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

Uses

- Informs on relative risks
- Improves capital planning
  - Better understand where further seismic analysis is needed
  - Prioritize seismic-related capital projects
  - Offer a consistent planning framework going forward
- 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
Seismic Hazard Rating (SHR)

- Site specific seismic evaluation of individual buildings
- ASCE 41-13: Seismic Evaluation and Retrofit of Existing Buildings
  - Tier 1 Checklist
  - Tier 2 Deficiency-Only Evaluation
  - Tier 3 Evaluation
- Seismic Hazard Rating
- Used to help prioritize seismic strengthening needs
## Seismic Hazard Rating Description

<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>
HAZUS
Prioritization Process

City-owned Portfolio

Hazus Analysis: High-Priority Buildings

SHR  SHR  SHR

Bond Programs
Other Sources
B.O.R.P Program
HAZUS
FY 2017 Results

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
- Tom Waddell Clinic — relocation planned
POSSIBLE RED-TAGGED BUILDINGS WITH >70% DAMAGE (SAN ANDREAS M7.9)

- **Total 10 Fire Facilities:**
  - **8 Fire Stations:**
    - 6, 17, 22, 25, 30, 34, 35, 40
  - Pump Station #2 – slated to be addressed in ESER 2014
  - Fire Chief’s Residence

- **ESER studies align with HAZUS results:**
  - 5 Fire Stations with previously completed studies: 6, 22, 25, 30, 35
  - 1 Fire Station with SHR level study: 40 (Battalion Station)
  - 2 Fire Station with studies underway: 17, 34
Prioritization Process
HAZUS and SHR
# Prioritization Process

## HAZUS and SHR

<table>
<thead>
<tr>
<th></th>
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<tbody>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1235 Sanche St</td>
<td>steel frame with reinforced concrete wall</td>
<td>1948</td>
<td>19630</td>
<td>X</td>
<td>very low</td>
<td>very low</td>
<td>X</td>
<td>High</td>
<td>70%</td>
<td>Red</td>
<td>5-10%</td>
<td>-</td>
<td>25%</td>
</tr>
<tr>
<td>17</td>
<td>1285 Shafter Ave</td>
<td>concrete shear wall</td>
<td>1955</td>
<td>12100</td>
<td>X</td>
<td>very low</td>
<td>low</td>
<td>2</td>
<td>Low</td>
<td>X</td>
<td>20%</td>
<td>Red</td>
<td>10-50%</td>
<td>-</td>
</tr>
<tr>
<td>22</td>
<td>1300 10th Ave</td>
<td>concrete shear wall</td>
<td>1961</td>
<td>5400</td>
<td>X</td>
<td>low</td>
<td>moderate</td>
<td>X</td>
<td>High</td>
<td>70%</td>
<td>Red</td>
<td>5-30%</td>
<td>-</td>
<td>25%</td>
</tr>
<tr>
<td>21</td>
<td>3305 3rd St</td>
<td>steel frame with un reinforced masonry infill</td>
<td>1938</td>
<td>6800</td>
<td>X</td>
<td>low</td>
<td>moderate</td>
<td>X</td>
<td>High</td>
<td>80%</td>
<td>Red</td>
<td>5-10%</td>
<td>-</td>
<td>25%</td>
</tr>
<tr>
<td>30</td>
<td>1300 6th St</td>
<td>steel frame with un reinforced masonry infill</td>
<td>1927</td>
<td>6400</td>
<td>X</td>
<td>low</td>
<td>moderate</td>
<td>X</td>
<td>High</td>
<td>40%</td>
<td>Red</td>
<td>5-10%</td>
<td>-</td>
<td>25%</td>
</tr>
<tr>
<td>34</td>
<td>429 111th Ave</td>
<td>steel frame with un reinforced masonry infill</td>
<td>1929</td>
<td>4400</td>
<td>X</td>
<td>moderate</td>
<td>moderate</td>
<td>X</td>
<td>High</td>
<td>70%</td>
<td>Red</td>
<td>5-30%</td>
<td>-</td>
<td>25%</td>
</tr>
<tr>
<td>35</td>
<td>Pee 32 1/2</td>
<td>concrete shear wall</td>
<td>1908</td>
<td>9600</td>
<td>X</td>
<td>High</td>
<td>high</td>
<td>X</td>
<td>High</td>
<td>80%</td>
<td>Red</td>
<td>10-50%</td>
<td>-</td>
<td>25%</td>
</tr>
<tr>
<td>40</td>
<td>4055 18th Ave</td>
<td>steel frame with un reinforced masonry infill</td>
<td>1941</td>
<td>8300</td>
<td>X</td>
<td>moderate</td>
<td>moderate</td>
<td>X</td>
<td>4</td>
<td>20%</td>
<td>Red</td>
<td>5-30%</td>
<td>-</td>
<td>25%</td>
</tr>
</tbody>
</table>
## Prioritization Process

