PLANNING AND PRESENT STATUS OF EMERGENCY COUNTERMEASURES CONCERNED WITH BUILDINGS AGAINST EARTHQUAKE HAZARD

Ichirou Nagao[1]

ABSTRACT

1. COUNTERMEASURES TO CONFIRM SECURITY OF BUILDINGS AGAINST EARTHQUAKE HAZARD

1.1. Confirmation of Earthquake-resistance of Buildings (as preparatory measures)

Since Japan is one of the countries which are hit by earthquakes quite frequently, to secure the earthquake-resistance for building is very important. And especially Tokai and South Kanto areas which said to face high risk to be hit by a severe earthquake are high building-density areas so improvement of earthquake-resistance of buildings is an urgent task for an administrative body.

1.1.1. Ensuring Earthquake-resistance in the Process of Construction

In 1980 the MOC (Ministry of Construction) made an amendment to the execution act of the Building Standard Law after learning lessons from several disasters caused by earthquakes such as the one occurred off the coast of Miyagi prefecture in 1978.

The amendment says that upon building buildings over certain scale, it is obliged to confirm the safety of the building against earthquake hazard by complete structural calculation.

As a result of this amendment, the structure of buildings built after 1981 has been much improved.

For example in case of the earthquake of intensity of about 5 on the Japanese seven-stage scale, those buildings would not get severely damaged and even in case of the strongest earthquake we can expect such as the Great Kanto Earthquake of 1923 which intensity was about 6 on the Japanese seven-stage scale, the structures of those buildings are supposed to be strong enough not to be collapsed.

Also in the process of building those buildings it is required that the design should be done by professionals (licensed architects) who has special skills, the plan should be checked by administrative body, and inspection upon completion should be carried out by an administrative body.

1.1.2. Ensuring Earthquake-resistance of Existent Buildings

Also the MOC has taken several measures to ensure earthquake-resistance of buildings built before 1980.

The MOC has established the standard to judge the earthquake-resistance of buildings as well as the guidance of

---

[1]*Ministry of Construction*

designing method up on repair.

Not only working on to spread the measures above, the MOC set up the special financing system served by governmental financial institutions for the cost of repair to improve the earthquake-resistance of the buildings which are for special use or over certain scale.

Also the MOC set up the tax preferential treatment for repairs of exterior walls or window glasses of those buildings to protect from falling.

1.2. Ensuring Security in Case of Emergency

A person who owes the first principle obligation to secure the safety of the building is the owner of the building.

An owner is required to secure safety under his own responsibility in case the building were damaged by an earthquake.

But if an earthquake causes damage to many buildings, the owner or the resident of damaged buildings can not always confirm security under his own responsibility but he might be exposed to the threat of the secondary damage caused by the earthquake.

Especially if there is a threat for damaged buildings to cause damage on adjacent roads or buildings, it means that there is a high possibility that the third party also might suffer some damage.

So to leave an owner all the responsibility for securing safety and do nothing as administration is undesirable situation in view of ensuring safety of local people after damage caused by an earthquake.

In 1990 after the review of these facts, the MOC, as an administrative body, launched the study to set up the standard to judge the degree of damage of buildings as a part of an emergency measures.

The points which came out in the series of studies are;
-plenty of specialists in the field of building structure are required to pursue the judging work.
-it would take a long time to make a thorough check and accurately judge the degree of damage of buildings.

Based on the facts above to proceed the work in immediate and systematic manner, the conclusion which the MOC has reached is that the MOC needs to set up a solid system of countermeasures in cooperation with civil professionals such as licensed architects.

At present the work to establish the judging system is under way in cooperation with local technicians especially in the regions of Tokai and South Kanto which face high risk of being hit by an earthquake.

2. OFF THE COAST OF KUSHIRO EARTHQUAKE AND REPORT ON DAMAGE

2.1. Outline of the Earthquake

In January Friday the 15th of 1993 at about 20:06, an earthquake hit Hokkaido through Chubu region and cities such as Kushiro in Hokkaido severely damaged.

No seismic wave occurred.

The Meteorological Agency made an announcement regarding the seismic Focus or intensities in each region.

The details are as follows;

Seismic Focus	: Off the coast of Kushiro (lat. 42°51'N, 144°23'E) Depth 107 km
Magnitude	: 7.8
Seismic Intensity	: 6 Kusiro 5 Obihiro, Hiroo, Urakawa, Hachinohe 4 Nemuro, Tomakomai, Otaru, Muroran, Hakodate, Aomori, Mutu, Miyako, Morioka, Oofutato, Isinomaki, Onahama 3 Monbetu, Abasiri, Asahikawa, Iwamizawa, Sapporo, Kuchan, Fukaura, Akita, Sendai, Sakata, Fukusima, Mito, Tokyo, Yokohama
Name	: "Heisei 5 Nen (1993 year) Earthquake Off the coast of Kushiro"

2.2. Outline of the Damage
(As of February the 24th 1993. Data source: the Fire Defence Agency)

2.2.1. Human Casualty

(1) Death.....	2	(gas-poisoning 1, hit by broken light bulb 1)
(2) Severely injured..	114	
(3) Slightly injured...	819	

2.2.2. Damage on Houses and Buildings

Houses completely destroyed.....	12
half destroyed.....	73
partially damaged.....	3,389

Non-residential buildings
---cracks on exterior tiled walls, broken windows, etc.

educational facilities.....	488
hospitals.....	208
social welfare facilities.....	165

Fires 11 cases

2.2.3. Damage on Utility Lines

Water stoppage	21,765 houses
Electricity interruption	57,200 houses
Gas stoppage	9,355 houses
Interruption of railway service	4

1. EARTHQUAKE DISASTER COUNTERMEASURES IN JAPAN

1.1. Progress of Earthquake Disaster Countermeasures

The national policy of Japanese government toward earthquakes until 1960 was mainly concentrated on remedial actions of exposto facto, such as providing financial assistance for relief and recovery activities on the damages inflicted by disaster.

With the enactment of The Disaster Countermeasures Basic Act in 1961, the national policy has gradually integrated various countermeasures such as emergency measures, prevention, restoration, and others so that various actions can be synthesized and coordinated into a comprehensive and objective executive actions attain the ultimate purpose of disaster relief.

