The California Hospital Seismic Retrofit Program: 12 Years to the Finishing Line

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The Need for Functioning Hospitals in a Natural Disaster

Olive View Medical Center
The 1st Ever Definition of Functionality

... that hospitals, that house patients who have less than the capacity of normally healthy persons to protect themselves, and that must be reasonably capable of providing services to the public after a disaster, shall be designed and constructed to resist, insofar as practical the forces generated by earthquakes, gravity, and winds.
Northridge Earthquake

The 1972 HSSA applied only to new hospital buildings

All existing hospitals licensed at that time were “grandfathered”

Northridge raised additional questions
## Northridge EQ - Hospital Performance

<table>
<thead>
<tr>
<th>Performance of all Buildings at 23 Hospital Sites with One or More Yellow or Red Tagged Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number (%) of Buildings</strong></td>
</tr>
<tr>
<td><strong>Type of Damage</strong></td>
</tr>
<tr>
<td>Structural Damage</td>
</tr>
<tr>
<td>Red tagged</td>
</tr>
<tr>
<td>Yellow tagged</td>
</tr>
<tr>
<td>Green tagged</td>
</tr>
<tr>
<td>Nonstructural Damage</td>
</tr>
<tr>
<td>Major</td>
</tr>
<tr>
<td>Minor</td>
</tr>
<tr>
<td><strong>Total Buildings</strong></td>
</tr>
</tbody>
</table>
California at Risk: Reducing Earthquake Hazards 1987 to 1992 – Initiative 1.2

Milestone 4 Report December, 1990

“Recommend a program by July, 1991 to bring existing hospitals into substantial compliance with the Hospital Seismic Safety Act by 2020”
New State Responsibilities For Seismic Safety in Hospitals

Northridge Earthquake:

Impetus for Senate Bill (SB) 1953 (Stats. 1995)

Brought existing buildings into the HFSSA

H&SC § 130000 – 130025

HEALTH AND SAFETY CODE - HSC

DIVISION 107. STATEWIDE HEALTH PLANNING AND DEVELOPMENT [127000 - 130070] (Division 107 added by Stats. 1995, Ch. 415, Sec. 9.)

PART 7. FACILITIES DESIGN REVIEW AND CONSTRUCTION [129675 - 130070] (Part 7 added by Stats. 1995, Ch. 415, Sec. 9.)

CHAPTER 1. Health Facilities [129675 - 130070] (Chapter 1 added by Stats. 1995, Ch. 415, Sec. 9.)

ARTICLE 8. New State Responsibilities For Seismic Safety in Hospitals [130000 - 130025] (Article 8 added by Stats. 1995, Ch. 415, Sec. 9.)

130000. (a) The Legislature hereby finds and declares the following:
(1) The Alfred E. Alquist Hospital Facilities Seismic Safety Act of 1983 was created because of the loss of life in the collapse of hospitals during the Sylmar earthquake of 1971.
(2) We were reminded of the vulnerability of hospitals in the Northridge earthquake of January 17, 1994.
(3) Several hospitals built prior to the act suffered major damage and had to be evacuated.
Hospital Seismic Safety Definitions

New law established system for rating buildings based on seismic risk

<table>
<thead>
<tr>
<th>Significant Risk of Collapse in a Major EQ</th>
<th>Low Risk of Collapse in a Major EQ</th>
<th>Reasonably Capable of Providing Services to the Public after a Major EQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008/2013</td>
<td>2030</td>
<td>2030+</td>
</tr>
<tr>
<td>SPC1</td>
<td>SPC2</td>
<td>SPC3</td>
</tr>
<tr>
<td></td>
<td>SPC4</td>
<td>SPC5</td>
</tr>
</tbody>
</table>
Calif. Hospital Seismic Retrofit Program
Major Milestones

- **1973** 1994 2002
- **2008** 2013 2015 2018 2020 2030

- **SB 1953 Enacted**
- **Seismic evaluations and plans for compliance submitted to OSHPD**
- **Improvements to allow Evacuation (NPC-2)**
- **Extensions**
- **All buildings capable of continued operation (SPC-3 or higher)**

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- Prevent collapse and loss of life (SPC-2 or higher)
- -- 1971 Sylmar, 1989 Loma Prieta, and 1994 Northridge EQs
Structure Performance Categories - Progress to Date

* Based on 2001 Hospital Survey Results based on hospital “self-report” and then “state-of-the-art” FEMA 178 standards from 1996
** SPC-5 includes buildings currently under construction
For SPC - “Not Assigned” is for non-building structures such as equipment yards, cooling towers etc that are still under construction

Total number of SPC Buildings = 2627

2001*

SPC-1, 1027, 39%
SPC-5, 342, 13%
SPC-4, 724, 27%
SPC-3, 334, 13%
SPC-2, 200, 8%

Total number of SPC Buildings = 3085 in 419 Facilities

5/31/2018**

Not Assigned, 29, 1%
SPC-1, 187, 6%
SPC-5, 1053, 34%
SPC-2, 629, 21%
SPC-3, 378, 12%
SPC-4, 809, 26%

Number of SPC-1 Facilities = 77
Extensions to SB 1953 Milestones

1.1.2008 Prevent collapse and loss of life

1998 1999 2000 2001 2002

1998 1999 2000 2001 2002

Seismic evaluations and plans for compliance submitted to OSHPD

Improvements to allow evacuation 1.1.2002

1.1.2008 Prevent collapse and loss of life

2008

SB 1801

2013 2015

SB 1661

2020

SB 306, SB 90

2030

All buildings capable of continued operation
The need to constantly re-examine and realign the program
“Safer Sooner” Option (SB 306)

