Mongolia
National Emergency Management Agency (NEMA)

THE PROJECT FOR STRENGTHENING THE NATIONAL CAPACITY OF EARTHQUAKE DISASTER PROTECTION AND PREVENTION IN MONGOLIA

SEPARATE VOLUME OF

TECHNICAL COOPERATION OUTPUT / TECHNICAL COOPERATION MATERIAL

JANUARY 2020

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
KOKUSAI KOGYO CO., LTD.
OYO INTERNATIONAL CORPORATION
URBAN DISASTER RESEARCH INSTITUTE

Separate Volume for the Output of Technical Cooperation

1. The Earthquake Disaster Protection Plan of Darkhan-Uul Aimag

Earthquake Disaster Protection Plan of Darkhan-Uul Aimag

Table of Contents

Earthquake Disaster Protection Plan of Darkhan-Uul Aimag

1. Overview of Darkhan-Uul Aimag

The foundations of Darkhan city were set on October 17,1961 and the city has developed over the years to become the second largest in Mongolia. Darkhan city was built through economic cooperation and support from former socialist states, namely the Soviet Union, Bulgaria, Poland, Hungary, Czech Republic and East Germany. According to the Law on the Administrative Units of Mongolia and their Governance passed through Parliament Resolution 32 of 1994, Darkhan city was reorganized to become Darkhan-Uul aimag.

1.1 Geographic Conditions

Darkhan-Uul aimag covers an area of 327.5 thousand hectares in the valley north-east of the Kharaa river within the Khentii mountain range in north Mongolia. Exploitable agricultural land makes up 70.7 percent of the total area, or 231.7 thousand hectares. Although the total land area of the aimag is small, it is rich in natural resources such as gold, limestone, coal and various raw minerals used for building materials.

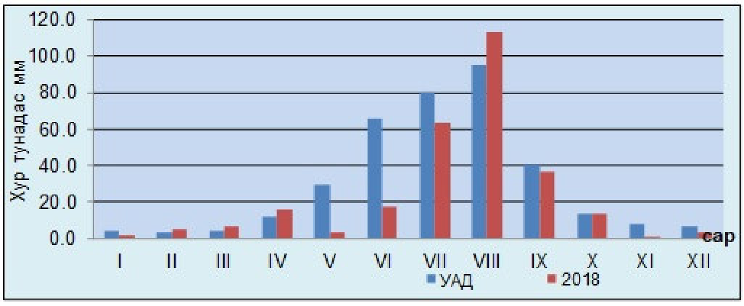
Picture 1. Geographic location of Darkhan city (Source: mn.wikipedia.org)

Picture 2. Darkhan-Uul aimag and its soums

The aimag is located at a relatively low elevation at 707 meters above sea level. The Kharaa, Zulzaga, Sharyn Gol, Yeruu, Orkhon, Khuitnii and Khavchuun rivers all flow through the aimag from their source in the Khentii mountains to form a confluence in the Orkhon river. Other small streams flow into the source of the Kharaa river, which forms the direct and indirect water source of Darkhan city's residents (in the form of surface and deep water).

The aimag is located in the central forest and farming region of Mongolia. Crop farming accounts for a significant portion of the aimag's agricultural products. The aimag is made up of 22.4 percent forests, 71.0 percent exploitable agricultural land, 0.7 percent water and 1.5 percent other use.

Temperatures reach a maximum of 42.6 degrees Celsius in July and a minimum of -43.7 degrees Celsius in January. The aimag sees an average of 310-320 mm of precipitation per year and 85-90%, or 284-290 mm, are seen in warmer seasons. The amount of precipitation in 2018 is shown compared to the average amounts in the graph below.

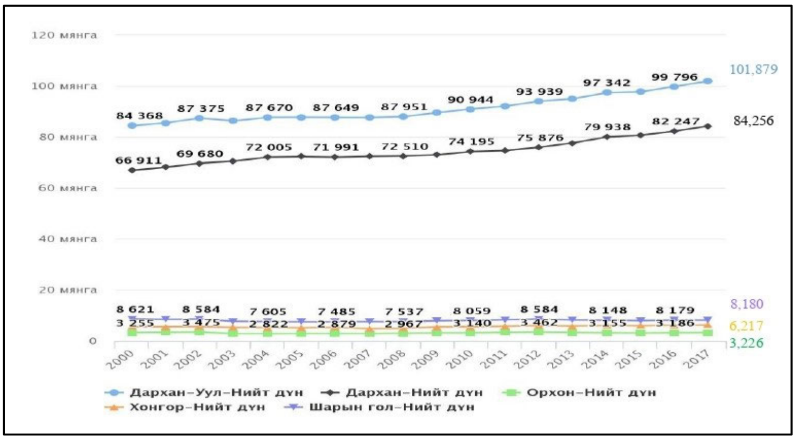


Picture 3. Precipitation in Darkhan-Uul aimag (2018)

1.2 Population and Industry

(1) Population

As of 2019, Darkhan-Uul aimag has a total of 104,090 residents in 30,574 households, among which 86,851 people live in Darkhan city. Among the total population, 52,936 are female while 51,157 are male. The population count of each soum in the aimag is shown in the graph below. (Source： National Statistical Office)



Picture 4. Population per soum, Darkhan-Uul aimag（2000～2017）

*(Legend: **Blue line** – Total population of Darkhan-Uul aimag, **Black line** – Darkhan soum, **Purple line** – Sharyn Gol soum, **Orange line** – Khongor soum, **Green line** – Orkhon soum)*

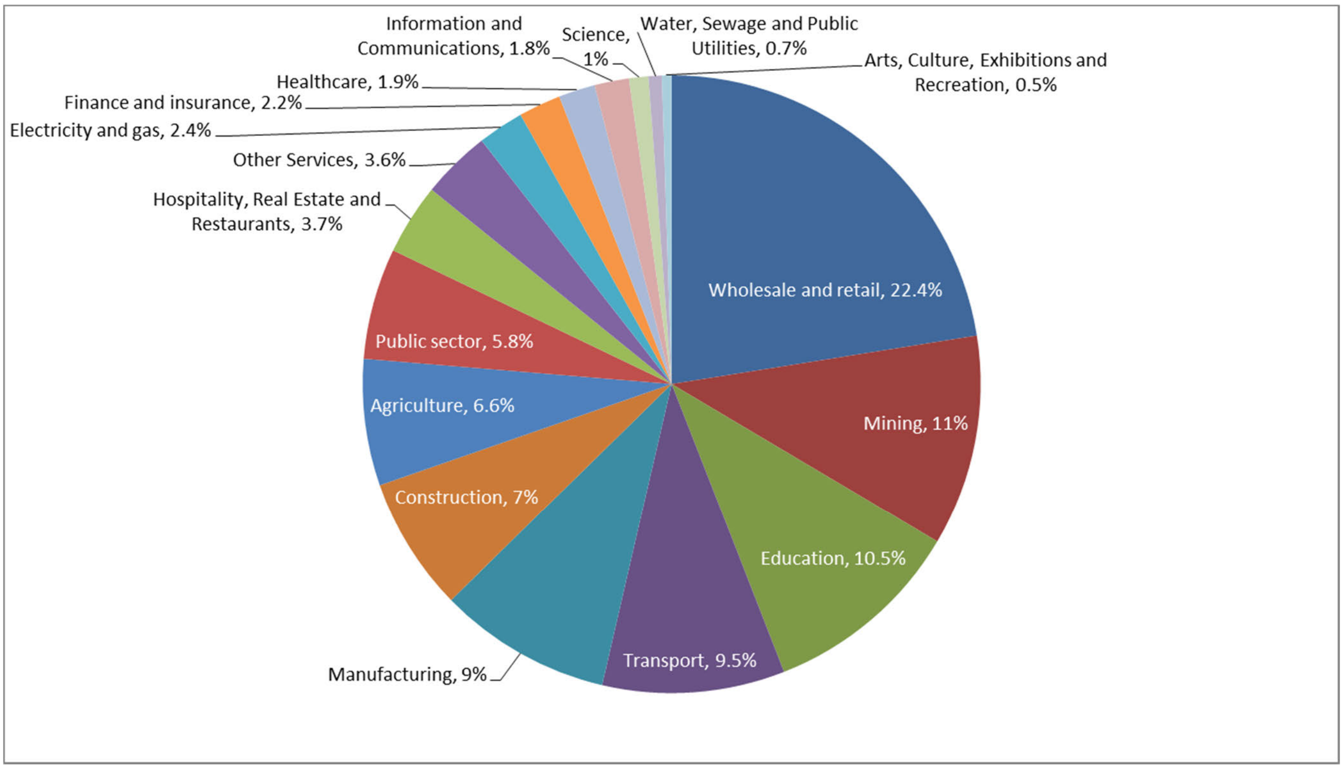
The number of aimag residents are shown below according to their age groups. Elderly residents make up 4.4% of the population, which is a relatively low amount.

Table 1. Population of Darkhan-Uul aimag according to age groups (Source: National Statistical Office)

Age Group	2002	2007	2012	2017
Total Population	87,375.	87,590.	93,939.	101,879.
0-4	5,654.	6,392.	9,195.	11,889.
5-9	7,424.	7,736.	7,176.	10,738.
10-14	10,627.	8,948.	7,478.	7,238.
15-19	10,443.	10,381.	8,362.	7,487.
20-24	8,152.	8,053.	10,476.	7,763.
25-29	7,064.	7,010.	8,749.	9,710.
30-34	7,026.	6,986.	7,862.	8,194.
35-39	7,578.	6,996.	7,497.	7,607.
40-44	6,537.	7,343.	6,576.	7,239.
45-49	5,441.	6,361.	6,357.	6,250.
50-54	3,558.	4,170.	5,000.	5,897.
55-59	2,574.	2,331.	3,250.	4,560.
60-64	2,057.	1,587.	2,054.	2,844.
65-69	1,349.	1,489.	1,481.	1,719.
70+	1,891.	1,807.	2,426.	2,744.

Population Growth Rate			
	2002-2007	2007-2012	2012-2017
Total	1.002	1.072	1.085
0-4	1.131	1.439	1.293
5-9	1.042	0.928	1.496
10-14	0.842	0.836	0.968
15-19	0.994	0.806	0.895
20-24	0.988	1.301	0.741
25-29	0.992	1.248	1.110
30-34	0.994	1.125	1.042
35-39	0.923	1.072	1.015
40-44	1.123	0.896	1.101
45-49	1.169	0.999	0.983
50-54	1.172	1.199	1.179
55-59	0.906	1.394	1.403
60-64	0.772	1.294	1.385
65-69	1.104	0.995	1.161
70+	0.956	1.343	1.131

According to statistics, 31,526 of the aimag residents (as of 2018) are employed; of which 16,816 are male and 14,710 are female. The graph below shows the employment rate according to the economic sector. (Source: National Statistics Office)



Picture 5. Darkhan-Uul aimag, employment rate according to economic sector

(2) Industry

○ Animal Husbandry : As of 2018, the livestock headcount was 306,014, which is a 1.6% decrease as compared to the same period of the previous year. The headcount included 17,660 horses, 44,260 cows, 60 camles, 147,060 sheep and 96,970 goats.

About 98.7% of the total counted livestock belong to private herders while the rest are owned by commercial entities. Livestock headcount by soum yields the following results: 68,362 in Darkhan soum, 165,314 in Khongor soum, 41,769 in Orkhon soum and 30,569 in Sharyn Gol soum. The 2018 headcount also included 1,135 pigs, 9,476 fowl, 2,376 hives of bees and a few rabbits raised as household pets.

○ Land Cultivation : Since Darkhan-Uul aimag is located in the central farming region of Mongolia, crop farming accounts for a significant portion of agricultural products. Crop farming companies are located close to research stations and collaborate with them. The agricultural sector of the aimag accounts for 30% of its residents' meat consumption, 90% of dairy product consupmtion, over 70% of flour and flour product consumption and all of the aimag's vegetable consumption; making it a strategically important sector.

As of 2018, a total of 20,502.1 hectares of land was used for crop farming, which includes: 11,944.6 hectares of grains, of which 11,396.6 hectares was made up of wheat, 603.31 hectares of potatoes, 1,268.24 hectares of vegetables, 2,503.7 hectares of livestock fodder and 4,182.2 hectares of rapeseed. Total area of cultivated land decreased by 2,026 hectares as compared to the previous year.

○ Manufacturing and Energy Sectors: The aimag is connected to a 220/110/35 kW thermal power station grid. In terms of manufacturing facilities, the aimag has a metal and steel factory, a cement factory, heavy machinery, a leather processing factory, a meat processing factory, chemical manufacturing facilities and a warehouse for crude oil products.

The total production by the commercial sector in Darkhan-Uul aimag is shown in the table below (as of 2017). (Source: National Statistics Office)

Table 2. Total production by the commercial sector (2017), in millions of tugriks

No.	Sector	Darkhan-Uul aimag	National level
1	Total agriculture	**34,800.8**	**2,842,724.3**
1.1	Crop farming	15,157.8	216,704
1.2	Animal husbandry	19,499.2	2,591,320.7
1.3	Other agriculture	143.9	34,699.6
2	Total mining and manufacturing	**188,913.2**	**11,527,012.1**
2.1	Mining	51,347	6,761,188.3
2.2	Manufacturing	75,910.3	2,939,000.1
2.3	Energy, water, sanitation and utilities	54,168	692,252.1
2.4	Construction	7,488	1,134,571.7
3	Total service sector	**197,720.8**	**13,525,787.7**
3.1	Trade, hospitality and restaurants	58,639.9	4,723,865.6
3.2	Transport, information and communications	13,170.8	1,924,686.4
3.3	Finance and trading	50,949.4	3,823,847.5
3.4	Other services	74,960.6	3,053,388.3

1.3 Administrative Units

The aimag is composed of 4 soums, namely Darkhan, Orkhon, Sharyn Gol and Khongor, and 24 bags. The aimag borders with Bayangol soum of Selenge aimag in the east and south-east, Nomgon soum of Selenge aimag in the north-west and with Javkhlan and Yeruu soums of Selenge aimag in the north-east.

Darkhan city, the aimag center is one of Mongolia's largest industrial and commercial centers. The aimag has a well-developed infrastructure; it is located along the Ulaanbaatar-Altanbulag international road and the Ulaanbaatar-Sukhbaatar international railway, is connected to the central energy grid and is serviced by high-speed fiber optic cables, digital radio-relay systems and cellular network.

The distance between Darkhan and Ulaanbaatar is 220 km, Darkhan-Selenge is 100 km, Darkhan-Erdenet is 180 km, Darkhan-Orkhon is 45 km, Darkhan-Khongor is 25 km and Darkhan-Sharyn Gol is 75 km.

1.4 Previous Disasters in Darkhan-Uul Aimag and Current Issues

Although no earthquake disasters have occurred in Darkhan-Uul aimag in recent years, the aimag is located in an area with an active fault that can cause a 7.0-8.0 intensity earthquake and buildings located in the aimag that were built before the 1980s were built without seismic engineering assessments. Therefore, there is a risk of old, poor-quality buildings, tall buildings and factory chimneys to collapse; causing injuries, losses of lives, disruption of normal daily operations and a severe deterioration in livelihoods which may lead to socio-economic burdens and crises at a national level.

The aimag's capacity for rescue and restoration operations will be limited depending on the magnitude of the earthquake, climatic conditions and disaster protection resources.

The Kharaa river which has its source in the Khentii mountains flows 56 km along the west side of the aimag center and into the Orkhon river. However, since most of the annual precipitation falls between the end of June and August, the river is usually flooded during this time. There is a growing number of people visiting near the river for their summer holidays and as a result, there have been incidents of drowning.

In the past 10 years, 15 people have drowned in the Kharaa river and therefore the aimag administration, the police, emergency management officials and citizens need to cooperate and ensure public participation in organizing large-scale, effective efforts in warning the public about floods and drowning hazards and protecting them from such hazards.

2. Risk Assessment

2.1 Main Objective

Based on the studies and observations of the current situation of Darkhan city, a general picture of potential future damages caused by an earthquake disaster in the city is shown through the risk assessment results.

The damage estimation developed as a result of the earthquake risk assessment should be used with sufficient understanding of the following:

【Issues to note when conducting earthquake risk assessment】

● An earthquake intensity of 8.0 is considered in the risk assessment according to the MSK scale specified in the “Standards and Guidelines for Planning Construction Works in Earthquake Zones”. The potential earthquake intensity in Darkhan city could even be greater than 8.0.

● The scope of damages and zones of the most severe damages as calculated through risk assessment can vary according to where the epicenter is located. Therefore, it is important to consider that actual damages and projected damages can vary.

2.2 Risk Assessment Method

Risk assessment was conducted using the “Simplified Earthquake Damage Assessment Excel Spreadsheet” developed by a NEMA Working Group. The excel spreadsheet assessment method was developed by NEMA and is based on the earthquake risk assessment method contained in the “Earthquake Risk Assessment Guideline” which is in the process of obtaining approval from the Head of NEMA.

(1) Earthquake Intensity

According to the scale specified in the “Standards and Guidelines for Planning Construction Works in Earthquake Zones”, the earthquake intensity of Darkhan city is 8.0. This is the intensity that is used in the evaluation.

(2) Building Damages

Buildings were categorized based on their purpose as housing complex, residential property, public buildings, gers and other residences. The seismic resistance of these buildings was also graded according to the 13 grades in the “Methodological Guideline on Providing Passports to Buildings Constructed in Earthquake Zones”. The rate of damage to each 13 building grade is calculated by entering the earthquake intensity, and this rate is multiplied with the number of buildings to calculated the number of buildings that will be destroyed or severely damaged.

(3) Human Casualties

The number of deaths and injuries are calculated based on the households living in buildings that will be destroyed or severely damaged. The number of households living in public and private residences shall be counted and entered into an excel spreadsheet, wherein potential casualties will be calculated.

(4) Infrastructure Lifelines

In terms of roads, bridges, clean water and sewage pipes, electricity transmission lines and transmission poles, by inputing data on soil conditions, the type of bridge, the type of pipeline and its diameter, and the design of the structure; the earthquake damage rates were calculated and the number of rupture points as well as the length of the pipelines were forecasted.

The damage calculation results are shown in Table 2.1.

Table 2.1. Forecast of Potential Earthquake Damages in Darkhan City

Type of Damage			Amount	Unit
Human Casualties	Deaths		384	people
	Injuries		477	people
	People left homeless		6210	people
Building Damages	Destroyed or severely damaged	Houses	1809	unit
		Housing complex	7	unit
	Amount of debris		5400	tons
Infrastructure Lifelines	Roads	Impossible to pass through	0	points
	Bridges	A methodology (collapsed)	None	
		B methodology (requires repair)	None	
	Transmission poles	Collapsed	0	nos.
	Transmission lines	Damage rate	0.5	%
	Underground pipes	Damage rate	0.1	%
	Clean water	Ruptured	8	points
	Sewage	Damage rate	19	%
	Hot water	Ruptured	15	points

2.3 Developing Potential Disaster Scenarios

Disaster scenarios for the following sectors were developed based on damage estimation: 1. Urban planning, buildings, infrastructure lifelines, 2. Health and medical care, 3. Environment, 4. Disaster protection measures and equipment, 5. Education and public participation, and 6. Information exchange.

(1) Urban planning, buildings, infrastructure lifelines

- ✓ A total of 1,816 buildings were destroyed or severely damaged, leading to 384 deaths and 477 injuries. An additional 6,210 people were left homeless.
- ✓ Buildings used for schools, kindergartens, hospitals, public gathering, commerce and services suffered heavy damages.
- ✓ There were 8 rupture points in clean water pipelines, cutting the supply of clean water to more than 1,200 people.
- ✓ Sewage pipes were ruptured, leading to soil contamination.

(2) Health and medical care

- ✓ There are a total of 8 hospitals, namely 2 general hospitals, 5 household medical centers and a maternity hospital. This facility is insufficient to handle 477 injured people.
- ✓ There are 12 medical specialists (internal, neurology), 6 surgeons, and 8 pediatricians and hospital staff. This person is not enough to handle the injured people with medical care.

- ✓ There are no fully-equipped ambulances, which will cause difficulties in transporting injured people and other patients.

(3) Environment

- ✓ A rupture in the sewage pipes will cause soil contamination and environmental degradation.
- ✓ There are only 2 sewage suction vehicles, and can collect human waste from only 150 households.
- ✓ The resulting debris will amount to 5,400 tons and considering a truck with a 10 ton capacity, it will have to make 540 trips to remove the rubble. There is no designated spot for amassing debris, which will slow the debris removal process.

(4) Disaster Protection Measures and Instruments

- ✓ Insufficient disaster reserves for victims.
- ✓ Difficulties in search and rescue operations due to lack of personnel and equipment.
- ✓ Lack of evacuation place for 6,210 disaster victims who have lost their homes. Although the evacuation places have been commissioned, they lack the necessary equipment and resources and as such, are impossible to properly function as evacuation place.

5) Education and Public Participation

- ✓ Activities to provide disaster risk reduction ("DRR") education started not long ago in 2017 and as such, the public is still not sufficiently knowledgeable and experienced enough to support in activities such as first aid.
- ✓ The "Safety Life Skills" program aimed at teachers in schools and pre-schools began implementation a short time ago and as such, there is still a substantial risk of a large number of disaster casualties involving children in schools.
- ✓ Since evacuation drill has not been implemented as of yet, victims cannot evacuate safely.

6) Information Exchange

- ✓ Landlines, mobile phones, fax and internet services will be cut off due to damages to cables and antennae.
- ✓ Insufficient personnel and equipment for the emergency repair of communications devices in remote areas.

Based on the scenarios above, working groups set improvement targets in the next 10 years, extracted issues to achieve them, set measures, prioritized them, examined budgets, and formulated disaster protection plans..

3. Main Principles

The main principles for planning earthquake disaster protection measures are outlined in this part.

3.1 Main Principles

・Planning appropriate DRR measures aimed at strengthening the capacity for earthquake DRR;
・Determining the earthquake risk in a target region and implementing real measures to reduce the risk;
・Include DRR measures in annual operations plans and monitor their implementation;
・Adhere to the principle of PDCA (Plan, Do, Check, Act) when monitoring implementation, and the plan must be modifiable at every moment in order to effectively implement DRR measures.

3.2 The Implementation Policy of Disaster Risk Reduction Plan in Each Sector

(1) Ensuring the Seismic Resistance of Buildings, Infrastructure and Lifelines

・Accelerate efforts to evaluate and ensure the seismic resistance of buildings.
・Continuously implement activities to evaluate and ensure the seismic resistance of infrastructure and lifelines.
・Conduct aging survey of clean water and sewage pipelines, and accelerate strengthening and reconstruction work based on their assessment.
・Accelerate repair work on power stations and transmission lines, and if necessary, upgrade them.

(2) Personnel, Equipment, Education and Training

・Organize comprehensive DRR training and evacuation drill.
・Refine the DRR education of pre-schools and secondary schools.
・Promote the development of evacuation places and the establishment of an evacuation system.

(3) Information and Communications

・Ensure the disaster preparedness of the information exchange network used between DRR-related organizations.
・Accelerate efforts of DRR-related organizations in disseminating information to the public.