### HAZUS and SHR

<table>
<thead>
<tr>
<th>Pre-Design</th>
<th>Address</th>
<th>Building Type</th>
<th>Total Area (square feet)</th>
<th>Foundation Type</th>
<th>Priorities</th>
<th>SHR Priorities</th>
<th>SHR Probability of Collapse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>123 Main St</td>
<td>Steel frame with reinforced concrete</td>
<td>7500</td>
<td>X</td>
<td>2, 3, 4</td>
<td>X</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>456 Park Ave</td>
<td>Concrete shear wall</td>
<td>1000</td>
<td>X</td>
<td>Low</td>
<td>2, 3, 4</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>789 Elm St</td>
<td>Steel frame with unreinforced masonry infill</td>
<td>1500</td>
<td>X</td>
<td>Low</td>
<td>2, 3, 4</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>101 Oak Rd</td>
<td>Steel frame with reinforced concrete</td>
<td>2000</td>
<td>X</td>
<td>2, 3, 4</td>
<td>X</td>
<td>High</td>
</tr>
<tr>
<td>5</td>
<td>234 Pine Ln</td>
<td>Concrete shear wall</td>
<td>2500</td>
<td>X</td>
<td>Low</td>
<td>2, 3, 4</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>567 Maple St</td>
<td>Steel frame with unreinforced masonry infill</td>
<td>3000</td>
<td>X</td>
<td>Moderate</td>
<td>2, 3, 4</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>890 Cherry Blvd</td>
<td>Concrete shear wall</td>
<td>3500</td>
<td>X</td>
<td>High</td>
<td>2, 3, 4</td>
<td>X</td>
</tr>
</tbody>
</table>

**HAZUS Analysis Results**

- 456 Park Ave: **High**, 2% Red, 5.30%
- 789 Elm St: **High**, 6% Red, 3.10%
- 101 Oak Rd: **High**, 7% Red, 5.30%
- 567 Maple St: **High**, 4% Red, 5.30%
- 890 Cherry Blvd: **High**, 10% Red, 10.53%
POSSIBLE RED-TAGGED BUILDINGS WITH >70% DAMAGE (SAN ANDREAS M7.9)

- Total 1 Police Facility:

- Park Station:
  - Being considered for inclusion in ESER bond
• Existing Pier/Dock/Parking: 14,820 GSF
• Remaining Pier (After Demo): 7,000 GSF
• Proposed New Pier*: 19,400 GSF
• Existing Pier Remaining: 7,000 GSF
• Total Shadow (Remaining + New): 26,400 GSF

* includes:
Barge or Pier = 14,400 sf; Ramp = 2,000 sf; Float (200’x15’) = 3,000 sf
for total shadow of all three NEW components on the Bay
PROGRAMMING - EXISTING VS. NEW FACILITY

EXISTING FACILITY (Historic and Shed)  6,100 gsf

- Dormitory (inadequate)
- Kitchen
- Dining/Day Room
- Lockers/Shower/Toilets (single sex)
- Fitness
- Storage
- Workshop

NEW PROPOSED FACILITY  16,880 gsf

**Existing Program** (Resized to correct Code and Program Requirements)
- Dormitory (adequately sized)
- Officers’ Quarters
- Kitchen
- Dining Room
- Lockers/Shower/Toilets (separate genders)
- Day Room
- Fitness + Study Rooms
- Storage
- Circulation and Gross Factor to accommodate walls, structure, and mechanical

**Existing Offsite Program**
- Jet Skis
- Rescue Boats
- Port Response Vehicles
- Oil Containment Room
- Fire Fighting Hose
- Fire Fighting Foam
- Scuba/Tank Filling
- Specialty Gear/Rescue Gear Storage

**Fire Department Program Requirements**
- Fireboat Working Area
- Ambulance Access out of Public Viewing
- Patient area
- Cranes To Raise/Lower Small Watercraft
- Proper Waste Separation
- Proper Decontamination
- Marine EOC
- Wet suit + life jacket storage
- Workshop / Boson’s Room / Hotwork room
- Extractor/ Dryer Room
- Decontamination Room
- Safe Fuel Storage
- Public Accessible Toilet
- Elevator + Stairs (Proper Handicap Access and Exiting)
- Circulation and Gross Factor to accommodate walls, structure, and mechanical
EXISTING CAPACITY

Existing Station  6,100 gsf

Assets
• Two Fire Boats
• One Fire Engine
• 7 SFFD Staff “24/7”

