THE PREPARATORY SURVEY
ON
EXPANSION OF NAM NGUM 1 HYDROPOWER STATION
IN
LAO PEOPLE'S DEMOCRATIC REPUBLIC
FINAL REPORT

Appendices

Appendix B Hydrology and Reservoir Operation

Appendix B-1 Hydrology

(Following data and documents are included in the Datafile)

Appendix B-2 Reservoir Operation Data

APPENDIX B-1: HYDROLOGY

Table B-1 Estimated Release from the Nam Ngum 2 Hydropower

(unit: m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Mean
1972	203	214	223	225	102	167	229	391	433	272	202	198	238.2
1973	208	210	219	218	216	182	229	278	433	283	202	199	239.7
1974	209	212	214	233	125	205	231	227	215	216	218	218	210.2
1975	234	141	45	37	80	214	231	266	433	287	194	206	197.5
1976	208	203	221	233	159	207	226	217	216	205	210	214	209.9
1977	210	223	235	233	74	82	217	226	222	214	229	238	200.1
1978	92	47	47	44	83	233	231	431	433	195	204	201	187.4
1979	212	213	223	224	213	210	226	225	210	216	219	219	217.5
1980	235	142	45	46	88	222	238	206	282	204	196	209	176.1
1981	212	215	216	233	140	234	240	434	433	395	194	206	262.9
1982	201	210	218	226	228	234	233	266	206	243	202	207	223.1
1983	201	210	218	227	228	155	217	223	214	204	212	219	210.8
1984	214	231	141	84	79	178	229	278	200	206	207	203	187.5
1985	213	215	217	234	128	224	228	227	208	214	216	215	211.3
1986	230	179	45	99	206	225	240	206	212	213	208	226	190.9
1987	234	141	45	46	66	128	145	216	225	226	221	237	161.0
1988	93	47	47	46	110	87	152	227	231	226	238	48	129.5
1989	46	47	47	41	87	233	222	226	220	212	222	224	152.9
1990	236	47	47	44	109	234	231	219	200	207	208	205	166.5
1991	217	222	226	107	53	189	226	227	213	222	229	229	196.4
1992	96	47	33	30	48	118	227	222	231	236	147	48	123.9
1993	46	47	34	0	108	225	239	270	209	203	214	222	152.3
1994	221	195	93	46	171	233	231	432	433	272	203	208	228.5
1995	202	212	223	224	166	232	216	278	434	195	204	201	232.0
1996	211	216	218	234	118	199	225	245	200	206	207	204	206.9
1997	215	219	225	158	97	170	238	239	281	203	196	209	204.0
1998	211	214	216	233	143	177	226	220	229	236	141	48	191.0
1999	32	0	37	46	192	234	235	215	215	205	215	223	155.0
2000	222	164	47	83	170	233	232	280	282	196	205	202	193.2
2001	213	217	228	217	153	234	230	279	242	203	204	201	218.4
2002	211	214	216	234	183	225	241	432	320	203	204	201	240.4
2003	211	214	216	234	110	178	231	220	231	233	228	97	199.9
2004	131	61	46	83	151	249	437	373	544	200	200	200	223.7
2005	200	207	200	200	131	320	471	688	460	283	200	200	297.5
2006	200	207	200	212	266	178	295	200	200	200	200	200	213.4
2007	200	198	43	39	80	131	193	200	200	200	200	200	156.8
Mean	187.0	158.9	134.7	128.5	126.1	192.1	222.5	266.9	274.4	233.5	208.5	200.0	194.5
Max	236.5	230.8	235.0	233.8	228.1	234.2	240.3	433.9	433.3	394.8	237.8	237.7	262.9
Min	32.0	46.8	32.9	0.0	48.1	81.8	144.7	206.0	199.9	194.7	147.2	48.5	123.9
STDV	57.8	72.6	87.3	92.4	58.2	48.0	24.1	76.2	97.6	44.4	17.6	49.1	35.2

Source; Southeast Asia Energy Limited, JICA Survey Team.

Table B-2 Diversion From the Nam Song River

(unit: m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Mean
1972	8.6	6.4	5.3	7.7	10.5	48.0	90.1	192.9	111.4	75.3	37.9	20.9	51.5
1973	12.4	10.1	10.6	5.9	17.4	59.0	173.7	143.1	210.0	88.7	28.2	16.2	64.9
1974	10.7	8.3	6.1	12.3	20.9	61.3	105.5	139.7	142.2	72.8	40.3	30.5	54.5
1975	18.2	13.0	8.7	6.3	26.0	129.4	192.5	210.0	145.9	88.5	36.0	20.1	75.0
1976	11.1	7.5	6.5	7.9	16.1	95.4	162.2	184.9	210.0	138.2	42.2	23.5	75.7
1977	14.2	10.2	8.6	23.4	12.3	54.7	133.8	178.2	190.3	85.9	41.7	23.7	65.1
1978	14.3	9.5	8.0	16.1	57.1	151.4	183.4	210.0	165.9	92.5	44.4	25.3	81.9
1979	14.7	9.8	8.2	6.5	20.8	81.7	169.4	186.7	137.8	57.8	22.0	13.3	61.1
1980	8.9	6.1	5.3	7.0	17.6	85.9	123.4	177.3	150.5	65.0	22.8	13.4	57.1
1981	8.9	6.4	5.3	18.5	14.4	69.9	108.4	202.3	210.0	164.5	29.8	16.4	71.6
1982	10.0	7.2	6.1	7.9	16.3	50.9	139.0	178.5	210.0	104.1	39.7	21.4	66.3
1983	13.7	9.5	8.0	7.3	38.0	52.0	153.4	209.7	184.4	100.6	38.7	19.9	70.1
1984	11.7	8.6	7.3	7.1	16.2	69.3	200.2	173.4	128.4	98.3	25.3	16.4	63.9
1985	10.9	6.3	4.7	4.7	44.2	56.0	105.6	180.2	142.7	81.3	55.5	23.3	60.0
1986	11.8	8.2	8.5	6.2	40.2	151.7	196.3	171.8	123.0	42.3	23.0	13.8	66.8
1987	8.7	6.4	4.8	7.6	10.6	31.9	94.1	170.6	167.6	82.2	48.5	25.0	55.1
1988	12.4	7.9	7.5	7.9	13.3	35.0	140.4	182.7	148.4	54.9	32.7	17.9	55.3
1989	14.0	10.2	9.5	10.3	32.2	141.2	161.9	160.5	127.3	73.4	35.8	22.5	66.9
1990	15.8	11.7	11.4	8.5	30.9	120.5	191.2	176.7	146.7	89.3	51.9	25.4	73.7
1991	17.0	12.4	9.7	9.1	14.3	88.5	157.4	174.8	165.6	76.8	34.7	21.1	65.4
1992	15.5	12.9	10.7	8.4	8.7	54.8	131.3	158.8	137.6	58.4	27.7	18.7	53.8
1993	12.7	10.3	8.4	8.0	27.3	113.4	200.5	200.9	165.9	66.6	28.8	17.9	72.1
1994	14.8	11.6	9.5	14.0	54.9	154.3	175.7	206.8	187.5	111.5	88.6	58.2	91.0
1995	14.0	11.4	9.3	13.1	23.0	59.2	114.9	200.0	138.9	39.8	23.0	20.7	55.9
1996	28.7	23.8	31.8	34.5	39.6	98.9	161.5	164.2	118.2	83.5	67.8	29.5	73.8
1997	18.5	14.4	11.7	11.8	11.1	0.0	5.0	71.5	73.0	88.4	40.0	22.6	30.8
1998	14.4	11.0	9.0	13.2	14.0	76.0	169.6	170.8	145.4	55.8	36.9	18.8	61.6
1999	12.3	9.6	8.6	15.7	94.4	232.8	214.1	101.8	90.9	108.2	49.1	25.3	80.6
2000	16.7	13.0	10.1	11.0	66.6	174.5	106.2	55.0	52.5	80.0	36.2	18.2	53.5
2001	11.0	6.9	13.1	6.5	59.7	163.3	206.5	40.3	55.0	102.2	43.1	19.1	60.9
2002	13.0	8.3	5.8	3.7	65.8	179.6	107.1	21.1	100.7	83.8	68.9	42.9	58.5
2003	20.1	13.1	10.1	6.8	16.3	58.7	162.1	194.0	161.1	70.2	30.7	14.2	63.5
2004	10.8	7.7	5.8	8.0	29.0	106.1	202.0	203.5	113.6	51.4	26.8	15.3	65.5
2005	11.4	7.6	5.4	4.3	7.5	123.5	204.6	100.6	92.6	66.1	36.8	6.0	55.8
2006	6.0	5.8	6.0	6.7	35.6	40.7	184.1	171.0	141.9	69.9	27.9	15.5	59.8
2007	8.3	9.0	5.4	7.3	18.0	71.9	103.8	184.6	181.9	117.9	44.4	18.8	64.6
Mean	13.2	9.2	7.8	9.5	24.4	85.1	151.7	181.3	161.3	85.6	38.1	21.9	66.0
Max	31.0	13.0	11.4	23.4	57.1	154.3	200.5	210.0	210.0	164.5	88.6	58.2	91.0
Min	6.0	6.1	4.7	4.7	8.7	31.9	90.1	139.7	111.4	42.3	22.0	13.3	51.5
STDV	4.1	2.2	2.0	4.5	14.1	39.5	35.5	19.8	30.5	27.1	14.3	9.0	9.7

Original data referred to Nam Ngum 1 Hydropower Extension Feasibility and Engineering Study (1995) by Lahmeyer International
The Data is further extended by the Survey Team.

Table B-3 Diversion From the Nam Leuk Hydropower Station

(unit: m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Mean
1972	7.7	8.1	7.4	7.6	10.3	21.7	35.6	37.4	36.6	27.6	6.1	6.1	17.7
1973	7.8	8.5	7.4	7.6	9.9	17.0	31.7	37.0	37.5	26.2	5.2	6.1	16.9
1974	7.6	6.1	7.3	5.6	9.1	17.3	30.5	36.4	22.0	29.2	6.2	6.1	15.4
1975	5.7	6.1	5.4	5.5	5.2	7.3	21.2	30.5	23.9	12.5	5.3	5.8	11.2
1976	5.9	6.0	5.5	5.7	5.0	11.8	24.2	34.0	38.6	18.4	7.1	7.9	14.2
1977	7.9	8.5	9.3	9.7	11.6	29.8	38.0	38.0	38.0	14.3	6.4	8.2	18.4
1978	7.8	8.6	9.4	9.7	11.0	23.1	38.0	38.0	38.0	29.8	6.1	6.2	18.9
1979	5.8	6.1	5.4	5.6	5.4	6.7	10.2	20.6	24.0	11.6	6.7	7.9	9.7
1980	8.0	10.3	9.4	9.7	11.4	37.6	38.0	38.0	38.0	15.1	7.4	8.7	19.3
1981	7.8	8.4	9.4	9.6	10.5	38.0	38.0	38.0	38.0	20.9	5.6	5.8	19.2
1982	5.7	6.2	5.4	5.6	5.7	6.7	14.8	25.0	32.8	10.6	5.2	5.9	10.8
1983	5.9	6.2	5.4	5.7	7.5	15.9	30.0	36.9	37.0	6.2	7.2	8.0	14.4
1984	7.9	8.3	9.5	7.8	12.9	38.0	38.0	38.0	38.0	25.3	5.8	6.0	19.7
1985	7.8	8.4	9.3	7.6	11.4	18.4	38.0	38.0	38.0	25.3	5.8	6.0	17.9
1986	5.7	6.1	5.4	5.6	5.1	7.1	14.2	27.6	36.4	14.3	5.1	5.9	11.6
1987	5.7	6.1	7.3	5.6	7.4	13.9	28.1	38.0	36.1	15.8	5.0	5.8	14.6
1988	7.7	8.1	7.4	7.6	10.3	21.7	35.6	37.4	36.6	27.6	6.1	6.1	17.7
1989	7.8	8.5	7.4	7.6	9.9	17.0	31.7	37.0	37.5	26.2	5.2	6.1	16.9
1990	7.6	6.1	7.3	5.6	9.1	17.3	30.5	36.4	22.0	29.2	6.2	6.1	15.4
1991	5.7	6.1	5.4	5.5	5.2	7.3	21.2	30.5	23.9	12.5	5.3	5.8	11.2
1992	5.9	6.0	5.5	5.7	5.0	11.8	24.2	34.0	28.6	18.4	7.1	7.9	13.4
1993	7.9	8.5	9.3	9.7	11.6	29.8	38.0	38.0	38.0	14.3	6.4	8.2	18.4
1994	7.8	8.6	9.4	9.7	11.0	23.1	38.0	38.0	38.0	29.8	6.1	6.2	18.9
1995	3.2	2.6	2.1	3.0	5.3	13.5	26.2	52.4	31.7	9.1	5.2	4.7	13.3
1996	2.1	1.7	2.5	3.6	4.5	10.8	24.2	38.1	23.2	9.4	7.2	4.5	11.1
1997	3.1	2.5	2.2	3.4	5.5	15.7	34.2	27.1	31.5	10.3	5.6	4.2	12.2
1998	3.6	3.2	2.7	3.7	4.1	9.9	23.7	17.9	12.1	3.9	2.5	1.7	7.5
1999	1.4	1.1	1.3	3.1	10.5	20.9	16.5	28.7	21.5	9.4	4.8	3.6	10.3
2000	2.7	2.4	12.2	24.1	31.9	20.8	29.5	34.9	35.1	11.9	5.9	5.8	18.2
2001	10.9	5.2	6.0	6.9	11.3	32.1	34.2	35.0	31.4	10.3	4.8	4.2	16.1
2002	7.2	7.7	7.5	7.2	9.2	24.3	31.5	31.3	30.3	15.2	6.8	5.4	15.3
2003	7.2	7.7	9.2	8.8	8.0	17.2	28.9	35.8	35.1	13.0	2.5	2.0	14.7
2004	7.3	8.1	9.6	3.4	4.8	31.3	31.9	33.9	32.6	10.7	5.2	5.1	15.4
2005	3.9	8.1	11.3	10.7	2.5	19.2	34.5	34.6	29.1	18.7	6.4	5.6	15.4
2006	2.6	1.7	7.1	19.5	17.3	24.3	29.7	36.0	29.3	9.6	3.7	4.9	15.5
2007	4.4	8.0	6.0	7.5	14.5	10.4	15.3	26.0	35.8	16.9	2.6	5.6	12.8
Mean	6.1	7.4	7.4	7.2	8.8	19.1	29.9	34.9	33.8	20.0	6.0	6.6	15.7
Max	31.0	10.3	9.5	9.7	12.9	38.0	38.0	38.0	38.6	29.8	7.4	8.7	19.7
Min	1.4	6.0	5.4	5.5	5.0	6.7	10.2	20.6	22.0	6.2	5.0	5.8	9.7
STDV	2.2	1.3	1.7	1.7	2.7	10.0	8.7	4.8	6.1	7.4	0.7	1.0	3.2

Original data referred to Nam Ngum 1 Hydropower Extension Feasibility and Engineering Study (1995) by Lahmeyer International
The operation records of the Nam Leuk Hydropower Station is added.

Table B-4 Inflow From the Intermediate Basin

(unit: m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Mean
1972	32.5	38.7	9.1	17.5	29.6	83.6	259.9	511.4	238.7	127.7	74.4	38.9	122.5
1973	36.3	25.8	22.2	34.6	18.1	91.1	262.0	330.7	472.4	136.4	59.9	37.5	127.7
1974	24.9	19.1	11.2	21.4	33.8	102.7	141.2	222.0	242.4	114.4	49.9	32.6	85.0
1975	32.7	19.2	16.9	10.7	43.3	133.4	160.6	430.9	379.6	142.6	66.1	37.3	123.4
1976	30.8	18.8	11.2	20.6	36.2	102.8	198.3	250.1	178.9	152.4	93.5	28.9	93.9
1977	29.7	22.1	60.1	60.9	38.6	42.6	212.5	188.9	169.9	58.2	39.5	28.7	79.8
1978	21.4	19.1	24.8	23.1	42.7	198.1	319.3	424.0	281.3	79.8	44.1	33.2	126.7
1979	35.5	37.1	27.5	31.6	74.1	120.5	124.9	280.0	193.6	78.9	52.3	29.4	90.8
1980	29.2	25.3	23.2	28.5	40.3	112.0	319.0	217.0	278.6	96.8	57.6	32.9	105.3
1981	32.2	22.4	39.7	12.8	50.9	185.0	477.5	349.9	290.7	191.9	59.4	40.1	147.2
1982	32.2	33.2	30.9	35.8	44.1	129.1	146.9	412.6	201.5	142.5	63.6	43.7	110.3
1983	33.7	37.9	27.2	24.9	41.2	67.0	210.9	260.8	185.9	108.1	51.6	40.5	91.3
1984	36.2	30.9	21.3	21.9	41.6	89.6	298.3	287.7	184.8	102.4	58.8	46.0	102.1
1985	43.5	36.8	25.8	22.8	45.3	114.7	179.8	262.7	206.4	75.1	54.4	37.6	92.5
1986	29.1	22.7	18.4	27.3	103.3	200.7	253.1	177.6	143.4	61.0	39.9	28.9	92.6
1987	21.2	21.4	18.6	31.3	26.0	65.1	95.3	252.5	140.6	87.1	58.2	34.5	71.4
1988	26.5	21.7	15.0	27.8	45.1	45.3	102.4	220.6	126.4	67.9	32.8	22.9	63.1
1989	20.9	17.4	18.2	19.2	45.7	152.5	165.2	222.7	155.0	94.9	50.4	35.1	83.5
1990	30.7	29.3	64.9	44.0	37.2	158.3	277.2	82.7	291.5	100.8	76.0	55.1	104.2
1991	43.3	34.3	24.2	26.0	33.8	86.0	183.4	232.5	134.6	80.6	55.6	37.8	81.5
1992	34.3	35.6	22.5	20.4	10.8	59.6	192.2	170.1	107.5	64.0	41.9	34.4	66.4
1993	26.0	21.8	18.7	19.0	36.5	122.8	325.9	296.4	234.9	92.7	54.7	50.9	109.1
1994	30.7	29.2	30.1	29.1	30.9	188.6	295.6	415.8	296.0	174.1	68.2	47.3	137.1
1995	27.5	21.4	18.9	27.9	44.9	115.4	221.0	454.3	266.4	77.6	44.8	40.3	114.1
1996	4.6	12.6	18.6	30.5	38.2	86.9	206.3	325.9	202.7	80.2	62.0	38.1	92.8
1997	33.4	21.8	19.0	30.5	46.9	247.5	248.6	231.9	269.9	88.4	47.6	36.2	110.4
1998	30.8	27.5	23.3	31.8	39.3	84.8	203.2	153.3	103.8	33.2	21.2	14.4	64.2
1999	11.8	9.8	10.9	27.0	89.8	179.0	141.5	245.2	183.8	80.7	40.9	30.4	88.0
2000	22.8	20.7	16.9	22.0	81.6	210.7	243.3	238.8	247.1	85.7	41.1	30.8	105.5
2001	23.4	16.5	39.7	15.9	73.9	154.0	246.0	302.5	213.0	97.4	47.2	38.7	106.4
2002	28.9	26.1	20.0	14.4	73.3	207.9	319.6	383.1	143.3	82.1	49.9	40.2	116.6
2003	30.3	24.0	19.9	16.5	37.1	85.3	134.6	189.5	160.7	53.8	31.9	27.8	67.9
2004	12.2	12.9	6.6	27.9	37.9	0.3	79.5	94.1	218.8	25.4	16.5	17.3	45.8
2005	18.8	18.5	10.7	21.5	21.8	28.9	90.6	344.1	203.3	67.3	25.9	31.0	74.0
2006	34.9	30.0	27.9	25.5	49.0	77.8	262.9	224.9	117.0	71.1	38.3	28.0	82.9
2007	25.3	23.6	20.3	18.7	37.8	62.1	95.3	157.4	185.0	253.8	38.1	29.3	79.4
Mean	28.3	27.0	25.3	26.6	41.3	115.3	226.2	282.6	223.2	105.7	56.6	37.1	100.3
Max	43.5	38.7	64.9	60.9	103.3	200.7	477.5	511.4	472.4	191.9	93.5	55.1	147.2
Min	4.6	17.4	9.1	10.7	10.8	42.6	95.3	82.7	107.5	58.2	32.8	22.9	63.1
STDV	8.1	7.2	13.7	10.6	18.1	47.6	89.6	102.1	86.9	36.7	13.5	7.7	22.6

Original data referred to Nam Ngum 1 Hydropower Extension Feasibility and Engineering Study (1995) by Lahmeyer International
The Data is further extended by the Survey Team.

Table B-5 Inflow into the Nam Leuk Reservoir

(unit: m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Mean
1972	3.7	4.4	1.0	2.0	3.4	9.5	29.7	58.6	27.3	14.6	8.5	4.5	14.0
1973	4.2	3.0	2.5	4.0	1.9	10.3	29.9	37.8	53.7	15.7	6.9	4.3	14.5
1974	2.9	2.2	1.3	2.3	3.7	11.7	16.1	25.3	27.8	13.0	5.7	3.8	9.7
1975	3.7	2.2	1.9	1.2	4.7	15.0	18.2	49.0	43.5	16.2	7.6	4.3	14.0
1976	3.5	2.2	1.3	2.3	4.0	11.8	22.7	28.6	20.3	17.4	10.7	3.3	10.7
1977	3.4	2.5	6.9	6.9	4.3	4.7	24.2	21.4	19.3	6.7	4.5	3.3	9.1
1978	2.5	2.2	2.8	2.6	4.7	22.5	36.5	48.5	32.1	9.1	5.0	3.8	14.4
1979	4.1	4.3	3.2	3.6	8.2	13.7	14.2	31.8	21.9	9.1	6.0	3.4	10.3
1980	3.4	2.9	2.7	3.2	4.4	12.6	36.4	24.7	31.8	11.1	6.6	3.8	12.0
1981	3.7	2.6	4.6	1.4	5.7	21.1	54.7	40.1	33.3	22.0	6.8	4.6	16.8
1982	3.7	3.8	3.5	4.1	4.9	14.8	16.8	47.2	22.9	16.3	7.3	5.0	12.6
1983	3.8	4.4	3.1	2.8	4.7	7.6	24.0	29.7	21.2	12.3	5.9	4.7	10.4
1984	4.2	3.5	2.4	2.5	4.6	10.1	34.0	32.7	21.1	11.6	6.8	5.3	11.6
1985	5.0	4.2	3.0	2.6	5.1	13.0	20.5	30.0	23.5	8.6	6.2	4.3	10.5
1986	3.3	2.6	2.1	3.1	11.8	22.9	28.9	20.2	16.4	6.9	4.6	3.3	10.6
1987	2.4	2.4	2.1	3.6	2.9	7.3	10.9	28.8	15.9	9.9	6.6	4.0	8.1
1988	3.0	2.5	1.7	3.2	5.1	5.1	11.5	25.1	14.4	7.7	3.8	2.6	7.2
1989	2.4	2.0	2.1	2.2	5.1	17.3	18.8	25.4	17.6	10.8	5.8	4.0	9.5
1990	3.5	2.7	3.4	3.6	5.4	19.3	32.1	19.2	24.8	10.7	7.3	4.7	11.4
1991	3.5	3.1	2.8	2.3	3.4	10.4	22.0	25.5	16.5	8.3	4.7	3.2	8.9
1992	3.0	2.9	2.2	2.0	2.3	6.7	22.0	19.0	12.9	6.2	3.4	2.9	7.2
1993	2.3	2.0	1.7	1.8	4.6	15.1	38.6	28.7	17.4	9.1	4.6	3.9	10.9
1994	3.3	3.2	3.5	3.1	6.5	22.1	36.0	45.8	29.4	15.8	6.7	5.0	15.1
1995	3.2	2.6	2.1	3.0	5.3	13.5	26.2	52.4	31.7	9.1	5.2	4.7	13.3
1996	2.1	1.7	2.5	3.6	4.5	10.8	24.2	38.1	23.2	9.4	7.2	4.5	11.1
1997	3.1	2.5	2.2	3.4	5.5	15.7	34.2	27.1	31.5	10.3	5.6	4.2	12.2
1998	3.6	3.2	2.7	3.7	4.1	9.9	23.7	17.9	12.1	3.9	2.5	1.7	7.5
1999	1.4	1.1	1.3	3.1	10.5	20.9	16.5	28.7	21.5	9.4	4.8	3.6	10.3
2000	2.7	2.4	2.0	2.6	9.5	24.6	28.4	27.9	28.9	10.0	4.8	3.6	12.3
2001	2.7	1.9	4.6	1.9	8.6	18.0	28.7	35.4	24.9	11.4	5.5	4.5	12.4
2002	3.4	3.1	2.3	1.7	8.6	24.3	37.3	44.8	16.7	9.6	5.8	4.7	13.6
2003	3.5	2.8	2.3	1.9	4.3	10.0	15.7	22.1	18.8	6.3	3.7	3.3	7.9
2004	2.9	2.8	2.0	4.2	7.1	10.9	27.7	29.7	37.1	7.9	4.4	3.6	11.7
2005	3.4	3.4	2.6	3.7	3.3	14.6	29.4	50.9	33.3	14.5	6.4	4.5	14.3
2006	3.8	3.4	3.3	3.0	7.8	9.1	30.7	26.3	13.7	8.3	4.5	3.3	9.8
2007	3.0	2.8	2.4	2.2	4.4	7.3	10.8	18.4	21.6	5.3	4.5	3.4	7.2
Mean	3.3	2.9	2.7	2.9	4.8	13.3	26.0	32.3	24.6	11.7	6.2	4.0	11.3
Max	31.0	4.4	6.9	6.9	11.8	22.9	54.7	58.6	53.7	22.0	10.7	5.3	16.8
Min	1.4	2.0	1.0	1.2	1.9	4.7	10.9	19.0	12.9	6.2	3.4	2.6	7.2
STDV	0.7	0.8	1.2	1.2	2.0	5.5	10.4	11.0	9.7	4.1	1.6	0.7	2.6

Source; Nam Mang 3 Hydropower Station, and extended by the JICA Survey Team

Table B-6 Inflow into the Nam Mang 3 Reservoir

(unit: m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Mean
1972	1.1	1.3	0.3	0.6	1.0	2.7	8.5	16.6	7.8	4.1	2.4	1.3	4.0
1973	1.2	0.8	0.7	1.1	0.5	2.9	8.5	10.7	15.3	4.5	2.0	1.2	4.1
1974	0.8	0.6	0.4	0.7	1.0	3.3	4.6	7.2	7.9	3.7	1.6	1.1	2.7
1975	1.1	0.6	0.5	0.3	1.3	4.3	5.2	13.9	12.4	4.6	2.2	1.2	4.0
1976	1.0	0.6	0.4	0.7	1.1	3.3	6.4	8.1	5.8	5.0	3.1	0.9	3.0
1977	1.0	0.7	2.0	2.0	1.2	1.3	6.9	6.1	5.5	1.9	1.3	0.9	2.6
1978	0.7	0.6	0.8	0.7	1.3	6.4	10.4	13.8	9.1	2.6	1.4	1.1	4.1
1979	1.2	1.2	0.9	1.0	2.3	3.9	4.0	9.1	6.2	2.6	1.7	1.0	2.9
1980	1.0	0.8	0.8	0.9	1.3	3.6	10.3	7.0	9.0	3.2	1.9	1.1	3.4
1981	1.1	0.7	1.3	0.4	1.6	6.0	15.5	11.4	9.5	6.2	1.9	1.3	4.8
1982	1.1	1.1	1.0	1.2	1.4	4.2	4.8	13.4	6.5	4.6	2.1	1.4	3.6
1983	1.1	1.2	0.9	0.8	1.3	2.2	6.8	8.5	6.0	3.5	1.7	1.3	3.0
1984	1.2	1.0	0.7	0.7	1.3	2.9	9.7	9.3	6.0	3.3	1.9	1.5	3.3
1985	1.4	1.2	0.8	0.7	1.4	3.7	5.8	8.5	6.7	2.4	1.8	1.2	3.0
1986	1.0	0.7	0.6	0.9	3.3	6.5	8.2	5.8	4.7	2.0	1.3	0.9	3.0
1987	0.7	0.7	0.6	1.0	0.8	2.1	3.1	8.2	4.5	2.8	1.9	1.1	2.3
1988	0.9	0.7	0.5	0.9	1.4	1.4	3.3	7.1	4.1	2.2	1.1	0.7	2.0
1989	0.7	0.6	0.6	0.6	1.4	4.9	5.4	7.2	5.0	3.1	1.6	1.1	2.7
1990	1.0	0.8	1.0	1.0	1.5	5.5	9.1	5.5	7.1	3.0	2.1	1.3	3.3
1991	1.0	0.9	0.8	0.6	1.0	3.0	6.2	7.3	4.7	2.4	1.3	0.9	2.5
1992	0.9	0.8	0.6	0.6	0.7	1.9	6.3	5.4	3.7	1.8	1.0	0.8	2.0
1993	0.7	0.6	0.5	0.5	1.3	4.3	11.0	8.1	4.9	2.6	1.3	1.1	3.1
1994	0.9	0.9	1.0	0.9	1.9	6.3	10.2	13.0	8.4	4.5	1.9	1.4	4.3
1995	0.9	0.7	0.6	0.9	1.5	3.8	7.4	14.9	9.0	2.6	1.5	1.3	3.8
1996	0.6	0.5	0.7	1.0	1.3	3.1	6.9	10.8	6.6	2.7	2.1	1.3	3.1
1997	0.9	0.7	0.6	1.0	1.6	4.5	9.7	7.7	9.0	2.9	1.6	1.2	3.5
1998	1.0	0.9	0.8	1.1	1.2	2.8	6.8	5.1	3.4	1.1	0.7	0.5	2.1
1999	0.4	0.3	0.4	0.9	3.0	5.9	4.7	8.1	6.1	2.7	1.4	1.0	2.9
2000	0.8	0.7	0.6	0.7	2.7	7.0	8.1	7.9	8.2	2.8	1.4	1.0	3.5
2001	0.8	0.5	1.3	0.5	2.4	5.1	8.2	10.1	7.1	3.2	1.6	1.3	3.5
2002	1.0	0.9	0.7	0.5	2.4	6.9	10.6	12.7	4.8	2.7	1.7	1.3	3.9
2003	1.0	0.8	0.7	0.5	1.2	2.8	4.5	6.3	5.3	1.8	1.1	0.9	2.3
2004	0.8	0.8	0.6	1.2	2.0	3.1	7.9	8.4	10.5	2.2	1.3	1.0	3.3
2005	1.0	1.0	0.7	1.1	0.9	4.2	8.4	14.5	9.5	4.1	1.8	1.3	4.1
2006	0.5	1.1	2.8	1.6	5.0	7.4	14.6	13.2	5.1	2.9	0.6	0.3	4.6
2007	0.7	1.3	1.3	1.3	2.3	6.1	5.3	10.8	13.2	6.1	0.8	0.7	4.2
Mean	0.9	0.8	0.8	0.8	1.4	3.8	7.4	9.2	7.0	3.3	1.8	1.1	3.2
Max	31.0	1.3	2.0	2.0	3.3	6.5	15.5	16.6	15.3	6.2	3.1	1.5	4.8
Min	0.4	0.6	0.3	0.3	0.5	1.3	3.1	5.4	3.7	1.8	1.0	0.7	2.0
STDV	0.2	0.2	0.4	0.3	0.6	1.6	3.0	3.1	2.7	1.2	0.5	0.2	0.7

Source; Nam Leuk Hydropower Station, and extended by the JICA Survey Team

APPENDIX B-2: RESERVOIR AND HYDROPOWER OPERATION

(1) Operation Rule After Expansion

The operation rule are developed using the analysis of variance method (ANOVA) with the DP results. The operation rules used in the Survey are presented hereinafter.

1) Year 2015

Jan	Vol (t+1)	=	1.4862907	x Vol (t)	+	0.0000000	x Qin (t)	+	-3580.9283823
Feb	Vol (t+1)	=	1.2181909	x Vol (t)	+	0.4398980	x Qin (t)	+	-2017.4386378
Mar	Vol (t+1)	=	1.3054796	x Vol (t)	+	0.0000000	x Qin (t)	+	-2304.4086143
Apr	Vol (t+1)	=	1.2645017	x Vol (t)	+	0.0000000	x Qin (t)	+	-2065.3465926
May	Vol (t+1)	=	1.1598026	x Vol (t)	+	0.0000000	x Qin (t)	+	-1296.4522496
Jun	Vol (t+1)	=	1.1117555	x Vol (t)	+	0.9633868	x Qin (t)	+	-1634.8034025
Jul	Vol (t+1)	=	1.0869769	x Vol (t)	+	0.7949928	x Qin (t)	+	-1241.9290717
Aug	Vol (t+1)	=	0.8344058	x Vol (t)	+	0.5494838	x Qin (t)	+	620.5705147
Sep	Vol (t+1)	=	0.5212046	x Vol (t)	+	0.4885398	x Qin (t)	+	2792.8721153
Oct	Qout (t)	=	0.9530991	x Vol (t)	+	1.0083032	x Qin (t)	+	-6706.8248452
Nov	Vol (t+1)	=	-1.0713620	x Vol (t)	+	0.6800711	x Qin (t)	+	13939.6673744
Dec	Vol (t+1)	=	0.0000000	x Vol (t)	+	0.8479533	x Qin (t)	+	6274.0853491

Where,

Vol (t+1) : The target storage at the t+1th month,

Vol (t) : The storage at the tth month,

Qin (t) : Expected inflow in the tth month, and

Qout (t) : Required discharge at the tth month.