1.2. Outline of Disaster Countermeasures

1.2.1. The Disaster Countermeasures Basic Act

After the World War II, Japan was stricken by various great disaster.

Such experiences induced various reports and recommendations for reinforcement and consolidation of the national disaster prevention system.

In the meantime, a great disaster was wreaked by the Ise-wan Typhoon of September 1959, which enhanced the motivation along the concerned circles to proceed on developing a nationwide, comprehensive and objective administrative system for disaster prevention.

As a consequence, "The Disaster Countermeasures Basic Act" was promulgated in 1961.

The Disaster Countermeasures Basic Act defines the basic administrative policies with regard to the following aspects:

(1) Clarify the jurisdiction and responsibility for the administration of disaster prevention.
(2) Establish the total disaster prevention system encompassing the national and local governments.
(3) Administer the disaster prevention measures purposefully.
(4) Strengthen the countermeasures for disaster prevention.
(5) Prepare for the expedited, and appropriate countermeasures for the emergency relife on the damages inflicted by disaster.
(6) Execute an expeditious recovery and restoration from the disaster damages.
(7) Assign the fiscal responsibilities to appropriate parties.
(8) Execute necessary actions while the disaster is being inflicted.

1.2.2. Emergency Countermeasures Against Earthquake Disaster

Upon the breaking out of a disaster, or when such is anticipated the national administrative organs, local governments, and public corporations will proceed to take various emergency countermeasures to prevent or control such a disaster.

Should an earthquake occur, the municipality will at first establish a Municipal Headquarters for Disaster Countermeasures to execute emergency operations.

If necessary, the prefectural government would establish its Headquarters for Disaster Countermeasures.

In the meantime, National Land Agency will make the assessment of its gravity, and if deemed necessary will call up the Meeting of Ministries and Agencies related to Disaster Countermeasures for exchanging pertinent information.

Should the need be recognized, the national government would establish the Headquarters for Major/Extraordinary Disaster Countermeasures, in accordance with the Disaster Countermeasures Basic Act, and proceed to execute a comprehensive disaster emergency countermeasures.

In order to carry out such emergency countermeasures smoothly and promptly, the administrative organs on each level from the national, prefectural, to municipal have prepared Plans for Emergency Countermeasures in order to cope with disaster.

A Typical Case of Planned Emergency Measures against Disaster
(Tokyo metropolitan plan for disaster prevention: Earthquake Disaster Version)

(1) Establishment of the system for emergency activities
(2) Collection and dissemination of information
(3) Application of the Disaster Relief Law
(4) Mutual assistance, and the plan for requesting dispatch of a disaster relife force
(5) Fire-fighting and disposal of dangerous material
(6) Flood defence and measures against tsunami
(7) Security guard and traffic control
(8) Emergency evacuation plan
(9) Rescue and ambulance plan
(10) Medical and first-aid plan
(11) Plan to supply drinking water, foodstuff, and other essential provisions for livelihood
(12) Emergency transportation plan
(13) Plan for cleaning, prevention of epidemics, and disposal of human remains
(14) Provisional housing plan
(15) Plan for temporary schooling, financing and employment
(16) Provisional measures to secure life-line facilities
(17) Provisional measures for operating public facilities, etc.

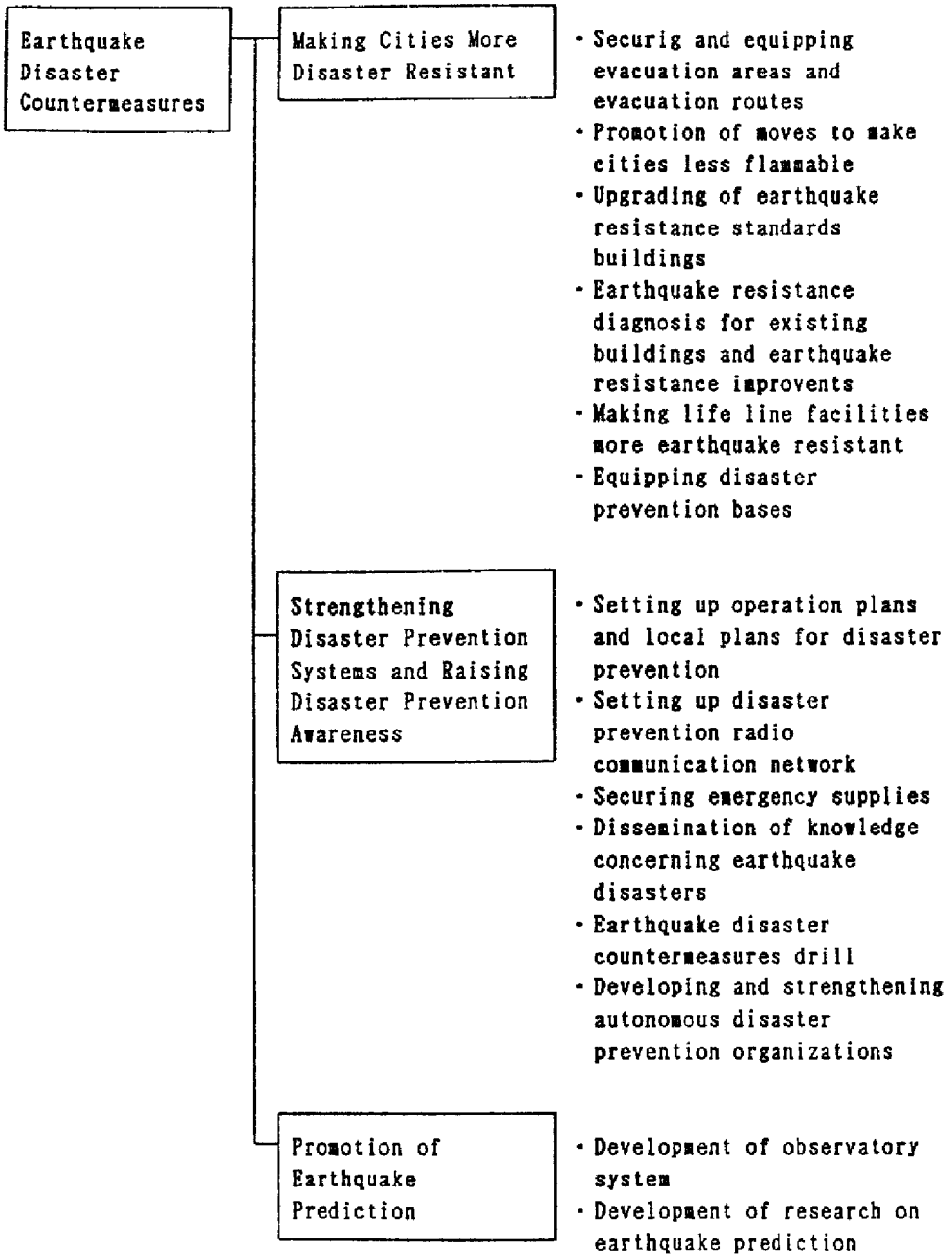
1.3. Summary of Earthquake Disaster Countermeasures

