Disaster Management Measures to School Facilities

～Earthquake resistance projects to school facilities and utilization as evacuation shelters～

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Department of Facilities Planning and Administration
# Relation between National assembly, Cabinet and Ministry

<table>
<thead>
<tr>
<th>Authorities to issue</th>
<th>Documents</th>
<th>Main Contents</th>
</tr>
</thead>
</table>
| National assembly    | The Building Standard Law | • Procedures, such as confirmation, permission, certification system  
• Penalties  
• Technical requirements (Outline) |
| Cabinet              | The Enforcement Order | • Technical requirements |
| MLIT (Ministry of Land, Infrastructure, Transport and Tourism) | The Enforcement Regulation of the Ministry | • Procedures (Details, such as application forms)  
• Technical requirements (Details) |
| Notification of the Ministry | | |
MEXT  The Ministry of Education, Culture, Sports, Science and Technology

is preparing guidelines and collections of past examples and making them known to all concerned parties at schools to help them maintain school facilities.

At the same time, MEXT is providing state subsidies to programs for maintaining school facilities, including projects for making facilities earthquake resistant and measures for preventing and suspending their deterioration.
Relation between School Management and National Government

Mainly high schools and special needs schools

Private schools

Mainly kindergartens, elementary and secondary schools
Background

Total Floor Areas of School Building
In Each Type of Construction in Japan
(public elementary and secondary schools)

Wood (73%)
RC (21%)
Steel (6%)

1965
3,619
1,661

2015
127,044
12,339
15,604

(unit:1,000m²)
School facilities are
- places for learning and living for students
- evacuation shelters for local residents in case of disasters*
*80% of all schools are public.
*90.5% of public schools (31,246 schools) are designated as evacuation shelters (as of May 2015)

Number and percentage of schools which have been designated as evacuation shelters (as of May 2015)

<table>
<thead>
<tr>
<th>Types of school</th>
<th>Total number of schools</th>
<th>Number of schools which have been designated as evacuation shelters</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary and Secondary school</td>
<td>29,851</td>
<td>28,177</td>
<td>94.4</td>
</tr>
<tr>
<td>High school</td>
<td>3,593</td>
<td>2,640</td>
<td>73.5</td>
</tr>
<tr>
<td>Secondary school</td>
<td>31</td>
<td>20</td>
<td>64.5</td>
</tr>
<tr>
<td>Special needs school</td>
<td>1,039</td>
<td>409</td>
<td>39.4</td>
</tr>
<tr>
<td>Total</td>
<td>34,514</td>
<td>31,246</td>
<td>90.5</td>
</tr>
</tbody>
</table>
Change of earthquake resistance rates and number of remaining buildings without earthquake resistance (public elementary and secondary schools)

Change of Earthquake Resistance Projects to Public Schools

Number of remaining buildings

Earthquake resistance rate

- Number of remaining buildings
- Earthquake resistance rate
The Great Hanshin Earthquake

- 17 January 1995  05:46
- Magnitude 7.3  
  (shindo/seismic intensity: 7)
- Number of deaths  
  6,437 people
- Damage to school facilities  
  3,883 buildings

Collapse of columns and beams

Collapse of column
Efforts Based on Damage Caused by The Great Hanshin Earthquake

● Enactment of laws
  • Act on Special Measures for Earthquake Disaster Countermeasures (June 1995)
    ➢ Stipulates special measures concerning financial matters of national government regarding earthquake disaster countermeasures for public facilities
  • Act on Promotion of the Earthquake Retrofitting of Buildings (October 1995)
    ➢ Stipulates items regarding promotion of seismic evaluation and earthquake retrofitting

● Subsidy for earthquake resistance projects to school facilities.