2) Year 2020

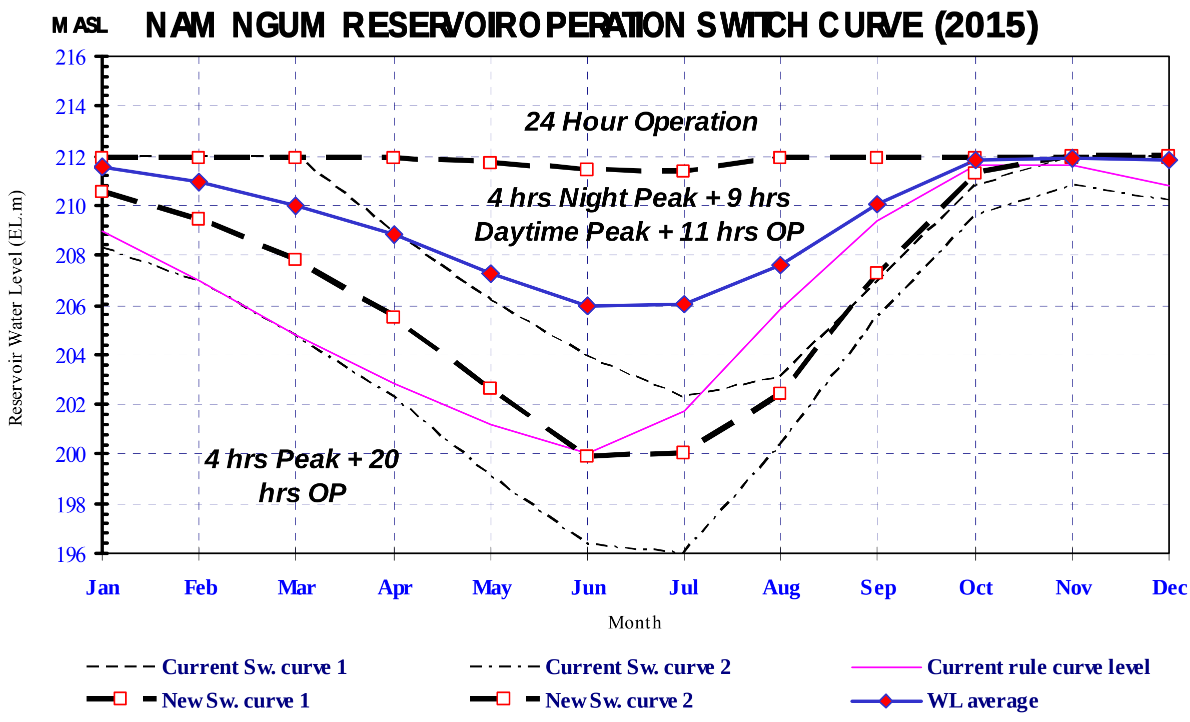
Jan	Vol (t+1)	=	1.058081	x Vol (t)	+	0.706528	x Qin (t)	+	-832.060561
Feb	Vol (t+1)	=	1.075961	x Vol (t)	+	0.771505	x Qin (t)	+	-1040.678822
Mar	Vol (t+1)	=	1.093491	x Vol (t)	+	0.776723	x Qin (t)	+	-1557.198529
Apr	Vol (t+1)	=	1.052759	x Vol (t)	+	0.787509	x Qin (t)	+	-1562.493838
May	Vol (t+1)	=	0.922142	x Vol (t)	+	0.590505	x Qin (t)	+	-380.829840
Jun	Vol (t+1)	=	0.923334	x Vol (t)	+	0.466465	x Qin (t)	+	-32.923832
Jul	Vol (t+1)	=	0.758797	x Vol (t)	+	0.000000	x Qin (t)	+	1796.685435
Aug	Vol (t+1)	=	0.719078	x Vol (t)	+	0.452597	x Qin (t)	+	1408.201666
Sep	Vol (t+1)	=	0.511445	x Vol (t)	+	0.404478	x Qin (t)	+	2916.265369
Oct	Qout (t)	=	0.998991	x Vol (t)	+	1.031919	x Qin (t)	+	-7057.452748
Nov	Vol (t+1)	=	0.000000	x Vol (t)	+	0.775820	x Qin (t)	+	6319.245468
Dec	Vol (t+1)	=	1.560967	x Vol (t)	+	0.865874	x Qin (t)	+	-4653.413143

3) Year 2025

Jan	Vol (t+1)	=	1.135762	x Vol (t)	+	0.665761	x Qin (t)	+	-1520.276858
Feb	Vol (t+1)	=	1.170279	x Vol (t)	+	0.752182	x Qin (t)	+	-1832.082811
Mar	Vol (t+1)	=	1.218516	x Vol (t)	+	0.000000	x Qin (t)	+	-1997.782820
Apr	Vol (t+1)	=	1.201524	x Vol (t)	+	0.000000	x Qin (t)	+	-1897.200930
May	Vol (t+1)	=	1.002317	x Vol (t)	+	0.825826	x Qin (t)	+	-838.791495
Jun	Vol (t+1)	=	1.033524	x Vol (t)	+	0.965100	x Qin (t)	+	-995.279263
Jul	Vol (t+1)	=	0.909098	x Vol (t)	+	0.607558	x Qin (t)	+	55.482931
Aug	Vol (t+1)	=	0.747513	x Vol (t)	+	0.424840	x Qin (t)	+	1479.376428
Sep	Qout (t)	=	0.623549	x Vol (t)	+	0.783678	x Qin (t)	+	-4201.729793
Oct	Qout (t)	=	0.975505	x Vol (t)	+	1.026411	x Qin (t)	+	-6890.813716
Nov	Vol (t+1)	=	0.000000	x Vol (t)	+	0.748298	x Qin (t)	+	6199.116925
Dec	Vol (t+1)	=	1.807525	x Vol (t)	+	0.524698	x Qin (t)	+	-6244.153627

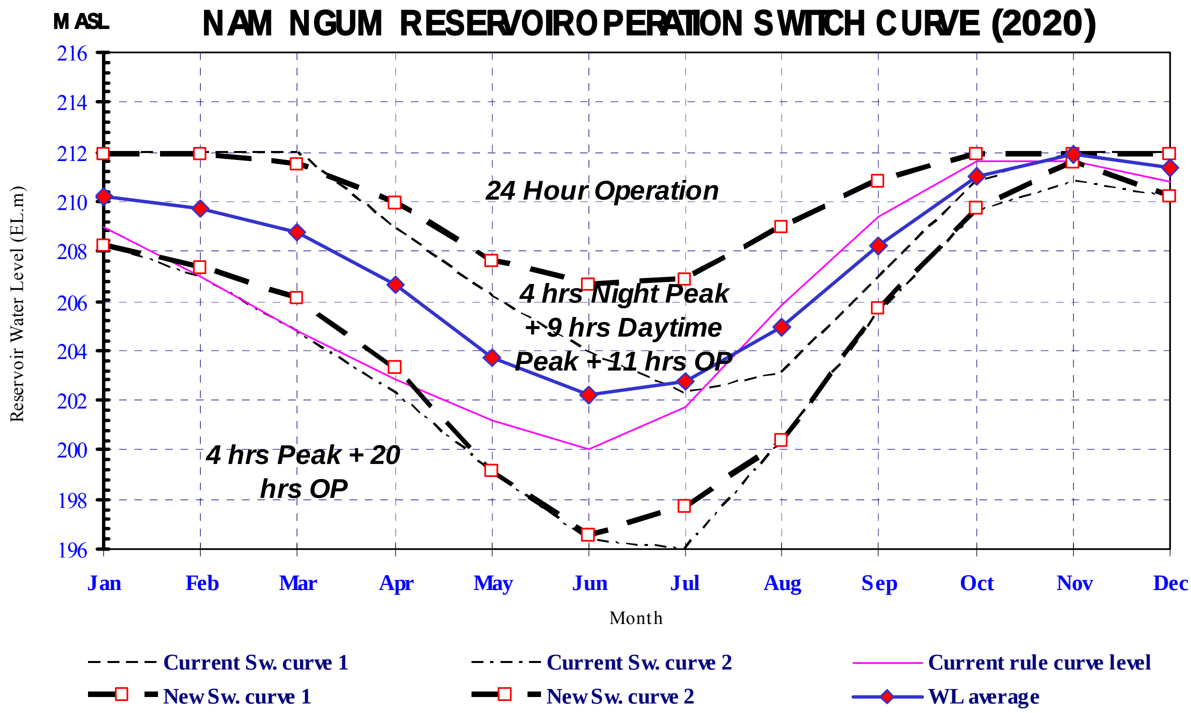
(2) Revised Switch Curve (Draft)

1) Year 2015



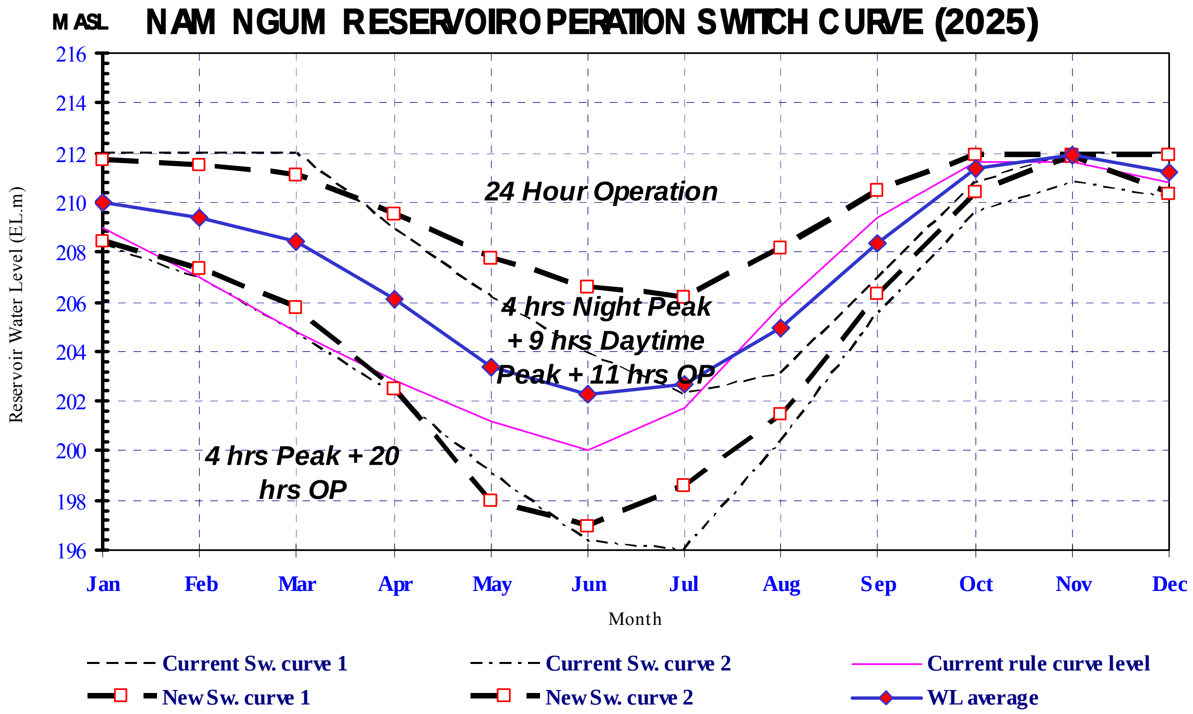
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current Sw. curve 1	212.0	212.0	212.0	208.9	206.2	203.9	202.3	203.1	206.9	210.8	212.0	212.0
Current Sw. curve 2	208.3	206.9	204.7	202.3	199.0	196.4	196.0	200.4	205.5	209.6	210.8	210.2
Current Rule Curve	209.0	207.0	204.8	202.8	201.2	200.0	201.7	205.8	209.4	211.6	211.6	210.8
New Sw. curve 1	211.9	211.9	211.9	211.9	211.7	211.4	211.4	211.9	211.9	211.9	211.9	211.9
Vol ave	211.6	210.9	210.0	208.8	207.2	206.0	206.0	207.6	210.1	211.8	211.9	211.8
New Sw. curve 2	210.5	209.4	207.8	205.5	202.6	199.9	200.0	202.4	207.3	211.3	212.0	212.0

2) Year 2020



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current Sw. curve 1	212.0	212.0	212.0	208.9	206.2	203.9	202.3	203.1	206.9	210.8	212.0	212.0
Current Sw. curve 2	208.3	206.9	204.7	202.3	199.0	196.4	196.0	200.4	205.5	209.6	210.8	210.2
Current Rule Curve	209.0	207.0	204.8	202.8	201.2	200.0	201.7	205.8	209.4	211.6	211.6	210.8
New Sw. curve 1	211.9	211.9	211.5	209.9	207.6	206.7	206.9	209.0	210.8	211.9	211.9	211.9
Vol ave	210.2	209.7	208.7	206.7	203.7	202.2	202.7	204.9	208.2	211.0	211.9	211.4
New Sw. curve 2	208.2	207.3	206.1	203.3	199.1	196.6	197.7	200.4	205.7	209.7	211.6	210.2

3) Year 2025



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current Sw. curve 1	212.0	212.0	212.0	208.9	206.2	203.9	202.3	203.1	206.9	210.8	212.0	212.0
Current Sw. curve 2	208.3	206.9	204.7	202.3	199.0	196.4	196.0	200.4	205.5	209.6	210.8	210.2
Current Rule Curve	209.0	207.0	204.8	202.8	201.2	200.0	201.7	205.8	209.4	211.6	211.6	210.8
New Sw. curve 1	211.9	211.9	211.9	211.9	211.7	211.4	211.4	211.9	211.9	211.9	211.9	211.9
Vol ave	211.6	210.9	210.0	208.8	207.2	206.0	206.0	207.6	210.1	211.8	211.9	211.8
New Sw. curve 2	210.5	209.4	207.8	205.5	202.6	199.9	200.0	202.4	207.3	211.3	212.0	212.0

(3) Generation Simulation

The annual energy of the expanded NN1 hydropower station is calculated for the year 2015, 2020 and 2025. The generation simulations of the NN 1 hydropower station for the three years scenarios are given in the following data files.

Appendix B-2-1 : Generation simulation for the year 2015

Appendix B-2-2 : Generation simulation for the year 2020

Appendix B-2-3 : Generation simulation for the year 2025

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Appendices

Appendix C Environment

(Following data and documents are included in the Datafile)

Appendix C Environment

Appendix C-1 Minutes of Public Consultation in Villages

Public Consultation schedule

In accordance with the TOR for the IESE study for Nam Ngum 1 Expansion Project, the survey team from SD&XP Consultant Group was fielded. Subsequently, the testing survey with draft questionnaire was conducted with JICA survey team at Ban Thaxan village in Keo Oudom District Vientiane Province on 22 May 2009. Then the survey team was engaged and trained for 5 teachers from Pakcheng Secondary school to conduct the field interview, which was started from 28 May to 6 June 2009. Afterwards, the public consultation workshop was organized on 16 July 2009 with participation of line agencies, District authorities of Keooudom, Viengkham and Thoulakhom and 24 downstream village authorities.

Selection criteria's for the interview:

The interview survey was conducted for 100 persons in villages selected from inhabitant of Nam Ngum river bank, nearby Nam Ngum dam and its downstream within 50 km and within 1 km from river bank. Although upstream villages are not affected by the expansion project, some villages from upstream of the Nam Ngum River Basin were also interviewed for reference.

For village level interviewing, the survey team conducted with village authorities as on the list given in the TOR for 25 downstream villages. Some villages upstream of the NN1 dam were also interviewed for reference in formation.

Methodology and process to conduct field interview

The survey team conducted interview in totally 27 villages (24 villages downstream and 3 upstream villages) and 94 potentially affecting households out of targeted 24 villages and additional 6 households from upstream 3 villages as reference. The household selection for interview was based on the main occupation of the households that is related to river water usage: riverside gardening, boat transportation, fishing, water pumping, etc. which is related to the water level increase and decrease. Then the candidate households were proposed by village chief in each village.

According to the selection for the optimum 40 MW of the NN1 Hydropower station expansion, the adverse impact study was focusing on how many household likely to be affected, compare to present water level, if the water level increases 0.5 m or more at peak time and how many households would affected from the water level decreases about 0.5 m or more at off-peak time.

(1) Survey team formation:

- The survey team included 1 Socio-economic Specialist and 1 Environmental Specialist from SD&XP Consultant Group, 5 surveyors engaged teachers from Pakagnoung Secondary school

- The survey team members were then trained on the scope and purposes of the project with all needed handout, medias, graphs and presentation material.

(2) Consultation with villagers

- Selection of households for interview: the surveyor would firstly consult with village authority about the list of household practicing riverside gardening, boat transportation, water pumping, fish caging, etc. that likely to be affected by operation of NN1 Hydropower expansion project. Particularly for the downstream villager who own the above occupations.
- Presentation venue: most of the villages conducted the interview at the temples or village chief's house.
- Presentation of project scope and objectives to the interviewees: before interview the surveyors were well present about project scope and objectives together with graph of water fluctuation when the system operates. In association with the presentation there were time for questions and answer to ensure full understanding of the participants.
- Interview survey: the interview involved 2 levels as the followings
  - (i) Village level interview: use village level questionnaire to interview village authority totally 24 available village downstream and some villages upstream (currently 24 downstream and 3 upstream villages)
  - (ii) Households level interview: use household level to interview 100 households that likely to be affected by NN1 Hydropower Expansion project (totally 94 downstream households and 5 upstream households
- Explanation that the goal of NN1 expansion project is to increase the national electricity output and export especially to develop socio-economic aspect of people in the project pilot villages.

Result of the field survey:

1. Economic and subsistence activities of the downstream people;
   The main income sources of the downstream people of NN1 are agriculture, fishery, boat transportation, etc. and the water level fluctuation of at the range of 0.5 m makes very little impact to them if compare to the current seasonal fluctuation.

2. Status of water use and hygienic condition;
   People are freely using natural river for several purposes such as fishing, boating, washing, irrigation, riverside garden watering, etc. For the sources of drinking water, most of the villagers use open well as well as tube wells.

3. Infrastructure/ public facilities in the downstream villages
   All downstream villages have easy access to good road structure, electricity, river transportation, etc. the same as easy access to public facilities like schools, dispensary and hospital in the District center of 3 target districts of Viengkham, Keo Oudom and Thoulakhom.

4. Condition of Natural resources use;
   Most of the downstream villages of NN1 dam own the land for rice and other cash crop production. None of the villages settle inside the protected areas or conservation area. Villagers are mainly engaged in agriculture and fisheries for their income earning.

5. Affecting water level increase for riverside gardening and affecting water level decrease for boat transportation, fish pond, gage fisheries and water pumping;
   The water level fluctuation is considered to affect during dry season for downstream households and it is confirmed by conducting field survey that there is almost no adverse impact to the economic status of downstream villagers by the fluctuation range at 0.5 m, while none of the riverside cultivators complaining that they will be affect at 0.5m of increase water.

6. Requirement for resettlement and compensation
   Since the result of village as well as household interview shown that the fluctuation of water level

will not affect to the assets of the community. The maximum water level is expect to increase about 0.5 m at peak time, while villagers confirmed that the allowable level of water is 0.5 m cm and when the water level decrease to 0.6 m at off peak time it will affect to two families, who engaged in boat transportation and fisheries as their allowable water level is 50 cm but they are all waive for project to go on.

7. Overall opinion of the downstream people to the project
All village authorities and household head interviewed are agreed with the Government's plan for NN1 Hydropower station expansion as it would be the main potential income sources for the country and all are opted to waive for any resettlement and compensation due to the water level will not at all affect their assets compare to natural disaster.

(3) Data computation and analysis
In order to be able to assess socio-economic and environmental condition in the project area a set of data analysis table were formed. All the data were computed, analyze and translate the result to the report text.

(4) Organize workshop for officially public consultation: on 16 July 2009 the project team organized a public consultation workshop at NN1 Hydropower camp. Attending this workshop are Mr. Vilath Sisouvong, Voce Governor of Vientiane province, Mr. Khammany Inthilath, the Director of EDL, Representative of WREA in Vientiane, the Board of director NN1, District Governors of 3 concern Districts, village chief of affected villages and concerned line agencies.

Appendix C-2 Minutes of Final Public Consultation

Minutes of the Public Consultation

Lao People's Democratic Republic
Peace Independence Democracy Unity Prosperity

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Minutes
of the consultative meeting on the Initial Environmental Examination of the Nam Ngum 1 Hydro Power Plant expansion project

The consultative meeting on the Nam Ngum 1 expansion project has been held at the meeting hall of the Nam Ngum 1 Hydro Power Station, Vientiane Province on 16 July 2009 from 13:30 to 17:00. Presence at the meeting were Mr. Vilath Sisouvong, head of Vientiane Provincial Cabinet, representative of Water Resource and Environment Agency, representative of the Department of Electricity, Ministry of Energy and Mine, representatives from villages concerned, representatives of NIPPON KOEI Co., Ltd of Japanese consultant for Nam Ngum 1 Expansion Study, SD & XP Consultants Group of local consultants for IESE study of Nam Ngum 1 Expansion Plan, and other participants from different divisions concerned from Electricite du Laos (list of participants attached). The meeting was co-chaired by Mr. Vilath Sisouvong, head of Vientiane Provincial Cabinet, Mr. Khammany Inthilath, member of the National Assembly for the 10th constituency of Vientiane Province and Director General of Electricite du Laos. Mr. Vilath delivered his opening remark by stressing the objective of the meeting as to discuss the Initial Environmental Examination Study with regard to the Nam Ngum 1 expansion project in order to make the participants more understood on the electricity development of the Electricite du Laos. He also raised the importance of the hydro power station and electricity development in Lao PDR aiming at implementing the government policy on national development in order to lift the country out of least developed country status. At the same time, Lao PDR will also make households across the country access to electricity at 70% by 2010 and at 90% by 2020, and to make Lao PDR a battery of ASEAN. Mr. Head of Vientiane Provincial Cabinet stressed the meeting should focus and participate actively on the consultation and officially opened the meeting.

After the opening, Mr. Khammany Inthilath, member of the National Assembly for the 10th Constituency of Vientiane Province, and Director General of the Electricite du Laos, who were also co-chaired of the meeting, had given their views on the general potential for the hydro power plant development, especially different projects in Vientiane Province which are important to the socio-economic development in the Lao PDR. He also raised the importance of the Nam Ngum 1 expansion project and the link of the transmission network in Lao PDR which covers the northern, central and southern parts of the country. He also reminded the future plan of electricity projects should take into account and focus on both positive and negative impacts on environment as well as society that may arise from the future development project and should follow the laws and regulations of the Lao PDR as main reference for carrying out measures under socio-environment management. This project is one of the projects that will supply electricity to locality and export of electricity in order to reduce the import of electricity and to generate revenue for the Lao PDR. They thanked to the village, district and provincial authorities for giving attention to and participation in the meeting.

The SD&XP Consultants Group, who conducts a joint study with NIPPON KOEI under JICA funding, presented details on background, technique, and outcomes of the environmental and socio-economic impact study of the Nam Ngum 1 expansion project in order to make participants more understood and saw the outcome of the study in 3 main areas as follows:

- The study of the existing environment which could be affected from the project during its construction and operation.
- Recommendations of measures, action plan, prevention and impact mitigation during the construction and operation, such as: water level fluctuation and mitigation measure for construction of expansion works
- Recommendations of environment monitoring during the construction and operation.

After that, the meeting was open for comments and discussion from participants on the report made by the consulting company, which are summarized as follows:

1. Comments from the participants, such as: Mr. Khaokeo Somchanmavong, Head of Thoulakhom District and Ms. Chanhpheng Viphavanh, Head of Viengkham District: Both agreed with the presentation of the consulting company on the information regarding initial environmental and social impact and measures to address the issues. They gave further instruction to organizations concerned such as: concerned units of the province, district and authority at the village level must take responsibility to help educate people in order to make them whom is likely to be affected from the project understand more with the aim to achieving overall national interest, otherwise misunderstanding such as impact on flood, which is not related to the expansion project, may occur.
2. Mr. Souphon, representative of the Water Resource and Environment Agency commented and advised for the plan for environmental management that the consultant should give focus on:

    - the further attention be given to the long term impact that may arise from the development of the project

- the allocation of funding in detail that will be used in the work of environmental and social management as well as monitoring from each relevant sector that should be done sufficiently.
- the attention should be given to the stage of working with locality especially the participation of the people as well as community who may be affected from the expansion project.

3. Comments from other participants such as Mr. Khamphuoa Phengphanhak, Head of Provincial Water Resource and Environment Office, Mr. Khammy Viengvilay, Village Head of Ban Sengsavang and Mr. Sisamone Boudsalath, Village Head of Ban Boungphoa:
    - They asked the project as well as consultant to pay attention to measures carefully and clearly in order to make the project goes smoothly, without or reduce possible negative impacts to the locality either on environment or society and those measures must be included in the agreement in order to make the contractor implement them and make it easier to monitor.

The project as well as consultant agreed to take all the comments made above into consideration in order to improve its report on the Initial Environmental Impact study of the project to make it more complete and with regard to the above mentioned comments.

Mr. Phoumy Nitibandith, Deputy Head of Production Division, Director of Nam Ngum Hydro Electric Dam 1 made additional clarification on the questions, benefit and negative impact from the extension project of Nam Ngum 1 as follows:

<u>Benefits:</u>

- Produce electricity for social consumption in an effective manner.
- Having the biggest reservoir in the country that can store water for fishery of the people.
- Using the reservoir as convenient transport route for the people living nearby the reservoir area of the Nam Ngum 1.
- Serving as beautiful tourist attraction site for the local people as well as for the foreign tourist, which can generate additional income to the people of Vientiane province as well as for Lao PDR.
- Water from the production of electricity can be used for irrigation and that amount of water can sufficiently feed the agriculture in the Vientiane plain.
- Can reduce flood in the sub-area of the Nam Ngum 1 and provide water for dry season.
- Serving as a venue for building and training of human resource of the Lao PDR on the hydro electric dam management skill and other jobs related to the management of dam, station and transmission line for example.
- The project has very limited negative impact on socio-environment compared to other new hydro power plant development projects and other similar projects.

Negative impacts:

- Loss of some riverside gardening land along the sub-area of Nam Ngum 1 during dry season if no consideration is held.

Through consultation mentioned above, the meeting concluded that the Initial Environmental Examination impact study and the mitigation plan are suitable, complete and implementable. In general, participants of the meeting as well as those who made comments have agreed in consensus with the said study and supported the development of the project (Nam Ngum 1 extension project).

At the end of the meeting, Mr. Vilath Sisouvong, Head of Vientiane Provincial Cabinet and Mr. Khammy Inthilath, member of the National Assembly for the 10^{th} constituency of Vientiane Province, co-chairs of the meeting had made additional guidance, namely: in general it is agreeable with the study, but it was requested that the consultant to provide answer to questions raised and provide clearer study in IESE. However, in order to make the project study right, suitable and implementable on the basis of the law and regulations of the Lao PDR, in case of any participants still have questions that could not be raise today, they can submit through the concerned authority of the village, district and province for further comments and clear answer. This is to improve the study report to make it more complete that in the next stage it will be submitted to the sector concerned: Electricity Department, Ministry of Energy and Mines and Water Resource and Environment Agency.

The meeting adjourned at 17:00 hours with consensus reached from all parties.

Vientiane Province, 16 July 2009

Chair of the Meeting	Recorder
pp. Signature for Chair of Meeting	
Mr. Vongvilay	Mr. Somsanith SENGTHONG

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Appendices

Appendix D Geology and Topography

Appendix D-1 Outcrop Observation

Appendix D-2 Permeability Test Sheets

Appendix D-3 Earthquake List within 500 km from Nam Ngum Dam

Appendix D-4 Instrumentation Data of Uplift Pressure of Nam Ngum Dam

Appendix D-5 Instrumentation Data of Water Relief Holes of Nam Ngum Dam

Appendix D-7 Topographic Area Survey Result

Appendix D-8 Location of River Cross Section Survey

(Following data and documents are included in the Datafile)

Appendix D-6 Final Report on Drilling Work by LAO CONSULTING GROUP

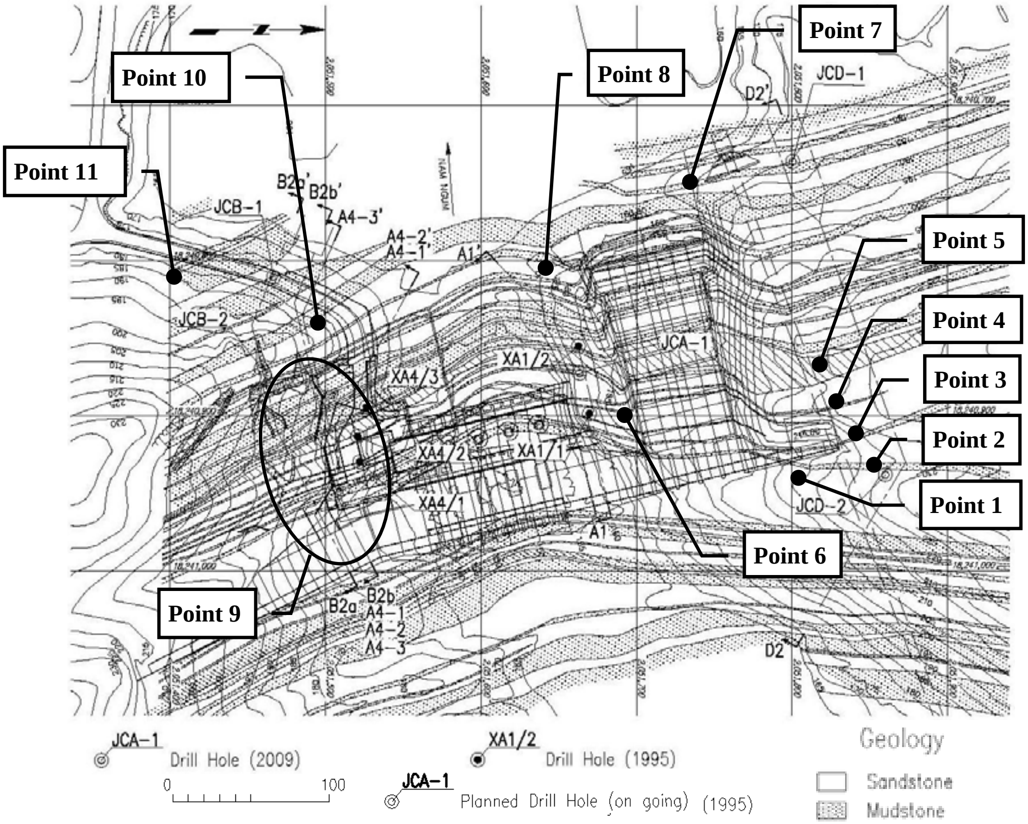
Appendix D-9 Dam Crest Alignment Survey Result

Appendix D-10 River Cross Section Survey Result

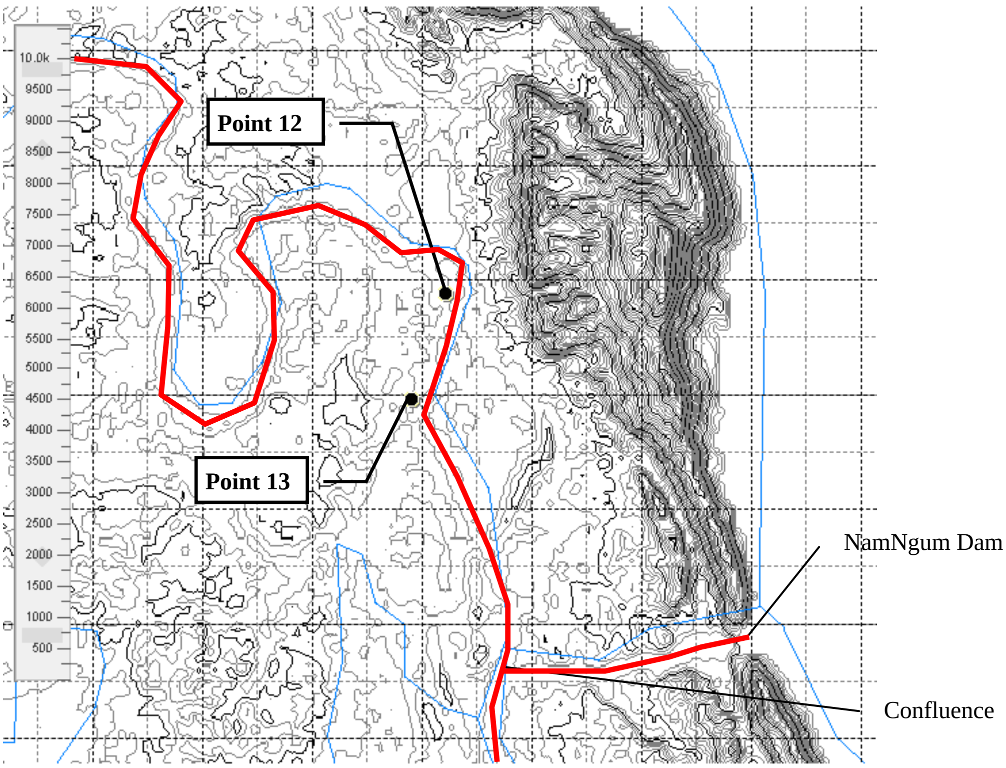
Appendix D-11 Riverside Alignment Survey Result

Appendix D-12 Final Report on Topographic Survey by LAO CONSULTING GROUP

Outcrop Observations (12-June-2009)



Outcrop Map 1



Outcrop Map 2

Point 1(1)

Dam site right abutment
(Same stratum of
the dam foundation sandstone)

Geology: sand stone
Weathering: moderately weathered
Hardness: moderately strong
Joints: (shown below)

Joints of bedding plane are spacing approximately 50 centimeters. Dip of bedding plane is consistent and most measurements range between 55 degrees and 60 degrees. Dip direction is also consistent at 255 degrees to 270 degrees. It is approximately parallel to the downstream face of the dam.

Additional joints are spacing 50 centimeters also, they are from 45 to 90 degrees to the bedding plane. Some are gradual and some are steep.

The joint on which the hammer lies is one of the major additional joint set. The left side scarp of the outcrop is the bedding plane.

Point 1(2)

Component particle size varies from fine to coarse and sometimes intercalates conglomerate layers.

Color varies grayish white to bluish grey in fresh rock and shows purple at the face of weathered joints.

Point 2

Dam site right abutment
(Mudstone layer
between sandstone strata)

Geology: mudstone
Weathering: highly weathered
Hardness: weak / very weak
Joints: impossible to confirm

Estimated distribution of mudstone layer is indicated on the photograph.
Dip direction of boundary is 270 degrees and dips westward 50 degrees.

