

Chapter 2 Implementation Process and Results of Seismic Hazard Assessment and Seismic Risk Assessment

2.1 Information of selected bridges for static and dynamic analysis

2.1.1 Survey of Existing Structure

The objective survey structure is bridge. Ahead of this project, JICA project “The Project for Construction of Ajilchin Flyover in Ulaanbaatar City” completed a similar survey and kindly provided their results, such as, survey sheets, design drawings as well as concrete strength test results, etc, which were used here as the basic information for bridge inventory and risk assessment. Static and dynamic analysis for a total of eight bridges were performed for the purpose of risk assessment. The eight bridges, shown in Table 2.1.1, were selected in consultation with the road department from those whose design drawings were available. Field survey for the selected bridges was carried out, where the design drawings, bearing and deterioration were confirmed. The detailed information of the selected bridges were summarized in Table 2.1.2.

Table 2.1.1 Bridges for static and dynamic analysis

Bridge No.	Name of bridge	Length (m)	Construction year
4	Arslantai Bridge	34.2	1962
5	Uliastai tsaad Bridge - Left	96.2	1967
18	Dund gol Deed Bridge	50.2	1975
19	Ikh Tenger Bridge	258.0	1994
24	Songolon Bridge	289.4	1971
26	Poultry farm Bridge	256.0	1989
34	Sharga Morit Bridge	50.4	1982
56	Uliastai tsaad Bridge - Right	96.2	2010

Table 2.1.2 Information of selected bridges for static and dynamic analysis













Bridge No. 04		Name : Arslantai Bridge	
Information		Picture	
Location	47.91825 106.92967		
Girder type	Simple		
Superstructure mat.	RC		
No. of Span	3		
Length (m)	34.20		
Width (m)	24.70		
Pier height (m)	2.40		
Construction year	1962		
Date of inspection	2012.5.1		
Falling prevention	No		
Support length (cm)	45		
Foundation			
Ground Classification	II		
Falling assessment	4		
Substructure mat.	RC		
Strength (N/mm2) (Super)	23.9		
Strength (N/mm2) (Sub)	32.7		
Sound Assessment	(ABC) A : G⇔C : B		
Seismic Assessment	(ABC) A : G⇔C : B		
			
		Girder	Bearing
Deterioration remarks			
<ul style="list-style-type: none"> • Constructed in 1962 and used for 50 years. • Exposure of reinforcing bar in the end of main girder. • Maximum of 15mm cracks in pier and abutment. 		<ul style="list-style-type: none"> • Exposure of reinforcing bar and detachment in pier. 	
Bridge No. 05		Name : Uliastai tsaad Bridge /Left/	
Parameter		Picture	
Location	47.90189 107.03037		
Girder type	Simple		
Superstructure mat.	RC		
No. of Span	4		
Length (m)	96.20		
Width (m)	10.00		
Pier height (m)	1.80		
Construction year	1967		
Date of inspection	2012.5.7		
Falling prevention	No		
Support length (cm)	71		
Foundation			
Ground Classification	II		
Falling assessment	4		
Substructure mat.	RC		
Strength (N/mm2) (Super)	32.7		
Strength (N/mm2) (Sub)	32.7		
Sound Assessment	(ABC) A : G⇔C : B		
Seismic Assessment	(ABC) A : G⇔C : B		
			
		Girder	Bearing
Deterioration Deterioration remarks			
<ul style="list-style-type: none"> • Constructed in 1962 and used for 45 years. 		<input type="checkbox"/>	

Table 2.1.2 Information of selected bridges for static and dynamic analysis (Cont.)

Bridge No. 18		Name : Dund gol Deed Bridge	
Information		Picture	
Location	47.90632	 <p>Top view</p>	 <p>Side view</p>
	106.92743		
Girder type	Simple		
Superstructure mat.	RC		
No. of Span	3		
Length (m)	50.20		
Width (m)	12.80		
Pier height (m)	3.50		
Construction year	1975		
Date of inspection	2012.4.28		
Falling prevention	No	 <p>Girder</p>	 <p>Bearing</p>
Support length (cm)	61		
Foundation			
Ground Classification	II		
Falling assessment	4		
Substructure mat.	RC		
Strength (N/mm2) (Super)	27.1		
Strength (N/mm2) (Sub)	23.1		
Sound Assessment	(ABC) A:G⇔C:B		
Seismic Assessment	(ABC) A:G⇔C:B		
		Deterioration Deterioration remarks	
<ul style="list-style-type: none"> • Constructed in 1989 and used for 37 years. • Free lime in interfilling slab. • Exposure of reinforcing bar in main girder. 		<ul style="list-style-type: none"> • Deformation in roadside barrier. • Exposure of reinforcing bar in wheel guard. • Out of alignment in bearing location. 	





Bridge No. 19		Name : Ikh Tenger Bridge	
Information		Picture	
Location	47.8873	 <p>Top view</p>	 <p>Side view</p>
	106.9395		
Girder type	Simple		
Superstructure mat.	RC		
No. of Span	12		
Length (m)	258.00		
Width (m)	15.50		
Pier height (m)	6.90		
Construction year	1994		
Date of inspection	2012.4.27		
Falling prevention	No	 <p>Girder</p>	 <p>Bearing</p>
Support length (cm)	89		
Foundation			
Ground Classification	II		
Falling assessment	5		
Substructure mat.	RC		
Strength (N/mm2) (Super)	30.3		
Strength (N/mm2) (Sub)	29.5		
Sound Assessment	(ABC) A:G⇔C:B		
Seismic Assessment	(ABC) A:G⇔C:B		
		Deterioration Deterioration remarks	
<ul style="list-style-type: none"> • Constructed in 1989 and used for 18 years. • Free lime in floor slab. • Slight damage in roadside barrier. 		<ul style="list-style-type: none"> • Bumpy of road near expansion apparatus. • Free lime in roadside wall. 	

Table 2.1.2 Information of selected bridges for static and dynamic analysis (Cont.)

















Bridge No. 24		Name : Sonsgolon Bridge	
Information		Picture	
Location	47.87426 106.78426		
Girder type	Simple		
Superstructure mat.	RC		
No. of Span	13		
Length (m)	289.40		
Width (m)	10.40		
Pier height (m)	5.70		
Construction year	1971		
Date of inspection	2012.4.30		
Falling prevention	No		
Support length (cm)	71		
Foundation			
Ground Classification	II		
Falling assessment	5		
Substructure mat.	RC		
Strength (N/mm2) (Super)	35.9		
Strength (N/mm2) (Sub)	29.5		
Sound Assessment	A(BC) A:G⇔C:B		
Seismic Assessment	A(BC) A:G⇔C:B		
		Top view	Side view
			
		Girder	Bearing
		Deterioration Deterioration remarks	
<ul style="list-style-type: none"> • Constructed in 1971 and used for 41 years. • Detachment and free lime in interfilling slab. • Exposure of reinforcing bar in main girder. • Exposure of reinforcing bar in wheel guard. 		<ul style="list-style-type: none"> • Pier and foundation scouring • Out of alignment in bearing location. 	
Bridge No. 26		Name : Poultry farm Bridge	
Information		Picture	
Location	47.80509 106.61619		
Girder type	Simple		
Superstructure mat.	RC		
No. of Span	14		
Length (m)	256.00		
Width (m)	10.70		
Pier height (m)	2.70		
Construction year	1989		
Date of inspection	2012.5.19		
Falling prevention	No		
Support length (cm)	55		
Foundation			
Ground Classification	II		
Falling assessment	4		
Substructure mat.	RC		
Strength (N/mm2) (Super)	32.7		
Strength (N/mm2) (Sub)	31.1		
Sound Assessment	A(BC) A:G⇔C:B		
Seismic Assessment	A(BC) A:G⇔C:B		
		Top view	Side view
			
		Girder	Bearing
		Deterioration Deterioration remarks	
<ul style="list-style-type: none"> • Constructed in 1989 and used for 23 years. • Exposure of reinforcing bar and free lime in interfilling slab. • Exposure of reinforcing bar and cracks in main girder. 		<ul style="list-style-type: none"> • Cracks in pavement. • Bumpy of road near expansion apparatus. • Out of alignment in bearing location. 	

Table 2.1.2 Information of selected bridges for static and dynamic analysis (Cont.)

Bridge No. 34		Name : Sharga Morit Bridge	
Information		Picture	
Location	48.05009		
	106.9025		
Girder type	Simple		
Superstructure mat.	RC		
No. of Span	3		
Length (m)	50.40		
Width (m)	9.20		
Pier height (m)	3.50		
Construction year	1982		
Date of inspection	2012.5.16		
Falling prevention	No		
Support length (cm)	57		
Foundation			
Ground Classification	II		
Falling assessment	4		
Substructure mat.	RC		
Strength (N/mm2) (Super)	26.3		
Strength (N/mm2) (Sub)	21.5		
Sound Assessment	ABC A:G⇔C:B		
Seismic Assessment	ABC A:G⇔C:B		
		Girder	Bearing
Deterioration remarks			
<ul style="list-style-type: none"> • Constructed in 1989 and used for 18 years. • Exposure of free lime in interfilling slab. • Exposure of reinforcing bar in main girder. • 0.3mm cracks in main girder. 		<ul style="list-style-type: none"> • Cracks in pavement. • Bumpy of road near expansion apparatus. • Pier scouring. 	
Bridge No. 56		Name : Uliastai tsaad Bridge - Right	
Information		Picture	
Location	47.90179		
	107.0303		
Girder type	Simple		
Superstructure mat.	RC		
No. of Span	2		
Length (m)	24.00		
Width (m)	12.00		
Pier height (m)	1.75		
Construction year	2000		
Date of inspection	2012.5.8		
Falling prevention	No		
Support length (cm)	50		
Foundation			
Ground Classification	II		
Falling assessment	4		
Substructure mat.	RC		
Strength (N/mm2) (Super)	27.1		
Strength (N/mm2) (Sub)	23.9		
Sound Assessment	ABC A:G⇔C:B		
Seismic Assessment	ABC A:G⇔C:B		
		Girder	Bearing
Deterioration remarks			
<ul style="list-style-type: none"> • Constructed in 1989 and used for 18 years. • Honeycomb in floor slab. • Slight damage in roadside barrier. • Bumpy of road. 		□	

2.2 Inventory of Transportation and Lifeline Structures

The inventory of transportation and lifeline structures covers road, bridge, water supply, sewerage, power and hot water pipeline. The inventory was made basically from the data provided by UB city. In the case of road and pipeline, the inventory was arranged according to district and khoroo.

(1) Road

The road inventory summarized the road length in each district and khoroo. which is shown in Table 2.2.1.

(2) Bridge

The bridge inventory was created based on the data from “the project for construction of Ajilchin flyover in Ulaanbaatar city”, having the content of bridge name, location (longitude, latitude), road name, length, width, pier height, number of span, girder type, superstructure material, substructure material, girder falling-off prevention, girder support length, ground classification and construction year. The inventory is shown in Table 2.2.2.

(3) Water supply

The water supply inventory has two parts: water supply reservoir and distribution pipeline. The entries for the reservoir are name, location (address, longitude, latitude), capacity, construction year and supply area, while that for the pipeline are pipe material, diameter and length. The inventory for the reservoir and pipeline are shown in Table 2.2.3 and Table 2.2.4, respectively.

(4) Sewerage

The inventory of sewerage is for pipeline and has the entries of pipe material, diameter and length, which is shown in Table 2.2.5.

(5) Power

The inventory of power includes power plant and substation. The inventory has the information of name, location (address, longitude, latitude), capacity, construction year and service area, shown in Table 2.2.6.

(6) Hot water pipeline

Hot water pipeline has two types: over ground (82%) and underground (18%). The inventory of hot water pipeline was created only for underground part because the data for over ground was not available. The contents of the inventory (shown in Table 2.2.7) are pipe material, diameter and length.

Table 2.2.1 Road inventory

Khoroo	Road Length (m)					
	Chingeltei	Bayangol	Songino khairkhan	Khan-uul	Sukhbaatar	Bayanzurkh
1	6,711	7,279	17,088	5,577	12,567	7,765
2	3,280	5,468	1,072	4,426	3,248	2,008
3	2,655	8,169	1,514	13,454	6,223	5,158
4	4,563	7,891	1,672	9,584	4,438	8,715
5	4,198	6,032	4,725	981	3,624	6,908
6	2,839	3,143	3,426	1,680	7,808	3,832
7	2,997	5,386	2,249	1,212	4,411	4,032
8	1,156	4,926	1,449	14,951	7,313	6,911
9	1,964	2,256	2,330	1,127	3,562	271
10	2,594	1,377	505	10,723	3,671	5,107
11	2,223	7,122	2,534	12,398	3,758	19,460
12	693	2,655	3,092	8,158	548	4,202
13	1,838	3,303	3,535	8,972	1,634	4,124
14	1,672	3,018	3,234	4,587	2,385	6,201
15	1,592	3,010	3,601	16,312	1,183	3,112
16	2,158	5,827	3,163	4,361	6,238	6,958
17	6,241	8,500	2,734		3,068	1,883
18	2,981	4,050	5,363		4,144	4,459
19	27,135	4,833	4,429		31,472	2,682
20		24,836	15,107		12,758	10,545
21		2,400	0			1,557
22		1,207	9,389			8,225
23		2,782	0			9,272
24			0			2,022
25			2,470			2,695
26			2,228			4,697
27			1,998			1,698
28			1,787			5,380
29			4,298			
30			0			
31			0			
32			20,204			
Sub-total	79,490	125,470	125,196	118,503	124,053	149,879
Total						722,591

Table 2.2.2 Bridge inventory

No.	Name	Location		Name of Road	Length (m)	Width (m)	Const. Year
		Longitude	Latitude				
4	Arslantai Bridge	106.92967	47.91825	Peace avenue	34.2	24.7	1962
5	Uliastai tsaad Bridge /Left/	107.03037	47.90189	for inspection gate road	96.2	10.0	1967
6	Uliastai tsaad Bridge	107.03872	47.89936	for inspection gate road	6.0	9.0	1985
7	Uliastai tsaad Bridge	107.05193	47.89576	for inspection gate road	17.5	9.0	1963
8	Bridge over the Hol river	107.07988	47.88683	for Nalaikh-inspection gate road	20.4	11.0	1963
9	Chuluut am Bridge	107.11819	47.86513	for Nalaikh road	11.0	11.0	1963
10	Bayanzurkh Bridge	107.06506	47.89389	for inspection gate road	252.6	11.8	1967 1987
11	Zaisan West am Bridge	106.91475	47.88716	Back side road for Bogd-uul	18.0	8.4	1971
12	Bridge in front of the 14th khoroo	106.96167	47.90788	Narii road	2.6	24.6	1963
13	Enkhtaivan Bridge Rehabilitation for Enkhtaiwan's bridge	106.91237	47.90637	Chingis avenue	339.5	16.8	1961 1980
14	Yarmag Bridge	106.86387	47.88731	Chingis avenue	259.4	12.4	1961, 1987
15	Yarmag Bridge to Airport	106.82621	47.86992	for Niseh road	9.6	11.0	1961
16	Tolgoit Parallel Bridge	106.83044	47.91104	Moscow street	36.0	17.2×2	1987
17	Selbe dund Bridge	106.93258	47.90815	Narii road	51.0	24.1	2002
18	Dund gol Deed Bridge	106.92743	47.90632	Olimpic street	50.2	12.8	1975
19	Ikh Tenger Bridge	106.93950	47.88730	In the Great Mongolia empire street	258.0	15.5	1994
20	Ikh Tenger dwon stream Bridge	106.93114	47.88588	Back side road for Bogd-uul	12.0	8.1	1979
21	Zaisan Bridge	106.90992	47.88980	For Zaisan road	224.0	12.3	1971
23	Dund gol Dood Bridge	106.85639	47.90319	Ajlchin street	67.0	12.9	1975
24	Songolon Bridge Rehavilitation	106.78426	47.87426	for Songolon road	289.4	10.4	1971 2007
25-1	Turgen river Bridge-1	106.74635	47.76653	Shuvuunii road	40.0	13.5	1987
25-2	Turgen river Bridge-2 (closed to traffic)	106.62936	47.79514	Shuvuunii road	36.0	13.3	
26	Poultry farm Bridge	106.61619	47.80509	north direction for Bio road	256.0	10.7	1989
27	Gurvaljin Bridge	106.85494	47.90843	Ajlchin street	108.0	28.5	1989
28	Naran Bridge	106.81021	47.92119	Tolgoit street	36.3	13.5	1986
29	Bridge behind of Meat Factory	106.79740	47.92035	Tolgoit street	54.0	13.5	1986
30	Nairamdal Bridge	106.73179	47.92892	for Nairamdal road	16.6	8.0	1986
31	Rashaant Bridge	106.91808	48.01495	UB-Darkhan road	12.0	10.0	1991
32	Khailaast Bridge	106.91391	47.94956	Chingis avenue	18.1	25.3	1987
33	Chingeltei Bridge	106.91738	47.96698	Chingis avenue	18.0	24.0	1987
34	Sharga Morit Bridge	106.90250	48.05009	For east sode of summer residence road	50.4	9.2	1982
35	Selbe gol Deed Parallel Bridge -1	106.93177	47.92954	Out side ring road /South/	45.5	10.5	1963
36	Selbe gol Deed Parallel Bridge -2	106.93180	47.92963	Outside ring road /North/	45.5	10.5	1982
37	Bridge for behind of Chinggis hotel	106.93177	47.92332	Beijing street	34.2	16.0	1990
38	Dambadarjaa Bridge	106.92600	47.97711	Dambadarjaa road	60.0	11.0	1995
39	Dambadarjaa naad Bridge	106.93884	47.97875	for Darie-eh road at the Belkh river	24.0	13.8	1990
40	Gachuurt Bridge	107.05412	47.91515	for Gachuurt road	30.0	9.0	1984
41	Gachuurt Bridge	107.04730	47.91324	for Gachuurt road	18.0	10.3	1984
43	Nalaikh Bridge	107.23254	47.77638		27.0	9.6	
44	Zaisan East Bridge	106.92203	47.88625	Back side road for Bogd-uul	12.0	8.2	1973

