Earthquake Resistance Standards for Buildings
(Building Standards Law, etc)

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1

CONTENTS

- Outline of the Building Standards Law
- Issue 1 Poor or negligent construction
  ⇒Interim Inspection System
- Issue 2 Old buildings without sufficient earthquake-resistance
  ⇒Promotion of seismic retrofit
- Issue 3 Quality of architects
  ⇒More stringent building confirmation
  ⇒Revision of registered architect system

2

Earthquake Resistance Standards Specified in the Building Standard Law

Various standards are specified in the Building Standard Law, and earthquake resistance standards for buildings are also specified in the Law

1 Standards in urban areas
(1) Relationship between building sites and roads
(2) Zoning
(3) Building-to-land ratio
(4) Floor area ratio
(5) Building height

2 Standards for buildings
(1) Fire prevention / Evacuation
(2) Safety in daily life
(3) Living environment / Sanitation
(4) Structure (Earthquake resistance standards)
(5) Building equipment

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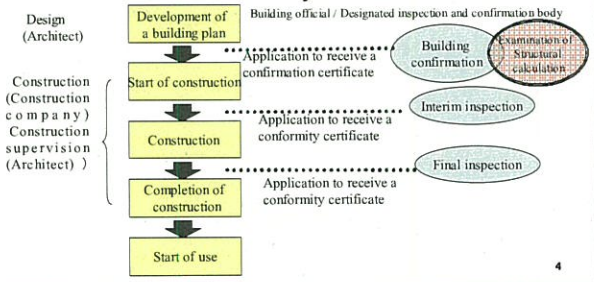
Procedures under the Building Standard Law

Procedures are specified, from the development of a building plan to the start of use, and the involvement of the administration ensures the safety.



4

Basic Concept of Earthquake Resistance Standards 1

The basic concept is that building structures must be safe against not only earthquakes but also the dead load, live load, snow load, and wind pressure.

Dead load: Weight of concrete, reinforcing bars, etc.
Live load: Weight of people, furniture, vehicles, etc.
Snow load: Weight of snow
Wind pressure: Swaying caused by wind
Earthquake: Swaying caused by an earthquake

5

Basic Concept of Earthquake Resistance Standards 2

The basic concept is to deal with a risk while considering economy, instead of perfectly dealing with any earthquakes,.

(1) Regular dead load and live load shall be safely supported.
(2) No damage shall be caused by a medium earthquake that rarely occurs (once in 20 years).
(3) No fall or collapse shall be caused by a large earthquake that very rarely occurs (once in 100 years)

6

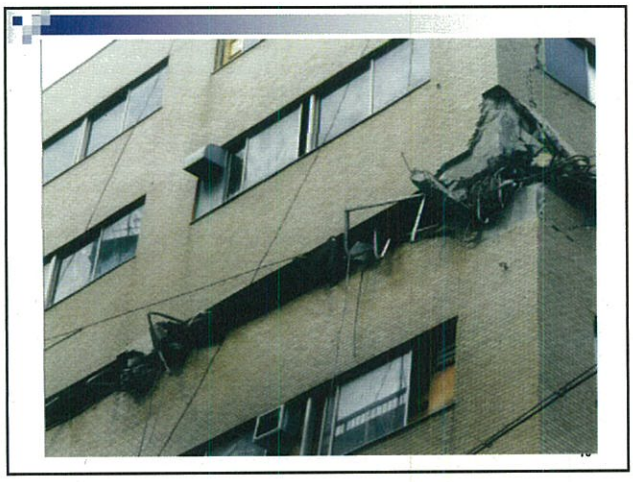
Earthquake Resistance Standards

Revision of the Law, with Earthquakes as a Trigger

In Japan, a country of earthquakes, huge earthquake disasters have acted to trigger the strengthening of earthquake-resistance standards. The base of the current standards were introduced in 1980.

