings
  - High-priority buildings included emergency response facilities, emergency shelter locations, primary department operation centers (DOCs), and vulnerable buildings

- The analysis has been updated twice since then, with the last run in 2013
  - The last run included 214 high-priority buildings

- In each analysis, four earthquake scenarios were modeled to estimate the impact on each building

- Significant driving factors affecting potential losses include building design level, building occupancy, building exposure value, and liquefaction potential
HAZUS
Uses

- Improved capital planning
  - Better understand where further seismic analysis is needed
  - Prioritize seismic-related capital projects
  - Offer a consistent planning framework going forward
  - Examples of vulnerable buildings identified by previous HAZUS analyses include:
    - Veteran’s Building (recently-completed retrofit)
    - Animal Care and Control facility (replacement facility is in design)
    - 101 Grove (relocation of staff is in planning)
    - Hall of Justice (some depts. relocated, complete exit is in planning)

- Guidance for important emergency response planning decisions
  - Inform emergency response actions plans, and locations of Emergency Operating Centers
  - E.g. seismically sound facilities with high peak occupancy (e.g. Moscone Center) may not need structural work, but do need a robust emergency response plan

- Improves eligibility for federal grants or FEMA reimbursement, and identified as action 3.1 in the City’s 2014 Hazard Mitigation Plan
HAZUS Prioritization Process

City-owned Portfolio

Hazus Analysis: High-Priority Buildings

SHR SHR SHR

Bond Programs
Other Sources
B.O.R.P Program
Recently completed an update of the HAZUS analysis, in conjunction with Public Works and Rutherford + Chekene

Analysis was expanded to include 239 facilities

Structural information for all buildings was further vetted by Public Works

Occupancy and content value assumptions were updated by departments
HAZUS FY 2017 Analysis

LIQUEFACTION SUSCEPTIBILITY

Legend
- High Priority Buildings

Liquefaction Susceptibility
- VH
- H
- M
- L
- VL
- Water
HAZUS
FY 2017 Analysis

GROUND SHAKING MAPS

San Andreas M7.9

San Andreas M7.2

San Andreas M6.5

Hayward M6.9
**HAZUS FY 2017 Results (1/3)**

**PROJECTED ECONOMIC IMPACT (LOSSES)**

<table>
<thead>
<tr>
<th></th>
<th>Hayward M6.9</th>
<th>San Andreas M6.5</th>
<th>San Andreas M7.2</th>
<th>San Andreas M7.9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$ in millions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural Damage</td>
<td>107.2</td>
<td>133.4</td>
<td>212.3</td>
<td>353.1</td>
</tr>
<tr>
<td>Non-Structural Damage</td>
<td>398.3</td>
<td>545.4</td>
<td>859.7</td>
<td>1,489.3</td>
</tr>
<tr>
<td><strong>Total Building Damage</strong></td>
<td>505.5</td>
<td>678.8</td>
<td>1,072.0</td>
<td>1,842.4</td>
</tr>
<tr>
<td>Content Damage</td>
<td>130.1</td>
<td>426.7</td>
<td>523.6</td>
<td>714.3</td>
</tr>
<tr>
<td>Operational Losses; Rent, Relocation &amp; Lost Income</td>
<td>154.8</td>
<td>191.9</td>
<td>314.7</td>
<td>527.2</td>
</tr>
<tr>
<td><strong>Total Economic Impact</strong></td>
<td><strong>790.4</strong></td>
<td><strong>1,297.3</strong></td>
<td><strong>1,910.3</strong></td>
<td><strong>3,083.8</strong></td>
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</tbody>
</table>
## Projected Building Damage