● Formulation of guidelines, manuals, and collections of examples pertaining to earthquake resistance projects to school facilities.
If Is value is less than 0.3 (Reinforcement) \((\frac{1}{3} \rightarrow \frac{1}{2} \rightarrow \frac{2}{3})\)

If Is value is more than 0.3 (Reinforcement) \((\frac{1}{3} \rightarrow \frac{1}{2} \rightarrow \frac{1}{2})\)

If Is value is less than 0.3 (Renovation) \((\frac{1}{3} \rightarrow \frac{1}{2})\)
Is Value (seismic index of structure)

- Value is an index to indicate earthquake-resistance performance of buildings and is decided by the following factors:
  ① strength of building ② building shape ③ deterioration due to aging

<table>
<thead>
<tr>
<th>Value index</th>
<th>Seismic Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.3</td>
<td>High risk of collapse against earthquake</td>
</tr>
<tr>
<td>0.3 ≤ Value index &lt; 0.6</td>
<td>There is risk of collapse against earthquake</td>
</tr>
<tr>
<td>0.6 ≤ Value index</td>
<td>Low risk of collapse against earthquake</td>
</tr>
</tbody>
</table>

- MEXT sets a goal for school facilities for a value after an earthquake resistance project to exceed roughly 0.7, considering safety of students at the time of earthquake as well as function as an evacuation site after the disaster.
Guidelines for Promotion of Earthquake-resistant School Buildings (Jul. 2003)


- Indicates how to formulate the promotion plan for earthquake resistance projects in order to proceed with a vast number of earthquake resistance projects promptly and steadily.

- Indicates how to decide which buildings have high priority for earthquake resistance projects.

Summary table on prioritization survey for earthquake resistance projects

<table>
<thead>
<tr>
<th>Classification</th>
<th>Evaluation items</th>
<th>Evaluation levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic classification</td>
<td>Construction year (), Number of floors ()</td>
<td>I II III IV V</td>
</tr>
<tr>
<td>Strength of concrete</td>
<td>Design criteria strength (), Strength test value ()</td>
<td>A B C</td>
</tr>
<tr>
<td>Aging</td>
<td>Corrosion of reinforcing steel (), Cracks ()</td>
<td>A B C</td>
</tr>
<tr>
<td>Plan</td>
<td>Number of span in beam direction (), Length of span in girder direction ()</td>
<td>A B C</td>
</tr>
<tr>
<td>Position of quake resisting walls</td>
<td>Structural frame with missing wall in lower level (), Intervals of walls in beam direction (), With or without of gable walls ()</td>
<td>A B C</td>
</tr>
<tr>
<td>Expected seismic intensity</td>
<td>Expected seismic intensity ()</td>
<td>A B C</td>
</tr>
</tbody>
</table>

Evaluation flow for prioritization

1. High
2. Medium
3. Low
4. Very Low
5. Lowest
Seismic Retrofitting Quick Reference:

School Facilities that Can Withstand Earthquakes ~ Examples of Seismic Retrofitting ~ (Sept. 2006)


- Indicates detailed information on examples of various earthquake reinforcement methods, including cost and period of work.

Steel brace has been added

Shear wall has been added
The Great East Japan Earthquake

- 11 March 2011 14:46
- Magnitude 9.0
  (shindo/seismic intensity: 7)
- Number of deaths and missing: 21,839 people
- Damage to school facilities: 7,988 buildings

Tsunami engulfed up to the 3rd floor of the school building

The school gymnasium was utilized as an evacuation shelter

The gymnasium’s ceiling completely collapsed
Effect of Earthquake Resistance Reinforcement

Area without earthquake resistance reinforcement

Area with earthquake resistance reinforcement

Collapse of column

No major damage
Future Efforts Based on The Great East Japan Earthquake

- **Further promotion of earthquake resistance projects for structures**
- **Promotion of earthquake resistance projects to non-structural features**
  - Measures against suspended ceilings at gymnasiums are a top priority
- **Measures against tsunamis**
  - Development of escape routes to elevated areas, installation of escape stairs to rooftops, relocation to elevated areas
- **Strengthen functioning as evacuation shelters**
The Basic Plan for the Promotion of Education
Cabinet decision on June 14, 2013

Second section:
Educational measures to be implemented for the next 5 years
Basic policy 19: Securing student safety at schools, such as development of an educational research environment and/or enhancement of education for safety.

Earthquake resistance projects for public school facilities shall be promoted steadily, aiming for the completion of earthquake resistance projects as quickly as possible before the end of fiscal year 2015, based on the Basic Policy for Facility Development for Public Compulsory Education Schools.