Liabilities
• Deteriorated Berthing Areas
• No Environmental Response Equipment Storage, e.g. Oil Spill Boom
• No capacity for: Jet Skis, Small Craft Rescue Equipment, Dive Boat, e.g. Small Rescue Watercraft
• No Storage Areas
• No Decon Area and No Dive Equipment Area
• No Rescue Unloading Areas
• No Changing Facilities for Firefighters
PROPOSED CAPACITY

New Station 16,880 gsf

Assets
• Three Fire Boats
• Rescue Watercraft
• Jet Skis
• Dive Boat
• One Fire Engine
• 12 SFFD Staff “24/7”

Features
• Addresses all liabilities of existing facility
• Construction to Essential Facility Standards
• Storage Areas Consolidated for Emergency Response Equipment
• Ambulance Access
• Equipment for Boat Access, Rescue, and Loading and Unloading
FIRST FLOOR PROGRAMMING

- EMERGENCY OPERATIONS CENTER
- STORAGE
- WORK SPACES
- EQUIPMENT LOCKERS
- EQUIPMENT WORK ROOMS
- SMALL CRAFT STORAGE
- NIGHTWATCH
- MECHANICAL
- BOSON'S ROOM
- BOAT EQUIPMENT STORAGE

PUBLIC ENTRY

EMBARCADERO

SAN FRANCISCO BAY

80'-0"
SECOND FLOOR PROGRAMMING

- Dormitory
- Study
- Lockers, Showers, Bathrooms
- Pantry
- Laundry
- Kitchen/Dining
- Outdoor Deck
- Corridor
- Officer's Quarters
- Dayroom

Scale: 1/16" = 1'-0"
<table>
<thead>
<tr>
<th></th>
<th>Guardian</th>
<th>Phoenix</th>
<th>Fireboat 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Builder</strong></td>
<td>Yarrows, Ltd., Esquimalt, British Columbia</td>
<td>Hugh F. Munroe of Plant Shipyard, Alameda, CA</td>
<td>Vigor Industrial, Seattle WA</td>
</tr>
<tr>
<td><strong>Year</strong></td>
<td>1951</td>
<td>1955</td>
<td>2016</td>
</tr>
<tr>
<td><strong>Type of vessel</strong></td>
<td>Fireboat</td>
<td>Fireboat</td>
<td>Fireboat</td>
</tr>
<tr>
<td><strong>Displacement</strong></td>
<td>185 long tons</td>
<td>146 tons</td>
<td>260 long tons (300 GRT ITC)</td>
</tr>
<tr>
<td><strong>Length overall (LOA)</strong></td>
<td>88 ft.</td>
<td>89 ft.</td>
<td>88 ft.</td>
</tr>
<tr>
<td><strong>Beam</strong></td>
<td>21’6”</td>
<td>19’6”</td>
<td>26’</td>
</tr>
<tr>
<td><strong>Freeboard</strong></td>
<td>fwd- 9’. Aft- 5’4”</td>
<td>fwd- 9’. Aft- 5’4”</td>
<td>fwd- 18’. Aft- 15’</td>
</tr>
<tr>
<td><strong>Air draft</strong></td>
<td>42’</td>
<td>30’</td>
<td>38’</td>
</tr>
</tbody>
</table>
ELEVATION OF EXISTING HISTORIC FS 35 + NEW FIRE BOAT STATION

South Elevation (NTS)
SEA LEVEL RISE

+14.30' Projected 2070 MHHW (50 yrs)
+3.0' Wave Action & 3.5' 100-Yr Flood

+12.72' Current MHHW
+3.0' Wave Action & 3.5' 100-Yr Flood

+10.90' Current Top of Pier

+7.77' Projected 2070 MHHW (50 yrs)

+6.22' Current 2015 MHHW

BARGE FLOATING STRUCTURE
Marine Engineering: STEEL BARGE

Steel Barge

Steel Barge with Deck Slab

Steel Barge with Guide Piles and Ramp
### Marine Engineering: Comfort Criteria

<table>
<thead>
<tr>
<th>Movement</th>
<th>Comfort Criteria, RMS Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll</td>
<td>2°</td>
</tr>
<tr>
<td>Vertical acceleration</td>
<td>0.02 g or 0.66 ft/s²</td>
</tr>
<tr>
<td>Lateral acceleration</td>
<td>0.03 g or 0.98 ft/s²</td>
</tr>
</tbody>
</table>

- Limit of comfort values for roll, vertical and horizontal accelerations in cruise liners (Faltinsen, 1990).
- Criteria to be satisfied under operational conditions.
- During episodes of extreme weather conditions (design conditions), some people will feel uncomfortable.
Marine Engineering: EXAMPLES OF BARGE SUPPORTED STRUCTURES

Gildersleeve School (Ketchikan, Alaska)
The Gildersleeve School in Ketchikan, Alaska was constructed on a 68 ft x 80 ft reinforced concrete barge. The school building has two levels with an apartment on 2nd level.

