

Urgent Recommendation
“Concerning School Facility Improvement
in Light of the Damage Caused by the Great East Japan Earthquake”

July 2011

Investigative Commission on School Facility Improvement in Light of
the Damage Caused by the Great East Japan Earthquake

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Introduction

We send our deep and abiding sympathy and prayers to the victims of the Great East Japan Earthquake of March 11, 2011, and also offer our deepest sympathies to all who were affected by the disaster.

In this disaster, the earthquake and tsunami caused a variety of damage to school facilities as well. Furthermore, while school facilities served as evacuation sites for school children and local residents, various problems appeared concerning the securement of safety, emergency evacuation and living in evacuation sites from just after the disaster until the resumption of schools.

The Investigative Commission conducted studies in order to apply the lessons learned from the disaster to the restoration and reconstruction of the afflicted areas while at the same time helping with the reinforcement of disaster-prevention and safety functions at schools across the nation.

The human and property damage caused by the disaster are so widespread and extensive that we haven't been able to grasp the details of all the damage. In addition, the accident at the Fukushima No.1 nuclear power plant is not yet completely over, preventing work for the recovery of schools situated inside the nuclear evacuation zone. However, considering that it is important to present effective measures for the improvement of school facilities as early as possible, the Investigative Commission had multiple discussions based on the currently available information and presents this urgent recommendation. We hope this recommendation will contribute to the strengthening of the disaster-prevention and safety functions of school facilities across the nation, as well as the recovery and reconstruction of the afflicted areas. We also hope this will serve as a reference for the strengthening of the disaster-prevention and safety functions of social education and sports facilities.

In the future, the analysis of the damage caused by the earthquake disaster will progress through the efforts of researchers and people involved in education, which will provide new knowledge that this recommendation could not present. In addition to the above, we expect that the Ministry of Education, Culture, Sports, Science and Technology (MEXT) will make further efforts on developing strategies for school establishments nationwide to improve school facilities.

Throughout the committee sessions, all members shared the conviction that "schools build a community bonds. The key to the reconstruction of the afflicted areas is the reconstruction of their schools." We sincerely hope that people in the afflicted areas, encouraged by the resumption of their schools and using the reconstruction of their schools as a stepping stone, will reconstruct the areas and regenerate local communities.

July 2011

Satoru NAGASAWA

Chair, Investigative Commission on School Facility Improvement in Light of the Damage Caused by the Great East Japan Earthquake

Chapter 1 Ensuring the Safety of School Facilities

(1) Promotion of earthquake protection for main structure

Points

- Some school facilities without earthquake resistance suffered significant damage in their structure.
- The rate of earthquake resistant school facilities is 73.3%* of all schools in the nation, which means that further promotion of earthquake residence of schools is required all over Japan.

* Rate of earthquake resistant public elementary and lower secondary school facilities as of April 1, 2010.

Damage to structure



Collapsed pillars and walls (school facilities built according to the old quake-resistance standards)



Comparison of the damage to the part with seismic reinforcement with the damage to the part without reinforcement
(Seismic retrofitting for the damaged part had been scheduled for the next year.)

(Damage to school facilities caused by the earthquake)

- Speaking of the damage known at present, while some school facilities (reinforced concrete school buildings) that had been built before the new quake-resistance standards (1981) and had not been retrofitted seismically suffered significant damage, such as the collapse of pillars/walls, most of the school facilities built after the new quake-resistance standards and those that had been reinforced experienced small or no damage. Regarding human damage, the Ministry received no reports of death caused by the collapse, etc. of a school facility.

(Impact of the earthquake motion on buildings)

- Wide areas were afflicted by this earthquake due to its large magnitude but, the observed earthquake motion in almost all regions was not the strongest to be assumed for school facilities because of the long distance from the earthquake center. For example, earthquake motion observed in not a few recent epicentral earthquakes obviously could cause greater damage to school facilities than the earthquake motion of the Great East Japan Earthquake.
- Consequently, future possible epicentral inland earthquake, even with lower magnitude levels, can have greater earthquake motion, causing greater damage.

(Further promotion of seismic strengthening of school facilities nationwide)

- From above, it became apparent again that ensuring the earthquake protection of school facilities is essential for securing the safety of children. However, the rate of earthquake resistant public elementary and lower secondary school facilities nationwide is still 73.3% as of April 1, 2010, which means approximately 30% of school facilities are without adequate earthquake protection. We need to further promote the seismic strengthening of school facilities all over Japan. In order to minimize damage due to the earthquake, it is necessary to improve earthquake protection further toward the level that enables continued use after a great earthquake.

(Planning and design for minimizing damage and maintaining functions after an earthquake)

- No major damage such as collapse was found to have occurred in school gymnasiums or school facilities of mixed structure (steel construction + reinforced concrete structure; timber structure + reinforced concrete structure) built after the enforcement of the new quake-resistance standards. However, there were cases where damage to structural members, such as concrete falling from joints between reinforced concrete and steel structures, made places unusable for emergency evacuation. Measures such as reinforcing joints or preventing falling are desirable.

- Some school facilities that had been seismically reinforced suffered only minor damage, but the damage to their nonstructural members required restoration work before the resumption of use. It is desirable to adopt a reinforcement design with flexibility, such as controlling structure deformation in addition to seismic strengthening of nonstructural members.

- In new construction or earthquake reinforcement of school facilities, it is necessary to not only ensure safety against collapse at the maximum possible earthquake motion but also to devise planning and design to limit damage to the lower level so that the facilities' functions would be maintained. Examples are: design with flexibility in bearing the force of pillars/beams if the spans in the direction of beams are large in a special classroom and; ensure high-level earthquake resistance of a reinforced concrete school building by balancing an earthquake-resisting wall in the ridge direction. For a steel gymnasium, design with flexibility in the stiffness of braces, the integrity of the roof, and joints between concrete and steel, and carry out detailed examination as needed.

- ★ Specialized and technical consultation concerning the earthquake protection of school facilities is provided at the consulting service for the promotion of earthquake resistance of school facilities (MEXT)
http://www.mext.go.jp/a_menu/shisetu/bousai/taishin/03061201/004.htm

(2)Earthquake protection for nonstructural members

Points

- Many school facilities suffered damage in their nonstructural members.*
- It is necessary to promptly take earthquake protection measures for nonstructural members as well as seismic reinforcement of the structure.
- Measures are needed especially to prevent ceiling materials, lighting equipment, outer walls (armoring material) and basket goals in gymnasiums from falling because it could possibly cause a fatal accident.
- Because social sports facilities and gymnasiums face similar risks, it is necessary to advance measures to prevent ceiling materials, lighting equipment, etc. from falling.

* Nonstructural members: members not included in the structure that is the primary subject of a structural design. They include ceiling materials, interior/armoring materials, lighting fittings, equipment items, window panes and furniture. Structural members include pillars, beams, walls and floors.

Damage to nonstructural members



Fallen ceiling material and lighting fittings

A case where students were injured by falling ceiling material

At lower secondary school in Tochigi Prefecture

- When students gathered in a gymnasium for a meeting to evaluate the graduation ceremony of the previous day, an earthquake of upper 5 intensity caused ceiling materials to collapse, leading to seven iron covers of lighting equipment falling.
- One school girl suffered a cut that required eight surgical stitches, and 19 students received hospital treatment for injuries such as contusions

(Summary of an article in Yomiuri Shimbun on March 24).



Cases of basket goals falling near evacuees

In gymnasiums used as emergency evacuation sites in Miyagi Prefecture

- In gymnasiums throughout Miyagi Prefecture where people evacuated to, many basket goals fixed to the ceiling or a wall were found broken.
- In an elementary school gymnasium in Sendai city, a goal board started to lean due to the breakage of fixing brackets, which forced about 400 evacuees to move to an adjacent school building.
- In a gymnasium in Onagawa town, a goal board fell near evacuees during an aftershock.

(Summary from articles in the April 15 issue of Asahi Shimbun)

(Damage to nonstructural members of school facilities)

- In this earthquake disaster, many school facilities suffered damage to nonstructural members, such as falling ceiling materials, lighting fittings and outer walls (armoring materials). The falling of nonstructural members not only caused injury but also made the school facilities unusable as emergency evacuation sites, which again reminded us of the importance of earthquake protection of nonstructural members.
- Nonstructural members may be damaged even when there is only minor damage to the main structure. Examples of the damage to nonstructural members in public school facilities reported to the MEXT are as follows.

(As of June 16, 2011)

Damage to ceiling materials	Damage to light fittings	Damage to outer walls (armoring materials)
1,636 schools	410 schools	968 schools

*Damage (falling, damage, etc.) confirmed based on reports made by boards of education.

(Approach to earthquake protection measures for nonstructural members)

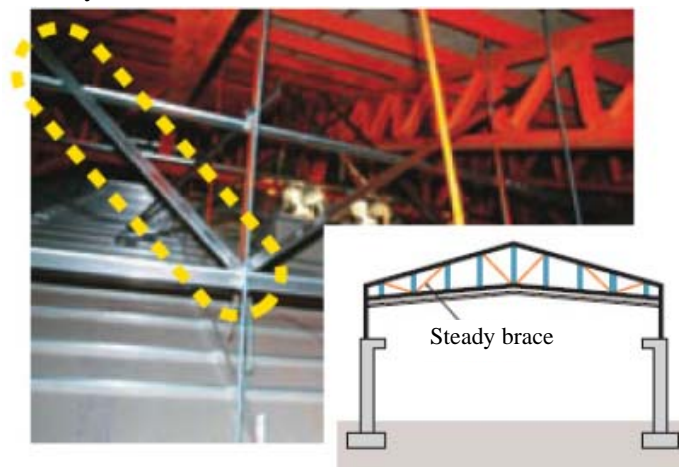
- There is a large variety of nonstructural members, and measures for them are also diverse. However, it is necessary to promptly start from available measures in order to nip possible dangers in the bud as much as possible and reduce the possible earthquake damage.
- Based on this approach, in future improvement of school facilities, it is critical to take earthquake protection measures not only for structures but also for nonstructural members, including the prevention of ceiling materials, light fittings, outer wall (armoring materials), equipment items, and furniture, etc. from falling and window glass from shattering, so that school facilities can ensure the safety of students and other people at the time of an earthquake and also serve as emergency evacuation sites.

(Earthquake protection measures for nonstructural members in a gymnasium)

- In a high-ceilinged gymnasium, in particular, falling ceiling materials, lighting fittings, etc. could cause a worse disaster because a large number of students frequently gather for physical education, meeting and other events, and because there is no furniture to serve as cover. Furthermore, damage to nonstructural members could make the gymnasium unusable for emergency evacuation after an earthquake. In this earthquake disaster, some gymnasiums were not used just because damage was found on their outer walls (armoring materials). Therefore, it is necessary to promote the earthquake protection of nonstructural members using the following specific measures as reference:
- High-ceilinged social sports facilities encompassing large spaces also require earthquake protection measures for nonstructural members, such as the prevention of ceiling materials, light fittings, etc. from falling.
- Because earthquake protection measures for ceiling materials, etc. of a large space, such as a gymnasium, require close considerations of each facility, it is important to cooperate with specialists, such as architects.
- Examples of specific measures to prevent ceiling materials, light fittings, outer walls (armoring materials), and basket goals from falling are as follows: (Source: “Protecting Children from Falling and Tumbling Objects due to an Earthquake—Guidebook for Earthquake Protection for Nonstructural Members of School Facilities—”

[Ceiling material]

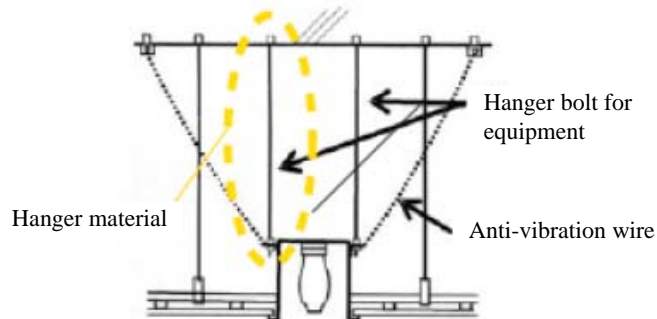
- Installation of steady brace
- Removal of ceiling material; use of a lighter ceiling material (finish board)
- Installation of a safety net



(Example of installation of steady braces)

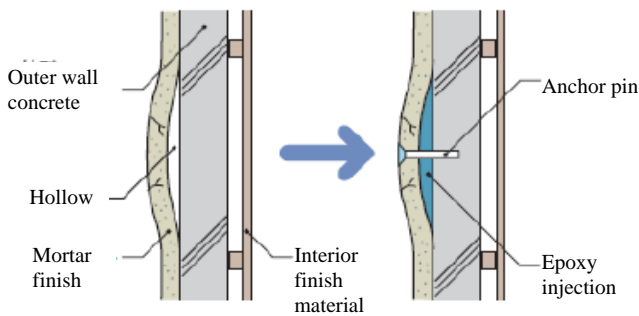
[Lighting equipment]

- Hang high-mass lighting equipment directly from the structure. In this process, install steady braces for lighting equipment.

