Cluster 4  Reducing the underlying risk factor

Importance to Improve Seismic Safety of Buildings and Houses for Reduction of Earthquake Disaster

Tsuneo OKADA
Professor Emeritus of University of Tokyo
President of Japan Building Disaster Prevention Association
KOBE in 1995 (Great Hanshin/Awaji Earthquake Disaster)
Summary on Building Damage due to Kobe Earthquake

1. Buildings constructed after 1981 took less damage than those constructed before.
2. Seismic performances have been improved according to construction years.
3. If seismic evaluations and/or retrofits had been done, the damage would have been reduced much.
## Damage Statistics of Buildings

-1995 Hyogo-ken Nambu Earthquake-

<table>
<thead>
<tr>
<th></th>
<th>Collapse or Severe</th>
<th>Moderate</th>
<th>Minor or Less</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1~2 Storied</td>
<td>46,022 (9.4%)</td>
<td>42,208 (8.6%)</td>
<td>401,046 (82.0%)</td>
<td>489,276 (100%)</td>
</tr>
<tr>
<td>(wooden)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 storied or more</td>
<td>3,081 (6.4%)</td>
<td>3,273 (6.7%)</td>
<td>42,165 (86.9%)</td>
<td>48,519 (100%)</td>
</tr>
</tbody>
</table>

Ministry of Construction 1995
### Damage Statistics of Reinforced Concrete School Buildings

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Collapse</strong></td>
<td>18 (5%)</td>
<td>2 (1%)</td>
<td>0</td>
<td>20 (3%)</td>
</tr>
<tr>
<td><strong>Severe</strong></td>
<td>24 (7%)</td>
<td>9 (5%)</td>
<td>0</td>
<td>33 (5%)</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>90 (27%)</td>
<td>39 (24%)</td>
<td>11 (8%)</td>
<td>40 (22%)</td>
</tr>
<tr>
<td><strong>Minor</strong></td>
<td>41 (12%)</td>
<td>21 (13%)</td>
<td>7 (5%)</td>
<td>69 (11%)</td>
</tr>
<tr>
<td><strong>Slight or No</strong></td>
<td>159 (48%)</td>
<td>95 (57%)</td>
<td>115 (87%)</td>
<td>369 (59%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>332(100%)</td>
<td>166 (100%)</td>
<td>133(100%)</td>
<td>631(100%)</td>
</tr>
</tbody>
</table>

AIJ 1995, Okada et al 2000
History of Earthquake Damage and Seismic Design & Seismic Evaluation

Structural Damage in Non-Engineered Buildings and/or in Non-Earthquake Engineered buildings

First Age: Adoption of Seismic Design Codes
(1920’s – 1940’s)

Structural Damage in Insufficiently Engineered Buildings

Second Age: Revision of the seismic Design Codes
(1980’s – 1990’s)

Promotion of Seismic Evaluation and Strengthening of Existing Buildings

Functional Damage in Engineered Buildings

Third Age: Adoption of Performance-based Engineering into Seismic Design Codes
(2000’s –) for High-rise buildings, since 1960’s

Controlled Damage in Highly Engineered Buildings
Actions for Seismic Retrofit in 1995

- **Hyogo-ken Nanbu Earthquake (Jan.)**
- **Quick Report on Building Damage (MOC) (March)**
- **Notice for Promotion of Seismic Retrofit (MOC) (March)**
- **Report on Damage of School Buildings (AIJ) (March)**
- **Network for Promotion of Seismic Retrofit (April)**
- **Special Law for Earthquake Countermeasures (Subsidy for Seismic Retrofit of School Buildings) (June)**
- **Recommendations of AIJ (July)**
- **Disaster Prevention Basic Plan revised (LA) (July)**
Recommendation-1

1) Utilizing excellent technologies developed in the 20th century for real practices, sweep up seismically vulnerable buildings and houses. (it would be possible)
Recommendation-2

- Prepare various types and levels of seismic design codes for various types of new buildings and houses,
- Develop evaluation standards and retrofit guidelines for various types of existing buildings and houses, and
- Establish guidelines for quick inspection of damaged buildings/houses, and train qualified inspectors.
Recommendation-3

Not only most sophisticated seismic design and construction technologies but also suitable level of technologies considering building use, life cycle, economic condition etc. be developed and implemented.

However, the concepts should be the same.