Earthquake	Revision of the Law
The Tokachi-Oki Earthquake (1968) Many cases of damage to RC buildings M 7.9, Death toll of 49 people, Complete destruction of 673 buildings	Introduction of new earthquake resistance standards (1980) • New establishment of provisions for structural calculation in secondary design • Increase of the shear wall capacity for wooden buildings
The Miyagi-Oki Earthquake (1978) Damage to buildings with pilotis or large eccentricity M 7.4, Death toll of 27 people, Complete destruction of 651 buildings	
The Great Hanshin-Awaji Earthquake (1995) Many of the buildings conforming to the old earthquake-resistance standards or that were poorly constructed fell or were damaged. M 7.2, Death toll of 6,432 people, Complete destruction of 104,906 buildings	Introduction of interim inspections (1998) Introduction of the Law for Promote Seismic Retrofit of Buildings (1995)

7



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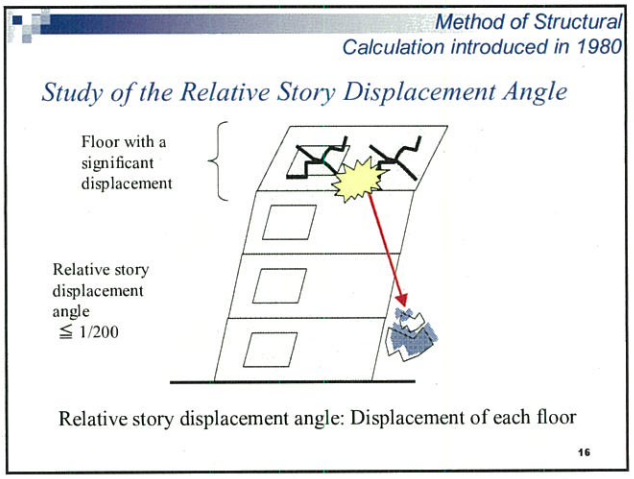
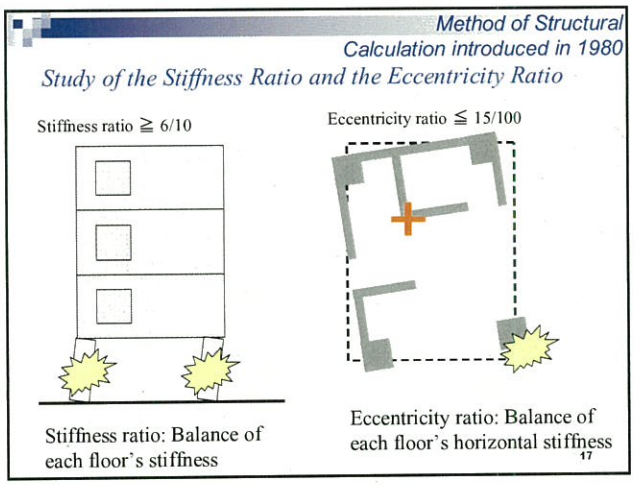
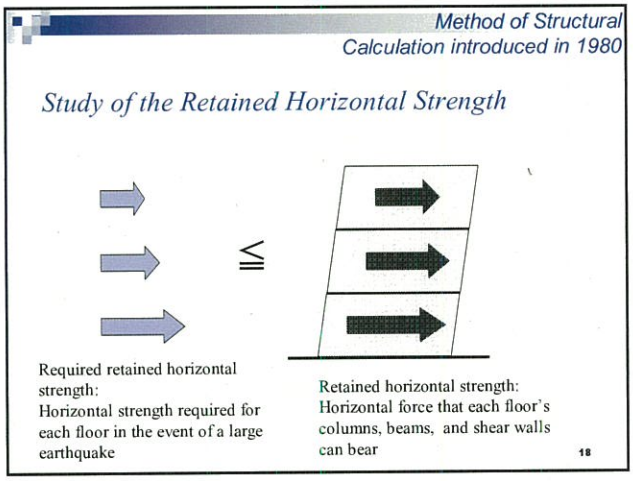

Method of Structural Calculation introduced in 1980
Study of the Relative Story Displacement Angle
Floor with a significant displacement
Relative story displacement angle ≦ 1/200
Relative story displacement angle: Displacement of each floor
16