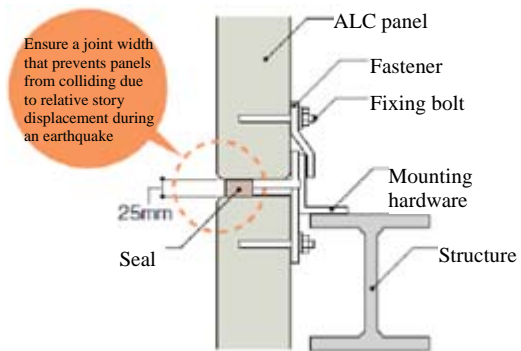


[Outer wall (armoring material)]

- Reinforce with an anchor pin (for mortar wall)
- Install outer wall (armoring material) using a mounting method with high tolerance to relative story displacement (for ALC panel)



(Example of reinforcement with an anchor pin)



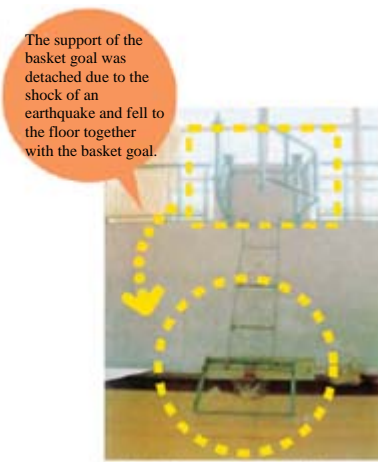
(Example of a mounting method with high tolerance to relative story displacement (Locking method))

[Basket goal]

- Fasten basket goals securely to the supporting material tightly clenching the mounting hardware.
- If any mounting hardware is loose, the basket goal could fall off due to the shock of an earthquake.



Basket goal attached to the ceiling



Fallen basket goal

(Implementation of earthquake protection inspection; measures for nonstructural members in existing facilities)

- It is necessary to implement the inspection of nonstructural members and take measures as early as possible in preparation for a large-scale earthquake. Simultaneous implementation of inspection/measures is desirable for early implementation, but, if this is difficult due to the situation of the school establisher, it is important to start implementation from what you can do. For example, you may implement the inspection at the same time as a seismic diagnosis of the main structure and advance measures at the same time as seismic reinforcement of the structure or large-scale repair work
- The seismic capacity of nonstructural members may be affected by deterioration due to aging, etc., therefore, continuing and regular inspections are required. For integrated and efficient implementation of such inspections and measures you may use statutory inspections, such as those based on the Building Standards Act. To ensure smooth implementation of inspections and measures, it is important to work with the school personnel and related departments, such as those in charge of architecture, as well as experts, including architects. The cooperation of school personnel is essential, especially for inspection, because they can easily discover defects in facilities and equipment while using school facilities on a daily basis.

(Utilization of the guidebook)

- Specific examples of the inspection and measures described above are compiled in “Protecting Children from Falling and Tumbling Objects due to an Earthquake—Guidebook for Earthquake Protection for Nonstructural Members of School Facilities—” (March 2010, Ministry of Education, Culture, Sports, Science and Technology). The cooperation of school personnel, in addition to that of school establishers, is essential for earthquake protection measures for nonstructural members; therefore, it is important that both school establishers and personnel promote earthquake protection measures for nonstructural members by using this guidebook.

★ “Protecting Children from Falling and Tumbling Objects due to an Earthquake—Guidebook for Earthquake Protection for Nonstructural Members of School Facilities—” is downloadable from:

<http://www.nier.go.jp/shisetsu/pdf/e-hikouzou.pdf>

(3) Inner walls (interior material)



(School)
Are there no abnormalities, such as cracks?

(Establisher)
Is the board not bulging, loose, sheared or uneven?

(2) Lighting equipment



(School)
Are there no abnormalities, such as deformation or corrosion, in lighting equipment?
(Establisher)

Is the hanging material of the lighting equipment secured to support material?

(1) Ceiling



(School)
Are there no abnormalities, such as breakage, in the ceiling material (finish board)?

(Establisher)
Is the hanging material of the ceiling material secured to support material?

(7) Window/Glass



(School)
Are there no abnormalities, such as cracks, in the windowpanes?

(Establisher)
Is hardened putty not used to fix glass in fixed windows?

(4) Athletic instruments



(School/Establisher)
Is the mounting bracket not corroded, broken, etc.?

(6) Broadcast equipment



(School/Establisher)
Is the mounting bracket not corroded, broken, etc.?

(5) Pianos, etc.



(School/Establisher)
Have any measures been taken to prevent pianos from skidding or tumbling?

Examples of items to be inspected by school/establisher

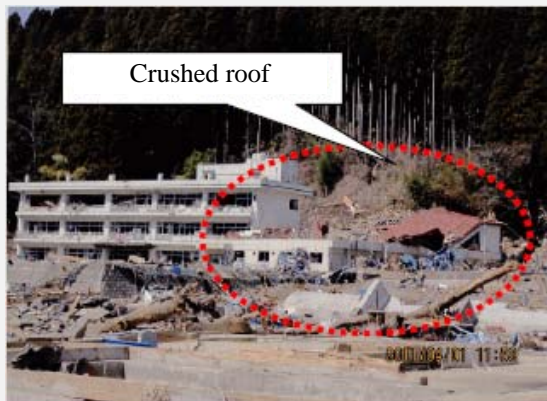
(Source: "Protecting Children from Falling and Tumbling Objects due to an Earthquake—Guidebook for Earthquake Protection for Nonstructural Members of School Facilities—")

(3) Tsunami protection measures

Points

- In order to protect children and local residents, necessary measures shall be taken in the areas afflicted by the tsunami and in other areas that face the risk of flooding due to a tsunami, using the following examples as a reference according to the situations of each area.
 - Build school facilities on safe higher ground where a tsunami will not reach, if a site is available.
 - Improve escape routes to ensure immediate evacuation to a safe place, such as a nearby elevated area or a hill behind the school.
 - If flooding will never reach upper floors, install outdoor emergency stairs that ensure immediate evacuation to the upper floors and improve the rooftop so that it can serve as an emergency evacuation site.
 - Make the school building tall so that upper floors can serve as safe emergency evacuation sites.
- Pay due consideration to the relationship between the school and the community when taking any of the measures above because the commuting of students requires attention and also because a school is the center of the local community and therefore they are closely related.
- Even if improvement of school facilities as effective measures against a tsunami is difficult, it is necessary to take sufficient measures for safe evacuation, such as evacuation drills.

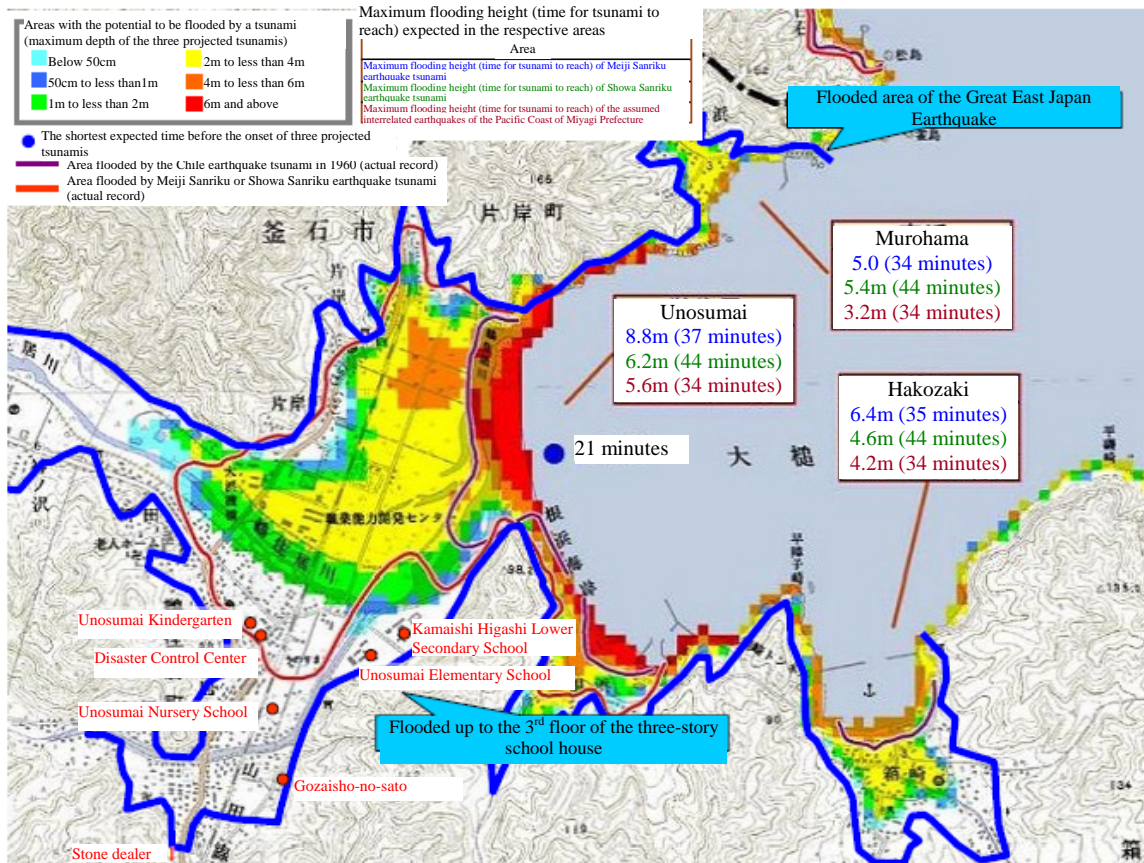
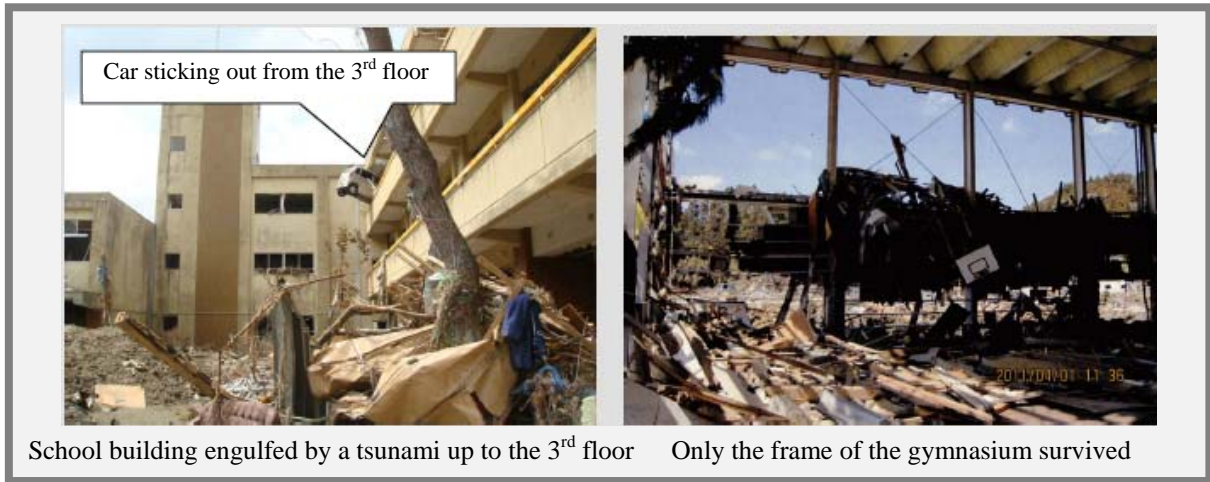
Damage caused by tsunami



Badly damaged gymnasium



Wall is lost due to water pressure



Comparison of the flooding levels assumed in the Tsunami Hazard Map and actual level of flooding (Otsuchi Bay)

(Need to review tsunami protection measures)

- In the Great East Japan Earthquake, tsunamis beyond the scope of assumption occurred in each area and caused catastrophic damage to buildings of the flooded areas. School facilities also suffered extensive damage, such as a smashed steel gymnasium, a gymnasium that maintained only its frame without any function as a building, and buildings flooded up to

their rooftops. In light of these damages, tsunami protection measures for schools in coastal areas need to be reviewed.