Earthquake disaster countermeasures in Japan have been promoted on the Basic of the Disaster Countermeasures Basic Act, and Basic Plan for Disaster Prevention. Through the lesson learned from the San Fernando Earthquake of 1971, as to required countermeasures against earthquake disaster on a larger city of modern building structures, the Central Disaster Prevention Council has adopted the "Essential of Earthquake Countermeasures for Larger Cities" in May 1971.

The same council has also decided in August 1975, and in May 1983, on "Contemporary Promotion of Urgent Disaster Prevention Countermeasures".

The present disaster countermeasures are being promoted in accordance with those laws and plans.

Framework of Earthquake Disaster countermeasures



2. THE ADMINISTRATION OF BUILDING CONSTRUCTION IN JAPAN

2.1. The Life Cycle of a Building and the Administration of Building Construction in Japan

Prior to the Second World War, building construction in Japan was regulated by the provisions of the Urban Building Law of 1919.

Faced with the need for a sweeping change of this law, as a result of the nation-wide chaos following the war, the government enacted the Building Standard Law of Japan under the provisions of the new constitution in 1950.

Although it has undergone extensive revisions, this law is still basic the legislation governing the design, construction, and the maintenance of buildings.

The provisions of the Building Standard Law are broadly classified as either part of the building code or part of the zoning code.

The building code, which treats every building as an independent object, establishes the technical standards to provide for structural safety, fire protection and evacuation, as well as to guarantee that each building is environmentally safe and hygienic.

The zoning code, on the other hand, prescribes standards that maintain order in the construction of buildings to ensure safety and rational land use: essential in towns and cities, which are collections of buildings.

The provisions of the zoning code are applied to buildings in city planning areas: districts where systematic land use plans are enforced.

Specifically, the code regulates the relationship between the location of buildings (their building sites) and roads, the nature of the land use designated in each district, the form of each building (its building coverage ratio, floor area ratio, height restrictions, shadow restrictions, etc.),and establishes fire protection districts.

2.1.1. Building Confirmation etc. When Constructing a Building

(1) Building Confirmation and Completed Building Inspection Systems

Under the provisions of the Building Standard Law, the decision that a building either does or does not satisfy all the standards required for a building is determined by means of the administrative action, "Confirmation of Construction of Buildings, Article 6", and a department staffed by building officials responsible for the confirmation is established within regional public bodies.

A building official receives documents submitted by a building owner, examines the information in these documents regarding the building (its site, structure, equipment) in light of the relevant legislation (including laws and regulations other than the Building Standard Law), and judges whether or not it conforms to the standards.

In accordance with a double check system (Consent etc. of Fire Inspect or etc., Article 93) which has been established as part of the pre-confirmation examination, the building official requests consent from the chief of the fire station having juris-diction over the building and who has expertise regarding fire protection in buildings.

In addition, when a building which has received confirmation, the building owner submits a written notification of the completion of the building to the building official, and the building is subjected to a final completed building

inspection (Article 7).

After the inspection is completed and the building official issues a certificate of inspection to the building owner, the owner can begin to use the building.

Table 1 Change in the Number of Applications for Confirmation of Construction of Building and the Number of Confirmations Rendered

	Apr. 1987 to Mar. 1988	1988 to 1989	1989 to 1990	1990 to 1991	1991 to 1992
Number of Applications	1,115,985	1,083,499	1,073,520	1,036,522	967,636
Number of Confirmations	1,097,994	1,062,073	1,052,853	1,018,758	954,954

(2) Architects Licensing System

To guarantee the safety of buildings, drawings/specifications are drawn up based upon the Building Standard Law and other regulations and are confirmed by the building official before construction work commences.

Supervision is provided to guarantee that the construction work is carried out correctly as laid down in the diagrams that have been confirmed.

The Architects Licensing System established under the Architects Law is the qualification system which guarantees that building design and supervision of construction work requiring such extensive knowledge and technical skills are performed correctly.

The Architects Law prohibits any person who is not an architect (1st or 2nd-Class Licensed Architect/Building Engineer, or Wooden-Building Licensed Architect/Building Engineer) from designing or performing supervision of construction work for any building larger than a given scale used for specified purposes and with specified structures.

This provision is to ensure the technical standards of such buildings while improving their quality.

To become a First Class Licensed Architect/Building Engineer, applicants must pass an examination given by the Minister of Construction, while anyone wishing to become a Second Class Licensed Architect/Building Engineer or a Wooden-Building Licensed Architect/ Building Engineer has to pass an examination given by the local prefectural governor.

These qualifications are awarded to those who are registered for licenses upon passing the required examination. Because an architect/building engineer who designs the building equipment in a large building or supervises its construction is required to possess a high level of specialized knowledge and technical skills, in cases in which the opinions of persons possessing qualifications determined by the Minister of Construction (Architects Law: Article 20, Persons Qualified in Building Equipment) have been solicited, this fact must be clearly indicated on the drawing/specification documents.

Table 2 Numbers of Architects/Building Engineers — As of March 1992

1st Class Licensed Architect/ Building Engineers	237,357
2nd Class Licensed Architect/ Building Engineers	521,905
Wooden Building Licensed Architect/Building Engineers	11,773
Total	771,035

(3) Building Construction Notification System

A building owner who plans to construct a building shall submit a notification of construction of a building to the governor of the local prefecture (Article 15) in addition to an application for building confirmation.

Under this system, established to accurately grasp construction activity in Japan, the statistical data gathered is passed on to the Ministry of Construction by the local prefectural governor, and the results are published as the Building Construction Survey.