(4) Health and Medical Aid

・Prepare professional human resources and strengthen the activities of healthcare institutions.
・Strengthen and refine the information conveyance system of healthcare institutions.

(5) DRR Measures

・Conduct risk assessment and raise awareness of risk reduction measures among the public.

・Refine the activities of the Regional DRR Committee and Regional Earthquake Disaster Management Committee.

・Implement measures to strengthen the cooperation between DRR-related organizations.

4. Measures Aimed at Fulfilling Disaster Risk Reduction Goals

Risk reduction measures to be implemented as shown below have been planned in consideration of the required measures to take according to the disaster scenarios developed based on the potential earthquake disaster damages.

I. Buildings, Urban Development, Infrastructure Lifelines

I.1 Urban Development for DRR

＜10-Year Goal＞

- Reduce the risk of buildings collapsing by 30% through risk reduction measures such as re-planning, strengthening and reconstructing existing buildings which are at risk of collapsing during an 8.0 intensity earthquake.

＜Measures to Take＞

- Evaluate the quality and seismic resistance of residential buildings, schools, kindergartens and hospital buildings; completing the process for obtaining building passports within 2019; demolishing and reconstructing buildings that are not resistant to earthquakes; researching buildings that may still be used and implementing a step-by-step plan to strengthen them.
- Buildings that are planned to be used as evacuation place especially need to be evaluated and ensured for seismic resistance.
- After completing the seismic assessment and passport process for buildings, develop recommendations for measures to take regarding residential and other buildings that do not fuilfill seismic resistance requirements.
- Include expenses for earthquake disaster risk assessment and reduction measures in regional budgets.
- Implement step-by-step training for strengthening the capacity for human resources.
- Improve DRR planning, calculated disaster risk in aimags and soums and align them with DRR planning.
- Organize activities to raise awareness of this plan among the public.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

Aimag Governor’s Office, Soum Governor’s Office, GASI, ALAGAC, EMA, Environment and tourism department

＜Required Budget＞

3～4.2 billion MNT

I.2 Ensuring the Seismic Resistance of Administrative Buildings

＜10-Year Goal＞

- Conduct seismic assessment and grant technical passports to 100% of government buildings.

＜Measures to Take＞

- Develop a list of buildings that need to be strengthened and include the relevant expenses in the budget of the next year.
- Create building profiles for each building.
- Complete disaster risk assessment of all buildings.
- Deconstruct buildings that do not meet requirements and re-plan them.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

Aimag Governor’s Office, Soum Governor’s Office, ALAGAC, GASI, EMA

＜Required Budget＞

250～350 million MNT

I.3 Ensuring the Seismic Resistance of Public Buildings

＜10-Year Goal＞

- Complete the strengthening of 100% of public buildings such as hospitals, schools and kindergartens

＜Measures to Take＞

- Promptly organize activities to check and evaluate the seismic resistance of public and residential buildings.
- Develop the action plan and include the expenses required for strengthening public buildings in the next year’s budget.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

Aimag Governor’s Office, Soum Governor’s Office, GASI, ALAGAC, EMA, Department of Education and Culture, Social Policy Division, Health Department

＜Required Budget＞

26 kindergartens (public) 156,0-208,0 million MNT
16 kindergartens (public) 96,0-128,0 million MNT
18 hospitals (public)78,0-104,0 million MNT
20 kindergartens (private) 120,0-160,0 million MNT
9 kindergartens (private) 54,0-72,0 million MNT
53 hospitals (private) 318,0-424,0 million MNT
Total 1,096.0 million MNT

I.4 Ensuring the Seismic Resistance of Residential Buildings

＜10-Year Goal＞

- Reduce the risk of earthquake damages to residential buildings by 50%

＜Measures to Take＞

- Include expenses related to risk assessment and granting technical passports in the national and regional budgets.
- Conduct risk assessment for all residential buildings
- Conduct seismic assessment on buildings constructed between 1957 and 1990 among the 1,816 buildings which resulted in collapse or severe damage according to the risk assessment.
- Improve the usage conditions of existing residential buildings and increase monitoring efforts.
- The first phase of re-planning includes deconstructing 1 barrack in the 6th bag and replacing it with a 5-storey residential building for 60 households and move 24 people in the old barrack.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞
Aimag Governor's Office, Soum Governor's Office, GASI, ALAGAC, EMA

＜Required Budget＞

- Passport process for 389 buildings: 1,945 million MNT;
- 9 buildings within the re-planning framework: 3,150 million MNT.

I.5 Ensuring the Maintenance and Seismic Resistance of Roads

＜10-Year Goal＞

- Improve the preparedness of road restoration works by 30% through a 50% increase in the human and technical resources for road repair and maintenance.

＜Measures to Take＞

- Conduct the necessary studies and develop the emergency plan of the Darkhan-Uul Aimag Regional Road and Road Maintenance Department for the restoration of roads during earthquake disasters.
- Develop the plan for ensuring the preparedness of the Darkhan-Uul Aimag Regional Road and Road Maintenance Department for the restoration of roads during earthquake disasters and assemble the necessary human, technical and material resources.
- In cooperation with transport police officials, determine the route for the reserve road to be used for circumventing broken roads and debris during earthquake disasters.
- Conduct climate and disaster risk assessments and take preventive measures.
- Start using modern and efficient equipment that are used abroad.
- Develop and implement the training program for ensuring the preparedness and capacity for specialized workers to fulfill their duties during earthquakes.
- Expand and develop specialized organizations for conducting evaluation on road quality, seismic resistance and potential damages.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞
Aimag Governor's Office, Soum Governor's Office, GASI, ALAGAC, EMA, Darkhan-Uul Aimag Regional Road and Road Maintenance Department

＜Required Budget＞

I.6 Ensuring the Seismic Resistance of Bridges

＜10-Year Goal＞

- Improve the preparedness of bridge restoration works by 30% through a 50% increase in the human and technical resources for the bridge construction, repair and maintenance unit.

＜Measures to Take＞

- Build new reinforced concrete bridges with modern technology.
- Provide adequate funding for maintenance work.
- Strengthen the capacity of specialized human resources to a high level.
- Build the framework for training and licensing specialized organizations for conducting earthquake risk and damage assessments for bridges.
- Conduct training for specialists on seismic assessment standards required for the comprehensive earthquake risk assessment for bridges and prepare evaluation specialists.
- Study and develop solutions for measures to ensure the laboratory requirements of bridge structures.

• Present the expenses related to road and bridge construction and maintenance, and technological upgrades to the Darkhan-Uul Aimag Standing Committee on Earthquake Disaster Protection and obtain funding.
＜Implementation Period＞ 2019～2029
＜Implementing Organization＞ Aimag Governor's Office, Soum Governor's Office, GASI, ALAGAC, EMA, Specialized units for roads and bridges
＜Required Budget＞

I.7 Ensuring the Seismic Resistance of Infrastructure Lifelines

＜10-Year Goal＞ • Reduce risk of earthquake damages to the electric heating network and the clean water and sewage pipelines of "Darkhan Heating Network" SOSC ("DHN" SOSC) and "Darkhan Water Supply" SC ("DWS" SC)by 50%.
＜Measures to Take＞ "Darkhan-Selenge Electricity Transmission Network" SC ("DSETN" SC), "DHN" SOSC • Conduct earthquake risk assessment on 100% of electricity transmission lines. • Upgrade up to 80% of outdated transmission lines and ensure their seismic resistance. • Conduct repair work on 6/0,4 kV sub-stations. • Upgrade up to 60% of "DHN" SOSC's machinery and equipment and ensure their technical preparedness. • Conduct earthquake disaster protection and preparedness training for 100% of "DHN" SOSC and "DWS" SC's engineers and technicians. "DWS" SC • Upgrade up to 80% of outdated transmission lines and ensure their seismic resistance. • Commission the manufacturing of steel reinforced with earthquake resistant substances and test their resistance. • Prioritize the solution for electricity supply to clean water sources in cooperation with "DSETN" SC. • Establishing memorandums aimed at improving the cooperation and coordination between organizations in charge of infrastructure. • Conduct earthquake disaster protection and preparedness training for 100% of "DHN" SOSC and "DWS" SC's engineers and technicians.
＜Implementation Period＞ 2019～2024
＜Implementing Organization＞ Aimag Governor's Office, "DWS" SC, "DHN" SOSC, "DSETN" SC
＜Required Budget＞ 20 billion MNT

I.8 Ensure the Seismic Resistance of Buildings that Store Hazardous Chemicals Substances

＜10-Year Goal＞ • Reduce 100% of risks associated with storing, using and treating hazardous chemical substances by ensuring the implementation of the standards for hazardous chemical substances.

＜Measures to Take＞

“DWS” SC

- Take measures to store hazardous chemical substances in durable, earthquake resistant containers.
- Train and inform people that may be affected by such chemical disaster.
- Establish cooperation agreements between organizations in charge of infrastructure.

“DHN“ SOSC

- Transfer the storage for hazardous chemical substances (H2SO4,NH3,C2H5) to the first floor of the facility and reinforce the storage.
- Reinforce the storage door with earthquake resistant materials.
- Store the chemicals separately in locked metal containers where they cannot react with one another and cause fires and explosions.

＜Implementation Period＞

2019～2024

＜Implementing Organization＞

“DWS” SC, “DHN” SOSC, “DSETN” SC

＜Required Budget＞

II. Disaster Protection Personnel and Equipment

II.1 DRR Equipment

＜10-Year Goal＞

- Resupply fire-fighting and support vehicles with capital city-standard Japanese vehicles and upgrade 50% of the fleet in 5 years.
- Increase the capacity of communications and alert systems and upgrade 80-100% of existing systems within 5-10 years

＜Measures to Take＞

- Upgrade the following vehicles and equipment:
  Vehicle for communication-1
  Rescue vehicle-1
  Vehicle for the Firefighting-1
- Early warning system
- Improve the quality of wireless stations
- Digital radio communications system
- Mobile radio communications vehicle

＜Implementation Period＞

Communications equipment: 2019～2029

Fleet upgrade: 2019～2024

＜Implementing Organization＞

EMA Specialist in charge of alerts and communications, the information and communications authority, Earthquake Standing Committee of the Aimag Government

＜Required Budget＞

- Alert and communications equipment: 3 billion MNT
- Upgrading the fleet of rescue vehicles: 3 billion MNT

II.2 DRR Personnel

＜10-Year Goal＞

- The percentage of expert rescuers, firefighters and fire chiefs reach 80% in 5 years.
- The percentage of expert officials and members of specialized units reach 90%.

＜Measures to Take＞

Strengthen the expertise of personnel and accelerate efforts to increase and employ specialized human resources.

＜Implementation Period＞

- Expert rescuers and firefighters: 2019～2024
- Expert officials and members of units: 2019～2025

＜Implementing Organization＞

NEMA, EMA, Aimag's Earthquake Standing Committee

＜Required Budget＞

Based on the annual budget

II.3 Disaster Reserves

＜10-Year Goal＞

- Increase the earthquake disaster reserves and equipment by 50%.

＜Measures to Take＞

- Promote disaster reserves step-by-step by accumulating disaster risk fund

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

Aimag's standing committee on earthquake disaster protection

＜Required Budget＞

Implement section 51.2 of Article 51 of the Law on Disaster Protection

II.4 Emergency Transport Equipment and Network

＜10-Year Goal＞

- Organize and establish a system of emergency transport

＜Measures to Take＞

- Establish an emergency management center in a newly built fire and rescue unit facility.
- Increase the number of vehicles to be used for emergency transport (Refer to "V.6 Evacuation Route")

＜Implementation Period＞

2019～2020

＜Implementing Organization＞

EMA, Road and transport authority, Aimag Governor's Office (establish agreement), Reserves unit

＜Required Budget＞

III. Information and Communications

III.1 Information and Communications Infrastructure

＜10-Year Goal＞

- Increase the disaster preparedness of communications equipment of the EMA of Darkhan-Uul aimag and DRR-related organizations by above 80%

＜Measures to Take＞

- Place earthquake resistant voice alert and siren systems in certain locations within the Darkhan region.
- Implement a mobile telephone exchange with a 100-person capacity that can be operated anywhere and equipped with a light, mobile power supply.
- Install reliable communications and alert systems based on damage estimations and potential disaster scenarios.
- Regularly train engineers and technicians for implementing measures to take during disasters and ensuring their preparedness.
- Build a satellite and radio station and establish air links in order to improve disaster early warning and alert systems.
- Establish direct communication links between aimags and soums for information exchange.
- Take measures to ensure the preparedness of engineers and technicians for repairing air links, radio stations and cables as a result of damages to communications facilities, cables, towers and equipment during a 8.0 intensity earthquake.
- Take priority measures to restore communications with the aid of satellites and radio stations in the event of a communications failure.
- Reinforcing communications towers and antennae located on hills and mountains and equip them with a reserve power supply.
- Utilization of Spatial Information System for Disaster Risk Reduction in Darkhan-Uul aimag.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

EMA, Mongolia Telecom Company

＜Required Budget＞

1. Wireless station (mobile) 120 pieces, 600,000 MNT
2. Fixed wireless stations, 12 pieces, 1,800,000 MNT
3. Retransmission antennae 2 million MNT

III.2 Organization and Management of Communications and Information Gathering Activities

＜10-Year Goal＞

- Implement the sequential DRR measures of the Darkhan-Uul Aimag Communications Department of the Mongolia Telecom Company.

＜Measures to Take＞

- Research and analyze measures for expanding radio networks and equipping emergency commissions of aimags and soums, the EMA and its divisions, DRR officials and specialized units with reliable comunications.
- Provide a preparation system in which standby power and radio equipment can be activated with priority during disasters.
- Plan measures to repair and restore telecommunications during disasters.
- The Darkhan-Uul Aimag Communications Department of the Mongolia Telecom Company shall

take the following measures in order to reduce disaster risk:
1. Use underground cable networks as reserve cables
2. Disseminate WiFi signals and establish air links

- Implement the following measures to strengthen earthquake disaster alert systems:
  1. Establish a wireless communications network.
  2. Increase the amount of mobile radio communications devices.
- Create a statistical database for all organizations and consolidate the data.
- Unify databases of all organizations.
- Define the data collection specifications for each sector.
- Update the information at regular intervals.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

EMA, Mongolia Telecom Company, telecommunications companies

＜Required Budget＞

III.3 Public Alerts and Warnings

＜10-Year Goal＞

- Improve the timely warning system for earthquake disasters.

＜Measures to Take＞

- Install earthquake resistant sirens and alert equipment in the urbanized areas of Darkhan city.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

EMA, Mongolia Telecom Company

＜Required Budget＞

IV. Health and Medical Care

IV.1 Hospitals, Number of Beds

＜10-Year Goal＞

- Establish the required reserves of hospital beds and medicines at no less than 80%.
- Conduct 100% seismic assessments on the buildings of general hospitals, specialized hospitals and medical centers.

＜Measures to Take＞

- Establish reserves of beds (folding beds, etc.).
- Increase the frequency and improve the scope of training programs.

＜Implementation Period＞

Phase 1: 2019～2024

Phase 2: 2025～2030

＜Implementing Organization＞

Aimag healthcare department ,General hospitals, Soums, Households and the private sector

＜Required Budget＞
100 million MNT

IV.2 Doctors and Nurses

＜10-Year Goal＞

- Prepare 366 doctors and 183 hospital staff for 100,000 people.
- Enroll 100% of doctors, nurses and hospital staff in training and drills for working in earthquake disaster conditions.

＜Measures to Take＞

- Obtain budget approval for the required funding.
- Mobilize human resources from retired professionals.

＜Implementation Period＞
2019～2020

＜Implementing Organization＞
Aimag healthcare department, General hospitals

＜Required Budget＞
100 million MNT

IV.3 Remote Hospital

＜10-Year Goal＞

- Increase the preparedness of medical aid for earthquake victims up to no less than 80%.

＜Measures to Take＞

- Mobilize volunteer groups, student groups, military and police forces to provide support in remote hospitals.
- Expand the capacity of remote hospitals. Prepare 40 tents, 40 doctors and 100 staff for remote hospital services.

＜Implementation Period＞
2019～2020

＜Implementing Organization＞
Aimag healthcare department, General hospitals

＜Required Budget＞
100 million MNT

IV.4 Medical Reserves

＜10-Year Goal＞

- Establish reserves of medicines and medical equipment of no less than 80%.

＜Measures to Take＞

- It becomes possible to solve the problem by reflecting the price increase in the annual national budget.
- Establish 5 months of medical reserves
- Establish agreements

＜Implementation Period＞

2019～2020

＜Implementing Organization＞

Aimag healthcare department, General hospitals

＜Required Budget＞

10 million MNT

IV.5 Information Transmission

＜10-Year Goal＞

- Ensure radio communications capacity of no less than 80%.

＜Measures to Take＞

- Establish a wireless communications network.
- Enroll organizations and the public in disaster management training programs.

＜Implementation Period＞

Phase 1: 2019～2020

＜Implementing Organization＞

Aimag healthcare department, General hospitals

＜Required Budget＞

10 million MNT

IV.6 Transport

＜10-Year Goal＞

- Ensure the supply of ambulances and special equipment are no less than 80%.

＜Measures to Take＞

- Establish and operate a special fund for earthquake DRR.
- Obtain 50 ambulances to serve the projected amount of 200,000 population.

＜Implementation Period＞

Phase 1: 2019～2020

＜Implementing Organization＞

Aimag healthcare department, General hospitals, Ambulance departments

＜Required Budget＞

500 million MNT

IV.7 Disinfection Measures

＜10-Year Goal＞

- Mobilize 4 infection prevention teams and 20 hospital staff.
- Enroll 100% of staff in the aimag healthcare department and hospitals in DRR training and drills.

＜Measures to Take＞

- Ensure sufficient reserves of clothing and equpiment.

＜Implementation Period＞

2021～2024

＜Implementing Organization＞

Aimag healthcare department, General hospitals, Ambulance departments

＜Required Budget＞

10 million MNT

IV.8 Mental Support

＜10-Year Goal＞

- Prepare specialized mental couselors to work in disaster conditions.

＜Measures to Take＞

- Prepare specialized mental counselors to work in disaster conditions.
- Organize training on providing mental support.

＜Implementation Period＞

2021～2024

＜Implementing Organization＞

Psychological health departments, Mongolian Red Cross Society

＜Required Budget＞

1 million MNT

V. Disaster Protection Measures and Instruments

V.1 Search for Missing Citizens

＜10-Year Goal＞

Ensure the supply of 50% of equipment for the search and rescue team.

＜Measures to Take＞

- Submit the proposal of the composition of the search and rescue team to the Head of NEMA for discussion and approval.
- Complete 85% of the process for approving the proposed composition of the search and rescue team with full management control.
- The capacity to provide management control is fulfilled by establishment of the Disaster Operation Center.

＜Implementation Period＞

2019～2020

＜Implementing Organization＞

NEMA, EMA, Regional administration, Disaster Operation and Early Warning Command Center

＜Required Budget＞

- Funding depending on the relevant budget
- Disaster Operation and Early Warning Command Center: 57 million MNT

V.2 Postmortem Identification and Burial

＜10-Year Goal＞ • Establish a framework for postmortem identification and burial activities.
＜Measures to Take＞ • Construct facilities for postmortem identification activities and increase the capacity for mortuary refrigerators. • Ensure the availability of a specialized commissioned official for postmortem identification .
＜Implementation Period＞ Obtain 2 mortuary refrigerators per year to obtain 20 in 10 years
＜Implementing Organization＞ General hospitals, EMA, Buyan LLC.
＜Required Budget＞ 10 million MNT per mortuary refrigerator, 200 million MNT for 20 mortuary refrigerators

V.3 Evacuation places

＜10-Year Goal＞ • Ensure the availability of 100% of the required evacuation places for people left homeless during earthquake disasters.
＜Measures to Take＞ • Introduce a bill for increasing the amount and capacity of evacuation places to the Aimag Citizens' Representative Council. • Include the supplying of evacuation places and ensuring their seismic resistance in the 5-10 year city development plan of Darkhan-Uul aimag and include the relevant expenses in the budget. • Construct no less than 2 buildings per year that can serve as evacuation place. • Conduct risk assessment and obtain the passport of building for schools, kindergartens and universities that can be used as evacuation place.
＜Implementation Period＞ 2019～2029
＜Implementing Organization＞ Education and culture department, Department of land affairs, construction and urban development
＜Required Budget＞ Passport of building for 117 structures: 585 million MNT

V.4 Resources for Evacuation places

＜10-Year Goal＞ • Acquire materials and equipment for evacuation places.
＜Measures to Take＞ • Establish a reserve for acquiring resources for evacuation places after discussing with the Aimag Governor. • Plan the amount of the relevant organizations' contributions to the reserve for acquiring resources at the aimag level.
＜Implementation Period＞ 2019～2029

＜Implementing Organization＞
Aimag Earthquake Construction Council, Aimag Governor’s Office, Bag Governors

＜Required Budget＞
1 person-day: 5800 MNT.
6210 people for 14 days: 504.2 million MNT

V.5 Wide-area Evacuation Site

＜10-Year Goal＞
- Organize the framework for transport activities to evacuation site.

＜Measures to Take＞
- Specify the evacuation sites according to the decision of the Chairman of the Aimag Emergency Committee.
- Paving unpaved roads to improve traffic conditions to the evacuation site.

＜Implementation Period＞
2019～2029

＜Implementing Organization＞
Aimag Governor’s Office, Road and transport department

＜Required Budget＞
From the national budget

V.6 Evacuation Route

＜10-Year Goal＞
- Organize and establish the framework for evacuation activities.

＜Measures to Take＞
- Pave roads within 5-10 years in order to reduce transport time during evacuation activities.
- Prepare the budget.
- Ensure the preparedness of specialized units and establish cooperation agreements.
  Buses 40 people/1800 people
  Minibuses 37/444 people
  Cars 123/492 people
  People 2,736
  6,210 people may be transported 3 times

＜Implementation Period＞
2019～2020

＜Implementing Organization＞
EMA, Road and transport department, Aimag Governor’s Office (establish agreement), Reserve unit

＜Required Budget＞

V.7 Traffic Regulation

＜10-Year Goal＞
- Establish the framework for traffic regulation in disaster conditions

＜Measures to Take＞

- Prepare a new reserve route in the event of damages to existing roads inside and outside the aimag.

＜Implementation Period＞

2019～2020

＜Implementing Organization＞

EMA, Road and transport department, Aimag Governor’s Office (establish agreement), Reserve unit

＜Required Budget＞

V.8 Potable Water, Food and Necessities

＜10-Year Goal＞

- Establish disaster reserves.

＜Measures to Take＞

- Funding from the Aimag Governor’s reserve.
- Improve the replenishment, storage and access to potable water by up to 85%.
- Establish disaster food reserves capable of feeding citizens for 14-25 days.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

Mongolian Red Cross Society, Volunteer groups, Aimag, soum and bag Governors, Finance and reserves department

＜Required Budget＞

1,7 billion MNT per month for 10,000 people
908 million MNT per 25 days for 6,210 people

V.9 Waste Treatment

＜10-Year Goal＞

- Strengthen the waste management system

＜Measures to Take＞

- Obtain funding.
- Implement waste separation process
- Construct a waste recycling facility.