Forecast of the earthquake resistance rate at the end of fiscal 2016: 98%
Further Promotion for Earthquake Resistance Projects to Non-structural Features

Request for promotion of measures to prevent ceilings, etc., from falling in national, public, and private schools (Aug. 2013 & Aug. 2016)

1. Implementation of a thorough inspection for ceilings, etc., in gymnasiums

○ Among school facilities, ceilings in *gymnasiums, martial arts halls, auditoriums, and indoor swimming pools (in gymnasiums, etc.*) are to be thoroughly inspected if the type of ceiling is any of the following:

1. the height is more than 6 m
   or
2. the horizontal projection area is more than 200 m²

The gymnasium’s ceiling collapsed
2. Implementation of measures to prevent ceilings, etc., from falling in gymnasiums, etc.

- Ceilings in the above-mentioned gymnasiums, etc., are to be improved alongside earthquake resistance projects on a priority basis from high-risk ceilings. Consider measures focusing on removal of ceilings in order to ensure student safety.

- Take measures such as thermal insulation, acoustic issues, etc., into account in order to not alter the utilization of the facility if such ceilings are removed.

- Ongoing projects shall be regarded as non-conforming for existing projects at the time of completion of construction. Therefore, design changes, etc., such as not installing ceilings or installation of light weight ceilings, etc., must be considered.

Request to aim to complete the work before fiscal 2015 for national and public schools.
Indicates concept and procedure for inspections and measures to prevent school gymnasium ceilings from falling due to earthquakes.

Checklist of direction and length for hanging bolts

<table>
<thead>
<tr>
<th>Item</th>
<th>Result of confirmation</th>
<th>Material to be confirmed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction of hanging bolt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Everything is vertically installed</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>□ Some are installed in an oblique direction</td>
<td>Consider removal</td>
<td></td>
</tr>
<tr>
<td>□ Some hanging bolts are installed with bent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ No material to confirm the condition</td>
<td>Site check</td>
<td></td>
</tr>
<tr>
<td>Length of hanging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Less than 3m both XY direction and no hanging bolt is mixed with different length (Length of hanging : m)</td>
<td>OK</td>
<td>rectangle figure, ceiling basic plan</td>
</tr>
<tr>
<td>□ Some hangings exceeds 3m</td>
<td>Consider removal</td>
<td></td>
</tr>
<tr>
<td>□ Hanging bolts with different length are mixed up</td>
<td>Need Consideration</td>
<td></td>
</tr>
<tr>
<td>□ No material to confirm the condition</td>
<td>Site check</td>
<td></td>
</tr>
</tbody>
</table>
Promotion of Earthquake Resistance Projects for Non-structural Features

Collection of examples of measures to prevent gymnasium ceilings, etc., from falling (April 2014) and Supplemental Edition (July 2015)

Indicates details of points to consider when actual measures take place: the review process, outline of measures, cost and work period, for each example.

Example where the ceiling is removed

Removal of ceiling
Guidebook for Earthquake Protection for Non-structural Features of School Facilities (Revised Edition / Mar. 2015)

Indicates contents and methods of inspections and measures in a plain way so that school teachers and school administrators will be able to perform inspections and measures for non-structural featured based on the status of each.

**<Examples of inspection items done by school teachers>**

Are racks and lockers fixed to walls or floors with metal fittings?

- Example where racks are combined and attached together.
- Example where the bottom of a rack is attached to the floor.

**<Examples of inspection items done by school establishers>**

Is there any flaking, chipping, cracking, or floating?

- Flaking of mortar
- Floating of mortar

Example of countermeasure:

- Outer wall concrete
- Hollow
- Mortar finish
- Interior finish material
- Anchor pin
- Epoxy injection

English version can be downloaded from: http://www.nier.go.jp/shisetsu/pdf/e-gijyutsu2.pdf
## Enhancement of Functioning as Evacuation Shelters

### Ideal State of Disaster-resilient School Facilities

~ Tsunami protection measures and enhancement of disaster functioning as evacuation shelter ~ (Mar. 2014)