No.	Name	Location		Name of Road	Length (m)	Width (m)	Const. Year
		Longitude	Latitude				
45	Milk factory Bridge	106.81838	47.91498	-	15.8	23.8	1996
46	Baruun-uul Dithc Bridge	106.82996	47.89785	-	27.7	25.2	1986
47	Bridge over the ditch west behind the 1st khoroolol	106.84267	47.91756	-	9.2	10.7	2007
48	Bridge to Khandgait-Sanzai	106.90237	48.11295	-	9.0	11.0	2004
49	South Bridge to Khandgait-Sanzai	106.90264	48.10956	-	9.0	11.0	2004
50	Tolgoit ger area road Bridge	106.79502	47.92848	-	18.0	6.0	2004
52	Bridge behind the 1st district	106.84996	47.91724	-	17.9	9.9	2006
53	Naran river Bridge	106.76858	47.91816	Narangiin street	27.7	11.1	2009
54	Damdinsuren street Bridge over the Selbe river	106.93012	47.91278	Damdinsuren street	67.8	19.5	2009
55	Bridge over the ditch west of the 39-th secondary school	106.90729	47.93540	-	10.0	10.5	2010
56	New right side Bridge of the Uliastai river Bridge to become parallel	107.03030	47.90179	-	96.2	10.0	2010
57	Morin/Horse/Hill Bridge	106.74119	47.85085	-	27.0	11.8	2009
58	Khailaast 1.1 km length road Bridge-1	106.89258	47.96423	-	9.0	9.0	2011
60	Bridge behind 1st khoroolol over drainage ditch	106.83305	47.91579	-	24.0	12.0	2000
63	Bridge on Chingeltei – Khailaast Road	106.90688	47.96895	Connect road for Chingeltei to Hailaast	24.0	9.2	2003
77	Wooden bridge rehabilitation work for front side of the Songino's nursing station	106.67616	47.84785	-	206.0	6.2	2005
78	Belkh river's RC bridge direction to Dambadarjaa-Belkh road	106.96342	47.99417	-	18.0	10.1	1995
89	Bridge for Bayanhoshuu ger area	106.82295	47.95868	-	24.8	11.5	2004
90	RC bridge Direction to the Orbit-Takhilt	106.74898	47.91428	-	27.0	11.0	2007
93	Golden park bridge of selbe river RC bridge	106.93176	47.92655	East side for Denver street	45.0	11.6	2008
95	Songino khairkhan district .4th and 5th khoroo's borderline road	106.80851	47.92505	-	36.0	12.4	2011
96	Shadivlan, for Selbe bridge	106.92164	48.01682	for Shadivlan road	54.1	13.3	2011
97	Goodoin bridge	106.91483	48.03567	Goodoi road	36.0	6.4	
98	Upper bridge of Sharga morit	106.89694	48.07795	Upper vallye for Sharga morit summer residence	27.0	7.0	
99	Upper bridge of Chingeltein am	106.88306	47.98361	To west direction for Chingeltei road	9.0	7.3	2004
100	behind the 4th khoroolol flood channel's bridge	106.87168	47.92884	For north road of Urguu cinema theatre	13.4	6.7	2004
103	Bridge for Bayanhoshuu ger area(north) under construction	106.81254	47.96702	Upper vallye for Sharga morit summer residence	17.3	11.6	2011

Table 2.2.2 Bridge inventory (Cont.)

No.	Name	Pier Height (m)	No. of Span	Girder Type	Material of Super-structure	Material of Sub-structure	Girder Falling Prevention	Girder Support Length (cm)	Ground Classification
4	Arslantai Bridge	2.40	3	Simple	RC girder	RC	No	45	3
5	Uliastai tsaad Bridge /Left/	1.80	4	Simple	RC girder	RC	No	71	3
6	Uliastai tsaad Bridge	2.45	1	Simple	RC	RC	No	42	3
7	Uliastai tsaad Bridge	2.70	3	Simple	RC	RC	No	46	3
8	Bridge over the Hol river	2.17	3	Simple	RC girder	RC	No	47	2
9	Chuluut am Bridge	2.70	1	Simple	RC girder	RC	No	46	2
10	Bayanzurkh Bridge	4.20	15	Simple	RC girder	RC	No	57	3
11	Zaisan West am Bridge	1.55	1	Simple	RC girder	RC	No	100	1
12	Bridge in front of the 14th khoroo	2.00	1	Box	RC	RC	No	—	3
13	Enkhtaivan Bridge Rehabilitation for Enkhtaiwan's bridge	7.50	27	Simple, continuous	RC girder	RC	No	42	3
14	Yarmag Bridge	6.20	11	Simple	RC girder	RC	No	63	3
15	Yarmag Bridge to Airport	1.60	2	Simple	RC slub	RC	No	—	3
16	Tolgoit Parallel Bridge	3.00	2	Simple	RC girder	RC	No	64	3
17	Selbe dund Bridge	3.00	3	Simple	RC girder	RC	No	92	3
18	Dund gol Deed Bridge	3.50	3	Simple	RC girder	RC	No	61	3
19	Ikh Tenger Bridge	6.90	12	Simple	RC girder	RC	No	89	3
20	Ikh Tenger dwon stream Bridge	3.00	1	Simple	RC girder	RC	No	56	3
21	Zaisan Bridge	5.50	13	Simple	RC girder	RC	No	51	3
23	Dund gol Dood Bridge	3.60	3	Simple	RC girder	RC	No	54	3
24	Songolon Bridge Rehavilitation	5.70	13	Simple	RC girder	RC	No	71	3
25-1	Turgen river Bridge-1	3.30	2	Simple	RC girder	RC	No	62	2
25-2	Turgen river Bridge-2 (closed to traffic)	3.10	2	Simple	RC girder	RC	No	53	2
26	Poultry farm Bridge	2.70	14	Simple	RC girder	RC	No	55	3
27	Gurvaljin Bridge	8.10	6	Simple	RC girder	RC	No	103	3
28	Naran Bridge	2.90	2	Simple	RC girder	RC	No	64	2
29	Bridge behind of Meat Factory	3.60	3	Simple	RC girder	RC	No	51	3
30	Nairamdal Bridge	2.10	2	Simple	RC girder	RC	No	65	2
31	Rashaant Bridge	2.15	1	Simple	RC	RC	No	45	2
32	Khailaast Bridge	2.00	1	Simple	RC girder	RC	No	95	2
33	Chingeltei Bridge	1.90	1	Simple	RC girder	RC	No	95	2
34	Sharga Morit Bridge	3.50	3	Simple	RC girder	RC	No	57	2
35	Selbe gol Deed Parallel Bridge -1	3.85	4	Simple	RC girder	RC	No	59	2
36	Selbe gol Deed Parallel Bridge -2	3.55	4	Simple	RC girder	RC	No	54	2
37	Bridge for behind of Chinggis hotel	2.65	3	Simple	RC	RC	No	53	3
38	Dambadarjaa Bridge	2.70	3	Simple	RC girder	RC	No	64	2
39	Dambadarjaa naad Bridge	2.25	2	Simple	RC girder	RC	No	59	2
40	Gachuurt Bridge	3.30	2	Simple	RC girder	RC	No	50	3
41	Gachuurt Bridge	1.55	1	Simple	RC girder	RC	No	78	1
43	Nalaikh Bridge	5.20	3	Simple	RC	RC	No	42	1
44	Zaisan East Bridge	3.00	1	Simple	RC girder	RC	No	37	3
45	Milk factory Bridge	1.35	5	Multi box	multi box	RC	No	—	3
46	Baruun-uul Dithc Bridge	2.20	7	Multi box	multi box	RC	No	—	3
47	Bridge over the ditch west behind the 1st khoroolol	2.90	1	Simple	RC	RC	No	43	1
48	Bridge to Khandgait-Sanzai	1.30	1	Simple	RC girder	RC	No	32	2
49	South Bridge to Khandgait-Sanzai	1.30	1	Simple	RC girder	RC	No	32	2
50	Tolgoit ger area road Bridge	2.00	3	Simple	RC	RC	No	30	2
52	Bridge behind the 1st district	2.90	2	Continuous	Steel Combined	RC	No	56	1

No.	Name	Pier Height (m)	No. of Span	Girder Type	Material of Super-structure	Material of Sub-structure	Girder Falling Prevention	Girder Support Length (cm)	Ground Classification
53	Naran river Bridge	1.60	3	Simple	RC	RC	No	45	3
54	Damdinsuren street Bridge over the Selbe river	5.00	5	Box, simple	RC	RC	No	90	3
55	Bridge over the ditch west of the 39-th secondary school	2.00	1	Simple	RC	RC	No	—	2
56	New right side Bridge of the Uliastai river Bridge to become parallel	1.40	4	Simple	RC	RC	No	62	3
57	Morin/Horse/Hill Bridge	3.25	2	Simple	RC	RC	No	50	3
58	Khailaast 1.1 km length road Bridge-1	1.45	1	Simple	RC	RC	No	35	1
60	Bridge behind 1st khoroolol over drainage ditch	1.75	2	Simple	RC girder	RC	No	50	3
63	Bridge on Chingeltei – Khailaast Road	2.90	1	Simple	RC girder	RC	No	83	1
77	Wooden bridge rehabilitation work for front side of the Songino's nursing station	—	14	Simple	Wooden	Wooden	No	—	3
78	Belkh river's RC bridge direction to Dambadarjaa-Belkh road	2.90	2	Simple	RC	RC	No	56	2
89	Bridge for Bayanhoshuu ger area	2.60	3	Simple	RC	RC	No	50	2
90	RC bridge Direction to the Orbit-Takhilt	2.40	3	Simple	RC	RC	No	45	3
93	Golden park bridge of selbe river RC bridge	2.90	4	Simple	RC	RC	No	52	2
95	Songino khairkhan district .4th and 5th khoroo's borderline road	2.70	2	Simple	RC	RC	No	87	1
96	Shadivlan, for Selbe bridge	2.75	3	Simple	RC	RC	No	80	2
97	Goodoin bridge	1.90	2	Simple	RC	RC	No	36	2
98	Upper bridge of Sharga morit	2.95	2	Simple	RC	RC	No	45	2
99	Upper bridge of Chingeltein am	1.70	1	Simple	RC	RC	No	31	2
100	behind the 4th khoroolol flood channel's bridge	0.95	3	Simple	RC	RC	No	—	1
103	Bridge for Bayanhoshuu ger area(north) under construction	2.40	2	Simple	RC	RC	No	45	2

Note: Ground classification by predominant period T_g :

1 - $T_g < 0.2s$

2 - $0.2s \leq T_g < 0.4s$

3 - $0.4s \leq T_g < 0.6s$

4 - $0.6s \leq T_g$

Table 2.2.3 Water supply reservoir inventory

No	Name	Location			Capacity (m ³)	Construction Year	Supply area	Remarks
		Address	Longitude	Latitude				
1	III, IV reservoir	Bayangol district 10th khoroo	47.9287	106.8655	6000	1985	Bayangol district	renewed in 2000
2	Hailaast reservoir	Chingeltei district 15th khoroo	47.968	106.8986	1500	1985	Chingeltei district	
3	Chingeltei reservoir	Chingeltei district 17th khoroo	47.9881	106.8827	500	2009	Chingeltei district	
4	North East reservoir	Bayanzurk district 2nd khoroo	47.9315	106.9468	6000	1985	Bayanzurkh district	renewed in 2000
5	Sharhad reservoir	Bayanzurk district 9th khoroo	47.9378	107.0148	500	1985	Bayanzurkh district	renewed in 2000
6	Zavsriin reservoir	Bayanzurk district 11th khoroo	47.8804	107.1169	12000	1989	Bayanzurkh district	
7	Niseh-Yarmag reservoir	Khan-uul district 16th khoroo	47.8632	106.7758	3500	1986	Khan-Uul district	renewed in 2000
8	Bayankhoshuu (lower)	Songinokhairkhan district 8th khoroo	47.9492	106.8384	500	2010	Songinokhair khan district	
9	Bayankhoshuu (upper)	Songinokhairkhan district 10th khoroo	47.9669	106.8467	1500	2010	Songinokhair khan district	
10	Tasgan reservoir	Chingeltei district 9th khoroo	47.928	106.8485	18000	1985	Sukhbaatar district	
11	West reservoir	Songinokhairkhan district 23th khoroo	47.9244	106.8299	6000	1985	Songinokhair khan district	

Table 2.2.4 Water supply pipeline inventory

	Khoroo	Pipe Material	Diameter (mm)	Length (m)	
Bayangol	Khoroo 1	steel, cast-iron	100, 125, 150, 200, 300, 400	8,927	
	Khoroo 2	steel, cast-iron	50, 76, 80, 100, 150, 600	4,250	
	Khoroo 3	steel, cast-iron	50, 100, 125, 150, 200, 220, 250, 300, 330, 400, 500, 700	14,614	
	Khoroo 7	steel, cast-iron	50, 80, 100, 150, 160, 300, 400	5,450	
	Khoroo 8	steel, cast-iron	50, 80, 89, 100, 110, 200, 250, 400	4,399	
	Khoroo 9	steel, cast-iron	40, 76, 300	3,151	
	Khoroo 10			1,037	
	Khoroo 11	steel, cast-iron	50, 80, 100, 150, 200, 300, 400	5,624	
	Khoroo 12			1,123	
	Khoroo 13	steel, cast-iron	50, 80, 125, 150, 200, 300	2,764	
	Khoroo 14	steel, cast-iron	50, 76, 100, 300	2,281	
	Khoroo 15	steel, cast-iron	50, 300, 400	1,763	
	Khoroo 17	steel, cast-iron	50, 60, 76, 80, 100, 125, 150, 200, 300	4,192	
	Khoroo 18	steel, cast-iron	50, 60, 80, 100, 150	4,065	
	Khoroo 19	steel, cast-iron	50, 150, 200, 250, 300, 400	3,637	
	Khoroo 20	steel, cast-iron	200, 400, 500, 1000	78,399	
	Khoroo 21				
	Khoroo 22	steel, cast-iron	50, 150	152	
	Sub-total			184,834	
	Bayanzurkh	Khoroo 1	steel, cast-iron	50, 150, 200, 300	7,357
		Khoroo 2	steel, cast-iron	50,80,100, 200, 250, 700	14,221
		Khoroo 3	steel, cast-iron	50, 100, 150, 200, 300	6,243
Khoroo 4		steel, cast-iron	80, 100, 200, 300, 500, 800	10,607	
Khoroo 5		steel, cast-iron	50, 150, 300,400, 500 600, 800	13,385	
Khoroo 6		steel, cast-iron	50, 100, 150, 500	5,128	
Khoroo 7		steel, cast-iron	100, 150, 200, 300	3,197	
Khoroo 8		steel, cast-iron	50, 100,150, 200, 600	11,830	
Khoroo 9					
Khoroo 10		steel, cast-iron	50, 100, 150, 200, 400	6,271	
Khoroo 11		steel, cast-iron	800	11,602	
Khoroo 12		steel, cast-iron	50, 100, 400	10,901	
Khoroo 13		steel, cast-iron	50, 70, 80, 100, 150, 400, 500, 700	11,408	
Khoroo 14		steel, cast-iron	50, 70, 80, 100, 150, 160, 200, 300, 400, 500, 600, 700	13,881	
Khoroo 15		steel, cast-iron	50, 200, 300	2,687	
Khoroo 16		steel, cast-iron	40, 50, 76, 80, 100, 150, 200, 300, 500, 600	16,265	
Khoroo 17					
Khoroo 18		steel, cast-iron	50, 80, 100, 108, 150, 200, 300, 500	5,698	
Khoroo 19		steel, cast-iron	50, 70, 100, 150	1,618m	
Khoroo 20					
Khoroo 21					
Khoroo 22		steel, cast-iron	40, 80, 100, 150, 200, 250, 500	6,992	
Khoroo 23		steel, cast-iron		1,190	
Khoroo 24		steel, cast-iron	50, 70	213	
Khoroo 25		steel, cast-iron	30, 40, 50, 70, 80, 100, 200, 700	5,117	
Khoroo 26		steel, cast-iron	80, 100, 150, 200	1,456	
Khoroo 27		steel, cast-iron	100, 110, 150, 250, 400	1,306	
Sub-total			166,955		
Chingeltei	Khoroo 1	steel, cast-iron	50, 80, 89, 100, 125, 300, 400	6,322	
	Khoroo 2	steel, cast-iron	50, 76, 80, 89, 100, 150, 159, 400	4,549	
	Khoroo 3	steel, cast-iron	50, 80, 100, 150, 400	3,823	
	Khoroo 4	steel, cast-iron	50, 80, 100, 150, 250	8,147m	
	Khoroo 5	steel, cast-iron	70, 100, 150, 250, 400, 800	5,441	
	Khoroo 6	steel, cast-iron	125	4,491	
	Khoroo 7				
	Khoroo 8	steel, cast-iron	100, 110, 400	968	
	Khoroo 9	steel, cast-iron	400, 500, 700	2,337	
	Khoroo 10				
	Khoroo 11	steel, cast-iron	80, 160, 500	2,062	
	Khoroo 12				
	Khoroo 13	steel, cast-iron	50, 160, 225	652	
Sub-total			30,645		
Khanuul	Khoroo 1	steel, cast-iron	50, 100, 150, 200, 400, 500	4,138	
	Khoroo 2	steel, cast-iron	50, 70, 80, 100, 150, 250, 300, 400	18,952	