Method of Structural Calculation introduced in 1980
Study of the Stiffness Ratio and the Eccentricity Ratio
Stiffness ratio ≧ 6/10
Eccentricity ratio ≦ 15/100
Stiffness ratio: Balance of each floor's stiffness
Eccentricity ratio: Balance of each floor's horizontal stiffness
17


Method of Structural Calculation introduced in 1980
Study of the Retained Horizontal Strength
≦
Required retained horizontal strength:
Horizontal strength required for each floor in the event of a large earthquake
Retained horizontal strength:
Horizontal force that each floor's columns, beams, and shear walls can bear
18

Related Issue 1

Issue 1

Defects due to poor or negligent construction

Construction not performed in compliance with the earthquake resistance standards

* Work in the natural environment, unlike the case of industrial products
* No buildings are the same
* Many people involved

19

Interim Inspection System 1

In the Great Hanshin-Awaji Earthquake, significant damage occurred due to defects caused by poor or negligent construction.

↓ 1998

The Building Standard Law mandates an interim inspection during the construction period and specifies that the local government shall determine its details.
(MLIT mandates an Interim Inspection to apartment houses exceeding three-story in 2007.)

※ **MLIT : Ministry of Land, Infrastructure and Transportation**

20

Interim Inspection System 2

In response, Tokyo Metropolitan Government (TMG) sets the most stringent standards in Japan.

◆ Buildings subject to the interim inspection
* All buildings with three stories or more, regardless of the structure

◆ Process checked in the interim inspection
* Wooden buildings: Roof construction
* Steel or steel framed reinforced concrete buildings: Frames of the first floor
* Reinforced concrete buildings: Floor construction on the second floor

※ Buildings with a total floor area exceeding 10,000 m^2: Additional foundation work

21

22

23

24

Related Issue 2

Issue 2

There still remain many buildings that do not meet the current earthquake-resistance standards.

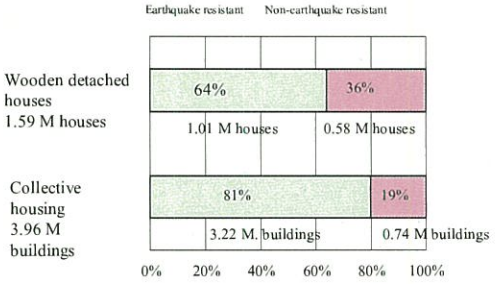
* Earthquake resistance standards are becoming increasingly stringent in light of earthquake damage, changes in the social economy, and the spread of new technologies.

25

Seismic Retrofit

Current Status of Earthquake Proofing of Residential Buildings

There still remain many residential buildings in the Tokyo Metropolis that do not meet the new earthquake resistance standards.



26

Establishment of the Law for Promote Seismic Retrofit of Buildings (1995)

- At the Great Hanshin-Awaji Earthquake, many non-earthquake resistant buildings (built before 1980) suffered severe damage.
- Strengthening seismic resistance performance of buildings nonconforming current standards are critical issue.

- Establishment of the Law for Promote Seismic Retrofit of Buildings (1995)

27

Outline of the Law for Promote Seismic Retrofit of Buildings

- The owner of buildings used by general public shall endeavor to consult seismic diagnosis and retrofit
- Approved seismic retrofitting shall not influenced any disqualification other than seismic resistant requirement
- Local governments shall establish Seismic Retrofit Promotion Plan

28

Related Issue 3

Issue 3

Some architects falsify the calculation so that the earthquake resistance standards can **NOT** be met.

* Deterioration of the trust in architects holding a national license
* Lack of professional ethics as an engineer

29

Related Issue 3

Structural Calculation Sheet Forgery Case

Mr. Aneha, a first-class architect, forged structural calculation sheets to cut costs and reduce working time (Revealed in Nov, 2005).