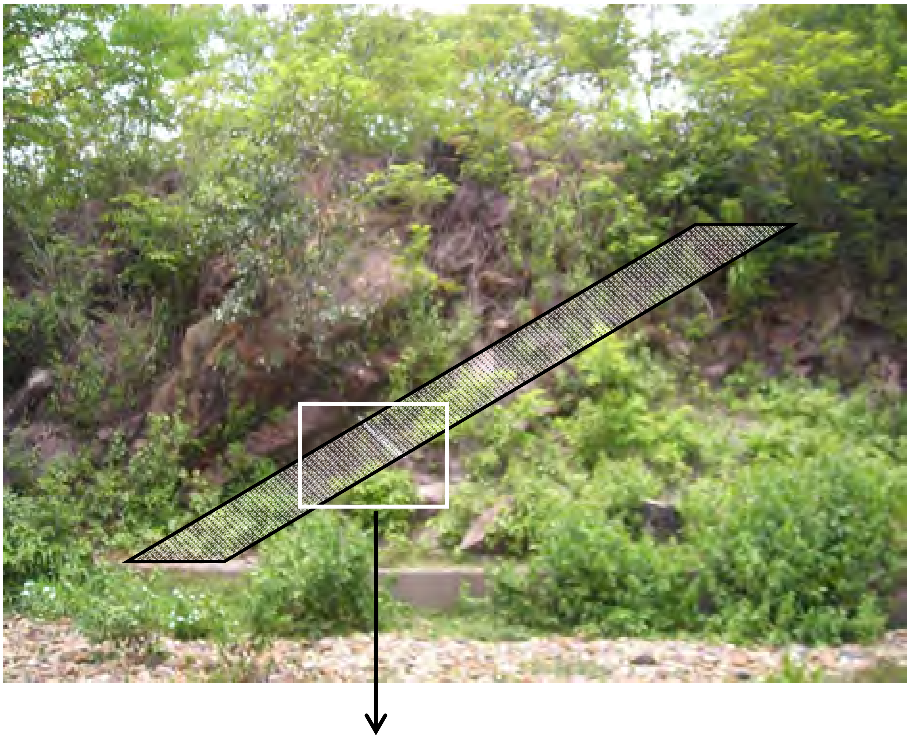
Point 3

Dam site right abutment
(Mudstone layer
between sandstone strata)

Geology: mudstone
Weathering: highly weathered
Hardness: weak / very weak
Joints: impossible to confirm

There is no outcrop and boundaries are not clear.

Point 4



Dam site right abutment
(Mudstone layer between sandstone strata)

Geology: mudstone
Weathering: highly weathered
Hardness: weak / very weak
Joints: (shown below)

Estimated distribution of mudstone layer is indicated on the photograph. Dip direction of boundary is 260 degrees and dips westward 60 degrees.

Some highly weathered mudstone layers are found between fresh sandstone strata like this outcrop.

Point 5

Dam site right abutment
(Weak mudstone stratum)

Geology: mudstone
Weathering: highly weathered
Hardness: weak
Joints: (shown below)

Mudstone exposed at the cut slope. Dip direction is 265 degrees and dips westward 55 degrees.

This mudstone stratum appears deformed and sheared rather than weathered.

Mudstone foundation shows muddy condition wetted by rain.

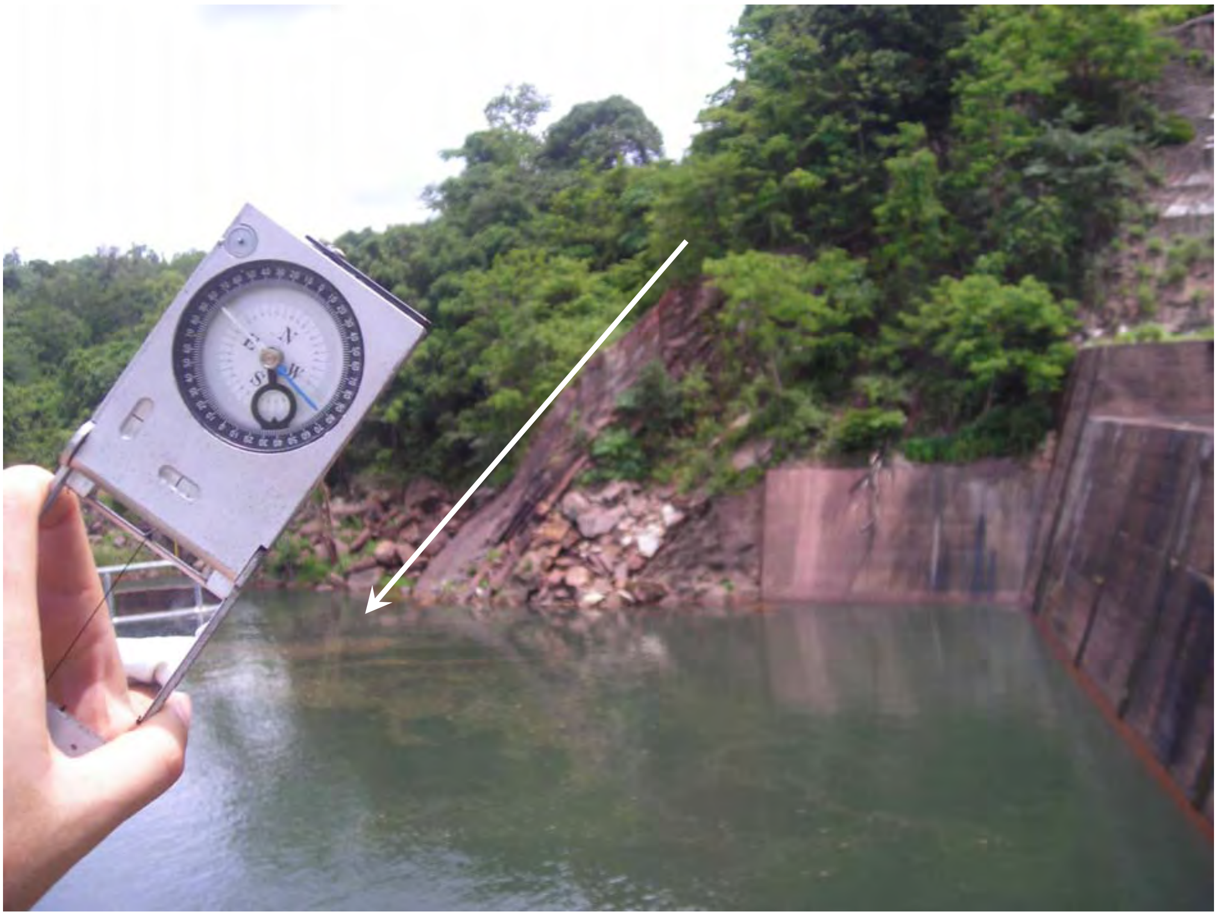
Point 6

Spillway left side
(foundation rock)

Geology: sand stone
Weathering: moderately weathered
Hardness: moderately strong
Joints: (shown below)

Dip direction of bedding is 260 degrees and dips westward 70 degrees.

Point 7



Spillway right side
(trace of a slide collapse)

Geology: sand stone
Weathering: slightly weathered
Hardness: moderately strong
Joints:
Dip direction of bedding is 260 degrees and dips westward 55 degrees.

This may be the trace of slope failure. Existing geological map indicates there was a thick mudstone stratum covering the slope. And the topography changed as if the mudstone stratum was removed. Any slopes parallel to the bedding plane may have a possibility of collapse like this slope.

Point 8

Right bank of tail bay

Geology: sand stone
Weathering: slightly weathered
Hardness: Strong
Joints: (shown below)

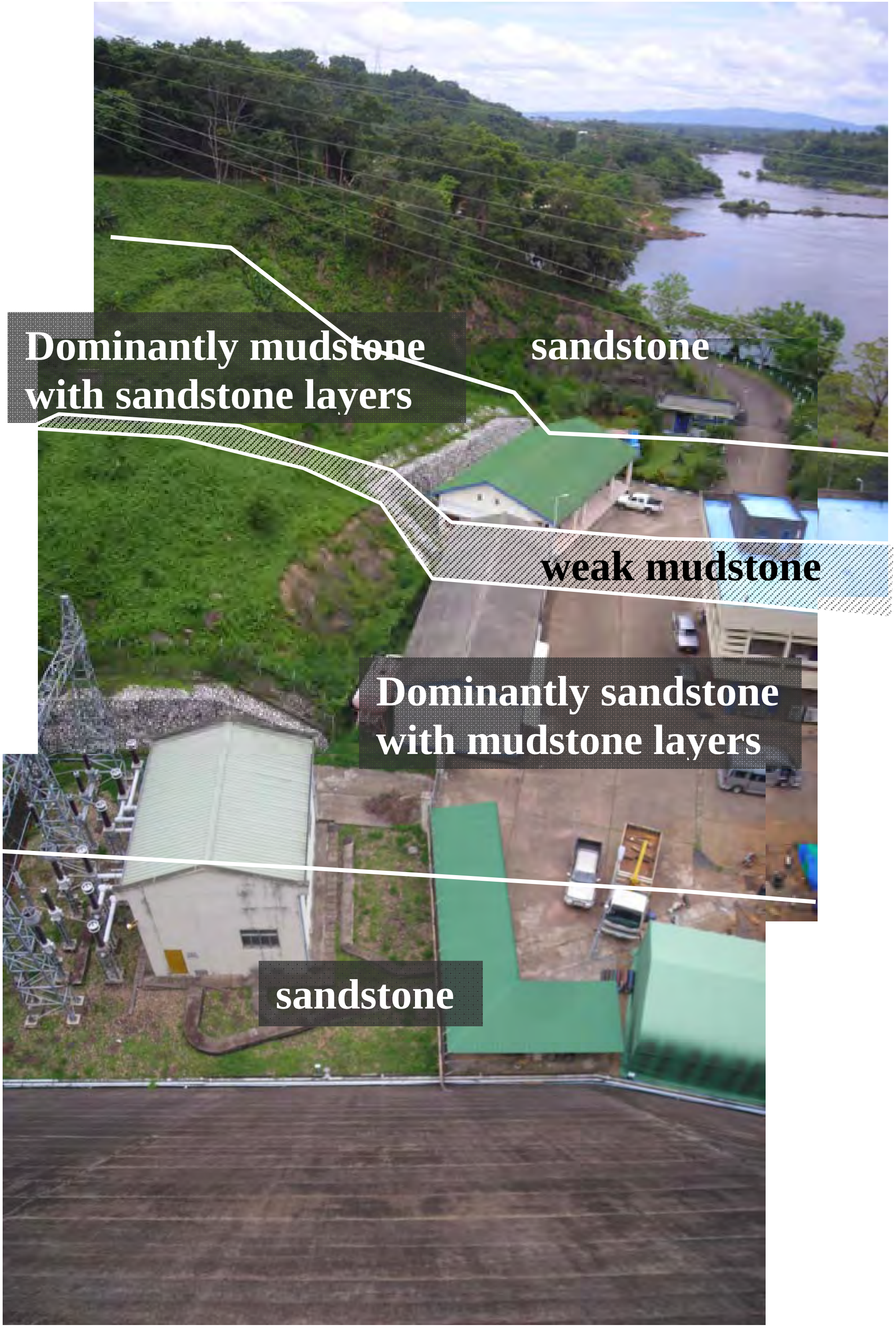
Dip direction of bedding is 260 degrees and dips westward 50 degrees.

Joints of bedding plane are spacing 60 centimeters. Dip and dip direction of bedding plane is consistent. The joints look tight and rock mass may be stiff.

Point 9

Left bank

The basement rock is shown on the photograph.



Point 10
Downstream of left bank

Geology: sand stone
Weathering: moderately weathered
Hardness: moderately strong
Joints: (shown below)

Dip direction of bedding is 250 degrees and dips westward 65 degrees.
It is little bit loosen.

Point 11
Downstream of left bank

Geology: fill or talus deposit
Weathering: N/A
Hardness: N/A
Joints: N/A

Point 12

Nam Lik river

Geology: alluvium

For the concrete aggregate

Point 13

Nam Lik river

Quarrying company

Nam Ngum 1 expansion preparatory survey

Permeability Test in Drill Hole (hole name JCA-1)

(SHEET 1 OF 1)

drill hole feature		test condition			Test date:	1/6/2009
Location:	Power house	Type of test:	single packer		Tested by:	Shengthong
Coordinate:	E= 18,240,872.7	Test section (m)			Drilled by:	Misai
	N= 2,051,663.3	from: 14.50	to: 20.00		Checked by:	JICA ST 2009
Collar Elevation (m):	177.296	section length ; L :	5.50			
Hole Depth (m):	20.00				Lu	62
diameter (cm); R:	7.5	Depth of groundwater (m)				
Inclination (degree):	90	before test:	7.00		K (cm/s)	8.2E-04
Direction:	-	after test:				

height of pressure gauge; H1:	0.87
length of rods installed; Lrod:	16.00
groundwater content :	Saturated
additional water head; H2:	7

L (m)	H1 (m)	H2 (m)	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t (min)	Qt (ℓ)	Q0 (ℓ/min)	Q (ℓ/min/m)	Q/P×10 (ℓ/min/m)	K(P,Q) (cm/s)	used for calculate
5.50	0.87	7.00	0.57	1.0	1.22	--	5	288.0	57.60	10.47	86.03	1.1E-03	○
5.50	0.87	7.00	1.28	3.0	2.51	--	5	431.0	86.20	15.67	62.50	8.3E-04	○
5.50	0.87	7.00	2.24	5.0	3.55	3.55	5	569.0	113.80	20.69	58.33	7.7E-04	○
5.50	0.87	7.00	1.19	3.0	--	2.60	5	415.0	83.00	15.09	58.11	7.7E-04	
5.50	0.87	7.00	0.58	1.0	--	1.21	5	291.0	58.20	10.58	87.66	1.2E-03	
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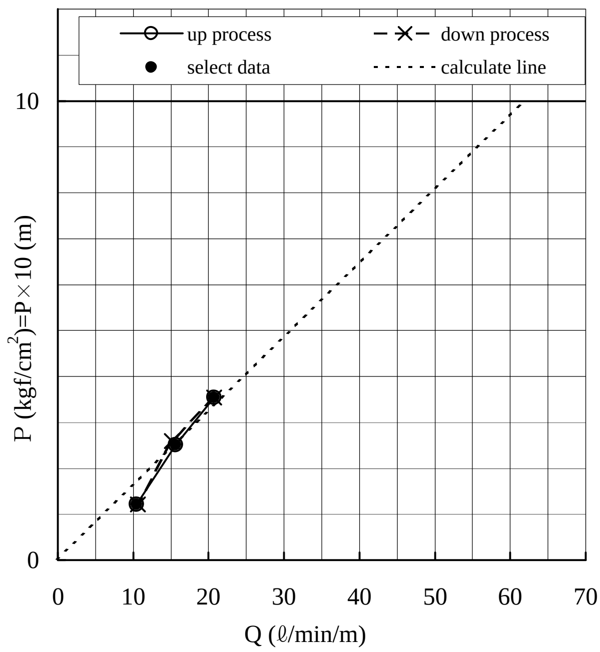
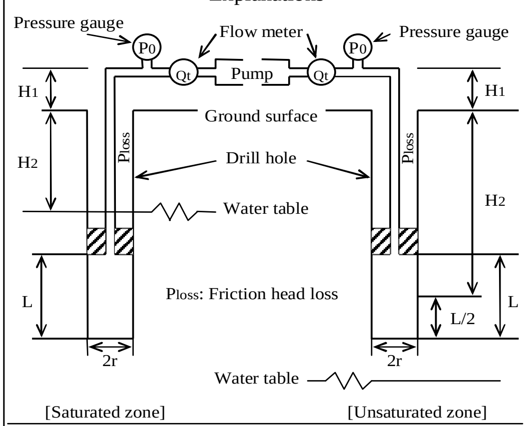


Explanations



$Lu = 10 \times Q_0/(PL)$

$P = P_0 + y_w(H_1 + H_2) - P_{loss}$

$P_{loss} = y_w Q_0^2 (\alpha L_{rod} + \beta)$

$\alpha = 7.6 \times 10^{-5}$ $\beta = 5.1 \times 10^{-4}$

$K = 100 \times 1/(2\pi L) \times 1/60 \times 1/1000 \times y_w \times \Delta Q_0/\Delta P \times \ln(100 \times 2L/R)$

Q_t: Water volume during time in “t”
t: Injected time
Q_0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
L_{rod}: Total length of rods installed

P : Effective pressure
P_0: Gauge pressure
P_{loss} : Friction head loss
y_w: Unit weight of water (0.1 kgf/cm^2/m))
R : Diameter of hole

Nam Ngum 1 expansion preparatory survey

Permeability Test in Drill Hole (hole name JCD-2)

(SHEET 1 OF 4)

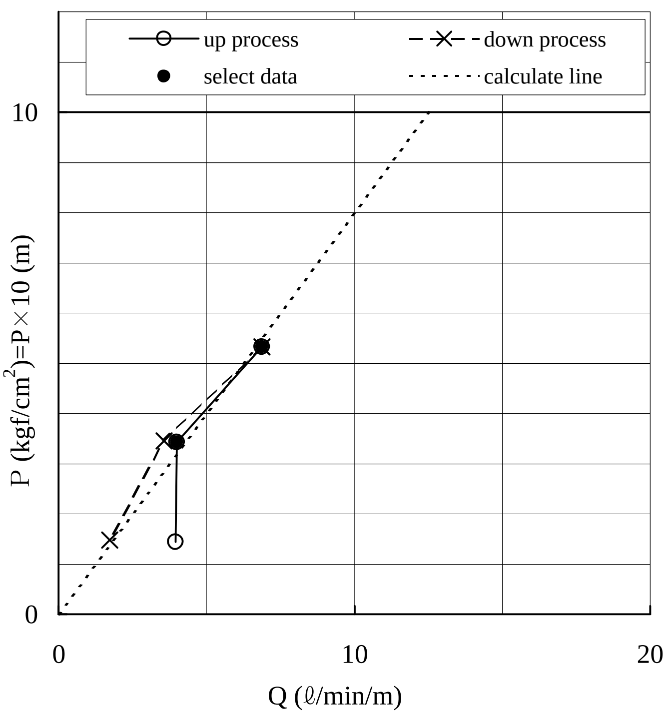
drill hole feature			**test condition**				
Location:	Right Abutment		Type of test:	single packer		Test date:	18/6/2009
Coordinate:	E=	18,240,938.0	Test section (m)			Tested by:	Shengthong
	N=	2,051,859.8	from: 10.00	to: 15.00		Drilled by:	Mom
Collar Elevation (m):	224.777		section length ; L :	5.00		Checked by:	JICA ST 2009
Hole Depth (m):	55.00						
diameter (cm); R:	7.5		Depth of groundwater (m)				
Inclination (degree):	90		before test:	4.00			
Direction:	-		after test:				

Lu	13
K (cm/s)	1.6E-04

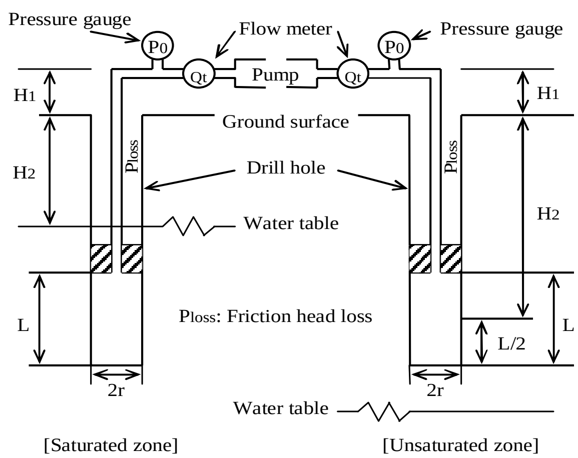
height of pressure gauge; H1: 0.87 groundwater content : Saturated

length of rods installed; Lrod: 11.50 additional water head; H2: 4

L m	H1 m	H2 m	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calculate
5.00	0.87	4.00	0.05	1.0	1.44		5	99.0	19.80	3.96	27.56	3.6E-04	
5.00	0.87	4.00	0.06	3.0	3.43		5	100.0	20.00	4.00	11.67	1.5E-04	○
5.00	0.87	4.00	0.16	5.0	5.33	5.33	5	172.0	34.40	6.88	12.92	1.7E-04	○
5.00	0.87	4.00	0.04	3.0		3.45	5	89.0	17.80	3.56	10.33	1.3E-04	
5.00	0.87	4.00	0.01	1.0		1.48	5	43.0	8.60	1.72	11.65	1.5E-04	



Explanations



$Lu = 10 \times Q_0/(PL)$

$P = P_0 + \gamma_w(H_1+H_2) - P_{loss}$

$P_{loss} = \gamma_w Q_0^2(\alpha L_{rod} + \beta)$

$\alpha = 7.6\times10^{-5}$ $\beta = 5.1\times10^{-4}$

$K = 100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P \times \ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion preparatory survey

Permeability Test in Drill Hole (hole name JCD-2)

(SHEET 2 OF 4)

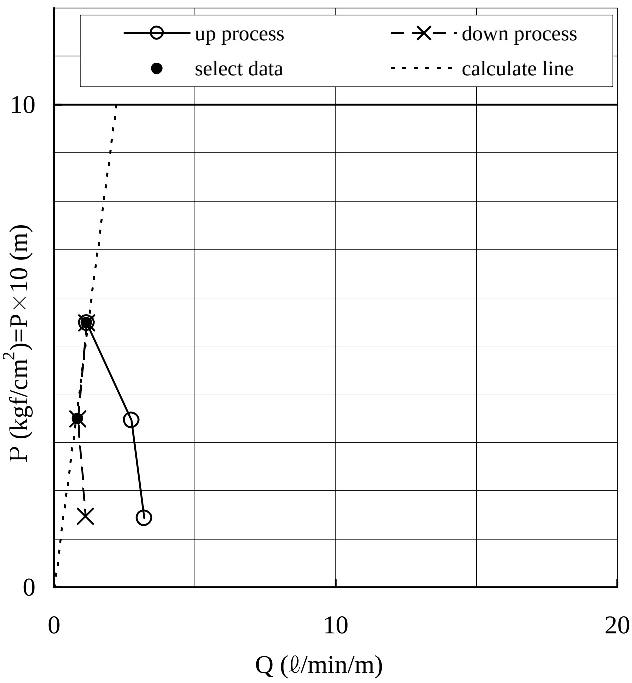
drill hole feature		**test condition**			
Location:	Right Abutment	Type of test:	single packer	Test date:	18/6/2009
Coordinate:	E= 18,240,938.0	Test section (m)		Tested by:	Shengthong
	N= 2,051,859.8	from: 15.00	to: 20.00	Drilled by:	Mom
Collar Elevation (m):	224.777	section length ; L :	5.00	Checked by:	JICA ST 2009
Hole Depth (m):	55.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	4.00		
Direction:	-	after test:			

Lu	2
K (cm/s)	2.9E-05

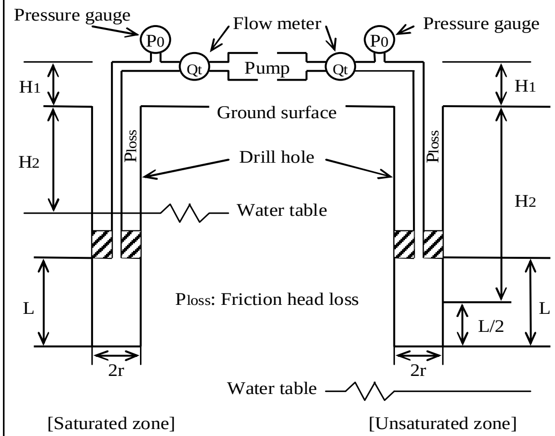
height of pressure gauge; H1: 0.87 groundwater content : Saturated

length of rods installed; Lrod: 16.50 additional water head; H2: 4

L m	H_1 m	H_2 m	Ploss kgf/cm2 (0.098MPa)	P_0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q_0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calculate
5.00	0.87	4.00	0.05	1.0	1.44		5	80.0	16.00	3.20	22.27	2.9E-04	
5.00	0.87	4.00	0.03	3.0	3.46		5	69.0	13.80	2.76	7.98	1.0E-04	
5.00	0.87	4.00	0.01	5.0	5.48	5.48	5	29.0	5.80	1.16	2.12	2.7E-05	○
5.00	0.87	4.00	0.00	3.0		3.49	5	21.0	4.20	0.84	2.41	3.1E-05	○
5.00	0.87	4.00	0.01	1.0		1.48	5	28.0	5.60	1.12	7.58	9.8E-05	



Explanations



$Lu = 10 \times Q_0/(PL)$

$P = P_0 + \gamma_w(H_1+H_2) - P_{loss}$

$P_{loss} = \gamma_w Q_0^2(\alpha L_{rod} + \beta)$

$\alpha = 7.6\times10^{-5}$ $\beta = 5.1\times10^{-4}$

$K = 100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P \times \ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion preparatory survey

Permeability Test in Drill Hole (hole name JCD-2)

(SHEET 3 OF 4)

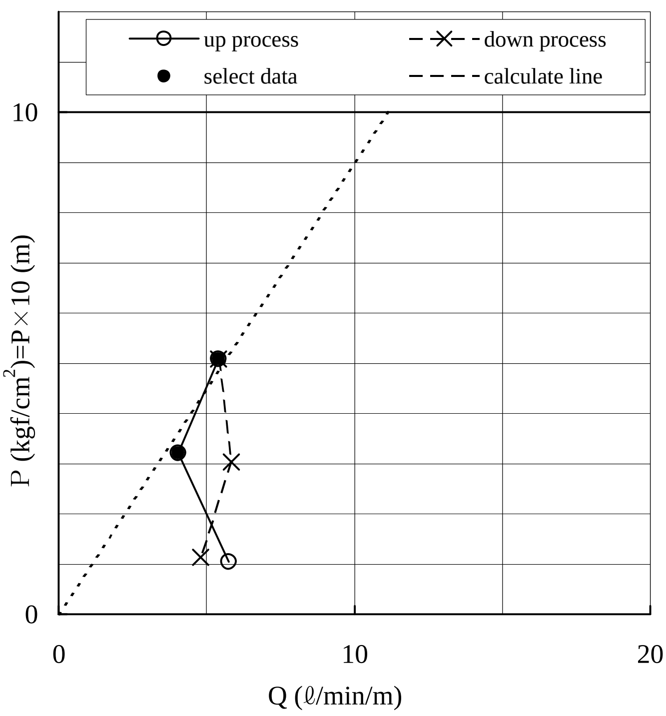
drill hole feature		**test condition**			
Location:	Right Abutment	Type of test:	single packer	Test date:	26/6/2009
Coordinate:	E= 18,240,938.0	Test section (m)		Tested by:	Shengthong
	N= 2,051,859.8	from: 41.00	to: 46.00	Drilled by:	Mom
Collar Elevation (m):	224.777	section length ; L :	5.00	Checked by:	JICA ST 2009
Hole Depth (m):	55.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	2.70		
Direction:	-	after test:			

Lu	11
K (cm/s)	1.5E-04

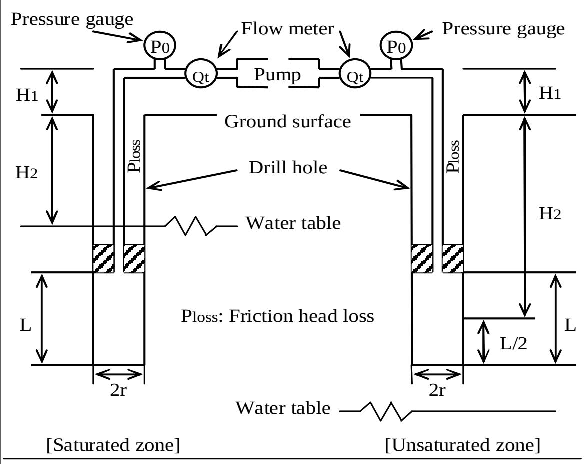
height of pressure gauge; H1: 0.87 — groundwater content : Saturated

length of rods installed; Lrod: 42.50 — additional water head; H2: 2.7

L m	H1 m	H2 m	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calculate
5.00	0.87	2.70	0.31	1.0	1.05		5	144.0	28.80	5.76	55.01	7.1E-04	
5.00	0.87	2.70	0.15	3.0	3.21		5	101.0	20.20	4.04	12.60	1.6E-04	○
5.00	0.87	2.70	0.27	5.0	5.09	5.09	5	135.0	27.00	5.40	10.62	1.4E-04	○
5.00	0.87	2.70	0.32	3.0		3.04	5	146.0	29.20	5.84	19.23	2.5E-04	
5.00	0.87	2.70	0.22	1.0		1.14	5	120.0	24.00	4.80	42.22	5.5E-04	



Explanations



$Lu=10\times Q_0/(PL)$

$P=P_0+\gamma_w(H_1+H_2)-P_{loss}$

$P_{loss}=\gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha=7.6\times10^{-5}$ $\beta=5.1\times10^{-4}$

$K=100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P\times\ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion preparatory survey

Permeability Test in Drill Hole (hole name JCD-2)

(SHEET 4 OF 4)

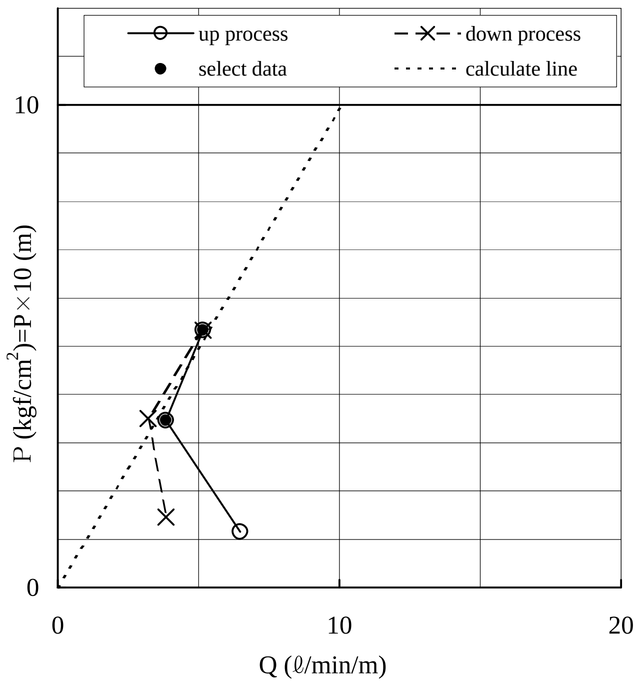
drill hole feature			**test condition**			
Location:	Right Abutment		Type of test:	single packer	Test date:	27/6/2009
Coordinate:	E=	18,240,938.0	Test section (m)		Tested by:	Shengthong
	N=	2,051,859.8	from: 50.00	to: 55.00	Drilled by:	Mom
Collar Elevation (m):	224.777		section length ; L :	5.00	Checked by:	JICA ST 2009
Hole Depth (m):	55.00					
diameter (cm); R:	7.5		Depth of groundwater (m)			
Inclination (degree):	90		before test:	5.30		
Direction:	-		after test:			

Lu	10
K (cm/s)	1.3E-04

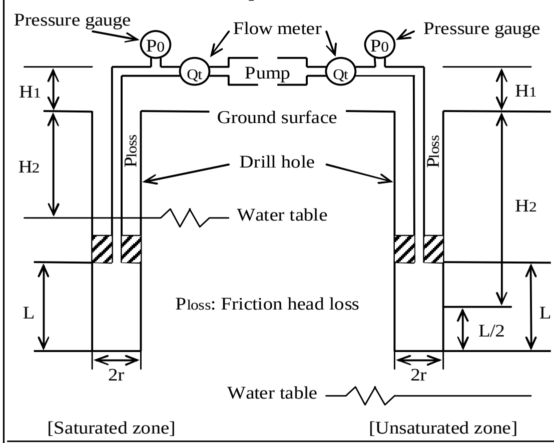
height of pressure gauge; H1: 0.87 groundwater content : Saturated

length of rods installed; Lrod: 51.50 additional water head; H2: 5.3

L	H1	H2	Ploss	P0	P		t	Qt	Q0	Q	Q/P×10	K(P,Q)	used for calculate
m	m	m	kgf/cm2 (0.098MPa)	kgf/cm2 (0.098MPa)	kgf/cm2 (0.098MPa)		min	ℓ	ℓ/min	ℓ/min/m	ℓ/min/m	cm/s	
5.00	0.87	5.30	0.46	1.0	1.16		5	162.0	32.40	6.48	56.01	7.3E-04	
5.00	0.87	5.30	0.16	3.0	3.46		5	96.0	19.20	3.84	11.11	1.4E-04	○
5.00	0.87	5.30	0.29	5.0	5.33	5.33	5	129.0	25.80	5.16	9.69	1.3E-04	○
5.00	0.87	5.30	0.11	3.0		3.51	5	80.0	16.00	3.20	9.12	1.2E-04	
5.00	0.87	5.30	0.16	1.0		1.46	5	96.0	19.20	3.84	26.36	3.4E-04	



Explanations



$Lu = 10 \times Q_0/(PL)$

$P = P_0 + \gamma_w(H_1+H_2) - P_{loss}$

$P_{loss} = \gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha = 7.6\times10^{-5}$ $\beta = 5.1\times10^{-4}$

$K = 100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P\times\ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA1/1)

(SHEET 1 OF 4)

