US-Italy collaborative projects on hospital seismic safety

ATC-51, 51-1, 51-2

Joe Maffei

25 February 2005

RUTHERFORD & CHEKENE
<table>
<thead>
<tr>
<th>ATC 51</th>
<th>Overall recommendations (2000)</th>
</tr>
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<tbody>
<tr>
<td>ATC 51-1</td>
<td>Earthquake emergency response planning (2002)</td>
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Collapse of the San Angelo dei Lombardi hospital in the 1980 Irpinia earthquake
## Project advisory panels, US participants

<table>
<thead>
<tr>
<th>ATC 51</th>
<th>ATC 51-1</th>
<th>ATC 51-2</th>
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<tbody>
<tr>
<td>Bill Holmes</td>
<td>Barbara Foster</td>
<td>John Gillengertten</td>
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<td>Henry Lagorio</td>
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<td>Maryann Phipps</td>
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<td>Pat Lama</td>
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<td>Chris Poland</td>
<td>Jay Love</td>
<td>Art Ross</td>
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<td>Bill Staehlin</td>
<td>Jay Murphy</td>
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<td>Chris Tokas</td>
<td>David Otey</td>
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<td>Chris Tokas</td>
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Giacomo DiPasquale  Project director for the Italian National Seismic Survey
Chris Rojahn          ATC project manager
Joe Maffei            Technical consultant and principal author
Projects over 4 years, including workshops, meetings, and hospital site visits in the U.S. and Italy
Applicability to U.S. needs

Most applicable to the U.S. outside of California

1. Lack of special seismic requirements and review process.

2. Programs still to be developed.


4. Range of seismicity, low to high.
Range of seismicity somewhat comparable to that of the US.
Most hospital buildings are 1-8 stories of reinforced concrete and 1-5 stories of masonry.
Hospital buildings of varying ages
Hospital at Treia
New Gemona hospital, demolished in 1979 because of damage in the 1976 Friuli earthquake
ATC 51 report

1. Background on Italian seismicity, zonation, design codes, hospital inventory, and hospital earthquake damage.

2. 6 short-term plus 4 long-term recommendations, based applying California experience to the situation in Italy.
ATC 51 short-term recommendations

1. Establish review and enforcement of design and construction quality.

2. Evaluate options for seismic risk-reduction programs, including objectives, strategies, and possible passive and active seismic retrofit programs.

3. Implement bracing for new installations of nonstructural systems. (ATC 51-2)
1. Damage to non-structural systems in Italian and US earthquakes.
2. Which non-structural items to retrofit?
3. Detailed design examples
Damage to non-structural systems in Italian and US earthquakes
Foligno hospital in the 1997 Umbria-March earthquake

Damage to unreinforced masonry partitions and floors

Damage to batteries used for emergency power
2001 Nisqually earthquake
0.7% maximum story drift reached
Building just meets the Operational limit state
Which nonstructural items to retrofit?
<table>
<thead>
<tr>
<th>Oxygen tank</th>
<th>high vulnerability</th>
<th>high importance</th>
<th>low cost and disruption to retrofit</th>
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<tr>
<td>1,2,3 zones to evaluate/retrofit</td>
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<tr>
<td>1,2,3,4 zones to anchor new</td>
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## Emergency generator

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</table>
Batteries for uninterrupted emergency power

very high vulnerability
high importance
very low cost and disruption to retrofit

1,2,3,4 zones to evaluate/retrofit

1,2,3,4 zones to anchor new
Surgery light

- medium vulnerability
- high importance
- med/high cost and disruption to retrofit
- 1 zones to evaluate/retrofit
- 1,2,3 zones to anchor new
**Elevator rail systems**

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1, 2 zones to evaluate/retrofit

1, 2, 3 zones to anchor new
ATC 51-2 detailed design examples

1. Rooftop chiller (4 pages)
2. Elevator rail system (11 pages)
3. Prescriptive pipe bracing (7 pages)
ATC 51-2 report

1. Limit states and performance objectives.
2. Seismic design responsibility for nonstructural.
3. Design and construction review.
4. Post-earthquake inspection.
1. Performance and bracing considerations for 15 defined component types.

2. Devices for seismic restraint.

3. Cost of non-structural bracing and retrofit.
ATC 51-1
Earthquake emergency response planning for hospitals
ATC 51-1 Recommendations

• Earthquake Emergency Response Planning
  - Management system; reference cards for emergency procedures; emergency operations center; evacuation plans, routes, and gathering areas; field hospitals using tents; emergency supplies
ATC 51-1 Recommendations

- Seismic Vulnerability Assessment
- Post-earthquake Inspection procedures and preparation
- Mitigation of hazards and reorganization of health functions
- Training
ATC 51 short-term recommendations

4. Restrict the use of unreinforced masonry in new construction, depending on the seismic zone.

5. Improve inventory of structural data by collecting and documenting information on seismic vulnerability.

6. Plan for emergency response and post-earthquake inspection. (ATC 51-1)