2.1.2. Maintenance and Periodic Reporting, Financing, and Taxation after Construction of a Building

(1) Maintenance and Periodic Reporting

An important task after a building is completed and occupied is how its safety is to be ensured.
These activities are generally referred to as maintenance and upkeep, and in recent years, public attention has been focused on this particular area.

This increased interest is attributable to the following factors.

(i) Buildings erected during an earlier period of the investment boom in building construction in the 1960s are now more than 30 years old, and require extensive replacement of, and repairs to both their structural components and equipment.

(ii) Recent progress in electronics, the spread of information technology, and the need to conserve energy have stimulated a strong demand for improvement in the quality of buildings.

To satisfy these demands, it is necessary to perform suitable renovations and replace building equipment.

(iii) There has been a sharp increase in the number of large-scale buildings equipped with equipment such as smoke exhaust systems and complex control systems which require reliable inspection.

(iv) Many accidents have occurred as a result of insufficient maintenance of buildings.

These circumstances include both factors inherent in buildings themselves and changing social conditions, technological progress, and a changing environment.

Consequently, the maintenance of buildings is now more than simply maintaining the original condition and performance of each building; it is necessary to alter the nature of the maintenance work to conform to the new standards which an existing building has to meet.

Article 8 of the Building Standard Law, an article included to ensure the maintenance of buildings, requires its owner, manager, or occupant to make an effort to maintain the building in a condition complying with legal requirements, and at the same time, draw up written maintenance plans and carry out systematic maintenance of buildings of a given size or larger and for buildings used for specified purposes.

These Periodic Reporting System (Article 12), requires the owner or manager of any building designated by the special administrative agency which is used by an unspecified number of persons to have a 1st- or 2nd-class Licensed Architect/Building Engineer or a qualified person designated by the Minister of Construction periodically inspect the site, structure, fire protection and evacuation conditions as well as the environmental hygiene of the building and report the inspection results to the special administrative agency.

Specifically, the inspector shall inspect the building to confirm (i) the safety of the site, structure, and fire protection and evacuation measures in the building, (ii) the maintenance and upkeep of the structure and the functions of the building equipment (smoke exhaust, emergency lightning. water supply and drainage, and ventilation equipment), and (iii) the maintenance of the structure and functions of the elevators and amusement facilities.

(2) Improvement of the Safety Performance of Existing Buildings and Financing and Tax Systems

Because buildings constructed prior to an enactment of the current Building Standard Law and buildings which have not been properly maintained may not comply with building safety performance that is deemed satisfactory according to present standards, it is necessary to adopt measures to improve the building safety of these buildings to a prescribed level by renovating them.

Essentially, it is desirable to renovate existing buildings at the time of each revision of the Building Standard Law so that these buildings meet the revised standards. However, because of the difficulty in financing such renovations, the Building Standard Law does not require that this be done and is not enforced retroactively.

Therefore, as a measure to encourage the improvement of the safety performance of these buildings, the Ministry of Construction has enacted policies for earthquake resistant renovation, the improvement of fire protection and evacuation facilities, the repair of external walls, etc.

At the same time, the Ministry has introduced a system allowing low interest long-term financing from the Japan Development Bank and other government affiliated financial institutions, and set up a special depreciation system under the tax system for the repair of external walls.

2.1.3. Demolishing Buildings

When a building has reached the end of its useful life and is to be demolished, the person who is to demolish the building must submit a notification of the building demolition to the governor of the local prefecture (Article 15).

Like notifications of the construction of a building, these notifications are passed on to the Minister of Construction by the prefectural governor to be used to compute an index of construction activity.

Table 3 Number of Staffs Engaged in the Administration of Construction
-As of 31st of March 1991

	Prefectures	Municipalities	Total
Total	2,567	4,807	7,374
Building Officials	927	799	1,726
Supervisors	653	600	1,253

2.2. Recent Development Trends in Building Construction Technology

The performance and functions of buildings that people demand have changed significantly in recent years under the influence of changes in the social environment and a diversification of the qualities they look for in a building.

In Japan membrane structures such as the Tokyo Dome and the Izumo Dome, large section wooden buildings, intelligent buildings featuring up-to-date information technology, and high-rise buildings exceeding 200 meters are now being constructed.

To take into account these new structures, fire preventive materials, execution technologies and equipment which are not covered by the ordinary building regulations, the Approval System by Minister of Construction has been established under Article 38 of the Building Standard Law.

The number of applications for such approval has grown steadily every year.