＜Implementation Period＞

2019～2024

＜Implementing Organization＞

Public utilities department

＜Required Budget＞

Waste recycling facility: 5-10 billion MNT

V.10　Sewage and Sanitation

＜10-Year Goal＞

- Reduce the risk of earthquakes damages to the sewerage system of “DWS” SC by 50%.

＜Measures to Take＞

- Acquire modern soil contamination monitoring devices.
- Acquire eco-friendly portable toilets.
- Upgrade and increase the fleet of high-capacity sewage suction vehicles.
- Build a special-purpose storage and establish a reserve of disinfectants and epidemic medicines.

＜Implementation Period＞

2019～2024

＜Implementing Organization＞

“DWS” SC, Heating system, Soum Governor’s Office, Environmental department, GASI

＜Required Budget＞

Portable toilets: 200 million MNT

V.11 Debris Removal

＜10-Year Goal＞

- Establish a framework for ensuring the preparedness of debris removal activities.

＜Measures to Take＞

- Research and calculate the requirements for debris removal machinery, develop a plan to operate the required machinery and adjust the plan on a yearly basis.

＜Implementation Period＞

2019～2024

＜Implementing Organization＞

EMA

＜Required Budget＞

500 million MNT

VI. Education and the Public

VI.1 DRR Education Programs

＜10-Year Goal＞

- Include earthquake DRR education programs in the curricula of 100% of compulsory schools, colleges and institutes of higher education.
- Include no less than 60% of all citizens in earthquake DRR education and training programs.

＜Measures to Take＞

- Develop and implement official and unofficial standard earthquake DRR training programs and conduct awareness-raising activities.
- Transmit awareness-raising content on self-protection during earthquakes and on the damages caused by earthquakes through radio and television.
- Construct new pre-school buildings with the latest earthquake-resistant technology and implement a step-by-step plan for strengthening that do not meet seismic resistance standards. (Refer to “1.3 Ensuring the Seismic Resistance of Public Buildings”).
- Include DRR education programs in the curricula of compulsory schools.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

Education and culture department, EMA

＜Required Budget＞

Expenses for radio and television programs: 8 million MNT per year, 80 million MNT for 10 years.

VI.2 DRR Training Materials

＜10-Year Goal＞

- Develop new training materials for earthquake DRR education.
- Develop manuals and guidelines for conducting earthquake disaster drills, contests, exams, etc. for school students.

＜Measures to Take＞

- Develop DRR education textbooks for compulsory schools and institutes of higher education.
- Develop manuals and handouts to be distributed when organizing earthquake DRR training and drills.
- Organize competitions for improving earthquake DRR knowledge.
- Develop and transmit short clips and videos aimed at improving earthquake DRR knowledge.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

EMA, Bag Governor, Social workers, Education and culture department, Consortium of institutes of higher education

＜Required Budget＞

Developing and printing manuals and handouts - 15 million MNT
Training materials - 10 million MNT
Developing short clips and video announcements - 10 million MNT, 350,000 million MNT in 10 years

VI.3 DRR Volunteer Activities

＜10-Year Goal＞

- Strengthen the capacity and increase the number of DRR volunteers.
- Accelerate efforts to improve DRR knowledge of the public implemented by DRR volunteers.

＜Measures to Take＞

- Organize public earthquake DRR training and drills in cooperation with volunteers.
- Register DRR volunteers.
- Organize training activities for volunteers at the aimag level.
- Establish a training center for DRR volunteer work and humanitarian aid.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

Aimag and soum governors, EMA, Mongolian Red Cross Society

＜Required Budget＞

- Organizing training for the public - 10 million MNT
- Advanced level training for volunteers - 8 million MNT

- Materials to distribute - 7 million MNT
- Establish a training center - 150 million MNT
- 1 billion and 750 million MNT in 10 years

VI.4 Coordination Between the Regional Administration and the Public

＜10-Year Goal＞

- Regional government and the public can collaborate to participate in disaster prevention measures and search / rescue activities.

＜Measures to Take＞

Within the framework of implementing the National Program for Earthquake DRR:

- Organize step-by-step activities to enforce the compliance of commercial entities operating within the aimag to the Law on Disaster Protection, the Fire Safety Law of Mongolia and all related standards, regulations and guidelines; and to inspect these commercial entities and provide them recommendations.
- Organize earthquake disaster prevention drills in April of each year with the participation of aimag, soum and bag governors, social workers and citizens.
- Cooperate with information technology officials to develop an online earthquake disaster prevention training program and raise awareness of the program among the public through media.

＜Implementation Period＞

2019～2029

＜Implementing Organization＞

Aimag Governor's Office, EMA, DRR officials, Specialized DRR units, Citizens

＜Required Budget＞

1. Activities for enforcing compliance to legislation - 3 million MNT
2. Expenses for training and drills -10 million MNT
3. Developing an online earthquake disaster prevention program and raising awareness among the public - 8 million MNT

138,000,000 MNT in 10 years (138 million MNT)

5. Funding and the Supervision of Funds

5.1 Main Policy

・The EMA shall collect information on the budget required for DRR-related organizations to implement DRR measures each year, and obtain a solution for funding.
・The EMA shall be informed of the DRR activities of DRR-related organizations and shall supervise the implementation of such activities.
・After supervising the implementation of DRR activities, evaluate the results with the PDCA (Plan, Do, Check, Act) method and develop further DRR measures.

5.2 Implementation Policy of Each Sector

(1) Ensuring the Seismic Resistance of Buildings and Infrastructure Lifelines

【Obtain Budget】

・Prioritize the funding for the main DRR activities, namely the seismic assessment and strengthening of buildings.
・The organization responsible for infrastructure and lifelines shall participate in obtaining the required funding for DRR activities from central and regional governments.
・Encourage the Citizens' Representative Council in order to include the activities in the regional budget.

【Monitoring】

・The Bord of Director grasps the status of budget acquisition and implementation of measures by the institution responsible for buildings, infrastructure, and lifelines.

(2) Personnel, Equipment, Education and Training

【Obtain Budget】

・Take appropriate measures to include the required expenses related to DRR personnel and equipment in the state and regional budget.
・Take measures to include expenses related to training specialized human resources, such as appointing a NEMA specialist to conduct training.
・Encourage the Citizens' Representative Council in order to include the activities in the regional budget.

【Monitoring】

・The EMA and the Emergency Commission shall regularly supervise the budgeting process and the implementation of planned activities.

(3) Information and Communications

【Obtain Budget】

・Take cooperative measures to obtain financing in addition to obtaining funding for each individual organization in the sector.

・Take measures to obtain financing from state-owned enterprises and large companies.

【Monitoring】

・Include DRR measures within the internal auditing and supervisory activities of related organizations and companies.

(4) Healthcare

【Obtain Budget】

・Take measures to obtain financing for DRR activities through budget funding.

・Optimize insurance system appropriate for DRR measures.

【Monitoring】

・Include DRR measures within the internal auditing and supervisory activities of healthcare-related organizations and hospitals.

(5) Disaster Protection Measures

【Obtain Budget】

・Supervise the expenditure of 1% of the budget allocated for DRR activities.

・Provide management and methodological support to DRR-related organizations in relation to obtaining budget financing for DRR activities.

【Monitoring】

・The EMA shall be informed of the budgeting process for DRR activities, as well as the implementation process of the activities.

2. Manual for Earthquake Disaster Risk Reduction Planning

Local Earthquake Disaster Protection Planning Manual

1. General Provisions

This manual contains methodologies to be used for developing earthquake disaster prevention and risk reduction plans according to the “Aimag/Soum Earthquake Disaster Protection Planning Guideline” and the “Capital City/District Earthquake Disaster Protection Planning Guideline”.

This results of the work conducted for developing and improving the earthquake disaster protection plans in aimags and Ulaanbaatar within the framework of the “Project for Strengthening the National Capacity of Earthquake Disaster Protection and Prevention in Mongolia” implemented between 2016 and 2019 were combined and shown with practical examples in this manual.

2. Preparation Work

(1) Establishing a Working Group

Firstly, activities to establish the working group at the planning division of the local emergency management department will be conducted according to the “Earthquake Disaster Protection Planning Guideline”. The relevant governor/mayor’s order to establish the working group will then be issued. The working group will be led by the specialist in charge of planning at the local emergency management department. Specialists from local DRR units will be appointed to the working group. In order to ensure the stability and continuity of working group activities, there should be no changes in the composition of working group members.

The procedure and structure of activities are shown in the table below. The working group will be composed of 1～2 members from the relevant organizations.

NEMA

↓ provide support

＜Working Group Management＞
Secretary: Official and specialist in charge of planning at regional EMDs

・Statistics department/division	・Health department/division
・Climate and environment analysis department/division	・Police department/division
・Land affairs, construction and urban planning department/division	・Education department/division
・Communications department/division	・EMD firefighting unit
・Public transport department/division	・EMD communications specialist
	・EMD division in charge of training

The working plan of the working group will be developed after establishing the working

group. Since it is more effective for the working group members to work together in formulating plans for each sector under their responsibility, it is appropriate to organize planning activities in the form of workshops. Work meetings, or workshops, for formulating plans should be organized a total of 6 times as whole-day events.
In relation to establishing the working group, the working group members should be presented with the “General Procedure for Formulating Plans” shown below and actively participate in the workshops.

(2) Issuing the Working Plan for Formulating Plans

Develop the general procedure for formulating disaster protection plans according to the guideline. The guideline specifies the following general working plan as shown below, and the actual working plan should be developed according to it.

Example of a General Procedure for Formulating Plans According to the Guideline

No.	Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	Establish a working group															
2.	Collect data															
3.	Examine and consolidate data															
4.	Develop the introduction															
5.	Conduct risk assessment															
6.	Run scenarios															
7.	Determine the main DRR objective (may be completed after 9.)															
8.	Establish a DRR goal															
9.	Formulate a disaster prevention and risk reduction plan															
	Budget funding, monitoring															
10.	Formulate a damage mitigation plan to be implemented during disasters															
11.	Post-disaster emergency restoration plan															
12.	Develop the appendix of the plan															
13.	Present to regional council															
14.	Obtain approval from governor/mayor															
15.	Present to Citizens’ Representative Council															
	Organize workshops					●	●	●	●	●	●		●			

(3) Collect, Examine and Consolidate Data

The activities related to collecting, examining and consolidating data specified in steps 2 and 3 of the general planning procedure are required for developing the introduction specified in step 4 and the risk assessment specified in step 5. The introduction section contains general information on the respective region, such as: 1) regional geographic conditions, 2) population and economy, 3) governance, 4) previous disasters that have occurred, etc. Refer to Appendix 2 for an example.

The "Manual for Conducting Simplified Earthquake Damages Using Excel" includes the information required for conducting risk assessment, and data will be collected accordingly.

3. Procedure of the Workshops for Formulating Plans

Activities from「5. Conduct risk assessment」to「9. Formulate a disaster prevention and risk reduction plan」shall be conducted in the form of workshops.

The workshop procedure is shown below.

1st Workshop (Risk assessment)
✓ Describing the importance of earthquake disaster protection planning ✓ Establishing a working group (NEMA, aimag EMDs, specialists from state DRR units) ✓ Conducting an earthquake risk assessment (using the Excel spreadsheet)

2nd Workshop (Running scenarios and damage projections)
✓ Issue a working plan for formulating the disaster protection plan ✓ Divide the working group into sub-groups Sub-Group 1: Buildings, Urban Development, Infrastructure and Lifelines Sub-Group 2: Personnel and Equipment, Information and Communications Sub-Group 3: Health and Disaster Protection Measures Sub-Group 4: Education and Training ✓ Develop the table for DRR measures ✓ Run potential disaster scenarios and damage projections

3rd Workshop (Disaster prevention and risk reduction planning)
✓ Set a DRR goal based on the scenarios (10-year goal) ✓ Determine the issues related to reaching the goal ✓ Determine measures to resolve the issues

4th Workshop (Disaster prevention and risk reduction planning)
✓ Determine measures to resolve the issues (continued) ✓ Prioritize the measures to implement ✓ Determine the main responsible organizations ✓ Determine the starting period and the implementation timeline of the measures ✓ Calculate the budget required for implementation

5th Workshop (Disaster prevention and risk reduction planning - continued)
✓ Prioritize the measures to take ✓ Determine the starting period and the implementation timeline of the measures

- ✓ Allocate the required budget for implementation throughout the implementation timeframe
- ✓ Combine into the Disaster Prevention and Risk Reduction Plan

6th Workshop (Combine with the disaster protection plan)

- ✓ Determine the overall disaster risk reduction goal
- ✓ Discuss the policy for obtaining the required financing for DRR measures, and methods for its supervision
- ✓ Review the structure and contents of the disaster protection plan

Adjustments to be conducted by the official in charge of planning

- ✓ Amendments and clarifications to the “Disaster Response Measures and Damage Mitigation Plan” currently in effect
- ✓ Amendments and clarifications to the “Post-Disaster Emergency Restoration Plan” currently in effect

7th Workshop (Combine with the disaster protection plan)

- ✓ Review the structure and contents of the disaster protection plan
- ✓ Finalize as an “Earthquake Disaster Protection Plan” according to the guideline

The training for formulating disaster protection plans in test regions shown in photos below.

Discussions among the 4 sub-groups

Presentation of work results

4. Points of Consideration When Organizing Workshops

(1) Present the importance of earthquake disaster protection planning

There is a high likelihood that the working group members do not have sufficient experience in disaster protection planning and as such they will need to obtain an understanding of the importance of disaster protection plans. The presentation on the importance of disaster protection planning will be conducted during the first meeting of the working group with the following contents, such as:

- ✓ Characteristics of earthquake disasters
- ✓ Importance of ensuring preparedness
- ✓ Structure of earthquake disaster protection plans.

Refer to Appendix 1 for the presentation.

(2) Earthquake Risk Assessment

An earthquake risk assessment needs to be conducted in order to run scenarios for potential earthquake damages. For this, the Excel sheet developed by the NEMA working group will be utilized. The resulting damage data calculated according to the "Manual for Conducting Simplified Earthquake Damages Using Excel" will be used, and in the case of Ulaanbaatar, those calculated within the framework of the "Project for Strengthening the Capacity for Earthquake Disaster Risk Prevention of Ulaanbaatar" implemented by JICA in 2013 will be used.

The working group members will conduct the earthquake risk assessment using the Excel spreadsheet, and the results will be jointly utilized.

The risk assessment results will be comprised of the following information.

Damage and Loss Data (example)

Type of Damage / Loss			Amount	Units
Human Casualties	Death toll	Urban areas		Person(s)
		Ger districts		Person(s)
	Injuries	Urban areas		Person(s)
		Ger districts		Person(s)
	Displaced persons	Urban areas		Person(s)
		Ger districts		Person(s)
Building Damages	Buildings destroyed or severely damaged	Urban areas		Buildings
		Ger districts		Buildings
	Amount of Debris			Tons
Infrastructure and Lifelines	Roads	Impassable due to damage		Points
	Bridges	"A" method	Bridge Name	
		"B" method	Bridge Name	
	Electricity poles	Collapsed		Poles
	Electricity transmission lines	Damage rate		%
	Underground transmission lines	Damage rate		%
	Clean water	Rupture		Points
	Sewage	Damage rate		%
	Heating	Rupture		Points

(3) Developing the Table for DRR Measures

1) Dividing into Sectors

The working group will be divided into 4 sub-groups. For instance, each sub-group will be assigned a sector as follows: Sub-Group 1 - “Urban Development and Ensuring Seismic Resistance”, Sub-Group 2 - “Personnel, Equipment and Communications”, Sub-Group 3 - “Health and Disaster Protection Measures”, Sub-Group 4 - “Health and Education”. According to the contents of the table shown below, each sub-group will conduct the following activities specified in the general planning procedure: 6) Run scenarios, 7) Determine the main DRR objective, 8) Establish a DRR goal, and 9) Formulate a disaster prevention and risk reduction plan. Activity 7 – “Determine the main DRR objective” may be conducted after Activity 9 – “Formulate a disaster prevention and risk reduction plan”. Working group members will conduct their work within their respective sub-groups.

（**Sub-Group 1**） **1. Construction, Urban Development, Infrastructure and Lifelines** 1.1 Urban Planning for DRR 1.2 Ensuring the seismic resistance of administrative buildings 1.3 Ensuring the seismic resistance of public buildings 1.4 Ensuring the seismic resistance of residential buildings 1.5 Road development and ensuring the seismic resistance of roads 1.6 Ensuring the seismic resistance of bridges and dams 1.7 Ensuring the seismic resistance of infrastructure and lifelines 1.8 Ensuring the seismic resistance of hazardous buildings containing lethal chemical substances, etc. （**Sub-Group 2**） **2. Personnel and Equipment** 2.1 DRR equipment 2.2 DRR personnel 2.3 Disaster reserves 2.4 Emergency transport vehicles and network **3. Information and Communications** 3.1 Information and communications infrastructure 3.2 Coordination of communications and data gathering	（**Sub-Group 3**） **4. Health** 4.1 Number of hospitals and beds 4.2 Doctors and nurses 4.3 Remote hospitals 4.4 Medicine reserves 4.5 Information transmission 4.5 Transport coordination 4.6 Disinfection 4.7 Psychological support **5. Disaster Protection Measures** 5.1 Search of missing persons 5.2 Body identification and interment 5.3 Designation of temporary housing 5.4 Emergency reserves in temporary housing 5.5 Roads for relocation 5.6 Traffic coordination 5.7 Food, potable water and primary household items 5.8 Waste treatment 5.9 Sewage and sanitary provisions 5.10 Debris removal （**Sub-Group 4**） **6. Training and Education** 6.1 DRR training and education program 6.2 DRR educational materials 6.3 DRR activities of schools and legal entities 6.4 Public volunteer organizations for DRR 6.5 Coordination between the local administration and the public 6.6 Transmitting alerts and warnings to the public

2) Structure of the Table for DRR Measures

A table with the sections 「Current State and Projections」,「10-Year Goal」, 「Current Issues」and「Solutions」will be developed for each sub-group component, such as「1.1 Measures to ensure the seismic resistance of buildings」,「1.2 Ensuring the seismic resistance of administrative buildings」 etc. For group discussions, it will be appropriate to print the table on an A0 piece of paper and insert the relevant information in the table using adhesive paper. An example of the table structure is shown below

.

Measures Aimed at Implementing DRR Goals

Sub-Group 1: Construction, Urban Development, Infrastructure and Lifelines

Sector	Measures	Current State	10-Year Goal	Current Issues	Measures to Implement
1. Construction, Urban Development, Infrastructure and Lifelines	1.1 Measures to ensure the seismic resistance of buildings				
	1.2 Ensuring the seismic resistance of administrative buildings				
	1.3 Ensuring the seismic resistance of public buildings				
	1.4 Ensuring the seismic resistance of residential buildings				
	1.5 Road development and ensuring the seismic resistance of roads				
	1.6 Ensuring the seismic resistance of bridges				
	1.7 Ensuring the seismic resistance of infrastructure and lifelines				
	1.8 Ensuring the seismic resistance of hazardous buildings containing lethal chemical substances, etc.				

3) Running Scenarios

Scenarios for each sub-group will be run according to the risk assessment results. Projections of disaster situations must be as accurate as possible, and the resulting information may be listed in no particular order. The information should be written down on adhesive paper and inserted in the table. An example is shown below for “1.7 Ensuring the Seismic Resistance of Infrastructure and Lifelines”.

Example Scenario

Sub-Group	Measure	Current State
1. Construction, Urban Development, Infrastructure and Lifelines	1.7 Ensuring the seismic resistance of infrastructure and lifelines	【Projection】 ・Clean water: Rupture on 8 points. 8 rupture points in clean water pipelines cut the supply of clean water to 1,200 people. If the rupture points are fed from 2 sides, there will not be an emergency. Otherwise, a potable water vehicle will distribute water to residents. A total of 57 workers, namely the heads of the Water Provision Department and the Housing Department, 7 engineers and 48 repairmen will work on clean water ruptures. ・Waste water: Damage rate - 19% There is a soil contamination hazard resulting from damages to sewer pipelines. A total of 14 workers, namely the unit leader, 3 engineers, and 10 repairmen will work on sewage pipeline damages. During a disaster, 90 people and 10 machinery comprising of 10 monitoring engineers, 3 unit leaders, 10 engineers, 58 brigade repairmen, 1 crane driver, 1 excavator driver, 2 suction excavator drivers, 1 loader driver, a welder and a welding machine, and 3 emergency vehicles will be needed. ・A total of 15 rupture points in the heat transmission network were observed. A total of 552 rupture points were observed in the heat distribution network. The company employs 1 lifting vehicle, 3 special-purpose and transport vehicles, 2 trucks, 2 human-transportation vehicles, 7 non-permanent staff and 54 specialists. ・Electricity The old wooden poles of 610, 4 KV in Darkhan-Uul aimag will collapse as a result of an 8.0-magnitude earthquake. Underground cables 1 and 2 disabled. Residents have no access to water and heating. Operations of large companies halted.

4) Establishing a DRR Goal

A DRR goal will be established on the basis of the potential disaster damage projections. The DRR goal will be represented with quantitative figures. An example is shown below.

Example of a DRR Goal

Sub-Group	Measure	10-Year Goal
1. Construction, Urban Development, Infrastructure and Lifelines	1.7 Ensuring the seismic resistance of infrastructure and lifelines	・Conduct earthquake risk assessment on 100% of electricity transmission lines and reduce earthquake risk to 0%. ・Reduce risk of earthquake damages to the electric heating network and the clean water and sewage pipelines of “Darkhan Heating Network” SOSC (“DHN” SOSC) and “Darkhan Water Supply” SC (“DWS” SC) by 50%. ・Upgrade up to 80% of outdated electricity, heating, clean water and sewage transmission lines and ensure their seismic resistance. ・Upgrade up to 60% of “DHN” SOSC and “DWS” SC’s machinery and equipment and ensure their technical preparedness.

5) Current Issues

Determine the issues in relation to implementing the DRR goals specified in part "3)". These issues may also be listed in no particular order. The information should be written down on adhesive paper and inserted in the table. An example is shown below.

Example of a Current Issue

Sub-Group	Measure	Current Issue
1. Construction, Urban Development, Infrastructure and Lifelines	1.7 Ensuring the seismic resistance of infrastructure and lifelines	・Unauthorized buildings (included in the protection zone). ・Low capacity of machinery and equipment. ・Outdated pipelines. ・Outdated electricity transmission lines. ・Outdated substation buildings. ・Lack of specialized machinery and equipment. ・20% of Darkhan-Uul aimag's 6/0.4 KV transmission lines have wooden poles. ・Although there are 3 specialized units and 16 emergency brigades (with 250 members), earthquake disaster training and preparedness is insufficient. ・Insufficient preparedness and capacity for implementing damage neutralization repair work on energy substations, transmission lines and equipment, and completing emergency restoration. ・Workers are paid reduced wages.

6) Measures to Resolve Current Issues

Specify measures to resolve the issues related to implementing the DRR goal established in "3)". The measures must be as realistic as possible. Include measures with quantitative performance indicators instead of imprecise measures aimed at "refining" or "accelerating".