	Khoroo	Pipe Material	Diameter (mm)	Length (m)
	Khoroo 3	steel, cast-iron	50, 76, 80, 100, 150, 200, 250, 300, 400, 500	47,446
	Khoroo 4			
	Khoroo 5			1,015
	Khoroo 6			
	Khoroo 7			
	Khoroo 8			
	Khoroo 9			
	Khoroo 10			
	Khoroo 11	steel, cast-iron	50, 100, 108, 133, 150, 160,	14,343
	Khoroo 12			
	Khoroo 13			
	Khoroo 14			
	Khoroo 15	steel, cast-iron	50, 76, 80, 100, 150, 200, 300, 400, 500	24,284
	Sub-total			110,178
	Songinokhairhan	Khoroo 1	steel, cast-iron	50, 100
Khoroo 2				
Khoroo 3				
Khoroo 4		steel, cast-iron	50, , 100, 150, 160, 225	4,092
Khoroo 5		steel, cast-iron	50	4,194
Khoroo 6		steel, cast-iron	50, 76, 100, 200, 300, 400	4,539
Khoroo 7				
Khoroo 8				
Khoroo 9				
Khoroo 10				
Khoroo 11				
Khoroo 12		steel, cast-iron	50	2,891
Khoroo 13		steel, cast-iron	50,100, 200, 600	2,239
Khoroo 14		steel, cast-iron	50, 300, 600	2,726
Khoroo 15		steel, cast-iron	300, 600	2,300
Khoroo 16		steel, cast-iron	70, 300, 600	2,297
Khoroo 17		steel, cast-iron	100, 200, 500, 600, 800	2,305
Khoroo 18		steel, cast-iron	50, 80, 85, 100, 150, 200, 250, 400	11,603
Khoroo 19		steel, cast-iron	50, 150, 200,250, 400	8,207
Khoroo 20		steel, cast-iron	50, 125, 150, 250, 300, 400, 800	29,767
Khoroo 21				
Khoroo 22				
Khoroo 23		steel, cast-iron		5,206
Khoroo 24				
Khoroo 25				
Khoroo 26				
Khoroo 27		steel, cast-iron	50, 57, 89, 100, 150	3,744
Khoroo 28				
Khoroo 29		steel, cast-iron	50, 100, 150, 200, 300, 400	9,380
Sub-total			97,682	
Sukhbaatar	Khoroo 1	steel, cast-iron	50, 80, 100, 150, 200, 219, 400, 500, 700	18,960
	Khoroo 2	steel, cast-iron	50, 150, 200, 300, 400, 700	2,228
	Khoroo 3	steel, cast-iron	50, 80, 100, 150, 200, 300, 400, 500, 700	4,289
	Khoroo 4	steel, cast-iron	50, 80, 150, 300	5,049
	Khoroo 5	steel, cast-iron	50, 80, 100, 150, 200, 219, 250, 400, 500, 700	14,441
	Khoroo 6	steel, cast-iron	50, 80, 100, 133, 150, 250, 300	7,806
	Khoroo 7	steel, cast-iron	50, 90, 100, 150, 200, 300	4,805
	Khoroo 8	steel, cast-iron	50, 60, 70, 76, 80, 89, 100, 120, 150, 200, 300	13,649
	Khoroo 9	steel, cast-iron	50, 76, 80, 100, 150, 500, 700	3,453
	Khoroo 10	steel, cast-iron	80, 100, 133, 150, 700	6,567
	Khoroo 11	steel, cast-iron	50, 76, 80, 250, 300, 700	4,052
	Khoroo 12	steel, cast-iron	500	1,043
	Khoroo 13	steel, cast-iron	200, 250, 280	874
	Sub-total			87,216
Total			677,510	

Table 2.2.5 Sewerage pipeline inventory

	Khoroo	Pipe Material	Diameter (mm)	Length (m)
Bayangol	Khoroo 1	cast-iron, ceramics	150, 300, 600, 800, 1000	9,551
	Khoroo 2	cast-iron, ceramics	100, 150, 200, 400, 500, 1000	8,123
	Khoroo 3	cast-iron, ceramics	100, 150, 200, 300, 500, 600, 800, 1000	11,264
	Khoroo 4	cast-iron, ceramics	100, 150, 200, 250, 300, 500, 600, 800, 1000, 1200	22,010
	Khoroo 5	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500, 600, 1000, 1200	8,472
	Khoroo 6	cast-iron, ceramics	100, 150, 200, 300, 500, 600, 700, 1000, 1200	10,285
	Khoroo 7	cast-iron, ceramics	100, 150, 200, 250, 300, 500, 600,	6,821
	Khoroo 8	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500, 600	7,254
	Khoroo 9	cast-iron, ceramics	100, 150, 200, 300, 500	2,566
	Khoroo 10	cast-iron, ceramics	100, 150, 300, 500	816
	Khoroo 11	cast-iron, ceramics	100, 150, 200, 300	6,621
	Khoroo 12	cast-iron, ceramics	100, 150, 200, 250, 300	3,571
	Khoroo 13	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500	2,984
	Khoroo 14	cast-iron, ceramics	100, 150, 200, 250, 300, 500, 600	4,958
	Khoroo 15	cast-iron, ceramics	100, 150, 200, 250, 300, 500, 600	3,382
	Khoroo 16	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500, 600, 1000	6,849
	Khoroo 17	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500, 600, 1250	4,707
	Khoroo 18	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500, 600	6,881
	Khoroo 19	cast-iron, ceramics	100, 150, 200, 250, 400, 500, 800, 1000	4,855
	Khoroo 20	cast-iron, ceramics	100, 150, 200, 300, 400, 600, 800, 1200, 1400	59,384
	Sub-total			191,354
Bayanzurkh	Khoroo 1	cast-iron, ceramics	150, 160, 200, 250, 300, 400	8,898
	Khoroo 2	cast-iron, ceramics	100, 150, 200, 250, 300,	7,918
	Khoroo 3	cast-iron, ceramics	100, 150, 200,	5,330
	Khoroo 4	cast-iron, ceramics	100, 150, 200	9,776
	Khoroo 5	cast-iron, ceramics	100, 110, 150, 160, 200, 250, 300,	9,168
	Khoroo 6	cast-iron, ceramics	100, 150, 200, 500, 600	5,754
	Khoroo 7	cast-iron, ceramics	150, 200,	4,648
	Khoroo 8	cast-iron, ceramics	100, 150, 200, 300, 400, 800, 900	11,482
	Khoroo 9			923
	Khoroo 10	cast-iron, ceramics	100, 150, 160, 200, 800	4,652
	Khoroo 11	cast-iron, ceramics	100, 150, 160, 160, 315, 400, 250	22,618
	Khoroo 12	cast-iron, ceramics	200, 800, 1000	3,758
	Khoroo 13	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500, 600, 800, 900, 1000	10,794
	Khoroo 14	cast-iron, ceramics	100, 150, 200, 300, 350, 500, 800, 1000	14,513
	Khoroo 15	cast-iron, ceramics	100, 150, 200, 500, 800	3,570
	Khoroo 16	cast-iron, ceramics	100, 150, 200, 300, 350, 400, 800, 900	14,497
	Khoroo 17			
	Khoroo 18	cast-iron, ceramics	100, 150, 200, 250, 400, 800	5,793
	Khoroo 19	cast-iron, ceramics	150, 200, 300, 400	3,066
	Khoroo 20	cast-iron, ceramics	500	565
	Khoroo 21			
	Khoroo 22	cast-iron, ceramics	100, 150, 200, 300	6,240
	Khoroo 23	cast-iron, ceramics	600	1,895
	Khoroo 24			
	Khoroo 25	cast-iron, ceramics	150, 200, 300, 400, 800	6,289
	Khoroo 26	cast-iron, ceramics	200, 300, 400, 1000	4,053
	Khoroo 27			
	Khoroo 28			560
	Sub-total			166,760
Chingeltei	Khoroo 1	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500	7,257
	Khoroo 2	cast-iron, ceramics	150, 200, 1000	4,517
	Khoroo 3	cast-iron, ceramics	150, 200,	4,853
	Khoroo 4	cast-iron, ceramics	100, 150, 200, 250, 300, 400	10,531
	Khoroo 5	cast-iron, ceramics	150, 200, 300, 400, 800, 1000	5,394
	Khoroo 6	cast-iron, ceramics	100, 150, 200, 300, 400	5,357
	Khoroo 7			
	Khoroo 8			
	Khoroo 9	cast-iron, ceramics	800	492
	Khoroo 10			
	Khoroo 11	cast-iron, ceramics	150, 800	683
	Khoroo 12	cast-iron, ceramics	150, 600, 800	319
	Khoroo 13	cast-iron, ceramics	100, 150, 600, 800	410

	Khoroo	Pipe Material	Diameter (mm)	Length (m)
	Khoroo 14			
	Khoroo 15			
	Khoroo 16			
	Khoroo 17			
	Khoroo 18			
	Khoroo 19			
	Khoroo 20			
	Khoroo 21			
	Khoroo 22			
	Khoroo 23			
	Khoroo 24			
	Khoroo 25			
	Khoroo 26			
	Khoroo 27			
	Sub-total			39,813
Khanuul	Khoroo 1	cast-iron, ceramics	150, 150, 200, 400,	6,361
	Khoroo 2	cast-iron, ceramics	100, 150, 200, 250, 300, 500, 800, 100, 1400	21,662
	Khoroo 3	cast-iron, ceramics	100, 150, 165, 200, 250, 300, 400, 500, 600, 800, 1000, 1400, 1500	45,687
	Khoroo 4			
	Khoroo 5			
	Khoroo 6			
	Khoroo 7			
	Khoroo 8			
	Khoroo 9			
	Khoroo 10			
	Khoroo 11	cast-iron, ceramics	100, 150, 200, 250, 300	20,077
	Khoroo 12			
	Khoroo 13			
	Khoroo 14			
	Khoroo 15	cast-iron, ceramics	100, 150, 160, 200, 250, 300, 400, 600, 1000	25,120
	Khoroo 16			
	Khoroo 17			
	Khoroo 18			
	Khoroo 19			
	Khoroo 20			
Khoroo 21				
Khoroo 22				
Khoroo 23				
Khoroo 24				
Khoroo 25				
Khoroo 26				
Khoroo 27				
	Sub-total			118,907
Songinokhairhan	Khoroo 1	cast-iron, ceramics	150	2,290
	Khoroo 2			
	Khoroo 3			
	Khoroo 4	cast-iron, ceramics	200, 300, 400, 500, 600	8,769
	Khoroo 5			
	Khoroo 6	cast-iron, ceramics	150, 200, 250, 500	3,196
	Khoroo 7			
	Khoroo 8			
	Khoroo 9			2,158
	Khoroo 10			
	Khoroo 11			
	Khoroo 12	cast-iron, ceramics	100, 300, 400, 1200	3,031
	Khoroo 13	cast-iron, ceramics	100, 150, 300, 1000, 1200	3,554
	Khoroo 14	cast-iron, ceramics	150, 200, 300, 1000, 1200	3,444
	Khoroo 15	cast-iron, ceramics	100, 200, 300, 1200	2,715
	Khoroo 16	cast-iron, ceramics	100, 200, 400, 1000, 1200	2,962
	Khoroo 17	cast-iron, ceramics	100, 150, 400, 1000, 1200	2,860
	Khoroo 18	cast-iron, ceramics	100, 150, 200, 300, 250, 500, 600, 1000, 1200	8,889
	Khoroo 19	cast-iron, ceramics	100, 200, 300, 400	7,663
	Khoroo 20	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500, 800, 1200, 1400	36,274

	Khoroo	Pipe Material	Diameter (mm)	Length (m)
	Khoroo 21			
	Khoroo 22			
	Khoroo 23			
	Khoroo 24			
	Khoroo 25			
	Khoroo 26			
	Khoroo 27	cast-iron, ceramics	150, 200, 400	2,476
	Khoroo 28			
	Khoroo 29	cast-iron, ceramics	250, 400, 500, 1200	6,781
	Sub-total		97,062	
Sukhbaatar	Khoroo 1	cast-iron, ceramics	100, 150, 200, 250, 400, 300, 350, 400, 500, 600, 800	20,875
	Khoroo 2	cast-iron, ceramics	100, 150, 200, 400, 500, 600, 800,	4,110
	Khoroo 3	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500, 600, 800	7,481
	Khoroo 4	cast-iron, ceramics	100, 150, 200, 250, 300, 400, 500,	5,105
	Khoroo 5	cast-iron, ceramics	100, 150, 200, 250, 400, 500, 800	4,942
	Khoroo 6	cast-iron, ceramics	100, 150, 200, 250, 400	7,669
	Khoroo 7	cast-iron, ceramics	100, 125, 150, 200, 250, 300,	7,713
	Khoroo 8	cast-iron, ceramics	100, 150, 200, 250, 300	14,932
	Khoroo 9	cast-iron, ceramics	100, 150, 159, 200, 300, 400, 800	2,627
	Khoroo 10	cast-iron, ceramics	100, 120, 150, 200, 300, 400	7,125
	Khoroo 11	cast-iron, ceramics	100, 150, 200, 250, 300, 350	3,773
	Khoroo 12			
	Khoroo 13			
	Khoroo 14			
	Khoroo 15			
	Khoroo 16			
	Khoroo 17			
	Khoroo 18			
	Khoroo 19			
	Khoroo 20			
	Khoroo 21			
	Khoroo 22			
	Khoroo 23			
	Khoroo 24			
	Khoroo 25			
	Khoroo 26			
	Khoroo 27			
	Sub-total		86,352	
	Total			700,248

Table 2.2.6 Power inventory

Power plant

No	Name	Location			Capacity	Const. Year	Service area
		Address	Longitude	Latitude			
1	Thermal Power Plant 2	Bayangol district 20th khoroo Moscow street	47.90512	106.8079	21.5 MW	1961	Songinohairkhan district, Khoroo: 4, 18, 19, 20, 27
2	Thermal Power Plant 3	Khanuul district 3rd khoroo, Ulaanbaatar-36	47.8962	106.86538	148 MW	1968	Bayanzurkh district, Khoroo: 1, 6, 25 Bayangol district, Khoroo: 1, 2, 3, 4 Chingeltei district, Khoroo: 1, 2, 3, 4, 5, 6 Khanuul district, Khoroo: 1, 2, 3 Sukhbaatar district, Khoroo: 6, 7, 8, 10
3	Thermal Power Plant 4	Bayangol district 20th khoroo Electricity street	47.8938	106.8036	580 MW	1968	Bayanzurkh district, Khoroo: 1, 3, 4, 5, 8, 13, 14, 17, 22, 24 Bayangol district, Khoroo: 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 Khanuul district, Khoroo: 1, 2, 4, 10, 11, 15, 16 Sukhbaatar district, Khoroo: 1, 6, 7, 8 Songinokhaikhan district, Khoroo: 1, 2, 5, 6, 7, 12, 13, 14, 15, 16, 17, 22, 29, 32

Substation

No	Name	Location			Capacity	Const. Year	Service area
		Address	Longitude	Latitude			
1	Esgjileh substation	Khanuul district 3rd khoroo Uildver street	47.903	106.8789	2*16 MW	1987	Khanuul district
2	South substation	Khanuul district 15th khoroo Tuul gol street	47.8914	106.9027	2*25 MW	1980	Khanuul district
3	East -1 substation	Bayanzurkh district 14th khoroo	47.9136	106.9508	2*16 MW	1988	Bayanzurkh district
4	Tuul substation	Bayanzurkh district 26th khoroo	47.9055	106.9546	2*25 MW	1979	Bayanzurkh district, Khanuul district
5	Ulaanbaatar substation	Bayanzurkh district 23rd khoroo Gachuurt road street	47.9043	107.0401	2*125 MW	1982	Bayanzurkh district
6	Amgalan substation	Bayanzurkh district 10th khoroo Gachuurt road street	47.9114	107.006	2*10 MW	1989	Bayanzurkh district
7	Bayanzurkh substation	Bayanzurkh district 11th khoroo	47.8807	107.1022	2*16 MW	1981	Bayanzurkh district
8	Gachuurt substation	Bayanzurkh district 20th khoroo Gachuurt road street	47.9324	107.1582	2*16 MW	1987	Bayanzurkh district, Khoroo: 20
9	Ulaankhuaran substation	Bayanzurkh district 9th khoroo	47.9348	106.9964	2*10 MW	1991	Bayanzurkh district
10	East-2 substation	Bayanzurkh district 2nd khoroo	47.9319	106.9347	2*25 MW	1988	Bayanzurkh district
11	Star substation	Sukhbaatar district 16th khoroo Dari-Ekh street	47.9646	106.9304	2*10 MW	1986	Sukhbaatar district, Bayanzurkh district
12	Yargait substation	Chingeltei district 19 th khoroo, Sanzain zam	48.031	106.9084	2*10 MW	1987	Sukhbaatar district, Chingeltei district
13	Bayankhoshuu substation	Songinokhairkhan district 7th khoroo Baruun salaa street	47.9603	106.8163	2*10 MW	1984	Songinokhairkhan district
14	Zev substation	Songinokhairkhan district 7th khoroo Bayankhoshuu street	47.945	106.824	2*10 MW	1983	Songinokhairkhan district
15	West substation	Bayangol district 21st khoroo, Ard Auysh street	47.9198	106.8554	2*25 MW	1982	Bayangol district
16	North	Bayangol district,	47.9306	106.8996	2*40	1985	Bayangol district

No	Name	Location			Capacity	Const. Year	Service area
		Address	Longitude	Latitude			
	substation	9th khoroo			MW		
17	Geo substation	Songinokhairkhan district, 4th khoroo, Tolgoit street	47.9218	106.8084	2*25 MW	1988	Songinokhairkhan district
18	Tseverlekh substation	Songinokhairkhan district, 20th khoroo, Tovchoonii zam	47.9049	106.7682	2*10 MW	1993	Songinokhairkhan district
19	Gerel substation	Songinokhairkhan district, 32nd khoroo, Tovchoonii zam	47.8987	106.6881	2*16 MW	1988	Songinokhairkhan district
20	Nisekh substation	Khanuul district 16th khoroo, Moringiin zam	47.8574	106.766	2*10 MW	1986	Khanuul district
21	Yarmag substation	Khanuul district 8th khoroo	47.8675	106.793	2*25 MW	1987	Khanuul district
22	Uildver substation	Bayangol district, 20th khoroo, Uildveriin toiruu	47.9037	106.8431	2*25 MW	1986	Bayangol district