Flooding level/ area	Rikuzentakada	Minamisannriku	Sendai	Yamamoto
Assumed inundation height	Approx. 6m	Approx. 4m	Approx. 3m	Approx. 3m
Inundation height of this disaster	15.4m	15.85m	11.77m	13.6m

Comparison of the assumed inundation height and the actual flooding level of the disaster in four areas

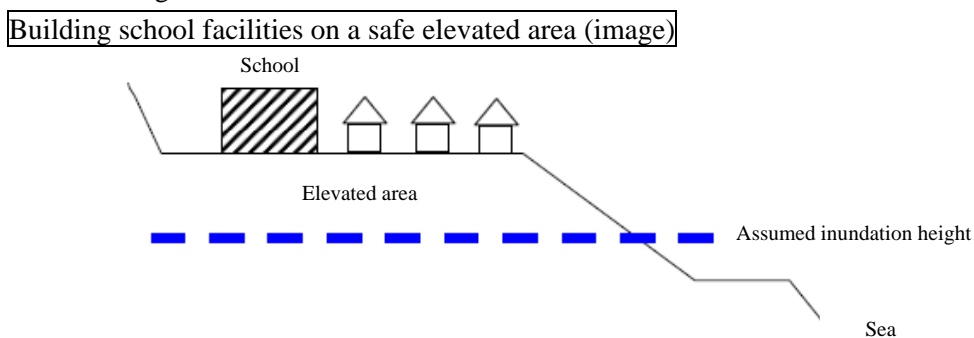
- Local governments of the coastal region will review their tsunami hazard map including the height and area of flooding in light of the disaster. In tsunami protection measures for school facilities, it is important to review the location and safety measures in light of the assumed height of tsunami and the time before it reaches, and carefully consider infants, younger elementary school children, students with disabilities and others who need more time and support for evacuation.

(Relation between reconstruction program and tsunami protection program)

- In discussions on the reconstruction programs in the afflicted areas, various ideas are considered, including: relocation of the entire community to higher ground; tsunami protection measures combining disaster prevention facilities, such as dikes, with public facilities that would serve as evacuation sites, and; similar plans where the community would be developed around schools. In these reconstruction programs and reviewing of tsunami protection measures by local governments across the nation, it is important to take adequate tsunami protection measures according to the role expected of the respective school facilities as places to ensure the safety and security of the community and further to be the center of the community. Examples of specific measures are provided below.

(Building school facilities on a safe elevated area, etc.)

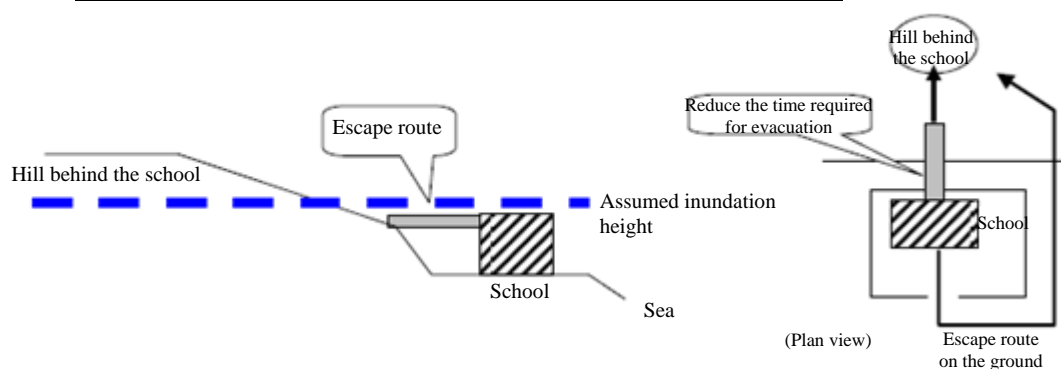
- It is necessary to build school facilities on safe higher ground that a tsunami will not reach in order to make sure to protect children’s lives, if a site is available. In this case, it is necessary to pay attention to the relationship between the community and the school as well as the commuting distance.



(Improvement of escape routes)

- If a safe evacuation area, such as an elevated area or a hill, is available near the school, it is necessary to take measures to ensure safe and rapid evacuation to a place that a tsunami will not reach by developing escape routes/stairs to a hill behind the school, for example. For the development of escape routes outside the school premises and other disaster preparedness functions, such as the storage of supplies in the evacuation site, it is necessary to advance evacuation measures in close coordination with the disaster prevention department, etc.

Improvement of escape routes to a hill behind the school (image)



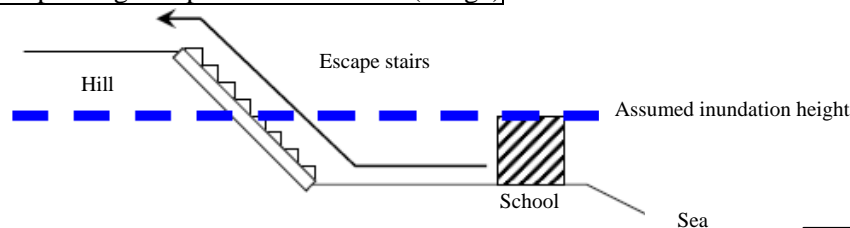
Example of succeeding in rapid evacuation using an escape slope

(Elementary school in Iwate Prefecture)

- A three-story school house was engulfed by the tsunami but all the school children and personnel evacuated safely.
- The escape slope for evacuation to an elevated area, completed in October last year, was useful for rapid evacuation.
- The escape slope reduced the time for evacuation from six or seven minutes on average to less than four minutes.

(Summary of an article of Yomiuri Shimbun on March 28)

Building/improving escape stairs to the hill (image)



Example of succeeding in rapid evacuation using escape stairs

(Elementary school in Iwate Prefecture)

- Because the old escape route to the elevated area was a long detour, a flight of approximately 30 meter-long escape stairs (with night guidance lights) was installed.
- The school building, gymnasium and schoolyard were flooded by the tsunami, but all students safely evacuated using these escape stairs.

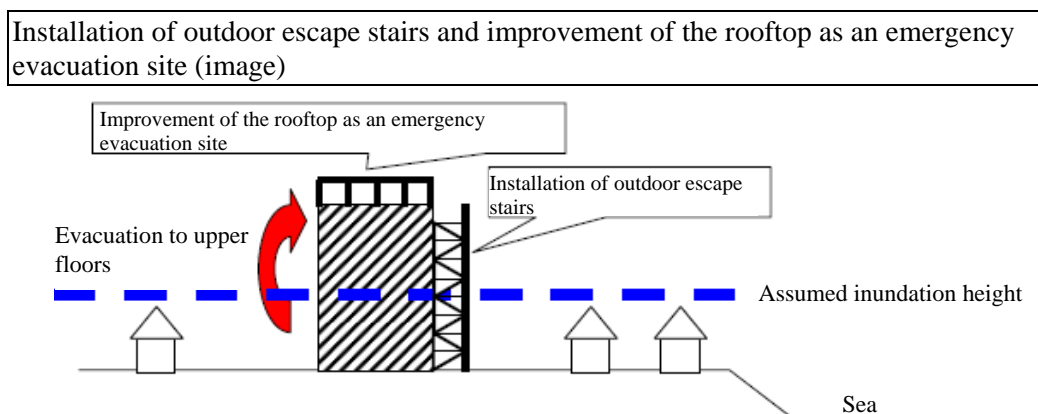
An evacuation drill



(Installation of outdoor escape stairs and improvement of rooftop)

- If inundation will never reach the upper floors of the school facilities and people are to evacuate to the upper floors, it is necessary to take such measures as installing outdoor emergency stairs that ensure immediate evacuation to the upper floors from outside the building and improving the rooftop so that it can serve as a safe emergency evacuation site. In this case, pay attention to the following:

- Ensure sufficient earthquake resistance of the outdoor escape stairs
- Ensure the width of the stairs for safe and rapid evacuation
- Ensure enough evacuation space on the rooftop, etc.
- Take safety measures, such as installing railings on the rooftop
- Plan the storage of enough supplies, including water, food and blankets, to last several days until rescue on a floor that will not be flooded.

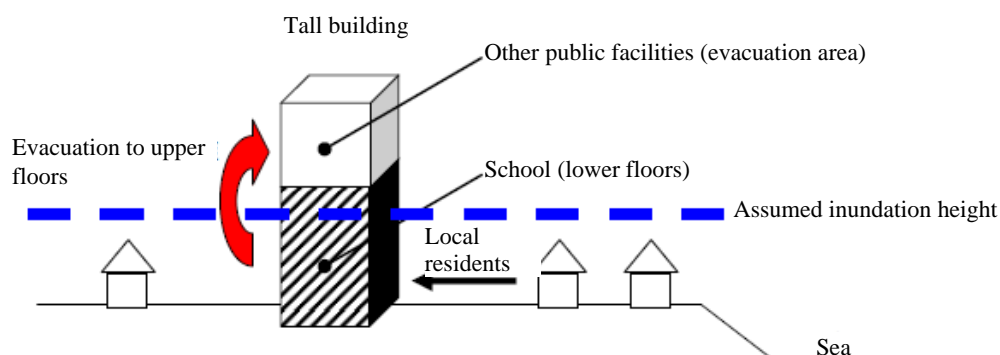


(Construction of a tall building)

- When building a tall school building so that the upper floors can serve as a safe emergency evacuation site, decide the height of the building after giving due consideration to the assumed inundation height, and plan an evacuation floor at a safe elevation. In areas where the assumed inundation height of a tsunami is extremely high, there is the option of constructing a tall building as a complex with other public facilities. It is necessary to plan adequate traffic lines and crime prevention to avoid adverse effects on school functions, while also paying attention to the connection thereof with the school playground in everyday school life, particularly for kindergarten and elementary schools.
- Tall buildings require more caution against earthquakes than lower buildings, therefore it is necessary to plan and design them with careful attention to their structure so that they can maintain their function after an earthquake. They shall have a reinforced concrete structure or steel-reinforced concrete structure, which are believed to be relatively resistant to the water pressure of a tsunami. They require careful consideration of safety, including the strength of the foundation.

- In a region that has no safe evacuation site around its schools, school facilities may be the only evacuation site for local residents. In such case, it is necessary to take measures as follows assuming the evacuation of local residents, in good coordination with the disaster prevention department, etc.
 - Ensure enough evacuation floor space according to the assumed number of local residents who will evacuate there.
 - Install outdoor stairs for rapid evacuation from outside (ensure sufficient earthquake resistance of the stairs.)
 - Ensure high visibility by measures such as installing easy-to-understand guiding signs so that anyone can easily evacuate.
 - Install guide lights, etc. to ensure safe and smooth evacuation at night.
 - Ensure the width of the entrance and steps for safe and smooth evacuation.
 - Plan the storage of enough supplies, including water, food and blankets, to last for several days until rescue on a floor that will not be flooded.

Construction of a tall building as a complex with other public facilities



(Tsunami protection measures, such as evacuation drills)

- Improvement of school facilities as effective measures against tsunamis may be difficult in some areas. In such cases it is necessary to ensure safe escape from a tsunami to a safe evacuation site by taking sufficient measures, including evacuation drills.

(Review of assumptions concerning disasters other than tsunami)

- The Great East Japan Earthquake inflicted further damage because the height of the tsunami greatly exceeded the assumed level. It is important to review the assumption of other disasters such as floods, tidal waves and landslides as needed and take adequate measures to ensure children's safety.