Example of Measure to Implement

Sub-Group	Measure	Measure to Implement
1. Construction, Urban Development, Infrastructure and Lifelines	1.7 Ensuring the seismic resistance of infrastructure and lifelines	・Replace current clean water transmission pipelines with earthquake-resistant pipelines. Upgrade up to 50% of the total clean water transmission network within 10 years. ・Reconstruct or strengthen 12 unauthorized buildings. ・Upgrade the electricity transmission lines, regularly conduct preparedness check-ups, maintenance and upgrades on the reserve heat network. ・Conduct renovations and ensure the seismic resistance of 6/0.4 KV substations. ・Conduct partial replacements on damaged sections of transmission networks (implement on the basis of a 5-year plan) ・Include the disposal and upgrade of outdated machinery and equipment in the organization's operating plan, and increase the capacity of specialized machinery and equipment. "DHN" SOSC ・Establish reserve energy sources ・Regularly ensure preparedness of emergency reserves ・Regularly train workers according to the disaster scenario and provide DRR education at a professional level.

		"DWS" SC ・Strengthen pipelines ・Conduct the necessary studies, obtain budget funding and conduct risk assessment. ・Study methods for conducting concrete earthquake risk assessments, and conducting risk assessments on electricity, heating and clean water networks. ・Cooperate with "DSETN" SC to prioritize the solution for electricity supply to clean water sources. Cooperate with "DHN" SOSC to obtain generators from "DHN" SOSC if needed.

7) Prioritizing Implementing Organizations and Measures to Implement

According to the examples shown above, the measures to implement may be listed for each implementing organization. Alternatively, the implementing organizations may be assigned for each measure. Moreover, it is important to consider the prioritization of measures to implement.

In the case of Mongolia, it is challenging to obtain the required budget funding for pre-disaster DRR measures and therefore, there is the issue of disaster prevention and risk reduction measures not being implemented. However, it should be understood that investment into pre-disaster DRR measures are more impactful than post-disaster recovery expenses, and more attention should be paid to obtaining the required budget funding for DRR.

Effective DRR funding requires determining the optimal combination of structural and non-structural measures, and the prioritization of sectors with the largest potential economic losses. Furthermore, the implementation procedure for structural measures that require a considerable amount of time for implementation needs to be determined and included in the plan.

8) Implementation Period, Required Budget

After prioritizing the measures to implement, the budget allocation plan for each measure will be developed. An example is shown below, and the contents of the measures to implement, as well as their order of implementation, may be modified during the discussion process. Likewise, there may even be a need to modify the overall DRR goal and therefore, the working group may make these modifications autonomously as a result of open discussions and issue the required budget funding plan. For this, the working group must also discuss ways for obtaining budget financing, and monitoring methods, and include them in the plan.

Budget Allocation Plan for DRR Measures (Example)

Measures to Implement	Annual Expenditure (2020～2029)
	2020 → 2029
＜ Electricity Transmission Network, Power Plant＞	
1. Conduct earthquake risk evaluation on 100% of electricity transmission lines.	1. 2020～2021, Total budget: 22,000,000 MNT
2. Upgrade up to 80% of outdated transmission lines and ensure their seismic resistance.	2. 2025～2029, Total budget: 2 billion 480 million MNT
3. Conduct repair work on 6/0.4 KV sub-stations.	3. 2020～2024, Total budget: 348 million MNT
4. Upgrade up to 60% of "DHN" SOSC's machinery and equipment and ensure their technical preparedness.	4. 2020～2029, Total expenditure: 4 billion 460 million MNT
5. Conduct earthquake disaster protection and preparedness training for 100% of "DHN" SOSC and "DWS" SC's engineers and technicians.	5. 2020～2029, Total expenditure: 80 million MNT
＜Water and Heat Networks＞	
1. Upgrade up to 80% of outdated transmission lines and ensure their seismic resistance.	1. Include a total of 115 million MNT in the regional development strategy plans for 2025-2029 and obtain approval.
2. Commission the manufacturing of steel reinforced with earthquake resistant substances and test their resistance.	2. Obtain a total funding of 21 million MNT from state and regional budgets from 2020 to 2024.
3. Prioritize the solution for electricity supply to clean water sources. Cooperate with "DSETN" SC.	3. Procure electricity supply equipment with funding from the Asian Devleopment Bank. A total of 100 million MNT from 2025 to 2029.
4. Establish agreements aimed at improving the cooperation and coordination between organizations in charge of infrastructure and lifelines.	4.. 2020～2021
5. • Take measures to store hazardous chemical substances in durable, earthquake resistant containers.	5. 2025～2026, Total budget: 20 million MNT. Procurement with funding from the Asian Development Bank.
6. • Conduct earthquake disaster protection and preparedness training for 100% of engineers and technicians.	6. 2020～2029, Total budget: 80 million MNT

5. Developing a Disaster Prevention and Risk Reduction Plan

1) The information contained in the Table for DRR Measures will be included in the Disaster Prevention and Risk Reduction Plan. The DRR goals, measures, implementing organizations and the required budget planning will be assigned to each section of the

Table for DRR Measures. An example is shown below.

1.7 Ensuring the seismic resistance of infrastructure and lifelines

＜DRR Goal (10-Year Goal)＞

- Reduce risk of earthquake damages to the electric heating network and the clean water and sewage pipelines of "Darkhan Heating Network" SOSC ("DHN" SOSC) and "Darkhan Water Supply" SC ("DWS" SC) by 50%;
- Conduct earthquake risk assessment on 100% of electricity transmission lines and reduce earthquake risk to 0%.

＜Measures to Implement＞

"DHN" SOSC

① Conduct earthquake risk evaluation on 100% of electricity transmission lines and ensure their seismic resistance.
② Upgrade up to 80% of outdated transmission lines and ensure their seismic resistance.
③ Conduct repair work on 6/0.4 KV sub-stations.
④ Upgrade up to 60% of the power plant machinery and equipment and ensure their technical preparedness.
⑤ Conduct earthquake disaster protection and preparedness training for 100% of engineers and technicians.

"DWS" SC

⑥ Upgrade up to 80% of the heating, clean water and sewage network and ensure their seismic resistance.
⑦ Commission the manufacturing of steel reinforced with earthquake resistant substances and test their resistance.
⑧ Prioritize the solution for electricity supply to clean water sources. Cooperate with "DSETN" SC.
⑨ Establish agreements aimed at improving the cooperation and coordination between organizations in charge of infrastructure and lifelines.
⑩ Take measures to store hazardous chemical substances in durable, earthquake resistant containers.
⑪ Conduct earthquake disaster protection and preparedness training for 100% of engineers and technicians.

＜Implementation Period＞

2020～2029

＜Implementing Organizations＞

Aimag Governor's Office, DWS, Heating provider, DSETN, DHN

＜Budget ＞（10 thousand MNT）

Number/year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
①	1100	1100								
②	24800	24800	24800	24800	24800	24800	24800	24800	24800	24800
③	6960	6960	6960	6960	6960					
④	44600	44600	44600	44600	44600	44600	44600	44600	44600	44600
⑤	800	800	800	800	800	800	800	800	800	800
Total (DHN)										
⑥	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150
⑦	420	420	420	420	420					

⑧						2000	2000	2000	2000	2000
⑨						1000	1000			
⑩	800	800	800	800	800	800	800	800	800	800
Total (DWS)										

The amount of budget funding will be determined for each measure to implement, year and implementing organization. In this manner, the Disaster Prevention and Risk Reduction Plan will be developed.

2) Ensuring Coherence with the Planning Guideline

Review and ensure the coherence between the contents of the newly developed Disaster Prevention and Risk Reduction Plan and the "Aimag/Soum Earthquake Disaster Protection Planning Guideline" and the "Capital City/District Earthquake Disaster Protection Planning Guideline".

6. Developing the Disaster Protection Plan

The Earthquake Disaster Protection Plan will be developed based on the "Earthquake Disaster Protection Planning Guideline" in the following manner. Moreover, as mentioned previously, it would be appropriate to determine the objective and overall goal of the plan during the final workshop. Methods to obtain budget funding, as well as the monitoring framework will be planned during this stage.

In terms of disaster response measures, damage mitigation planning, emergency recovery and post-disaster restoration planning, the official in charge of planning will amend the currently effective plans.

－Structure of the Earthquake Disaster Protection Plan－

１．　General Overview of the Region

２．　Objective of the Plan

３．　Main Purpose

４．　Amendments to the Plan

５．　Coordination for Disaster Protection

６．　Cooperation Agreements

７．　Coordination of Earthquake Disaster Risk Assessment and Prevention Activities

7-1 Earthquake Disaster Risk Assessment, Potential Disaster Scenario and Damage Projections

7-2 Coordination of Earthquake Disaster Prevention Activities

８．　Earthquake Disaster Prevention and Risk Reduction Plan

8-1 Ensuring the Seismic Resistance of Buildings, Infrastructure and Lifelines

8-2 Personnel and Equipment

8-3 Information and Communications

8-4 Health and Medical Assistance

8-5 Disaster Protection Measures

8-6 Education, Training and Drills

９．　Planning Disaster Response Measures and Damage Mitigation Activities

１０．Post-Disaster Emergency Recovery and Restoration Plan

１１．Monitoring the Implementation of the Plan

3. Creation Manual of the Disaster Risk Reduction White Paper

“MANUAL ON PREPARING THE WHITE PAPER ON DISASTER RISK REDUCTION”

ULAANBAATAR
2019

PREFACE

As a result of climate change and human errors, disaster occurrences and their ensuing damages are increasing around the world year after year; negatively impacting socio-economic development and people's livelihoods.

The "Sendai Framework for Disaster Risk Reduction 2015-2030" was approved by 187 nations during the Third UN World Conference on Disaster Risk Reduction ("DRR").

In Mongolia, expanding DRR-focused public-private partnerships between the Government, non-governmental organizations and private entities according to section 3.4.2 of the "Mid-Term Strategy to Implement the Sendai Framework for Disaster Risk Reduction in Mongolia" approved through Government resolution 355 of 2017, and "supporting the participation of chambers of commerce and commercial entities in national and regional platforms for DRR" according to the "Ulaanbaatar Declaration" issued during the "2018 Asian Ministerial Conference on Disaster Risk Reduction" are being implemented as policy requirements.

Since its inception, the National Emergency Management Agency ("NEMA") has been implementing state DRR policies according to international standards and trends, and has been actively conducting multi-faceted DRR activities aimed at the public; especially activities related to disaster and prevention, risk reduction, self-protection and the protection of others.

It is standard practice of emergency management agencies in other countries to publicize information related to their DRR activities as well as DRR innovations, best practices and achievements in order to ensure public participation and strengthen cooperation through private sector support.

Withiin the framework of the "Project for Strengthening the National Capacity of Earthquake Disaster Protection and Prevention in Mongolia" jointly implemented by NEMA and the Japanese International Cooperation Agency ("JICA") between 2016-2019, the "Disaster Risk Reduction White Paper – 2017" was first published in Mongolia with the purposes of spreading awareness of Mongolia's DRR policies and activities as well as the country's exposure to disaster, and to increase public participation in DRR activities.

The contents of the "Disaster Risk Reduction White Paper – 2017" include the legal environment for DRR and its improvement, DRR activities, multi-lateral cooperation, fire protection, strategic reserves and humanitartian aid, earthquake hazard prevention, DRR research, the budget and funding for DRR activities, and an annual report on DRR activities.

The guideline for preparing the DRR White Paper has been developed in order to provide guidance on: determining the structure and contents of the White Paper, collecting data, how previously encountered difficulties were resolved and on how to prepare subsequent White Papers.

One. Methodology for Developing the White Paper

The DRR White Paper shall be developed according to the following procedure.

1. Establish a Working Group (“WG”) for developing the DRR White Paper

   It is necessary to establish a WG in order to ensure the participation of the relevant departments and divisions during the preparation of the White Paper.

   ①Determine the budget,
   ②Exchange ideas on the structure and contents of the White Paper,
   ③Determine the required data and data sources, and then organize data collection activities,
   ④Assemble the collected data,
   ⑤Prepare the first draft,
   ⑥Review and modify the first draft,
   ⑦Translate to English and review,
   ⑧Nominate the printing company,
   ⑨Monitor the printing company’s preparation of the White Paper draft.
   The tasks listed above shall be allocated to the WG members.

2. Planning the development of the White Paper

The WG shall create a work plan to develop the White Paper. An example of a work plan to develop the White Paper is shown below.

Table 1: Work Plan for Developing the White Paper (Example)

	Nov			Dec			Jan			Feb			Mar.			May		
Establish the WG	△																	
Create the work plan	△																	
Determine the structure, contents and form of the White Paper	■	■	■															
Obtain feedback from the executive committee			■															
Obtain approval from the Head of NEMA			■															
Create a data collection work plan			■	■														
Data collection					■	■	■	■	■	■	■	■						
Assemble the collected data								■	■	■	■	■	■	■				
Prepare the first draft													■	■	■			
Revision of the first draft by the WG															■			
Develop the appendix to the White Paper																■	■	■
Present to NEMA																■	■	
Obtain approval from the Head of NEMA																	■	
Foreword by the Head of NEMA																	■	
Determine where to distribute the White Paper																■		
Nominate the printing company													■					
Monitor the preparation of the White Paper draft															■	■	■	
Nominate the translator													■					
Translation work															■	■	■	
Final revision of the White Paper draft																		■
Printing and distribution																		■

The WG shall organize their activities according to the work plan. The development process of the "Disaster Risk Reduction White Paper - 2017" is briefly summarized below.

The development work for the 2017 White Paper started in February 2017 and activities related to preparation work, collection and assembly of materials, review, translation, nominating a printing company, developing a first draft and printing continued for around 1.5 years. The work plan needs to be scheduled accurately starting from the expected printing period of the White Paper.

Table 2: Progress of the Work Plan for Developing the "Disaster Risk Reduction White Paper - 2017"-

No.	Activity	Time Spent								
1	Research related to the White Paper	Feb – Mar 2017 1 month								
2	Develop and obtain approval on the plan for developing the structure and contents of the White Paper		Apr – May 2017 1 month							
3	Collect materials			Jul – Dec 2017 6 months						
4	Assemble materials									
5	Submit to executive committee for review and approval					Jan – Feb 2018 14 days				
6	Translate and review						May 2018 14 days			
7	Nominate printing company and establish engagement agreement							Jun 2018 14 days		
8	Print the White Paper								Jul – Sep 2018 2 months	

Two. Determining the Structure, Contents and Form of the White Paper

The structure of the "Disaster Risk Reduction White Paper – 2017" was initially planned with a background section, eight chapters, a conclusion section and an appendix which include contents related to the legal environment for DRR and its improvement, DRR activities, multi-lateral cooperation, fire protection, strategic reserves and humanitartian aid, earthquake hazard prevention, DRR research, the budget and funding for DRR activities, and an annual report on DRR activities.

The contents were developed in line with legal and policy documents with further explanation on some matters, and efforts were made to no omit the operational reports of all relevant divisions.

A more comprehensive section on legislation was initially planned to be included in the appendix. However, in that case the White Paper's scope would have become too wide and therefore, only the list of disaster protection legislation was included.

Since the 2017 version of the annual White Paper was the first to be printed in Mongolia, it included some policy documents and some activities implemented prior to 2017.

White Papers related to national defense, crime and exonerations, business and economics, international trade and information technology are also printed in Mongolia; and the structure and contents of these White Papers need to be studied.

The structure and contents of the White Paper shall be submitted to the executive committee of NEMA for discussion, and the work plan and structure of the development of the White Paper shall be approved by the Head of NEMA.

Three. Developing a Work Plan

Since the White Paper includes the DRR activities and the status of hazards and disasters of the given year, the White Paper is scheduled in NEMA's operational plan to be printed and published in the first period of the following year.

Therefore, once the structure and contents of the White Paper are determined, the relevant data collection work should be planned accurately. (Refer to Table 3 and Graph 1 for examples).

Table 3. Example of the Data Collection Work Plan for the DRR White Paper of Mongolia

No.	Chapter, Sub-section	Development Period	Responsible Department
Chapter One. The Legal Environment for DRR in Mongolia, and its Improvement.			
1.1.	DRR Legislation of Mongolia	July 2017	Policy Coordination and Cooperation
1.2.	Approved Policy Documents Related to DRR	July 2017	Policy Coordination and Cooperation
1.3.	DRR Framework, Structure and Organization	August 2017	Policy Coordination and Cooperation, Administrative
Chapter Two. DRR Activities.			
2.1.	Disaster Risk Reduction and Disaster Prevention Activities	August 2017	Disaster Risk Management Disaster Prevention
2.2.	DRR Training and Awareness-Raising	September 2017	Disaster Prevention
2.3.	Measures to Ensure Disaster Preparedness	October 2017	Disaster Operation
2.4.	Disaster Alerts and Emergency Management	October 2017	Disaster Operation
2.5.	Disaster Loss Mitigation Measures	December 2017	National Emergency Commission, Disaster Operation
2.6.	DRR Personnel and Equipment	December 2017	Disaster Operation
2.7	DRR Training and Drills	December 2017	Disaster Prevention
Chapter Three. Cooperation in DRR.			
3.1.	International Cooperation in DRR	December 2017	Policy Coordination and Cooperation
3.2.	Coordination of DRR Officials	November 2017	Disaster Operation
3.3	Participation of Civil Society, Non-Governmental Organizations and Citizens in DRR Activities	November 2017	Policy Coordination and Cooperation
Chapter Four. Fire Protection.			
4.1.	Documents Related to Fire Protection	September 2017	Fire Protection
4.2.	Activities to Combat Fires	September 2017	Fire Protection
Chapter FIve. Strategic Reserves and Humanitarian Aid.			
5.1.	Documents Related to Strategic Reserves and Humanitarian Aid	September 2017	Strategic Reserves and Humaniatrian Aid
5.2.	Activities Related to Strategic Reserves and Humanitarian Aid	September 2017	Strategic Reserves and Humaniatrian Aid
Chapter Six. Earthquake Hazard Prevention Activities			
6.1.	Earthquake Disaster Prevention Standing Committee	August 2017	Disaster Operation
6.2.	Documents Related to Enhancing Earthquake Disaster Prevention Measures	August 2017	Disaster Operation
6.3.	Current Status and Research of Earthquakes in Mongolia	October 2017	Disaster Operation
6.4.	Study of Faults Near Ulaanbaatar City	October 2017	Disaster Operation
6.5.	Earthquake Emergency Plan for Ulaanbaatar City	November 2017	EMDC
6.6	Earthquake Disaster Prevention Training	December 2017	Disaster Prevention
Chapter Seven. Activities of the Disaster Research Institute.			
7.1.	Research Conducted by the Disaster Research Institute	November 2017	Disaster Research Institute
7.2.	Disaster Information Database	December 2017	Disaster Research Institute
Chapter Eight. DRR Budget and Funding.			

8.1.	Funding from the National Budget	December 2017	Finance, Provisions and Funding
8.2.	Foreign Funding	December 2017	Finance, Provisions and Funding
8.3	Projects and Programs Implemented at NEMA	September 2017	Policy Coordination and Cooperation
8.4.	Compensation for Disaster Victims	November 2017	Finance, Provisions and Funding
8.5.	Measures Taken to Mitigate Disaster Losses	December 2017	National Emergency Commission, Finance, Provisions and Funding
Chapter Nine. 2017 DRR Activities Report for 2017.			
9.1.	Improving the Legal Environment, Organization and Coordination for DRR Activities	January 2018	Policy Coordination and Cooperation
9.2.	Developing and Strengthening the Capacity of Human Resources	January 2018	Administrative
9.3	DRR Development Policy and Program	January 2018	Disaster Risk Reduction
9.4.	Organizing Training and Awareness-Raising Activities for Disaster Prevention	January 2018	Disaster Prevention
9.5.	Strengthening the Capacity for Emergency Management and Ensuring Preparedness	January 2018	Disaster Operation
9.6.	Strengthening Activities to Combat Fires and Improving the Preparedness of Personnel and Equipment	January 2018	Fire Protection
9.7	Management of Strategic Reserves and Organizing Humanitarian Aid	January 2018	Strategic Reserves and Humaniatrian Aid
9.8	Budget, Finance and Funding	January 2018	Finance, Provisions and Funding
9.9	Introducing Scientific Methods of Disaster Research and Research on the Disaster Information Database	January 2018	Disaster Research Institute
	Prepare the foreword and objective sections of the DRR White Paper	January 2018	WG
	Prepare the first draft of the DRR White Paper	October 2017 – January 2018	WG
	Print the DRR White Paper	February 2018	WG
Prepare the appendices		November 2017 – January 2018	WG

				2017								2018					
				5	6	7	8	9	10	11	12	1	2	3	4	5	6
Chapter One. The Legal Environment for DRR in Mongolia, and its Improvement.																	
1.1.	DRR Legislation of Mongolia	Jul-17	Policy Coordination and Cooperation		■												
1.2.	Approved Policy Documents Related to DRR	Jul-17	Policy Coordination and Cooperation		■												
1.3.	DRR Framework, Structure and Organization	Aug-17	Policy Coordination and Cooperation, Administrative				■										
Chapter Two. DRR Activities.																	
2.1.	Disaster Risk Reduction and Disaster Prevention Activities	Aug-17	Disaster Risk Management, Disaster Prevention				■										
2.2.	DRR Training and Awareness-Raising	Sep-17	Disaster Prevention					■									
2.3.	Measures to Ensure Disaster Preparedness	Oct-17	Disaster Operation						■								
2.4.	Disaster Alerts and Emergency Management	Oct-17	Disaster Operation						■								
2.5.	Disaster Loss Mitigation Measures	Dec-17	National Emergency Commission, Disaster Operation								■						
2.6.	DRR Personnel and Equipment	Dec-17	Disaster Operation								■						
2.7	DRR Training and Drills	Dec-17	Disaster Prevention								■						
Chapter Three. Cooperation in DRR.																	
3.1.	International Cooperation in DRR	Dec-17	Policy Coordination and Cooperation								■						
3.2.	Coordination of DRR Officials	Nov-17	Disaster Operation							■							
3.3	Participation of Civil Society, Non-Governmental Organizations and Citizens in DRR Activities	Nov-17	Policy Coordination and Cooperation							■							
Chapter Four. Fire Protection.																	
4.1.	Documents Related to Fire Protection	Sep-17	Fire Protection					■									
4.2.	Activities to Combat Fires	Sep-17	Fire Protection					■									
Chapter FIve. Strategic Reserves and Humanitarian Aid.																	
5.1.	Documents Related to Strategic Reserves and Humanitarian Aid	Sep-17	Strategic Reserves and Humaniatrian Aid					■									
5.2.	Activities Related to Strategic Reserves and Humanitarian Aid	Sep-17	Strategic Reserves and Humaniatrian Aid					■									
Chapter Six. Earthquake Hazard Prevention Activities																	
6.1.	Earthquake Disaster Prevention Standing Committee	Aug-17	Disaster Operation				■										
6.2.	Documents Related to Enhancing Earthquake Disaster Prevention Measures	Aug-17	Disaster Operation				■										
6.3.	Current Status and Research of Earthquakes in Mongolia	Oct-17	Disaster Operation						■								
6.4.	Study of Faults Near Ulaanbaatar City	Oct-17	Disaster Operation						■								
6.5.	Earthquake Emergency Plan for Ulaanbaatar City	Nov-17	EMDC							■							
6.6	Earthquake Disaster Prevention Training	Dec-17	Disaster Prevention								■						
Chapter Seven. Activities of the Disaster Research Institute.																	
7.1.	Research Conducted by the Disaster Research Institute	Nov-17	Disaster Research Institute							■							
7.2.	Disaster Information Database	Dec-17	Disaster Research Institute								■						
Chpater Eight. DRR Budget and Funding.																	
8.1.	Funding from the National Budget	Dec-17	Finance, Provisions and Funding								■						
8.2.	Foreign Funding	Dec-17	Finance, Provisions and Funding								■						
8.3	Projects and Programs Implemented at NEMA	Sep-17	Policy Coordination and Cooperation					■									
8.4.	Compensation for Disaster Victims	Nov-17	Finance, Provisions and Funding							■							
8.5.	Measures Taken to Mitigate Disaster Losses	Dec-17	National Emergency Commission, Finance, Provisions and Funding								■						
Chapter Nine. 2017 DRR Activities Report for 2017.																	
9.1.	Improving the Legal Environment, Organization and Coordination for DRR Activities	Jan-18	Policy Coordination and Cooperation									■					
9.2.	Developing and Strengthening the Capacity of Human Resources	Jan-18	Administrative									■					
9.3	DRR Development Policy and Program	Jan-18	Disaster Risk Reduction									■					
9.4.	Organizing Training and Awareness-Raising Activities for Disaster Prevention	Jan-18	Disaster Prevention									■					

Graph 1. Example of a Work Plan Schedule for Developing the White Paper

Since the data, information and operational report to be included in the White Paper will be obtained from various sources, it is important that the division or official in charge of the given information, research, topic or chapter be notified, in advance and without delay, of this work plan and of when the relevant information will be required.