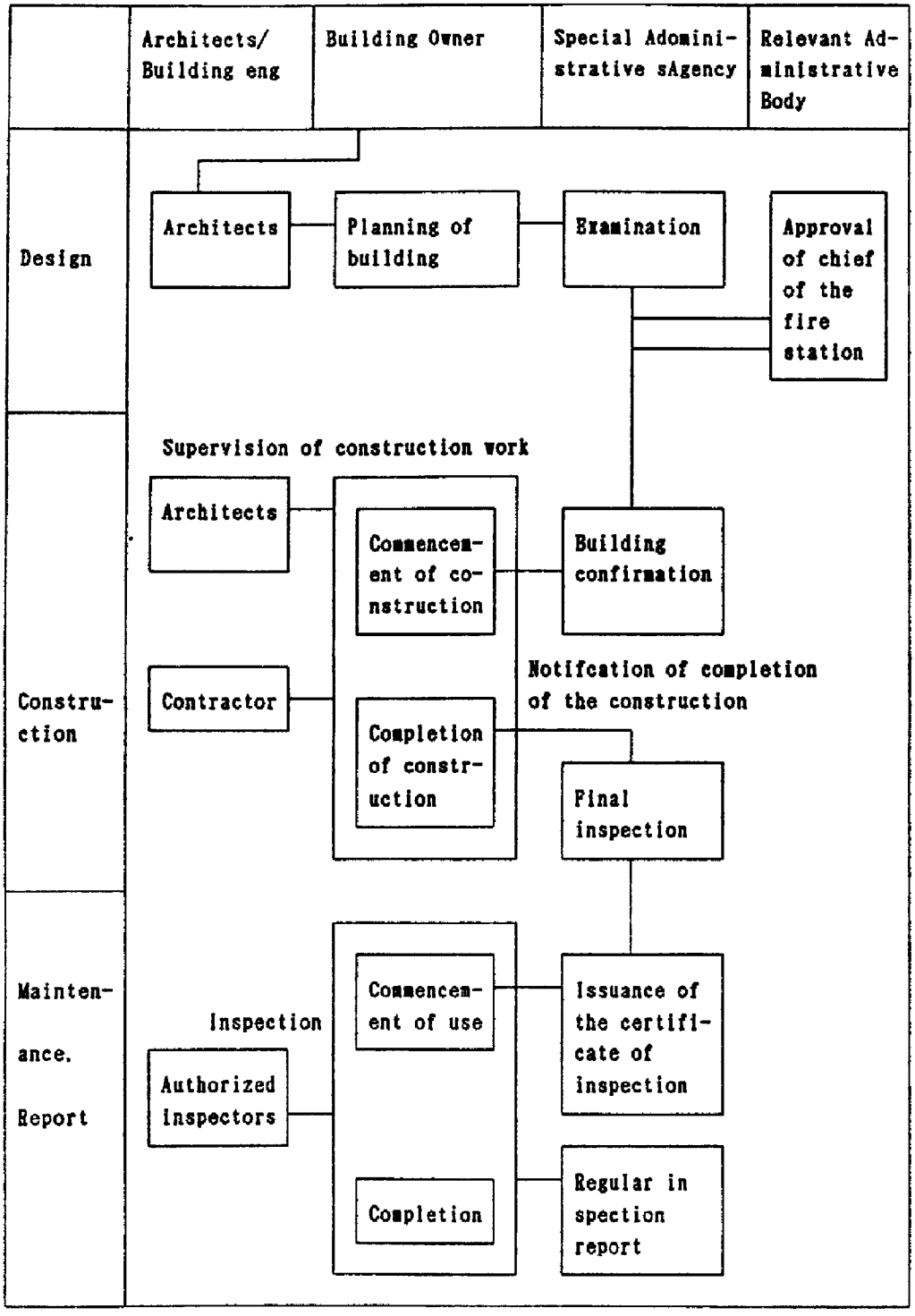
The negative effects of building on the environment is another important issue.

Measures must be taken immediately to reduce the burden that buildings place on the environment by reducing energy consumption in cooling and heating buildings and cutting down on the volume of garbage generated by office buildings.

Now bureaus in charge of the administration of construction must respond appropriately to adopt various new construction technologies and methods: design techniques that help expand the activity range of the elderly and handicapped, life-cycle design methods that reduce the life-cycle costs associated with the limited life of buildings, and have to encourage the use of facility management concept based on management strategy which fully incorporates the utilization and profitability of buildings.

We believe that the mission which those of us involved in the administration of construction and in construction technology will bear in the future is to find ways to continue to construct high quality buildings that meet the varied requirements that a building is now expected to fulfill.

Flow of the procedure of building adoministration
under The Building Standard Law



3. CONFIRMATION OF SECURITY OF BUILDINGS UPON OCCURRENCE OF DISASTERS (EMERGENCY MEASURES)

When a large scale of earthquake occurs, there is a high risk that the buildings which structural resistance has deteriorated might break down by an aftershock and that might cause the secondary disaster to human being, or properties.

So the following are the possible problems coming out after a hit by an earthquake;

(1) Protection of Hazard to the Third Person

Buildings which have been taken care of by people who do not have professional knowledge hold higher possibility to be collapsed by an aftershock and cause damage to the owner or the third person.

And also it is possible for some buildings which owner is absent because of evacuation or with some other reason to be omitted to have professional judgement of the degree of damage, to collapse on to such as adjacent properties, and to cause damage to the third person.

This is because of the lack of accurate judgement by professionals.

(2) Rush of Calls to an Administrative Office (i.e. to Department of Construction)

Calls to inquire "How can I check my building to see if it is safe?" or "Please introduce a professional who can judge the degree of damage" would rush to a construction bureau.

This is because judging the safety of buildings from structural point of view requires high skill of constructing technique.

In other words general owners can not judge the safety of buildings by themselves.

(3) Accurate Grasp of the Degree of Damage for Restoration

Department of construction needs accurately to grasp how serious the damage is and to set up an adequate guidance for restoration.

It is almost impossible for administrative staff to cover the tasks such as protection of the secondary damage which might be caused by collapsed buildings, or meeting the residents' request to introduce professionals, or to grasp the conditions of damage since the number of buildings to be checked is enormous.