Chapter 2 Securement of School Facilities' Function as Centers for the Local Community

(1) Enhancement of disaster prevention function of school facilities

(Need to improve disaster prevention functions of school facilities)

- After the occurrence of the earthquake, many school children remained in the school and lived in classrooms for several days before they were handed over to their guardians. In addition, many school facilities were designated as an emergency evacuation site and provided shelter to local residents. However, while schools were serving as emergency evacuation sites for children and local residents, various problems concerning living in a shelter emerged from just after the earthquake to the time when school activities were resumed.

Number of schools used as emergency evacuation sites (at the peak on March 17, 2011)

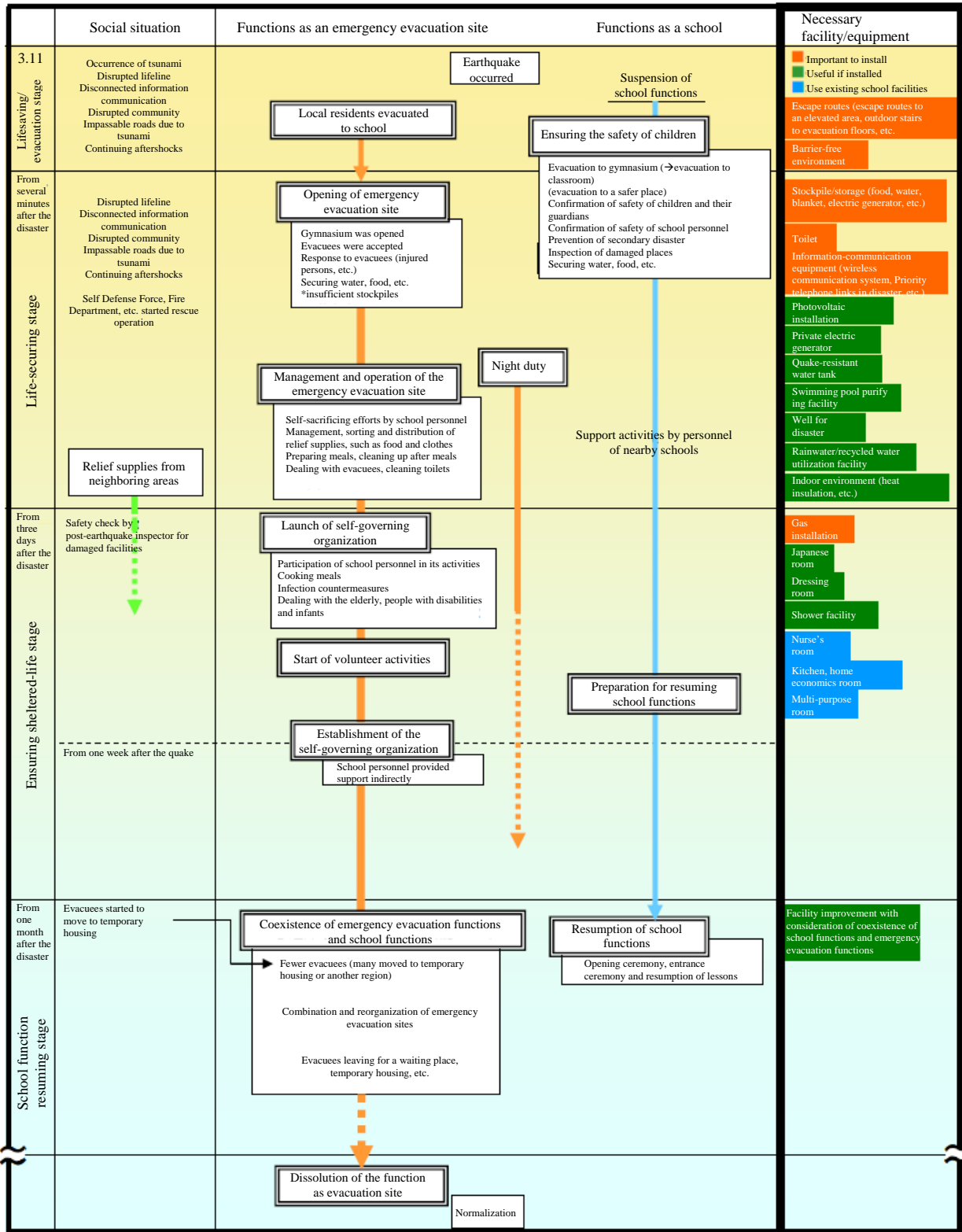
Iwate	Miyagi	Fukushima	Ibaraki	Other (Tokyo and 6 prefectures)	Total
64	310	149	75	24	622

- In light of the disaster, there is a need to change the way of thinking in future development/improvement of school facilities to provide functions necessary for emergency evacuation sites in addition to educational functions so that schools can fulfill their important role as emergency evacuation sites for children and local residents.
- It is also important to use knowledge and lessons learned from the disaster for the future improvement of school facilities and to pass on the knowledge and techniques for the improvement and operation of disaster prevention functions of schools.
- Furthermore, after the earthquake there were cases where people with disabilities were not accepted in some shelters or found life in a shelter difficult. In light of these cases, when improving school facilities as emergency evacuation sites, it is necessary to improve the environment for smooth acceptance of people requiring assistance, including those with disabilities, by making arrangements for accepting them or designating special needs schools as welfare evacuation sites, for example. In this case, it is desirable that prefectural boards of education, welfare departments and local governments cooperate in advance.

(Disaster prevention functions of school facilities required at each stage after a disaster)

- The process until the resumption of school functions will vary depending on the scale and the level of the disaster, but we divided the period from the beginning of this earthquake disaster to the resumption of school into four stages, for examination: (1) lifesaving/evacuation stage (just after the disaster to evacuation); (2) life-securing stage (several days from just after the evacuation); (3) ensuring sheltered-life stage (several days to several weeks after the disaster) and; (4) school function resuming stage (several weeks to several months after the disaster).
- First, we organized the facilities and equipment that would be necessary for functions as a school and emergency evacuation site into the table on the next page based on the interviews, etc. of the personnel of schools that served as emergency evacuation sites during the disaster. In the following pages we listed points to consider, etc. when improving facilities/equipment for each stage from (1) to (4).
- When developing or reviewing local disaster prevention plans, local governments, after defining the extent of the role as an emergency evacuation site that school facilities should fulfill, are required to determine facilities and equipment that school facilities should have. It is also necessary for the board of education and the disaster management department to cooperate to determine the expected scope and number of evacuees beforehand.
- It is important that schools improve their educational environment and provide school children with the opportunity to learn as soon as possible after a disaster. Furthermore, the resumption of a school can inspire moves toward the restoration and reconstruction of the community and energize the community toward its restoration and reconstruction. With this in mind, it is necessary, before the occurrence of a disaster, to plan the space to be used by local residents and the area to be opened for local residents based on the functions of individual special classrooms, so that education activities can be resumed smoothly when the school is used as an emergency evacuation site.
- In August 2007, the National Institute for Educational Policy Research compiled approaches and measures concerning the improvement of disaster prevention functions of school facilities in “For Functional Improvement of School Facilities for Disaster Prevention—Investigative Research Report on Disaster Prevention Capability at School Facilities when Utilized as an Emergency Evacuation Site—“
- ★ “For Functional Improvement of School Facilities for Disaster Prevention—Investigative Research Report on Disaster Prevention Capability at School Facilities when Utilized as an Emergency Evacuation Site—” is downloadable at:
<http://www.nier.go.jp/shisetsu/pdf/e-bousaitsuiki.pdf>

Facilities and equipment that are considered necessary based on an example of the process up to the resumption of school functions





Emergency evacuation site (gymnasium)

1) Lifesaving/ evacuation stage (from just after the disaster to evacuation)

This is the period from just after the disaster until the time when school children and local residents complete evacuation to schools that are emergency evacuation sites. Measures to ensure smooth evacuation are required.

School facilities where people evacuate safely

Cases from the Great East Japan Earthquake

- The first floor of the school building was flooded by the tsunami but people were saved by fleeing to upper floors.
- The tsunami came in a short period of time but school children and neighborhood residents were safe because they could swiftly flee to the rooftop of the school.

- Take necessary measures to ensure routes to escape from a tsunami using the following examples as reference, giving first priority to the lives of children as described in Chapter 1 (3) and also paying attention to the evacuation of local residents:

<If evacuation to a nearby elevated area is assumed>

- If a safe evacuation area such as an elevated area is available near the school, develop an escape route to the elevated area (For the development of escape routes outside the school premises and other disaster preparedness functions such as storage of supplies in the evacuation site, it is necessary to advance evacuation measures in close coordination with

the disaster management department, etc.)

<If evacuation to the upper floors of the building is assumed>

- Ensure escape routes such as outdoor emergency stairs (ensure good seismic resistance and sufficient width of steps when installing outdoor escape stairs, for example)
 - Arrangement for using the rooftop as an emergency evacuation site (ensure enough evacuation space, safety measures such as installing railings on the rooftop, planning the storage of supplies including water, food and blankets for several days before rescue on a floor that will not be flooded, for example)
 - Build a tall school building so that its upper floors can serve as a safe emergency evacuation site (plan adequate traffic lines and crime-prevention to avoid adverse effects on school functions; for kindergarten and elementary school children, pay attention to the connection with school playground.)
 - Plan signs for smooth guidance to the evacuation site (assume evacuation at night as well.)
-
- Examples above will be also effective against other disasters, such as flood and tidal waves.
 - In this earthquake disaster, many local residents evacuated by car to schools on an elevated area. In light of this experience, it is necessary to consider ensuring traffic lines assuming evacuation by car, an entrance dedicated to cars, parking space, etc.
 - Parts and level of damage to school facilities to be assumed vary depending on the type and scale of the disaster. It is necessary to develop evacuation plans encompassing evacuation methods and traffic lines according to the characteristics of the building.

2) Life-securing stage (several days from just after the evacuation)

The duration of this stage is several days from the evacuation of children and local residents to school until relief supplies begin to arrive or they are rescued. Measures are required, including the stockpiling of life-supporting supplies for the period, and toilet and information-communication equipment to communicate with the outside.

Stockpile/storage

Cases from the Great East Japan Earthquake

- There were many school children in the school when the earthquake occurred. The tsunami forced them to stay at the school for several days. In addition, because a greater-than-expected number of residents evacuated to the school, stockpiled supplies were not enough at all. The amount of water distributed to each person on the day of the quake was just one glass.
- Evacuees from the coastal area hit by the tsunami were accepted to inland school facilities. The inland schools that accepted more than the assumed number of evacuees ran short of stockpiled supplies such as food, water, clothes and blankets. There was a stockpile of pregelatinized rice, crackers and water for about 1,000 people but it was not enough because about 1,200 evacuees were taken in.
- Because the school had no stockpile of supplies such as food, water, and blankets, people had to search for food in the school building to stay alive.
- Because the tsunami reached the second floor of the school building, people survived by fleeing to the rooftop. However they were without food or drink for several days because stockpile storage had been washed away.
- There was snow in the Tohoku Region on the night of the earthquake. Without such essential utilities as electricity, school children, evacuees, etc. protected themselves against the cold by wrapping themselves in classroom curtains.
- People protected themselves against the cold using the oil stoves that had been used in the school, but ran out of fuel after several days.
- A portable generator provided by a nearby builder was very helpful for lighting lamps and charging mobile phones.

- The above shows that various supplies are necessary for a large number of evacuees, including children and local residents, to live in a school. Therefore, it is important to ensure a storage space (stockpile storage) in the school or near the school.
- It is necessary to plan a storage space to stockpile the following commodities, for example, in accordance with the assumed number of evacuees, including the school children and local residents. The stockpile space needs to be planned in a place that can withstand assumed

disasters:

- Food, drinking water, clothes (including protection against cold), blankets, portable toilets, electric fans, oil stoves (with fuel), portable generators, portable gas stoves, etc.