- 99 cases of forgeries were found nationwide
- Huge damage involving collective housing

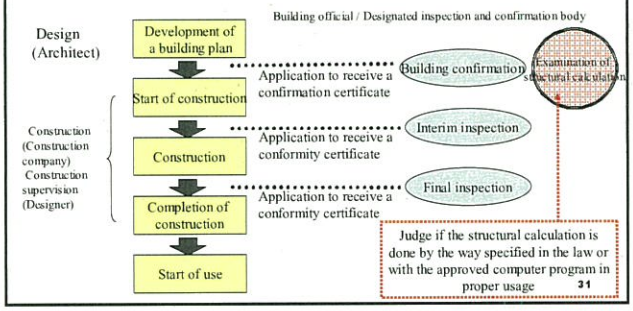
- The development of structural calculation sheets is sophisticated and complicated.
  Utilizing computers → Difficulty in detecting a forgery

30

Revision of the Building Standard Law Enforced in June, 2007

1 More stringent building confirmation and inspection

◆ Buildings of a certain height or higher → Examination of structural calculation



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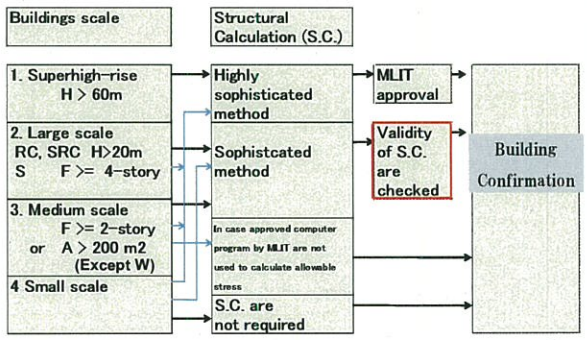
Buildings required "Examination of Structural Calculation"



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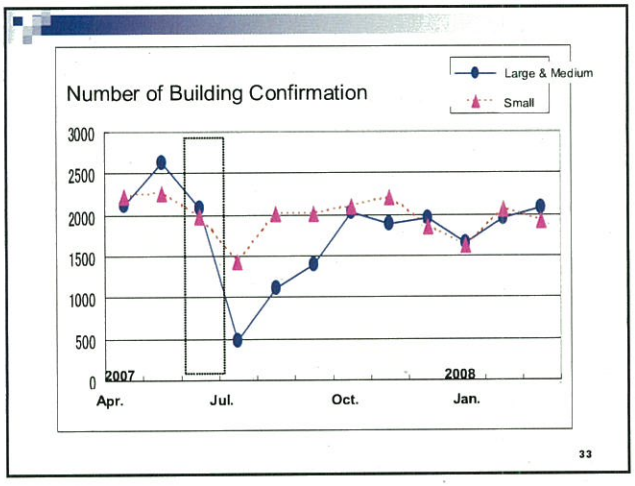


33

Revision of the Building Standard Law Enforced on June,2007

2 Penalty strengthened in relation to the work of architects, etc.

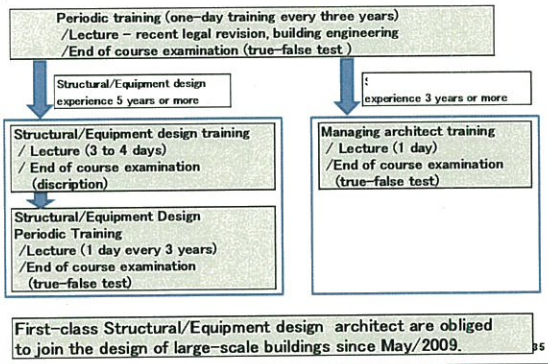
Details of violation	Before revision	Revised
Violation of significant substantive provisions, such as the earthquake resistance standards	Fine of ¥500,000	3 years' penal servitude / Fine of ¥3 million (¥100 million for a corporation)

3 Disclosure of information on architects and architect offices

◆ Public disclosure of the names of architects and architect offices punished, etc.

34

Revised requirements to Registered First-class Architect



First-class Structural/Equipment design architect are obliged to join the design of large-scale buildings since May/2009.

35

Thank you for your kind attention!

36