#### Necessary functions for school facilities which can be used as evacuation shelter

<table>
<thead>
<tr>
<th>Social situation</th>
<th>Situations at the shelter</th>
<th>Basic conditions of school facilities</th>
<th>Functions necessary for a shelter (for emergency)</th>
<th>Space necessary for a shelter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifesaving/evacuation stage (just after the disaster)</td>
<td>Occurrence of tsunami disrupted lifelines and disconnected information communication</td>
<td>Local residents evacuated to school</td>
<td><strong>Earthquake protection (including for nonstructural members, fire resistance)</strong></td>
<td>Living/operation spaces</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Barrier-free environment, thermal insulation</strong></td>
<td>Stockpile of food, drinking water, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Information, communication</strong></td>
<td></td>
</tr>
<tr>
<td>Lifesecuring stage (for several days after the disaster)</td>
<td>Opening of emergency evacuation shelter operated by the municipality</td>
<td>Arrival of relief supplies</td>
<td><strong>Securing subsistence at the shelter</strong></td>
<td>Spaces dedicated to students with disability, the elderly, expectant and nursing mothers, infectious disease patients, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Transition to the operation by a self-governing organization; start of volunteer activities</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>transition to sound living at the shelter</strong></td>
<td></td>
</tr>
<tr>
<td>Ensuring sheltered life stage (for several days after the disaster)</td>
<td>Gradual restoration of lifelines and information communication</td>
<td>Gradual restoration of lifelines and information communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School function resuming stage (several months after the disaster)</td>
<td>Resumption of school activities (Coexistence of emergency evacuation functions and school functions)</td>
<td>Resumption of school activities (Coexistence of emergency evacuation functions and school functions)</td>
<td>Dissolution of the shelter; normalization</td>
<td>Space to store relief supplies</td>
</tr>
</tbody>
</table>
Necessary functions for school facilities which can be utilized as evacuation shelter

**Earthquake protection, fire resistance, barrier-free environment, thermal insulation**
* Improvement of these basic functions for school facilities is important also for strengthening of their function as a shelter.

**Information communication**
* It is important to develop reception equipment for disaster management administration radio communications and the school broadcasting system in preparation for power failure, etc. in order to obtain disaster information and communicate it at the school during the lifesaving/evacuation stage  
* It is important to develop radio equipment capable of intercommunication for communication with the town (village) office, etc.

**Stockpile warehouse**
* It is important to secure a stockpile according to the assumed number of evacuees in a place safe from disasters
Necessary functions for school facilities which can be utilized as evacuation shelters

**Electricity, gas**
* It is important to store portable generators, etc. to secure power for lighting and other equipment. It is desirable to install photovoltaic power generation equipment capable of self-sustaining operation.
* It is important to secure LP gas, portable gas stove, etc. as a heat source for cooking because the existing heat source may become unusable.

**Toilet**
* It is important to secure the necessary number of toilets in combination with multiple types including manhole toilet and portable toilet assuming water outage and other situations.
* It is effective to install piping and pumps to use swimming pool water for flushing ordinary toilets and manhole toilets.

Photovoltaic power generation equipment capable of self-sustaining operation

Installation of large water-collecting tank

Installation of faucets to an water receiving tank
Changes in installation ratio of disaster management facilities and equipment at school

Enhancement of Function as Evacuation Shelters

National government subsidy pertaining to the enhancement of functioning as evacuation shelters

- Disaster management enhancement project
  Subsidy for installation of stockpile warehouses, freshwater tanks, fire cisterns, wells, and outdoor toilets as well as a non-utility generation facility. Target: public schools, Subsidy rate: 1/3
The 2016 Kumamoto Earthquake

- **14 April 2016 21:26**
  - Magnitude 6.5
    - *(shindo/seismic intensity: 7)*

- **16 April 2016 1:25**
  - Magnitude 7.3
    - *(shindo/seismic intensity: 7)*

- Over 2000 times of aftershocks had followed

- Number of deaths and missing: 49 people

- Damage to school facilities: 942 buildings

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Tsunami engulfed up to the 3rd floor of the school building
The school gymnasium was utilized as an evacuation shelter
The corridor's ceiling collapsed
The gymnasium's ceiling collapsed
April 16, 2016  Kumamoto Earthquake

June 13, 2016

A committee was established to advance the discussion on the following topics:

1. Validating the existing schools facilities against disaster risks, considering the damages to school buildings and experience served as evacuation centers
2. Examining the key issues for enhancement of school facilities

July 28, 2016

“Post-Kumamoto Earthquake: Urgent Recommendation for School Facility Improvement”

Committee Members

- Experts on School building design
- Experts on Structural engineering (Reinforced concrete and Steel structures)
- Experts on non-structural elements of buildings
- Local government officials (different size of governments)
- Experts on Disaster Preparedness
- MEXT officials (secretariat)

Advance the policy implementation to improve the disaster resilience of school facilities.