Furthermore, determining the sources of information for the contents of the White Paper will save time and facilitate the development of the White Paper. (Refer to the table below for an example.)

Table 4. Sources to be Used for Obtaining Information for the White Paper

No.	Chapter, Sub-section	Source	Responsible Department
Chapter One. Current State of DRR Activities in Mongolia.			
1.1.	DRR Legislation in Mongolia	- Law on Disaster Protection of Mongolia (revised version), 2017. - Law on the Fire Safety of Mongolia (revised version), 2015. - Law on the National Reserves of Mongolia, 2009. www.legalinfo.mn	Policy Coordination and Cooperation
1.2.	Policy Documents Related to DRR	- Parliament Resolution 22 on "Approving s State Policy or Program on Disaster Protection", 2011. - Government Resolution 30 on "Approving a Plan", 2012. - Compilation of Disaster Protection Policy Documents, 2016. www.legalinfo.mn - Resolution 112 of the Deputy Prime Minister of Mongolia on "Approving a Plan", 2015. - "Mid-Term Strategy Plan of NEMA", Ulaanbaatar. www.nema.gov.mn	Policy Coordination and Cooperation, Administrative
1.3.	DRR Framework, Structure and Organization	- Government Resolution 66 on "Reorganizing the Structure of NEMA Units and Divisions", 2016. - Decree 79 of the Deputy Prime Minister of Mongolia on "Approving a Regulation", 2016. - Working Procedure of the Authority Responsible for Issues Related to Emergencies in Regions and Regional Centers. - Presentation on the Regional Centers of the Authority Responsible for Issues Related to Emergencies. www.nema.gov.mn.	Policy Coordination and Cooperation, Administrative
Chapter Two. DRR Activities.			
2.1.	Disaster Prevention and Disaster Risk Reduction Measures	- Government Resolution 303 on "Approving a Program", 2015. - "National Program to Reduce Disaster Risk with Public Participation". - Page 20 of the "Compilation of Disaster Protection Policy Documents", Ulaanbaatar, 2016. - Government Resolution 286 on "Approving the List of Water and Weather Hazards and Disasters".	Disaster Prevention

Four. Feedback, Revision, Translation and Printing

Once the White Paper draft is prepared, it shall be submitted to NEMA divisions for feedback. After incorporating the feedback into the draft, it shall be submitted to the executive committee of NEMA for approval and once approved, it shall be prepared for printing.

The White Paper was printed in both English and Mongolian in relation to the Asian Minsterial Conference on Disaster Risk Reduction organized in Mongolia in July, 2018. An English summary of the White Paper was printed and handed out to the conference participants.

Graph 2. White Paper Summary

The translation of the White Paper required a lot of time and funds. The translation had minor discrepancies in terms of professional terminology and there was no plan as to who would review the translated materials. These issues were resolved by allocating the chapters and sections of the White Paper to various translators and by advising them to utilize the professional terminology found in the policy documents placed on the NEMA website.

Therefore, matters such as translation time, revision of translated materials and translation fees need to be planned beforehand.

5. RECOMMENDATIONS

We recommend the following structure for the 2018 White Paper.

- Table of Contents
- List of Abbreviations
- Foreword
- Chapter One. Analysis Conducted on the Hazards and Disasters that Occurred in the Center and Regional Areas
- Chapter Two. DRR Activities Report of 2018
- Chapter Three. Restructurings and Notable Events
- Chapter Four. Findings and Conclusions
- Chapter Five. Recommendations
- Appendix
- Terminology

We consider it important for further research and exchange of information and best practices if the contents of the 2018 White Paper include hazardous events that have occurred, the reasons for their occurrence, the ensuing losses and the measures taken at the regional level, or at the level of the 21 aimags, and include the results of their analysis in relation to Mongolian emergency management activities shifting to a regional implementation framework 2018. (Refer to the White Paper on Crime in Mongolia - 2016)

Furthermore, it is important to include the targets and objectives of the “Sendai Framework for Disaster Risk Reduction 2015-2030” as well as the strategy and plan to implement in Mongolia.

It will be more interesting and easier to understand for citizens if the restructurings of policy and organizational structure as well as achievements and notable events of the year were described using simple language accompanied by pictures, tables and graphs.

It would be appropriate if the Disaster Prevention Department, the Spatial Information and Technology Division of the Disaster Operations Department and the Disaster Research Institute of NEMA cooperated to develop the White Paper in accordance with the practice of nominating a research team or organization composed of the relevant scientists and researchers, which is standard practice in developing White Papers in other sectors.

In doing this, it is important to not just mention statistical data, but to cooperate with other specialized organizations to analyze the reasons and impact of disasters and hazardous events, to search for scientific methods of reducing risks and to include advice and risk reduction methods for citizens.

The benefits and importance of this White Paper will be enhanced if the data, information and research results included within are comprehensive and practical such that not only emergency management officials, but also students, teachers, researchers, other institutions and citizens will be able to use them.

The effectiveness of disaster risk reduction and prevention activities may be enhanced by conducting the relevant research on a scientific basis and improving citizens’ life safety knowledge and skills based on the research.

In order to ensure that the White Paper is sufficiently distributed to the NEMA headquarters and regional offices, the Emergency Management School, international institutions, non-governmental organizations and citizens; it is important to determine the number of copies to print and the associated costs. As such, the activities for developing and printing the annual DRR White Paper must be included in NEMA’s annual operations plan and the related costs must be provisioned in the budget.

4. Dissemination Materials of the Project at International Conferences, etc

4-1 The brochure of the project distributed in the AMCDRR, 2018

National Emergency Management Agency (NEMA)

Japan International Cooperation Agency (JICA)

GOVERNMENT OF MONGOLIA

Ministry of Construction and Urban Development (MCUD)

GOVERNMENT OF MONGOLIA

Ministry of Education, Culture, Science and Sports (MECSS)

General Agency for Specialized Inspection (GASI)

Master Planning Agency of Capital City

PROJECT FOR STRENGTHENING THE NATIONAL CAPACITY OF EARTHQUAKE DISASTER PROTECTION AND PREVENTION IN MONGOLIA

July, 2018
JICA EXPERT TEAM

BACKGROUND OF THE PROJECT

No large-scale human and property damage due to earthquakes has occurred until now in Mongolia, however, the largest inland earthquakes of magnitude 8 class have been recorded frequently in the western and southwestern area. In addition, movements of multiple active faults are observed near Ulaanbaatar, the Capital City of Mongolia, which is densely concentrated with half of the Mongolian population, and increased fault movement is said to be observed at one of those active faults. There are growing concerns about rising earthquake risk.

In February 2017, the amended Law on Disaster Protection was enforced in Mongolia. The content of the former Law, which focused on preventive measures against dzuds as well as emergency response to fires, had been reviewed and newly developed clauses related to activities for Disaster Risk Reduction (DRR) such as disaster risk assessment, enhancement of disaster protection plan, training and awareness raising for disaster management and others were incorporated in the amended Law.

As represented by enforcing the amended Law on Disaster Protection, the importance of DRR is being recognized increasingly in Mongolia. On the other hand, it is an urgent task for the National Emergency Management Agency (NEMA) and other related authorities and organizations to improve the overall capacity of responding appropriately to DRR activities especially to earthquake disaster management. Under these circumstances, the central government of Mongolia requested the government of Japan to provide aid for technical cooperation project aiming at strengthening the national capacity of earthquake disaster management.

In Japan, there is a long history of improving the legal framework and social systems for disaster prevention and mitigation based on a lot of lessons learned from each experience of past major disasters. On the basis of such longtime Japanese experience and knowledge gained from past disasters, the technical cooperation project to support mainly improvement of the capacity for disaster prevention and mitigation against earthquake disaster in Mongolia with the NEMA as the main counterparts of the project has begun.

CHIEF OF NEMA,
MAJOR GENERAL

T. BADRAL

FOREWORD

Among the over 40 types of disaster that are caused by unanticipated phenomenon of nature and human beings throughout the world, earthquake is a disaster that causes enormous damage in human life, health, society, economy and the environment in the shortest time.

While 85% of the population concentrates in urban areas, seismicity remains active in the central, northern, western and southern regions of Mongolia.

An earthquake of magnitude 6.6 to 7.6 may occur in active areas of the earthquake, and survey result shows that in that situation 22 to 50% of the buildings in Ulaanbaatar city will be damaged and collapsed, and more than 30,000 people will be affected.

The above circumstances and the results of the related study are major alarms for us, and the necessity to strengthen the system for prevention of earthquake disasters, disaster preparedness, strengthening the structure for risk mitigation, and improving national capacity of earthquake disaster prevention is high.

Under such circumstance, Japan International Cooperation Agency (JICA), extended the following cooperation for the Emergency Management Department of the Capital City (EMDC) through the technical cooperation for development planning named "The Project for Strengthening the Capacity of Seismic Disaster Risk Management in Ulaanbaatar City" from February 2012 to October 2013. As a result of requesting JICA to implement Phase 2 after the previous project was implemented smoothly, "The Project for Strengthening the National Capacity of Earthquake Disaster Protection and Prevention in Mongolia" is being implemented from 2016 to 2019.

By implementing this project, we will acquire the latest practice of Japan and improving legal frameworks of earthquake disaster protection countermeasures, and coordination among related organizations will be enhanced, progress of prevention and preparedness and also awareness of public will be developed and realized.

We will do own best to make this project smoothly.

PROJECT OVERVIEW

Project for Strengthening the National Capacity of Earthquake Disaster Protection and Prevention in Mongolia

OVERALL GOAL

Seismic risk will be reduced.

PROJECT PURPOSE

The capacity of the National Emergency Management Agency (NEMA) will be enhanced through the activities for strengthening the countermeasures for seismic risk.

PROJECT PURPOSE

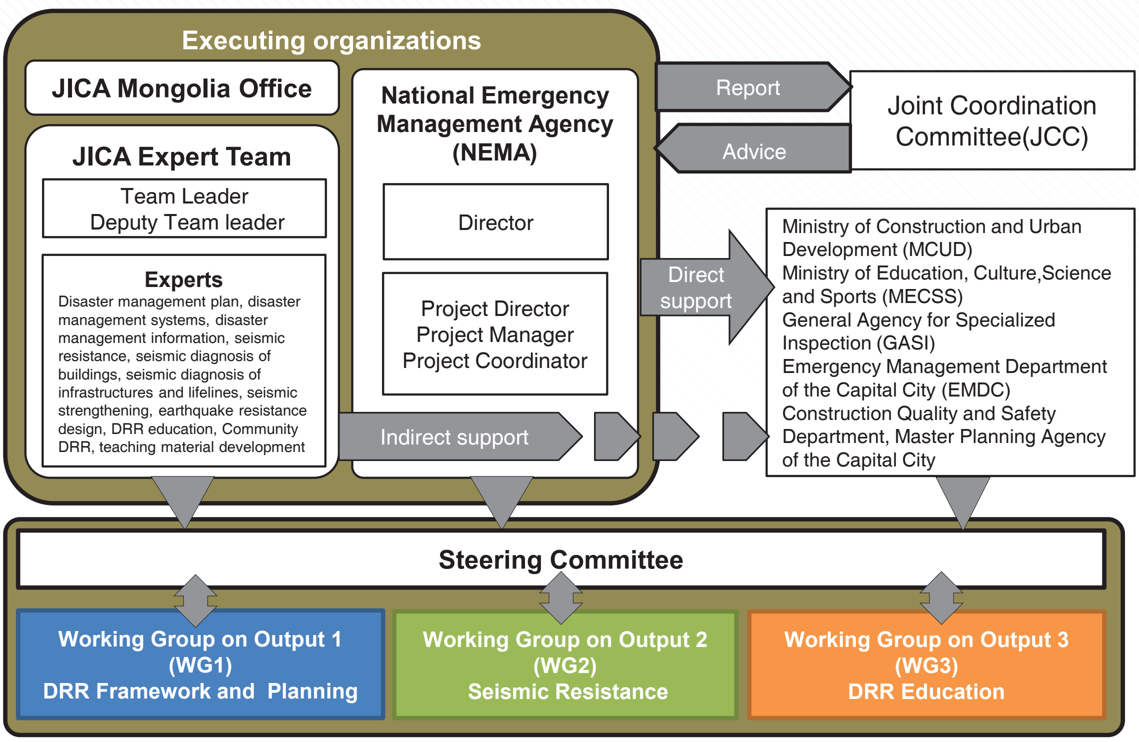
Output 1: Capacity for data collection on disaster risk reduction and coordination among related organizations will be enhanced.

Output 2: Capacity of public administration officer related to the seismic assessment and seismic strengthening of buildings will be enhanced.

Output 3: Implementing a plan on disaster risk reduction education and awareness raising activities will be developed and realized.

December, 2016 | **PROJECT PERIOD: 3 YEARS** | January, 2020

PROJECT IMPLEMENTATION STRUCTURE



OUTPUT1: DRR FRAMEWORK AND PLANNING

1-1. DISASTER RISK ASSESSMENT

The WG1 decided to develop two types of earthquake disaster risk assessment guidelines (GLs). One is comprehensive version for the central and local governments and the other is detailed version for experts and researchers. As a first step, the comprehensive version has been developed to be applied to the pilot activities for regional earthquake disaster protection planning. In this GL, the risk assessment method prescribes a method suitable for Mongolia, so that governmental staff who are not familiar with expertize in earthquake risk can also evaluate it by using the attached application software.

1-2. DISASTER PROTECTION PLANNING

The WG1 is preparing four types of disaster protection planning guidelines (GLs) targeted at National level, Aimag /Soum Level, Capital City/ District Level and State services. The WG member learned the composition and concept of the disaster protection plan in Japan at the training in Japan. The results of the learning at the training were reflected in the contents of new GLs. Especially, in order to use the results of risk assessment in the earthquake disaster protection plan effectively, we have adopted a new concept in Mongolia that sets earthquake disaster reduction goals.

Pilot activity for regional disaster protection planning in Umnugovi Aimag

1-3. DISASTER REDUCTION AGREEMENT

Draft agreements for each field such as "information / communication", "fuel" ,"medicine" are under discussion within each related organization. It is expected to be signed between NEMA, organization and private sectors in the near future.

In order to test the effectiveness of agreement for earthquake disaster response, and to demonstrate good practice of agreement to promote agreement in health sector to other sectors, a joint training was made on April 9th. A total of 38 participants from various sectors jointed the training.

Table top exercise in the joint training for testing effectiveness of agreement

1-4. WHITE PAPER

The preparation work of the "2017 White Paper" has been completed. This document was edited by reference to the white paper on disaster management in Japan and it was the first trial in Mongolia.

1-5. DISASTER DATABASE

The need to establish a management team to operate and manage Disaster Spatial Database (DSDB) for DRR had been discussed in the WG continuously. Finally the new division was established under the Public Announcement and Emergency Administration Centre in NEMA at the end of May 2018. The Guideline (GL) for operation and management of DSDB using the Internet-based Disaster Spatial Information System (I-DSIS) is being developed in parallel with discussing the detailed work procedure and responsibility in the new division.

Group exercise for utilization of I-DSIS in the database training

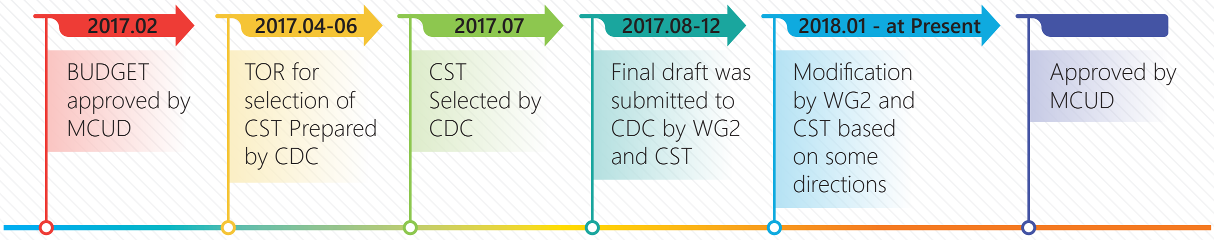
OUTPUT2: SEISMIC RESISTANCE

2-1. SEISMIC DIAGNOSIS OF BUILDINGS

The WG2 decided to develop three types of guidelines (GLs) for seismic evaluation and retrofitting method of existing buildings based on the Japanese standard for seismic evaluation and seismic strengthening. Reinforced Concrete Buildings(RC), Wall Type Precast Concrete Buildings (PC) and Masonry Buildings were selected as targets for preparation of GLs.

Since the newly established GLs must be used practically, WG2 decided to follow the approval procedure in the Ministry of Construction and Urban Development (MCUD) shown in the figure below to make standards and regulations. In the figure, a tentative schedule is also given.

Draft guidelines for seismic diagnosis of buildings



TOR: Terms of Reference, CDC: Construction Development Centre, CST: Consulting Service Team

Procedure to prepare guidelines

2-2. SEISMIC DIAGNOSIS OF INFRASTRUCTURES AND LIFELINES

The WG2 is also preparing the GL of seismic evaluation for infrastructures and lifelines by going through the same procedure as GLs of buildings. The GL has already been approved by the Science and Technology Council of MCUD in December 2017, and now in waiting for signing by the Minister of MCUD.

Explanatory meeting for seismic diagnosis of infrastructures & lifelines

2-3. DESIGN FOR SEISMIC STRENGTHENING

The WG2 is going to implement a trial design for seismic strengthening targeted at existing buildings for Kindergartens (Masonry), School (Masonry), Public Office (Masonry), Hospital (RC) and Apartment House (PC).

4-DAY TRAINING FOR SEISMIC EVALUATION

For improvement of knowledge and ability for those who carry out seismic estimation on buildings, infrastructures and lifelines, 4-day training was conducted in collaboration with the MCUD from June 4th to 7th, 2018. This training attracted a lot of interest of responsible officers for seismic evaluation and there were more than 100 participants for the training on building diagnosis (June 4th-6th) and more than 80 participants for the training on infrastructure and lifeline diagnosis (June 7th) respectively.

OUTPUT3: DRR EDUCATION

3-1. SCHOOL DRR EDUCATION

The WG3 is preparing the guideline (GL) which shows contents, teaching method and implementation way of Disaster Risk Reduction (DRR) Education titled "The Program for Life Safety Education" in kindergarten and primary and secondary schools based on amended Law on Disaster Protection and the knowledge learned in the training in Japan. After submitting the final draft GL to the Ministry of Education, Culture, Science and Sports (MECSS) in March 2018, the GL was modified based on the comments provided by the reviewers in the official approval process in the MECSS. The GL was approved by the MECSS on 6th April 2018.

As the educational materials such as textbooks and supplementary reading materials for DRR education, the "Guidebook" is being developed as an annex of "The Program of Life Safety Education".

TRIAL LESSONS FOR DRR EDUCATION

For the reference of the sample lesson plans, trial lessons for pre-school, 5th grade students, and 8th grade students were conducted by the JICA Expert Team on 1st and 2nd May 2018 by inviting the staff members of the counterpart organizations including of working group members and teachers of the target schools.

3-2. COMMUNITY DRR EDUCATION

Development of Institutional Framework for DRR Education and Raising Awareness

For developing better environment for comprehensive work planning for DRR education and raising awareness at national and local levels in Mongolia, the institutional framework among stakeholders such government organizations and donor agencies is being constructed through a series of regular meetings and developing a mailing list and a user-friendly website for managing related activities plans with every stakeholder.

Development of DRR Training Materials for Community

The WG3 is developing the instructor's guidebook and tools for the community-based DRR education and raising awareness in cooperation with the World Vision Mongolia. Now, the materials is being revised and updated through a series of pilot trainings as well as other support activities for wide dissemination of the activities in Mongolia.

Development of Educational & Training Program in Training Centre

The WG3 is also developing the educational and training program in the Disaster Protection Training and Methodology Centre of the Emergency Management Department of the Capital City (EMDC) by improving the exhibits and training program for the earthquake experience room based on the learning in Japan.

IMPLEMENTATION OF TRAININGS ON DRR EDUCATION AND RAISING AWARENESS

The Training for Trainers (ToTs) were conducted on March 2018 in Ulaanbaatar City and in Zavkhan Aimag combined with the "Be Ready" program organized by the World Vision Mongolia and Mongolian Red Cross Society.
And then, under the initiative of instructors trained in ToTs, the Workshops for DRR Awareness Raising were successfully conducted on May 2018 in Otgon Soum and Uliastai Soum in Zavkhan Aimag, and Bayangol District and Bayanzurkh District in Ulaanbaatar City.

IMPLEMENTATION OF TWO TIMES TRAININGS IN JAPAN

For learning the disaster risk reduction and management system in Japan, the first training was conducted from March 20th to 29th, 2017. The twelve trainees from the Mongolian side took part in the training. After the training, representatives of each Working Group (WG) who attended in the training shared their knowledge and experiences obtained through the training with other WG members and related officers in NEMA and other organizations, and they actively advanced each WG activity by reflecting the lessons learned from the first training.

For gaining more specific knowledge and learning a technical approach which are directly utilized to prepare guidelines, agreements, and training programs for the activities of each WG, the Mongolian side requested further training in Japan on April 2017. As the result of series of discussions about the further training in Japan, implementation of the second training was decided by dividing into three times for each WG. First, the training for WG3 (OUTPUT3) with ten trainees named "Capacity Improvement for the promotion of DRR" was implemented from October 29th to November 11th, 2017. Then, the training for WG2 (OUTPUT2) with nine trainees named "Capacity Improvement for Seismic Diagnosis and Strengthening Buildings" was also implemented from November 12th to 22nd, 2017. Finally, the training for WG1 (OUTPUT1) with thirteen trainees named "Capacity Improvement for Disaster Management Planning" was implemented from December 6th to 16th, 2017.