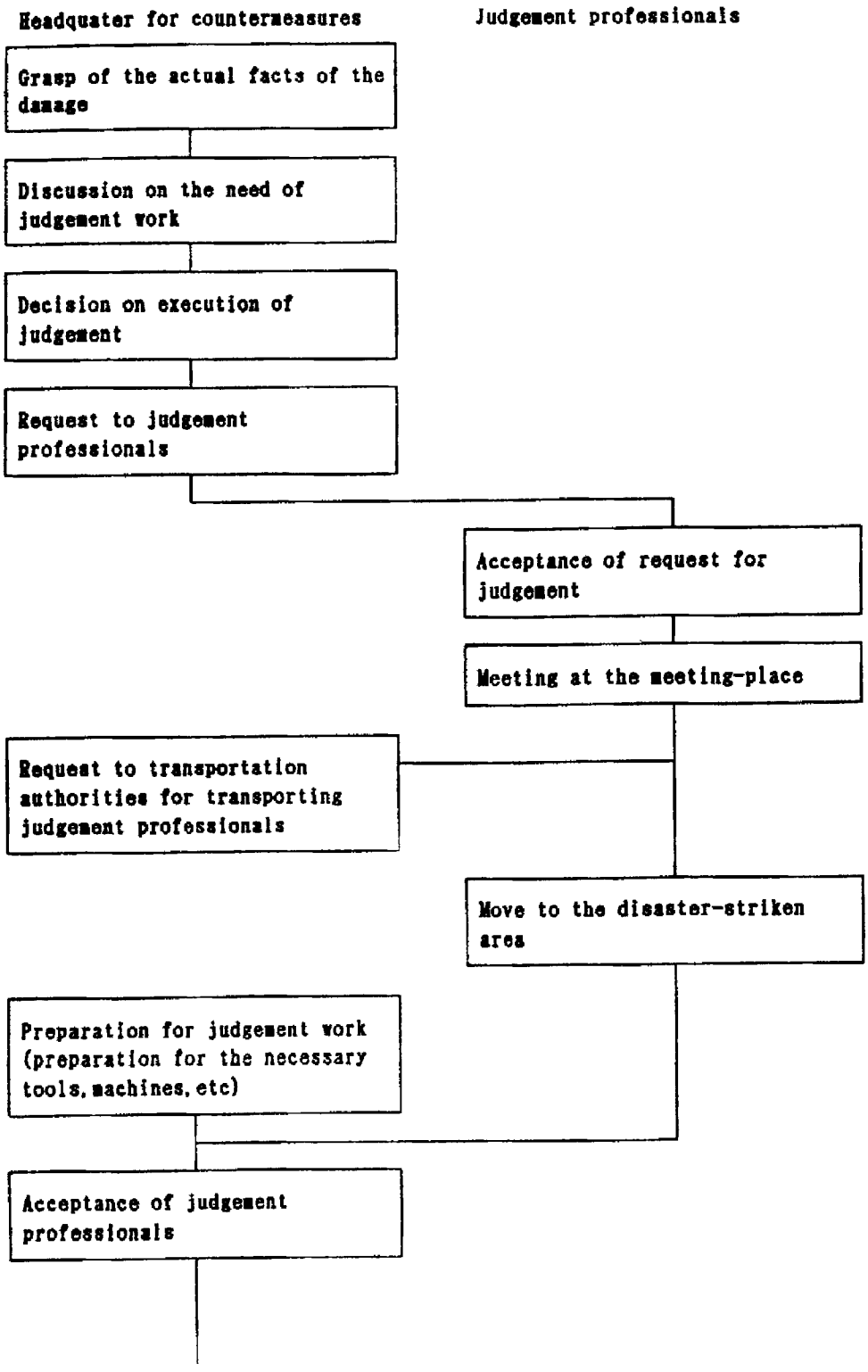
But still a diagnosis work is an urgent business in order to prevent the secondary disaster by an aftershock or some other reason.

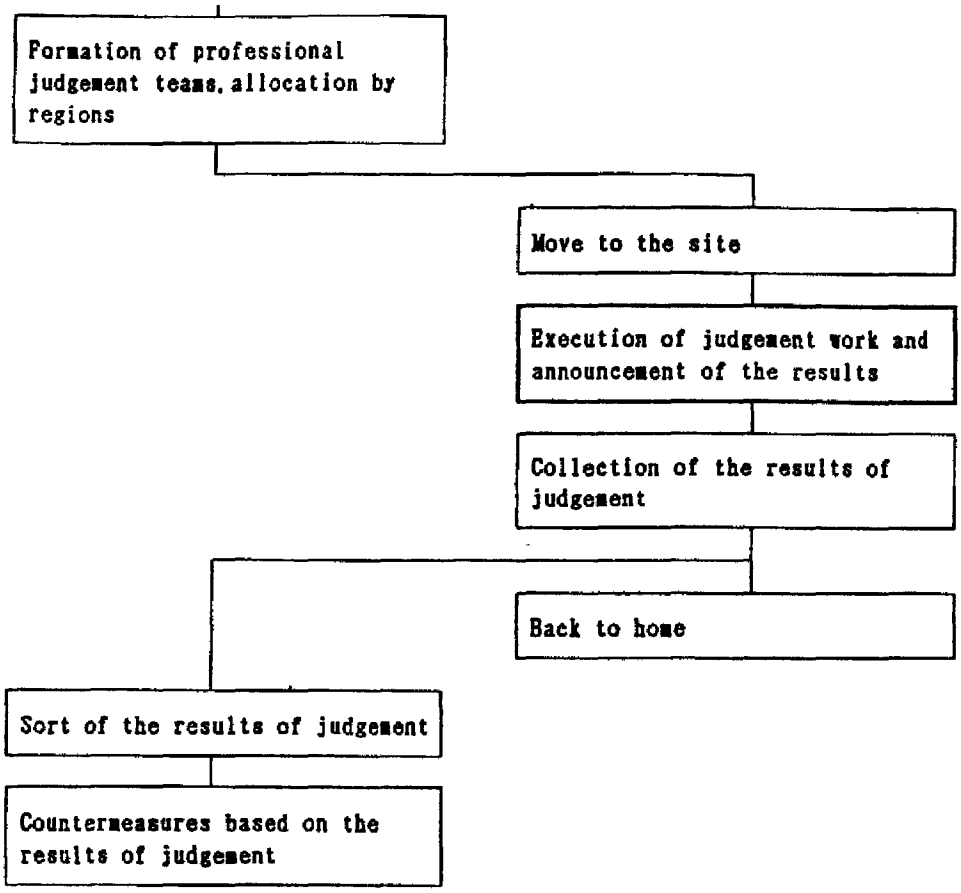
So an effective and adequate method for the administrative body is to get hold of the professionals in the field of structural construction in advance, and to have a procedure to ask their cooperation in case of disaster, and to make a quick judgement on the degree of hazard, and to take necessary measures such as to forbid entrance of certain area.

In 1990 the Ministry of Construction launched the study to set up the standard to judge the degree of damage of the buildings as a part of an emergency measures.