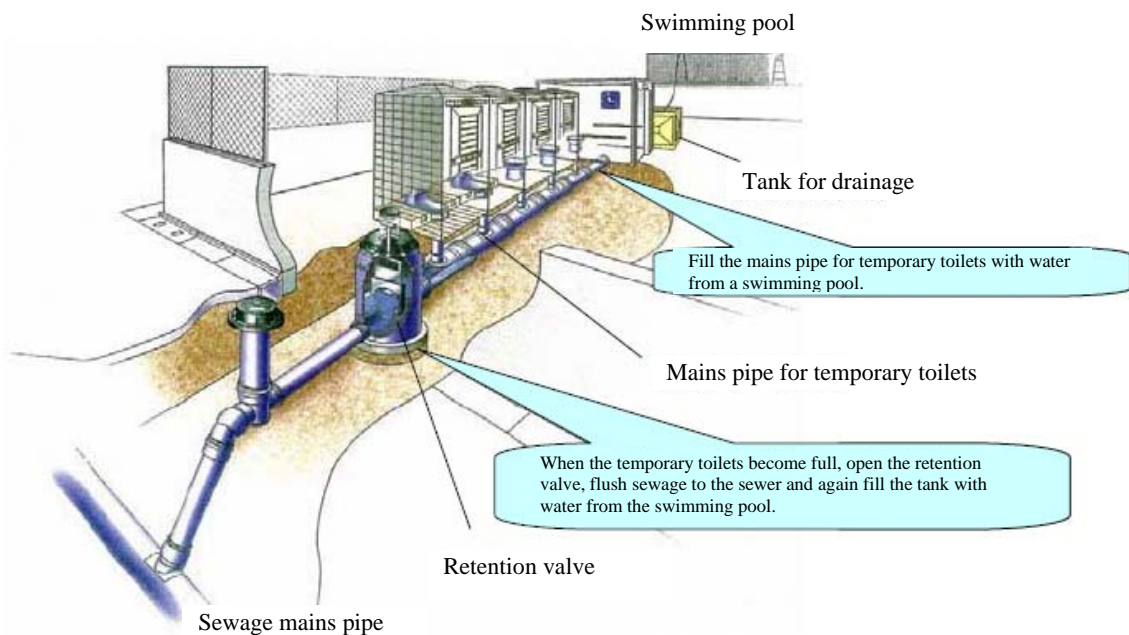
- In this earthquake disaster, there were cases of inland schools accepting evacuees from coastal areas hit by the tsunami. It is desirable to plan storage place in consideration of the response to evacuees from other areas as well while reflecting the actual circumstances of the community.

Toilet

Cases from the Great East Japan Earthquake

- We could not use a flushing toilet due to water and power outages caused by the earthquake.
- Because we did not have water to flush the toilet, we prepared a temporary toilet by digging pits in the schoolyard, placing plates over them and surrounding the places with a plywood wall.
- We used stored portable toilets in addition to toilets in the school building. Because water was cut off, we carried water from a swimming pool to flush the toilets.
- Manhole toilets were appreciated by users, especially by the elderly, because they were Western style and did not include a step.
- We had portable toilets but it was difficult to find an installation place to protect users' privacy.
- Many of the toilets in the school were Japanese-style. Elderly evacuees could not use them because they could not squat down.
- Because the sewage treatment facility was damaged by the tsunami and stopped operating, toilets of the school facilities that were used as an emergency evacuation site became unusable within several days.
- Due to the blackout just after the earthquake, people were too afraid to use the toilet at night.

- In this earthquake disaster, there were cases where portable toilets were useful as an emergency response to the losing of the toilet function just after the disaster. In terms of facilities, it is necessary to consider improvement to use manhole toilets, which were found useful.



Source: Website of the Ministry of Land, Infrastructure and Transport
 (<http://www.mlit.go.jp/crd/city/sewerage/info/jisin/070330/02.pdf>)

Manhole toilet

- In this earthquake disaster, the water outage lasted for a long time and the sewage system was disabled due to damage to sewage treatment facilities caused by the tsunami. As a response to such cases, it may be effective to develop a sewage tank on the school premises.
- For cases where a toilet stopped functioning due to a water outage, etc., it is effective to install piping or use a portable pump to enable use of water from a swimming pool to flush toilets in the school building and gymnasium.
- In this earthquake disaster, self-contained toilets that use microbial substances to decompose sewage were usable also during the water outage without a bad smell. Their installation may be considered while paying attention to their limited processing capacity and higher maintenance cost.
- In light of the above, ensuring the toilet function in times of a disaster requires a flexible response combining multiple measures, such as toilets in the school building and temporary toilets, rather than responding with a single measure.

- It is desirable for toilets assumed to be used by people requiring assistance, including the elderly and people with a disability, to be western-style toilets. Multi-function toilets with a dressing-room and diaper changing function will be convenient not only for people requiring assistance but also other evacuees.
- It is necessary to consider the installation of lighting equipment for temporary toilets to be used at night.

Information-communication equipment

Cases from the Great East Japan Earthquake

- Mobile phones and fixed-line phones stopped working just after the disaster, which disrupted the operation of emergency evacuation sites. In addition, evacuees could not obtain necessary information because they could not use information equipment, such as PCs and televisions, in gymnasiums that served as emergency evacuation sites.
 - There was much difficulty because there were no communication means for several days after the disaster and we could not communicate with the outside. We felt a great need for a wireless system.
 - Because the gymnasium was not equipped with a telephone and was located far from the school building, the only way to conduct communication was by school personnel or evacuees going back and forth.
 - Walkie-talkies used for extracurricular lessons were useful for communication in the school.
 - The community wireless system for intercommunication installed at the school was useful for communication with the town office.
 - There was a satellite phone but it was not charged. However, we could communicate with the outside because there happened to be a power generator.
- In this earthquake disaster, the community wireless system was useful in the area where functions were maintained in the town office equipped with the base phone of the system. It is necessary to consider the installation of a community wireless system for intercommunication. However, in the area where the town office was damaged and lost its function, schools could not communicate with their terminals. Therefore, it is necessary to consider the installation of a community wireless system in cooperation with the boards of education and the disaster management department.
 - Because priority telephone links were useful for communication with the outside in some schools that were not flooded by the tsunami, it is necessary to consider the installation of telephone links taking priority in a disaster that are capable of transmission that is not subject to communication restriction during disasters.

- Other communication tools assumed to be used during a disaster include:
 - MCA (Multi-channel Access): intercommunication with a wireless system for business, through which local governments can have priority to make phone calls during disasters
 - Satellite phone: communication network using telephones that directly communicate with a communication satellite

- When considering the installation of information-communication equipment in school facilities, it is necessary to pay due attention to initial and running costs, etc. in addition to the functions of each means.

- When installing information-communication equipment, it is also necessary to study how to ensure power during a power failure.

- In order to use information-communication equipment in the space used by evacuees, such as a gymnasium, it is necessary to install wiring, outlets, etc. for television, telephone and the internet. In order to allow persons other than school personnel to use the school's PC in an emergency, it is necessary to check licenses, etc. beforehand and take necessary measures.

- In this earthquake disaster, many school documents including student records got scattered and were lost. On the other hand, there were cases where utilization of groupware, the school website, etc. on a cloud computing* platform was effective for communication such as safety confirmation. For the future, it is necessary to consider the utilization of cloud computing technology concerning the computerization of school business.

* Cloud computing technology: Technology to use computer resources, such as various data, software and hardware, via the Internet. Users with an Internet connection can use computer resources "from anywhere, when you need and what you need" without processing or storing information on their computer as they would otherwise do.

- In this earthquake disaster, there were cases of delayed evacuation because people stayed at home to obtain information on the tsunami by watching TV. Installing information-communication equipment in schools that serve as an emergency evacuation site during a disaster might promote evacuation to the sites.

Electricity, water and indoor environment

- **Electricity (photovoltaic installation, private power generating equipment, etc.)**
 - In this earthquake disaster, there were cases where photovoltaic installation failed and could not generate power due to power failure in the surrounding area. In light of this experience, it is necessary to explore disaster preparedness functions that enable the use of photovoltaic generated power during power failure as well.
 - When installing fixed-type private power generating equipment and storage batteries, it is necessary to make considerations according to the needs while paying attention to whether or not such equipment will be used on a daily basis and their cost-benefit performance including maintenance and operation costs.
 - It is desirable to consider ensuring the necessary number of outlets and electric power for equipment that will be used in the space for evacuees (gymnasium, etc.)

- **Water (earthquake-resistant water tank, swimming pool purifying facility, wells for use in a disaster, rainwater/recycled water utilization facilities, etc.)**
 - Drinking water can be obtained during water failure if a quake-resistant water tank, swimming pool purifying facility, etc. is installed. Water for daily life and toilet-flushing water can be obtained if a well for use in a disaster or rainwater/recycled water utilization facilities are installed.

- **Indoor environment**
 - In this earthquake disaster, measures against the cold became an issue, as seen in the cases described above. It is necessary to study how to ensure heat insulation performance of the spaces that may serve as evacuation sites, such as gymnasiums, in order to improve the indoor environment.
 - In cold regions, it is effective to install heating facilities in the spaces that may serve as evacuation sites in preparation for evacuation in winter.
 - When planning measures against heat in summer, it is important to design the spaces that may serve as evacuation sites with attention given to ventilation while ensuring heat insulation performance. It is necessary to consider installation of curtains for shading, anti-insect measures for when windows are opened, and the use of electric fans, for example.

3) Ensuring sheltered-life stage (From several days to several weeks after the disaster)

This period starts from several days after the disaster, when relief supplies begin to arrive in full scale and the isolation from the outside is resolved. Measures are required to make evacuees' life smooth, including securing gas facilities for cooking and tatami-mat space.

Gas facilities

Cases from the Great East Japan Earthquake

- When relief supplies from neighborhood areas and all over the country started to arrive one to several weeks after the disaster, evacuees cooked meals for themselves. However, there were problems with the hot-water supply, cooking, etc. because the gas supply was not restored.
- Because the school was equipped with propane gas facilities, we could use them for cooking.

- When assuming the use of propane gas in place of city gas that is used for hot-water supply and cooking in normal times, it is necessary to prepare end connections for temporary installation of gas conversion apparatus in order to use propane gas with cooking equipment. In this earthquake disaster, portable gas stoves were useful for emergency use until the restoration of gas services.

Necessary spaces, barrier-free environment, shower equipment

- Space that would become necessary

(Tatami-mat/carpeted spaces, etc.)

- In this earthquake disaster, the health of the elderly, persons with disabilities, etc. was upset due to the cold wooden floor of the gymnasium that served as an emergency evacuation site, or their fatigue became worse due to living on a hard wooden floor.
- It is effective to provide tatami-mat space, like as Japanese rooms, considering the living conditions of the elderly, people with disabilities, etc. Carpeted multi-purpose rooms can be used as an emergency evacuation site for the elderly, people with disabilities, etc.
- Carpeted spaces are also useful for households with a baby.
- Because the management of indoor conditions is more important for people requiring assistance such as the elderly and people with disabilities compared to other evacuees, it is effective to prepare rooms where separate management, including temperature control is possible.

(Changing space for women)

- In this earthquake disaster, there were cases where the gymnasium that served as an

emergency evacuation site did not have a dressing room for women and a broadcast room at the wing of the stage was hastily used as dressing room. In light of this experience, it is necessary to consider spaces to ensure the privacy of women, including spaces for changing and breast feeding. There was a case of setting up a tent to use as dressing space for women in the gymnasium that served as an emergency evacuation site.

(Space for the operation of an evacuation site)

- It is necessary to consider preparing a space necessary for the operation of an emergency evacuation site, including: execution of operation by staff and volunteers; first aid; cooking; carrying in, sorting out, storage and distribution of relief supplies; notice and contacting for information gathering and communication.
 - In this earthquake disaster, there were many cases of setting up a space for first aid in a classroom or nurse's office. In order to use a classroom or nurse's office as first-aid space, it is desirable to pay attention to easy access for emergency vehicles and the possibility of integrated use with an adjacent space to ensure large indoor space, for example. There were also cases of spreading infections, such as influenza. It is effective to setting up a space for isolation as an infection countermeasure.
 - Several days after the earthquake, relief supplies from all over the country started to arrive and people started to cook meals for evacuees. Because school kitchens or home economics rooms were used for cooking in some cases, it is desirable to take the measures described above to ensure the use of gas, etc. in times of disaster.
- **Barrier-free environment**
- It is necessary to make school facilities barrier-free by installing slopes, toilets for people with disabilities, for example, to ensure trouble-free living for people requiring assistance, including the elderly and people with disabilities. A barrier-free environment is effective to ensure trouble-free living for other evacuees as well.
- **Shower facilities**
- Because life as evacuees continued for a long period of time in this earthquake disaster, shower facilities installed in school gymnasiums were useful.
 - In light of this experience, it is necessary to consider the installation of shower facilities at schools that are designated as emergency evacuation sites.