PROVISION OF EQUIPMENT

The equipment for seismic diagnosis of buildings and the equipment of earthquake simulation experience for the Disaster Protection Training and Methodology Centre are supposed to be procured and donated by JICA. In order to illustrate the key role equipment, the Mongolian side proposed the Operation and Maintenance (O&M) plans with training program respectively and those plans were submitted to JICA. The process of procurement of the equipment has begun.



JICA EXPERT TEAM

The National Emergency Management Agency
Ulaanbaatar, Sukhbaatar District, Partisan St-6, Po/box - 210644

16TH EUROPEAN CONFERENCE ON EARTHQUAKE ENGINEERING THESSALONIKI 18 - 21 JUNE 2018

SEISMIC DIAGNOSIS AND FORMULATION OF REINFORCEMENT DESIGN STANDARDS FOR MASONRY BUILDINGS IN MONGOLIA

Shigenori KITA[1], Seiichirou FUKUSHIMA[2]

ABSTRACT

In Mongolia, along with the three active faults recently discovered near Ulaanbaatar, the capital city, the increasing number of felt and unfelt earthquakes have raised the concern regarding seismic risk. Since buildings with unknown seismic performance exist around the country, especially in Ulaanbaatar, prompt earthquake diagnosis and reinforcement plans are highly desired. However, the existing earthquake resistance evaluation standard of Mongolia is mainly for deterioration diagnosis, and there are no provisions for seismic diagnosis. The paper will introduce seismic diagnosis and formulation of reinforcement design standards for masonry buildings, where JICA (Japan International Cooperation Agency) is contributing with: “The Project for Strengthening the National Capacity of Earthquake Disaster Protection and prevention in Mongolia”. This standard is related to the “Guidelines for Seismic Evaluation of Existing Brick Masonry Buildings” from the Hokkaido Building Engineering Association, and aims to respond to the actual situation in Mongolia while usable by many people. This standard seeks the approval of the Mongolian Government and the indexes are under formulation while writing this article.

Keywords: Mongolia; masonry; diagnosis; JICA; seismic performance

1. INTRODUCTION

In Mongolia, earthquake chronology shows frequent and large earthquakes of magnitude 8, centered on the west area of the country. In recent years, three active faults (Hostay fault, Emilute fault, Gunjin fault) were discovered near the capital city of Ulaanbaatar, where half of the total population (about 3 million people) is located. Furthermore, felt and unfelt earthquakes are increasing in Ulaanbaatar City, and concerns about seismic risk have risen.
In addition, Kawase et al. (2004) has pointed out the problems of seismic performance in existing buildings in Mongolia. As a matter of fact, in Ulaanbaatar there are several masonry buildings that had removed the earthquake-resistant walls to convert the first floor into a store (Figure 1,2).

Figure 1. Masonry building first floor converted into stores

[1]President, Kita Shigenori Structural Design Office Co., Ltd., Tokyo, Japan, kitakozo@design.zaq.jp
[2]President, RKK Consulting Co., Ltd. Tokyo, Japan, fukushima@rkk-c.co.jp

Figure 2. Masonry building where walls were removed for use as a store

This was done by the residents themselves after the transition to market economy in 1991, and the Application for business had been submitted to the government office, but it seems that the application for building modifying such as removing walls had not been submitted. Since the first floor is the most important on earthquake resistance, the current situation that the walls of this floor have been removed without structural consulting is very dangerous. And many masonry building floors are wooden. Since wooden floor has considerably lower rigidity than masonry walls, it cannot play a role as an appropriate diaphragm. In fact, some reports have decided that wooden floor buildings should be rebuilt unconditionally due to their poor performance.

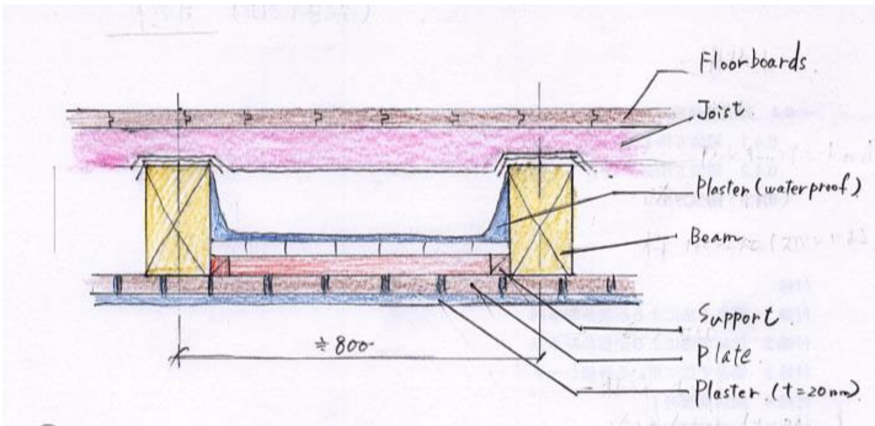


Figure 3. Typical wooden floor in Mongolia

Under such circumstances, it is urgent to conduct seismic diagnosis of existing buildings and reinforce them if necessary. Though, the instructions related to earthquake resistance assessment provided by the national Construction Development Center (“BD31-102-00”, 2000), that are currently used in Mongolia, correspond to instructions for deterioration diagnosis which is not directly related to earthquake resistance evaluation. Then, in 2013, the National Emergency Management Agency (NEMA), of the central government of Mongolia, submitted the formal aid request to the Japanese Government with the aim of improving the disaster prevention capability against earthquakes in Mongolia. The project started in 2016 after an agreement between both parties. Among the request’s contents, this paper will explain the creation of seismic diagnosis and reinforcement design standards for existing RC/PC/Masonry buildings, but focuses mainly on masonry. This standard is currently under the scrutiny of the Mongolian government for approval, and the indexes are being formulated as this article is being prepared.

1.1 Purpose of Standard

2. STANDARD OVERVIEW

2.1 Purpose of Standard

Seismic diagnosis and retrofit design criteria for existing masonry buildings in Mongolia were created for the following purposes.

- Evaluate the seismic performance of existing masonry buildings based on continuous numerical values.
- Have a simple diagnostic method, where it is possible to obtain results even if the researcher is not a specialized engineer. Since it aims to be applied, not only in Ulaanbaatar City, but also in different places around Mongolia.
- Diagnosis / reinforcement method suitable for the actual situation of Mongolia.
- The Mongolian earthquake disaster preparedness capacity improvement, forming a framework that Mongolian officials and engineers are the main body, and the process of deciding the contents is through discussions and consensus of the matter.

2.2 Continuous Numerical values

The reason for an index evaluation based on the continuous numerical value is not only to judge whether a certain criterion is satisfied but also to confirm at what degree the performance is insufficient. Thus, it will be an index to judge whether to reinforce or rebuild. Currently, the judgement to whether perform seismic reinforcement or rebuilding is done solely by the owner. The index will contribute to the decision making of the owner by showing the necessity and to what extent the reinforcement is needed.

2.3 Simple Diagnostic Method

The simple diagnostic method responds to an urgent need for seismic diagnosis. It is not feasible to conduct seismic diagnosis of many building with only a limited number of engineers in Mongolia. Therefore, by adopting a simple diagnostic method, it becomes possible for a lot of people who are not engineers to perform a diagnosis, even if accuracy is slightly sacrificed; making it possible to respond to the urgency. For the actual method, we consider that commercially available spreadsheet software can be used to obtain diagnostic results.

2.4 Suitable Actual Situation of Mongolia

In order to develop the diagnostic method according to the actual situation of Mongolia, the required performance level in the seismic diagnosis shall not deviate from the seismic performance level of the newly built buildings currently adopted in the country. When preparing the diagnostic criteria, we will refer to the standards of other countries, but if it adopted as it is, it might be a higher seismic performance than the new buildings in Mongolia. Then, it is necessary to determine the required performance level while maintaining the balance with the current building standard of Mongolia. Regarding the reinforcement method, from among various existing methods currently being proposed and implemented, it is necessary to propose an appropriate method in accordance to the Mongolian country's building technology, available materials, etc.

2.5 Mongolian Officials and Engineers are the main body

In many countries, including Mongolia, methods of advanced countries with different conditions are adopted directly, ending up with a poor usability, there are even examples when it is eventually non-utilized. Therefore, by forming a framework where Mongolian officials (WG: Working Group) and engineers (MACE: Mongolian Association of Civil Engineers) are the main body in this project, JICA (Japan International Cooperation Agency) members have just devoted to support them.

3. REFERENCE STANDARD

In order to prepare the standard that satisfy the purpose described in the previous chapter, consider reference standards of other countries.

3.1 Guidelines for seismic evaluation of existing brick masonry buildings 2nd edition

In the "Guidelines for Seismic Evaluation of Existing Brick Masonry Buildings" (2015) prepared by the Hokkaido Building Technical Association of Japan, the judgement is done by comprehensively assessing the horizontal load bearing capacity, shape of the building, aging deterioration, etc. ($Is_1 > Is_0$), and diagnosing the out-of-plane strength of the wall body ($Is_2 > Is_0$). With this method, seismic diagnosis can be performed only with commercially available spreadsheet software without using a structural analysis model or similar tool for judgement, and at the same time accessible to several people. Thus, we decided to prepare Mongolian seismic diagnostic standards based on this method. However, since the Hokkaido Standard corresponds to the masonry characteristics in Japan, this standard cannot be applied directly to Mongolia. For example, under the provisions of Article 1, the number of floors of a building is limited to three floors or less; but Mongolian masonry building, have up to four-story and five-story buildings. Moreover, the Hokkaido Standard, considers rigid floors from the second floor and above, but in Mongolia there are many buildings with wooden floors that do not respond to rigid floor assumptions. If these buildings are excluded, the standards make no sense for most buildings in Mongolia. Accordingly, as a systematic diagnostic method, while basically referring to this Hokkaido Standard, it has partially changed to correspond to the reality in Mongolia.

4. CONTENTS OF THE STANDARD

4.1 Scope of Application

It defines the applicable scope of this standard. With respect to the number of building floors and wooden floor which are out of the scope of application under Hokkaido Standards, this standard can be applied on the premise that appropriate measures are taken.

4.1.1 Number of Stories

The number of floors of the building shall be five stories or less. However, in the case of four stories or more, investigation of the bending component of the entire building shall be checked. Because in the case of 4 to 5 stories, there is a possibility that the bending stress generated cannot be ignored depending on the aspect ratio of the building. In that case, it is required to perform the appropriate calculation or reinforcement.

4.1.2 Stiffness of floor

If the floor is made of wood or other material that do not match the rigid floor characteristics, this standard can be applied on the premise that it will be reinforced. The importance of the stiffness of floor slab and roof slab in the masonry building has been clarified from various sources and earthquake damages in the world so far (Ishiyama et al. 2013). For this reason, some standards even exclude masonry buildings with wooden floor from the scope and classify them as impossible to diagnose, leaving the real performance of those masonry buildings unknown. Hence, in the proposed diagnosis, it can be continued by assuming that the performance of the wooden floor is clarified or reinforced.

4.1.3 Joint

If the joint between the floor and the wall easily separate, the building will suffer great damage (Figure 4). Therefore, it was requested to confirm that the join strength between the beam and the wall is secured, and if the proof stress is insufficient or unknown, the diagnosis can be continued on the premise that reinforcement is performed.

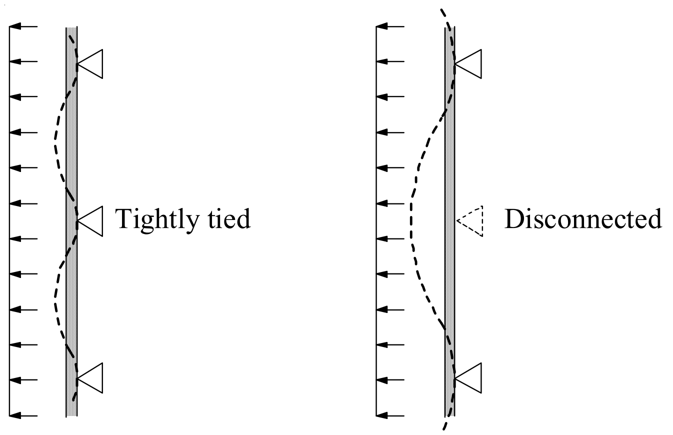


Figure 4. Difference of the stress depends on the joint between floor and wall

Figure 5. Out-of-plane destruction due to insufficient coupling with the horizontal plane

4.2 Judgement of Earthquake Resistance Performance

The judgment of the earthquake resistance performance of the structure is based on equation (1).

$$Is \geqq Is_0 \tag{1}$$
$$Is = \min(Is_1, Is_2)$$

Is: An index representing the seismic performance of structure
Is_0: Seismic demand index of structure
Is_1: In-plane seismic performance index, depends on equation (3)
Is_2: Out-of-plane seismic performance index, depends on equation (4)

Based on the result of equation (1), the seismic performance of the building can be judged as follows.
$Is < Is_0$: It has below performance compare to the current Mongolian standards

$Is_0 \leq Is < 1.5\ Is_0$: It has equivalent performance compare to the current Mongolian standards
$1.5\ Is_0 \leqq Is$: It has enough performance compare to the current Mongolian standards

This judgment result is indicated by continuous values, and it becomes an indicator to judge that the owner will reinforce or rebuild based on the ratio of Is to Is_0.

4.3 Seismic demand index of structure

Seismic demand index of structure Is_0 is obtained by equation (2)

$$Is_0 = A\beta \tag{2}$$

A: Design seismic activity that is PGA in [G] (Mongolian standard)
β : Spectral amplification (Mongolian standard)

Is_0 indicates the lower limit value of the performance required for the building. A and β are the values shown in Mongolian standards BNBD 22-01-01 * (2006), by which the base shear coefficient at the elastic response of the building can be obtained. By adopting this value, the required performance can be made equivalent to new buildings in Mongolia.

4.4 In-plane Structural seismic Performance Indicator

In-plane structural seismic performance indicator (Is_1) is calculated by equation (3).

$$Is_1 = Qu \cdot F \cdot T \cdot Sd / (\Sigma W \cdot Ai) \tag{3}$$

Q_u: horizontal load bearing capacity
F: Ductility index (1.0)
T: Time index (~1.0)
S_d: Irregularity index (~1.0)
ΣW: Building load during earthquake
Ai: Story-shear modification factor. (n + i) / (n + 1).
n: Number of building floors, i: Floor number of target floor

As mentioned above, the performance of the wall In-plane takes into consideration various points in addition to the strength of wall. By setting F = 1.0, the performance after the plasticity of the wall is not considered. Time index is a reduction coefficient for evaluating the condition of deterioration such as cracking and S_d is a reduction coefficient evaluated by shape such as irregularity of the walls or void of floors. Ai assumes triangle distribution of loads, and assuming that this inverse number is taken, the performance will be reduced by the upper floor.

4.5 Horizontal Shear force Strength in-plane (Q_u)

The horizontal shear force strength in-plane is calculated by the formula (4).

$$Q_u = \alpha \cdot A_w \cdot (\tau_w + 0.56\ \sigma_o)\ [N] \tag{4}$$

A_w: horizontal cross-sectional area of wall in each direction [mm^2]
τ_w: Shear strength per horizontal cross-sectional area of wall [N / mm^2]
σ_o: Vertical load per horizontal cross-sectional area of wall [N / mm^2]
α: Reduction coefficient based on the ratio of wall height h_w and width l_w. depends on i) to iii).
i) $h_w / l_w \leq 2.0$: $\alpha = 1.0$
ii) $h_w / l_w \geqq 3.0$: $\alpha = 0$
iii) $2.0 < h_w / l_w < 3.0$: $\alpha = 3.0 - h_w / l_w$

The value of the shear strength τ_w is defined by the material test, and the upper limit value is set to

0.39 N / mm^2. Constant 0.56 in (4) corresponds to the coefficient of friction. Both are quoted of Mongolian standard values (BNBD 51-02-05). The value of α is a coefficient that decreases in consideration of the influence of bending from the aspect ratio of individual load bearing walls.

4.6 Out-of-plane Structural seismic Performance Indicator

The out-of-plane structural seismic indicator (Is_2) is calculated by equation (5).

$Is_2 = Is_0 \times S_a$ (5)

S_a: Out-of-plane safety factor. Depends on (6) and (7), respectively.

When $\sigma_c \geqq \sigma_b$; S_a = Compression stress of wall / ($\sigma_c + \sigma_b$) [N / mm ^{2}] (6)
When $\sigma_c < \sigma_b$; S_a = Tensile strength of wall / ($\sigma_b - \sigma_c$) [N / mm 2] (7)

σ_c = N / A (Axial force of wall / Cross sectional area of wall) [N / mm 2]
σ_0 = M / Z_t (bending moment of the wall / section modulus in the out-of-plane direction of the wall) [N / mm ^{2}]
M = κWH / 8 (for both end pins) [N · mm]
M = κWH / 12 (for both ends fixed) [N · mm]
$\kappa = A\beta \cdot A_i$
H: effective bending span in the out-of-plane direction of the wall [mm]
W: Wall weight [mm]
A: Design earthquake activity (Mongolian standard)
β: Earthquake response spectrum (Mongolian standard)
A_i: Story-shear modification factor. (n + i) / (n + 1).
n: Number of building floors, i: Floor number of target floor

S_a indicates the safety factor against the stress in the out-of-plane direction of the wall, and by multiplying Is_0 by S_a, the performance in the out-of-plane direction is shown. In fact, as is clear from the formula, it is enough to check $S_a > 1.0$, but since we need to show the building performance in the form of $Is > Is_0$, we adopt equation (5).

5. CONCLUSIONS

We have introduced the earthquake resistance diagnostic criteria prepared for the actual situation of masonry buildings in Mongolia. For future work, we plan to conduct diagnosis with this method for several buildings and verify its validity. We are currently discussing the applicable reinforcement methods in Mongolia for buildings judged as $Is < Is_0$ by the diagnosis. Problems related to risk of earthquake resistance of masonry are concerned not only in Mongolia but also around the world. We hope that this diagnosis and reinforcement method will contribute to ease the problem.

6. ACKNOWLEDGMENTS

We would like to express our deepest appreciation for valuable advice and information by the JICA Expert members as well as for permitting and encouraging this paper presentation by the JICA. And we also appreciate the cooperation for execution of structural evaluation by the NEMA, MPDUB and MACE members.

7. REFERENCES

Saruul DORJPALAM, Hiroshi KAWASE, Narenmandula HO (2004). Earthquake disaster simulation for Ulaanbaatar, Mongolia based on the field survey and numerical modeling of masonry buildings. *13th World Conference on Earthquake Engineering*, 1-6 August, Vancouver, B.C., Canada.

BD31-102-00 (2000) Instruction for assessing earthquake resistance rate of existing building, the public institution, Construction Development Center, Mongolia.

BNBD 22-01-01 * (2006), Design standards and regulations of buildings in areas where seismic activity is active, the public institution, Construction Development Center, Mongolia.

Guidelines for seismic evaluation of existing brick masonry buildings 2nd ed. (2015). Hokkaido Building Technical Association of Japan, Japan.

Yuji ISHIYAMA, Anand S. ARYA, Teddy BOEN (2013). Guidelines for earthquake resistant non-engineered construction, UNESCO.

BNBD 51-02-05 (2005), Masonry structures, the public institution, Construction Development Center, Mongolia.

Paper ID ACEE0066 The 7th Asia Conference on Earthquake Engineering, 22-25 November 2018, Bangkok, Thailand

Development of Seismic Diagnosis and Retrofitting Standards for Existing Buildings in Mongolia

Hideto Omine
Structual Desing and Seismic risk Consult
RKK Consulting Co., Ltd.
Tokyo, Japan
hideto.omine@rkk-c.co.jp

Sei'ichiro Fukushima
Headquarter
RKK Consulting Co., Ltd.
Tokyo, Japan
fukushima@rkk-c.co.jp

Kiyotaka Owada
Urban & Regional Development and Disaster Risk Reduction
Oriental Consultants Global Co., Ltd.
Tokyo, Japan
Owada-ky@ocglobal.jp

***Abstract*— Along with three active faults recently found near Ulaanbaatar, the capital city in Mongolia, an increasing number of felt and unfelt earthquakes are causing deep concern regarding seismic risk. Since many of the buildings in the country are old and deteriorated, their current seismic performance is unknown or its assessment considerably worse compared to the situation when they were constructed, therefore prompt actions such as seismic diagnosis and follow-up seismic retrofitting are highly required. In Mongolia the existing structural diagnosis standards against seismic risk are focused on building deterioration, and there is no provision for seismic diagnosis and retrofitting so far. This paper introduces the development of seismic diagnosis and retrofitting standards for three typical structures, namely, reinforced concrete buildings, precast panel buildings, and brick masonry buildings. To developing Mongolian standards, we applied current Japanese standards with some modifications due to Mongolian practicality, which will surely encourage a wide propagation. Thus, we conducted trial seismic diagnosis to verify the adequacy of methodology, concluding that the newly standards can properly evaluate the seismic performance of existing buildings. This present work is supported by Japan International Cooperation Agency (JICA) as part of "The Project for Strengthening the National Capacity of Earthquake Disaster Protection and Prevention in Mongolia."**

Keywords*— Mongolia, seismic diagnosis, seismic retrofitting, JICA

I. Introduction

In Mongolia, earthquake chronology shows frequent and large earthquakes of magnitude 8, centered on the west area of the country. In recent years, three active faults (Hostay fault, Emilute fault, Gunjin fault) were discovered near the capital city of Ulaanbaatar, where half of the total population (about 3 million people) is located. Furthermore, felt and unfelt earthquakes are increasing in Ulaanbaatar City, and concerns about seismic risk have risen.

This paper presents the necessity of taking proper action on seismic diagnosis and retrofitting, especially for brick masonry buildings and precast panel buildings. Buildings of main structure in Ulaanbaatar City are mostly made of reinforced concrete, precast panel, and brick masonry. The brick masonry buildings have been built mainly since 1950s by way of the former Soviet Union or China for to provide a modern living environment. They are still in present, and due to the capitalistic waves after the democratization of 1991 there is a building whose first floor is renovated into a shop. (Fig.1)

Fig. 1. *Typical masonry building of 1950s*

Another case is the brick masonry buildings, kindergartens and schools prepared due to the housing complex, later mentioned. They are made by same structural form of the former Soviet Union standard and found in several districts. (Fig.2）

Fig. 2. *Typica kindergarten building by l masonry*

The precast panel building is a housing complex constructed with precast panels produced by Mongolian factories (at that time three) by way of the former Soviet Union standard. (Fig.3) Between 1965 and 2000, 1077 precast panel buildings were built in 14 districts of the capital UB city. The details of each floor are in Table 1, and they provide 45462 houses totally. (2015 survey) At present the factories are closed and no more precast panel buildings.

Table 1: *Number of Precast Panel Building in UB City*

Story of building	*12-story*	*9-story*	*5-story*
Number of building	*34*	*780*	*263*

Fig. 3. *Typical apartment house by precast panel structure*

It is not clear whether Mongolian assumption of seismic design load on those days was suitable for those buildings or not, and the adequacy to their own seismic risk has not been investigated. Moreover, in case of renovations such as the removal of walls, there is no quantification method prepared for how much they affect the seismic performance.