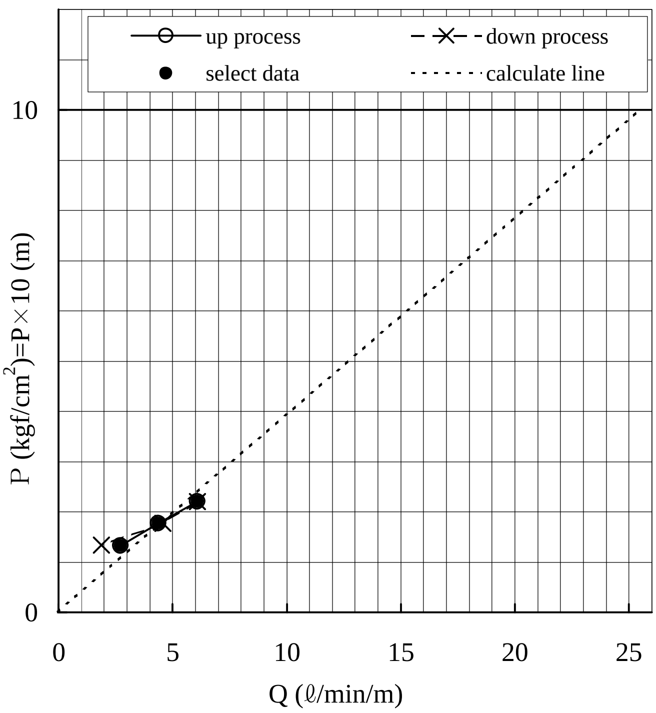
drill hole feature		test condition			
Location:	turbine axis	Type of test:	single packer	Test date:	6/5/1995
Coordinate:	X= 18,240,899.000	Test section (m)		Tested by:	Boon My
	Y= 2,051,670.000	from: 8.65	to: 14.20	Drilled by:	
Collar Elevation (m):	178.19	section length ; L :	5.55	Checked by:	JICA ST 2009
Hole Depth (m):	30.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	6.75		
Direction:	-	after test:			

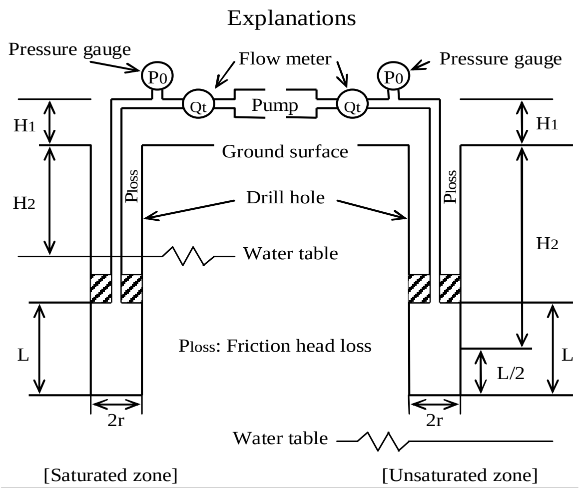
Lu	25.4
K (cm/s)	3.4E-04

height of pressure gauge; H_1: 1.75 groundwater content : Saturated

length of rods installed; L_{rod}: 10.15 dditional water head; H_2: 6.75

L (m)	H_1 (m)	H_2 (m)	Ploss kgf/cm2 (0.098MPa)	P_0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t (min)	Qt (ℓ)	Q_0 (ℓ/min)	Q (ℓ/min/m)	Q/P×10 (ℓ/min/m)	K(P,Q) (cm/s)	used for calculate
5.55	1.75	6.75	0.03	0.5	1.32		10	151.0	15.10	2.72	20.61	2.7E-04	○
5.55	1.75	6.75	0.08	1.0	1.77		10	243.0	24.30	4.38	24.75	3.3E-04	○
5.55	1.75	6.75	0.15	1.5	2.20	2.20	10	337.5	33.75	6.08	27.64	3.7E-04	○
5.55	1.75	6.75	0.08	1.0		1.77	10	253.5	25.35	4.57	25.82	3.4E-04	
5.55	1.75	6.75	0.01	0.5		1.34	10	104.0	10.40	1.87	13.96	1.9E-04	





$Lu = 10 \times Q_0/(PL)$

$P = P_0 + \gamma_w(H_1+H_2) - P_{loss}$

$P_{loss} = \gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha = 7.6\times10^{-5}$ $\beta = 5.1\times10^{-4}$

$K = 100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P\times\ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q_0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
L_{rod}: Total length of rods installed

P : Effective pressure
P_0: Gauge pressure
Ploss : Friction head loss
γ_w: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA1/1)

(SHEET 2 OF 4)

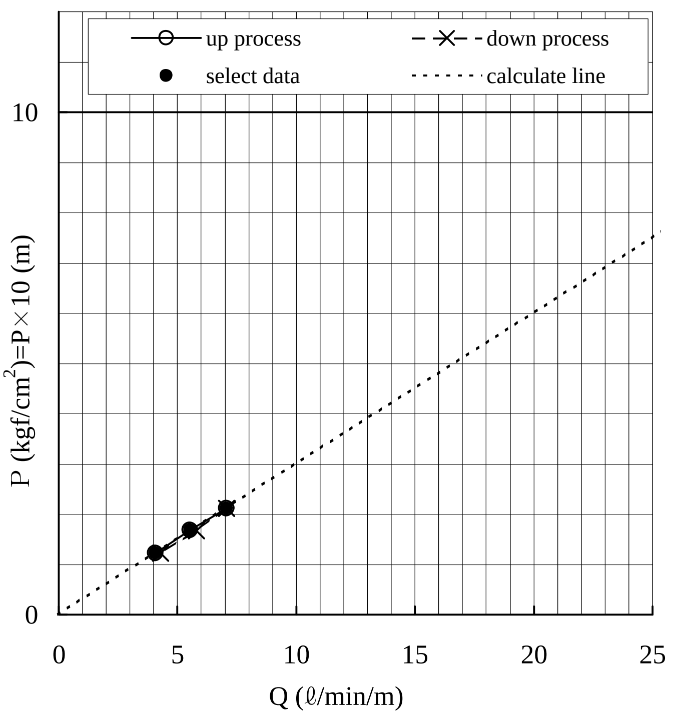
drill hole feature		test condition			
Location:	turbine axis	Type of test:	single packer	Test date:	7/5/1995
Coordinate:	X= 18,240,899.000	Test section (m)		Tested by:	Boon My
	Y= 2,051,670.000	from: 14.00	to: 18.50	Drilled by:	
Collar Elevation (m):	178.19	section length ; L :	4.50	Checked by:	JICA ST 2009
Hole Depth (m):	30.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	6.90		
Direction:	-	after test:			

Lu	33.3
K (cm/s)	4.2E-04

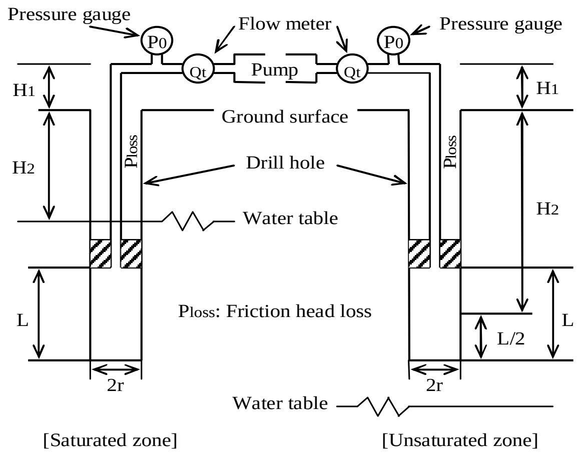
height of pressure gauge; H1: 0.9 groundwater content : Saturated

length of rods installed; Lrod: 15.50 dditional water head; H2: 6.9

L m	H1 m	H2 m	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calculate
4.50	0.90	6.90	0.06	0.5	1.22		10	182.5	18.25	4.06	33.28	4.2E-04	○
4.50	0.90	6.90	0.10	1.0	1.68		10	249.0	24.90	5.53	32.92	4.2E-04	○
4.50	0.90	6.90	0.17	1.5	2.11	2.11	10	317.5	31.75	7.06	33.46	4.2E-04	○
4.50	0.90	6.90	0.11	1.0		1.67	10	261.0	26.10	5.80	34.73	4.4E-04	
4.50	0.90	6.90	0.06	0.5		1.22	10	192.5	19.25	4.28	35.08	4.5E-04	



Explanations



$Lu=10\times Q_0/(PL)$

$P=P_0+\gamma_w(H_1+H_2)-P_{loss}$

$P_{loss}=\gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha=7.6\times10^{-5}$ $\beta=5.1\times10^{-4}$

$K=100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P\times\ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA1/1)

(SHEET 3 OF 4)

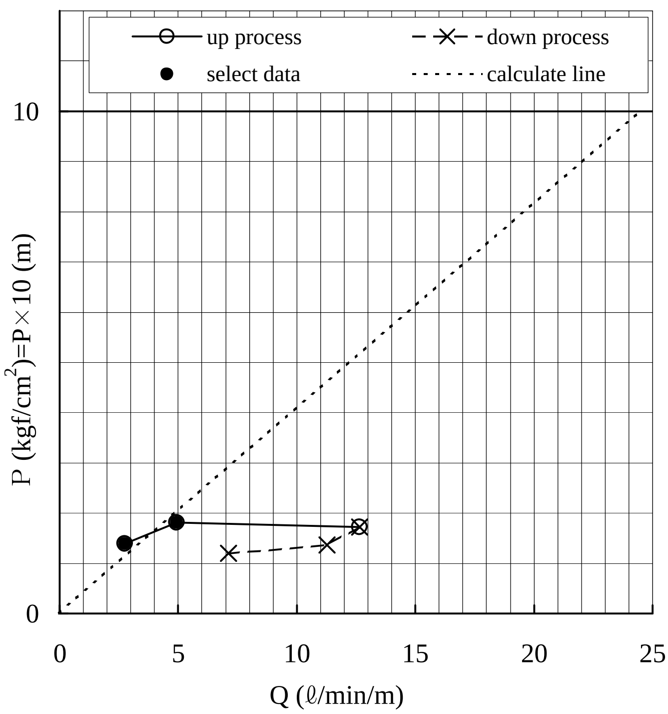
drill hole feature		test condition		
Location:	turbine axis	Type of test:	single packer	Test date: 8/5/1995
Coordinate:	X= 18,240,899.000	Test section (m)		Tested by: Boon My
	Y= 2,051,670.000	from: 19.00	to: 23.60	Drilled by:
Collar Elevation (m):	178.19	section length ; L :	4.60	Checked by:JICA ST 2009
Hole Depth (m):	30.00			
diameter (cm); R:	7.5	Depth of groundwater (m)		
Inclination (degree):	90	before test:	7.20	
Direction:	-	after test:		

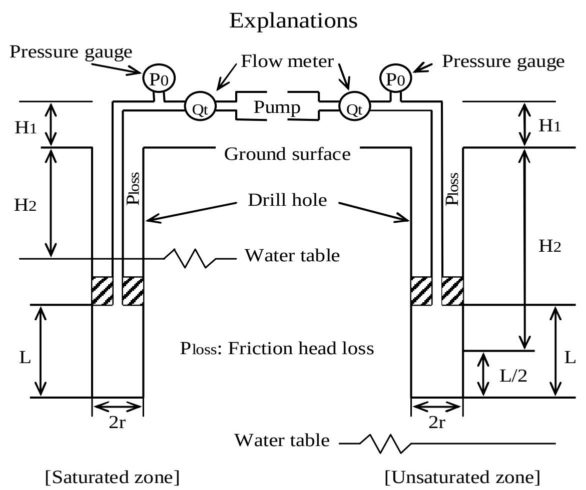
Lu	24.4
K (cm/s)	3.1E-04

height of pressure gauge; H1: 2 groundwater content : Saturated

length of rods installed; Lrod: 20.50 additional water head; H2: 7.2

L m	H1 m	H2 m	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calculate
4.60	2.00	7.20	0.03	0.5	1.39		10	126.0	12.60	2.74	19.71	2.5E-04	○
4.60	2.00	7.20	0.11	1.0	1.81		10	227.0	22.70	4.93	27.24	3.5E-04	○
4.60	2.00	7.20	0.70	1.5	1.72	1.72	10	582.0	58.20	12.65	73.55	9.4E-04	
4.60	2.00	7.20	0.56	1.0		1.36	10	519.0	51.90	11.28	82.94	1.1E-03	
4.60	2.00	7.20	0.22	0.5		1.20	10	327.0	32.70	7.11	59.25	7.6E-04	





$Lu=10\times Q_0/(PL)$

$P=P_0+\gamma_w(H_1+H_2)-P_{loss}$

$P_{loss}=\gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha=7.6\times10^{-5}$ $\beta=5.1\times10^{-4}$

$K=100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P\times\ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA1/1)

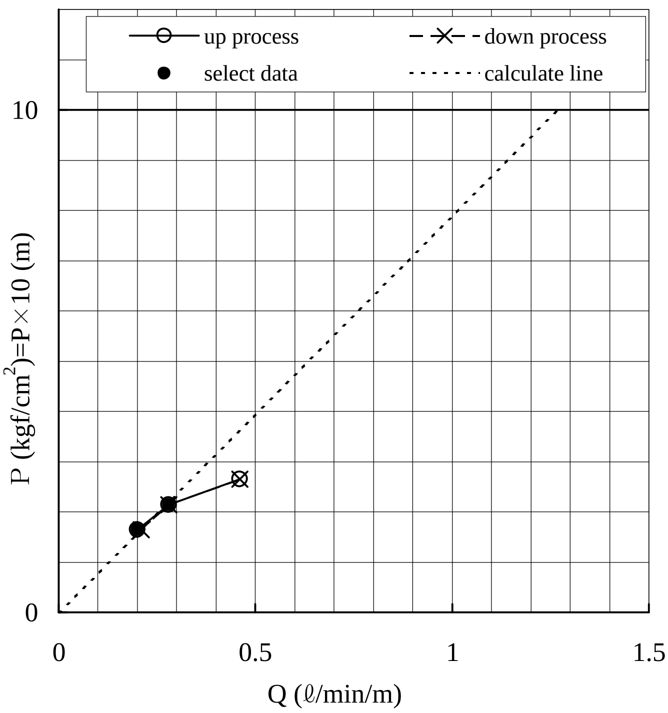
(SHEET 4 OF 4)

drill hole feature		test condition			
Location:	turbine axis	Type of test:	single packer	Test date:	8/5/1995
Coordinate:	X= 18,240,899.000	Test section (m)		Tested by:	Boon My
	Y= 2,051,670.000	from: 24.00	to: 29.00	Drilled by:	
Collar Elevation (m):	178.19	section length ; L :	5.00	Checked by:	JICA ST 2009
Hole Depth (m):	30.00			Lu	1.3
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	8.45	K (cm/s)	1.6E-05
Direction:	-	after test:			

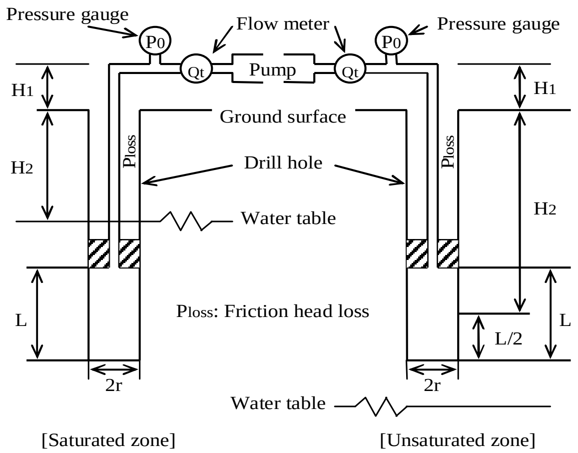
height of pressure gauge; H1: 3 groundwater content : Saturated

length of rods installed; Lrod: 25.50 additional water head; H2: 8.45

L (m)	H_1 (m)	H_2 (m)	Ploss kgf/cm2 (0.098MPa)	P_0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t (min)	Qt (ℓ)	Q_0 (ℓ/min)	Q (ℓ/min/m)	Q/P×10 (ℓ/min/m)	K(P,Q) (cm/s)	used for calcurate
5.00	3.00	8.45	0.00	0.5	1.65		10	9.8	0.98	0.20	1.22	1.5E-05	○
5.00	3.00	8.45	0.00	1.0	2.15		10	14.0	1.40	0.28	1.31	1.7E-05	○
5.00	3.00	8.45	0.00	1.5	2.65	2.65	10	23.1	2.31	0.46	1.74	2.3E-05	
5.00	3.00	8.45	0.00	1.0		2.15	10	13.8	1.38	0.28	1.31	1.7E-05	
5.00	3.00	8.45	0.00	0.5		1.65	10	10.5	1.05	0.21	1.28	1.7E-05	



Explanations



$Lu = 10 \times Q_0/(PL)$

$P = P_0 + \gamma_w(H_1+H_2) - P_{loss}$

$P_{loss} = \gamma_w Q_0^2(\alpha L_{rod} + \beta)$

$\alpha = 7.6\times10^{-5}$ $\beta = 5.1\times10^{-4}$

$K = 100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P \times \ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA1/2)

(SHEET 1 OF 4)

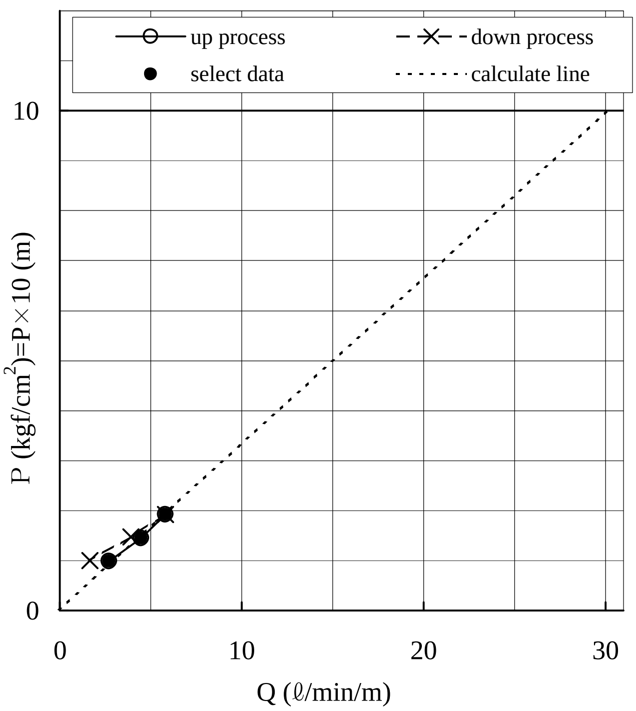
drill hole feature			test condition			
Location:	turbine axis		Type of test:	single packer	Test date:	9/5/1995
Coordinate:	X=	18,240,855	Test section (m)		Tested by:	Boon My
	Y=	2,051,663	from: 5.00	to: 9.75	Drilled by:	
Collar Elevation (m):	177.50		section length ; L :	4.75	Checked by:	JICA ST 2009
Hole Depth (m):	25.00					
diameter (cm); R:	7.5		Depth of groundwater (m)			
Inclination (degree):	90		before test:	4.28		
Direction:	-		after test:			

Lu	30.1
K (cm/s)	3.9E-04

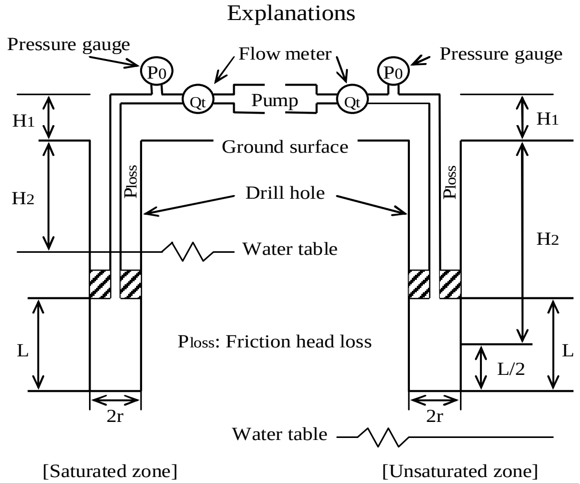
height of pressure gauge; H1: 0.75 groundwater content : Saturated

length of rods installed; Lrod: 6.50 itional water head; H2: 4.28

L	H1	H2	Ploss	P0	P		t	Qt	Q0	Q	Q/P×10	K(P,Q)	used for calculate
m	m	m	kgf/cm2 (0.098MPa)	kgf/cm2 (0.098MPa)	kgf/cm2 (0.098MPa)		min	ℓ	ℓ/min	ℓ/min/m	ℓ/min/m	cm/s	
4.75	0.75	4.28	0.02	0.5	0.98		10	129.0	12.90	2.71	27.57	3.5E-04	○
4.75	0.75	4.28	0.05	1.0	1.45		10	213.0	21.30	4.48	30.83	4.0E-04	○
4.75	0.75	4.28	0.08	1.5	1.92	1.92	10	277.0	27.70	5.83	30.32	3.9E-04	○
4.75	0.75	4.28	0.03	1.0		1.47	10	185.5	18.55	3.90	26.48	3.4E-04	
4.75	0.75	4.28	0.01	0.5		0.99	10	78.0	7.80	1.64	16.52	2.1E-04	



Explanations



$Lu=10\times Q_0/(PL)$

$P=P_0+\gamma_w(H_1+H_2)-P_{loss}$

$P_{loss}=\gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha=7.6\times10^{-5}$ $\beta=5.1\times10^{-4}$

$K=100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w\times\Delta Q_0/\Delta P\times\ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA1/2)

(SHEET 2 OF 4)

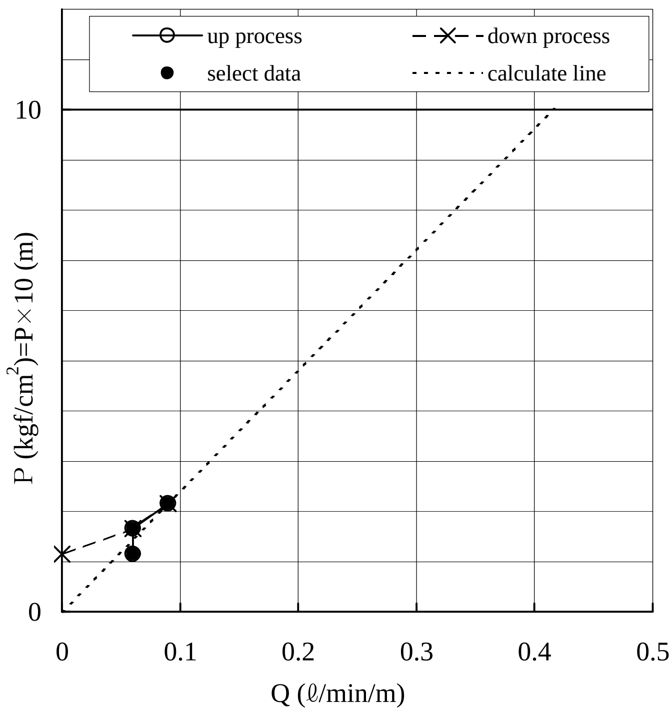
drill hole feature		test condition			
Location:	turbine axis	Type of test:	single packer	Test date:	9/5/1995
Coordinate:	X= 18,240,855	Test section (m)		Tested by:	Boon My
	Y= 2,051,663	from: 9.75	to: 15.15	Drilled by:	
Collar Elevation (m):	177.50	section length ; L :	5.40	Checked by:	JICA ST 2009
Hole Depth (m):	25.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	4.40		
Direction:	-	after test:			

Lu	0.4
K (cm/s)	5.5E-06

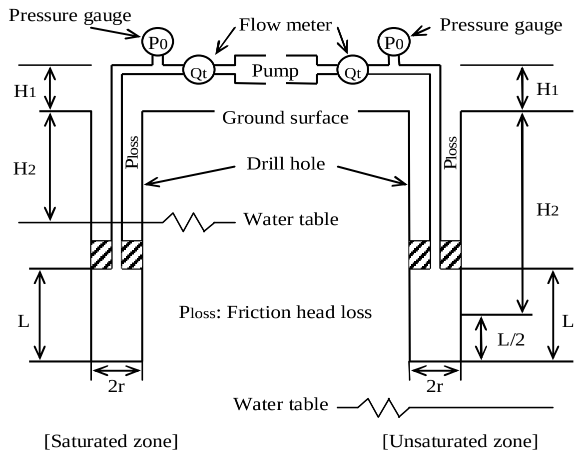
height of pressure gauge; H1: 2.1 groundwater content : Saturated

length of rods installed; Lrod: 11.25 additional water head; H2: 4.4

L m	H1 m	H2 m	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calculate
5.40	2.10	4.40	0.00	0.5	1.15		10	3.0	0.30	0.06	0.52	6.4E-06	○
5.40	2.10	4.40	0.00	1.0	1.65		10	3.3	0.33	0.06	0.36	4.9E-06	○
5.40	2.10	4.40	0.00	1.5	2.15	2.15	10	5.0	0.50	0.09	0.42	5.7E-06	○
5.40	2.10	4.40	0.00	1.0		1.65	10	3.4	0.34	0.06	0.36	5.0E-06	
5.40	2.10	4.40	0.00	0.5		1.15	10	0.0	0.00	0.00	0.00	0.0E+00	



Explanations



$Lu=10\times Q_0/(PL)$

$P=P_0+\gamma_w(H_1+H_2)-P_{loss}$

$P_{loss}=\gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha=7.6\times10^{-5}$ $\beta=5.1\times10^{-4}$

$K=100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w\times\Delta Q_0/\Delta P\times\ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA1/2)

(SHEET 3 OF 4)

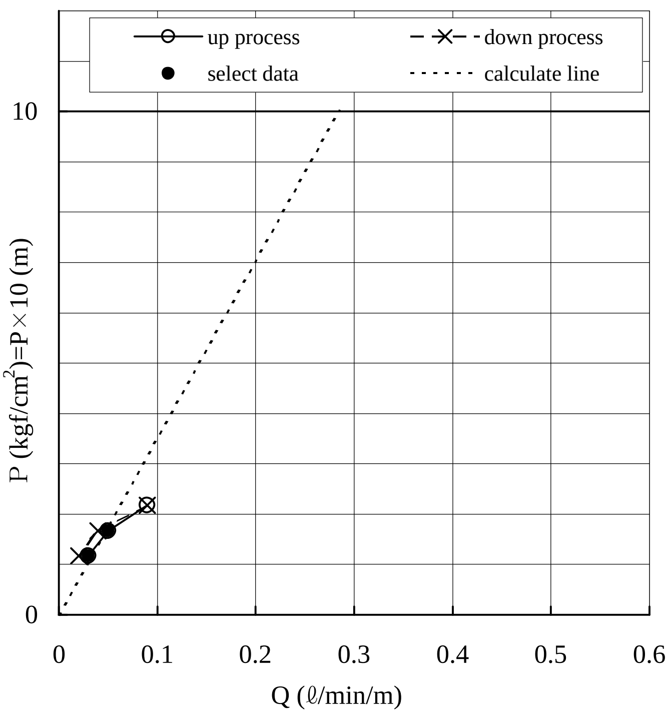
drill hole feature		**test condition**			
Location:	turbine axis	Type of test:	single packer	Test date:	9/5/1995
Coordinate:	X= 18,240,855	Test section (m)		Tested by:	Boon My
	Y= 2,051,663	from: 16.00	to: 20.80	Drilled by:	
Collar Elevation (m):	177.50	section length ; L :	4.80	Checked by:	JICA ST 2009
Hole Depth (m):	25.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	4.75		
Direction:	-	after test:			

Lu	0.3
K (cm/s)	3.3E-06

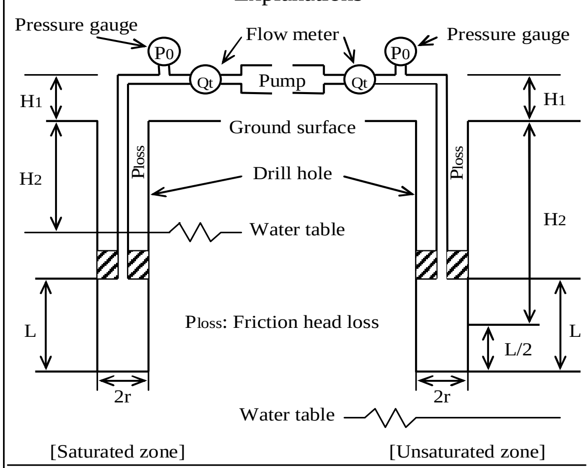
height of pressure gauge; H1: 1.95 groundwater content : Saturated

length of rods installed; Lrod: 17.50 additional water head; H2: 4.75

L (m)	H1 (m)	H2 (m)	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t (min)	Qt (ℓ)	Q0 (ℓ/min)	Q (ℓ/min/m)	Q/P×10 (ℓ/min/m)	K(P,Q) (cm/s)	used for calculate
4.80	1.95	4.75	0.00	0.5	1.17		10	1.2	0.12	0.03	0.26	2.8E-06	○
4.80	1.95	4.75	0.00	1.0	1.67		10	2.2	0.22	0.05	0.30	3.5E-06	○
4.80	1.95	4.75	0.00	1.5	2.17	2.17	10	4.5	0.45	0.09	0.41	5.6E-06	
4.80	1.95	4.75	0.00	1.0		1.67	10	1.8	0.18	0.04	0.24	2.9E-06	
4.80	1.95	4.75	0.00	0.5		1.17	10	0.8	0.08	0.02	0.17	1.8E-06	



Explanations



$Lu=10\times Q_0/(PL)$

$P=P_0+\gamma_w(H_1+H_2)-P_{loss}$

$P_{loss}=\gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha=7.6\times10^{-5}$ $\beta=5.1\times10^{-4}$

$K=100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P\times\ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA1/2)

(SHEET 4 OF 4)

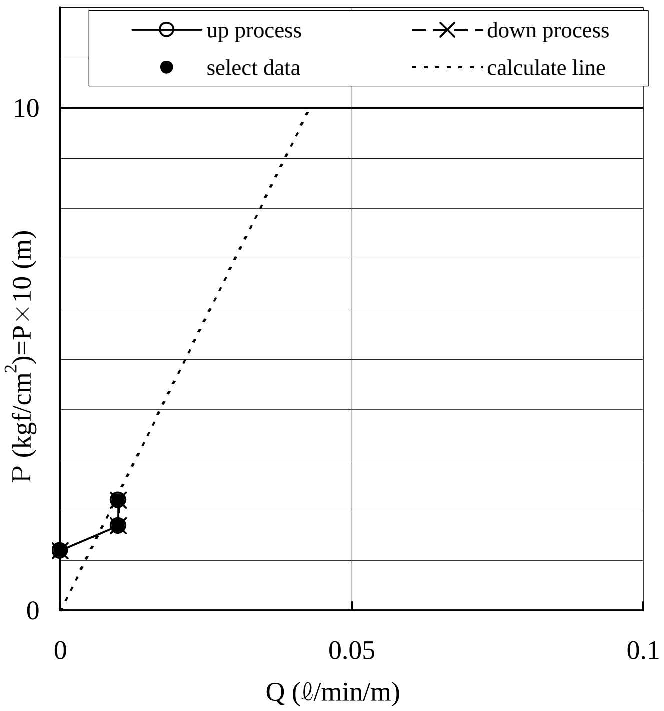
drill hole feature		test condition			
Location:	turbine axis	Type of test:	single packer	Test date:	10/5/1995
Coordinate:	X= 18,240,855	Test section (m)		Tested by:	Boon My
	Y= 2,051,663	from: 19.00	to: 25.00	Drilled by:	
Collar Elevation (m):	177.50	section length ; L :	6.00	Checked by:	JICA ST 2009
Hole Depth (m):	25.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	4.85		
Direction:	-	after test:			

Lu	0.043
K (cm/s)	6.0E-07

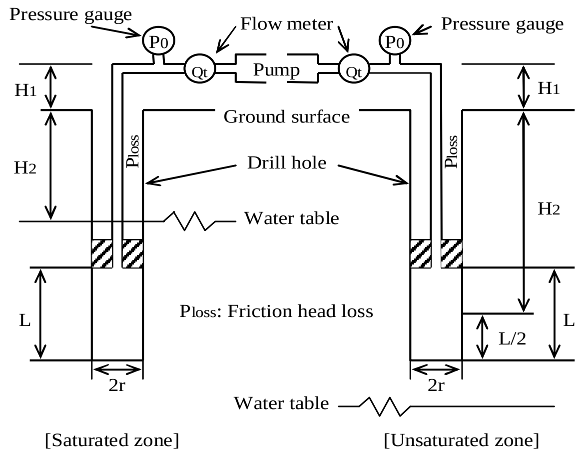
height of pressure gauge; H1: 2 groundwater content : Saturated

length of rods installed; Lrod: 20.50 additional water head; H2: 4.85

L m	H1 m	H2 m	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calcurate
6.00	2.00	4.85	0.00	0.5	1.19		10	0.0	0.00	0.00	0.00	0.0E+00	○
6.00	2.00	4.85	0.00	1.0	1.69		10	0.4	0.04	0.01	0.06	5.3E-07	○
6.00	2.00	4.85	0.00	1.5	2.19	2.19	10	0.8	0.08	0.01	0.05	8.2E-07	○
6.00	2.00	4.85	0.00	1.0		1.69	10	0.4	0.04	0.01	0.06	5.3E-07	
6.00	2.00	4.85	0.00	0.5		1.19	10	0.0	0.00	0.00	0.00	0.0E+00	



Explanations



$Lu = 10 \times Q_0/(PL)$

$P = P_0 + \gamma_w(H_1+H_2) - P_{loss}$

$P_{loss} = \gamma_w Q_0^2(\alpha L_{rod} + \beta)$

$\alpha = 7.6\times10^{-5}$ $\beta = 5.1\times10^{-4}$

$K = 100 \times 1/(2\pi L) \times 1/60 \times 1/1000 \times \gamma_w \times \Delta Q_0/\Delta P \times \ln(100 \times 2L/R)$

Qt: Water volume during time in “t”
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA4/1)

(SHEET 1 OF 5)

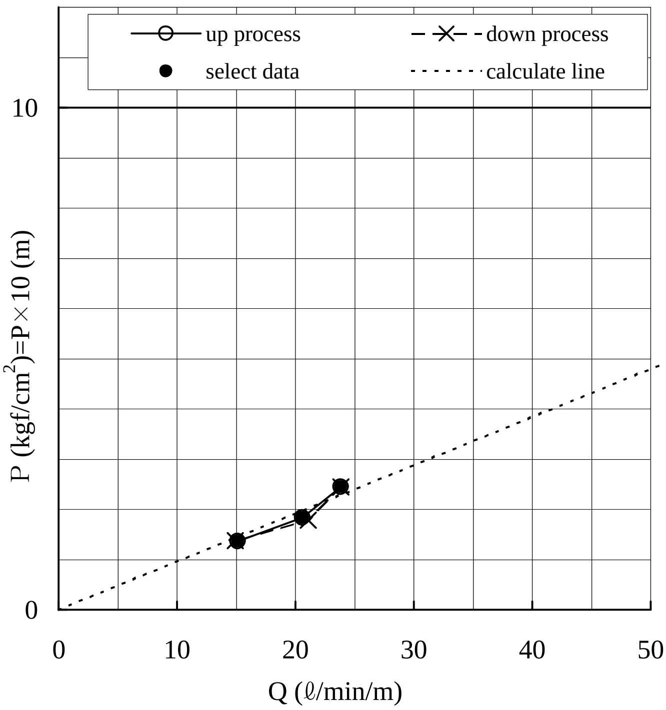
drill hole feature			**test condition**				
Location:	turbine axis		Type of test:	single packer		Test date:	22/4/1995
Coordinate:	E=	18,240,930	Test section (m)			Tested by:	Boon My
	N=	2,051,522	from: 6.00	to: 11.00		Drilled by:	
Collar Elevation (m):	177.11		section length ; L :	5.00		Checked by:	JICA ST 2009
Hole Depth (m):	30.00						
diameter (cm); R:	7.5		Depth of groundwater (m)				
Inclination (degree):	90		before test:	9.30			
Direction:	-		after test:				