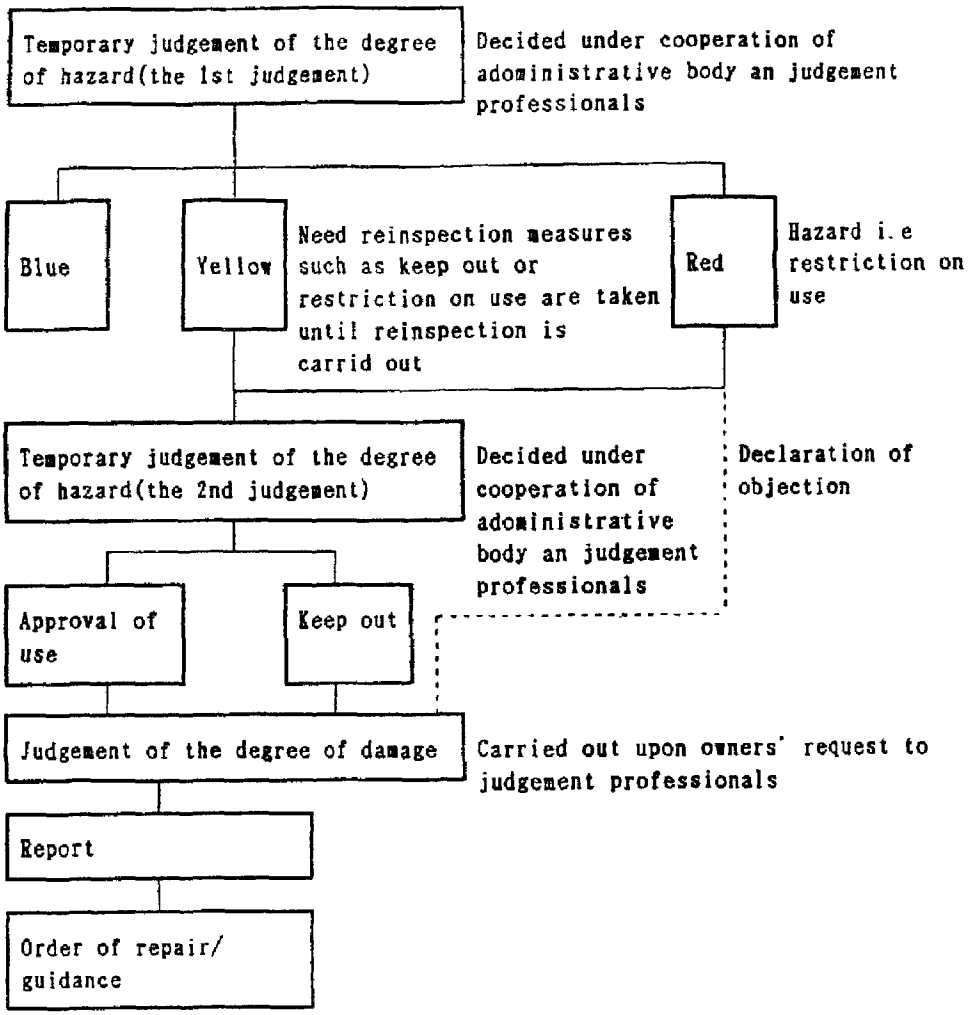
At present, based on the results of the study, to establish the judgement system is under way in cooperation with local professionals especially in the regions of Tokai and South Kanto which face high risk of being hit by an earthquake.

1 Outoline of judgement system




Formation of professional judgement teams, allocation by regions
Move to the site
Execution of judgement work and announcement of the results
Collection of the results of judgement
Back to home
Sort of the results of judgement
Countermeasures based on the results of judgement

2 Concrete flow of the judgement work



4. OFF THE COAST OF KUSHIRO EARTHQUAKE AND A REPORT ON DAMAGE

4.1. Outline of the Earthquake

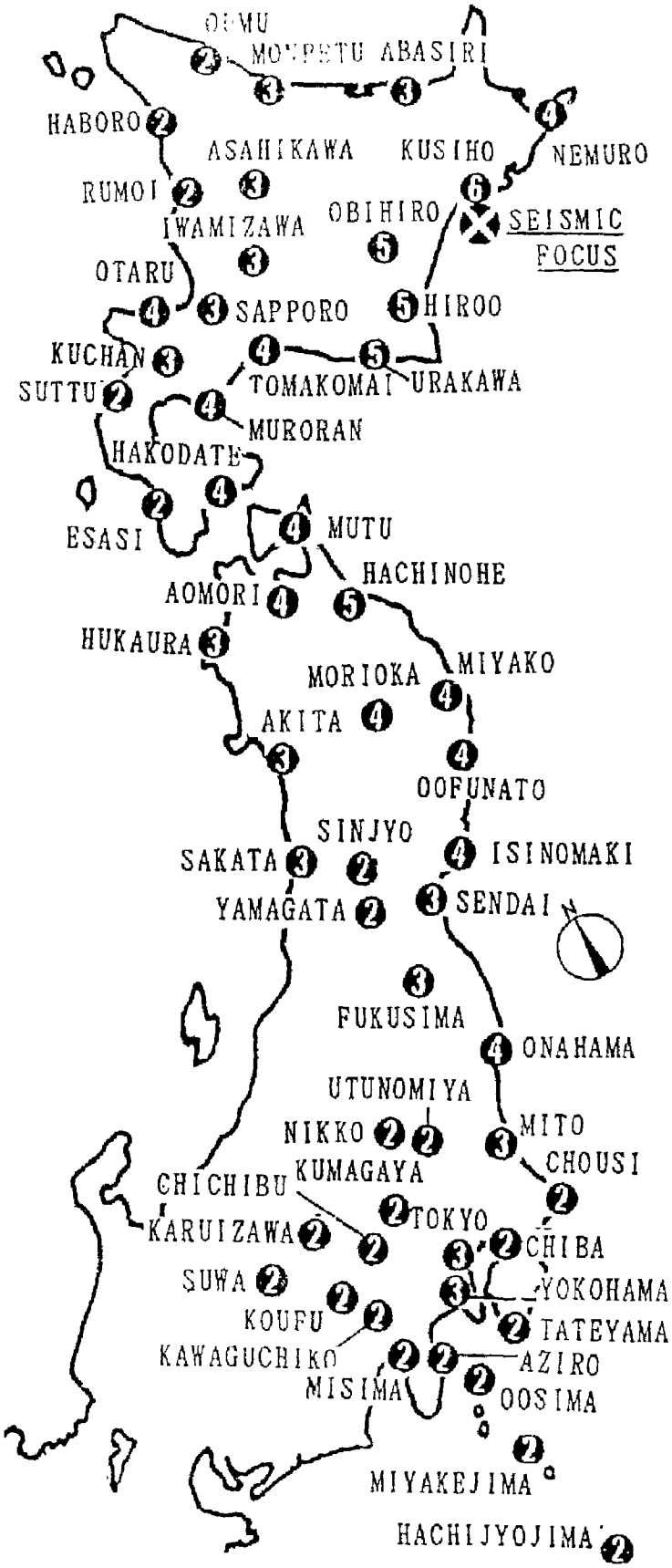
In January Friday the 15th of 1993 at about 20:06, an earthquake hit the area of Hokkaido through Chubu region and cities such as Kushiro-city in Hokkaido suffered a severe damage.