• Enacted in 2007

• Provides a delay in compliance for SPC-1 buildings if the hospitals demonstrates they lack the financial capacity to remove SPC-1 buildings from service by 2013

• If extension granted, hospital must replace all SPC-1 buildings by 2020

• 24 hospitals granted SB 306 extensions
SPC-1 Ratings

Imminent Threat

Minor Risk to Life

SPC1

SPC2

SPC3

SPC4

SPC5

Pose a Significant Risk of Collapse

Reasonably Capable of Providing Services to the Public

2008/2013

2030

2030+

2030+
### HAZUS - Building Damage Estimation

#### Significant Structural Deficiency

<table>
<thead>
<tr>
<th>Deficiency</th>
<th>Capacity</th>
<th>Response</th>
<th>Structural Damage - Complete</th>
<th>Collapse</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over-Strength Factor</td>
<td>Cyclic Drage</td>
<td>Fragility Curve Median</td>
<td>Frangible Curve Variability (Beta) Factor</td>
</tr>
<tr>
<td>Age (Pre-1933 buildings)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials Tests (None)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Redundancy</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weak Story Irregularity</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft Story Irregularity</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass Irregularity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical Discontinuity</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Torsional Irregularity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deflection Incompat.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Short Column</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Deterioration</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel Deterioration</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Deterioration</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weak Column-Steel</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Weak Column-Conc.</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cripple Walls</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Topping Slab (Missing)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall Anchorage</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Damage States:
- **N** - None,
- **S** - Slight,
- **M** - Moderate,
- **E** - Extensive,
- **C** - Complete
“The Public has the Right to Know” (SB 499)

Enacted in 2009

Requires hospitals to report compliance progress

Authorizes use of HAZUS to evaluate seismic risk
Compliance Time Vs Risk (SB 90)

SB 90 authorizes OSHPD to:

- Grant hospitals an extension of up to seven years beyond the 2013 deadline to retrofit or replace SPC-1 hospital buildings.
- The length of the extension is determined by OSHPD:
  - On case by case based on the following criteria:
    - (1) structural integrity of the building;
    - (2) community access to care if the hospital building were to close; and
    - (3) financial capacity of the hospital to complete the construction projection.
- Not to exceed the time necessary to reasonably complete the construction project.
- Does not change the 2030 deadline.
Compliance Time Vs Risk

$P(1.2\% < H < ?\%, E)$

Years

Risk

Time

$P$, Compliance Priority Rating

Years
Hospital Seismic Compliance to Date

1313 Max. No of Buildings classified as SPC-1 @ Some point in time
1097 @ Start of HAZUS 2007

677
825
Last date HAZUS 2007

411
337

187 5/31/18

1126 Buildings 85.8%

< 1.6 years left

1/1/2001
2007
11/1/2010
1/1/2014
1/1/2015
1/1/2020
Anticipation Completion Dates, SPC-1 Buildings
The Future . . . 2030 and Beyond

Location of SPC-2 Buildings
New Seismic Performance Category

2016 California Administrative Code

Introduced Structural Performance Category SPC-4D (Damage control)

Nonconforming Buildings (Building originally built to pre-1973 Code) can be upgraded to SPC-4D (Instead of SPC-5) to provide service beyond 2030
Performance Expectation of SPC-4D Buildings

May control damage to permit return to function similar to SPC-3 or 4 buildings but not as quickly as SPC-5 buildings

Performance should be equivalent to SPC-3 and SPC-4 buildings
Buildings Not Eligible for SPC-4D

1. Hospital buildings with the potential for surface fault rupture and surface displacement at the building site

2. Unreinforced masonry shear wall buildings

3. Precast concrete buildings
Nonstructural Performance Categories

**OSHPD 2001***

- NPC-4, 150, 6%
- NPC-3, 50, 2%
- NPC-2, 412, 15%
- NPC-1, 2000, 74%

Total number of NPC Buildings = 2709

**OSHPD 5/31/2018***

- NPC-4, 870, 27%
- NPC-3, 248, 8%
- NPC-2, 1859, 58%

Total number of NPC Buildings = 3218

***Includes buildings under construction, tunnels and equipment yards
For NPC - "Not Assigned" are for buildings and nonbuilding structures either under construction or where the nonstructural performance category has not been verified
Buildings under construction or just built are assigned a preliminary NPC of 4
NPC Requirements Revisited

2016 CBC
- SPC-4D (Damage Control Category)

_HSSA § 130005_

(f) The office, _in consultation with the Hospital Building Safety Board_, shall develop regulations to identify the most critical nonstructural systems and to prioritize the timeframes for upgrading those systems that represent the greatest risk of failure during an earthquake.

2019 CBC
- NPC-4D?
NPC Requirements Revisited

What non-structural anchorage and bracing of equipment and systems is practical in an existing hospital building constructed prior to 1983?
Concluding Remarks

The extent that policies are implemented is affected by events that occur even before policy is adopted.

The need to mitigate against the likely consequences of NHE it takes public regulation of private behavior to protect the public interest.

Assumptions can’t be made that organizations outside the policy makers will automatically comply w/directives and regulations imposed on them.
Concluding Remarks

3 Questions* to consider before you start on drafting a policy intended to reduce the risks associated w/ NHE

◦ What are the primary obstacles to implementing public regulatory policies?
◦ How do “Organizations” make choices of how much to spend on mitigating the likely consequences of rare but potentially catastrophic events?
◦ What characteristics of public policies increase the likelihood of successful implementation?