Lu	104
K (cm/s)	1.4E-03

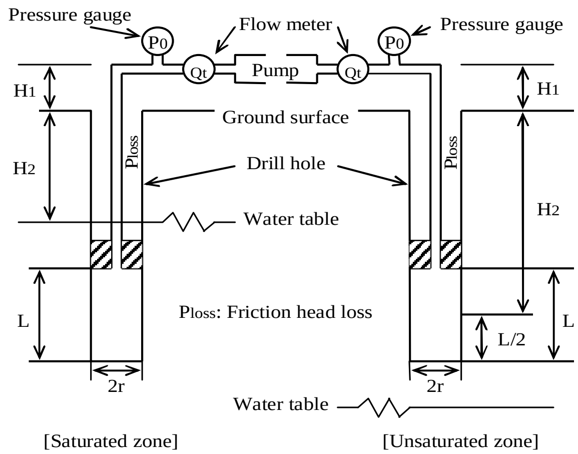
height of pressure gauge; H_1: 1.3 — groundwater content : Unsaturated

length of rods installed; L_{rod}: 7.50 — additional water head; H_2: 8.5

L (m)	H_1 (m)	H_2 (m)	P_{loss} kgf/cm2 (0.098MPa)	P_0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t (min)	Qt (ℓ)	Q_0 (ℓ/min)	Q (ℓ/min/m)	Q/P×10 (ℓ/min/m)	K(P,Q) (cm/s)	used for calculate
5.00	1.30	8.50	0.62	1.0	1.36		10	756.0	75.60	15.12	111.18	1.4E-03	○
5.00	1.30	8.50	1.15	2.0	1.83		10	1031.0	103.10	20.62	112.68	1.5E-03	○
5.00	1.30	8.50	1.53	3.0	2.45	2.45	10	1192.0	119.20	23.84	97.31	1.3E-03	○
5.00	1.30	8.50	1.20	2.0		1.78	10	1053.0	105.30	21.06	118.31	1.5E-03	
5.00	1.30	8.50	0.60	1.0		1.38	10	745.0	74.50	14.90	107.97	1.4E-03	



Explanations



$Lu = 10 \times Q_0/(PL)$

$P = P_0 + \gamma_w(H_1+H_2) - P_{loss}$

$P_{loss} = \gamma_w Q_0^2(\alpha L_{rod} + \beta)$

$\alpha = 7.6\times10^{-5}$ $\beta = 5.1\times10^{-4}$

$K = 100 \times 1/(2\pi L) \times 1/60 \times 1/1000 \times \gamma_w \times \Delta Q_0/\Delta P \times \ln(100\times 2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q_0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
L_{rod}: Total length of rods installed

P : Effective pressure
P_0: Gauge pressure
P_{loss} : Friction head loss
γ_w: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA4/1)

(SHEET 2 OF 5)

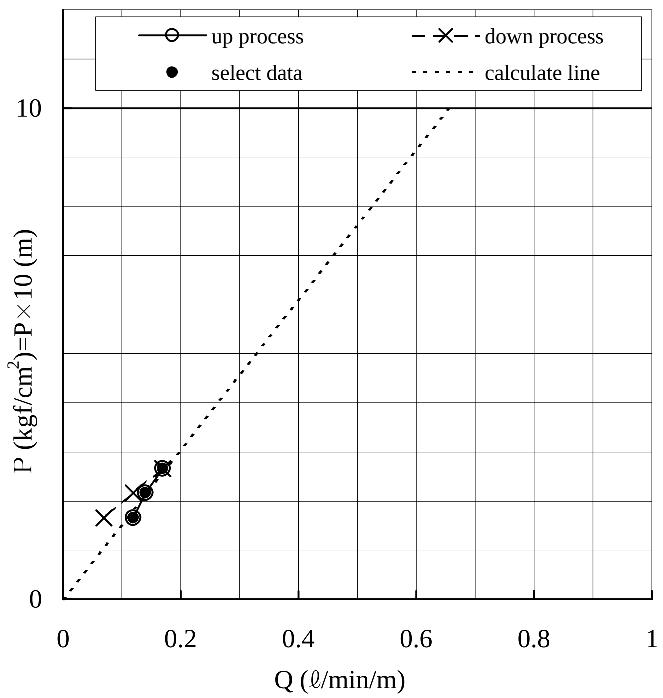
drill hole feature			**test condition**			
Location:	turbine axis		Type of test:	single packer	Test date:	23/4/1995
Coordinate:	E=	18,240,930	Test section (m)		Tested by:	Boon My
	N=	2,051,522	from: 10.00	to: 15.00	Drilled by:	
Collar Elevation (m):	177.11		section length ; L :	5.00	Checked by:	JICA ST 2009
Hole Depth (m):	30.00					
diameter (cm); R:	7.5		Depth of groundwater (m)			
Inclination (degree):	90		before test:	9.25		
Direction:	-		after test:			

Lu	0.66
K (cm/s)	8.7E-06

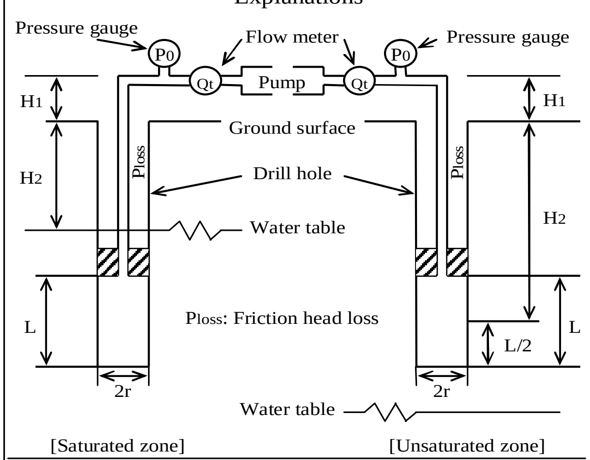
height of pressure gauge; H_1: 2.35 groundwater content : Saturated

length of rods installed; L_{rod}: 11.50 additional water head; H_2: 9.25

L (m)	H_1 (m)	H_2 (m)	Ploss kgf/cm2 (0.098MPa)	P_0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa) (up)	P kgf/cm2 (0.098MPa) (down)	t (min)	Qt (ℓ)	Q_0 (ℓ/min)	Q (ℓ/min/m)	Q/P×10 (ℓ/min/m)	K(P,Q) (cm/s)	used for calculate
5.00	2.35	9.25	0.00	0.5	1.66		10	6.1	0.61	0.12	0.72	9.5E-06	○
5.00	2.35	9.25	0.00	1.0	2.16		10	7.1	0.71	0.14	0.65	8.5E-06	○
5.00	2.35	9.25	0.00	1.5	2.66	2.66	10	8.7	0.87	0.17	0.64	8.5E-06	○
5.00	2.35	9.25	0.00	1.0		2.16	10	5.8	0.58	0.12	0.56	7.0E-06	
5.00	2.35	9.25	0.00	0.5		1.66	10	3.6	0.36	0.07	0.42	5.6E-06	



Explanations



$Lu=10\times Q_0/(PL)$

$P=P_0+\gamma_w(H_1+H_2)-P_{loss}$

$P_{loss}=\gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha=7.6\times10^{-5}$ $\beta=5.1\times10^{-4}$

$K=100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P\times\ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA4/1)

(SHEET 3 OF 5)

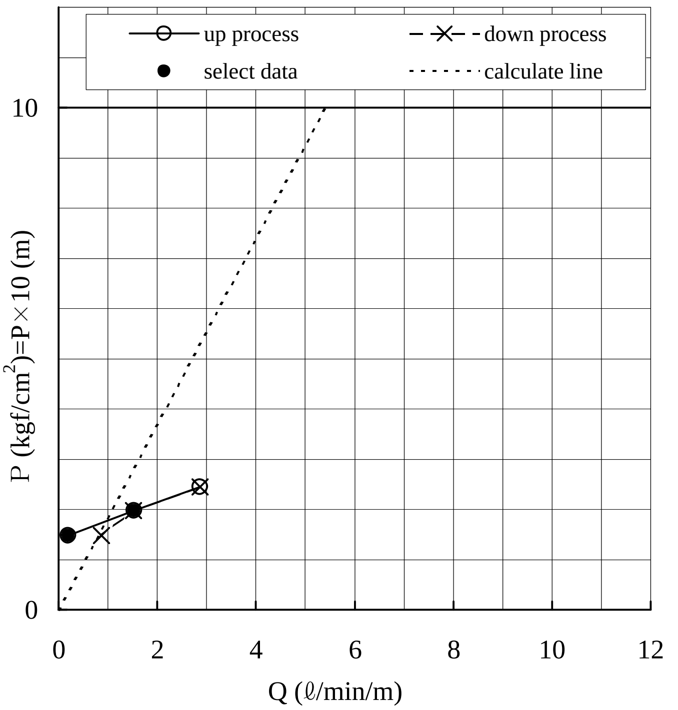
drill hole feature		test condition			
Location:	turbine axis	Type of test:	single packer	Test date:	24/4/1995
Coordinate:	E= 18,240,930	Test section (m)		Tested by:	Boon My
	N= 2,051,522	from: 15.00	to: 20.00	Drilled by:	
Collar Elevation (m):	177.11	section length ; L :	5.00	Checked by:	JICA ST 2009
Hole Depth (m):	30.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	8.35		
Direction:	-	after test:			

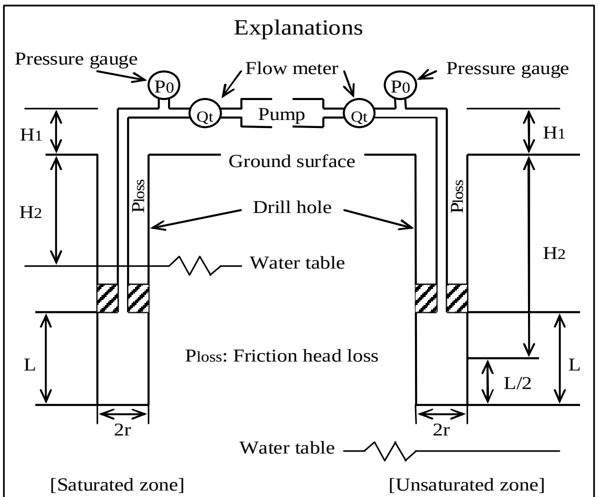
Lu	5.4
K (cm/s)	7.1E-05

height of pressure gauge; H1: 1.45 — groundwater content : Saturated

length of rods installed; Lrod: 16.50 — additional water head; H2: 8.35

L (m)	H1 (m)	H2 (m)	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t (min)	Qt (ℓ)	Q0 (ℓ/min)	Q (ℓ/min/m)	Q/P×10 (ℓ/min/m)	K(P,Q) (cm/s)	used for calculate
5.00	1.45	8.35	0.00	0.5	1.48		10	9.6	0.96	0.19	1.28	1.7E-05	○
5.00	1.45	8.35	0.01	1.0	1.97		10	76.7	7.67	1.53	7.77	1.0E-04	○
5.00	1.45	8.35	0.04	1.5	2.44	2.44	10	143.5	14.35	2.87	11.76	1.5E-04	
5.00	1.45	8.35	0.01	1.0		1.97	10	76.0	7.60	1.52	7.72	1.0E-04	
5.00	1.45	8.35	0.00	0.5		1.48	10	43.5	4.35	0.87	5.88	7.6E-05	





Lu=10×Q0/(PL)

P=P0+yw(H1+H2)-Ploss

Ploss=ywQ0²(αLrod+β)

$\alpha=7.6\times10^{-5}$ $\beta=5.1\times10^{-4}$

K=100×1/(2πL)×1/60×1/1000×yw × ΔQ0/ΔP×ln(100×2L/R)

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
yw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA4/1)

(SHEET 4 OF 5)

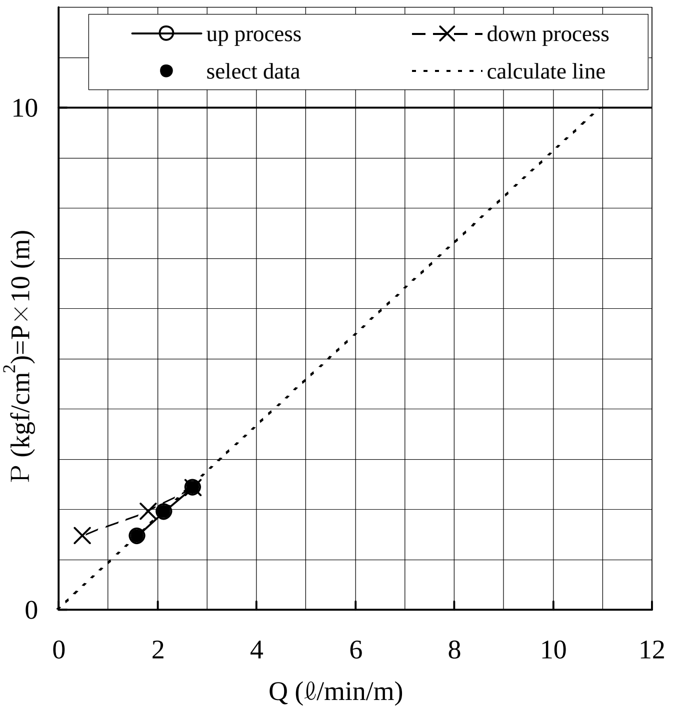
drill hole feature		**test condition**			
Location:	turbine axis	Type of test:	single packer	Test date:	25/4/1995
Coordinate:	E= 18,240,930	Test section (m)		Tested by:	Boon My
	N= 2,051,522	from: 20.00	to: 25.05	Drilled by:	
Collar Elevation (m):	177.11	section length ; L :	5.05	Checked by:	JICA ST 2009
Hole Depth (m):	30.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	8.28		
Direction:	-	after test:			

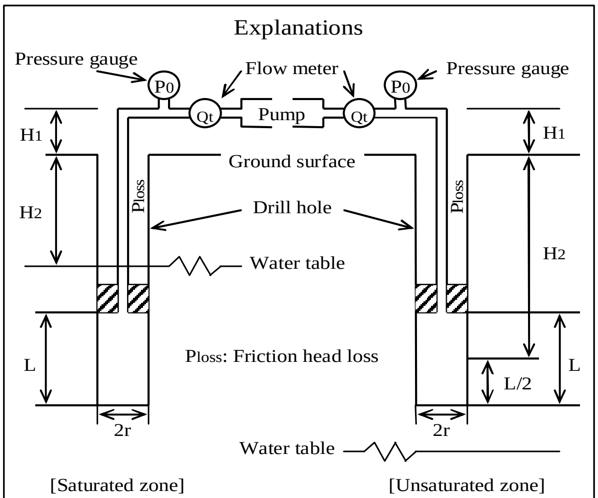
Lu	10.9
K (cm/s)	1.4E-04

height of pressure gauge; H1: 1.5 — groundwater content : Saturated

length of rods installed; Lrod: 21.50 — additional water head; H2: 8.28

L m	H1 m	H2 m	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calculate
5.05	1.50	8.28	0.01	0.5	1.47		10	80.5	8.05	1.59	10.83	1.4E-04	○
5.05	1.50	8.28	0.03	1.0	1.95		10	108.0	10.80	2.14	10.99	1.4E-04	○
5.05	1.50	8.28	0.04	1.5	2.44	2.44	10	137.5	13.75	2.72	11.16	1.5E-04	○
5.05	1.50	8.28	0.02	1.0		1.96	10	91.5	9.15	1.81	9.24	1.2E-04	
5.05	1.50	8.28	0.00	0.5		1.48	10	24.0	2.40	0.48	3.25	4.2E-05	





Lu=10×Q0/(PL)

P=P0+γw(H1+H2)-Ploss

Ploss=γwQ0²(αLrod+β)

α=7.6×10⁻⁵ β=5.1×10⁻⁴

K=100×1/(2πL)×1/60×1/1000×γw × ΔQ0/ΔP×ln(100×2L/R)

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA4/1)

(SHEET 5 OF 5)

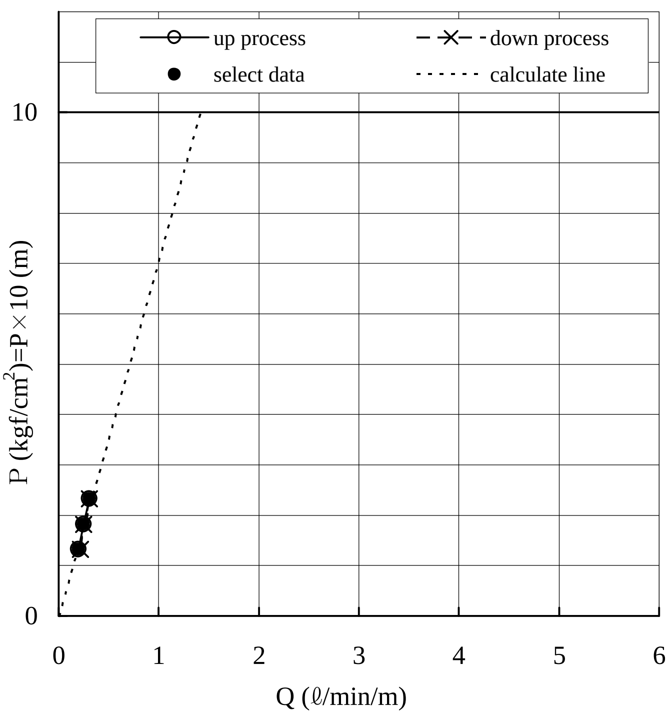
drill hole feature		**test condition**			
Location:	turbine axis	Type of test:	single packer	Test date:	25/4/1995
Coordinate:	E= 18,240,930	Test section (m)		Tested by:	Boon My
	N= 2,051,522	from: 25.00	to: 30.00	Drilled by:	
Collar Elevation (m):	177.11	section length ; L :	5.00	Checked by:	JICA ST 2009
Hole Depth (m):	30.00				
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	7.60		
Direction:	-	after test:			

Lu	1.4
K (cm/s)	1.8E-05

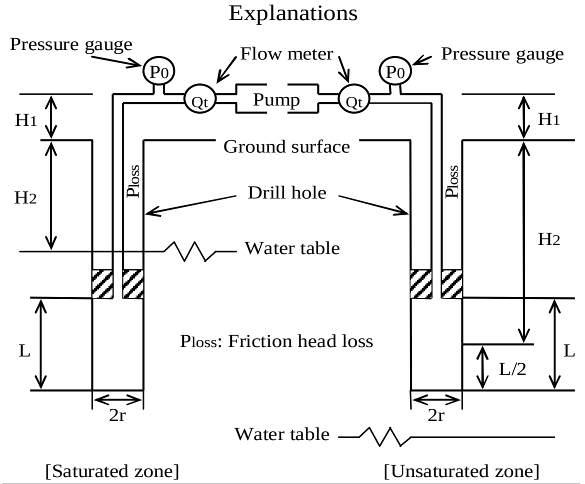
height of pressure gauge; H1: 0.6 groundwater content : Saturated

length of rods installed; Lrod: 26.50 additional water head; H2: 7.6

L (m)	H1 (m)	H2 (m)	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t (min)	Qt (ℓ)	Q0 (ℓ/min)	Q (ℓ/min/m)	Q/P×10 (ℓ/min/m)	K(P,Q) (cm/s)	used for calculate
5.00	0.60	7.60	0.00	0.5	1.32		10	9.8	0.98	0.20	1.52	1.9E-05	○
5.00	0.60	7.60	0.00	1.0	1.82		10	12.4	1.24	0.25	1.37	1.8E-05	○
5.00	0.60	7.60	0.00	1.5	2.32	2.32	10	15.3	1.53	0.31	1.34	1.7E-05	○
5.00	0.60	7.60	0.00	1.0		1.82	10	12.5	1.25	0.25	1.37	1.8E-05	
5.00	0.60	7.60	0.00	0.5		1.32	10	11.2	1.12	0.22	1.67	2.2E-05	



Explanations



$Lu=10\times Q_0/(PL)$

$P=P_0+\gamma_w(H_1+H_2)-P_{loss}$

$P_{loss}=\gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha=7.6\times10^{-5}$ $\beta=5.1\times10^{-4}$

$K=100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P\times\ln(100\times2L/R)$

- Qt: Water volume during time in "t"
- t: Injected time
- Q0: Water volume per minute
- Q : Water volume per minute per m
- L: Length of test section
- Lrod: Total length of rods installed
- P : Effective pressure
- P0: Gauge pressure
- Ploss : Friction head loss
- γw: Unit weight of water (0.1 kgf/cm²/m))
- R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA4/2)

(SHEET 1 OF 4)

drill hole feature

Location: tailrace
Coordinate: X= 18,240,913
Y= 2,051,521
Collar Elevation (m): 177.17
Hole Depth (m): 25.00
diameter (cm); R: 7.5
Inclination (degree): 90
Direction: -

test condition

Type of test: single packer
Test section (m)
from: 6.90 to: 12.15
section length ; L : 5.25

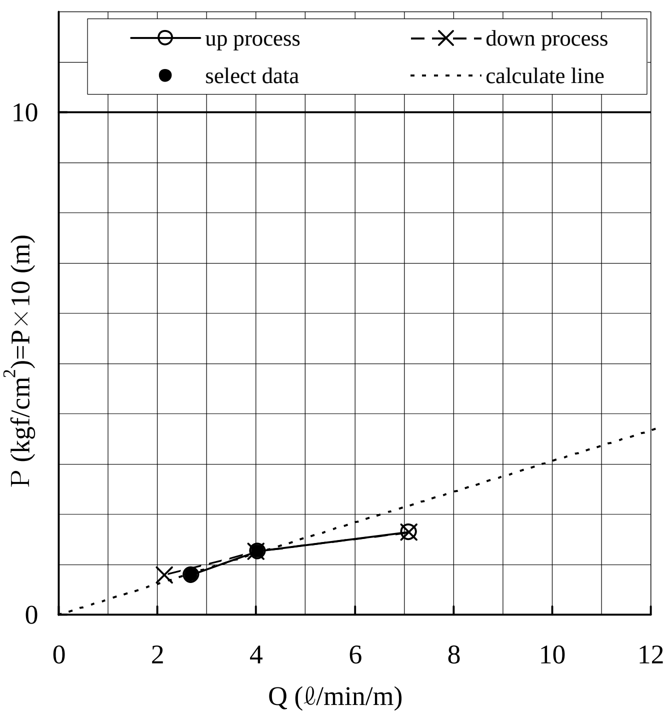
Depth of groundwater (m)
before test: 0.95
after test:

Test date: 28/4/1995
Tested by: Boon My
Drilled by:
Checked by:JICA ST 2009

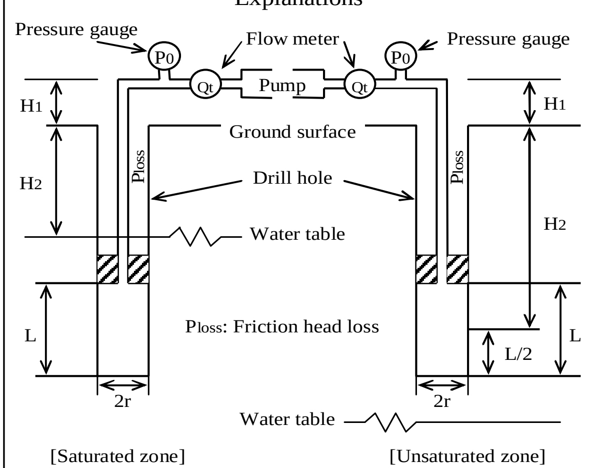
Lu	32.7
K (cm/s)	4.3E-04

height of pressure gauge; H1: 2.1 groundwater content : Saturated
length of rods installed; Lrod: 8.40 additional water head; H2: 0.95

L m	H1 m	H2 m	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calculate
5.25	2.10	0.95	0.02	0.5	0.79		10	140.5	14.05	2.68	34.14	4.5E-04	○
5.25	2.10	0.95	0.05	1.0	1.26		10	211.5	21.15	4.03	32.11	4.2E-04	○
5.25	2.10	0.95	0.16	1.5	1.65	1.65	10	372.5	37.25	7.10	43.16	5.7E-04	
5.25	2.10	0.95	0.05	1.0		1.26	10	210.0	21.00	4.00	31.87	4.2E-04	
5.25	2.10	0.95	0.01	0.5		0.80	10	112.5	11.25	2.14	26.92	3.5E-04	



Explanations



$Lu=10\times Q_0/(PL)$

$K=100\times 1/(2\pi L)\times 1/60\times 1/1000\times \gamma_w \times \Delta Q_0/\Delta P\times \ln(100\times 2L/R)$

$P=P_0+\gamma_w(H_1+H_2)-P_{loss}$

$P_{loss}=\gamma_w Q_0^2(\alpha L_{rod}+\beta)$

$\alpha=7.6\times 10^{-5}$ $\beta=5.1\times 10^{-4}$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA4/2)

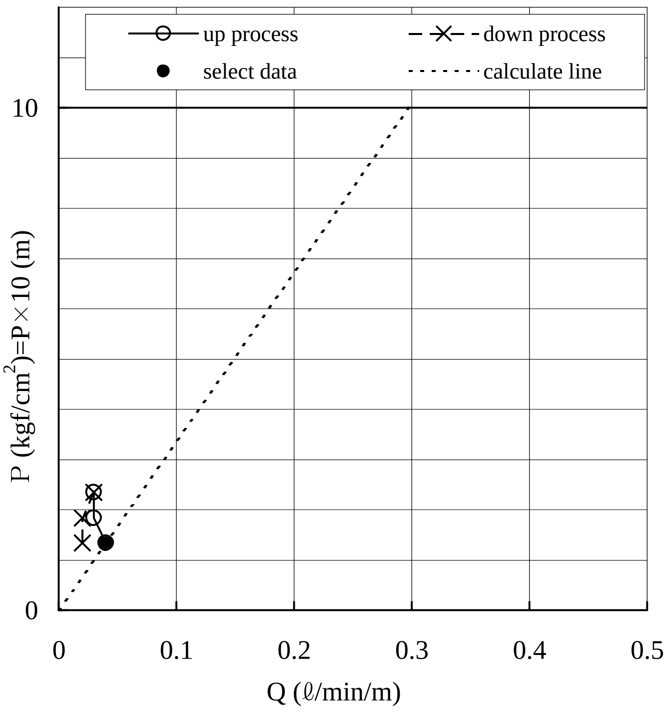
(SHEET 2 OF 4)

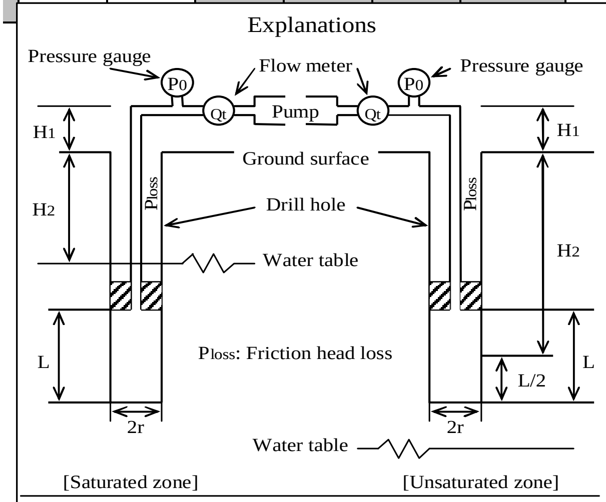
drill hole feature		test condition			
Location:	tailrace	Type of test:	single packer	Test date:	29/4/1995
Coordinate:	X= 18,240,913	Test section (m)		Tested by:	Boon My
	Y= 2,051,521	from: 12.80	to: 17.30	Drilled by:	
Collar Elevation (m):	177.17	section length ; L :	4.50	Checked by:	JICA ST 2009
Hole Depth (m):	25.00			Lu	0.3
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	6.80	K (cm/s)	3.4E-06
Direction:	-	after test:			

height of pressure gauge; H1: 1.6 groundwater content : Saturated

length of rods installed; Lrod: 14.30 additional water head; H2: 6.8

L	H1	H2	Ploss	P0	P		t	Qt	Q0	Q	Q/P×10	K(P,Q)	used for calculate
m	m	m	kgf/cm2 (0.098MPa)	kgf/cm2 (0.098MPa)	kgf/cm2 (0.098MPa)		min	ℓ	ℓ/min	ℓ/min/m	ℓ/min/m	cm/s	
4.50	1.60	6.80	0.00	0.5	1.34		10	1.6	0.16	0.04	0.30	3.4E-06	○
4.50	1.60	6.80	0.00	1.0	1.84		10	1.4	0.14	0.03	0.16	2.1E-06	
4.50	1.60	6.80	0.00	1.5	2.34	2.34	10	1.3	0.13	0.03	0.13	1.6E-06	
4.50	1.60	6.80	0.00	1.0		1.84	10	0.8	0.08	0.02	0.11	1.2E-06	
4.50	1.60	6.80	0.00	0.5		1.34	10	1.0	0.10	0.02	0.15	2.1E-06	





Lu=10×Q0/(PL)

P=P0+yw(H1+H2)-Ploss

Ploss=ywQ0²(αLrod+β)

α=7.6×10⁻⁵ β=5.1×10⁻⁴

K=100×1/(2πL)×1/60×1/1000×yw × ΔQ0/ΔP×ln(100×2L/R)

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
yw: Unit weight of water (0.1 kgf/cm²/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA4/2)

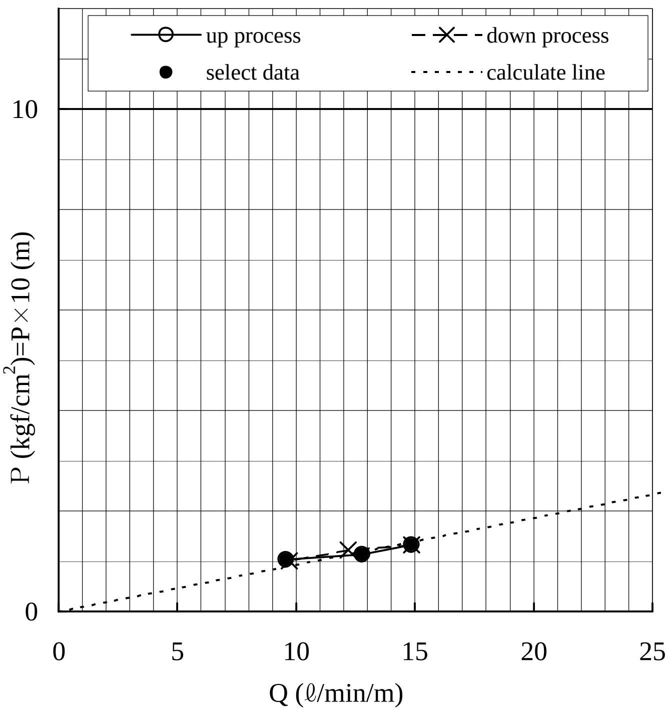
(SHEET 3 OF 4)

drill hole feature			**test condition**			Test date:	30/4/1995
Location:	tailrace		Type of test:	single packer		Tested by:	Boon My
Coordinate:	X=	18,240,913	Test section (m)			Drilled by:	
	Y=	2,051,521	from: 17.00	to: 22.30		Checked by:	JICA ST 2009
Collar Elevation (m):	177.17		section length ; L :	5.30			
Hole Depth (m):	25.00					Lu	107.4
diameter (cm); R:	7.5		Depth of groundwater (m)				
Inclination (degree):	90		before test:	9.72		K (cm/s)	1.4E-03
Direction:	-		after test:				

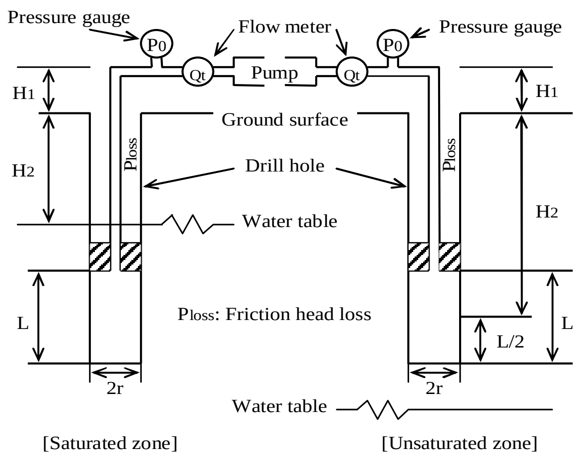
height of pressure gauge; H1: 0.45 groundwater content : Saturated

length of rods installed; Lrod: 18.50 additional water head; H2: 9.72

L	H1	H2	Ploss	P0	P		t	Qt	Q0	Q	Q/P×10	K(P,Q)	used for calculate
m	m	m	kgf/cm2 (0.098MPa)	kgf/cm2 (0.098MPa)	kgf/cm2 (0.098MPa)		min	ℓ	ℓ/min	ℓ/min/m	ℓ/min/m	cm/s	
5.30	0.45	9.72	0.49	0.5	1.03		10	507.5	50.75	9.58	93.28	1.2E-03	○
5.30	0.45	9.72	0.88	1.0	1.14		10	678.0	67.80	12.79	112.49	1.5E-03	○
5.30	0.45	9.72	1.19	1.5	1.33	1.33	10	788.0	78.80	14.87	112.06	1.5E-03	○
5.30	0.45	9.72	0.80	1.0		1.22	10	646.0	64.60	12.19	100.16	1.3E-03	
5.30	0.45	9.72	0.51	0.5		1.01	10	515.0	51.50	9.72	96.52	1.3E-03	