Table 2.2.7 Hot water pipeline inventory

District	Khoroo	Pipe Material	Diameter (mm)	Length (m)
Bayangol	Khoroo 1	steel	60, 250, 400, 500, 600, 800	18,661
	Khoroo 2	steel	60, 250, 400, 500, 600	14,656
	Khoroo 3	steel	60,80,125, 150, 250, 400, 800	20,911
	Khoroo 4	steel	50, 60,76, 80,100, 125, 150, 250, 400, 800	23,267
	Khoroo 5	steel	50, 60, 80,100, 125, 150, 200, 500, 800	12,028
	Khoroo 6	steel	50, 60, 80,100, 125, 150, 200, 500, 800	10,108
	Khoroo 7	steel	50, 60, 80,100, 125, 150, 200, 500, 800	8,334
	Khoroo 8	steel	50, 60, 80,100, 125, 150, 200, 500, 800	6,918
	Khoroo 9	steel	40, 50, 76, 80, 100, 150	2,432
	Khoroo 10	steel	40,50,62, 100	604
	Khoroo 11	steel	40, 50, 76, 80, 100, 150	4,570
	Khoroo 12	steel	76,80,125,150, 300	2,254
	Khoroo 13	steel	50, 60, 80,100, 125, 150, 200	2,475
	Khoroo 14	steel	50, 60, 80,100, 125, 150	2,301
	Khoroo 15	steel	40,50, 76,80,125, 150	2,991
	Khoroo 16	steel	50,80, 250, 400, 500, 600, 800	8,770
	Khoroo 17	steel	40, 50, 60,80,100, 125, 150, 250, 300	6,345
	Khoroo 18	steel	50, 76,80,100, 125, 150, 200, 400	8,600
	Khoroo 19	steel	50, 76,80,100, 125, 150, 200, 400,500	9,750
	Khoroo 20	steel	60,80,125, 150, 250, 300,400, 800	47,389
	Khoroo 21			
	Khoroo 22			
	Khoroo 23			
	Sub-total			213,364
Bayanzurkh	Khoroo 1	steel	50,76,80, 100, 150, 200, 250, 300, 350, 400	11,482
	Khoroo 2	steel	50,80,100, 150, 200,	6,556
	Khoroo 3	steel	50,60, 76,80, 100, 125, 150, 200,250	8,830
	Khoroo 4	steel	50, 60,76, 80, 100, 125, 150, 250,	10,194
	Khoroo 5	steel	50, 60, 80,100, 125, 150, 200, 300, 350	9,591
	Khoroo 6	steel	50, 60, 80,100, 125, 150, 200, 300,500	6,710
	Khoroo 7	steel	50, 60, 80,100, 125, 150, 200, 300	2,395
	Khoroo 8	steel	50, 60, 80,100, 125, 150, 200	9,954
	Khoroo 9			
	Khoroo 10			
	Khoroo 11	steel	200	2,816
	Khoroo 12	steel		313m
	Khoroo 13	steel	50, 80,100, 125, 150, 200, 300	8,732
	Khoroo 14	steel	50, 60, 76, 80, 100, 125, 150, 200, 500, 700	17,078
	Khoroo 15	steel	50, 76, 80,100, 125, 150, 200,	5,989
	Khoroo 16	steel	50,80,100, 150, 200, 250, 300, 500	13,359
	Khoroo 17			
	Khoroo 18	steel	50, 76,80,100, 125, 150, 200, 400	8,192
	Khoroo 19	steel	200, 250	1,700
	Khoroo 20			
	Khoroo 21			
	Khoroo 22	steel	50, 60, 80,100, 125, 150, 200, 350, 500,700	9,561
	Khoroo 23			
	Khoroo 24			
	Khoroo 25	steel	50,76,80, 100, 150, 200, 250, 300, 350,400	88,851
	Khoroo 26	steel	200,300	4,905
	Khoroo 27			
	Khoroo 28			
	Sub-total			224,502
Chingeltei	Khoroo 1	steel	50, 80, 100, 125, 150, 200, 300	8,898
	Khoroo 2	steel	50, 76, 80, 100, 125, 150, 200, 300, 500	8,496
	Khoroo 3	steel	50, 76, 80, 100, 125, 150, 200, 300	5,927
	Khoroo 4	steel	50, 76, 80, 100, 125, 150, 200, 250, 300	12,563
	Khoroo 5	steel	50, 70, 80,100, 125, 150, 200, 250, 500, 600	5,954
	Khoroo 6	steel	50, 70, 80,100, 125, 150, 200, 250, 600	7,696
	Khoroo 7			
	Khoroo 8			
	Khoroo 9			
	Khoroo 10			

District	Khoroo	Pipe Material	Diameter (mm)	Length (m)
	Khoroo 11			
	Khoroo 12			
	Khoroo 13			
	Khoroo 14			
	Khoroo 15			
	Khoroo 16			
	Khoroo 17			
	Khoroo 18			
	Khoroo 19			
	Sub-total			49,534
Khanuul	Khoroo 1	steel	50, 80, 100, 125, 150, 200, 300	4,143
	Khoroo 2	steel	50, 76, 80, 100, 125, 150, 200, 300, 500,800	19,334
	Khoroo 3	steel	50, 80, 100, 125, 150, 200, 300, 500,800	28,682
	Khoroo 4	steel		334
	Khoroo 5			
	Khoroo 6			
	Khoroo 7			
	Khoroo 8			
	Khoroo 9			
	Khoroo 10	steel	50, 80, 100, 150, 200, 300	3,176
	Khoroo 11	steel	32,50, 80, 100, 150,200, 300	24,155
	Khoroo 12			
	Khoroo 13			
	Khoroo 14			
	Khoroo 15	steel	50, 70, 80, 100, 125, 150, 200, 300	31,961
	Khoroo 16	steel	150	1,773
	Sub-total			113,558
Songinokhairkhan	Khoroo 1	steel		58
	Khoroo 2			
	Khoroo 3			
	Khoroo 4	steel	50,70,80,100, 150, 200,400	6,893
	Khoroo 5			
	Khoroo 6	steel	125, 150	2,390
	Khoroo 7			
	Khoroo 8			
	Khoroo 9			
	Khoroo 10			
	Khoroo 11	steel	80,100	307
	Khoroo 12	steel	80,100, 125, 150, 400	6,573
	Khoroo 13	steel	80,100, 125, 150, 200, 250, 300, 400	3,707
	Khoroo 14	steel	80, 100, 125, 150, 200, 400	2
	Khoroo 15	steel	70,100, 125, 150, 200, 250,300, 400	3,767
	Khoroo 16	steel	50, 80,100, 125, 150, 400	2,925
	Khoroo 17	steel	50, 80,100, 150, 400	2,812
	Khoroo 18	steel	32, 50, 80,100, 125, 150, 200, 300,350, 400	10,766
	Khoroo 19	steel	32, 50, 80,100, 125, 150, 200, 250, 400, 500	5,698
	Khoroo 20	steel	50, 80,100, 125, 150, 200, 250	34,734
	Khoroo 21			
	Khoroo 22			
	Khoroo 23			
	Khoroo 24			
	Khoroo 25			
	Khoroo 26			
	Khoroo 27	steel	32, 50, 70,80, 100, 125, 150	3,392
	Khoroo 28			
	Khoroo 29	steel	50, 80, 100, 125, 150, 200, 250, 300, 350, 400, 500	9,497
	Khoroo 30			
	Khoroo 31			
	Khoroo 32			
	Sub-total			93,521
Sukhbaatar	Khoroo 1	steel	50, 70, 80, 100, 125, 150, 200, 250,300, 350, 500, 800	25,154
	Khoroo 2	steel	80, 100, 125, 150, 200, 250, 500, 800	6,537
	Khoroo 3	steel	50, 70, 80, 100, 125, 150, 200, 500, 800	12,431
	Khoroo 4	steel	50, 80, 100, 125, 150, 200, 250, 500	8,106

District	Khoroo	Pipe Material	Diameter (mm)	Length (m)
	Khoroo 5	steel	50, 70, 76, 80, 100, 125, 150, 200, 250, 400	9,045
	Khoroo 6	steel	50, 70, 80, 100, 125, 150, 200, 250,300, 350, 600	11,663
	Khoroo 7	steel	50, 60, 80, 100, 125, 150, 200, 250, 300, 400	8,268
	Khoroo 8	steel	50, 60, 80,100, 125, 150, 200, 250, 300, 350, 600	19,284
	Khoroo 9	steel	40, 50, 76, 80, 100, 150	528
	Khoroo 10	steel	40, 50, 76, 80, 100, 125, 150	6,554
	Khoroo 11	steel	40, 50, 76, 80, 100, 125, 150, 250, 300	4,750
	Khoroo 12			
	Khoroo 13			
	Khoroo 14			
	Khoroo 15			
	Khoroo 16			
	Khoroo 17			
	Khoroo 18			
	Khoroo 19			
	Khoroo 20			
	Sub-total			112,320
Total				806,799

2.3 Model of Bridge Pier

The static and dynamic analysis were performed by a popularly used software named UC-win/F-RAME(3D). The pier was modeled as a lumped mass model. The dimension and bar arrangement of the pier are given in Figure 2.3.1.

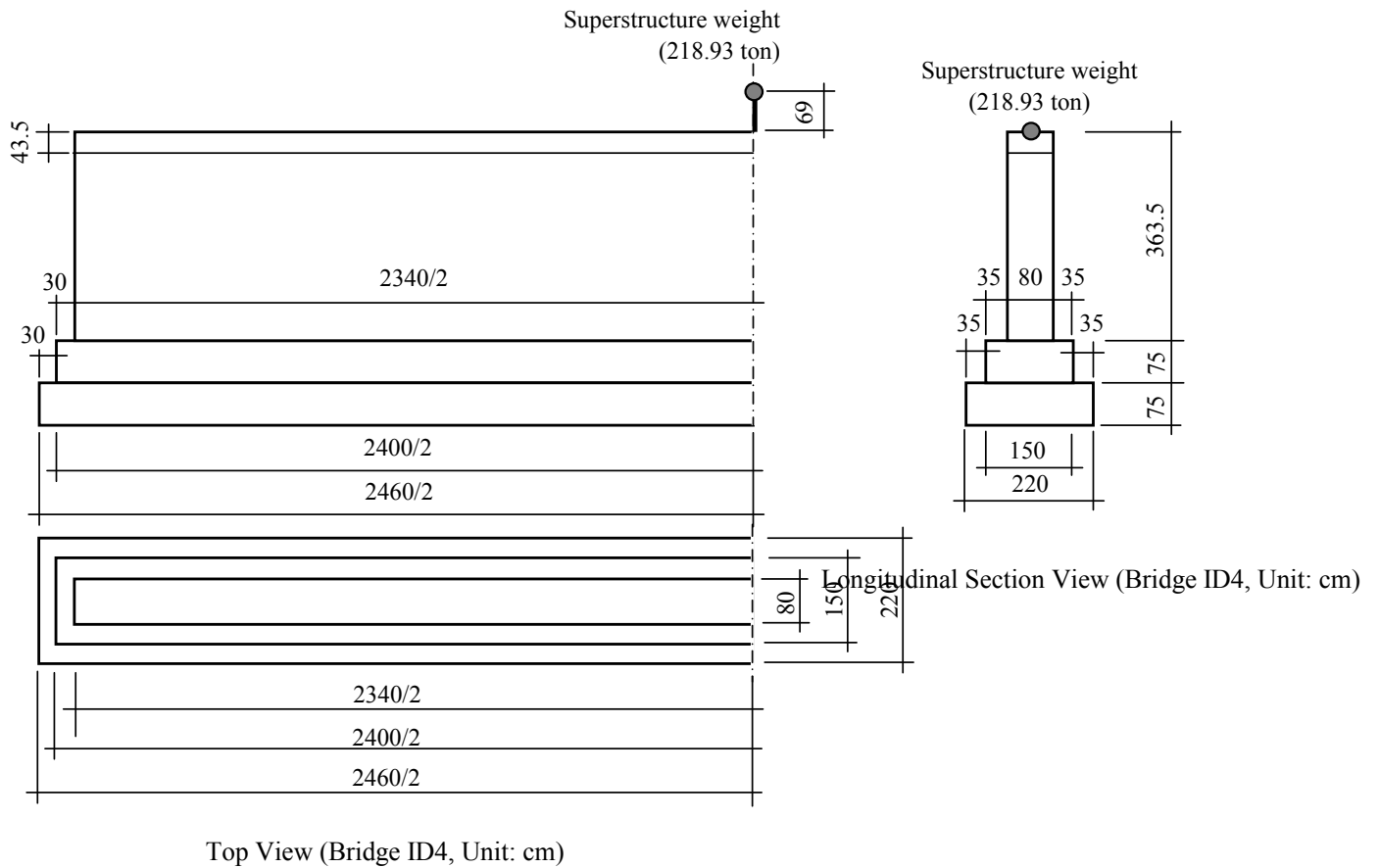
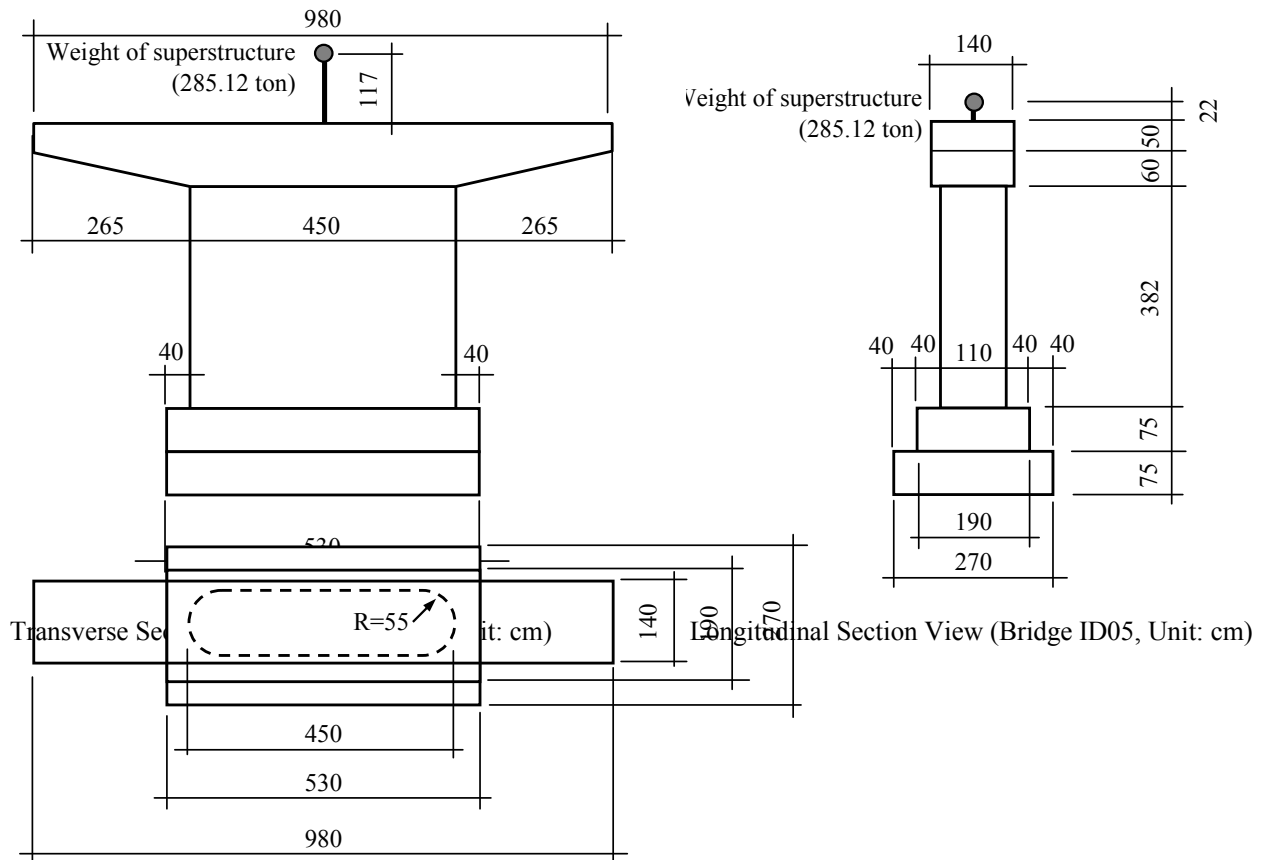


Figure 2.3.1 Dimension of bridge pier and bar arrangement (Bridge No.4)



Top View (Bridge ID05, Unit: cm)

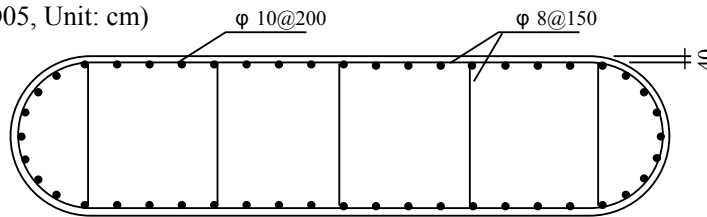


Figure 2.3.1 Dimension of bridge pier and bar arrangement (Bridge No.5)