- It is necessary to consider the introduction of a solar heating system to supply hot water when the supply of city gas is disrupted due to disaster.

4) School function resuming stage (from several weeks to several months after the disaster)

This is the period from several weeks after the disaster, when education activities are resumed, until the time when the role as an emergency evacuation site is completed. After resuming educational activities, schools are expected to promptly complete their role as an emergency evacuation site and return to being a place for education. However, evacuees lived in a shelter for an extended period of time during this earthquake disaster. Assuming such situation, measures are required for carrying out smooth educational activities while continuing evacuation site functions.

Cases from the Great East Japan Earthquake

- Even now, several months after the onset of the disaster, the gymnasium is used as an emergency evacuation site and PE lessons are conducted using gymnasiums of nearby elementary and lower secondary schools.
- Thanks to the cooperation of evacuees, classrooms were given back smoothly for lessons.
- Because rooms necessary to resume school activities, including special classrooms and the nurse's office, were used as an emergency evacuation site, we built prefabricated houses on the premises and moved functions of the emergency evacuation site there.

Number of schools used as an emergency evacuation site (at the peak on March 17, 2011) (reposted)

Iwate	Miyagi	Fukushima	Ibaraki	Other (Tokyo and 6 prefectures)	Total
64	310	149	75	24	622

The total includes: 7 kindergartens, 336 elementary schools, 168 lower secondary schools, 86 upper secondary schools, 1 secondary school, 6 special needs schools, 15 universities, 1 junior college and 2 technical colleges.

Number of schools currently used as an emergency evacuation site (as of June 1, 2011)

Iwate	Miyagi	Fukushima	Total
37	76	19	132 (75 elementary schools, 43 lower secondary schools, 12 upper secondary schools, 1 special needs school, and 1 technical college)

- At this stage, schools are expected to complete their role as an emergency evacuation site and return to being a place for normal education. If schools are assumed to maintain functions as an emergency evacuation site at this stage, it is necessary to improve facilities

for coexistence with the daily life of evacuees in order to avoid the disruption of education activities. Clear zoning of the area for education activities and the evacuation area can be effective.

(2) Cooperation between boards of education and disaster prevention departments

- For schools to play a role as an emergency evacuation site for local residents while at the same time fulfilling their primary role as a school, it is necessary that the board of education and the disaster prevention department improve their disaster prevention functions while clearly defining their respective roles.

- Schools that are designated as an emergency evacuation site for the local community are expected to play both the role of emergency evacuation site and that of a school at times of disaster. However, the top priority of any school is the safety of school children. Schools are required to fulfill the role of temporary evacuation site for children from the beginning of a disaster until they can go home safely.
 - In this earthquake disaster, there were many cases where school personnel worked day and night for evacuees. Schools were found to have facility/equipment problems to fulfill the role of an emergency evacuation site. In the future, for a school to assume a role as an emergency evacuation site for local residents after fulfilling its primary responsibilities, it is most important that the board of education and the disaster prevention department, which is responsible of the improvement of the disaster management system of the community, deal with situations in close coordination/cooperation.
 - Based on the lessons learned from this earthquake disaster, it is necessary that the board of education and the disaster prevention department improve disaster prevention functions of schools while clearly defining their respective roles:
 - Positioning of schools as emergency evacuation site in the local disaster prevention plan
 - Development of a school facility utilization plan for when using schools as an emergency evacuation site
 - Operation of emergency evacuation areas at each stage from just after the disaster to the resumption of school functions and normal stages
 - Improvement and maintenance of functions required for an emergency evacuation site
- [Specific examples]
- Development of an evacuation site according to the scale of evacuation
 - Installation, maintenance and operation of outdoor toilets, shower facilities, and information-communication equipment

- Making facilities barrier-free
- Installation, maintenance and operation of facilities, including photovoltaic installation and private power facilities in preparation for power failure
- Acquisition/management of stockpile and relief supplies.
- Preparation, maintenance and operation of a space to be used as a base for relief/search operations by the SDF

(3) Planning and design for utilization of schools as centers for the local community

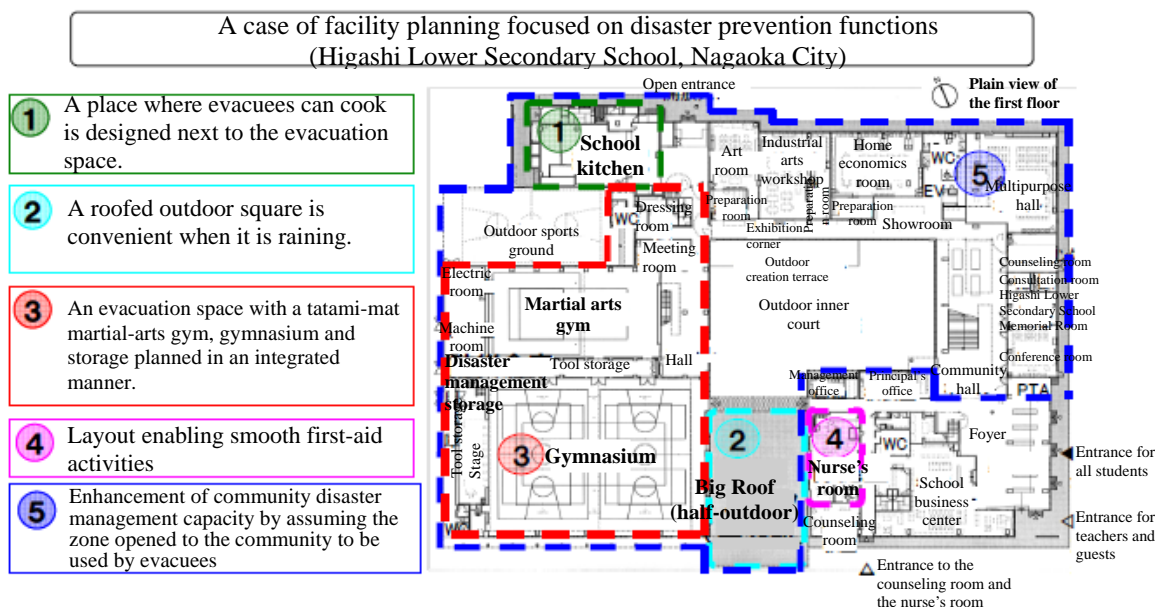
- **The significance of schools in the community was reaffirmed after the Great East Japan Earthquake.**
- **In future school facility improvement, it is important to enhance school's function as a center of the local community that flexibly responds to various local needs in addition to the enhancement of their disaster prevention function (e.g. forming a complex facility with social education /welfare facilities, building facilities close to each other)**

- This earthquake disaster reminded us of the importance of strengthening the disaster prevention function of schools. Elementary and lower secondary schools are important learning places for children who will shoulder the future, and at the same time, they are familiar public facilities for local residents. Schools are expected to fulfill not only disaster prevention functions but also other various functions according to the local needs, including those as facilities for local residents to learn or enjoy sports on a regular basis, and a place to facilitate intergenerational exchange and the staging of festivals and events of the community.
- In the areas afflicted by the disaster, in particular, it is essential to take the point of view that the reconstruction of schools that are a center of the community is a starting point for community regeneration and that the community bonds can be deepened and the afflicted areas can be revitalized by developing schools as a foothold for all local residents, both children and adults alike.
- It is important to improve school facilities from this point of view, flexibly responding to the various needs of the community, such as fulfilling the role as a center of the local community in ordinary times and a disaster prevention base to protect lives in times of disaster as shown in the examples below.
- When considering the improvement of school facilities as the center of the local community and that of disaster prevention functions, pay attention that, while the concentration of

facilities has the advantage of concentrating various functions, the concentration of disaster prevention functions could lead to the loss of the disaster prevention functions of the community, if school facilities become afflicted, In addition, pay attention that concentration of facilities could make the evacuation route longer, rendering evacuation difficult depending on the situations of the community. Therefore, it is necessary to consider the distribution of functions according to the situations of the community.

(Example 1) A school that strengthened its functions for learning and opening up to local residents at ordinary times, as well as disaster prevention functions

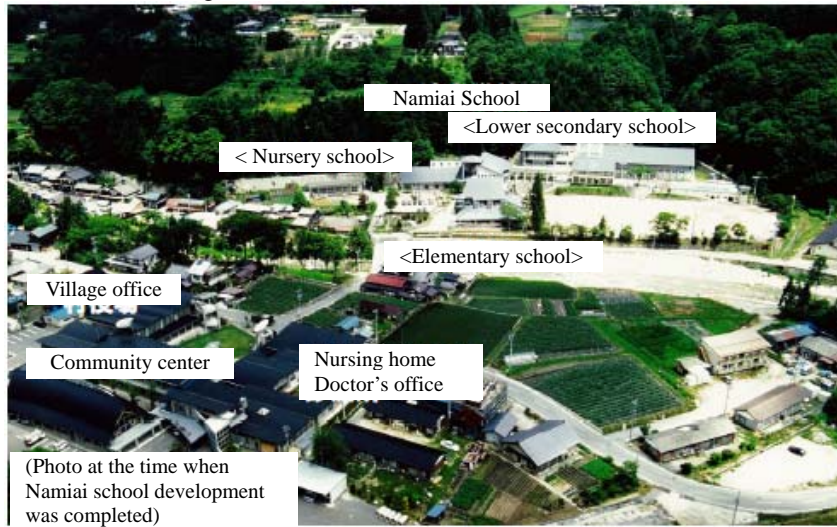
- Integration of the library with ICT space, enhancement of special classrooms in response to diverse learning contents and activities; opening facilities up to local residents through zoning
- Designed to combine various functions required for an emergency evacuation site in times of disaster
 - A place where evacuees can cook is designed next to the evacuation space.
 - A roofed outdoor square was planned to enable the smooth transportation of injured persons and the carrying in of relief supplies under rainfall or snow.
 - A tatami-mat martial-arts gym and small Japanese rooms are planned next to a gymnasium in an integrated manner in order to respond to the diverse needs of evacuees.
 - A nurse's room is planned at the location that allows smooth first-aid activities considering transportation with an ambulance or helicopter as well.
 - The zone opened to local residents in normal times is planned to serve as the evacuation zone so that local residents evacuating to the facility will be able to find the locations of individual areas easily.



(Example 2) Town development concentrating schools, public offices and facilities such as social education facilities together

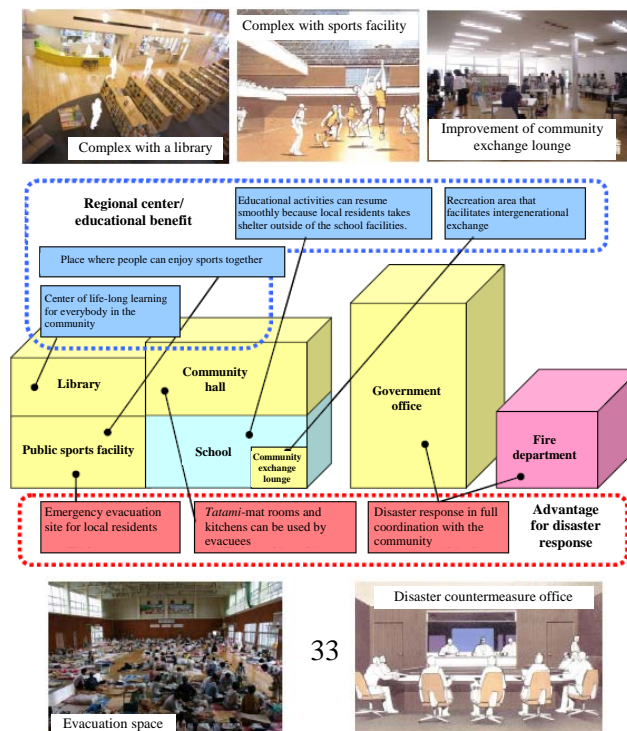
(Actual case) Namiai School: Achi village, Shimoina-gun, Nagano Prefecture (schools and public facilities including the community center and village office were developed in a concentrated manner)

- A nursery school, an elementary school and a lower secondary school were developed in an integrated manner, while the village office, a community center and welfare facilities are arranged around the premises, forming the center of the community.
- The library and some special classrooms are opened to the community, providing the center of learning for all local residents.



