HISTORY OF MAJOR AMENDMENTS TO BUILDING STANDARDS LAW
AND TYPICAL CONFLICTS OF NON-CONFORMED EXISTING BUILDINGS IN JAPAN

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  • Major amendments

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• Case studies of evaluation in fire for existing buildings by a performance-based method

• Ongoing projects for fire safety of existing buildings
Outline of the Laws for fire safety of buildings

- **Building Standards Law (BSL)**
  Ministry of Land, Infrastructure and Tourism (MLIT)
  - Regulations of **buildings and equipment** (Lifts, plumbing, etc.):
    - **Material**: Fire preventive materials
    - **Structure**: Fire resistance of building elements, Fire compartment
    - **Evacuation**: Evacuation route
      - Smoke and Fire compartment

- **Fire Service Law (FSL)**
  Fire and Disaster Management Agency (FDMA), Ministry of internal affairs and communications
  - Regulations of **fire protection equipment** and fire service activity:
    - Fire extinguisher
    - Suppression system
    - Alarm system
    - Emergency exit (such as evacuation ladders)
    - Guidance system (Emergency exit sign)
    - Water source, reservoir tanks
    - Facilities for fire service activities (heat and smoke exhaust system, standpipe, etc.)
Outline of the Laws for fire safety of buildings

• Application of BSL amendments to existing buildings
  (Non-retroactivity principle is based on the Constitution)

• The BSL has relaxations for existing buildings.
  • Requirements by an amendment do not apply to existing buildings, building under construction that had conformed old codes at that time.
  • If large-extension, large-scale repair, renovation, or reconstruction (extension etc.) of the buildings is not conducted after an amendment.

• The latest codes are applied to the whole building when extension etc. is conducted.

• A building with conflicts are named “Non-conformed existing building”, and distinguished with “illegal building”.
Outline of the Laws for fire safety of buildings

- Application of FSL amendments to existing buildings
- Retroactivity in FSL
  • Specified fire-prevention objects [buildings and structures] * have to follow an amendment to all fire protection equipment.
  
  Example of fire protection equipment: Fire hydrant, suppression system (sprinkler) etc. (relatively high cost)

  • ALL existing buildings except single dwellings have to follow a new amendment to part of fire protection equipment:
    Fire extinguisher, emergency exit sign lighting etc. (relatively low cost)
  • Fire alarm is required in bed room in single dwellings

* Specified fire-prevention buildings and structures:
  Occupancy type: department store, hospital, night club, hotel, theater, underground shopping district etc., in which heavy casualties would be incurred in case of a fire
Triggers of retroactivity of existing buildings

**Existing non-conformed building**

**Trigger**
- Extension
- Rebuild

**Additional construction**
- Large-scale repair, renovation
- Over ½ of elements etc.

**Conversion**
- Repair, renovation except for the left

**Seismic retrofit based on the Promotion Act**

**No additional Extension etc.**

**New building**
- Latest codes to whole Building*

**Latest codes to whole Building**

**Not necessarily to meet Latest codes**

**Necessarily to meet Latest codes **

To meet Latest codes regarding Seismic regulations

**Not necessarily to meet Latest codes**

Over 1/2 of principal elements

*: Very small scale extension etc. (less than 10m²) are exceptional

**: if occupation of the conversion is similar to the previous occupation, it is not necessary to meet latest codes.
## History of fire incidents and major amendment of BSL and FSL (fire safety)

<table>
<thead>
<tr>
<th>Years</th>
<th>Major fire incidents</th>
<th>BSL</th>
<th>FSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>Established</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>Established</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1953-1959</td>
<td>Theaters</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>1961-</td>
<td>Department stores</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1966-1969</td>
<td>Hotel (Japanese style)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1970-1974</td>
<td>Huge fires in Department stores, etc.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1975-1979</td>
<td>Multitenant building</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1980-1986</td>
<td>Underground shopping district, hotels</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1987</td>
<td>Social welfare facilities</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1989</td>
<td>A condominium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990-1997</td>
<td>Department store</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1998-2000</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2001-2002</td>
<td>Multitenant building</td>
<td>✓</td>
<td>PBC</td>
</tr>
<tr>
<td>2006-2010</td>
<td>Care houses</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>2013-2015</td>
<td>A clinic, Multitenant building</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

✓: relaxation  ✓: restriction  ✓: Performance Based Code
## History of major amendments of BSL (fire safety etc.)

<table>
<thead>
<tr>
<th>Years</th>
<th>Amendments of BSL</th>
</tr>
</thead>
</table>
| 1959  | Definition of Fire resistive structure, Non-combustible material  
       | Fire compartmentation (floor area, different occupancy, penetration seal)  
       | Staircase specification for department store and hall |
| 1961  | Interior finish restriction (IFR) to Night club, Bar, etc. |
| 1963  | IFR to high-rise buildings (over 31m) |
| 1964  | Compartmentation and IFR above11 story (500m² + Non-comb., 200m²+ Quasi-non-comb.)  
       | Specific staircase (staircase with an ancillary room) in buildings with 15 story |
| 1969  | Restriction to Shaft, atrium, stairwell, through 3 story, common path of travel, automatic close fire doors, Specific staircase in basement, Compartment of underground shopping district |
| 1970  | Smoke exhaust equipment, smoke compartment, Emergency EV (over 31m), Rescue entry, Emergency lighting, Width of corridor in stores |
| 1973  | Fire doors with smoke barrier performance for stairwell, restriction of installation of 2 staircases |
| 1981  | Revised seismic design  
       | Fire damper in ducts on penetration, Definition of rooms with no room |
| 1982  | Smoke barrier in EV hall |
| 1987  | Scope of Fire resistive building and quasi-fireproof building |
| 1992  | Definition of quasi-fire resistive building |
| 1993  | Expanded the scope of quasi-fire resistive building |
| 1994  | Barrier free |
| 2000  | Implement of performance based codes |
| 2005  | Extension of buildings |
| 2009  | Approval of total renovation plan for existing building |
| 2015  | Inspection of fire doors, Relaxation of timber buildings and extension of buildings |
Typical conflicts of existing buildings

- A survey of office buildings built before 1972
- The number of sample buildings was around 840.

