# Recent Development of Seismic Retrofit Methods

Building Control Section
**Urban Building Division**
**Bureau of Urban Development**
TMG

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1. Damage caused by various earthquakes
2. Seismic diagnosis method
3. Seismic retrofit method

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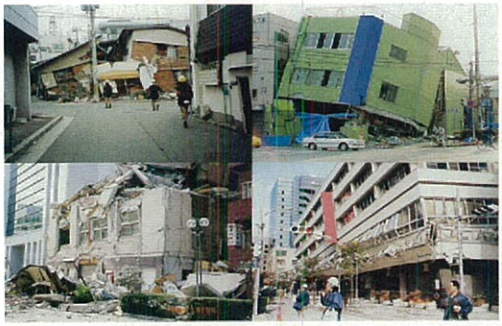
## Damage by the Great Hanshin-Awaji Earthquake

阪神淡路大震災 被災状況



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## Damage by the Great Hanshin-Awaji Earthquake

阪神淡路大震災 被災状況

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## Damage by the Great Hanshin-Awaji Earthquake

阪神淡路大震災 被災状況

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## Damage by the Great Hanshin-Awaji Earthquake

阪神淡路大震災 被災状況

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## Damage by the Great Hanshin-Awaji Earthquake

阪神淡路大震災　被災状況

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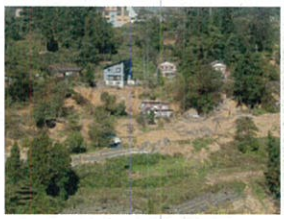
## Damage by the Niigata Chuetsu Earthquake

新潟県中越地震　被災状況



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## Damage by the Niigata Chuetsu Earthquake

新潟県中越地震　被災状況

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## Damage degree V

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## Damage degree V

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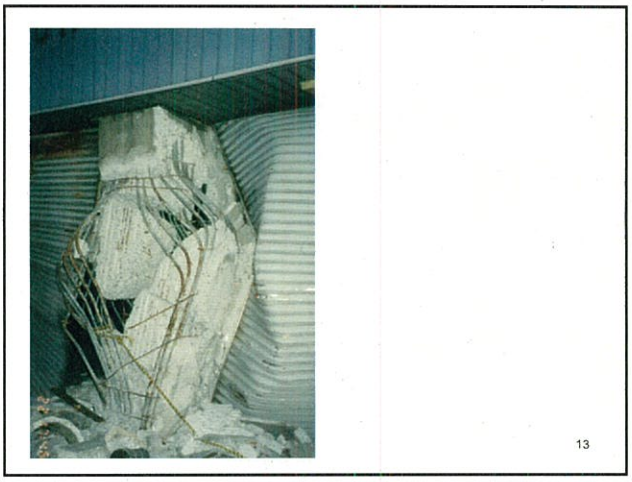
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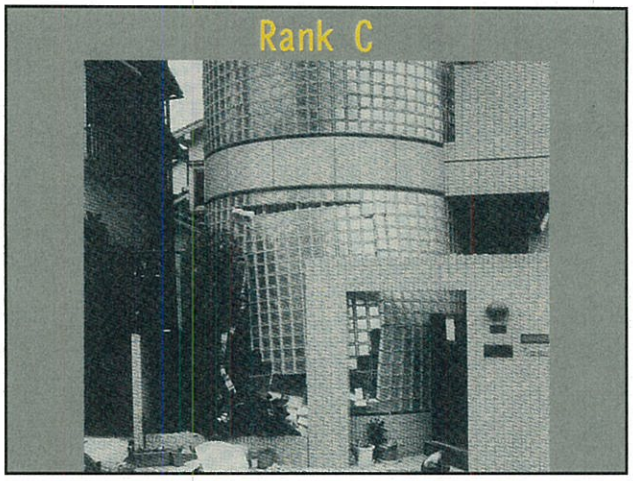
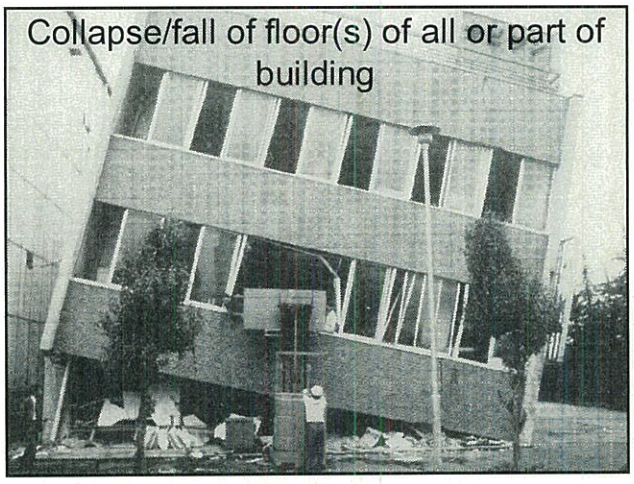
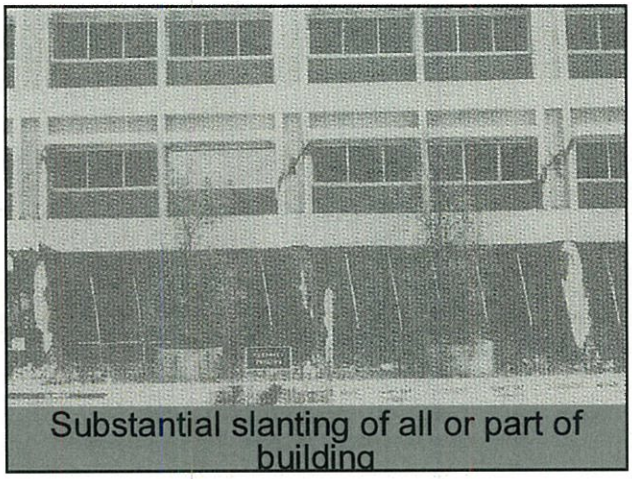
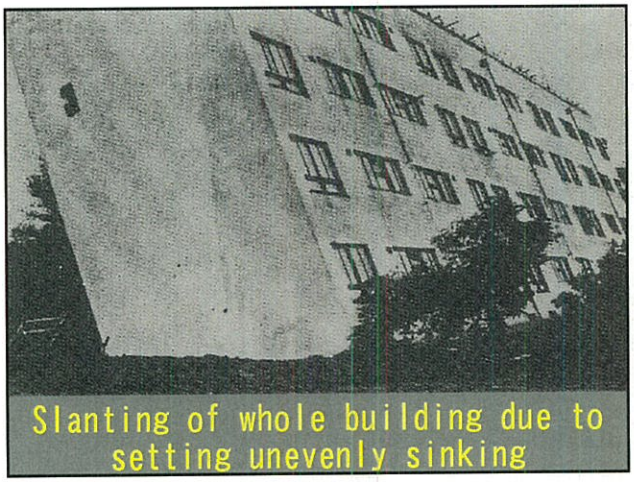