Explanations



$Lu = 10 \times Q_0/(PL)$

$P = P_0 + \gamma_w(H_1+H_2) - P_{loss}$

$P_{loss} = \gamma_w Q_0^2(\alpha L_{rod} + \beta)$

$\alpha = 7.6\times10^{-5}$ $\beta = 5.1\times10^{-4}$

$K = 100\times1/(2\pi L)\times1/60\times1/1000\times\gamma_w \times \Delta Q_0/\Delta P \times \ln(100\times2L/R)$

Qt: Water volume during time in "t"
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm^2/m))
R : Diameter of hole

Nam Ngum 1 expansion F/S

Permeability Test in Drill Hole (hole name XA4/2)

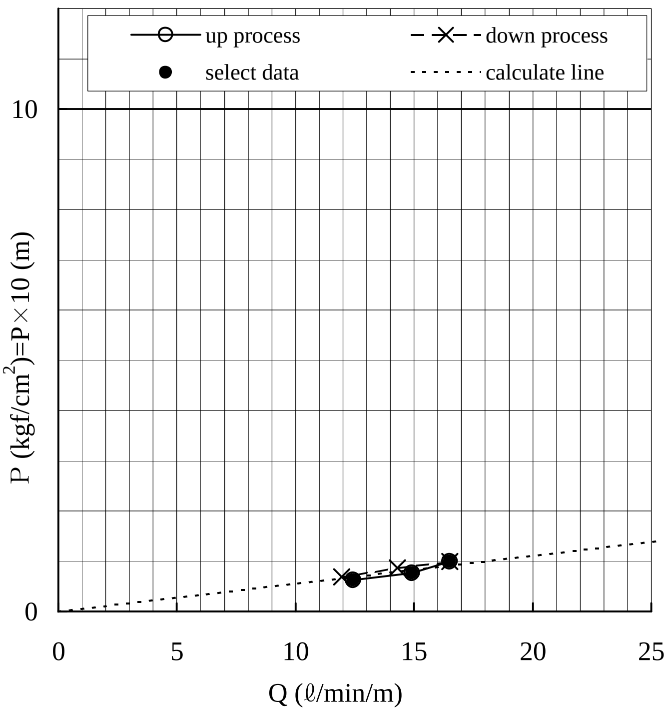
(SHEET 4 OF 4)

drill hole feature		test condition			
Location:	tailrace	Type of test:	single packer	Test date:	30/4/1995
Coordinate:	X= 18,240,913	Test section (m)		Tested by:	Boon My
	Y= 2,051,521	from: 20.00	to: 25.00	Drilled by:	
Collar Elevation (m):	177.17	section length ; L :	5.00	Checked by:	JICA ST 2009
Hole Depth (m):	25.00			Lu	180.0
diameter (cm); R:	7.5	Depth of groundwater (m)			
Inclination (degree):	90	before test:	9.10	K (cm/s)	2.3E-03
Direction:	-	after test:			

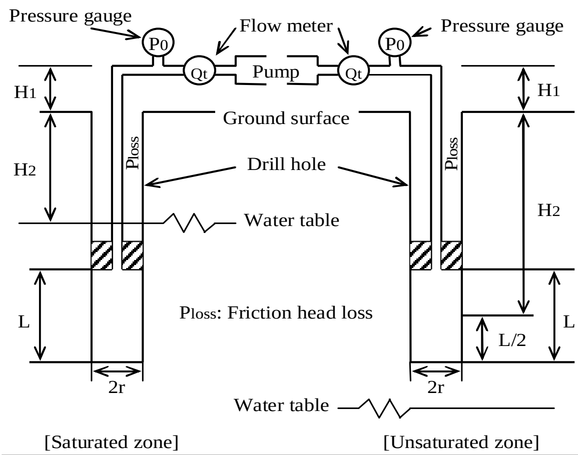
height of pressure gauge; H1: 0.5 groundwater content : Saturated

length of rods installed; Lrod: 21.50 additional water head; H2: 9.1

L m	H1 m	H2 m	Ploss kgf/cm2 (0.098MPa)	P0 kgf/cm2 (0.098MPa)	P kgf/cm2 (0.098MPa)		t min	Qt ℓ	Q0 ℓ/min	Q ℓ/min/m	Q/P×10 ℓ/min/m	K(P,Q) cm/s	used for calculate
5.00	0.50	9.10	0.83	0.5	0.63		10	622.0	62.20	12.44	197.46	2.6E-03	○
5.00	0.50	9.10	1.19	1.0	0.77		10	746.0	74.60	14.92	193.77	2.5E-03	○
5.00	0.50	9.10	1.46	1.5	1.00	1.00	10	825.0	82.50	16.50	165.00	2.1E-03	○
5.00	0.50	9.10	1.10	1.0		0.86	10	715.0	71.50	14.30	166.28	2.2E-03	
5.00	0.50	9.10	0.77	0.5		0.69	10	598.0	59.80	11.96	173.33	2.2E-03	



Explanations



Lu=10×Q0/(PL)

P=P0+γw(H1+H2)-Ploss

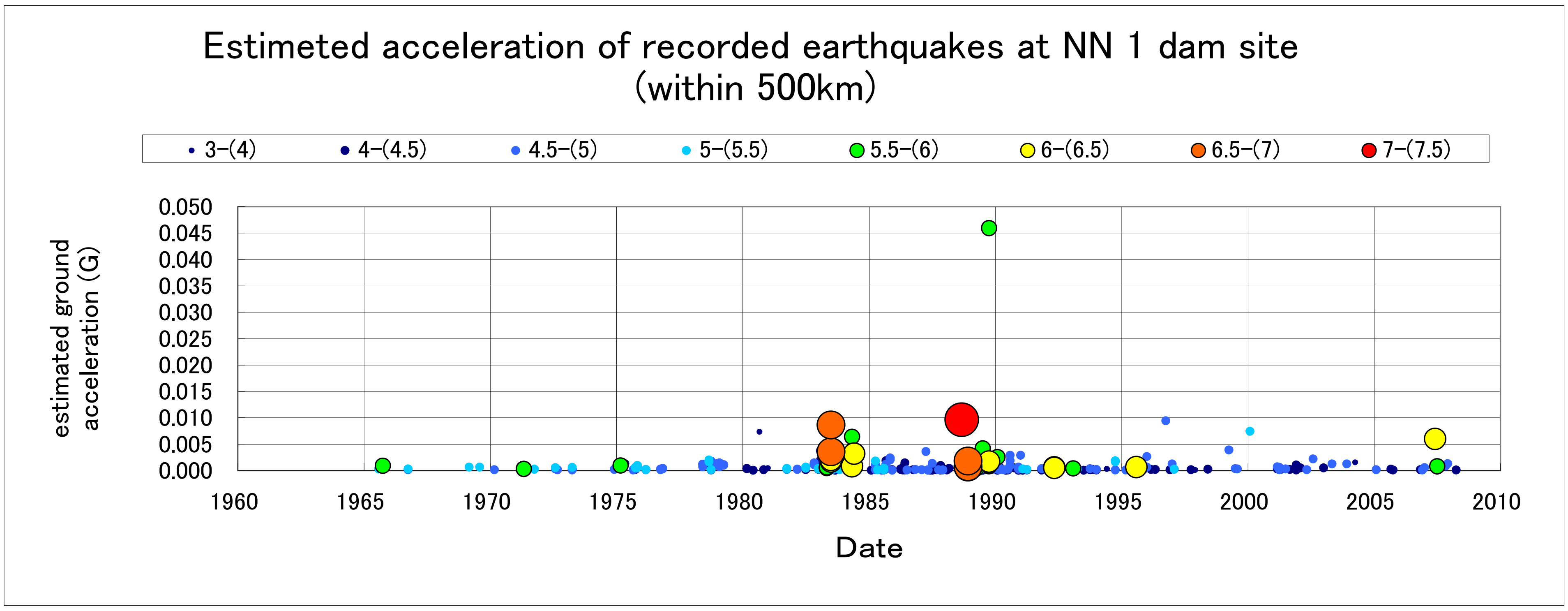
Ploss=γwQ0^2(αLrod+β)

α=7.6×10^{-5} β=5.1×10^{-4}

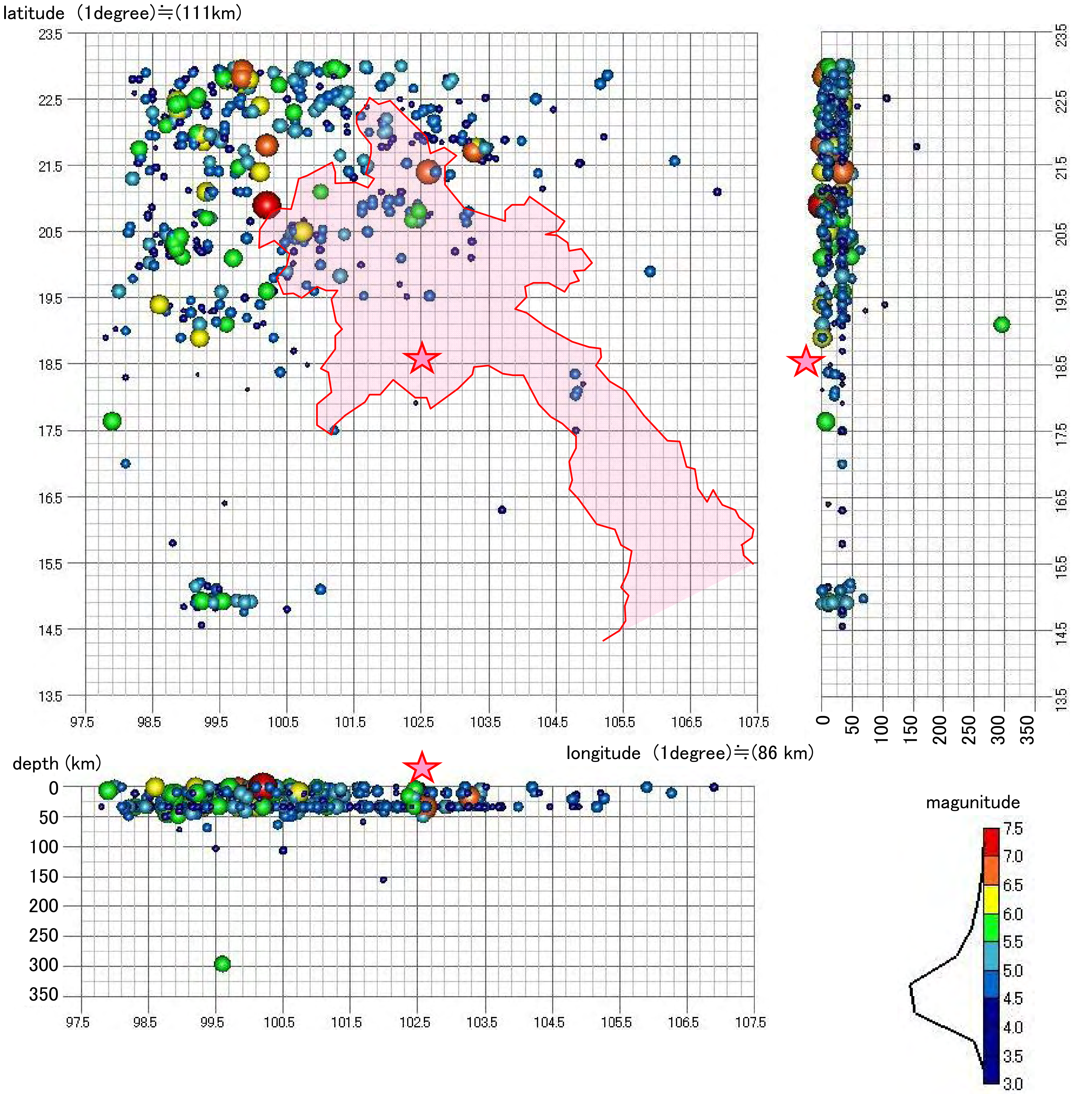
K=100×1/(2πL)×1/60×1/1000×γw × ΔQ0/ΔP×ln(100×2L/R)

Qt: Water volume during time in “t”
t: Injected time
Q0: Water volume per minute
Q : Water volume per minute per m
L: Length of test section
Lrod: Total length of rods installed

P : Effective pressure
P0: Gauge pressure
Ploss : Friction head loss
γw: Unit weight of water (0.1 kgf/cm^2/m))
R : Diameter of hole



the attenuation is based on "Shi et Midorikawa,1999"



Original seismic source data are given from USGS and NOAA web-site. Shown data were uncritically selected under a condition of Magnitude 3 or over.

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
NOAAseasia	1965	7	3	22.600	101.400	14	5.30	456	95	465.8	3.5402	1.9572	2.456759757	1.250714058	-0.5276840556	0.2966989056	0.00030	0.022710984	0.11234316	0.00011
NOAAseasia	1965	9	22	20.700	99.300	11	5.50	244	277	369.1	3.6273	2.0618	3.092877289	1.574555711	-0.0507680577	0.8896761375	0.00091	0.056833869	0.316742371	0.00032
NOAAseasia	1966	9	18	22.700	101.900	7	4.90	467	52	469.9	3.3101	1.6986	1.550110612	0.789147221	-0.7730357420	0.1686414230	0.00017	0.012191743	0.055622995	0.00006
NOAAseasia	1966	9	18	22.800	102.000	33	5.30	478	43	479.9	3.6219	2.0294	2.456759757	1.250714058	-0.5011683691	0.3153781715	0.00032	0.024396014	0.121806459	0.00012
NOAAseasia	1969	2	9	21.650	101.291	33	5.00	350	104	365.1	3.4719	1.8554	1.739252713	0.885437745	-0.1878758001	0.6488199571	0.00066	0.036453245	0.191761713	0.00020
NOAAseasia	1969	7	2	20.706	99.369	33	5.00	245	271	365.3	3.4719	1.8554	1.739252713	0.885437745	-0.1887125120	0.6475711437	0.00066	0.036399794	0.191444014	0.00020
NOAAseasia	1970	2	6	22.984	100.826	33	4.80	498	145	518.7	3.3719	1.7394	1.381537537	0.703328201	-0.9002714370	0.1258138821	0.00013	0.009693827	0.042927901	0.00004
NOAAseasia	1971	4	28	22.934	101.280	15	5.60	493	105	504.1	3.6945	2.135	3.470265395	1.766680565	-0.5232961722	0.2997117902	0.00031	0.026470609	0.133574401	0.00014
NOAAseasia	1971	4	28	22.978	101.210	11	5.60	498	111	510.2	3.6773	2.1198	3.470265395	1.766680565	-0.5639844266	0.2729075643	0.00028	0.024556038	0.122709696	0.00013
NOAAseasia	1971	9	14	22.947	100.773	33	5.40	494	149	516.0	3.6719	2.0874	2.756529785	1.403324254	-0.5910635764	0.2564108649	0.00026	0.021956888	0.108137167	0.00011
NOAAseasia	1971	9	14	22.973	100.715	42	5.30	497	154	520.3	3.6606	2.0636	2.456759757	1.250714058	-0.6185996574	0.2406580219	0.00025	0.020216383	0.098501967	0.00010
NOAAseasia	1972	7	7	20.466	98.900	27	5.00	218	311	379.8	3.4461	1.8326	1.739252713	0.885437745	-0.2748392248	0.5310810133	0.00054	0.031076617	0.160121674	0.00016
NOAAseasia	1972	7	7	20.491	98.143	37	4.80	221	377	437.0	3.3891	1.7546	1.381537537	0.703328201	-0.5637522555	0.2730534980	0.00028	0.017354821	0.082898137	0.00008
NOAAseasia	1972	8	27	22.669	100.645	33	4.60	463	160	489.9	3.2719	1.6234	1.097394273	0.558673448	-0.8888791873	0.1291578517	0.00013	0.008974238	0.039344793	0.00004
NOAAseasia	1972	8	27	22.634	100.691	33	4.80	459	156	484.8	3.3719	1.7394	1.381537537	0.703328201	-0.7692984627	0.1700989126	0.00017	0.012122935	0.055268388	0.00006
NOAAseasia	1973	3	22	21.996	100.806	33	4.50	388	146	414.6	3.2219	1.5654	0.978053676	0.497918235	-0.6405526048	0.2287954562	0.00023	0.013123493	0.06044994	0.00006
NOAAseasia	1973	3	22	22.170	100.620	33	4.70	408	162	439.0	3.3219	1.6814	1.231296626	0.626841919	-0.6387809139	0.2297307266	0.00023	0.014464912	0.067477169	0.00007
USGSneic	1973	3	22	22.02	100.62	33	5.4	391	162	423.2	3.6719	2.0874	2.756529785	1.403324254	-0.2270652802	0.5928362067	0.00060	0.041021979	0.219133497	0.00022
NOAAseasia	1973	3	24	21.419	98.458	18	4.50	324	349	476.2	3.1574	1.5084	0.978053676	0.497918235	-0.9498804614	0.1122327330	0.00011	0.007546694	0.032349317	0.00003
NOAAseasia	1973	3	24	21.624	98.323	33	4.90	347	361	500.7	3.4219	1.7974	1.550110612	0.789147221	-0.7811200411	0.1655312364	0.00017	0.012466325	0.057040649	0.00006
NOAAseasia	1974	11	16	20.580	98.167	33	4.60	231	374	439.6	3.2719	1.6234	1.097394273	0.558673448	-0.6910404826	0.2036852204	0.00021	0.01260639	0.057765366	0.00006
USGSneic	1975	2	17	17.64	97.9	6	5.9	96	398	409.4	3.8058	2.2748	4.90188016	2.495502627	-0.0397169042	0.9126055294	0.00093	0.06937659	0.396799059	0.00040
NOAAseasia	1975	4	30	20.226	100.993	33	4.40	192	130	231.9	3.1719	1.5074	0.871691256	0.443770094	0.1092698379	1.2860854886	0.00131	0.047584879	0.259143269	0.00026
NOAAseasia	1975	8	18	22.860	105.267	19	4.80	484	239	539.8	3.3117	1.6862	1.381537537	0.703328201	-1.0410429722	0.0909823244	0.00009	0.007478278	0.032018121	0.00003
NOAAseasia	1975	8	18	22.729	105.160	33	4.90	470	230	523.3	3.4219	1.7974	1.550110612	0.789147221	-0.8680352931	0.1355079287	0.00014	0.010749663	0.04824765	0.00005
NOAAseasia	1975	9	11	20.761	99.139	35	4.00	251	290	383.5	2.9805	1.283	0.55	0.28	-0.7543877694	0.1760403529	0.00018	0.008549046	0.037244912	0.00004
NOAAseasia	1975	9	11	20.779	99.217	35	4.50	253	284	380.3	3.2305	1.573	0.978053676	0.497918235	-0.4916418080	0.3223726520	0.00033	0.017049256	0.081250706	0.00008
USGSneic	1975	9	11	20.76	99.14	35	4	251	290	383.5	2.9805	1.283	0.55	0.28	-0.7543877694	0.1760403529	0.00018	0.008549046	0.037244912	0.00004
NOAAseasia	1975	9	18	19.989	98.519	10	4.70	165	344	381.5	3.223	1.594	1.231296626	0.626841919	-0.5043939767	0.3130444606	0.00032	0.017733418	0.084944541	0.00009
NOAAseasia	1975	9	18	20.310	98.451	33	5.10	201	350	403.6	3.5219	1.9134	1.951473641	0.99347749	-0.2969459838	0.5047240696	0.00051	0.031563207	0.162957618	0.00017
USGSneic	1975	9	18	20.03	98.45	33	5.1	170	350	389.1	3.5219	1.9134	1.951473641	0.99347749	-0.2376339268	0.5785385385	0.00059	0.03499704	0.183128265	0.00019
NOAAseasia	1975	10	21	21.436	101.672	33	4.80	326	72	333.9	3.3719	1.7394	1.381537537	0.703328201	-0.1552096394	0.6995042550	0.00071	0.035242746	0.184581772	0.00019
NOAAseasia	1975	10	21	21.405	101.422	33	4.80	323	93	336.1	3.3719	1.7394	1.381537537	0.703328201	-0.1646500190	0.6844630071	0.00070	0.034659606	0.1811343	0.00018
USGSneic	1975	10	21	21.41	101.42	33	4.8	323	93	336.1	3.3719	1.7394	1.381537537	0.703328201	-0.1646500190	0.6844630071	0.00070	0.034659606	0.1811343	0.00018
NOAAseasia	1975	10	27	21.578	101.638	2	5.00	342	74	349.9	3.3386	1.7376	1.739252713	0.885437745	-0.2571973484	0.5530987176	0.00056	0.031099861	0.160257012	0.00016
NOAAseasia	1975	10	27	21.500	101.698	33	5.10	333	69	340.1	3.5219	1.9134	1.951473641	0.99347749	-0.0324914658	0.9279157241	0.00095	0.050156426	0.275023017	0.00028
USGSneic	1975	10	27	21.5	101.7	33	5.1	333	69	340.1	3.5219	1.9134	1.951473641	0.99347749	-0.0324914658	0.9279157241	0.00095	0.050156426	0.275023017	0.00028
NOAAseasia	1976	2	16	22.750	100.679	26	4.90	472	157	497.4	3.3918	1.7708	1.550110612	0.789147221	-0.7984571232	0.1590533705	0.00016	0.011984109	0.054553734	0.00006
NOAAseasia	1976	2	16	22.742	100.706	33	5.00	471	155	495.8	3.4719	1.8554	1.739252713	0.885437745	-0.7123273495	0.1939423486	0.00020	0.014713587	0.068789474	0.00007
NOAAseasia	1976	2	19	22.787	100.604	17	5.10	476	164	503.5	3.4531	1.8526	1.951473641	0.99347749	-0.7610794671	0.1733486776	0.00018	0.01389135	0.064461621	0.00007
NOAAseasia	1976	2	19	22.808	100.610	26	4.90	479	163	506.0	3.3918	1.7708	1.550110612	0.789147221	-0.8316789268	0.1473401383	0.00015	0.011323292	0.051166905	0.00005
NOAAseasia	1976	9	19	22.546	101.110	15	4.80	450	120	465.7	3.2945	1.671	1.381537537	0.703328201	-0.7719927011	0.1690469342	0.00017	0.011771678	0.053462264	0.00005
NOAAseasia	1976	9	19	22.439	100.980	24	4.90	438	131	457.2	3.3832	1.7632	1.550110612	0.789147221	-0.6499761820	0.2238843920	0.00023	0.015415046	0.072506616	0.00007
USGSneic	1976	9	19	22.44	100.98	24	4.9	438	131	457.2	3.3832	1.7632	1.550110612	0.789147221	-0.6499761820	0.2238843920	0.00023	0.015415046	0.072506616	0.00007
NOAAseasia	1976	10	16	21.382	99.732	33	4.80	320	239	399.4	3.3719	1.7394	1.381537537	0.703328201	-0.4292077070	0.3722136476	0.00038	0.021798562	0.107256459	0.00011
NOAAseasia	1976	10	16	21.505	99.927	33	4.60	334	222	401.0	3.2719	1.6234	1.097394273	0.558673448	-0.5354312587	0.2914531418	0.00030	0.016506348	0.078333155	0.00008
USGSneic	1976	10	16	21.38	99.73	33	4.8	320	239	399.4	3.3719	1.7394	1.381537537	0.703328201	-0.4292077070	0.3722136476	0.00038	0.021798562	0.107256459	0.00011
NOAAseasia	1978	5	25	19.279	99.660	8	4.80	87	245	260.0	3.2644	1.6444	1.381537537	0.703328201	0.0671250917	1.1671457466	0.00119	0.051080298	0.28075427	0.00029
NOAAseasia	1978	5	25	19.136	99.447	30	4.70	71	264	273.4	3.309	1.67	1.231296626	0.626841919	0.0500499726	1.1221475682	0.00114	0.048462621	0.264551233	0.00027
USGSneic	1978	5	25	19.28	99.07	8	4.8	87	296	308.5	3.2644	1.6444	1.381537537	0.703328201	-0.1522957021	0.7042134213	0.00072	0.034447352	0.179881334	0.00018
NOAAseasia	1978	8	2	20.460	100.672	15	5.10	218	158	269.2	3.4445	1.845	1.951473641	0.99347749	0.2036880309	1.5984094222	0.00163	0.074976496	0.433177018	0.00044
NOAAseasia	1978	8	2	20.505	100.576	33	5.10	223	166	278.0	3.5219	1.9134	1.951473641	0.99347749	0.2408172421	1.7410740480	0.00177	0.081621759	0.476804915	0.00049
USGSneic	1978	8	2	20.5	100.58	33	5.2	222	166	277.2	3.5719	1.9714	2.189589438	1.114700078	0.2940897805	1.9682931475	0.00201	0.093856392	0.558321247	0.00057
NOAAseasia	1978	9	1	20.444	100.622	48	4.90	216	162	270.0	3.4864	1.8544	1.550110612	0.789147221	0.2425500160	1.7480345650	0.00178	0.076167332	0.440959479	0.00045
NOAAseasia	1978	9	1	20.421	100.533	48	4.90	213	170	272.5	3.4864	1.8544	1.550110612	0.789147221	0.2310700183	1.7024329578	0.00174	0.074606663	0.430763309	0.00044
USGSneic	1978	9	1	20.42	100.53	48	4.9	213	170	272.5	3.4864	1.8544	1.550110612	0.789147221	0.2310700183	1.7024329578	0.00174	0.074606663	0.430763309	0.00044
NOAAseasia	1978	9	4	20.663	100.745	33	4.10	240	152	284.1	3.0219	1.3334	0.61711015	0.314165167	-0.2848135670	0.5190227961	0.00053	0.020476172	0.099933505	0.00010
NOAAseasia	1978	9	9	22.988	101.670	33	5.10	499	72	504.2	3.5219	1.9134	1.951473641	0.99347749	-0.6949805056	0.2018456965	0.00021	0.015905315	0.075117783	0.00008
NOAAseasia	1978	9	12	22.943	101.129	33	4.50	494	118	507.9	3.2219	1.5654	0.978053676	0.497918235	-1.0084137215	0.0980813147	0.00010	0.006972624	0.029582696	0.00003
NOAAseasia	1978	9	12	22.912	101.151	33	4.60	490	117	503.8	3.2719	1.6234	1.097394273	0.558673448	-0.9427031293	0.1141029494	0.00012	0.008185788	0.035461604	0.00004
NOAAseasia	1978	9	28	21.785	101.908	33	4.30	365	51	368.5	3.1219	1.4494	0.77689565	0.395510512	-0.5509521362	0.2812210748	0.00029	0.013979661	0.064924885	0.00007

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
NOAAseasia	1978	9	28	21.774	101.988	155	4.10	364	44	366.6	3.5465	1.797	0.61711015	0.314165167	-0.1182229086	0.7616879612	0.00078	0.031567161	0.162980685	0.00017
USGSneic	1978	9	28	21.78	101.91	33	4.3	364	51	367.6	3.1219	1.4494	0.77689565	0.395510512	-0.5471923837	0.2836662166	0.00029	0.014072054	0.06540997	0.00007
NOAAseasia	1978	12	13	20.443	100.558	43	4.60	216	168	273.6	3.3149	1.6614	1.097394273	0.558673448	0.0552454602	1.1356524971	0.00116	0.047445826	0.258287716	0.00026
NOAAseasia	1978	12	13	20.371	100.623	43	4.60	208	162	263.6	3.3149	1.6614	1.097394273	0.558673448	0.1013503339	1.2628458284	0.00129	0.051562638	0.283751843	0.00029
USGSneic	1978	12	13	20.37	100.62	43	4.6	208	162	263.6	3.3149	1.6614	1.097394273	0.558673448	0.1013503339	1.2628458284	0.00129	0.051562638	0.283751843	0.00029
NOAAseasia	1979	1	9	20.973	101.769	33	4.70	275	63	282.1	3.3219	1.6814	1.231296626	0.626841919	0.0233054509	1.0551287357	0.00108	0.04632687	0.251415033	0.00026
NOAAseasia	1979	1	9	20.914	101.770	33	4.80	268	63	275.3	3.3719	1.7394	1.381537537	0.703328201	0.1040198196	1.2706320908	0.00130	0.055961028	0.311251046	0.00032
NOAAseasia	1979	1	9	21.530	102.280	33	4.80	337	19	337.5	3.3719	1.7394	1.381537537	0.703328201	-0.1706479089	0.6750751027	0.00069	0.034294314	0.178978556	0.00018
NOAAseasia	1979	1	9	20.966	102.170	33	4.90	274	29	275.5	3.4219	1.7974	1.550110612	0.789147221	0.1528416721	1.4218103526	0.00145	0.063831665	0.361152709	0.00037
USGSneic	1979	1	9	20.91	101.77	33	4.8	268	63	275.3	3.3719	1.7394	1.381537537	0.703328201	0.1040198196	1.2706320908	0.00130	0.055961028	0.311251046	0.00032
USGSneic	1979	1	9	20.97	102.02	33	4.9	274	41	277.1	3.4219	1.7974	1.550110612	0.789147221	0.1455407802	1.3981081914	0.00143	0.06299824	0.35582881	0.00036
NOAAseasia	1979	1	22	20.344	100.745	33	4.50	205	152	255.2	3.2219	1.5654	0.978053676	0.497918235	0.0477580782	1.1162412775	0.00114	0.044388739	0.239562189	0.00024
NOAAseasia	1979	1	22	20.218	100.419	63	4.50	191	180	262.5	3.3509	1.6794	0.978053676	0.497918235	0.1426555534	1.3888506723	0.00142	0.05425599	0.300556337	0.00031
USGSneic	1979	1	22	20.34	100.75	33	4.5	204	151	253.8	3.2219	1.5654	0.978053676	0.497918235	0.0543379844	1.1332819831	0.00116	0.044921805	0.242815625	0.00025
NOAAseasia	1979	3	18	20.902	101.980	33	4.60	267	45	270.8	3.2719	1.6234	1.097394273	0.558673448	0.0250949545	1.0594853465	0.00108	0.044489374	0.240176002	0.00024
NOAAseasia	1979	3	18	20.923	102.440	33	4.50	269	5	269.0	3.2219	1.5654	0.978053676	0.497918235	-0.0164284621	0.9628786073	0.00098	0.039522516	0.210104029	0.00021
USGSneic	1979	3	18	20.9	101.98	33	4.6	267	45	270.8	3.2719	1.6234	1.097394273	0.558673448	0.0250949545	1.0594853465	0.00108	0.044489374	0.240176002	0.00024
NOAAseasia	1980	2	10	19.353	99.229	5	4.20	95	283	298.5	2.9515	1.285	0.692408976	0.352499115	-0.4199505705	0.3802326702	0.00039	0.016313348	0.077298971	0.00008
NOAAseasia	1980	2	10	19.352	99.226	10	4.10	95	283	298.5	2.923	1.246	0.61711015	0.314165167	-0.4483412563	0.3561711542	0.00036	0.014914161	0.069850041	0.00007
USGSneic	1980	2	10	19.35	99.23	10	4.1	94	283	298.2	2.923	1.246	0.61711015	0.314165167	-0.4470054614	0.3572683454	0.00036	0.014949789	0.070038625	0.00007
NOAAseasia	1980	5	14	22.232	98.680	33	4.20	415	330	530.2	3.0719	1.3914	0.692408976	0.352499115	-1.2437065156	0.0570549704	0.00006	0.004038979	0.015961987	0.00002
NOAAseasia	1980	8	27	17.914	102.410	33	3.80	65	8	65.5	2.8719	1.1594	0.436880529	0.222411906	0.8562716032	7.1824333260	0.00732	0.162437579	1.037709405	0.00106
NOAAseasia	1980	10	12	21.733	100.127	0	4.30	359	205	413.4	2.98	1.324	0.77689565	0.395510512	-0.8773858686	0.1326215598	0.00014	0.007593014	0.032573774	0.00003
NOAAseasia	1980	12	23	18.118	99.915	0	3.70	42	223	226.9	2.68	0.976	0.389370181	0.19822482	-0.3572791252	0.4392592086	0.00045	0.014655015	0.068480114	0.00007
NOAAseasia	1981	9	12	21.940	99.357	19	4.90	382	272	468.9	3.3617	1.7442	1.550110612	0.789147221	-0.7175135750	0.1916401160	0.00020	0.013632938	0.063108246	0.00006
NOAAseasia	1981	9	12	21.550	99.350	16	5.00	339	272	434.6	3.3988	1.7908	1.739252713	0.885437745	-0.5448242835	0.2852172029	0.00029	0.019170188	0.092761506	0.00009
USGSneic	1981	9	12	21.06	99.35	15	5	284	272	393.2	3.3945	1.787	1.739252713	0.885437745	-0.3816303001	0.4153074291	0.00042	0.025410289	0.127544244	0.00013
NOAAseasia	1982	2	20	22.295	102.508	30	4.50	422	1	422.0	3.209	1.554	0.978053676	0.497918235	-0.6833178345	0.2073395566	0.00021	0.012138791	0.055350077	0.00006
NOAAseasia	1982	2	20	22.258	102.422	34	4.60	418	7	418.1	3.2762	1.6272	1.097394273	0.558673448	-0.6005185744	0.2508888874	0.00026	0.01476182	0.069044342	0.00007
USGSneic	1982	2	20	22.26	102.42	33	4.6	418	7	418.1	3.2719	1.6234	1.097394273	0.558673448	-0.6048185744	0.2484170646	0.00025	0.01463322	0.068365044	0.00007
NOAAseasia	1982	6	1	21.992	101.936	33	5.10	388	49	391.1	3.5219	1.9134	1.951473641	0.99347749	-0.2458494289	0.5677414088	0.00058	0.034499308	0.180187945	0.00018
NOAAseasia	1982	6	1	21.992	101.936	33	5.10	388	49	391.1	3.5219	1.9134	1.951473641	0.99347749	-0.2458494289	0.5677414088	0.00058	0.034499308	0.180187945	0.00018
NOAAseasia	1982	6	1	22.200	101.979	33	5.10	411	45	413.5	3.5219	1.9134	1.951473641	0.99347749	-0.3371203038	0.4601290957	0.00047	0.029436238	0.15060417	0.00015
USGSneic	1982	6	1	22.02	101.98	33	5.2	391	45	393.6	3.5719	1.9714	2.189589438	1.114700078	-0.2063643667	0.6217784034	0.00063	0.038718337	0.205279637	0.00021
NOAAseasia	1982	6	7	21.943	102.440	19	4.30	383	5	383.0	3.0617	1.3962	0.77689565	0.395510512	-0.6713788255	0.2131185116	0.00022	0.011131482	0.050188575	0.00005
NOAAseasia	1982	6	7	21.943	102.440	19	4.30	383	5	383.0	3.0617	1.3962	0.77689565	0.395510512	-0.6713788255	0.2131185116	0.00022	0.011131482	0.050188575	0.00005
NOAAseasia	1982	6	7	21.895	102.680	33	4.40	377	16	377.3	3.1719	1.5074	0.871691256	0.443770094	-0.5376890158	0.2899419024	0.00030	0.014983135	0.070215184	0.00007
USGSneic	1982	6	7	21.9	102.07	33	4.4	378	37	379.8	3.1719	1.5074	0.871691256	0.443770094	-0.5480505816	0.2831062247	0.00029	0.014714242	0.068792932	0.00007
NOAAseasia	1982	6	12	21.838	102.360	33	4.00	371	12	371.2	2.9719	1.2754	0.55	0.28	-0.7119509772	0.1941104976	0.00020	0.009184691	0.040388987	0.00004
NOAAseasia	1982	6	12	21.849	102.800	33	3.90	372	26	372.9	2.9219	1.2174	0.490188016	0.249550263	-0.7689629013	0.1702303918	0.00017	0.007938109	0.034251555	0.00003
NOAAseasia	1982	6	12	21.849	102.800	33	3.90	372	26	372.9	2.9219	1.2174	0.490188016	0.249550263	-0.7689629013	0.1702303918	0.00017	0.007938109	0.034251555	0.00003
USGSneic	1982	6	12	21.84	102.04	33	4	371	40	373.2	2.9719	1.2754	0.55	0.28	-0.7202812013	0.1904227351	0.00019	0.009051752	0.039729024	0.00004
NOAAseasia	1982	10	17	20.799	102.330	33	4.70	255	15	255.4	3.3219	1.6814	1.231296626	0.626841919	0.1463903818	1.4008459594	0.00143	0.057851484	0.323158353	0.00033
NOAAseasia	1982	10	17	20.949	102.000	42	4.60	272	43	275.4	3.3106	1.6576	1.097394273	0.558673448	0.0427089572	1.1033389685	0.00112	0.046339992	0.251495504	0.00026
NOAAseasia	1982	10	17	20.949	102.000	42	4.60	272	43	275.4	3.3106	1.6576	1.097394273	0.558673448	0.0427089572	1.1033389685	0.00112	0.046339992	0.251495504	0.00026
USGSneic	1982	10	17	20.8	102.03	33	4.7	256	41	259.3	3.3219	1.6814	1.231296626	0.626841919	0.1281400991	1.3431981937	0.00137	0.05596917	0.311302224	0.00032
NOAAseasia	1982	12	1	21.150	104.301	10	4.10	294	156	332.8	2.923	1.246	0.61711015	0.314165167	-0.5983878830	0.2521227973	0.00026	0.011423703	0.051679916	0.00005
NOAAseasia	1982	12	1	21.150	104.301	10	4.10	294	156	332.8	2.923	1.246	0.61711015	0.314165167	-0.5983878830	0.2521227973	0.00026	0.011423703	0.051679916	0.00005
NOAAseasia	1982	12	28	22.402	100.992	7	5.20	434	130	453.1	3.4601	1.8726	2.189589438	1.114700078	-0.5574877199	0.2770207368	0.00028	0.020376933	0.099386377	0.00010
NOAAseasia	1982	12	28	22.402	100.992	7	5.20	434	130	453.1	3.4601	1.8726	2.189589438	1.114700078	-0.5574877199	0.2770207368	0.00028	0.020376933	0.099386377	0.00010
NOAAseasia	1982	12	28	22.326	100.918	30	5.20	425	137	446.5	3.559	1.96	2.189589438	1.114700078	-0.4324459931	0.3694485845	0.00038	0.026067277	0.131276834	0.00013
USGSneic	1982	12	28	22.33	100.92	30	5.2	426	137	447.5	3.559	1.96	2.189589438	1.114700078	-0.4364128335	0.3660894103	0.00037	0.025889669	0.13026656	0.00013
NOAAseasia	1983	1	10	19.705	102.180	0	4.00	134	28	136.9	2.83	1.15	0.55	0.28	0.2811552558	1.9105361336	0.00195	0.054816235	0.304065676	0.00031
NOAAseasia	1983	1	10	19.705	102.180	0	4.00	134	28	136.9	2.83	1.15	0.55	0.28	0.2811552558	1.9105361336	0.00195	0.054816235	0.304065676	0.00031
NOAAseasia	1983	1	10	19.525	102.280	33	4.00	114	19	115.6	2.9719	1.2754	0.55	0.28	0.5600807859	3.6314559950	0.00370	0.095541381	0.569660898	0.00058
USGSneic	1983	1	10	19.52	102.28	33	4	113	19	114.6	2.9719	1.2754	0.55	0.28	0.5668360577	3.6883833910	0.00376	0.096817881	0.578268849	0.00059
NOAAseasia	1983	4	15	14.908	99.870	10	5.30	399	227	459.1	3.523	1.942	2.456759757	1.250714058	-0.5185251158	0.3030225051	0.00031	0.022946221	0.113658948	0.00012
NOAAseasia	1983	4	15	14.917	99.960	17	5.20	398	220	454.8	3.5031	1.9106	2.189589438	1.114700078	-0.5212063066	0.3011575070	0.00031	0.02198449	0.108290794	0.00011
NOAAseasia	1983	4	15	14.917	99.960	17	5.20	398	220	454.8	3.5031	1.9106	2.189589438	1.114700078	-0.5212063066	0.3011575070	0.00031	0.02198449	0.108290794	0.00011
NOAAseasia	1983	4	15	14.854	99.139	10	3.90	405	290	498.1	2.823	1.13	0.490188016	0.249550263	-1.3690437276	0.0427519839	0.00004	0.002730649	0.010256059	0.00001
NOAAseasia	1983	4	15	15.150	99.317	10	4.20	372	275	462.6	2.973	1.304	0.692408976	0.352499115	-1.0806551844	0.0830509904	0.00008	0.005167299	0.021085691	0.00002