(Idea) Comprehensive complex facilities consisting of schools, public offices and facilities such as social education facilities

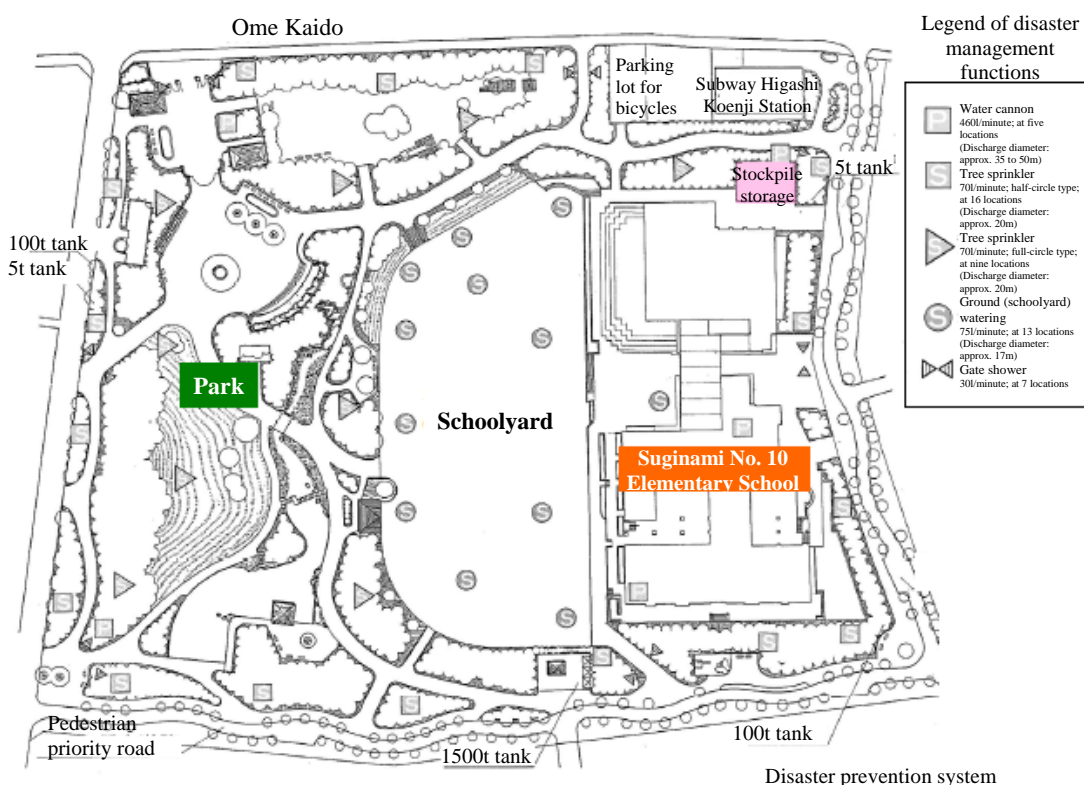
- For ordinary times, develop complexes consisting of a school, library, community center and public sports facility and ensure necessary space so as to provide the function as a life-long learning center for local residents while helping the enrichment of students' coursework, learning activities after school and on holidays and hands-on activities.
- At times of disaster, develop the complexes as comprehensive evacuation facilities with a function of headquarters of local disaster preparedness so that they can maximize their necessary functions in a time of disaster.



(Example 3) Town development by developing a school, a park, welfare facilities, etc. in an integrated manner

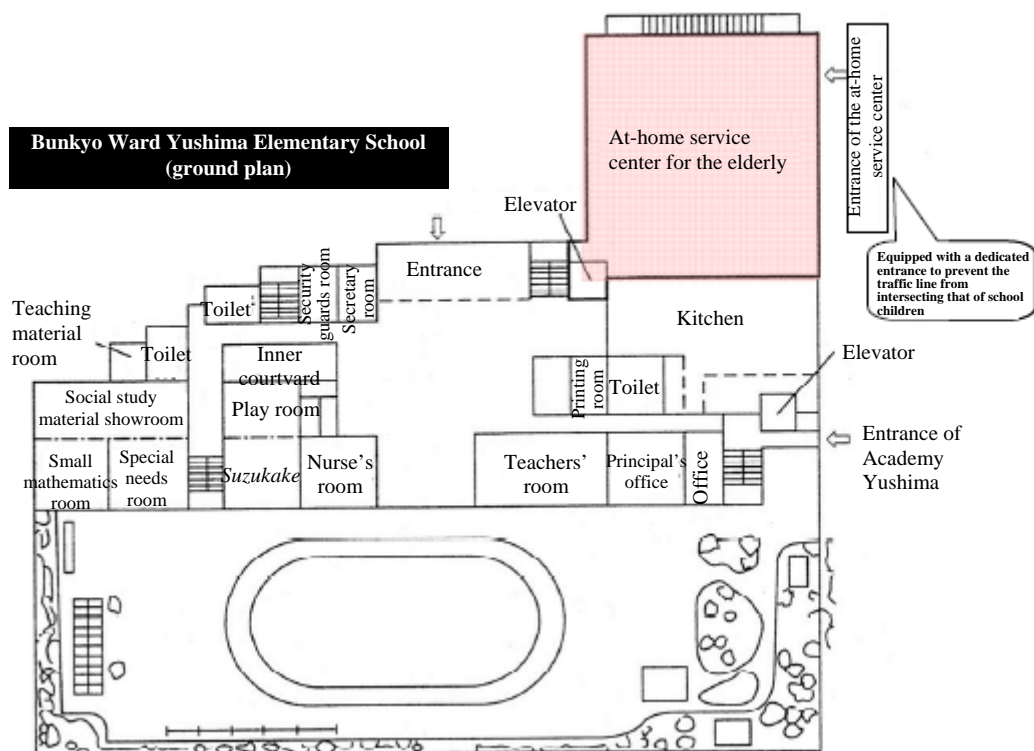
(Case 1) Sugunami No. 10 Elementary School, Sugunami Ward (a school and a park were developed in an integrated manner)

- A school, a park, stockpile storage, etc. were developed in an integrated manner.
- The park was planned as a temporary evacuation area at a time of disaster, with a fire protection forest surrounding the park to prevent the spread of fire, and with a wide open space in the center surrounded by trees and fireproof school buildings.
- There are various disaster prevention facilities, such as emergency water tanks, stockpile storage, water cannons, tree sprinklers, a schoolyard watering system and gate showers
- The sports ground in the park doubles as Sugunami No.10 Elementary School's playground. It is used for community athletic meetings as well as the school's PE lessons. The ground is managed by the board of education.



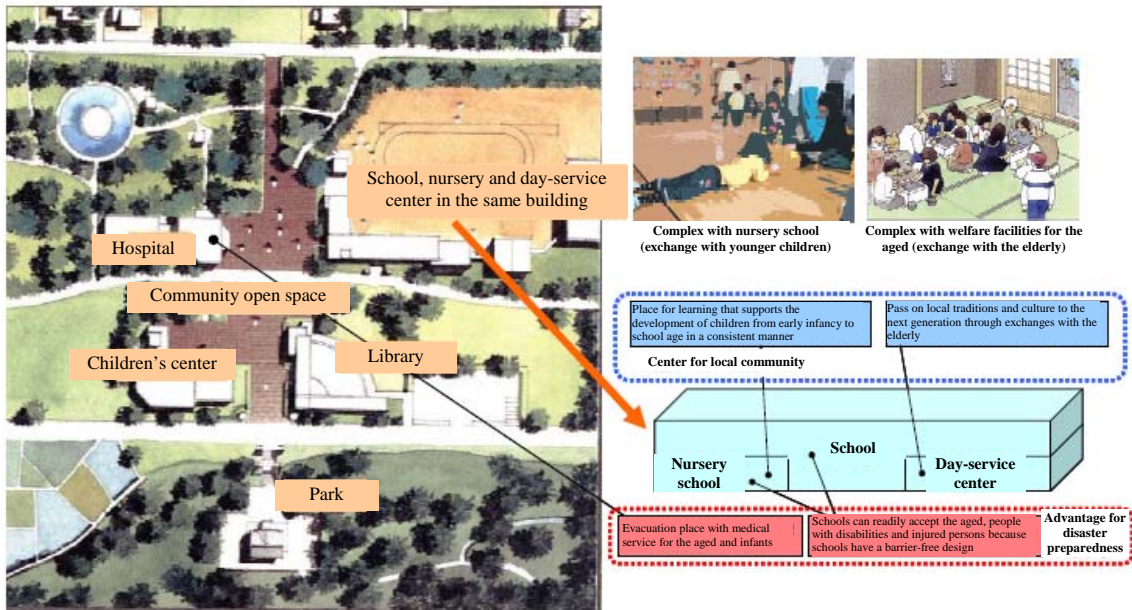
(Case 2) Yushima Elementary School, Bunkyo Ward (Development of a complex of a school and an at-home service center for the elderly)

- Incorporated an at-home service center for the elderly when renovating the school building
- The center is placed on the first floor and equipped with a dedicated gate and an entrance to prevent the traffic line from intersecting that of school children.
- There are interactions with the elderly year round including:
 - Invitation of the elderly to school lunch. Children listen to the history of the town, etc. during lunch time.
 - School children visit the at-home service center to enjoy playing traditional games.



(Idea) Priority barrier-free zone that combines schools, parks, welfare facilities and others

- In ordinary times, support the development of children from early infancy to school age in a consistent manner by developing a nursery school, kindergarten, elementary school, welfare facilities for the aged, etc. in an integrated fashion. In addition, local traditions and culture will be passed on through exchanges with the elderly.
- At times of disaster, develop a barrier-free area with medical and nursing functions for evacuation of vulnerable people, such as infants, people with disabilities and the elderly, to provide them with safe and secure shelter.



Chapter 3 Energy Conservation Measures in School Facilities in Response to the Reduced Power Supply Capacity

- **Electricity supply capacity was greatly reduced after the earthquake and school facilities are also required to take energy conservation measures more than ever, therefore it is necessary to further promote the development of Eco-Schools including the improvement of existing facilities.**
- **Taking measures that produce a great effect in a short period of time and improvements that can be done by people at schools, including students, is also necessary as an immediate response to the reduced electricity supply capacity.**

(Further promotion of Eco-Schools)

- Because the electricity supply capacity was greatly reduced after the earthquake disaster, Tokyo Electric and Tohoku Electric carried out a planned power outage in areas not afflicted by the earthquake as an emergency measure. In addition, measures are required to improve the power supply-demand situation, including the reduction of maximum electricity use in summer, when power demand reaches its peak.
- Because energy conservation measures are required also in school facilities more than ever to contribute to the reduction of power demand, it is necessary to further promote Eco-School development. Among other things, it is necessary to focus on improving existing schools into Eco Schools because about 70 percent of public elementary and lower secondary schools are older than 25 years and have become decrepit. It is important to implement multiple measures of different kinds to enhance effectiveness, while at the same time improving the learning environment through the measures.
- When developing school facilities, including the improvement of existing facilities, it is important to use an effective combination of building materials and facilities that contribute to reducing the energy burden and loss while at the same time harnessing nature's bounty, such as sunlight and wind, to control energy consumption that increases with the enhanced performance of school facilities.
It is also possible to introduce leading-edge technologies that can generate energy or dramatically improve efficiency.
Such improvement will contribute to strengthening functions in a time of disaster, including the improvement of the indoor environment in times of disaster.
- It is also important to "visualize" their mechanism, principle and consumed energy as well as to use school facilities as materials to teach school children about the mechanism, principle, and more environment-friendly use thereof.