<table>
<thead>
<tr>
<th>Damage Tag</th>
<th>Hayward M6.9</th>
<th>San Andreas M6.5</th>
<th>San Andreas M7.2</th>
<th>San Andreas M7.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green-tagged</td>
<td>195</td>
<td>183</td>
<td>127</td>
<td>75</td>
</tr>
<tr>
<td>Yellow-tagged</td>
<td>32</td>
<td>44</td>
<td>89</td>
<td>74</td>
</tr>
<tr>
<td>Red-tagged</td>
<td>12</td>
<td>12</td>
<td>23</td>
<td>90</td>
</tr>
<tr>
<td>Total Buildings</td>
<td>239</td>
<td>239</td>
<td>239</td>
<td>239</td>
</tr>
</tbody>
</table>
POSSIBLE RED-TAGGED BUILDINGS WITH >70% DAMAGE (SAN ANDREAS M7.9)

- Animal Care and Control Facility — replacement facility in design
- DPH Central Office (101 Grove) — relocation of staff planned
- 9 Fire Stations — 3 will be addressed under ESER Program, others need further study
- Fire Chief’s Residence
- Hall of Justice — some depts. already relocated, complete exit in planning
- Hunters Point Art Studios
- Kezar Pavilion — study underway
- Maxine Hall Health Center — renovation underway
- McLaren Lodge
- Mothers Building
- Municipal Railway Overhead Lines — will be replaced by new ACC facility
- Park Police Station — being considered for ESER Program
- Park Senior Center
- Produce Market
- REC Corporate Yard Buildings
- SFFD Equipment Unit Headquarters — being considered for ESER Program
- Tom Waddell Clinic — relocation planned
## Seismic Hazard Rating Categories

<table>
<thead>
<tr>
<th>SHR</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHR-1</td>
<td><strong>Minor damage</strong> <em>(good performance).</em> Some structural or nonstructural damage and/or falling hazards may occur, but these would pose minimal life hazards to occupants. The damage can be repaired while the building is occupied and with minimum disruptions to functions.</td>
</tr>
<tr>
<td>SHR-2</td>
<td><strong>Moderate damage</strong> <em>(fair performance).</em> Structural and nonstructural damage and/or falling hazards are anticipated which would pose low life hazards to occupants. The damage can be repaired while the building is occupied.</td>
</tr>
<tr>
<td>SHR-3</td>
<td><strong>Major damage</strong> <em>(poor performance).</em> Structural and nonstructural damage are anticipated which would pose appreciable life hazards to occupants. The building has to be vacated during repairs, or possibly cannot be repaired due to the extent and/or economic considerations.</td>
</tr>
<tr>
<td>SHR-4</td>
<td><strong>Partial/total collapse</strong> <em>(very poor performance).</em> Extensive structural and nonstructural damage, potential structural collapse and/or falling hazards are anticipated which would pose high life hazards to occupants. There is a good likelihood that damage repairs would not be feasible.</td>
</tr>
</tbody>
</table>
Seismic Hazard Ratings
Results for select City buildings

Seismic Hazard Rating Matrix - Draft

Safety Hazard Level

HIGH

MODERATELY HIGH

MODERATE

MODERATELY LOW

LOW

SHR/Collapse Potential

1/LOW

2/LOW

2/MODERATELY LOW

3/MODERATE

3/MODERATE LOW

3/MODERATE HIGH

4/MODERATE

4/MODERATE HIGH

SFD HQ/ Pump Station 1 (143)

Hall of Flowers (750)

Fire Station 36 (20)

City Hall (1475)

911 ECC (160)

DPW Yard Building A (35)

DPW Yard Building B (21)

DPW Yard Building C (21)

Fire Station 31 (20)

30 Van Ness (517)

Hall of Justice (3027)

Willie Woo Woo (20)

Fire Station 8 (20)

Animal Care & Control (80)

Mclaren Lodge (20)

McLaren Annex (200)

YGC Admin. Bldg (187)

SFGH Bldg 80/90 (530)

Fire Station 2, 11*, 15*, 21*, 38*, 40 (20)

SFGH Bldg 10/20 (287)

101 Grove (297)
Building Occupancy Resumption Program (BORP)

- Expedited post-disaster building inspection and occupancy determinations
- 156 private and 8 public buildings are participating in the program
- In addition, 22 facilities are part of the Port’s BORP program
Questions & Comments

onesanfrancisco.org

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