Rank C


Collapse/fall of floor(s) of all or part of building


Substantial slanting of all or part of building


Slanting of whole building due to setting unevenly sinking

## Others

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## Seismic Diagnosis (for RC structure)

(Means to determine whether a relevant building has the required seismic performance against possible large earthquakes)

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## Primary diagnosis

- The most simple method
- For buildings with a sufficient number of walls
- Use
  ① sectional areas of walls and columns
  ② strength of concrete
  to determine the seismic performance

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## Secondary diagnosis

- Most common method
- For buildings whose vertical members (columns and walls) are likely to fall or collapse before horizontal members (beams) are.
- Use the ultimate strength of vertical members, such as columns and walls, to determine the seismic performance

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## Tertiary (precise) diagnosis

- For buildings whose horizontal members (beams) are likely to fall or collapse before vertical members (columns and walls) are.
- Use the strength of all frames, such as columns, walls and beams, to determine the seismic performance.
- Based on the analysis of the frame with advanced knowledge and judgment skill

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## The result of a seismic diagnosis

**Index**

- Is =the Seismic Index of Structure
- $C_{TU}$,$S_D$ =Index of Retained Horizontal Strength

The risk of fall or collapse due to earthquake tremors and shocks is judged low if

**Is $\geqq$ 0.6, and $C_{TU} \times S_D \geqq$ calculated value**

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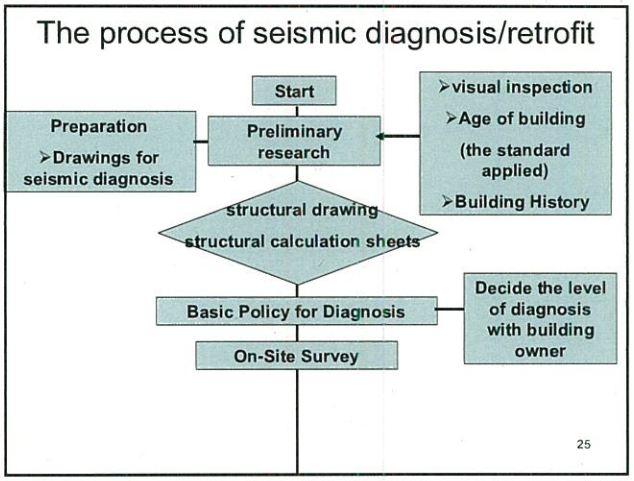


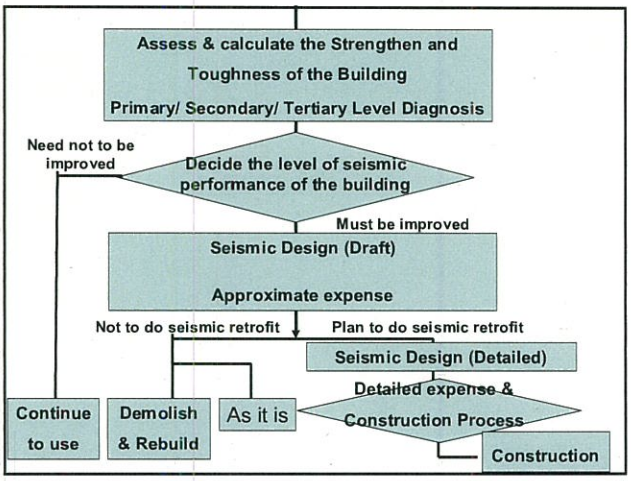


## Seismic Retrofit Methods

- Reducing the weight itself
- Installing new additional structural members to increase elements of seismic resistance
- Retrofitting structural members to increase strength and tenacity
- Reducing the seismic force input to the building

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