No seismic wave occurred.

The Meteorological Agency made an announcement regarding the seismic center or intensities in each region.

The details are as follows;

The seismic focus	: Off the coast of Kushiro (lat. 42°51'N, 144°23'E) Depth 107 km
Magnitude	: 7.8
Seismic Intensity	: 6 Kushiro 5 Obihiro, Hiroo, Urakawa, Hachinohe 4 Nemuro, Tomakomai, Otaru, Muroran, Hakodate, Aomori, Mutu, Miyako, Morioka, Oofutato, Isinomaki, Onahama 3 Monbetu, Abasiri, Asahikawa, Iwamizawa, Sapporo, Kuchan, Fukaura, Akita, Sendai, Sakata, Fukusima, Mito, Tokyo, Yokohama
Name	: "Heisei 5 Nen (1993 year) Earthquake off the coast of Kushiro"



SEISMIC INTENSITY

4.2. Outline of the Damage (As of February the 21th, 1993, Data source:the Fire Defence Agency)

4.2.1. Human Casualty

(1) Death : 2

A joint of gas pipes laid underground was dislocated by vibration from the earthquake and gas leaked from the joint caused death of one woman who lived on the first floor of collective dwelling (causality with the earthquake is under investigation by police).

Also one man was killed inside the house under a chandelier (with a diameter of 0.87m, wight of 18kg) which broke off from a post.

(2) Severely Injured : 114 / Slightly Injured : 819

Human casualty and cause (clarified cases)

(i) Burns/scalds..... 152
Caused by a fall of kettles from stoves, etc.

(ii) Incised wounds..... 129
Caused by broken pieces of glasses, etc.

(iii) Bruises..... 104
Caused by stumbling during evacuation, fall of furniture or building parts, etc.

(iv) Sprains..... 44
Caused by stumbling during evacuation, fall of furniture or building parts, etc.

(v) Gas poisoning..... 39
Caused by cracks in gas pipes, dislocation of joints, etc.

(vi) Fractures..... 37
Caused by fall of furniture or building parts, etc.

4.2.2. Damage on Houses and Buildings

Regarding the damage on houses:
(i) Completely destroyed..... 12
(ii) Half destroyed..... 73
(iii) Partially damaged..... 3,389
Damage on non-residential buildings (cracks on exterior tiled walls, broken windows, etc.) is;
(iv) Educational facilities..... 488
(v) Hospitals..... 208
(vi) Social welfare facilities..... 165
(vii) Fires..... 11 cases

* Reference: General information of Kushiro city

Population	: 202,756 (as of 31st of January 1992)
Total households	: 78,423 (as of 31st of January 1992)
Total area	: 221.38 km^2 (as of 1st of October 1990)

Stock of houses, non-residential buildings (as of 1st of January 1993)

Houses	: 54,609
Non-residential buildings	: 20,808
Total	: 75,417

4.2.3. Damages on Utility Lines

Water stoppage	21,765 houses
Electricity interruption	57,200 houses
Gas stoppage	9,355 houses
Interruption of railway service	4

4.3. Outline of Damage on Buildings and Houses and Administrative Measures in Future

4.3.1. Buildings

(1) Damage on the Main Structures
(Principal parts to maintain structural resistance)

Not a great deal of damage to the main structure of schools or hospitals has been observed and possibility of hazard such as collapse of a building is low though structural resistance might have been affected by the earthquake.

So even if future earthquakes would not cause the as bad as collapse of these buildings they might cause heavy structural damage on to buildings.

Since the number of public buildings which are in urgent need to have confirmation of safety counts one thousand and some hundreds, an urgent task is to pick up those buildings which have been damaged badly and have higher priority in use (schools, hospitals, welfare facilities, and fire station, and so on) and then to make temporary judgement on the degree of both damage and hazard by consulting well with authorities concerned.

And the aim to complete the overall judgement work covering the judgement on less damaged public buildings is set within 1-2 rears.

Upon execution of judgement work, an administrative body will hold seminars to foster more judging professionals and also wake up and distribute brochures of guidance.

(2) Damage on Exterior or Interior Materials

Regarding exterior or interior materials (mortar finishing, tile finishing, window glasses, signs, etc), many buildings with tile finishing were observed to have capillary cracks or partial fall of tiles.

This kind of damage will deteriorate under natural circumstance such as rain or wind and possibly leads personal injury of materialistic damage in case tiles fall off.

Middle-high and high-rise buildings especially require higher security levels and they need their exterior materials to be inspected and checked periodically and to be repaired accordingly if necessary.

Also regarding the buildings which the Building Standard Law of Japan designates to make periodic inspection and report, an administrative body informs the owners that their buildings should be inspected to see if there is any damage on exterior or interior materials from the earthquake by the means of sending notice or through disaster prevention check.

And upon submission of the periodic report at a counter, an administrative staff conducts thorough hearings about the condition of exterior and interior materials and if necessary an owner might be guided to repair. (Guidance covers the area of buildings equipments and guides to inspect if there is any gap between pipes and so on)

Regarding buildings which are not designated to have periodical inspection, an administrative body will call owners' attention through brochures and so forth and set up a system (special counter) to introduce judging professionals such as architects.

4.3.2. Houses

(1) Damage on Properties

Main cause of damage on houses is a landslide or cracks on the ground.

Since winter season is not over yet, detailed information regarding cracks on the ground is hard to get but as soon as spring comes, reinspection is going to be conducted especially in the areas hit by landslides.

Also an administrative body will make up and distribute brochures and guide owners to conduct a spontaneous inspection.

(2) Damage on Exterior and Interior Materials as well as Chimneys

Since most of houses are wooden and have mortar finishing, the earthquake caused capillary cracks on the walls and some parts of mortar fall off.

It is necessary to call owners' attention to the possible damage caused by natural circumstance in future and to guide them to thorough inspection and judgement of their buildings.

Also there have been number of cases that a collected chimney built on like brick made building had partial damage, so an administrative body also warns the hazard of possible collapse and calls attention even to the owners whose buildings were not observed to have been suffered from the earthquake.

The measure to this kind of case is the same and an administrative body will make up and distribute brochures which persuade owners to have complete inspection and repair if necessary.