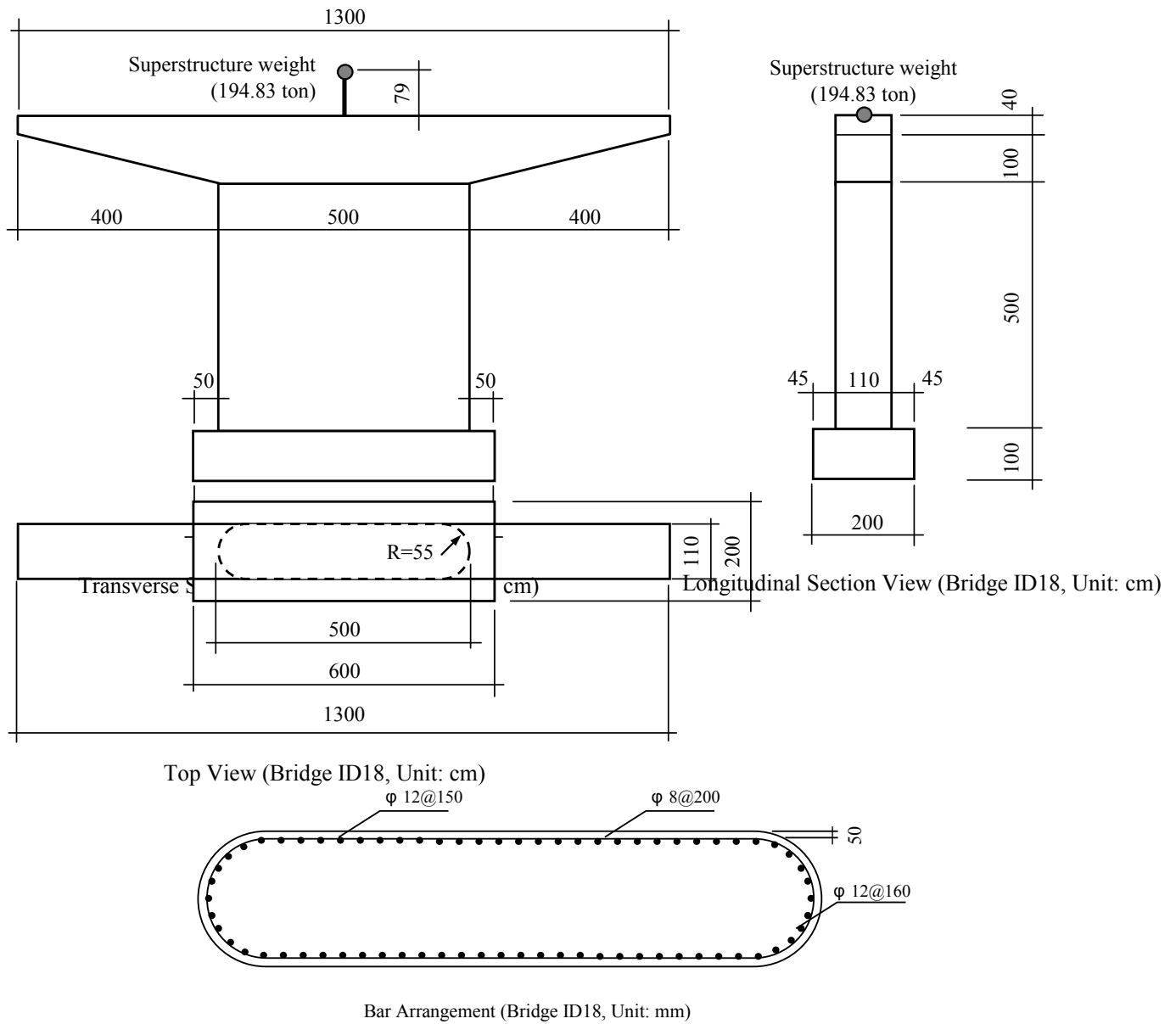


Figure 2.3.1 Dimension of bridge pier and bar arrangement (Bridge No.18)

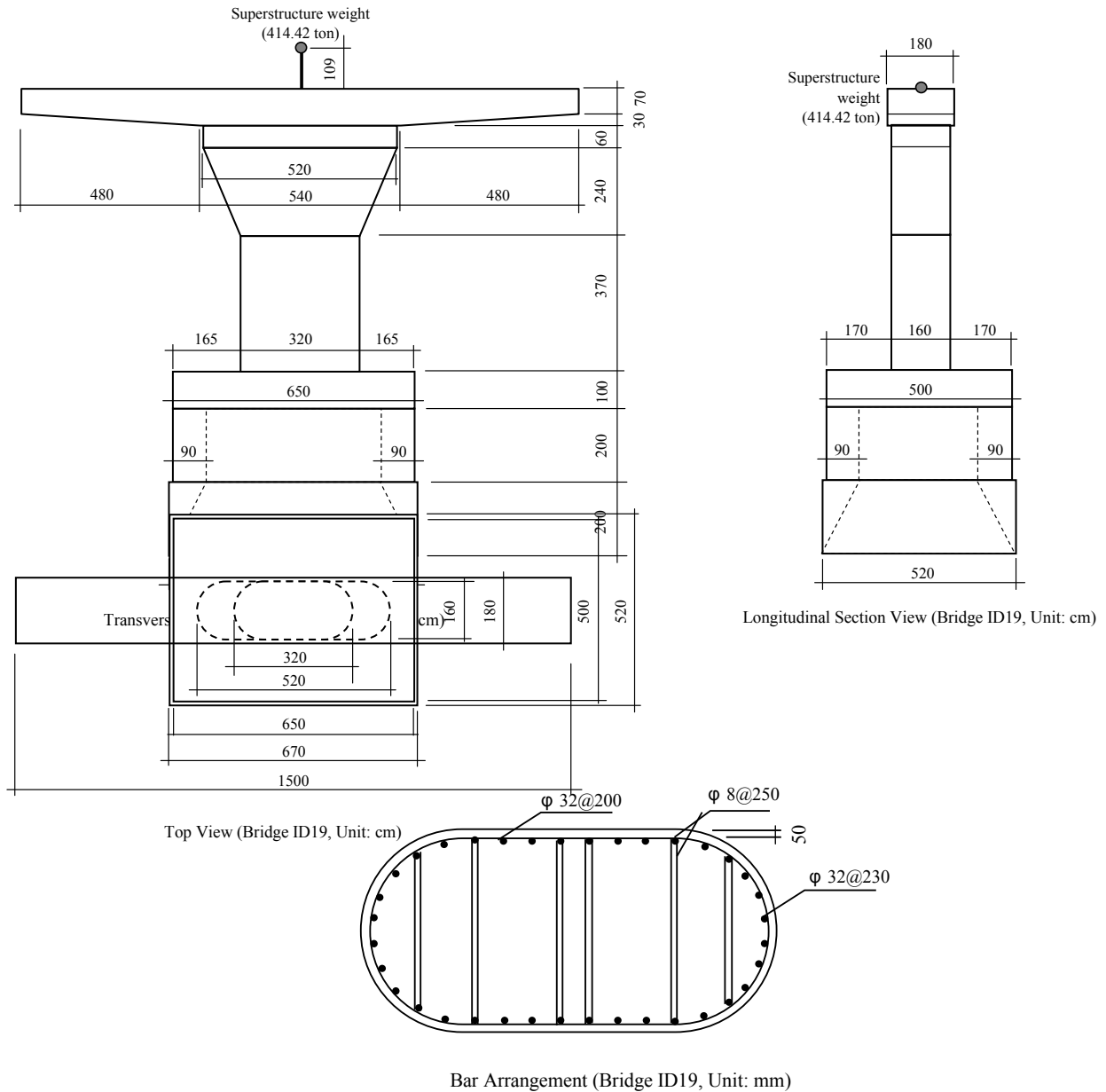


Figure 2.3.1 Dimension of bridge pier and bar arrangement (Bridge No.19)

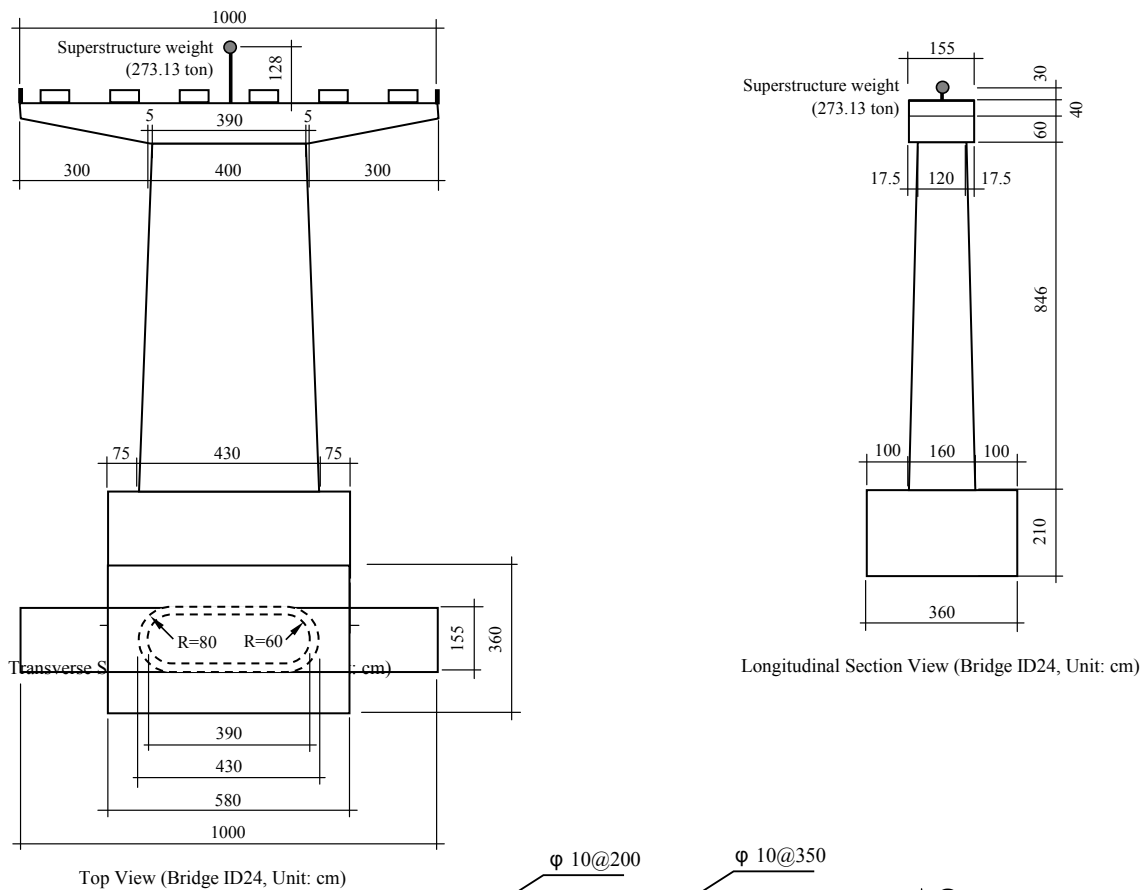


Figure 2.3.1 Dimension of bridge pier and bar arrangement (Bridge No.24)
 Bar Arrangement (Bridge ID24, Unit: mm)

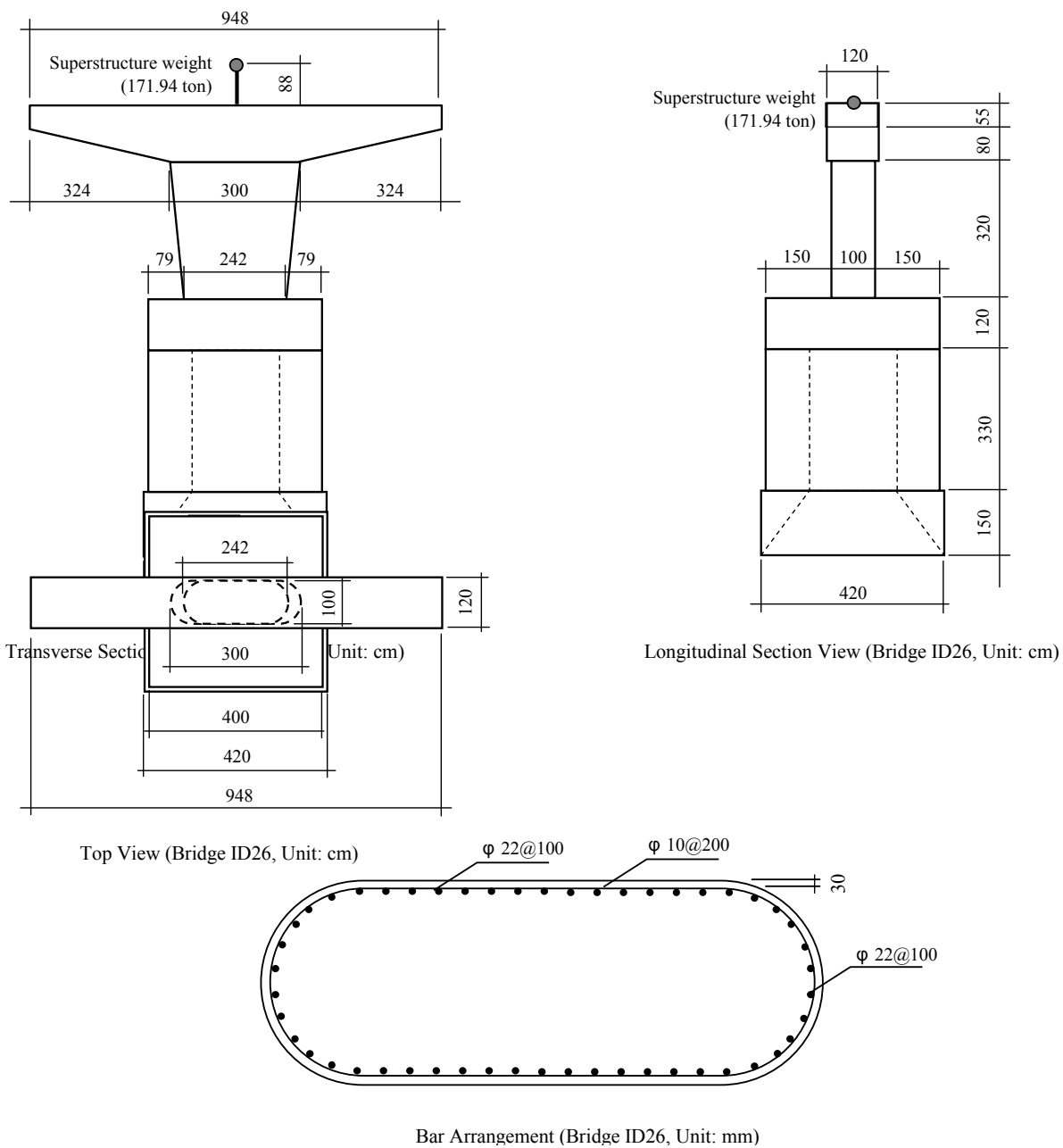


Figure 2.3.1 Dimension of bridge pier and bar arrangement (Bridge No.26)

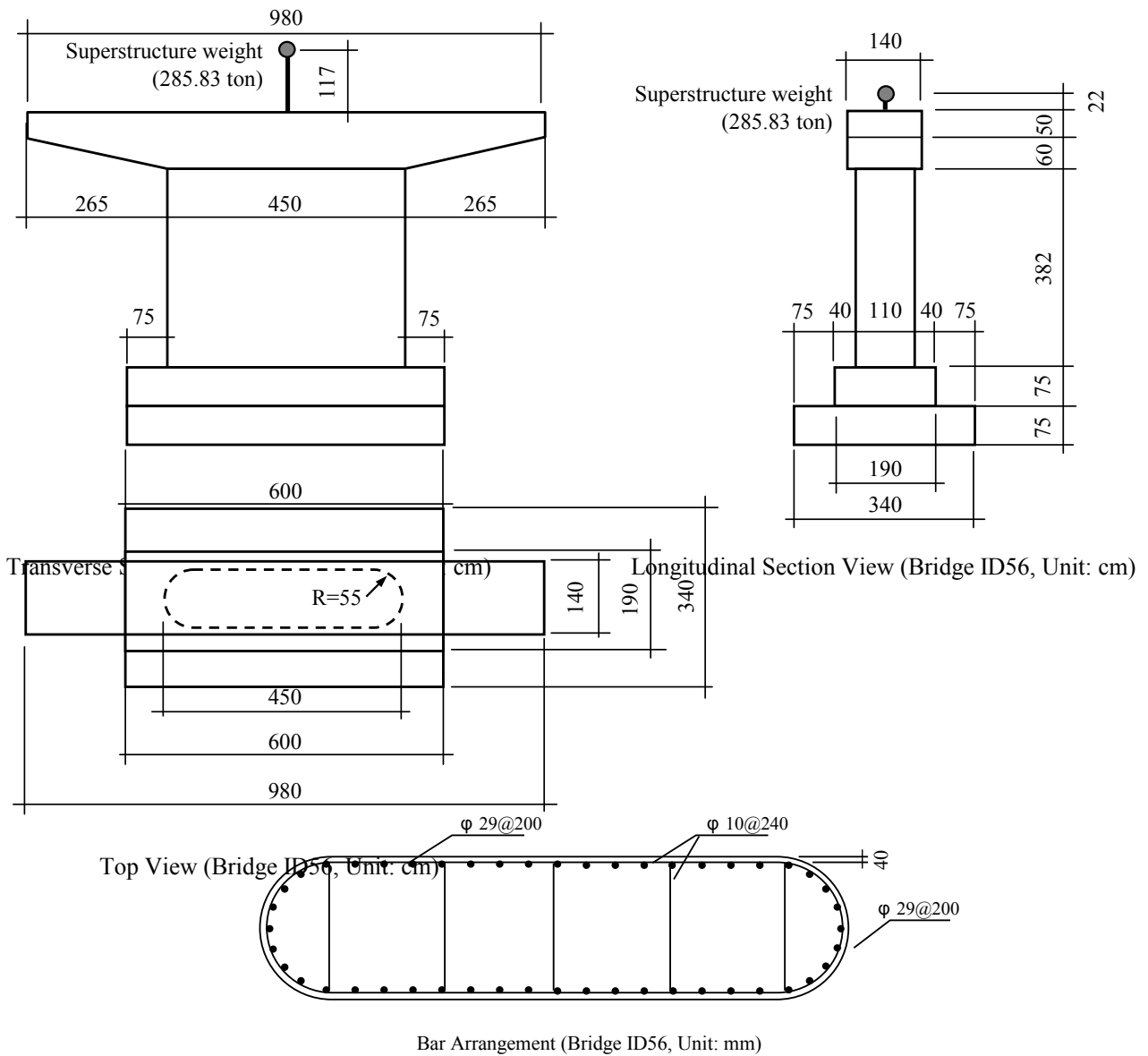


Figure 2.3.1 Dimension of bridge pier and bar arrangement (Bridge No.56)

Chapter 3 Disaster Awareness Survey

3.1 Questionnaire of Disaster Awareness of Ulaanbaatar City Citizens – Ger Area

3.1.1 Questionnaire of Disaster Awareness of Ulaanbaatar City Citizens – Ger Area

Questionnaire of Disaster Awareness of Ulaanbaatar City Citizens **【Ger Area】**

The possibility of occurrence of earthquake is pointed out according the recent finding of active faults near Ulaanbaatar city which may cause the earthquake of about MSK scale 10. The government of Mongolia and the city of Ulaanbaatar are preparing the Earthquake Risk Management Plan.