This paper aims to clarify some key points of seismic diagnosis and retrofitting standards fitting for Mongolia, investigating the building characteristics under the on-site survey and the verification of original drawings.

II. Characteristics of Buildings in Mongolia

A. *Masonry Buildings*

In Mongolia many masonry buildings have been built since 1950s and still been under construction. One of their characteristics is that a brick exterior wall is 64 cm thick, thicker than other regions due to the necessity of good thermal insulation performance for the severe winter. Therefore, it is required to evaluate the seismic performance by examining the wall amount against the seismic force and also the strength of mortar bond between bricks.

The horizontal shear force strength Q_u in-plane is calculated by means of the following formula.

$$Q_u = \alpha \cdot A_w \cdot (\tau_w + 0.56\,\sigma_0) \quad (1)$$

A_w : Horizontal cross-sectional area of wall

τ_w : Shear strength per area of wall

σ_0 : Vertical load per area of wall

α : Coefficient based on the ratio of height and width

Moreover, there exists a masonry building which is vulnerable to the earthquake.

Kawase et al. (2004) has pointed out the problems of seismic performance in existing buildings in Mongolia. As a matter of fact, in Ulaanbaatar there are several masonry buildings that had removed the earthquake-resistant walls to convert the first floor into a store (Figure 4).

This was done by the residents themselves after the transition to market economy in 1991, and the Application for business had been submitted to the government office, but it seems that the application for building modifying such as removing walls had not been submitted. Since the first floor is the most important on earthquake resistance, the current situation that the walls of this floor have been removed without structural consulting is very dangerous. And many masonry building floors are wooden. Since wooden floor has considerably lower rigidity than masonry walls, it cannot play a role as an appropriate diaphragm. In fact, some reports have decided that wooden floor buildings should be rebuilt unconditionally due to their poor performance.

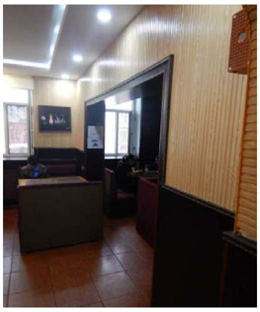


Fig. 4. *Masonry building where walls were removed for use as a store*

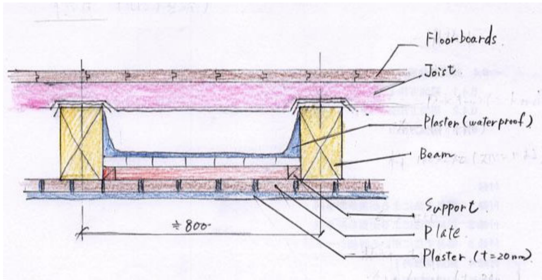


Fig. 5. *Typical wooden floor in Mongolia*

Another is that there is a brick wall which is not connected horizontally with a floor and a roof slab. A building, three stories high, in Fig.6 shows that the bonding force between wooden floor and wall is not strong enough and also the roof is disconnected with the wall. This will cause a high risk of out-of-plane destruction (Fig.7) due to the wall's low resistance against seismic force.

Fig. 6. *Out-of-plane direction vulnerable building in Mongolia*

Fig. 7. *Out-of-plane destruction in other country*

B. Precast Panel Buildings

The housing complex of precast panel buildings in Mongolia had a standard drawing in each 5, 9, and 12-story-high building, and each building was constructed followed by each standard respectively.

Checking the original drawing of 9-story-high building, we find that a room is arranged to exterior side and has a middle through corridor. Therefore, the wall position of X direction is set with two exterior walls and two inner walls: as for the exterior has a large opening window space and the inner a large door opening space. Y direction has more walls as partition of the standard span of 3.6 m. The inner wall is 14-16 cm thick of precast panel and the exterior wall is a panel format sandwiched with an insulation layer, whose standard is 30 cm thick.

As for the steel bar arrangement, for example, the inner wall B29 is doubly arranged, the vertical steel bar is ϕ5-400 mm pitch, and the horizontal steel bar is ϕ4-400 mm pitch. (Fig.9) The bonding method of each wall and floor is wet joint that is to weld to each anchor bar and fill with cast-in-place concrete at the joint connection.

The vertical joint part is welded with the vertical joint bar and anchor bar overlaid and filled with cast-in-place concrete. The surface of a wall side jagged also have a connecting effect. (Fig.12 and 14) The horizontal joint part has 2 or 3 cotter parts in each panel installed with ϕ12 horizontal joint steel bar, shown in Fig. 9 of MB1 and MB2. Those are welded at the building site before being filled with cast-in-place concrete. The exterior wall is 30 cm thick, but its outside is 5 cm thick and its inside 8 cm, and there is an insulation layer between them, which is to protect Mongolian severe winter. The inside part of 8 cm wall is the only effective part for shear strength. (Fig.13)

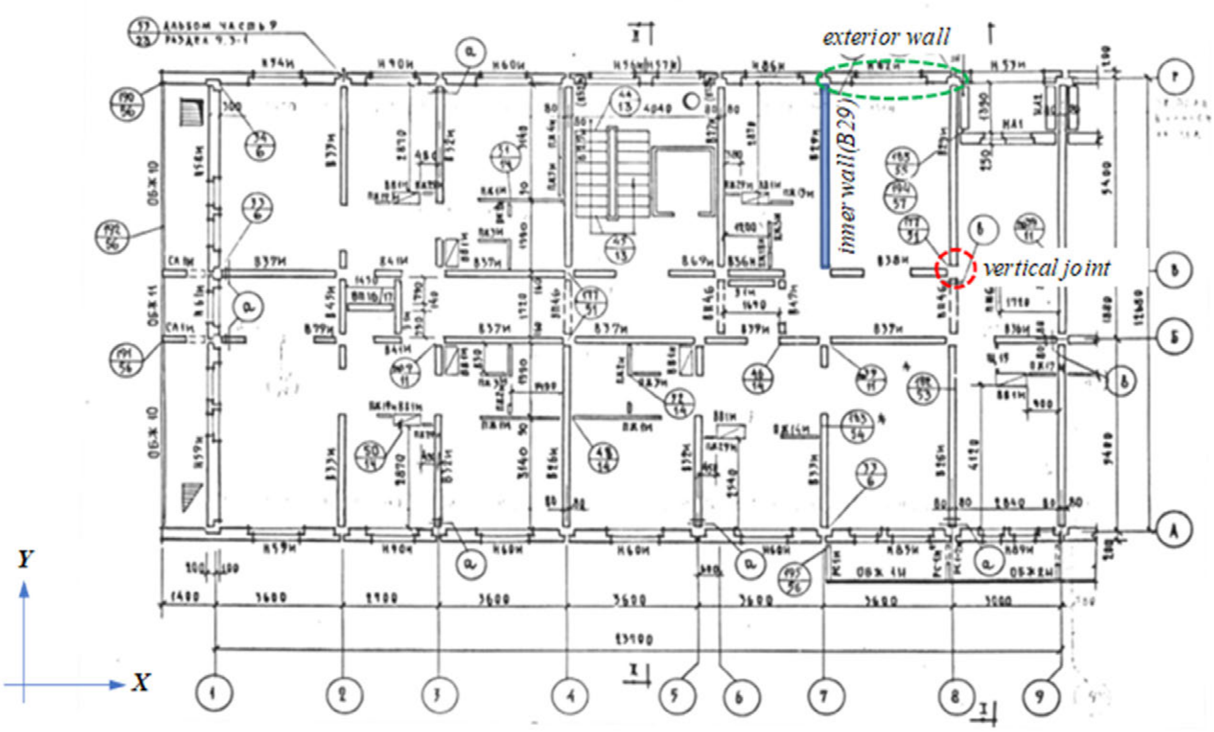


Fig. 8. *Framing plan of typical 9-story-high precast panel building: Original drawing*

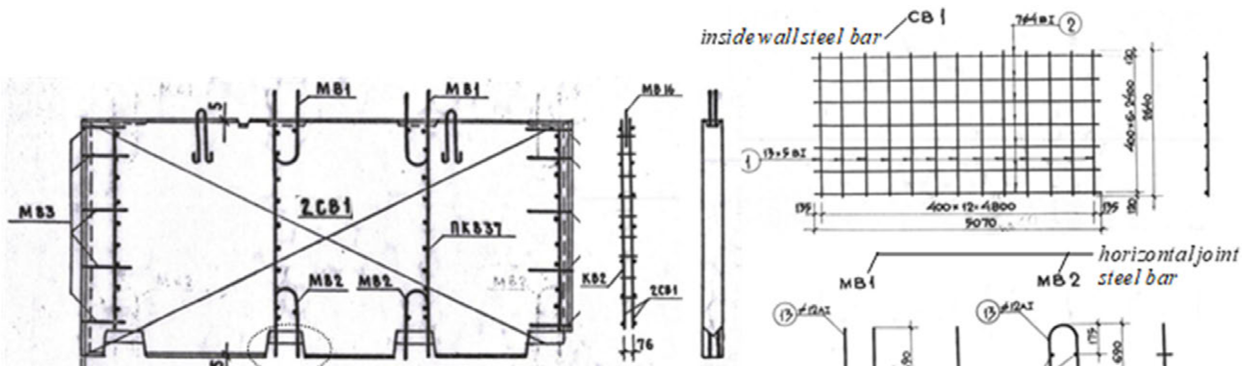


Fig. 9. *B29 Wall's steel bar arrangement: Original drawing*

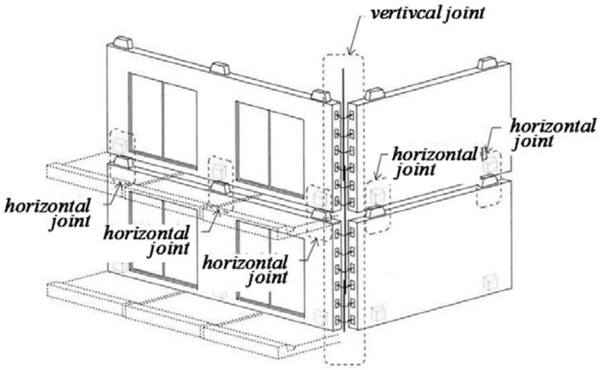


Fig. 10. *Overview of panel connection*

Fig. 11. *Inner wall and exterior wall: Deconstruction building*

Fig. 12. *Detail of vertical joint: Deconstruction building*

Fig. 13. *Exterior wall with insulation layer: Deconstruction building*

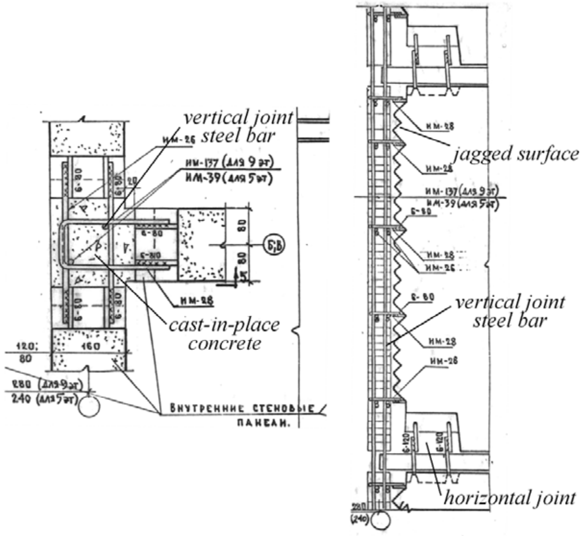


Fig. 14. *Detail of vertical and horizontal joint: Original drawing*

According to these characteristics of precast panel structure in Mongolia, the horizontal shear force strength Q_u will be estimated by the ultimate shear strength of own panel Q_{su} determined by the wall thickness and the inside steel bar, the shear at the rupture of joint Q_{hu} determined by the horizontal joint connect shear force, the shear at the ultimate flexural failure Q_{mu} determined by the vertical joint connect force and etc. The seismic diagnosis should be performed under the consideration of these destructive modes.

$$Q_u = min(Q_{su}, Q_{hu}, Q_{mu}) \quad (2)$$

Q_{su} : Ultimate shear strength of own panel

Q_{hu} : The shear at the rupture of joint

Q_{mu} : The shear at the ultimate flexural failure

III. KEY OF STANDARD

Under such circumstances, it is urgent to conduct seismic diagnosis of existing buildings and reinforce them if necessary. Though, the instructions related to earthquake resistance assessment provided by the national Construction Development Center (“BD31-102-00”, 2000), that are currently used in Mongolia, correspond to instructions for deterioration diagnosis which is not directly related to earthquake resistance evaluation. Then, in 2013, the National Emergency Management Agency (NEMA), of the central government of Mongolia, submitted the formal aid request to the Japanese Government with the aim of improving the disaster prevention capability against earthquakes in Mongolia. The project started in 2016 after an agreement between both parties . Among the request’s contents, this paper will explain the creation of seismic diagnosis and reinforcement design standards for existing RC/PC/Masonry buildings, but focuses mainly on masonry. This standard is currently under the scrutiny of the Mongolian government for approval, and the indexes are being formulated as this article is being prepared.

A. Purpose of Standard

Seismic diagnosis and retrofit design criteria for existing buildings in Mongolia were created for the following purposes.

- Evaluate the seismic performance of existing buildings based on continuous numerical values.
- Have a simple diagnostic method, where it is possible to obtain results even if the researcher is not a specialized engineer. Since it aims to be applied, not only in Ulaanbaatar City, but also in different places around Mongolia.
- Diagnosis/reinforcement method suitable for the actual situation of Mongolia.
- The Mongolian earthquake disaster preparedness capacity improvement, forming a framework that Mongolian officials and engineers are the main body, and the process of deciding the contents is through discussions and consensus of the matter.

B. Continuous Numerical values

The reason for an index evaluation based on the continuous numerical value is not only to judge whether a certain criterion is satisfied but also to confirm at what degree the performance is insufficient. Thus, it will be an index to judge whether to reinforce or rebuild. Currently, the judgement to whether perform seismic reinforcement or rebuilding is done solely by the owner. The index will contribute to the decision making of the owner by showing the necessity and to what extent the reinforcement is needed.

C. Simple Diagnostic Method

The simple diagnostic method responds to an urgent need for seismic diagnosis. It is not feasible to conduct seismic diagnosis of many building with only a limited number of engineers in Mongolia. Therefore, by adopting a simple diagnostic method, it becomes possible for a lot of people who are not engineers to perform a diagnosis, even if accuracy is slightly sacrificed; making it possible to respond to the urgency. For the actual method, we consider that commercially available spreadsheet software can be used to obtain diagnostic results.

D. Suitable Actual Situation of Mongolia

In order to develop the diagnostic method according to the actual situation of Mongolia, the required performance level in the seismic diagnosis shall not deviate from the seismic performance level of the newly built buildings currently adopted in the country. When preparing the diagnostic criteria, we will refer to the standards of other countries, but if it adopted as it is, it might be a higher seismic performance than the new buildings in Mongolia. Then, it is necessary to determine the required performance level while maintaining the balance with the current building standard of Mongolia. Regarding the reinforcement method, from among various existing methods currently being proposed and implemented, it is necessary to propose an appropriate method in accordance to the Mongolian country's building technology, available materials, etc.

E. Mongolian Officials and Engineers are the main body

In many countries, including Mongolia, methods of advanced countries with different conditions are adopted directly, ending up with a poor usability, there are even examples when it is eventually non-utilized. Therefore, by forming a framework where Mongolian officials (WG: Working Group) and engineers (MACE: Mongolian Association of Civil Engineers) are the main body in this project, JICA (Japan International Cooperation Agency) members have just devoted to support them.

IV. Evaluation Method of Seismic Performance

A. Judgement of Earthquake Resistance Performance

The judgment of the earthquake resistance performance of the structure is based on equation (3).

$$Is \geqq Iso \tag{3}$$

Is : An index representing the seismic performance of structure

Iso : Seismic index required for a building to be safe

Based on the result of equation (3), the seismic performance of the building can be judged as follows.

$Is/Iso \geqq 1.0$: Low risk of collapse, collapse

$0.5 \leqq Is/Iso < 1.0$: Some risk of collapse, collapse

$Is/Iso \leqq 0.5$: High risk of collapse, collapse

This judgment result is indicated by continuous values, and it becomes an indicator to judge that the owner will reinforce or rebuild based on the ratio of Is to Iso.

B. Seismic demand index of structure

Seismic demand index of structure Iso is obtained by equation (4)

$$Iso = A \tag{4}$$

A : Design seismic load that is PGA in [G] (Mongolian standard)

Iso indicates the lower limit value of the performance required for the building. A and β are the values shown in Mongolian standards BNBD 22-01-01 * (2006), by which the base shear coefficient at the elastic response of the building can be obtained. By adopting this value, the required performance can be made equivalent to new buildings in Mongolia.

C. Structural seismic Performance Indicator

Seismic demand index of structure Iso is obtained by equation (4)

structural seismic performance indicator is calculated by equation (5).

$$Is = \frac{Q_u \cdot F \cdot T \cdot S_d}{(\sum W \cdot A_i) \cdot \beta} \tag{5}$$

Q_u : Ultimate lateral strength

F : Ductility index representing the deformation capacity of structure

T : Time index

S_d : Irregularity index in structural plan and elevation

$\sum W$: Total weight supported by the story concerned

A_i : Story-shear modification factor.

β : Response spectral amplification (Mongolian standard)

V. CONCEPT AND METHOD OF SEISMIC RETROFIT

Seismic retrofit will be required in case when a conducted seismic diagnosis is evaluated under the safe seismic performance and yet the building is still in use. Since seismic performance is evaluated by the combination of strength C and ductility F, the purpose of seismic retrofit is to improve strength C or ductility F, or the both after due consideration of the characteristics on existing buildings. Fig. 15 shows how seismic performance is improved by conducting seismic retrofit fitting on each purpose. The methods are classified according to each purpose: for instance, Fig. 17 shows a construction overview. In Mongolia seismic retrofit should be conducted in the following: perform seismic diagnosis on an existing building, assess the seismic performance and the building characteristics, find a retrofitting target, and then select a construction method more suitable for their construction environment.

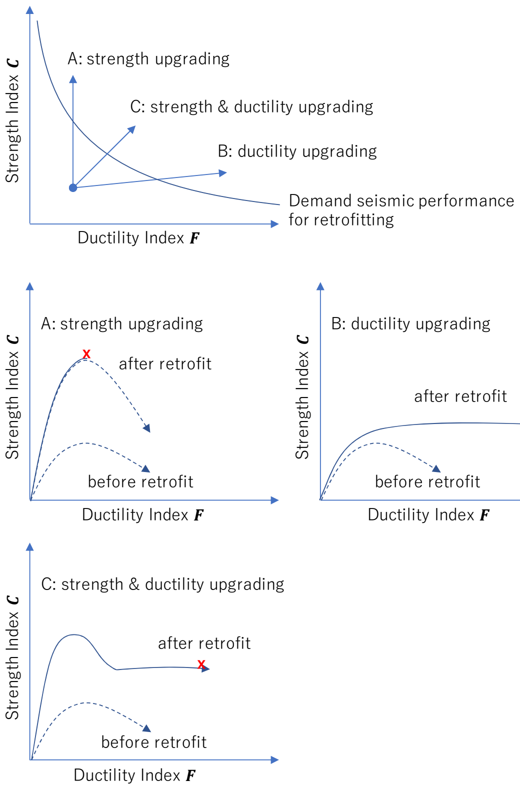


Fig. 15. *Concept of seismic retrofit*

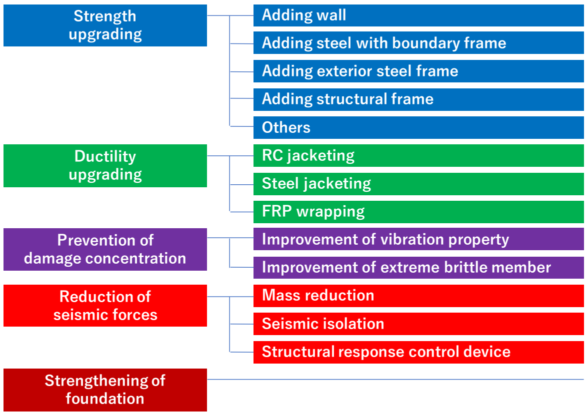


Fig. 16. *Classification of seismic upgrading method*

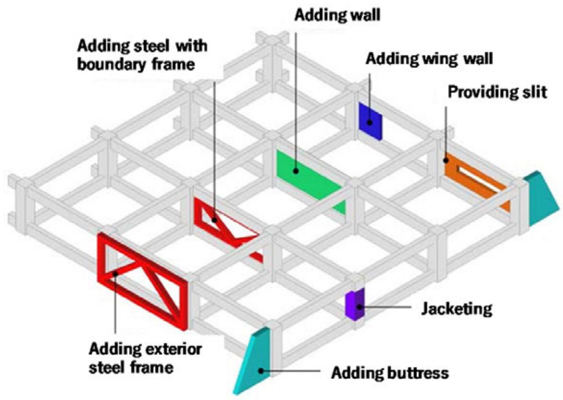


Fig. 17. *Overview of seismic upgrading*

REFERENCES

[1] Shigenori Kita, Sei'ichiro Fukushima, "Seismic diagnosis and formulation of reinforcement design standartds for masonry buidings in Mongolia", 16th European Conference on Earthquake Engineering, 18-21 June, 2018, Thessaloniki, Greece.

[2] Saruul Dorjpalam, Hiroshi Kawase, Narenmandula HO, "Earthquake disaster simulation for Ulaanbaatar, Mongolia based on the field survey and numerical modeling of masonry buildings.", 13th World Conference on Earthquake Engineering, 1-6 August, 2004, Vancouver, B.C., Canada.

[3] BD31-102-00: Instruction for assessing earthquake resistance rate of existing building, the public institution, Construction Development Center, 2000, Mongolia.

[4] BNBD 22-01-01: Design standards and regulations of buildings in areas where seismic activity is active, the public institution, Construction Development Center, 2006, Mongolia.

[5] BNBD 51-02-05: Masonry structures, the public institution, Construction Development Center, 2005, Mongolia.

[6] Guidelines for seismic evaluation of existing brick masonry buildings 2nd ed, 2015, Hokkaido Building Technical Association, Japan.

[7] Guidelines for seismic evaluation of existing precast panel buildings, 2005, The Japan Building Disaster Prevention Association, Japan.

[8] Standard for seismic evaluation of existing reinforced concrete buildings, 2001, guidelines for seismic retrofit of existing reinforced concrete buildings, 2001, and Technical manual for seismic evaluation and seismic retrofit of existing reinforced concrete buildings, 2001, The Japan Building Disaster Prevention Association, Japan.