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
NOAAseasia	1983	4	15	15.150	99.317	10	4.20	372	275	462.6	2.973	1.304	0.692408976	0.352499115	-1.0806551844	0.0830509904	0.00008	0.005167299	0.021085691	0.00002
NOAAseasia	1983	4	22	14.926	99.230	10	5.90	397	283	487.5	3.823	2.29	4.90188016	2.495502627	-0.3318197025	0.4657794218	0.00047	0.042151002	0.225960712	0.00023
NOAAseasia	1983	4	22	14.922	99.540	32	5.80	398	256	473.2	3.8676	2.3156	4.368805291	2.224119057	-0.2310359510	0.5874407220	0.00060	0.049217414	0.269211887	0.00027
NOAAseasia	1983	4	22	14.922	99.540	32	5.80	398	256	473.2	3.8676	2.3156	4.368805291	2.224119057	-0.2310359510	0.5874407220	0.00060	0.049217414	0.269211887	0.00027
NOAAseasia	1983	4	22	14.931	99.760	33	5.20	397	237	462.4	3.5719	1.9714	2.189589438	1.114700078	-0.4823694739	0.3293294176	0.00034	0.024017981	0.11967577	0.00012
NOAAseasia	1983	4	22	14.914	99.940	40	5.30	398	221	455.2	3.652	2.056	2.456759757	1.250714058	-0.3741398814	0.4225324993	0.00043	0.030634169	0.157548003	0.00016
NOAAseasia	1983	4	22	14.914	99.940	40	5.30	398	221	455.2	3.652	2.056	2.456759757	1.250714058	-0.3741398814	0.4225324993	0.00043	0.030634169	0.157548003	0.00016
NOAAseasia	1983	4	23	14.968	99.139	17	4.40	392	290	487.6	3.1031	1.4466	0.871691256	0.443770094	-1.0485393998	0.0894253400	0.00009	0.006066542	0.025276887	0.00003
NOAAseasia	1983	4	23	14.968	99.139	17	4.40	392	290	487.6	3.1031	1.4466	0.871691256	0.443770094	-1.0485393998	0.0894253400	0.00009	0.006066542	0.025276887	0.00003
NOAAseasia	1983	4	23	14.961	99.179	33	4.40	393	287	486.6	3.1719	1.5074	0.871691256	0.443770094	-0.9758494002	0.1057184044	0.00011	0.007024768	0.02983281	0.00003
NOAAseasia	1983	4	23	14.923	99.370	33	4.50	397	270	480.1	3.2219	1.5654	0.978053676	0.497918235	-0.9006155453	0.1257142344	0.00013	0.00838336	0.036430277	0.00004
NOAAseasia	1983	4	23	14.981	99.370	68	4.50	391	270	475.2	3.3724	1.6984	0.978053676	0.497918235	-0.7309693756	0.1857935464	0.00019	0.011767081	0.053438676	0.00005
NOAAseasia	1983	4	23	14.981	99.370	68	4.50	391	270	475.2	3.3724	1.6984	0.978053676	0.497918235	-0.7309693756	0.1857935464	0.00019	0.011767081	0.053438676	0.00005
NOAAseasia	1983	4	26	15.106	99.488	0	4.10	377	260	458.0	2.88	1.208	0.61711015	0.314165167	-1.1554502534	0.0699116813	0.00007	0.004274022	0.01701553	0.00002
NOAAseasia	1983	4	26	15.106	99.488	0	4.10	377	260	458.0	2.88	1.208	0.61711015	0.314165167	-1.1554502534	0.0699116813	0.00007	0.004274022	0.01701553	0.00002
NOAAseasia	1983	4	27	14.896	99.132	12	4.60	400	291	494.7	3.1816	1.5436	1.097394273	0.558673448	-0.9978042399	0.1005068727	0.00010	0.007233824	0.030837967	0.00003
NOAAseasia	1983	4	27	14.896	99.132	12	4.60	400	291	494.7	3.1816	1.5436	1.097394273	0.558673448	-0.9978042399	0.1005068727	0.00010	0.007233824	0.030837967	0.00003
NOAAseasia	1983	4	27	14.962	99.550	33	4.60	393	255	468.5	3.2719	1.6234	1.097394273	0.558673448	-0.8053256784	0.1565576600	0.00016	0.010355542	0.046253574	0.00005
NOAAseasia	1983	5	26	22.547	101.126	1	4.80	450	119	465.5	3.2343	1.6178	1.381537537	0.703328201	-0.8314067004	0.1474325237	0.00015	0.010428567	0.046622315	0.00005
NOAAseasia	1983	5	26	22.547	101.126	1	4.80	450	119	465.5	3.2343	1.6178	1.381537537	0.703328201	-0.8314067004	0.1474325237	0.00015	0.010428567	0.046622315	0.00005
NOAAseasia	1983	5	26	22.503	101.136	33	4.70	445	118	460.4	3.3219	1.6814	1.231296626	0.626841919	-0.7235952445	0.1889751747	0.00019	0.012498957	0.057209398	0.00006
USGSneic	1983	5	26	22.5	101.14	33	4.7	444	118	459.4	3.3219	1.6814	1.231296626	0.626841919	-0.7196534419	0.1906981844	0.00019	0.012583945	0.057649164	0.00006
NOAAseasia	1983	5	28	22.493	101.100	10	4.90	444	121	460.2	3.323	1.71	1.550110612	0.789147221	-0.7220070081	0.1896675315	0.00019	0.013363164	0.061698912	0.00006
NOAAseasia	1983	5	28	22.468	101.268	10	5.00	441	106	453.6	3.373	1.768	1.739252713	0.885437745	-0.6461350905	0.2258733066	0.00023	0.015969085	0.075458198	0.00008
USGSneic	1983	5	28	22.49	101.01	10	4.9	443	129	461.4	3.323	1.71	1.550110612	0.789147221	-0.7267341922	0.1876142440	0.00019	0.013255016	0.061134968	0.00006
NOAAseasia	1983	6	24	21.774	103.308	18	6.00	364	70	370.7	3.9074	2.3784	5.5	2.8	0.2198812088	1.6591330279	0.00169	0.11606717	0.709776498	0.00072
NOAAseasia	1983	6	24	21.721	103.282	18	6.10	358	68	364.4	3.9574	2.4364	6.171101499	3.141651672	0.2953284516	1.9739150194	0.00201	0.138769313	0.868543519	0.00089
NOAAseasia	1983	6	24	21.813	103.372	12	4.50	368	75	375.6	3.1316	1.4856	0.978053676	0.497918235	-0.5710550065	0.2685004349	0.00027	0.014424444	0.067263885	0.00007
NOAAseasia	1983	6	24	21.766	103.499	33	4.60	363	86	373.0	3.2719	1.6234	1.097394273	0.558673448	-0.4200846832	0.3801152703	0.00039	0.020185577	0.098332375	0.00010
NOAAseasia	1983	6	24	21.400	102.604	33	4.60	322	9	322.1	3.2719	1.6234	1.097394273	0.558673448	-0.2038678507	0.6253629524	0.00064	0.02954314	0.151222363	0.00015
NOAAseasia	1983	6	24	21.363	102.578	49	5.10	318	7	318.1	3.5907	1.9742	1.951473641	0.99347749	0.1311801688	1.3526335923	0.00138	0.068246765	0.389504736	0.00040
NOAAseasia	1983	6	24	21.714	103.404	21	4.80	357	78	365.4	3.3203	1.6938	1.381537537	0.703328201	-0.3403074667	0.4567647002	0.00047	0.025083973	0.125694954	0.00013
NOAAseasia	1983	6	24	21.713	103.346	33	4.50	357	73	364.4	3.2219	1.5654	0.978053676	0.497918235	-0.4340424580	0.3680929859	0.00038	0.018811725	0.090803865	0.00009
NOAAseasia	1983	6	24	21.605	103.489	34	4.00	345	85	355.3	2.9762	1.2792	0.55	0.28	-0.6409669702	0.2285772639	0.00023	0.010415082	0.046554195	0.00005
NOAAseasia	1983	6	24	21.603	103.609	33	4.10	345	96	358.1	3.0219	1.3334	0.61711015	0.314165167	-0.6071520922	0.2470858686	0.00025	0.011556194	0.052357724	0.00005
USGSneic	1983	6	24	21.72	103.28	18	6.6	358	67	364.2	4.2074	2.7264	10.97394273	5.586734482	0.5405673327	3.4719009978	0.00354	0.269183647	1.836348058	0.00187
USGSneic	1983	6	24	21.77	103.5	33	4.6	363	86	373.0	3.2719	1.6234	1.097394273	0.558673448	-0.4200846832	0.3801152703	0.00039	0.020185577	0.098332375	0.00010
USGSneic	1983	6	24	21.4	102.6	33	6.9	322	9	322.1	4.4219	2.9574	15.50110612	7.891472208	0.9271961391	8.4566068213	0.00862	0.623300224	4.742506448	0.00483
USGSneic	1983	6	24	21.71	103.35	33	4.5	357	73	364.4	3.2219	1.5654	0.978053676	0.497918235	-0.4340424580	0.3680929859	0.00038	0.018811725	0.090803865	0.00009
USGSneic	1983	6	24	21.6	103.61	33	4.1	344	96	357.1	3.0219	1.3334	0.61711015	0.314165167	-0.6029397136	0.2494941037	0.00025	0.01164201	0.052797324	0.00005
NOAAseasia	1983	6	25	21.720	103.310	25	4.10	358	70	364.8	2.9875	1.303	0.61711015	0.314165167	-0.6696888787	0.2139494238	0.00022	0.010255842	0.045750684	0.00005
NOAAseasia	1983	6	25	21.690	103.481	33	4.20	354	85	364.1	3.0719	1.3914	0.692408976	0.352499115	-0.5824457924	0.2615496888	0.00027	0.012634529	0.057911091	0.00006
USGSneic	1983	6	25	21.69	103.48	33	4.2	354	85	364.1	3.0719	1.3914	0.692408976	0.352499115	-0.5824457924	0.2615496888	0.00027	0.012634529	0.057911091	0.00006
NOAAseasia	1983	7	3	21.625	103.508	0	4.20	347	87	357.7	2.93	1.266	0.692408976	0.352499115	-0.6974588024	0.2006971464	0.00020	0.009923235	0.044077628	0.00004
NOAAseasia	1983	7	14	16.400	99.573	10	3.90	233	253	343.9	2.823	1.13	0.490188016	0.249550263	-0.7457507695	0.1795763874	0.00018	0.008043643	0.034766555	0.00004
NOAAseasia	1983	7	15	21.757	103.436	3	5.10	362	81	371.0	3.3929	1.7994	1.951473641	0.99347749	-0.2917523275	0.5107962174	0.00052	0.030680658	0.157818199	0.00016
NOAAseasia	1983	7	15	21.771	103.435	10	5.10	363	81	371.9	3.423	1.826	1.951473641	0.99347749	-0.2653990969	0.5427513385	0.00055	0.032405238	0.167878543	0.00017
USGSneic	1983	7	15	21.77	103.43	10	5.1	363	80	371.7	3.423	1.826	1.951473641	0.99347749	-0.2645666994	0.5437926091	0.00055	0.032452504	0.168155267	0.00017
NOAAseasia	1983	7	17	15.152	99.140	44	5.10	372	290	471.7	3.5692	1.9552	1.951473641	0.99347749	-0.5213588928	0.3010517161	0.00031	0.02173804	0.106920022	0.00011
NOAAseasia	1983	7	17	15.205	99.210	46	4.70	366	284	463.3	3.3778	1.7308	1.231296626	0.626841919	-0.6791149788	0.2093558116	0.00021	0.013732528	0.063629435	0.00006
NOAAseasia	1983	8	3	21.764	98.543	0	3.80	363	342	498.7	2.73	1.034	0.436880529	0.222411906	-1.4643196605	0.0343305167	0.00003	0.002180555	0.00795391	0.00001
NOAAseasia	1983	8	29	14.894	99.302	11	4.20	401	276	486.8	2.9773	1.3078	0.692408976	0.352499115	-1.1710678574	0.0674422643	0.00007	0.00443134	0.017724934	0.00002
NOAAseasia	1983	8	29	14.919	99.150	33	4.20	398	290	492.4	3.0719	1.3914	0.692408976	0.352499115	-1.0982283167	0.0797575277	0.00008	0.005175725	0.021124548	0.00002
NOAAseasia	1983	10	19	22.313	99.990	0	5.20	424	217	476.3	3.43	1.846	2.189589438	1.114700078	-0.6787724932	0.2095209752	0.00021	0.01638718	0.077694408	0.00008
NOAAseasia	1983	10	19	22.296	99.910	37	4.90	422	224	477.8	3.4391	1.8126	1.550110612	0.789147221	-0.6749528319	0.2113718595	0.00022	0.015032706	0.070477742	0.00007
USGSneic	1983	10	19	22.3	99.91	37	4.9	422	224	477.8	3.4391	1.8126	1.550110612	0.789147221	-0.6749528319	0.2113718595	0.00022	0.015032706	0.070477742	0.00007
NOAAseasia	1984	3	4	22.245	101.594	0	4.60	416	78	423.2	3.13	1.498	1.097394273	0.558673448	-0.7672703647	0.1708951098	0.00017	0.010579896	0.04738752	0.00005
NOAAseasia	1984	3	4	22.290	101.377	33	4.70	421	97	432.0	3.3219	1.6814	1.231296626	0.626841919	-0.6108198225	0.2450079505	0.00025	0.015180516	0.071261308	0.00007
USGSneic	1984	3	4	22.29	101.38	33	4.7	421	97	432.0	3.3219	1.6814	1.231296626	0.626841919	-0.6108198225	0.2450079505	0.00025	0.015180516	0.071261308	0.00007
NOAAseasia	1984	4	4	22.900	100.100	33	4.10	489	207	531.0	3.0219	1.3334	0.61711015	0.314165167	-1.2966989503	0.0505011246	0.00005	0.003515998	0.013646929	0.00001
NOAAseasia	1984	4	7	19.800	100.300	33	4.60	144	190	238.4	3.2719	1.6234	1.097394273	0.558673448	0.1773992073	1.5045243027	0.00153	0.05865124	0.328211079	0.00033

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
NOAAseasia	1984	4	7	22.592	101.221	2	4.70	455	111	468.3	3.1886	1.5636	1.231296626	0.626841919	-0.8879645455	0.1294301500	0.00013	0.009034308	0.039642519	0.00004
NOAAseasia	1984	4	7	22.481	101.200	33	4.50	442	112	456.0	3.2219	1.5654	0.978053676	0.497918235	-0.8059953436	0.1563164402	0.00016	0.009861914	0.04376996	0.00004
USGSneic	1984	4	7	22.48	101.2	33	4.5	442	112	456.0	3.2219	1.5654	0.978053676	0.497918235	-0.8059953436	0.1563164402	0.00016	0.009861914	0.04376996	0.00004
NOAAseasia	1984	4	23	19.600	100.200	33	5.80	122	199	233.4	3.8719	2.3194	4.368805291	2.224119057	0.7955451244	6.2451823608	0.00637	0.302259706	2.093291401	0.00213
NOAAseasia	1984	4	23	22.550	99.175	8	5.70	450	287	533.7	3.7144	2.1664	3.893701814	1.982248196	-0.6171541721	0.2414603512	0.00025	0.023447295	0.116467513	0.00012
NOAAseasia	1984	4	23	21.860	99.260	33	6.00	373	280	466.4	3.9719	2.4354	5.5	2.8	-0.1011499773	0.7922276988	0.00081	0.067801921	0.386637039	0.00039
NOAAseasia	1984	4	23	22.490	99.136	17	5.90	443	291	530.0	3.8531	2.3166	4.90188016	2.495502627	-0.4651741244	0.3426303860	0.00035	0.033906585	0.176693667	0.00018
NOAAseasia	1984	4	24	21.912	99.570	0	4.30	379	253	455.7	2.98	1.324	0.77689565	0.395510512	-1.0465188008	0.0898423699	0.00009	0.005669493	0.023415582	0.00002
NOAAseasia	1984	4	24	21.800	99.249	33	4.30	367	281	462.2	3.1219	1.4494	0.77689565	0.395510512	-0.9302593186	0.1174196229	0.00012	0.007241001	0.030872543	0.00003
NOAAseasia	1984	4	24	20.400	99.900	33	4.90	211	225	308.5	3.4219	1.7974	1.550110612	0.789147221	0.0049681094	1.0115051758	0.00103	0.048981865	0.267756431	0.00027
NOAAseasia	1984	4	24	21.961	99.344	0	5.20	385	273	472.0	3.43	1.846	2.189589438	1.114700078	-0.6619520151	0.2177950400	0.00022	0.016866834	0.080269013	0.00008
NOAAseasia	1984	4	24	21.860	99.510	33	5.30	373	258	453.5	3.6219	2.0294	2.456759757	1.250714058	-0.3975236587	0.4003836564	0.00041	0.029149198	0.148945734	0.00015
NOAAseasia	1984	4	24	21.964	99.402	33	5.00	385	268	469.1	3.4719	1.8554	1.739252713	0.885437745	-0.6082726617	0.2464491577	0.00025	0.017583916	0.084135761	0.00009
USGSneic	1984	4	24	21.8	99.25	33	4.3	367	281	462.2	3.1219	1.4494	0.77689565	0.395510512	-0.9302593186	0.1174196229	0.00012	0.007241001	0.030872543	0.00003
NOAAseasia	1984	4	25	20.500	101.700	0	4.90	222	69	232.5	3.28	1.672	1.550110612	0.789147221	0.2131911493	1.6337708735	0.00167	0.069040744	0.394629162	0.00040
NOAAseasia	1984	4	25	22.500	100.500	106	4.30	444	173	476.5	3.4358	1.7268	0.77689565	0.395510512	-0.6724704112	0.2125835175	0.00022	0.012455947	0.056986994	0.00006
NOAAseasia	1984	5	6	18.900	99.200	0	6.00	44	285	288.4	3.83	2.31	5.5	2.8	0.4966004139	3.1376205006	0.00320	0.185784137	1.207757523	0.00123
NOAAseasia	1985	1	31	14.562	99.230	33	4.20	438	283	521.5	3.0719	1.3914	0.692408976	0.352499115	-1.2104305543	0.0615984020	0.00006	0.004274174	0.017016217	0.00002
NOAAseasia	1985	3	20	20.460	101.350	3	5.00	218	99	239.4	3.3429	1.7414	1.739252713	0.885437745	0.2424320893	1.7475599748	0.00178	0.07618554	0.441078592	0.00045
NOAAseasia	1985	3	20	20.886	101.628	10	4.80	265	75	275.4	3.273	1.652	1.381537537	0.703328201	0.0046628825	1.0107945287	0.00103	0.04572233	0.247710859	0.00025
NOAAseasia	1985	3	20	20.793	101.612	10	4.70	255	77	266.4	3.223	1.594	1.231296626	0.626841919	-0.0037368982	0.9914323870	0.00101	0.043116657	0.231818954	0.00024
NOAAseasia	1985	3	20	22.300	99.600	33	4.60	422	251	491.0	3.2719	1.6234	1.097394273	0.558673448	-0.8931510654	0.1278936360	0.00013	0.008908911	0.039021309	0.00004
USGSneic	1985	3	20	20.89	101.63	10	4.8	266	75	276.4	3.273	1.652	1.381537537	0.703328201	0.0000966226	1.0002225064	0.00102	0.045348013	0.245420497	0.00025
NOAAseasia	1985	4	24	22.300	98.500	33	5.10	422	346	545.7	3.5219	1.9134	1.951473641	0.99347749	-0.8537042606	0.1400540717	0.00014	0.012141046	0.055361698	0.00006
NOAAseasia	1985	6	7	22.500	98.400	33	4.70	444	354	567.8	3.3219	1.6814	1.231296626	0.626841919	-1.1366361532	0.0730068897	0.00007	0.006181949	0.025820921	0.00003
NOAAseasia	1985	6	9	21.944	102.548	0	4.40	383	4	383.0	3.03	1.382	0.871691256	0.443770094	-0.7031860861	0.1980678165	0.00020	0.010772049	0.048361203	0.00005
NOAAseasia	1985	6	9	21.935	102.598	33	4.30	382	8	382.1	3.1219	1.4494	0.77689565	0.395510512	-0.6074591600	0.2469112283	0.00025	0.01266408	0.058064171	0.00006
USGSneic	1985	6	9	21.93	102.6	33	4.3	381	9	381.1	3.1219	1.4494	0.77689565	0.395510512	-0.6033233834	0.2492737898	0.00025	0.012755884	0.05854003	0.00006
NOAAseasia	1985	7	5	21.745	99.645	0	4.40	361	247	437.4	3.03	1.382	0.871691256	0.443770094	-0.9239434197	0.1191397214	0.00012	0.007343123	0.031365003	0.00003
NOAAseasia	1985	7	15	14.900	99.400	0	5.00	400	268	481.5	3.33	1.73	1.739252713	0.885437745	-0.7986622041	0.1589782807	0.00016	0.01212288	0.055268104	0.00006
NOAAseasia	1985	7	15	19.600	98.000	0	5.30	122	389	407.7	3.48	1.904	2.456759757	1.250714058	-0.3560498735	0.4405042740	0.00045	0.029986724	0.153790604	0.00016
NOAAseasia	1985	8	19	20.800	103.200	0	4.90	256	60	262.9	3.28	1.672	1.550110612	0.789147221	0.0689562470	1.1720772786	0.00119	0.053101617	0.293340313	0.00030
NOAAseasia	1985	8	19	20.000	101.600	33	4.20	167	78	184.3	3.0719	1.3914	0.692408976	0.352499115	0.2518460922	1.7858545811	0.00182	0.057074854	0.318260423	0.00032
NOAAseasia	1985	8	19	22.150	102.684	10	4.80	406	16	406.3	3.273	1.652	1.381537537	0.703328201	-0.5562210442	0.2778298828	0.00028	0.016974697	0.080849308	0.00008
NOAAseasia	1985	8	19	22.154	102.666	10	4.80	406	14	406.2	3.273	1.652	1.381537537	0.703328201	-0.5558145033	0.2780900798	0.00028	0.01698669	0.080913856	0.00008
NOAAseasia	1985	8	19	17.500	104.800	33	4.20	111	199	227.9	3.0719	1.3914	0.692408976	0.352499115	0.0291381956	1.0693951143	0.00109	0.037773259	0.199626613	0.00020
NOAAseasia	1985	8	19	22.176	102.696	10	4.90	408	17	408.4	3.323	1.71	1.550110612	0.789147221	-0.5149310079	0.3055406457	0.00031	0.019110669	0.092436131	0.00009
NOAAseasia	1985	8	19	22.190	102.666	10	4.70	410	14	410.2	3.223	1.594	1.231296626	0.626841919	-0.6218973244	0.2388375874	0.00024	0.01445244	0.067411431	0.00007
NOAAseasia	1985	8	19	22.330	102.540	33	4.90	426	3	426.0	3.4219	1.7974	1.550110612	0.789147221	-0.4870870231	0.3257714170	0.00033	0.020662679	0.100962686	0.00010
USGSneic	1985	8	19	22.15	102.67	10	4.8	406	15	406.3	3.273	1.652	1.381537537	0.703328201	-0.5562210442	0.2778298828	0.00028	0.016974697	0.080849308	0.00008
USGSneic	1985	8	19	22.18	102.7	10	4.9	409	17	409.4	3.323	1.71	1.550110612	0.789147221	-0.5189891017	0.3026989387	0.00031	0.018976488	0.091703074	0.00009
NOAAseasia	1985	10	18	18.100	104.820	21	4.60	44	200	204.8	3.2203	1.5778	1.097394273	0.558673448	0.2922491495	1.9599687617	0.00200	0.071727707	0.412027547	0.00042
NOAAseasia	1985	10	18	18.350	104.788	21	4.70	17	198	198.7	3.2703	1.6358	1.231296626	0.626841919	0.3733192174	2.3622138823	0.00241	0.086862878	0.511543607	0.00052
USGSneic	1985	10	18	18.03	104.79	20	4.7	52	198	204.7	3.266	1.632	1.231296626	0.626841919	0.3381776460	2.1786007359	0.00222	0.081311931	0.474760226	0.00048
NOAAseasia	1985	11	25	15.800	98.800	33	4.20	300	320	438.6	3.0719	1.3914	0.692408976	0.352499115	-0.8866536987	0.1298214039	0.00013	0.007443591	0.031850349	0.00003
NOAAseasia	1985	11	28	22.900	98.400	33	4.60	489	354	603.7	3.2719	1.6234	1.097394273	0.558673448	-1.3208099114	0.0477738332	0.00005	0.004312977	0.017190881	0.00002
NOAAseasia	1986	3	5	21.859	103.206	10	4.30	373	61	378.0	3.023	1.362	0.77689565	0.395510512	-0.6893834804	0.2044638431	0.00021	0.010667288	0.047830073	0.00005
NOAAseasia	1986	3	5	21.903	102.972	33	4.40	378	41	380.2	3.1719	1.5074	0.871691256	0.443770094	-0.5497066875	0.2820287045	0.00029	0.014671728	0.068568372	0.00007
USGSneic	1986	3	5	21.9	102.97	33	4.4	378	41	380.2	3.1719	1.5074	0.871691256	0.443770094	-0.5497066875	0.2820287045	0.00029	0.014671728	0.068568372	0.00007
NOAAseasia	1986	4	17	18.200	104.900	33	3.90	33	207	209.6	2.9219	1.2174	0.490188016	0.249550263	-0.0293057697	0.9347473234	0.00095	0.029942769	0.15353589	0.00016
NOAAseasia	1986	4	17	22.379	101.687	58	4.00	431	70	436.6	3.0794	1.3704	0.55	0.28	-0.8710304827	0.1345765893	0.00014	0.007191804	0.030635626	0.00003
NOAAseasia	1986	4	20	21.300	98.200	33	4.20	311	372	484.9	3.0719	1.3914	0.692408976	0.352499115	-1.0690718890	0.0852958912	0.00009	0.005440417	0.022349325	0.00002
NOAAseasia	1986	5	8	20.200	103.000	33	4.10	189	43	193.8	3.0219	1.3334	0.61711015	0.314165167	0.1517655166	1.4182915538	0.00145	0.045471865	0.246178053	0.00025
NOAAseasia	1986	5	8	22.961	101.379	33	4.40	496	97	505.4	3.1719	1.5074	0.871691256	0.443770094	-1.0486836440	0.0893956437	0.00009	0.00620274	0.025919073	0.00003
NOAAseasia	1986	6	23	22.300	98.500	33	4.90	422	346	545.7	3.4219	1.7974	1.550110612	0.789147221	-0.9533858580	0.1113304955	0.00011	0.009298619	0.040955559	0.00004
NOAAseasia	1986	9	17	19.977	98.300	11	4.30	164	363	398.3	3.0273	1.3658	0.77689565	0.395510512	-0.7686565853	0.1703505008	0.00017	0.009301621	0.040970501	0.00004
NOAAseasia	1986	10	26	19.000	98.100	0	4.50	56	380	384.1	3.08	1.44	0.978053676	0.497918235	-0.6578487681	0.2198625354	0.00022	0.012212176	0.055728348	0.00006
NOAAseasia	1987	1	6	21.565	106.267	10	4.70	341	326	471.8	3.223	1.594	1.231296626	0.626841919	-0.8672898754	0.1357407125	0.00014	0.009463797	0.041778606	0.00004
NOAAseasia	1987	3	26	17.500	101.200	33	4.50	111	112	157.7	3.2219	1.5654	0.978053676	0.497918235	0.5482831352	3.5341350009	0.00360	0.112408522	0.684546787	0.00070
NOAAseasia	1987	4	1	21.942	98.542	3	4.50	382	342	512.7	3.0929	1.4514	0.978053676	0.497918235	-1.1558910114	0.0698407651	0.00007	0.00519655	0.021220621	0.00002
NOAAseasia	1987	4	1	21.954	98.464	33	4.70	384	349	518.9	3.3219	1.6814	1.231296626	0.626841919	-0.9509129863	0.1119662192	0.00011	0.008472118	0.03686642	0.00004