This questionnaire is to hear your disaster experience, damages of Buildings, Electricity, Water Supply and others and your preparedness for disasters. Please mark ○ from choices of answers to fit to your case. Some questions are filling in form there.

Earthquake Experience

1. Have you ever experience Earthquakes? (Only one ○)
 - ① No
 - ② Yes

2. To whom answered ② in Q1. Where did you experience Earthquake ? (Only one ○)
 - ① Experienced in Ulaanbaatar
 - ② Experienced outside of Ulaanbaatar

3. To whom answered ② in Q1. How much did the Earthquake in UB city shake ? (Only one ○)
 - ① Slight
 - ② Heavy
 - ③ Extremely heavy

4. Have you experience Earthquakes in UB city in this 2 to 3 years? (Only one ○)
 - ① No
 - ② Yes, slightly
 - ③ Yes, heavily
 - ④ Yes, extremely heavily

5. To whom answered ②to ④ in Q4. What did you do during Earthquake shaking? (Only one ○)
 - ① Nothing
 - ② Holding furniture
 - ③ Extinguished fire
 - ④ Stay safe place in house
 - ⑤ Go outside of house
 - ⑥ Other (please write: _____)

Knowledge of Earthquake

6. Do you know Earthquake? (Multiple ○)
 - ① Do not know
 - ② Yea, from Parents
 - ③ Yes, in school

- ④ Yes, from TV, Newspapers
- ⑤ Yes, experienced

Possibility of Earthquake in Ulaanbaatar

7. Do you think Earthquake occurs in Ulaanbaatar? (Only one ○)
- ① No
 - ② Small earthquake may come, but not soon
 - ③ Big earthquake may come, but not soon
 - ④ Small earthquake may come soon
 - ⑤ Big earthquake may come soon
8. What may happen if Earthquake occurs? (Multiple ○)
- ① Fall down in side of house
 - ② TV and electric equipment may fall down
 - ③ House may be collapsed
 - ④ Furniture may fall down
 - ⑤ Door may not open
 - ⑥ Window glass may be broken
 - ⑦ Electricity may be shut off
 - ⑧ Water supply may stop
 - ⑨ Hot water system may down
 - ⑩ Fire breaks out
 - ⑪ (Mobile) Telephone may not work
 - ⑫ Car cannot run
 - ⑬ Bridges may fall down
 - ⑭ Road may sink down
 - ⑮ Big buildings may collapse
 - ⑯ Traffic may be paralyzed
 - ⑰ People rush to food stores
 - ⑱ City may confuse
 - ⑲ Nothing may occur
 - ⑳ No idea
9. What may happen the school building if Earthquake occur? (Only one ○)
- ① May not be damaged
 - ② Slight damage
 - ③ Heavy damage

Difficulty after Earthquake

10. What are difficult things after earthquake occur? (Multiple ○)
- ① Rescue team may not com
 - ② Firefighters may not come
 - ③ Lose house to live
 - ④ Lose house to live by fire
 - ⑤ Cannot get information without TV
 - ⑥ Electricity and water supply may not come
 - ⑦ Hot water system may stop
 - ⑧ Cannot contact with family without phone
 - ⑨ Rescue materials cannot be delivered by collapse of Roads and Bridges
 - ⑩ No food
 - ⑪ School collapsed and no class

- ⑫ Suffer gender problems
- ⑬ Robbery
- ⑭ No problems in country side
- ⑮ No problem

Actions during Earthquake

11. What actions do you take during earthquake? (Only one ○)

- ① Stay in house
- ② Go out from house
- ③ Other (please write: _____)

12. What actions do you take after earthquake? (Only one ○)

- ① Help others
- ② Clean house
- ③ Stay in garden
- ④ Evacuate to wide open space
- ⑤ Other (please write: _____)

13. Where do you go if house collapsed? (Only one ○)

- ① Live in garden
- ② Go to relative's house
- ③ Evacuate to school
- ④ Other (please write: _____)

14. What action do you take if fire breaks out (Only one ○)

- ① Extinguish fire
- ② Telephone to fire station
- ③ Escape

Preparation for earthquake

15. What do you prepare for earthquake? (Multiple ○)

- ① House was made strong
- ② Decided where to evacuate
- ③ Stock drinking water
- ④ Stock food
- ⑤ Other (please write: _____)

Participation to Disaster Drill

16. Have you ever participated the earthquake drill? (Multiple ○)

- ① Evacuation from building
- ② Evacuation to evacuation place
- ③ Fire extinguish
- ④ Other (please write: _____)

17. Who dose organize the drill? (Multiple ○)

- ① UB city
- ② District
- ③ kholoo
- ④ Resident organization
- ⑤ NGO or International Organizations
- ⑥ Other (please write: _____)

Action from Earthquake from Government

18. Did you get disaster information came from Government? (Multiple ○)
- ① Distribution of booklets about disaster
 - ② Distribution of risk of earthquake
 - ③ Disaster drill
 - ④ Firefighting drill
 - ⑤ Publication and guideline of risk of house
 - ⑥ Distribution of booklet about actions in case of earthquake
 - ⑦ Other (please write: _____)

19. Request to government about earthquake disaster (Multiple ○)
- ① Disaster knowledge
 - ② Risk of earthquake occurrence, high risk place in UB city
 - ③ Time of Earthquake will occur
 - ④ High risk place in UB city
 - ⑤ Evacuation drill
 - ⑥ Firefighting drill
 - ⑦ Building risk
 - ⑧ Safety of my house
 - ⑨ Strengthening school buildings
 - ⑩ How to reinforce building for Earthquake
 - ⑪ Action to be taken during Earthquake occurs
 - ⑫ Preparedness for Earthquake
 - ⑬ Other (please write: _____)

Community Organization

20. Is there community organization in your area? (Only one ○)
- ① No
 - ② Yes, for long time
 - ③ Yes, recently organized
21. What are the activity of your community organization? (Multiple ○)
- ① Transfer information from government to residents
 - ② Transfer requests from residents to government
 - ③ Cleaning of community
 - ④ Water Selling
 - ⑤ Firefighting in case of fire
 - ⑥ Help each other in case of disaster occurs
 - ⑦ Other (please write: _____)
22. How to selection of community organization leader? (Only one ○)
- ① Select by residents
 - ② Nominated from local government
 - ③ Other (please write: _____)

About answerer

23. Sex (Only one ○)
- ① Male
 - ② Female

24. Age (Only one ○)

- ① 10th
- ② 20th
- ③ 30th
- ④ 40th
- ⑤ 50th
- ⑥ 60th or over

25. Living years at present house (Only one ○)

- ① Less than 5 years
- ② Less than 10 years
- ③ Less than 20 years
- ④ More than 20 years

26. Type of house you are now living (Only one ○)

- ① Apartment house(up to 5 floors)
- ② Apartment house(more than 5 floors)
- ③ Ger
- ④ Individual house
- ⑤ Other (please write: _____)

27. Structure of house (Only one ○)

- ① Wood
- ② Bricks
- ③ Concrete panel
- ④ Steel
- ⑤ Ger
- ⑥ Other (please write: _____)

28. Occupations (Only one ○)

- ① Public servant
- ② Teacher
- ③ Private owner
- ④ Private company employee
- ⑤ House wife
- ⑥ Student
- ⑦ No occupation
- ⑧ Other (please write: _____)

29. Academic career (Only one ○)

- ① Elementary School
- ② Junior High School
- ③ High School
- ④ University
- ⑤ University Graduate School

3.1.2 Questionnaire of Disaster Awareness of Ulaanbaatar City Citizens- Apartment Area

Questionnaire of Disaster Awareness of Ulaanbaatar City Citizens **【Apartment Area】**

The possibility of occurrence of earthquake is pointed out according the recent finding of active faults near Ulaanbaatar city which may cause the earthquake of about MSK scale 10. The government of Mongolia and the city of Ulaanbaatar are preparing the Earthquake Risk Management Plan.

This questionnaire is to hear your disaster experience, damages of Buildings, Electricity, Water Supply and others and your preparedness for disasters. Please mark ○ from choices of answers to fit to your case. Some questions are filling in form there.

Earthquake Experience

30. Have you ever experience Earthquakes? (Only one ○)
- ① No
 - ② Yes
31. To whom answered ② in Q1. Where did you experience Earthquake ? (Only one ○)
- ① Experienced in Ulaanbaatar
 - ② Experienced outside of Ulaanbaatar
32. To whom answered ② in Q1. How much did the Earthquake in UB city shake ? (Only one ○)
- ① Slight
 - ② Heavy
 - ③ Extremely heavy
33. Have you experience Earthquakes in UB city in this 2 to 3 years? (Only one ○)
- ① No
 - ② Yes, slightly
 - ③ Yes, heavily
 - ④ Yes, extremely heavily
34. To whom answered ②to ④ in Q4. What did you do during Earthquake shaking? (Only one ○)
- ① Nothing
 - ② Holding furniture
 - ③ Extinguished fire
 - ④ Stay safe place in house
 - ⑤ Go outside of house
 - ⑥ Other (please write: _____)

Knowledge of Earthquake

35. Do you know Earthquake? (Multiple ○)
- ① Do not know
 - ② Yea, from Parents
 - ③ Yes, in school
 - ④ Yes, from TV, Newspapers
 - ⑤ Yes, experienced

Possibility of Earthquake in Ulaanbaatar

36. Do you think Earthquake occurs in Ulaanbaatar? (Only one ○)
- ① No
 - ② Small earthquake may come, but not soon
 - ③ Big earthquake may come, but not soon
 - ④ Small earthquake may come soon
 - ⑤ Big earthquake may come soon
37. What may happen if Earthquake occurs? (Multiple ○)
- ① Fall down in side of house
 - ② TV and electric equipment may fall down
 - ③ House may be collapsed
 - ④ Furniture may fall down
 - ⑤ Door may not open
 - ⑥ Window glass may be broken
 - ⑦ Electricity may be shut off
 - ⑧ Water supply may stop
 - ⑨ Hot water system may down
 - ⑩ Fire breaks out
 - ⑪ (Mobile) Telephone may not work
 - ⑫ Car cannot run
 - ⑬ Bridges may fall down
 - ⑭ Road may sink down
 - ⑮ Big buildings may collapse
 - ⑯ Traffic may be paralyzed
 - ⑰ People rush to food stores
 - ⑱ City may confuse
 - ⑲ Nothing may occur
 - ⑳ No idea
38. Do you think your house may collapse if earthquake occurs? (Only one ○)
- ① May not be damaged
 - ② May get small damaged
 - ③ May get big damage
 - ④ Other (please write: _____)
39. To whom answered ② or ③ in previous question, What do you do? (Only one ○)
- ① Do nothing
 - ② Retrofit house by my expense
 - ③ Ask retrofit house by government expense
 - ④ Move to much strong house
 - ⑤ Move to Ger
40. What may happen the school building if Earthquake occur? (Only one ○)
- ① May not be damaged
 - ② Slight damage
 - ③ Heavy damage

Difficulty after Earthquake

41. What are difficult things after earthquake occur? (Multiple ○)
- ① Rescue team may not com
 - ② Firefighters may not come

- ③ Lose house to live
- ④ Lose house to live by fire
- ⑤ Cannot get information without TV
- ⑥ Electricity and water supply may not come
- ⑦ Hot water system may stop
- ⑧ Cannot contact with family without phone
- ⑨ Rescue materials cannot be delivered by collapse of Roads and Bridges
- ⑩ No food
- ⑪ School collapsed and no class
- ⑫ Suffer gender problems
- ⑬ Robbery
- ⑭ No problems in country side
- ⑮ No problem

Actions during Earthquake

42. What actions do you take during earthquake? (Only one ○)

- ① Stay in house
- ② Go out from house
- ③ Other (please write: _____)

43. What actions do you take after earthquake? (Only one ○)

- ① Help others
- ② Clean house
- ③ Stay in garden
- ④ Evacuate to wide open space
- ⑤ Other (please write: _____)

44. Where do you go if house collapsed? (Only one ○)

- ① Live in garden
- ② Go to relative's house
- ③ Evacuate to school
- ④ Other (please write: _____)

45. What action do you take if fire breaks out (Only one ○)

- ① Extinguish fire
- ② Telephone to fire station
- ③ Escape

Preparation for earthquake

46. What do you prepare for earthquake? (Multiple ○)

- ① House was made strong
- ② Decided where to evacuate
- ③ Stock drinking water
- ④ Stock food
- ⑤ Other (please write: _____)

Participation to Disaster Drill

47. Have you ever participated the earthquake drill? (Multiple ○)

- ① Evacuation from building
- ② Evacuation to evacuation place

- ③ Fire extinguish
- ④ Other (please write: _____)

48. Who dose organize the drill? (Multiple)

- ① UB city
- ② District
- ③ kholoo
- ④ Resident organization
- ⑤ NGO or International Organizations
- ⑥ Other (please write: _____)

Action from Earthquake from Government

49. Did you get disaster information came from Government? (Multiple)

- ① Distribution of booklets about disaster
- ② Distribution of risk of earthquake
- ③ Disaster drill
- ④ Firefighting drill
- ⑤ Publication and guideline of risk of house
- ⑥ Distribution of booklet about actions in case of earthquake
- ⑦ Other (please write: _____)

50. Request to government about earthquake disaster (Multiple)

- ① Disaster knowledge
- ② Risk of earthquake occurrence, high risk place in UB city
- ③ Time of Earthquake will occur
- ④ High risk place in UB city
- ⑤ Evacuation drill
- ⑥ Firefighting drill
- ⑦ Building risk
- ⑧ Safety of my house
- ⑨ Strengthening school buildings
- ⑩ How to reinforce building for Earthquake
- ⑪ Action to be taken during Earthquake occurs
- ⑫ Preparedness for Earthquake
- ⑬ Other (please write: _____)

Community Organization

51. Is there community organization in your area? (Only one)

- ① No
- ② Yes, for long time
- ③ Yes, recently organized

52. What are the activity of your community organization? (Multiple)

- ① Transfer information from government to residents
- ② Transfer requests from residents to government
- ③ Cleaning of community
- ④ Water Selling
- ⑤ Firefighting in case of fire
- ⑥ Help each other in case of disaster occurs
- ⑦ Other (please write: _____)

53. How to selection of community organization leader? (Only one ○)

- ① Select by residents
- ② Nominated from local government
- ③ Other (please write: _____)

About answerer

54. Sex (Only one ○)

- ① Male
- ② Female

55. Age (Only one ○)

- ① 10th
- ② 20th
- ③ 30th
- ④ 40th
- ⑤ 50th
- ⑥ 60th or over

56. Living years at present house (Only one ○)

- ① Less than 5 years
- ② Less than 10 years
- ③ Less than 20 years
- ④ More than 20 years

57. Type of house you are now living (Only one ○)

- ① Apartment house(up to 5 floors)
- ② Apartment house(more than 5 floors)
- ③ Ger
- ④ Individual house
- ⑤ Other (please write: _____)

58. Structure of house (Only one ○)

- ① Wood
- ② Bricks
- ③ Concrete panel
- ④ Steel
- ⑤ Ger
- ⑥ Other (please write: _____)

59. Occupations (Only one ○)

- ① Public servant
- ② Teacher
- ③ Private owner
- ④ Private company employee
- ⑤ House wife
- ⑥ Student
- ⑦ No occupation
- ⑧ Other (please write: _____)

60. Academic career (Only one ○)

- ① Elementary School

- ② Junior High School
- ③ High School
- ④ University
- ⑤ University Graduate School

3.2 Result of Survey

Result of survey is shown in Figure 3.2.1.