Building research Institute (Japan) conducted this survey in 2013.
**Typical conflicts of existing buildings**

- **Requirement to Atrium, shaft, high ceiling, stair well, void (1969)**
  - Atrium, Staircase, EV hall, lobby and corridor etc. are not divided by fire doors, fire curtain, and so on.
  - Compartmentations are not clearly defined.

  - Difficulties
    - To add the equipment to buildings after completion, because of low ceiling height, floor height.
    - To exhaust smoke from rooms inside building, because of no window facing the outside

- **Requirement to common path to travel (1969)**
  - Length of overlap of egress routes $\leq 1/2$ of egress route

- **Requirement to smoke barrier on EV hall (1982)**
Typical conflicts of existing buildings

No 2-way egress route
No compartmentation of staircase

No compartmentation between staircase and corridor
Case studies of evaluation safety for existing buildings by a performance-based method

- **Outline of building (Completion of construction: 1968)**
  - Construction: Steel encased Reinforced Concrete
  - Height, Number of floors: 31m, 8F
  - Floor height: 3.6m (2-8 F), 5.2m (1F)
  - Ceiling height: 2.5m (2-8 F), 3.0m (1F)
  - Building area, Total floor area: 615m², 4,951m²

- **Occupancy:** Office
  - 1F: Entrance hall, administration room, restaurant, 2F: Office, well
  - 3-5F: Office (large room type), 6F: Meeting room
  - 7-8F: Office (small room type)

- **Equipment**
  - EV (for occupants) x 2, No emergency EV for fire brigade
  - Air conditioning system: single duct system + fan coil unit
  - Fire protection equipment: Automated fire detector, Fire alarm, Indoor fire hydrant, fire department connection
  - Fire doors without link to fire detectors in staircase (fire doors manually closed as needed)
  - Smoke exhaust equipment: Null

- **Compartmentation**
  - EV, EV hall: Null, Shaft/Staircase: Null
Case studies of the evaluation for existing buildings by a performance-based method

2F floor plan

Smoke barrier with glazing

6F floor plan

Office (315m²)
Results of evaluation before taking measures

- A fire in atrium in 1F

<table>
<thead>
<tr>
<th>Smoke height</th>
<th>Egress time</th>
<th>Smoke descend time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2F office</td>
<td>2.500</td>
<td>2.500</td>
</tr>
<tr>
<td>3F office</td>
<td>2.500</td>
<td>2.500</td>
</tr>
<tr>
<td>4F office</td>
<td>2.500</td>
<td>2.500</td>
</tr>
<tr>
<td>5F office</td>
<td>2.500</td>
<td>2.500</td>
</tr>
<tr>
<td>6F corridor</td>
<td>2.500</td>
<td>2.500</td>
</tr>
<tr>
<td>7F corridor</td>
<td>2.500</td>
<td>2.500</td>
</tr>
<tr>
<td>8F corridor</td>
<td>2.500</td>
<td>2.500</td>
</tr>
</tbody>
</table>

Evacuees escape from outside stair

Staircase and shaft contaminated with smoke because of no smoke barrier in EV, fire doors without link to detectors
Case studies of the evaluation for existing buildings by a performance-based method

• Evaluation of measures
  • Egress from fire room
    • Smoke chamber using space in ceiling
    • Increase in a width of exit doors of fire room
    • Installation of smoke exhaust equipment (difficulties in practice)
  • Egress from fire floor
    • Increase in smoke barrier performance of doors
    • Installation of smoke exhaust equipment (difficulties in practice)
  • Egress from building
    • ✔ Increase in smoke barrier performance of lift landing doors
    • ✔ Installation of automatic closing fire doors linked to fire alarm or fire doors kept close

✔: measures to existing building.
Results of evaluation before/after taking measures

- Effect of the measures
- **A**: Installation of fire doors linked to smoke detectors
- **B**: Installation of A and smoke barrier on EV shaft

![Graph showing smoke height, smoke descend time, and egress time for different scenarios: Existing building, Measures A, and Measures B.](image-url)
Ongoing projects for fire safety of existing buildings

- Promotive projects for building standards provisions
- R&D of a method for improving fire safety performance of existing buildings (2016, Fire safety project No.11)
  - Objective:
    - To promote adequate improvement and renovation of existing buildings
  - Target: Mid – high rise buildings
    - Office, Department store, hotel, complex building, etc.
  - Research contents:
    - A survey on staircase and smoke exhaustion equipment in existing buildings
    - Establishment of step by step practical approach to conform fire regulation in Approval of total renovation plan for existing building
      - Total renovation plan: within 5years or 20years
    - Evaluation of fire prevention measure and control by occupant
Ongoing projects for fire safety of existing buildings

• General technology development projects
  • R&D of a rational fire safety regulation system for utilizing exiting buildings (2016.4-2020.3)

  • Objective:
    • To Utilize historic buildings and valuable existing buildings in local area, such as traditional Japanese dwellings or timber buildings.
    • To encourage renovation or conversion of existing buildings to attractive buildings, e.g. accommodations or restaurants, which conform fire safety performance with remaining its authentic taste.

Example of utilization of traditional existing building

Dwelling → B&B

Office → Shopping mall

Installation of SP for straw roof and street

Development of Fire prevention measures for historical towns
Thank you for your kind attention.