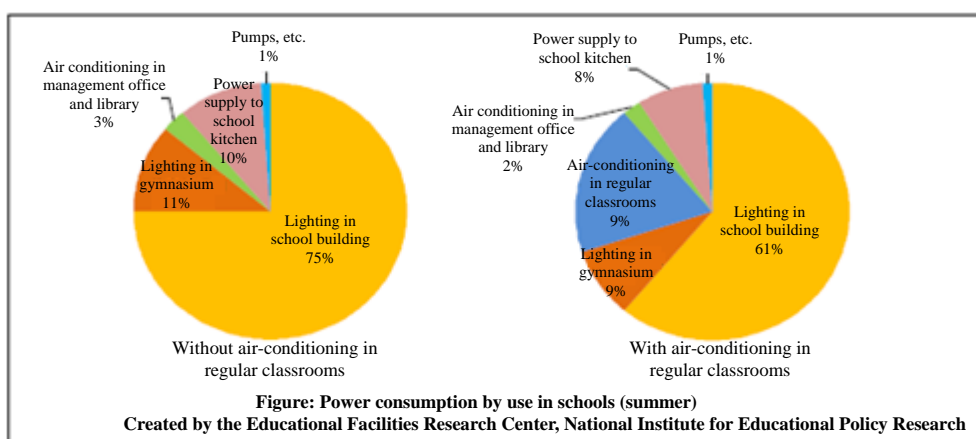
Below are some examples of specific measures:

1) Heat insulation and equipment efficiency improvement (lighting, air conditioning)

It is important to reduce the energy burden and loss of the school facilities by improving the heat insulation of roofs/walls and introducing double insulating glass, for example, to improve the basic environmental performance of school facilities.

It is also possible to introduce energy-saving air conditioners, the efficiency of which has been dramatically improved in recent years. Introducing them in combination with heat insulation of the building to make the most of their performance will provide a comfortable learning environment with less energy use.

Because electricity accounts for large portion of energy consumption in schools and lighting accounts for about 70 to 80% of electricity use in a school where air conditioners are installed only in limited classrooms, such as special classrooms, it is effective to take energy-saving measures for lighting.

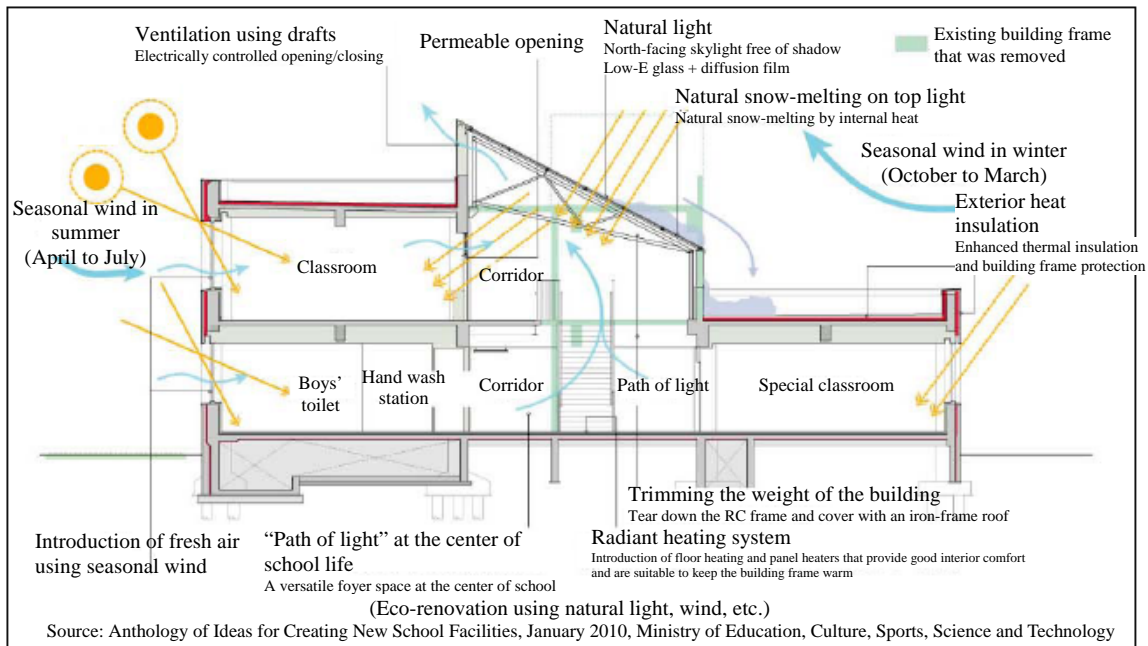


Possible measures include reviewing the areas to light up and when to do so, using adjustable equipment (such as dimming) and using lighting equipment that uses less power.

2) Harnessing nature's bounty, such as sunlight and wind

In order to reduce energy consumption, it is important to introduce devices that actively utilize nature's bounty, which reduces the use of electricity.

Possible examples include installing windows to introduce natural light and eaves/louvers to block insolation in summer and allow it in winter. Planting vines on the wall of a school building, called a "Green Curtain," and applying heat shield film on window panes will make classrooms a pleasant place to be in summer. Other ideas include: arranging openings such as windows, taking the path of wind into consideration, and ensuring efficient ventilation based on natural wind and the temperature difference between inside the room and outside.



It is also possible to introduce facilities using renewable energy, such as solar thermal, earth thermal or biomass, which are relatively simple and require less electricity.

3) Utilization of leading-edge technologies, etc.

It is possible to introduce power generation installation that uses renewable energy, including photovoltaic, wind power, and fuel cell energy, and also actively introduce facilities using leading-edge technology, such as LED lighting, the power efficiency of which has been dramatically improved.

4) “Visualize” mechanisms, principles and energy consumption to help education

It is important to visualize the various equipment introduced to the school facilities so that children can see and feel their mechanisms and principles. It is also important to introduce display systems to check the energy consumption and the electricity generated by the photovoltaic installation as needed.

Furthermore, effects are expected to spillover to families and the community through children who have learned from school facilities, such as by visualizing the equipment and the mechanisms, principles and more environment-friendly use thereof.

(Immediate measures to reduced power supply capacity)

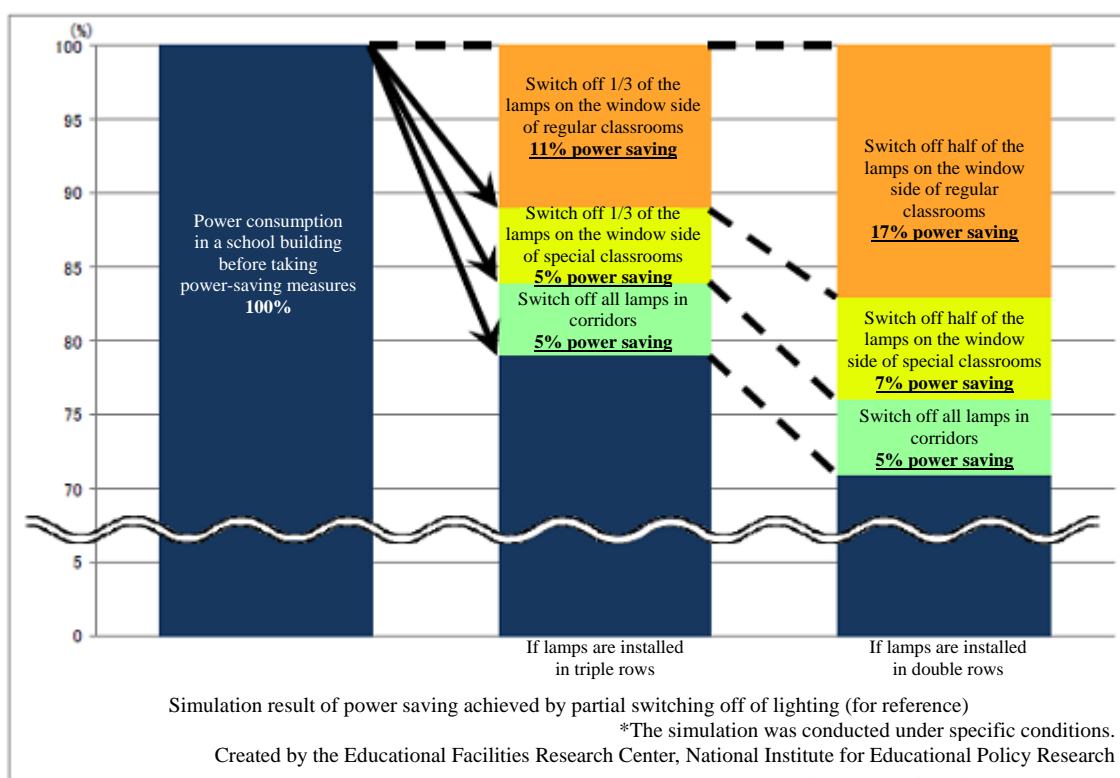
- In order to reduce maximum electricity use this summer in response to the greatly reduced electricity supply capacity, it is also important to take measures that produce effects in a short period of time and can be carried out by people of the school, including the students.

Examples are:

- Review the scope and time of lighting, including turning off the light when lighting is not necessary.

(*The simulation result of power saving achieved by partial switching off of lighting is shown below as a reference value.)

- Install green curtains, Japanese rolling blinds, vertical rolling blinds, etc.
- Apply heat shield film on window panels
- Keep air conditioners set at an appropriate temperature, and make sure to switch them off when leaving the room.
- Replace old equipment with high-efficiency lighting equipment, etc.



Reference Literature

- **About Investigation Concerning School Facility Improvement in Light of the Damage Caused by the Great East Japan Earthquake**
- **History of investigations by the Investigative Commission on School Facility Improvement in Light of the Damage Caused by the Great East Japan Earthquake**

About Investigation Concerning School Facility Improvement in Light of the Damage Caused
by the Great East Japan Earthquake

May 27, 2011

Decision by the Director-General,
Department of Facilities Planning and Administration

1. Purpose

School facilities are not only places for students to learn and live but also serve as emergency evacuation sites for local residents in times of disaster. Therefore, it is critical to ensure their disaster-prevention and safety functions.

In light of the above, we have implemented a variety of research and surveys and presented points to consider concerning safety measures for school facilities.

However, new challenges that had not been assumed appeared in the Great East Japan Earthquake, including a great deal of damage to school facilities and obstacles to facilities' functions as emergency evacuation sites.

For this reason, urgent investigation shall be conducted on the especially important issues, including securement of the disaster-prevention and safety functions of school facilities in light of the damage caused by the earthquake disaster.

2. Items to be studied

Securement of the disaster-prevention and safety functions of school facilities in light of the damage caused by the Great East Japan Earthquake.

(Specific examples)

- Items concerning safety measures for school facilities (earthquake resistance/tsunami protection measures)
- Items concerning facility functions necessary for utilizing schools as emergency evacuation sites
- Items concerning energy conservation measures for school facilities (response to the reduced electricity supply capacity)

3. Implementation method

Investigation of the items listed in 2. above shall be conducted with the cooperation of academic experts listed in the exhibit.

4. Term of the commissioners

The term shall be the period from June 8, 2011, to September 30, 2011.

5. Other

General affairs of the Commission shall be conducted by the Facilities Planning Division, Department of Facilities Planning and Administration, Minister's Secretariat, with the cooperation of related departments and divisions.

(Exhibit)

**Investigative Commission on School Facility Improvement in Light of the Damage Caused
by the Great East Japan Earthquake**

List of Commissioners

Name	Job title
Kazunori ABE	Director of Educational Facilities , Board of Education , Nagaoka City
Toshiharu IKAGA	Professor, Faculty of Science and Technology, Keio University
Jun UENO	Vice President, Tokyo Metropolitan University
Toshitaka KATADA	Professor, Graduate School of Engineering, Gunma University
Toshimi KABEYASAWA	Professor, Earthquake Research Institute, The University of Tokyo
Satoru NAGASAWA*	Professor, Faculty of Science and Engineering, Toyo University

(Six commissioners in all. Listed in the order of the Japanese syllabary. Honorifics omitted)

*: Chair

(Special collaborator)

Koichi SHINPO	Director, Educational Facilities Research Center, National Institute for Educational Policy Research
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**History of investigations by the Investigative Commission on School Facility Improvement
in Light of the Damage Caused by the Great East Japan Earthquake**

First Session (June 8, 2011)

- About key issues at the Investigative Commission on School Facility Improvement in Light of the Damage Caused by the Great East Japan Earthquake (free discussion)
- Presentation by members involved, etc.

Second Session (June 20, 2011)

- Deliberation of “Concerning School Facility Improvement in Light of the Damage Caused by the Great East Japan Earthquake (preliminary draft),” etc.

Third Session (June 30, 2011)

- Deliberation of “Concerning School Facility Improvement in Light of the Damage Caused by the Great East Japan Earthquake (draft)”