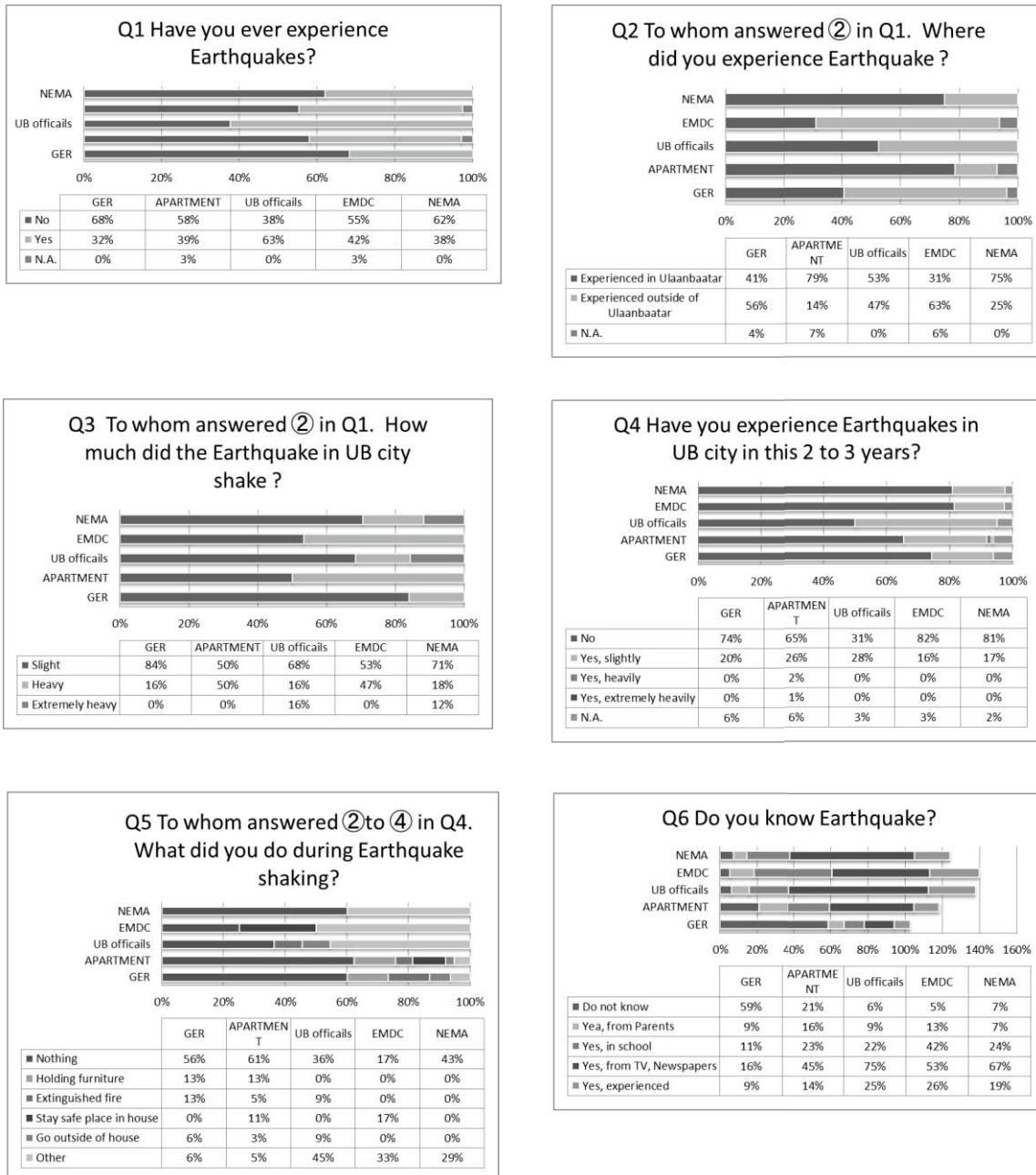


Figure 3.2.1 Result of survey

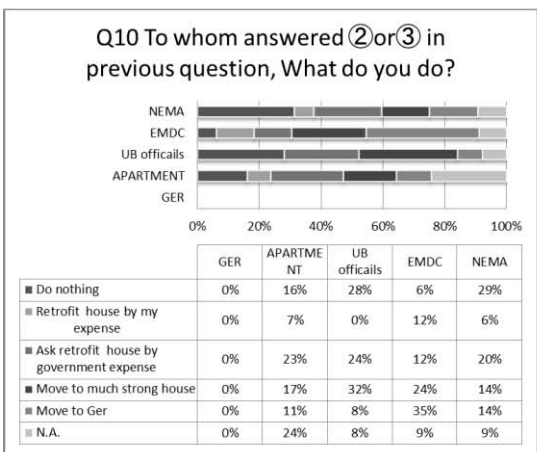
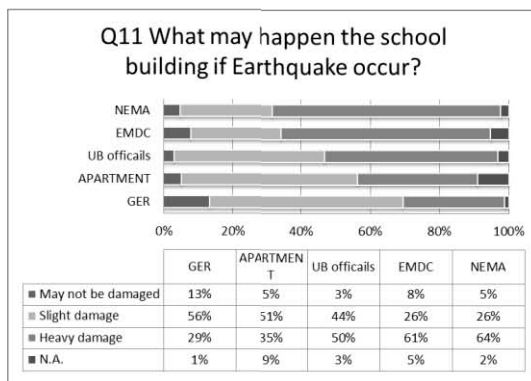
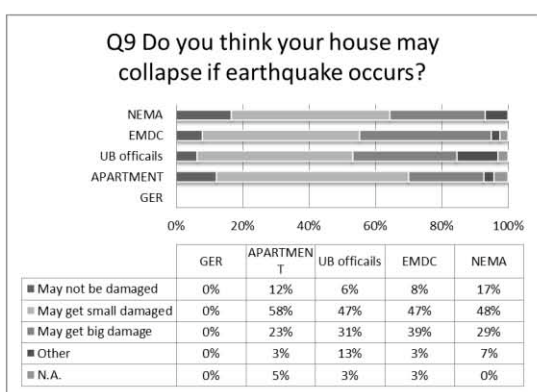
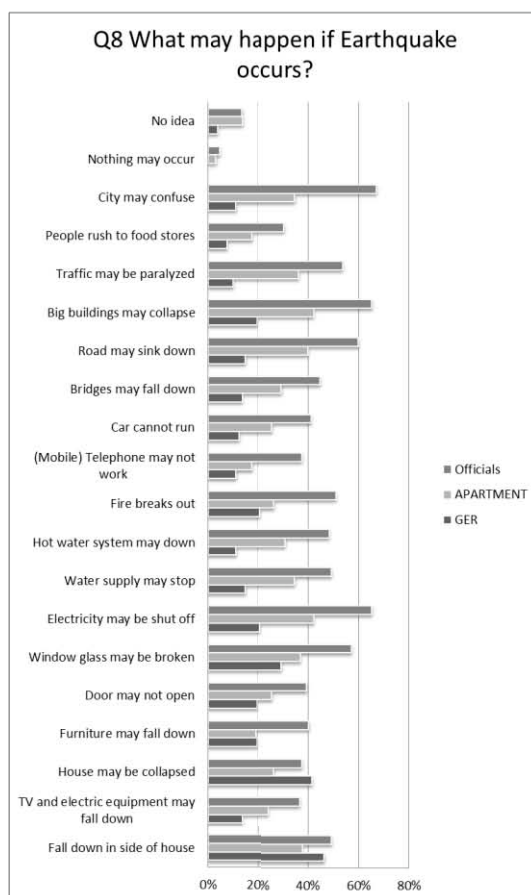
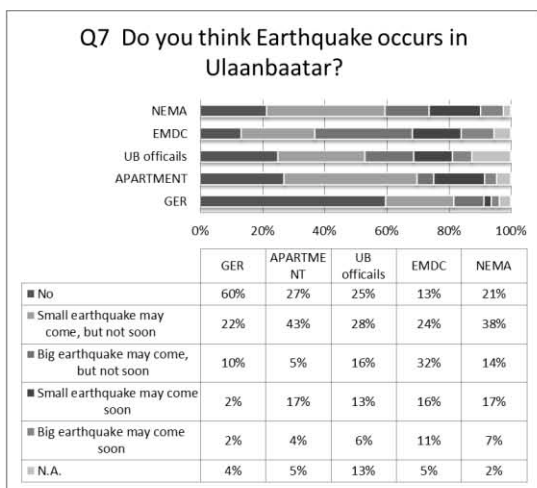


Figure 3.2.1 Result of survey (cont.)

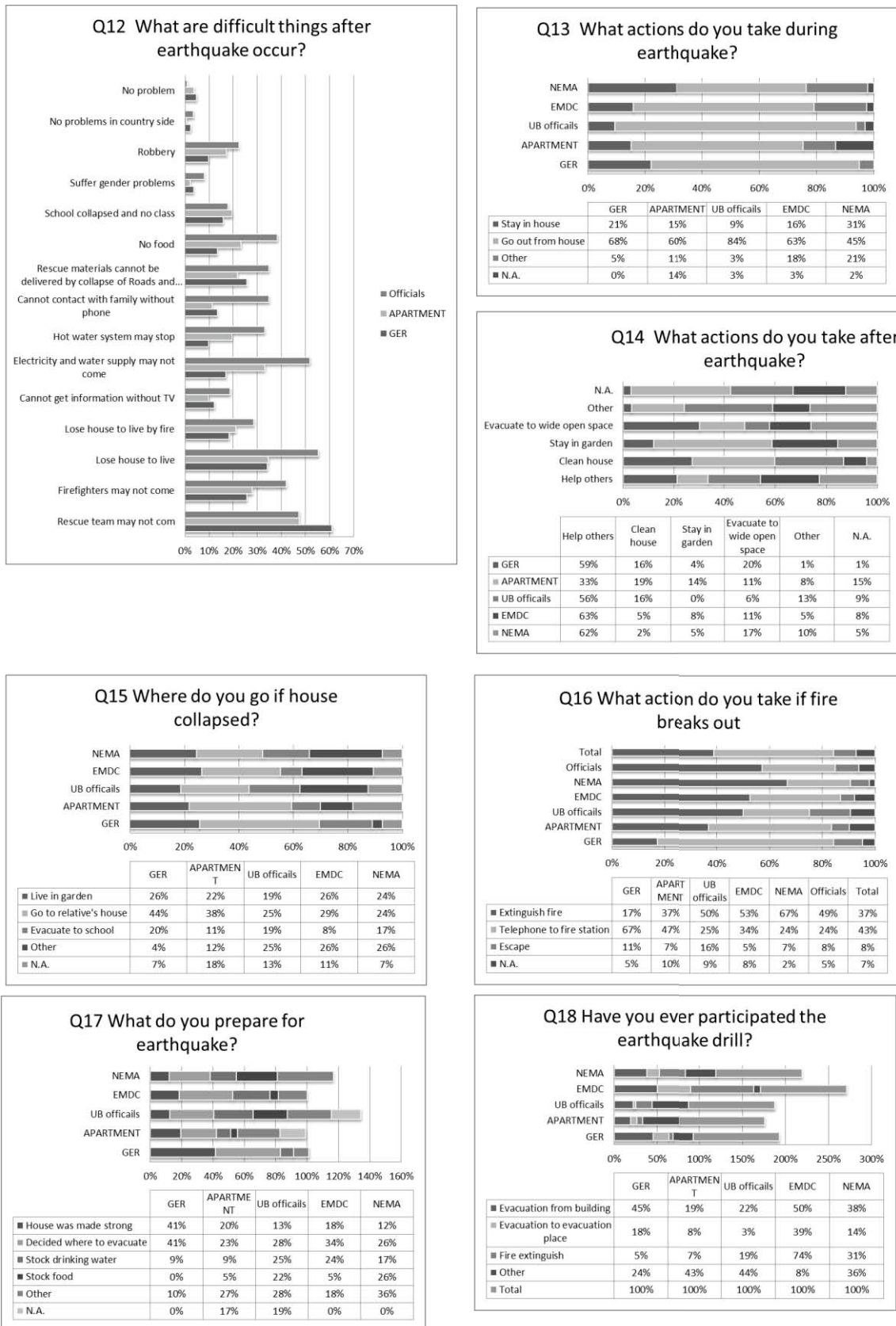


Figure 3.2.1 Result of survey (cont.)

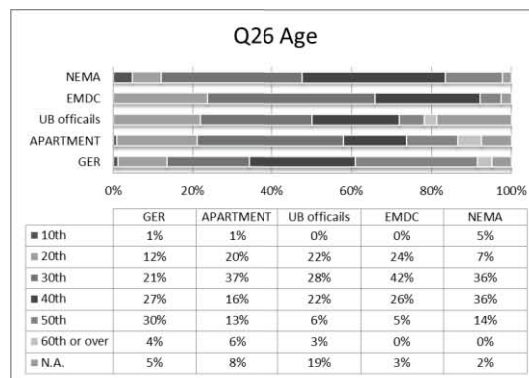
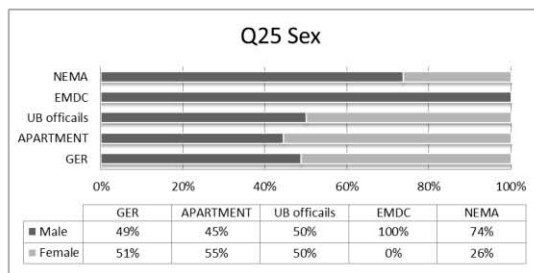
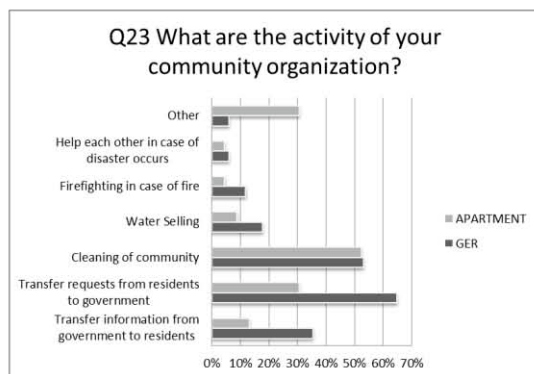
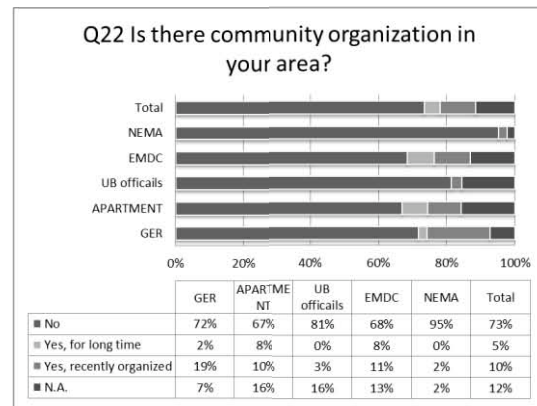
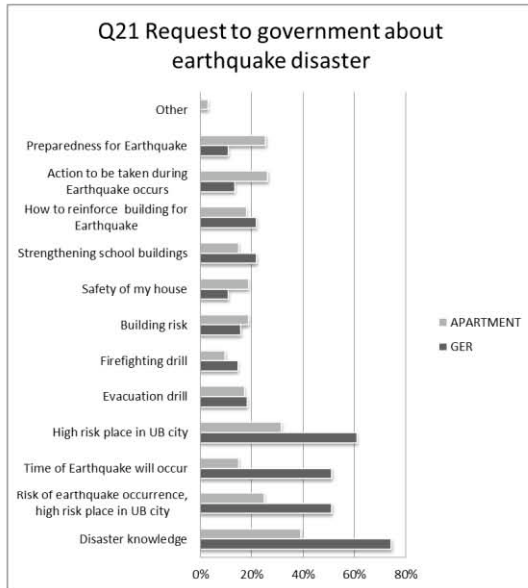
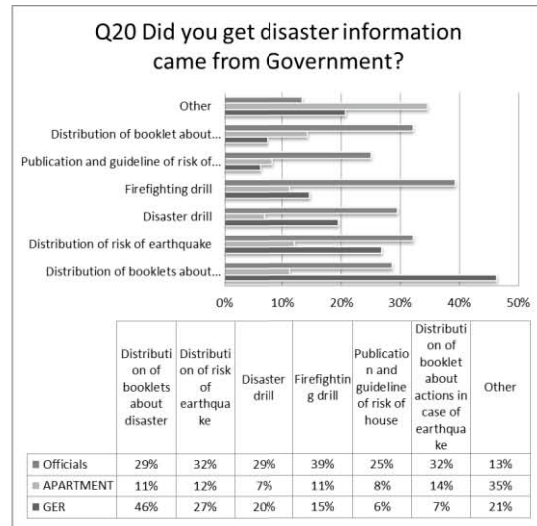
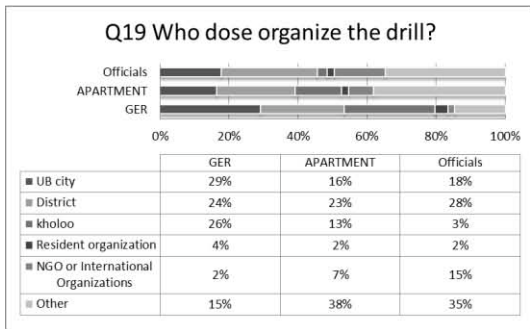


Figure 3.2.1 Result of survey (cont.)

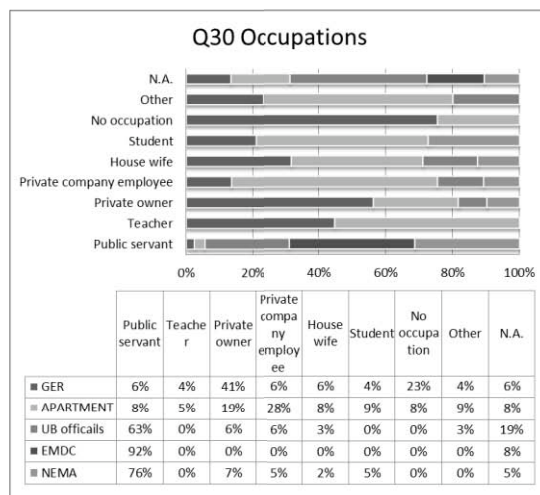
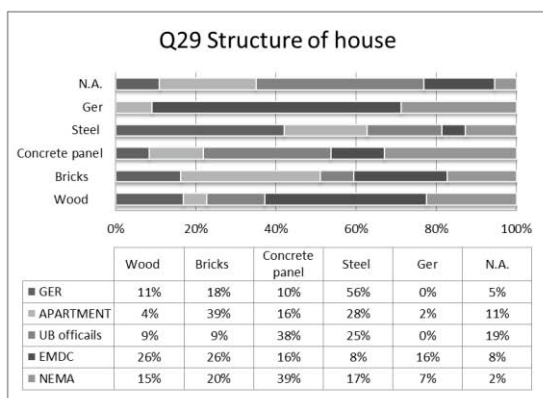
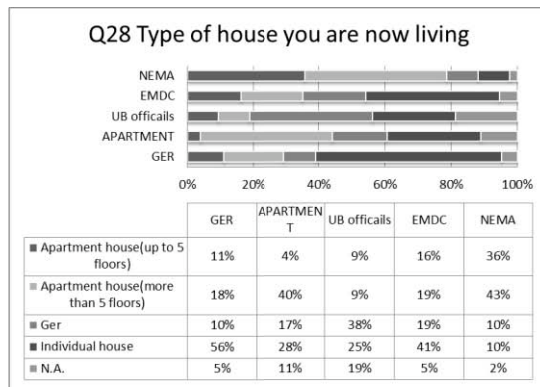
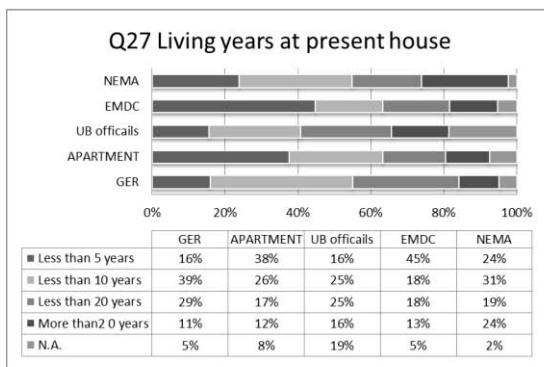


Figure 3.2.1 Result of survey (cont.)