XXX-X-XXXX-XXXX-X/XX/$XX.00 ©20XX 7ACEE

4-4 Development of Seismic Evaluation and Retrofit Standards for Existing Buildings in Mongolia, International Science Conference on Strengthening Urban Disaster Resilience in Mongolia, 2019

Development of Seismic Evaluation and Retrofit Standards for Existing Buildings in Mongolia

Seiichiro Fukushima[1)], Kiyotaka Owada[2)], Masahide Aoki[3)], Hideto Omine[3)], Shigenori Kita[3)], Odbayar Dorjhand[4)], Ganbayar Bayasgalan[5)]

1) Team leader of JICA project, PhD (Eng.)
2) Project manager of JICA project, M.Sc., M.Eng.
3) Project member of JICA project, M.Eng.
4) National Staff of JICA project, B.Eng.
5) National Staff of JICA project, M.Eng.

Abstract:

Along with more than three active faults recently found near Ulaanbaatar, the capital city in Mongolia, an increasing number of felt and unfelt earthquakes are causing deep concern regarding seismic risk. Since many of the buildings in the country are old and deteriorated, their current seismic performance is unknown or its assessment considerably worse compared to the situation when they were constructed, therefore prompt actions such as seismic evalauation and follow-up seismic retrofit are highly required. In Mongolia the existing structural evaluation standards against seismic risk are focused on building deterioration, and there is no provision for seismic evaluation and retrofit so far. This paper introduces the development of seismic evaluation and retrofit standards for three typical structures, namely, reinforced concrete buildings, precast concrete panel buildings, and brick masonry buildings. To develop Mongolian standards, we applied current Japanese standards with some modifications due to Mongolian practicality, which will surely encourage a wide propagation. Thus, we conducted trial seismic diagnosis to verify the adequacy of methodology, concluding that the newly standards can properly evaluate the seismic performance of existing buildings. This present work is supported by Japan International Cooperation Agency (JICA) as part of “The Project for Strengthening the National Capacity of Earthquake Disaster Protection and Prevention in Mongolia”.

Keywords; Seismic risk, Seismic Evaluation, Retrofit, Japan International Cooperation Agency

1. Introduction

In recent years, three active faults (Hustai fault, Emeelt fault and Gunjiin fault) were identified near the capital city, where half of the total population (about 3 million people) is located. In addition to the fault above, it is said that new fault was identified close to the Ulaanbaatar city. Furthermore, felt and unfelt earthquakes are increasing in Ulaanbaatar city, so that concerns about seismic risk have risen.

Reflecting above situation, intensity of ground motion for seismic design have been revised and increased through Mongolia, so seismic capacity of many of existing buildings cannot conform to new standard meaning that thaey are disqualified ones. Another cause of disqualification is the illegal renovation of buildings after the democratization of 1991.

There are two ways to reduce disqualified buildings to realize safer city; one is reconstruction and the other is evaluation and retrofit. The former is time and cost consuming though it is the fundamental solution, the latter is insisted as a realistic solution. This paper introduces the newly established standards for seismic evaluation and retrofit. It is noted that two types of buildings, masonry buildings and precast concrete panel buildings are of concern in this paper, since many of these buildings are relatively old. Appearance of these buildings are shown in Fig. 1.

Figure 1 Appearance of typical apartment buildings

2. Characteristics of Buildings in Mongolia

2.1 Masonry buildings

In Mongolia many masonry buildings have been built since 1950s and still been under construction. One of their characteristics is a brick exterior wall of 64 cm thick, thicker than ones in other regions due to the necessity of good thermal insulation performance for the severe winter.

Kawase et al. (2004) has pointed out the problems of seismic performance in existing buildings in Mongolia. As a matter of fact, in Ulaanbaatar there are several masonry buildings that had removed the earthquake-resistant walls to convert the first floor into a store (See Fig. 2). This was done by the residents themselves after the transition to market economy in 1991, and the application for business had been submitted to the government office, but it seems that the application for building modifying such as removing walls had not been included in the submission form. Since the first floor is the most important on earthquake resistance, the current situation that the walls of this floor have been removed without structural consulting is very dangerous.

And many masonry building floors are wooden as shown in Fig.3. Since wooden floor has considerably lower rigidity than masonry walls, it cannot play a role as an appropriate diaphragm. In fact, some reports have concluded that wooden floor buildings should be rebuilt unconditionally due to their poor performance.

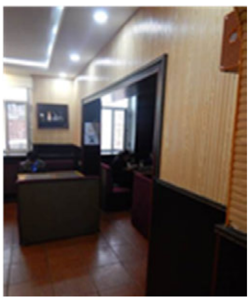


Figure 2 Masonry building where walls were removed for use as a store

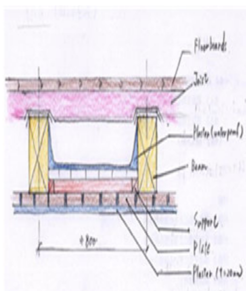


Figure 3 Typical wooden floor in Mongolia

Another is that there is a brick wall which is not connected horizontally with a floor and a roof slab. A three-story building shown in Fig.4 shows that the bonding force between wooden floor and wall is not strong enough and also the roof is disconnected with the wall. This may cause an out-of-plane destruction as shown in Fig.5 due to the wall's low resistance against seismic force.

Figure 4 Out-of-plane direction vulnerable building in Mongolia

Figure 5 Out-of-plane destruction in other country

2.2 Precast concrete panel buildings

The precast concrete panel buildings in Mongolia had a standard drawing in each 5-, 9-, and 12-story building, and each building was constructed following each standard respectively. Checking the original drawing of 9-story building (Fig. 6), we find that rooms are arranged to exterior side remaining a middle through corridor. Therefore, the wall position of X direction is set with two exterior walls and two inner walls: as for the exterior has a large opening window and the inner a large door opening. Y direction has more walls as partition of the standard span of 3.6 m. The inner wall is 14-16 cm thick of precast concrete panel and the exterior wall is a panel format sandwiched with an insulation layer, whose standard is 30 cm thick.

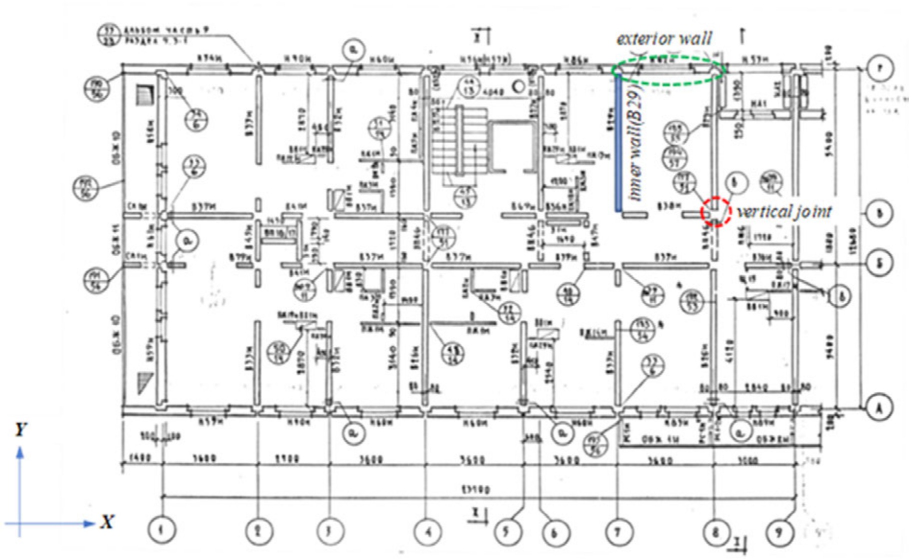


Figure 6 Framing plan of typical 9-story precast concrete panel building

As for the reinforcement arrangement, for example, the inner wall B29 is doubly arranged, the vertical reinforcement is of ϕ5-400 mm pitch, and the horizontal one is of ϕ4-400 mm pitch (Fig. 7) . The horizontal joint part has 2 or 3 cotter parts in each panel installed with ϕ12 horizontal joint reinforcement. Those are welded at the building site before being filled with cast-in-situ concrete.

The vertical joint part is welded with the vertical joint bar and anchor bar overlaid and filled with cast-in-situ concrete. The surface of a wall side jagged also have a connecting effect (Fig. 8).

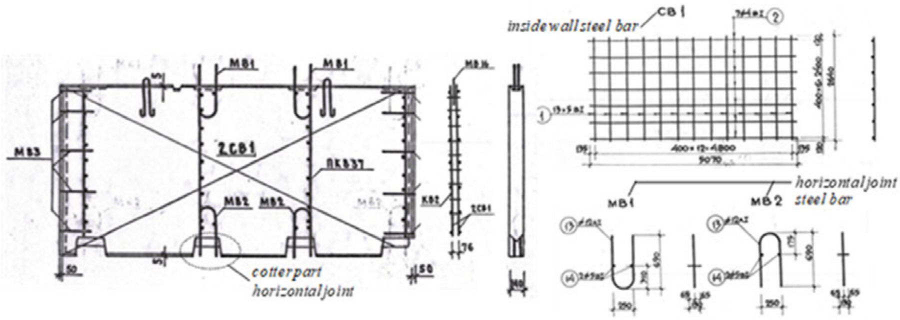


Figure 7 Example of arrangement of reinforcement

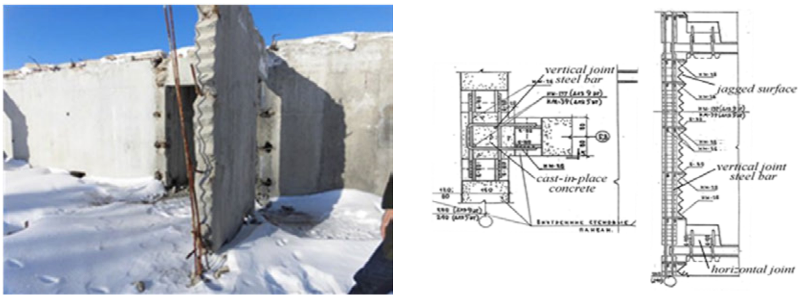


Figure 8 Detail of vertical joint

3. Development of Standards

3.1 Background of development

Under such circumstances, it is urgent to conduct seismic evaluation of existing buildings and retrofit them if necessary. Though, the instructions related to earthquake resistance assessment provided by the national Construction Development Center (“BD31-102-00”, 2000), that are currently used in Mongolia, correspond to instructions for deterioration diagnosis which is not directly related to earthquake resistance evaluation. Then, in 2013, the National Emergency Management Agency (NEMA), of the central government of Mongolia, submitted the formal aid request to the Japanese Government with the aim of improving the disaster prevention capability against earthquakes in Mongolia. The project started in 2016 after an agreement between both parties . Among the request’s contents, this paper will explain the creation of seismic diagnosis and reinforcement design standards for existing RC/PC/Masonry buildings. These standards were currently approved by Ministry of Construction and Urban Development.

3.2 Features of standard developed

a) Seismic performance of existing buildings using continuous numerical values

The reason for an index evaluation based on the continuous numerical value is not only to judge whether a certain criterion is satisfied but also to confirm at what degree the performance is insufficient. Thus, it will be an index to judge whether to retrofit or rebuild. Currently, the judgement to whether perform seismic reinforcement or rebuilding is done solely by the owner. The index will contribute to the decision making of the owner by showing the necessity and to what extent the retrofit is needed.

b) Simple evaluation method

The simple method responds to an urgent need for seismic evaluation. It is not feasible to conduct seismic evaluation of many building with only a limited number of engineers in Mongolia.

Therefore, by adopting a simple method, it becomes possible for a lot of people who are not engineers to perform an evaluation, even if accuracy is slightly sacrificed; making it possible to respond to the urgency. For the realistic method, we consider that commercially available spreadsheet software can be used to obtain diagnostic results.

c) Suitable actual situation of Mongolia

In order to develop the evaluation method according to the actual situation of Mongolia, the required performance level in the seismic diagnosis shall not deviate from the seismic performance level of the newly built buildings currently adopted in the country. When preparing the diagnostic criteria, we will refer to the standards of other countries, but if it adopted as it is, it might be a higher seismic performance than the new buildings in Mongolia. Then, it is necessary to determine the required performance level while maintaining the balance with the current building standard of Mongolia. Regarding the reinforcement method, from among various existing methods currently being proposed and implemented, it is necessary to propose an appropriate method in accordance to the Mongolian country's building technology, available materials, etc.

4. Outline of Seismic Evaluation

4.1 Concept of evaluation

The method of seismic evaluation is based on the Japanese retrofit standard, in which reverse procedure of seismic design is employed as shown in Fig.9. The upper procedure corresponds to the seismic design and the lower procedure is for seismic diagnosis. Seismic design checks if member strength is larger than member force for given earthquake intensity and on the contrary seismic evaluation checks if earthquake intensity by which the element reaches the limit state is larger than reference intensity.

It is noted that the items between two procedures are also employed in current Mongolian standard, so that this seismic evaluation method can easily be applied to buildings designed by Mongolian standard.

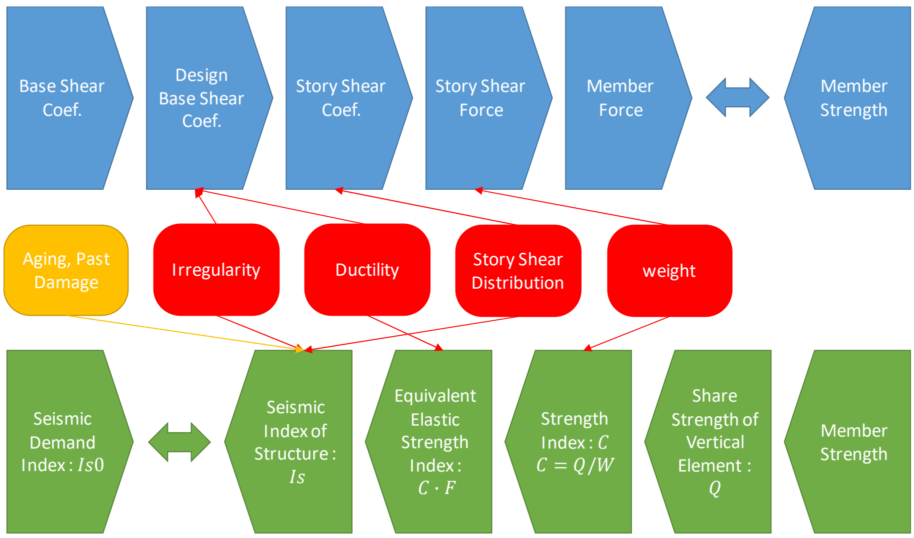


Figure 9 Concept of Seismic Evaluation

4.2 Judgement of earthquake resistance performance

The judgment of the earthquake resistance performance of the building is based on equation (1)

$$I_S \geqq I_{S0} \tag{1}$$

I_S is an index representing the seismic performance of structure and I_{S0} is a seismic demand index required for a building to be safe. Table 1 shows the risk of building based on the values.

Table 1 Concept of risk of buildings based on I_S value

Degree of I_S	Description of Risk
$I_{S0} \leq I_S$	Low risk of collapse
$0.5 \times I_{S0} \leq I_S < I_{S0}$	Medium risk of collapse
$I_S < 0.5 \times I_{S0}$	High risk of collapse

4.3 Seismic demand index

As seismic demand index I_{S0}, the "A" value in Mongolian standard "BNBD 22-01-01* (2006)" is employed, since the value is familiar to relevant officers and engineers in Mongolia. It is noted that the seismic evaluation judges if the building has the strength as same as new buildings.

4.4 Seismic index of structure

Seismic index of structure I_s is given by equation (2).

$$I_S = \frac{Q_{ui} \cdot F_i}{W_i} \cdot \frac{n+1}{n+i} \cdot T \cdot S_D \cdot \frac{1}{\beta} \tag{2}$$

- Q_{ui} ultimate story shear strength of i^{th} story
- F_i ductility index of i^{th} story, representing the effect of deformation capacity of structure
- W_i sum of building weight of i^{th} story and higher
- T time index, representing the effect of deterioration
- S_D irregularity index, representing the effect of irregular shape of building in plan and elevation
- $\frac{n+1}{n+i}$ story shear modification factor, by which story shear is converted to base shear
- $\frac{1}{\beta}$ reciprocal of spectral amplification, by which base shear converted to peak ground acceleration

a) Seismic performance of existing buildings using continuous numerical values

The ultimate story shear strength of brick masonry seismic walls Q_u is calculated by equation (3).

$$Q_u = \alpha \cdot A_w \cdot (\tau_w + 0.56\,\sigma_0) \tag{3}$$

- A_w horizontal cross-sectional area of wall
- τ_w allowable shear stress of wall
- σ_0 vertical stress of wall
- α coefficient based on the ratio of height and width

b) Ultimate story shear strength of precast concrete panel buildings

The ultimate story shear strength of precast concrete panel Q_u is calculated by equation (4).

$$Q_u = min(Q_{su}, Q_{hu}, Q_{mu}) \tag{4}$$

Q_{su} ultimate shear strength of panel
Q_{hu} shear at the rapture of joint
Q_{mu} shear at the ultimate flexural failure of panel

5. Outline of Seismic Retrofit

5.1 Concept of retrofit

Seismic retrofit will be required in case that a seismic evaluation judges the building of concern is risky and still in use. Since seismic performance is evaluated from the viewpoint of strength and ductility, the method of seismic retrofit is categorized into improvement of strength or ductility, or the both after due consideration of the characteristics on existing buildings. Figure 10 shows how seismic performance is improved by conducting seismic retrofit fitting on each purpose.

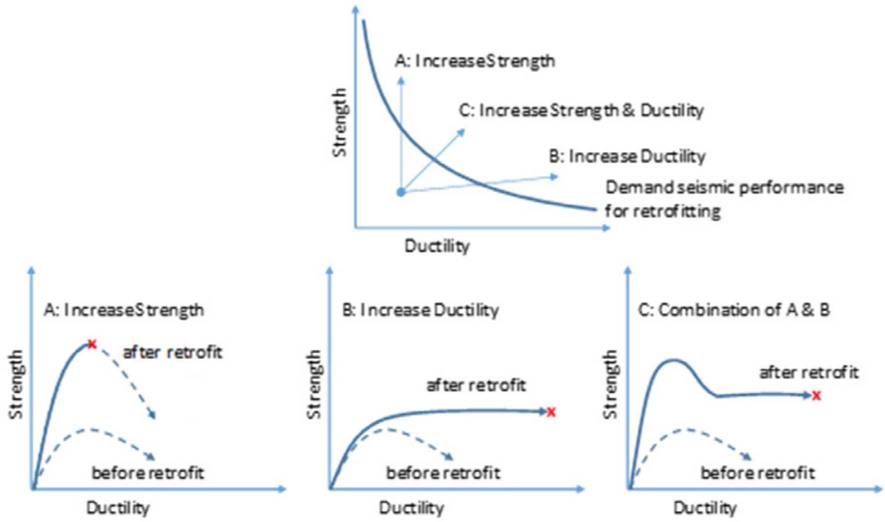


Fig. 10 Concept of seismic retrofit

The retrofit methods including ones corresponding to the concept described above are classified according to each purpose: for instance, Fig. 11 shows a categorization of retrofit methods.

5.2 Examples of retrofit

Figs. 12 to 14 show examples of retrofit construction.

Fig. 11 Categorization of seismic retrofit methods

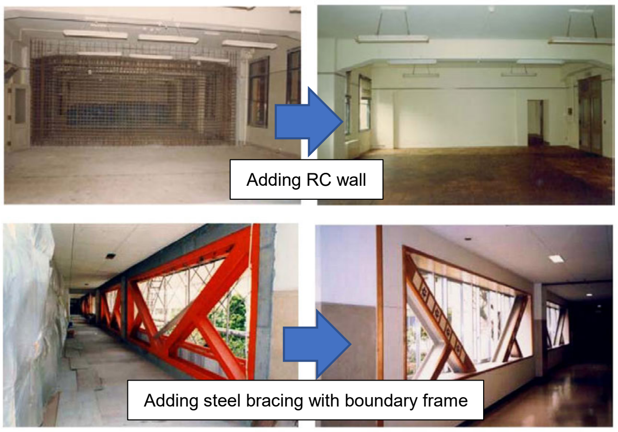


Fig. 12 Example of seismic retrofit method (increase strength)

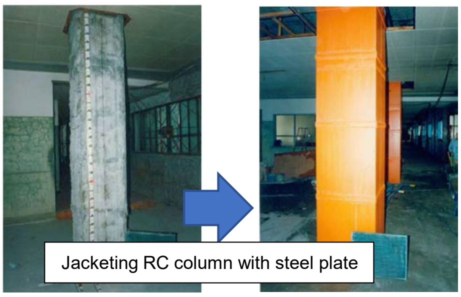


Fig. 13 Example of seismic retrofit method (increase ductility)

1. Make gap between column and wall

2. Size of gap is 3-5 cm

3. Waterproof sealing after providing fire resistance material

4. Painting for finishing

(http://taishinsekkei.com/info/taishinhokyo-slit/)

Fig. 14 Example of seismic retrofit method (prevent damage concentration)

6. Dissemination of Technology

In order to disseminate the technology, three training courses regarding to seismic evaluation, nondestructive testing and seismic retrofitting were held. Moreover training of trainers have been conducted to candidates of trainers in relevant organizations such as NEMA, MCUD, GASI, UBUDA and others as well as ones in private companies.

It is noted that Mongolian Association of Civil Engineers decided to include the training course of seismic evaluation and retrofitting in their program giving the trainees motivation to attend, so that continuous technology transfer will hopefuly be achieved.

7. Conclusion

This paper introduces the newly established standards for seismic evaluation and retrofit of existing buildings. Safer city against future earthquakes will be realised by desseminating the technology throughout Mongolia.

Acknouledgement

Authors express the great thanks to NEMA, JICA and relevent organizations for their collabolation in establishment of guidelines.

References

[1] BD31-102-00: Instruction for assessing earthquake resistance rate of existing building, the public institution, Construction Development Center, 2000, Mongolia.

[2] BNBD 22-01-01: Design standards and regulations of buildings in areas where seismic activity is active, the public institution, Construction Development Center, 2006, Mongolia.

[3] BNBD 51-02-05: Masonry structures, the public institution, Construction Development Center, 2005, Mongolia.

[4] Dorjpalam S., Kawase H., Ho N., “Earthquake disaster simulation for Ulaanbaatar, Mongolia based on the field survey and numerical modeling of masonry buildings.”, 13th World Conference on Earthquake Engineering, 1-6 August, 2004, Vancouver, B.C., Canada.

[5] Guidelines for seismic evaluation of existing brick masonry buildings 2nd ed, 2015, Hokkaido Building Technical Association, Japan.

[6] Guidelines for seismic evaluation of existing precast panel buildings, 2005, The Japan Building Disaster Prevention Association, Japan.

[7] Kita S., Fukushima S., “Seismic diagnosis and formulation of reinforcement design standards for masonry buildings in Mongolia”, 16th European Conference on Earthquake Engineering, 18-21 June, 2018, Thessaloniki, Greece.

[8] Omine H., Fukushima S., Owada K.: Development of seismic diagnosis and retrofitting standards for existing buildings in Mongolia, 7th ACEE, Paper No.0066, 2018.11

[9] Standard for seismic evaluation of existing reinforced concrete buildings, 2001, guidelines for seismic retrofit of existing reinforced concrete buildings, 2001, and Technical manual for seismic evaluation and seismic retrofit of existing reinforced concrete buildings, 2001, The Japan Building Disaster Prevention Association, Japan.