Vernon C. Bain Prison Barge (New York, NY)
Built in New Orleans along the Mississippi River brought to New York in 1992. The 625 ft x 125 ft steel barge is equipped with 14 dormitories and 100 cells for inmates.

Brook St. Pier Ferry Terminal (Australia)
Concrete Barge, Ferry Berth, mark and Restaurants.

Barge 225 Floating Offices (Cleveland, OH)
150 ft x 45 ft Steel barge was converted to a restaurant and then in 2013 to an office space.
NEW FIRE BOAT STATION 35 AT PIER 22.5

MARCH 27TH, 2017

Building Design & Construction

BOAT STATIONS IN OTHER CITIES - MATERIALITY

NYFD Fireboat station

rheinzink - zinc shingles

concrete

decorative metal
solar screen

insulated aluminum panels

Portland Fireboat Station

Los Angeles Fire Boat House

NYFD Fireboat station

tile/concrete block

Rainscreen panels

tile/concrete block

Boston - Cambridge Yacht Club

Boston - Harvard Boat House

Boston Contemporary Museum on the water

Boston - Rowes Wharf

BUILDING DESIGN & CONSTRUCTION

15
Context: RELATIVE SCALE

Pier 22.5 - Fire Station 35

Pier 26 - Adjacent Pier

Pier 28

Pier 15 - Exploratorium

Pier 27 - Cruise Ship Terminal
### PRIMARY PERMITTING AGENCIES

<table>
<thead>
<tr>
<th>Agency</th>
<th>Type of Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF Port Building Permit Division</td>
<td>Port Building Permit</td>
</tr>
<tr>
<td>SF City Planning Environmental Planning Division</td>
<td>CEQA Review and Determination including procedures for historical resources</td>
</tr>
<tr>
<td>San Francisco Fire Department (SFFD) Administration</td>
<td>Design Review</td>
</tr>
<tr>
<td>San Francisco Fire Commission</td>
<td></td>
</tr>
<tr>
<td>San Francisco Port Commission</td>
<td></td>
</tr>
<tr>
<td>Central Waterfront Advisory Group (CWAG)</td>
<td></td>
</tr>
<tr>
<td>Citizen Advisory Committees (CAC)</td>
<td>Public Design Review</td>
</tr>
<tr>
<td>Waterfront Design Advisory Committee (WDAC)</td>
<td>Public Design Review</td>
</tr>
<tr>
<td>San Francisco Bay Conservation and Development Commission (BCDC)</td>
<td>1) BCDC Permit; Design-Build team to confirm whether Major or Administrative</td>
</tr>
<tr>
<td></td>
<td>2) Engineering Criteria Review Board (ECRB)</td>
</tr>
<tr>
<td></td>
<td>3) Design Review Board (DRB)</td>
</tr>
<tr>
<td>US Army Corps of Engineers (USACE)</td>
<td>Sec. 10 (RHA) / Sec. 404 (CWA) Permit for discharge of dredged or fill material</td>
</tr>
<tr>
<td></td>
<td>(33 CFR 323)</td>
</tr>
<tr>
<td>National Marine Fisheries Service (NMFS)</td>
<td>1) Consultation under Sec. 7 (FESA)</td>
</tr>
<tr>
<td></td>
<td>2) Incidental Take Authorization under Marine Mammal Protection Act (MMPA)</td>
</tr>
<tr>
<td>San Francisco Bay Regional Water Quality Control Board (RWQCB)</td>
<td>Sec. 401 (CWA) Water Quality Certification</td>
</tr>
<tr>
<td>CA Department of Fish and Wildlife (CDFW)</td>
<td>Incidental Take Permit Sec. 2081 (FGC)</td>
</tr>
<tr>
<td>US Coast Guard</td>
<td>Maritime Transportation Security Act of 2002 (33 CFR)</td>
</tr>
<tr>
<td>US Fish and Wildlife Services (FWS)</td>
<td>Consultation under Sec. 7 (FESA)</td>
</tr>
<tr>
<td>CA State Lands Commission</td>
<td>Use plan consultation</td>
</tr>
<tr>
<td>State Historic Preservation Officer</td>
<td>Sec. 106 (NHPA) consultation</td>
</tr>
</tbody>
</table>
http://www.sfearthquakesafety.org/neighborhood-firehouses.html