Chapter 4 Minutes of Meeting

Minutes of Discussions
on the Project for Strengthening the Capacity of Seismic Disaster Risk Management
in Ulaanbaatar City, Mongolia
(Explanation of Draft Inception Report)

In March 2012, the Japan International Cooperation Agency dispatched the Project Team on the Project for Strengthening the Capacity of Seismic Disaster Risk Management in Ulaanbaatar City, Mongolia (hereinafter referred as "the Project") to Mongolia.

In order to explain the study content of the Project to the relevant organizations of the Steering Committee (hereinafter referred as "SC"), the first SC meeting was held in Ulaanbaatar on March 19, 2012. In the SC meeting, the content of the Project described in the Draft Inception Report was explained by Dr. Fukushima, Deputy Team Leader of the Project.

As the result of discussions, the content of the Inception Report was approved by the SC and both parties agreed on the followings.

- ✓ The relevant organizations of the SC shall provide the Project Team with information, documents and data necessary to the Project.
- ✓ The Government of Ulaanbaatar City (hereinafter referred as "GOU") shall assign eligible personnel for Working Groups of the Project and inform the Project Team at the earliest possible date.
- ✓ GOU shall provide the Project Team with appropriate project office near the City Government Office at the earliest possible date.

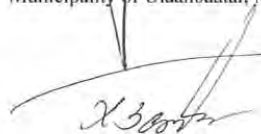
Ulaanbaatar, March 20, 2012



For Masaru Arakida
Team Leader of the Project for Strengthening
the Capacity of Seismic Disaster Risk
Management in Ulaanbaatar City, Mongolia



Munkhbaatar Begzjav
Vice Mayor
Municipality of Ulaanbaatar, Mongolia



Batbileg Khalzankhuu
Director Commissioner
The Emergency Management Department of
the Capital City, Mongolia

Minutes of Discussions
on the Project for Strengthening the Capacity of Seismic Disaster Risk Management
in Ulaanbaatar City, Mongolia
(Explanation of Draft Progress Report I)

In March 2012, the Japan International Cooperation Agency dispatched the Project Team on the Project for Strengthening the Capacity of Seismic Disaster Risk Management in Ulaanbaatar City, Mongolia (hereinafter referred as “the Project”) to Mongolia, then the Project Team started necessary surveys with the assigned Working Groups to conduct the Project.

Due to wide personnel change after the nationwide election of Mongolia on June 28, 2012, the Steering Committee (hereinafter referred as “SC”) to explain the progress of the Project could not be held. Instead of SC, the meeting with the representative of SC was held in Ulaanbaatar on November 29, 2012. In the meeting, the content of the Project described in the Draft Progress Report was explained by Mr. Arakida, Team Leader of the Project.

As the result of discussions, the content of the Progress Report was approved by Mr. Batbileg Khalzankhuu, on behalf of SC, Director Commissioner of the Emergency Management Department of the Capital City, and both parties agreed on the followings.

- ✓ The relevant organizations of the SC shall provide the Project Team with information, documents and data necessary to the Project.
- ✓ The Working Groups of the Project shall continuously work for each objective.

Ulaanbaatar, November 29, 2012



Masaru Arakida
Team Leader of the Project for Strengthening
the Capacity of Seismic Disaster Risk
Management in Ulaanbaatar City, Mongolia



Batbileg Khalzankhuu
Director Commissioner
The Emergency Management Department of
the Capital City, Mongolia

**Minutes of Meeting of the first Joint Coordination Committee
on the Project for Strengthening the Capacity of Seismic Disaster Risk Management
in Ulaanbaatar City, Mongolia
(Explanation of Draft Progress Report II)**

In March 2012, the Japan International Cooperation Agency (hereinafter referred as “JICA”) dispatched the Project Team (hereinafter referred as “PT”) on the Project for Strengthening the Capacity of Seismic Disaster Risk Management in Ulaanbaatar City, Mongolia (hereinafter referred as “the Project”) to Mongolia, then the Project Team started necessary surveys with the assigned Working Groups (hereinafter referred as “WG”) to conduct the Project.

The first Joint Coordination Committee (hereinafter referred as “JCC”) to explain the second progress of the Project is held on March 26, 2013. In JCC, the contents of the Project described in the Draft Progress Report were explained by PT and WG as followings.

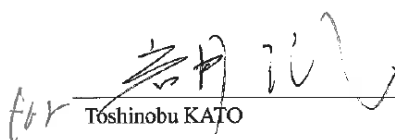
- ✓ Current situation of the Project
- ✓ The brief summary of the Draft Progress Report II
- ✓ The outline of activities and next schedule of WGs
- ✓ The overview of the training course in Japan

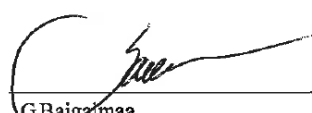
As the result of discussions in JCC, the content of the Progress Report II was approved by Mr. G.Baigalmaa, on behalf of JCC, Vice Minister of the Ministry of Construction and Urban Development, and both parties agreed on the followings.


- ✓ Related parties shall adjust contents of Draft Progress Report II
- ✓ The survey result shall be reflected to future plans and policies
- ✓ The relevant organizations of the JCC shall contribute the earthquake disaster prevention awareness campaign of UB city on 22-23 May 2013.
- ✓ Next JCC for the Final Report of the Project shall be held on June 2013.

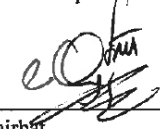
Annex: Detail of minutes of 1st JCC, Participants list

Ulaanbaatar city, 26 March 2013


Toshinobu KATO
Chief Representative, JICA Mongolia Office


G.Baigalmaa
Vice Minister, Ministry of Construction and
Urban Development


Masaru ARAKIDA
Team Leader of the Project for Strengthening the
Capacity of Seismic Disaster Risk Management
in Ulaanbaatar City, Mongolia


S.Ochirbat
Vice Mayor, Ulaanbaatar City

Detail of Minutes of the 1st JCC

Name	The Project for Strengthening the Capacity of Seismic Disaster Risk Management in Ulaanbaatar City	
Date & Time	26 th March 2013 (TUE) 14:00-16:00	
Place	Meeting room, 3 rd Ministry of Construction and Urban Development	
Participants (Omit titles)	JCC member:	Vice Minister, and others (see participants list)
	JICA Mongolia Office:	Iwai, Kaneda, Bulgan
	Project Team:	Arakida, Fukushima, Ogawa, Kamimura, Has Baatar, Naranbat (Translation), Tegshjargal, Oyunjargal (Note)
Circulation	Agenda, Progress presentation, Progress Report II, Plan of the Disaster Prevention Campaign, Document of WG and Study meeting activity, Japanese Training Course presentation	

Objectives:

- ✓ Progress of the project
- ✓ Brief explanation of Progress Report II
- ✓ Explanation of WG and Study meeting Activities
- ✓ Report of the Training Course in Japan

1. Introduction

- (1) Introduction from Mr. Batjargal, Adjutant General, EMDC
- (2) Opening address from Ms. Baigalmaa, Vice Minister of Construction and Urban Development
- (3) Address from Mr. Arakida, Team Leader of the JICA project

2. Process of the Meeting

- (1) Mr. Arakida explained the progress of the project.
- (2) Mr. Fukushima briefly explained the progress report II. There were some questions and comments to the report. (the part after “→” shows answer and future actions to the question/comments responded by the project team)

Ms. Erdenetseteg, Ministry of Construction and Urban Development:

• For the damage estimation of water and sewerage system, is it based on the field research, or macro estimation with numerical simulation?

→ It is estimated with numerical simulation based on the experiences in the past earthquake damages in Japan. This simulation targeted all UB city area.

• Based on which data, did you estimate damage impact on water and sewage system? Where did you get the data ?

→ The GIS data including pipe length, bore diameter, pipe material are provided by the urban planning and development division of UB.

Ms. Baigalmaa, Vice Minister of Construction and Urban Development:

• How many buildings are targeted? Are other factors such as structure type and built year considered for the estimation?

→ It is simulated with individual building structure type and built year. Totally 180 thousands buildings are targeted.

1

C.O

[Signature]

[Signature]

Mr. Khurelshagai, Director of Administration of Land affairs, Geodesy and Cartography:

• The legend of soil type is partially mismatched to the one used in Mongolia. Is it based on Japanese classification?

→ The soil distribution map seems in line with Mongolian hypsographic map, however, the data is categorized under Japanese classification rule. The detail of the classification rule we used for this project is explained in the Progress Report II.

Future Actions: After detail data verification, the project team will explain the gap and its background to related organization in Mongolia.

Mr. Ochirbat, Vice Mayor:

• Do you have detail information of active faults? Is the new airport a part of evaluation in this project?

→ We have limited information about the new airport. According to the distance between the identified 4 faults and the location, the risk which might be caused by the earthquake seems relatively low. If the new airport would be constructed according to the current building code of Mongolia, damage of the building would be minor.

• Is the unknown fault included to this research project?

→ Such unknown fault is out of the scope of this damage estimation.

Mr. Altangerel, Deputy Director of Urban Planning division:

• Are the power plants and substations included to the damage estimation?

→ Only distribution cable is included in the damage estimation target.

Mr. Jargalsaikhan, National Security Committee:

• In this project, the size of possible earthquake is estimated Mw7.6 by Hustai fault, Mw7.0 by Emeelt fault, and Mw7.0 by Gunjin fault. Is the case caused by Hustai fault biggest scale and biggest damage?

→ Yes, the project estimated so.

• Emeelt and Gunjin faults are closer to UB than Hustai fault. Why is the damage caused by far fault estimated bigger than the one caused by closer faults?

→ It depends on the structure type. The damage of soft structure is bigger in case of large-scale earthquake (caused by Hustai fault, in this case) even the distance between the building location and fault is far. And the damage of hard structure becomes bigger in case of earthquake happened close distance (caused by Emeelt and Gunjin faults, in this case).

Future Action: The project team will set another occasion to explain the relation between distance from fault, earthquake scale and the size of damage.

• The Mw7.6 for earthquake caused by Hustai is considered as maximum. Is it possible to estimate damage impacts in case of lower Mw.7 or Mw6, for example?

→ In this project, the project team uses Mw7.6 for maximum damage estimation, but numerical simulation itself is able to calculate with lower magnitude.

Mr. Sukhbaatar, head of National Science Academy:

• Was there any difference between the result of conducted drilling survey with 50 points in UB under this project and ground survey data surveyed in the past?

Handwritten notes and signatures: "ng", "C.O", a circled "2", and a signature.

→ The project team confirmed there was no difference, after comparing result of this project and past drilling data.

• This project estimated hazard scale is bigger than the present estimation done by the Research Center of Astronomy and Geophysics, Mongolian Academy of Sciences. What do you think about this gap?

→ The project member think the gap is caused by the difference of amplification characteristic of subsurface layer.

• National science academy uses probability theory evaluation, don't you use this theory?

→ In case of planning building, the probability theory is suitable. However, in case of damage estimation, worst situation with fixed location(s) and scale is suitable, we believe. This damage estimation under this project is not meant for utilization of building code.

Mr. Jargalsaikhan, National security committee:

• Why is the pipe damage with far fault bigger?

→ For estimation of pipe damage, not acceleration but velocity become influential on relational expression. And the velocity depends on the size of magnitude than the distance from the fault. Thus, estimated damage on pipe is considered larger, when the magnitude of the earthquake is bigger.

(3) Dr. Ogawa explained for WG and study meeting activities.

(4) Mr. Turmandakh, Audit Inspector, EMDC of Bayangol district, shared his lessons learned from the training course in Japan.

3. Miscellaneous

• Mr. Odkhuu, Expert, Ministry of Information, mail and communication: We are implementing the project of the early warning system in collaboration with NEMA. 4 mobile phone companies are engaged. We hope future cooperation between our project and this Seismic Disaster Risk Management project on this matter.

→ We would like to know more detail later.

• Mr. Jargalsaikhan, National security committee: Earthquake is the new disaster for Mongolia. Currently, UB city has big population but no experience of earthquake disaster. I personally believe that the result of this research report shall be reflected to national plans and policy in the future.

• Ms. Baigalmaa, Vice Minister of Construction and Urban Development: I expect the final report will be more comprehensive with reflection of recommendations from JCC within next three months. And also I expect the continuation of this project, the detail shall be discussed with persons in charge of this project. In my ministry, we have a plan to establish the earthquake research center. I would like to cooperate with Japan from the preparation phase by utilizing Japanese experiences and knowledge on earthquake. Furthermore, I expect cooperation for human resource development and adoption of equipment and materials. And there were a lot of technical contents in today's presentations. I guess some of participants don't understand well, therefore I would like to ask you for additional personal explanations to them, and I hope more easy description in the final report for non-technical persons.

3



3



- Mr. Iwai, JICA: In area of disaster preparedness, JICA is implementing a grant project to provide 22 fire trucks including aerial truck from Japan. It is planned that those trucks to be reached in UB before Naadam. In terms of the continuation of this Technical Assistance project, it is necessary to make detail proposal by the end of June. Ms. Kaneda and Ms. Bulgan are in charge of this matter at JICA Mongolia office.
- Mr. Arakida: The campaign of Earthquake Disaster Prevention will be held at 22-23 May. A chair-type machine to experience earthquake will be brought from Japan for this event. JICA project team would appreciate very much if the vice minister could try to feel it.
→ I hope to try it (Answered by Vice Minister).



4



JCC member and participants list

Name of committee member	Position	Attendance ○ By Proxy △ Absence × Absence	Name of Proxy Attendees	Other Change of member or position
(Mongolia) G.Baigalmaa	Vice Minister of Construction and Urban Development	○		
S.Ochirbat	Vice Mayor	○		
G.Mergenbayar	General Director of Strategic Policy and Planning Department, Ministry of Construction and Urban Development	△	E.Dondmaa	
Yo.Jargalsaikhan	Senior Officer of National Security Council	○		
Ts.Bayarbat	Deputy Director of Urban Development and Land Management Policy Department, Ministry of Construction and Urban Development	○		
R.Erdenetssetseg	Head of House and Community facilities policy execution Coordination Department, Ministry of Construction and Urban Development	○		
Ts.Bor (WG3)	Chief expert, Department of Construction and best policy execution, Ministry of Road and Transportation	×		
R.Erdenebaatar	Expert of Financial Policy Debt Management Division	×		There was a change in R.Erdenebaatar from B.Tuguldur by a personnel reshuffle.
Ts.Jadambaa	Chairman of Information Technology, Post and Telecommunications Authority	△	Ts.Odkhuu	
D.Gunibazar	Deputy Commissioner of National Inspection Agency	×		
T.Dulamdorj	Chairman of National Emergency Management Agency Colonel	×		
A.Khurelshagai	Director of Land Management and Surveying Department	○		
N.Natsagdorj	Director of City Planning Bureau General Architecture of UB city	△	T.Ganzorig	
S.Bayarbaatar	Director of Department Urban Development and Policy, Office of Mayor	○		It changes from G.Nandinjargal to S.Bayarbaatar by a personnel reshuffle. The member this official position doesn't have the change.
S.Bayar-Ulzii	UB City General Engineer, Head of Lifeline Facility Department Office of Mayor	△	Altangerel	
D.Nanzaddorj	Head of UB City Road Department	×		
B.Bayarsaikhan	Director of Government-owned Corporate Architectural Development Board	○		
U.Sukhbaatar (WG1)	Head of Research Center of Astronomy and Geophysics Mongolian Academy of Sciences	○		
S.Tsakhuur	General Manager of Design Department, UB City	×		
E.Ganzorig	Chairman of Civil Engineering Association	×		
(Japan) Iwai	Deputy Director, JICA Mongolia Office	○		
Kaneda	Planning Investigator, JICA	○		

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	Mongolia Office			
Bulgan	Staff, JICA Mongolia Office	○		
Kiguchi	Chief Adviser of Urban Development Ability Improvement JICA project team	○		
(PT) Arakida	Project leader	○		
Fukushima	Deputy leader	○		
Ogawa	Disaster prevention planning and the fire charge	○		
Has Baatar	Speacialist of Hazard and GIS	○		
Kamimura	Mapping	○		
(Secretary) N.Ulambayar	Head of Emergency Management Department of the Capital City	△	Batjargal	
(Other) E.Ariunnyam	Ministry of Construction and Urban Development	○		
Ts.Turmandakh	Disaster Prevention Inspector of Bayangol District Emergency Management Department of the Capital City	○		

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