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
NOAAseasia	1987	4	4	22.918	100.410	33	3.40	491	181	523.3	2.6719	0.9274	0.275652978	0.140332425	-1.6169794430	0.0241557517	0.00002	0.001451887	0.005023242	0.00001
NOAAseasia	1987	4	29	21.300	98.200	33	4.60	311	372	484.9	3.2719	1.6234	1.097394273	0.558673448	-0.8694339408	0.1350722267	0.00014	0.009277858	0.040852246	0.00004
NOAAseasia	1987	5	20	22.300	98.500	33	4.40	422	346	545.7	3.1719	1.5074	0.871691256	0.443770094	-1.2028471344	0.0626834463	0.00006	0.004771918	0.019271837	0.00002
NOAAseasia	1987	6	10	22.800	98.300	33	4.30	478	363	600.2	3.1219	1.4494	0.77689565	0.395510512	-1.4575577760	0.0348692193	0.00004	0.002954051	0.011209139	0.00001
NOAAseasia	1987	6	14	19.400	100.100	0	4.70	100	207	229.9	3.18	1.556	1.231296626	0.626841919	0.1264412443	1.3379541912	0.00136	0.054135045	0.299799362	0.00031
NOAAseasia	1987	6	14	19.400	99.500	103	4.10	100	259	277.6	3.3229	1.5994	0.61711015	0.314165167	0.0457161647	1.1110053870	0.00113	0.039837247	0.211995639	0.00022
NOAAseasia	1987	8	5	22.000	101.400	33	4.10	389	95	400.4	3.0219	1.3334	0.61711015	0.314165167	-0.7824629030	0.1650201954	0.00017	0.008506782	0.037036914	0.00004
NOAAseasia	1987	9	9	21.300	98.200	33	4.80	311	372	484.9	3.3719	1.7394	1.381537537	0.703328201	-0.7696877812	0.1699464976	0.00017	0.012114858	0.055226781	0.00006
NOAAseasia	1987	10	5	22.362	101.330	12	4.10	429	101	440.7	2.9316	1.2536	0.61711015	0.314165167	-1.0352507657	0.0922038880	0.00009	0.005342536	0.021895488	0.00002
NOAAseasia	1987	10	5	22.365	101.343	10	4.10	429	100	440.5	2.923	1.246	0.61711015	0.314165167	-1.0430539036	0.0905620190	0.00009	0.005257078	0.021500138	0.00002
USGSneic	1987	10	5	22.36	101.34	10	4.1	429	100	440.5	2.923	1.246	0.61711015	0.314165167	-1.0430539036	0.0905620190	0.00009	0.005257078	0.021500138	0.00002
NOAAseasia	1987	10	10	20.200	100.600	33	4.30	189	164	250.2	3.1219	1.4494	0.77689565	0.395510512	-0.0283337432	0.9368417935	0.00095	0.035483521	0.186007385	0.00019
NOAAseasia	1987	10	10	21.794	98.875	33	4.20	366	313	481.6	3.0719	1.3914	0.692408976	0.352499115	-1.0562104264	0.0878596712	0.00009	0.005561549	0.022912433	0.00002
NOAAseasia	1987	10	10	21.538	98.286	33	4.40	338	364	496.7	3.1719	1.5074	0.871691256	0.443770094	-1.0150556637	0.0965927068	0.00010	0.006569283	0.02765638	0.00003
NOAAseasia	1987	11	13	21.577	103.407	33	4.40	342	78	350.8	3.1719	1.5074	0.871691256	0.443770094	-0.4266374100	0.3744230615	0.00038	0.018205029	0.087501651	0.00009
NOAAseasia	1987	11	13	21.580	103.390	33	4.30	342	77	350.6	3.1219	1.4494	0.77689565	0.395510512	-0.4756732016	0.3344466101	0.00034	0.01595506	0.075383316	0.00008
USGSneic	1987	11	13	21.58	103.39	33	4.3	342	77	350.6	3.1219	1.4494	0.77689565	0.395510512	-0.4756732016	0.3344466101	0.00034	0.01595506	0.075383316	0.00008
NOAAseasia	1987	11	25	22.402	99.648	33	4.50	434	246	498.9	3.2219	1.5654	0.978053676	0.497918235	-0.9736640702	0.1062517104	0.00011	0.007398663	0.031633205	0.00003
NOAAseasia	1987	11	25	22.396	99.663	33	4.60	433	245	497.5	3.2719	1.6234	1.097394273	0.558673448	-0.9183500045	0.1206840832	0.00012	0.008533349	0.037167643	0.00004
USGSneic	1988	1	30	22.81	102.88	33	4.4	479	33	480.1	3.1719	1.5074	0.871691256	0.443770094	-0.9505195157	0.1120677066	0.00011	0.007336131	0.031331253	0.00003
NOAAseasia	1988	2	18	18.869	99.168	5	4.20	41	288	290.9	2.9515	1.285	0.692408976	0.352499115	-0.3859762138	0.4111722403	0.00042	0.017335259	0.082792555	0.00008
USGSneic	1988	2	18	18.87	99.17	5	4.2	41	288	290.9	2.9515	1.285	0.692408976	0.352499115	-0.3859762138	0.4111722403	0.00042	0.017335259	0.082792555	0.00008
NOAAseasia	1988	7	24	19.116	100.150	20	4.00	68	203	214.1	2.916	1.226	0.55	0.28	-0.0580308928	0.8749215369	0.00089	0.029283011	0.149718607	0.00015
NOAAseasia	1988	7	24	19.820	100.510	33	4.20	147	172	226.3	3.0719	1.3914	0.692408976	0.352499115	0.0369886661	1.0889016757	0.00111	0.038321234	0.202902137	0.00021
USGSneic	1988	7	24	19.08	100.05	33	4.2	64	212	221.4	3.0719	1.3914	0.692408976	0.352499115	0.0611662852	1.1512410985	0.00117	0.040061894	0.213347014	0.00022
NOAAseasia	1988	8	6	20.900	100.200	0	7.40	267	199	333.0	4.53	3.122	27.56529785	14.03324254	0.9740160737	9.4192445756	0.00960	0.82343424	6.496219364	0.00662
NOAAseasia	1988	8	6	21.300	98.200	33	4.60	311	372	484.9	3.2719	1.6234	1.097394273	0.558673448	-0.8694339408	0.1350722267	0.00014	0.009277858	0.040852246	0.00004
NOAAseasia	1988	8	14	21.100	106.900	0	4.40	289	380	477.4	3.03	1.382	0.871691256	0.443770094	-1.0818746759	0.0828181117	0.00008	0.005596469	0.023075063	0.00002
NOAAseasia	1988	8	14	22.700	100.600	33	4.50	467	164	495.0	3.2219	1.5654	0.978053676	0.497918235	-0.9585624600	0.1100113616	0.00011	0.007592034	0.032569023	0.00003
NOAAseasia	1988	8	14	22.852	99.781	33	4.70	484	235	538.0	3.3219	1.6814	1.231296626	0.626841919	-1.0238750904	0.0946509352	0.00010	0.007483625	0.032043989	0.00003
NOAAseasia	1988	8	14	22.837	99.740	33	4.70	482	239	538.0	3.3219	1.6814	1.231296626	0.626841919	-1.0238750904	0.0946509352	0.00010	0.007483625	0.032043989	0.00003
NOAAseasia	1988	10	22	20.775	102.639	13	3.90	253	12	253.3	2.8359	1.1414	0.490188016	0.249550263	-0.3284748275	0.4693806397	0.00048	0.017011286	0.081046261	0.00008
NOAAseasia	1988	10	22	20.733	102.588	33	4.00	248	8	248.1	2.9719	1.2754	0.55	0.28	-0.1679884636	0.6792216750	0.00069	0.024214939	0.120785337	0.00012
USGSneic	1988	10	22	20.73	102.59	33	4	248	8	248.1	2.9719	1.2754	0.55	0.28	-0.1679884636	0.6792216750	0.00069	0.024214939	0.120785337	0.00012
NOAAseasia	1988	11	6	21.400	100.100	0	6.10	322	207	382.8	3.88	2.368	6.171101499	3.141651672	0.1416826633	1.3857429037	0.00141	0.103723783	0.625089976	0.00064
NOAAseasia	1988	11	6	21.100	99.300	33	6.10	289	277	400.3	4.0219	2.4934	6.171101499	3.141651672	0.2119703256	1.6291847102	0.00166	0.122185386	0.752197302	0.00077
NOAAseasia	1988	11	6	22.830	99.830	3	6.60	481	231	533.6	4.1429	2.6694	10.97394273	5.586734482	-0.1939568570	0.6397983902	0.00065	0.074209721	0.428174407	0.00044
NOAAseasia	1988	11	6	22.920	99.830	9	6.70	491	231	542.6	4.2187	2.7502	12.31296626	6.268419188	-0.1533248728	0.7025465852	0.00072	0.084242599	0.494140995	0.00050
NOAAseasia	1988	11	6	22.800	99.594	18	6.00	478	251	539.9	3.9074	2.3784	5.5	2.8	-0.4490151336	0.3556189263	0.00036	0.036647148	0.192914735	0.00020
NOAAseasia	1988	11	6	22.789	99.611	18	6.10	477	250	538.5	3.9574	2.4364	6.171101499	3.141651672	-0.3942343336	0.4034276555	0.00041	0.042236502	0.226478708	0.00023
NOAAseasia	1988	11	6	21.800	100.200	0	6.60	367	199	417.5	4.13	2.658	10.97394273	5.586734482	0.2455755842	1.7602549902	0.00179	0.157242736	1.000287331	0.00102
NOAAseasia	1988	11	6	22.400	100.100	33	6.00	433	207	479.9	3.9719	2.4354	5.5	2.8	-0.1538997720	0.7016172014	0.00072	0.061933083	0.349037952	0.00036
NOAAseasia	1988	11	6	19.900	105.900	0	4.80	156	294	332.8	3.23	1.614	1.381537537	0.703328201	-0.2923824528	0.5100556317	0.00052	0.026625626	0.134458668	0.00014
NOAAseasia	1988	11	6	22.715	100.380	10	5.60	468	183	502.5	3.673	2.116	3.470265395	1.766680565	-0.5386249952	0.2893177006	0.00029	0.025605881	0.128654177	0.00013
NOAAseasia	1988	11	6	22.815	99.558	10	5.80	479	254	542.2	3.773	2.232	4.368805291	2.224119057	-0.5912448413	0.2563038670	0.00026	0.025802551	0.129771339	0.00013
NOAAseasia	1988	11	6	19.300	98.700	33	4.60	89	328	339.9	3.2719	1.6234	1.097394273	0.558673448	-0.2805510604	0.5241419736	0.00053	0.025795004	0.129728449	0.00013
NOAAseasia	1988	11	6	20.000	101.000	33	4.80	167	130	211.6	3.3719	1.7394	1.381537537	0.703328201	0.4087580421	2.5630556867	0.00261	0.097553577	0.583236659	0.00059
NOAAseasia	1988	11	6	22.980	99.710	10	5.00	498	241	553.2	3.373	1.768	1.739252713	0.885437745	-1.0308454450	0.0931439293	0.00009	0.008279865	0.035922478	0.00004
NOAAseasia	1988	11	6	20.100	102.200	33	4.60	178	26	179.9	3.2719	1.6234	1.097394273	0.558673448	0.4745276774	2.9821375922	0.00304	0.101676887	0.611168737	0.00062
NOAAseasia	1988	11	6	22.700	100.600	33	4.90	467	164	495.0	3.4219	1.7974	1.550110612	0.789147221	-0.7590630830	0.1741553888	0.00018	0.012945028	0.059521843	0.00006
NOAAseasia	1988	11	6	22.662	99.739	10	4.00	462	239	520.2	2.873	1.188	0.55	0.28	-1.4042292786	0.0394249110	0.00004	0.002698957	0.010121653	0.00001
NOAAseasia	1988	11	6	22.600	99.400	33	4.00	456	268	528.9	2.9719	1.2754	0.55	0.28	-1.3386249526	0.0458537699	0.00005	0.003118865	0.01191835	0.00001
NOAAseasia	1988	11	6	22.466	99.790	10	3.90	441	234	499.2	2.823	1.13	0.490188016	0.249550263	-1.3733008217	0.0423349624	0.00004	0.002710868	0.010172143	0.00001
NOAAseasia	1988	11	6	22.514	99.816	10	4.60	446	232	502.7	3.173	1.536	1.097394273	0.558673448	-1.0373559169	0.0917580305	0.00009	0.00674231	0.02848091	0.00003
NOAAseasia	1988	11	6	22.600	101.300	33	5.30	456	104	467.7	3.6219	2.0294	2.456759757	1.250714058	-0.4534426846	0.3520118757	0.00036	0.026477245	0.133612245	0.00014
NOAAseasia	1988	11	6	20.200	103.000	33	4.30	189	43	193.8	3.1219	1.4494	0.77689565	0.395510512	0.2514087298	1.7840570163	0.00182	0.059369148	0.332754334	0.00034
NOAAseasia	1988	11	6	22.799	98.993	10	4.30	478	303	565.9	3.023	1.362	0.77689565	0.395510512	-1.4280355061	0.0373219644	0.00004	0.003000246	0.011407416	0.00001
NOAAseasia	1988	11	6	22.300	100.600	0	5.70	422	164	452.7	3.68	2.136	3.893701814	1.982248196	-0.3376299166	0.4595894845	0.00047	0.037401757	0.19740946	0.00020
NOAAseasia	1988	11	6	22.100	98.700	33	5.50	400	328	517.3	3.7219	2.1454	3.092877289	1.574555711	-0.5463313437	0.2842291762	0.00029	0.024873542	0.124504061	0.00013
NOAAseasia	1988	11	6	22.100	99.575	10	4.60	400	253	473.3	3.173	1.536	1.097394273	0.558673448	-0.9230422949	0.1193871830	0.00012	0.008198816	0.035525387	0.00004
NOAAseasia	1988	11	6	22.600	98.500	33	4.30	456	346	572.4	3.1219	1.4494	0.77689565	0.395510512	-1.3535886760	0.0443077550	0.00005	0.003520468	0.013666536	0.00001

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
USGSneic	1988	11	6	22.01	99.57	10	4.6	390	253	464.9	3.173	1.536	1.097394273	0.558673448	-0.8900834882	0.1288001924	0.00013	0.008675987	0.037870438	0.00004
NOAAseasia	1988	11	7	19.900	100.500	33	5.00	156	173	232.9	3.4719	1.8554	1.739252713	0.885437745	0.4027993332	2.5281295981	0.00258	0.104901704	0.633117437	0.00065
NOAAseasia	1988	11	8	22.900	99.100	33	4.60	489	294	570.6	3.2719	1.6234	1.097394273	0.558673448	-1.1970662128	0.0635234076	0.00006	0.005314265	0.021764608	0.00002
NOAAseasia	1988	11	11	22.936	99.504	10	4.70	493	259	556.9	3.223	1.594	1.231296626	0.626841919	-1.1944363758	0.0639092358	0.00007	0.005419188	0.022250802	0.00002
NOAAseasia	1988	11	11	22.923	99.565	20	4.40	491	254	552.8	3.116	1.458	0.871691256	0.443770094	-1.2856523190	0.0518021376	0.00005	0.00406896	0.016095939	0.00002
NOAAseasia	1988	11	12	21.100	102.200	33	4.40	289	26	290.2	3.1719	1.5074	0.871691256	0.443770094	-0.1626999693	0.6875432626	0.00070	0.029082985	0.148563475	0.00015
NOAAseasia	1988	11	17	20.400	101.000	33	4.90	211	130	247.8	3.4219	1.7974	1.550110612	0.789147221	0.2816904348	1.9128919291	0.00195	0.080596807	0.470044693	0.00048
NOAAseasia	1988	11	18	22.722	99.629	10	4.40	469	248	530.5	3.073	1.42	0.871691256	0.443770094	-1.2438984137	0.0570297656	0.00006	0.004304785	0.01715399	0.00002
NOAAseasia	1988	11	19	22.930	99.850	33	5.20	492	229	542.7	3.5719	1.9714	2.189589438	1.114700078	-0.7925085104	0.1612469429	0.00016	0.014143245	0.065784024	0.00007
NOAAseasia	1988	11	19	22.800	99.800	33	5.10	478	233	531.8	3.5219	1.9134	1.951473641	0.99347749	-0.8008390871	0.1581834025	0.00016	0.013281316	0.061272055	0.00006
NOAAseasia	1988	11	20	22.700	100.600	33	4.30	467	164	495.0	3.1219	1.4494	0.77689565	0.395510512	-1.0583862838	0.0874205866	0.00009	0.005813637	0.02408941	0.00002
NOAAseasia	1988	11	27	22.810	99.950	8	5.40	479	220	527.1	3.5644	1.9924	2.756529785	1.403324254	-0.7410582908	0.1815272001	0.00019	0.016411651	0.077825527	0.00008
NOAAseasia	1988	11	27	22.730	99.858	16	5.00	470	228	522.4	3.3988	1.7908	1.739252713	0.885437745	-0.8878466852	0.1294652800	0.00013	0.010647836	0.047731527	0.00005
NOAAseasia	1988	11	27	22.749	99.852	16	5.00	472	229	524.6	3.3988	1.7908	1.739252713	0.885437745	-0.8962657595	0.1269796836	0.00013	0.010496374	0.046965011	0.00005
NOAAseasia	1988	11	27	22.680	99.920	33	5.40	464	223	514.8	3.6719	2.0874	2.756529785	1.403324254	-0.5864577923	0.2591446264	0.00026	0.022129887	0.109100439	0.00011
NOAAseasia	1988	11	27	22.300	99.300	33	4.80	422	277	504.8	3.3719	1.7394	1.381537537	0.703328201	-0.8468063007	0.1422963300	0.00015	0.010618813	0.047584538	0.00005
NOAAseasia	1988	11	28	22.100	100.400	0	5.40	400	181	439.0	3.53	1.962	2.756529785	1.403324254	-0.4321829777	0.3696723959	0.00038	0.027551764	0.139755476	0.00014
NOAAseasia	1988	11	30	21.100	101.000	0	5.50	289	130	316.9	3.58	2.02	3.092877289	1.574555711	0.1241596885	1.3309437112	0.00136	0.076405612	0.442518614	0.00045
NOAAseasia	1988	11	30	22.800	99.940	9	6.00	478	221	526.6	3.8687	2.3442	5.5	2.8	-0.4370932589	0.3655162935	0.00037	0.036916121	0.194515472	0.00020
NOAAseasia	1988	11	30	22.773	99.844	15	5.60	475	230	527.8	3.6945	2.135	3.470265395	1.766680565	-0.6142155096	0.2430997378	0.00025	0.022671453	0.112122214	0.00011
NOAAseasia	1988	11	30	22.761	99.844	15	5.50	473	230	526.0	3.6445	2.077	3.092877289	1.574555711	-0.6570319150	0.2202764582	0.00022	0.020077802	0.097739308	0.00010
NOAAseasia	1988	11	30	22.700	100.600	33	5.30	467	164	495.0	3.6219	2.0294	2.456759757	1.250714058	-0.5598553367	0.2755146288	0.00028	0.022064742	0.108737591	0.00011
NOAAseasia	1988	11	30	22.720	99.830	33	6.00	469	231	522.8	3.9719	2.4354	5.5	2.8	-0.3193806107	0.4793131999	0.00049	0.046681483	0.253590773	0.00026
NOAAseasia	1989	1	16	22.701	99.379	33	4.30	467	270	539.4	3.1219	1.4494	0.77689565	0.395510512	-1.2288360047	0.0590423990	0.00006	0.004348813	0.017352375	0.00002
NOAAseasia	1989	1	23	17.000	98.100	33	4.50	167	380	415.1	3.2219	1.5654	0.978053676	0.497918235	-0.6425748092	0.2277325928	0.00023	0.013077557	0.060210897	0.00006
NOAAseasia	1989	1	24	22.883	99.497	36	4.50	487	260	552.1	3.2348	1.5768	0.978053676	0.497918235	-1.1642864259	0.0685036282	0.00007	0.005372677	0.022035127	0.00002
NOAAseasia	1989	1	24	22.100	98.800	33	4.40	400	320	512.2	3.1719	1.5074	0.871691256	0.443770094	-1.0748780531	0.0841631433	0.00009	0.00593177	0.024643267	0.00003
NOAAseasia	1989	1	24	22.881	99.611	33	4.50	487	250	547.4	3.2219	1.5654	0.978053676	0.497918235	-1.1593800658	0.0692819231	0.00007	0.005393868	0.022133362	0.00002
NOAAseasia	1989	3	1	21.750	98.300	33	5.70	361	363	511.9	3.8219	2.2614	3.893701814	1.982248196	-0.4262760348	0.3747347475	0.00038	0.033630737	0.175070154	0.00018
NOAAseasia	1989	4	7	18.700	100.600	33	4.10	22	164	165.5	3.0219	1.3334	0.61711015	0.314165167	0.3049856327	2.0182995933	0.00206	0.060642678	0.340831369	0.00035
NOAAseasia	1989	4	7	20.434	100.705	10	4.20	215	155	265.0	2.973	1.304	0.692408976	0.352499115	-0.2463791465	0.5670493455	0.00058	0.022396328	0.110585912	0.00011
NOAAseasia	1989	4	7	20.537	100.656	10	4.00	226	159	276.3	2.873	1.188	0.55	0.28	-0.3981445278	0.3998116752	0.00041	0.015616339	0.073577415	0.00008
NOAAseasia	1989	4	7	20.567	100.593	5	4.40	230	165	283.1	3.0515	1.401	0.871691256	0.443770094	-0.2510750480	0.5609510329	0.00057	0.024109038	0.1201886	0.00012
NOAAseasia	1989	4	7	19.200	99.900	33	4.50	78	225	238.1	3.2219	1.5654	0.978053676	0.497918235	0.1290602884	1.3460471982	0.00137	0.051467533	0.28316051	0.00029
NOAAseasia	1989	4	7	20.576	100.586	10	4.60	231	165	283.9	3.173	1.536	1.097394273	0.558673448	-0.1335408893	0.7352907638	0.00075	0.032672384	0.169443271	0.00017
USGSneic	1989	4	7	20.43	100.71	10	4.2	214	155	264.2	2.973	1.304	0.692408976	0.352499115	-0.2426695129	0.5719136830	0.00058	0.022546967	0.111426782	0.00011
USGSneic	1989	4	7	20.58	100.59	10	4.6	231	165	283.9	3.173	1.536	1.097394273	0.558673448	-0.1335408893	0.7352907638	0.00075	0.032672384	0.169443271	0.00017
NOAAseasia	1989	4	8	21.100	101.900	33	4.10	289	52	293.6	3.0219	1.3334	0.61711015	0.314165167	-0.3275679255	0.4703618334	0.00048	0.018966163	0.091646697	0.00009
NOAAseasia	1989	4	14	16.300	103.700	33	4.30	244	104	265.2	3.1219	1.4494	0.77689565	0.395510512	-0.0985439128	0.7969958998	0.00081	0.031244909	0.161101868	0.00016
NOAAseasia	1989	4	16	22.500	98.500	33	4.20	444	346	562.9	3.0719	1.3914	0.692408976	0.352499115	-1.3677651350	0.0428780341	0.00004	0.00327263	0.012584428	0.00001
NOAAseasia	1989	4	22	22.700	100.000	33	4.10	467	216	514.5	3.0219	1.3334	0.61711015	0.314165167	-1.2335059757	0.0584109170	0.00006	0.00391516	0.015410153	0.00002
NOAAseasia	1989	4	24	21.300	98.200	33	4.30	311	372	484.9	3.1219	1.4494	0.77689565	0.395510512	-1.0191474439	0.0956869157	0.00010	0.006217184	0.025987285	0.00003
NOAAseasia	1989	5	3	22.600	98.800	33	4.20	456	320	557.1	3.0719	1.3914	0.692408976	0.352499115	-1.3458725996	0.0450948971	0.00005	0.003396191	0.013122637	0.00001
NOAAseasia	1989	5	6	22.434	99.804	3	4.60	437	233	495.2	3.1429	1.5094	1.097394273	0.558673448	-1.0384419950	0.0915288498	0.00009	0.006663919	0.028107003	0.00003
NOAAseasia	1989	5	6	22.471	99.776	10	4.70	441	235	499.7	3.223	1.594	1.231296626	0.626841919	-0.9758781659	0.1057114023	0.00011	0.007858618	0.03386423	0.00003
NOAAseasia	1989	5	6	22.900	100.300	33	5.10	489	190	524.6	3.5219	1.9134	1.951473641	0.99347749	-0.7733408325	0.1685229945	0.00017	0.013917141	0.064596879	0.00007
NOAAseasia	1989	5	18	14.800	100.500	33	4.20	411	173	445.9	3.0719	1.3914	0.692408976	0.352499115	-0.9157113368	0.1214195624	0.00012	0.007079773	0.030096906	0.00003
NOAAseasia	1989	5	22	22.344	104.465	33	4.10	427	170	459.6	3.0219	1.3334	0.61711015	0.314165167	-1.0198627610	0.0955294416	0.00010	0.005643171	0.023292775	0.00002
NOAAseasia	1989	5	22	15.800	98.800	33	3.90	300	320	438.6	2.9219	1.2174	0.490188016	0.249550263	-1.0364537324	0.0919488427	0.00009	0.004987516	0.020258594	0.00002
USGSneic	1989	5	22	22.34	104.46	33	4.1	427	169	459.2	3.0219	1.3334	0.61711015	0.314165167	-1.0182851277	0.0958770962	0.00010	0.005658497	0.023364271	0.00002
NOAAseasia	1989	6	4	22.600	99.400	33	4.20	456	268	528.9	3.0719	1.3914	0.692408976	0.352499115	-1.2387417514	0.0577109533	0.00006	0.004073213	0.016114948	0.00002
NOAAseasia	1989	6	16	20.810	102.460	3	5.60	257	3	257.0	3.6429	2.0894	3.470265395	1.766680565	0.4561418475	2.8585240302	0.00291	0.145375642	0.915409803	0.00093
NOAAseasia	1989	6	16	20.670	102.360	15	5.50	241	12	241.3	3.6445	2.077	3.092877289	1.574555711	0.5325114555	3.4080931434	0.00347	0.161814703	1.033214086	0.00105
NOAAseasia	1989	6	16	20.668	102.451	17	5.00	241	4	241.0	3.4031	1.7946	1.739252713	0.885437745	0.2949599894	1.9722410295	0.00201	0.084916146	0.498607736	0.00051
NOAAseasia	1989	6	16	20.672	102.446	33	5.10	241	5	241.1	3.5219	1.9134	1.951473641	0.99347749	0.4129017414	2.5876274015	0.00264	0.111485121	0.678195821	0.00069
USGSneic	1989	6	16	20.67	102.45	33	5.5	241	4	241.0	3.7219	2.1454	3.092877289	1.574555711	0.6113448933	4.0864378036	0.00417	0.189913027	1.238131787	0.00126
NOAAseasia	1989	8	20	20.215	99.320	39	4.20	191	275	334.8	3.0977	1.4142	0.692408976	0.352499115	-0.4323826980	0.3695024326	0.00038	0.016571337	0.078681751	0.00008
NOAAseasia	1989	8	20	20.263	99.163	33	4.30	196	288	348.4	3.1219	1.4494	0.77689565	0.395510512	-0.4663454996	0.3417074916	0.00035	0.016219188	0.076794992	0.00008
NOAAseasia	1989	8	20	20.312	99.319	10	4.50	201	275	340.6	3.123	1.478	0.978053676	0.497918235	-0.4322899596	0.3695813440	0.00038	0.01836204	0.088354903	0.00009
NOAAseasia	1989	8	20	19.900	100.400	33	4.50	156	181	238.9	3.2219	1.5654	0.978053676	0.497918235	0.1252094836	1.3341648165	0.00136	0.051106911	0.280919562	0.00029
NOAAseasia	1989	8	20	20.273	99.322	33	4.60	197	275	338.3	3.2719	1.6234	1.097394273	0.558673448	-0.2737085037	0.5324655276	0.00054	0.026108468	0.131511271	0.00013

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
USGSneic	1989	8	20	20.26	99.16	33	4.3	196	289	349.2	3.1219	1.4494	0.77689565	0.395510512	-0.4697393746	0.3390475617	0.00035	0.016122566	0.076278228	0.00008
USGSneic	1989	8	20	20.27	99.32	33	4.6	197	275	338.3	3.2719	1.6234	1.097394273	0.558673448	-0.2737085037	0.5324655276	0.00054	0.026108468	0.131511271	0.00013
NOAAseasia	1989	8	27	20.357	98.813	9	4.50	206	319	379.7	3.1187	1.4742	0.978053676	0.497918235	-0.6009578402	0.2506352549	0.00026	0.013639243	0.063141225	0.00006
NOAAseasia	1989	8	27	20.352	98.820	13	4.20	206	318	378.9	2.9859	1.3154	0.692408976	0.352499115	-0.7301175189	0.1861583329	0.00019	0.009520758	0.042062865	0.00004
USGSneic	1989	8	27	20.36	98.81	9	4.5	207	319	380.3	3.1187	1.4742	0.978053676	0.497918235	-0.6034418080	0.2492058265	0.00025	0.013580177	0.062832327	0.00006
NOAAseasia	1989	9	19	22.000	101.900	33	4.10	389	52	392.5	3.0219	1.3334	0.61711015	0.314165167	-0.7501219466	0.1777780153	0.00018	0.008999386	0.039469401	0.00004
NOAAseasia	1989	9	28	18.300	98.100	33	4.10	22	380	380.6	3.0219	1.3334	0.61711015	0.314165167	-0.7010723848	0.1990341577	0.00020	0.009803313	0.043476177	0.00004
NOAAseasia	1989	9	28	20.161	98.536	33	4.00	185	343	389.7	2.9719	1.2754	0.55	0.28	-0.7885429117	0.1627260521	0.00017	0.008034478	0.034721794	0.00004
NOAAseasia	1989	9	28	20.214	98.746	33	4.10	190	324	375.6	3.0219	1.3334	0.61711015	0.314165167	-0.6803385431	0.2087668108	0.00021	0.010165092	0.045293489	0.00005
NOAAseasia	1989	9	28	20.610	99.120	31	4.10	234	292	374.2	3.0133	1.3258	0.61711015	0.314165167	-0.6831194079	0.2074343105	0.00021	0.010090943	0.044920324	0.00005
NOAAseasia	1989	9	28	19.100	99.200	0	5.40	67	285	292.8	3.53	1.962	2.756529785	1.403324254	0.1809594413	1.5169086968	0.00155	0.080863479	0.471802502	0.00048
NOAAseasia	1989	9	28	20.430	98.910	10	5.80	214	310	376.7	3.773	2.232	4.368805291	2.224119057	0.0618966016	1.1531786722	0.00118	0.079441558	0.462438472	0.00047
NOAAseasia	1989	9	28	20.364	98.817	11	5.50	207	318	379.4	3.6273	2.0618	3.092877289	1.574555711	-0.0935233522	0.8062628471	0.00082	0.052735617	0.291056667	0.00030
NOAAseasia	1989	9	28	20.329	98.822	11	5.40	203	318	377.3	3.5773	2.0038	2.756529785	1.403324254	-0.1344481986	0.7337562296	0.00075	0.04687064	0.254752232	0.00026
NOAAseasia	1989	9	28	20.390	98.780	45	5.90	210	321	383.6	3.9735	2.423	4.90188016	2.495502627	0.2333068751	1.7112240492	0.00174	0.11724795	0.717941306	0.00073
NOAAseasia	1989	9	28	19.400	99.500	33	4.70	100	259	277.6	3.3219	1.6814	1.231296626	0.626841919	0.0437584817	1.1060085434	0.00113	0.048061904	0.262080736	0.00027
NOAAseasia	1989	9	28	19.788	98.205	49	4.50	143	371	397.6	3.2907	1.6262	0.978053676	0.497918235	-0.5026133821	0.3143305684	0.00032	0.017021981	0.081103838	0.00008
NOAAseasia	1989	9	28	20.212	98.518	18	4.20	190	344	393.0	3.0074	1.3344	0.692408976	0.352499115	-0.7667570410	0.1710972223	0.00017	0.008987069	0.039408367	0.00004
NOAAseasia	1989	9	28	20.205	98.510	33	4.30	189	345	393.4	3.1219	1.4494	0.77689565	0.395510512	-0.6539911649	0.2218241546	0.00023	0.011676945	0.052976351	0.00005
NOAAseasia	1989	9	28	20.560	98.670	23	4.50	229	331	402.5	3.1789	1.5274	0.978053676	0.497918235	-0.6344199172	0.2320492039	0.00024	0.01309475	0.06030035	0.00006
USGSneic	1989	9	28	20.21	98.75	33	4.1	190	324	375.6	3.0219	1.3334	0.61711015	0.314165167	-0.6803385431	0.2087668108	0.00021	0.010165092	0.045293489	0.00005
USGSneic	1989	9	28	20.33	98.82	10	5.7	203	318	377.3	3.723	2.174	3.893701814	1.982248196	0.0099542835	1.0231852799	0.00104	0.069252823	0.395999243	0.00040
USGSneic	1989	9	28	20.2	98.51	33	4.3	189	345	393.4	3.1219	1.4494	0.77689565	0.395510512	-0.6539911649	0.2218241546	0.00023	0.011676945	0.052976351	0.00005
NOAAseasia	1989	9	29	20.294	99.285	10	3.90	199	278	341.9	2.823	1.13	0.490188016	0.249550263	-0.7372213105	0.1831380938	0.00019	0.008165523	0.035362418	0.00004
NOAAseasia	1989	9	30	20.440	98.790	10	4.80	216	321	386.9	3.273	1.652	1.381537537	0.703328201	-0.4768467407	0.3335440972	0.00034	0.01949003	0.094512256	0.00010
NOAAseasia	1989	9	30	20.356	98.782	10	4.80	206	321	381.4	3.273	1.652	1.381537537	0.703328201	-0.4541509826	0.3514382417	0.00036	0.020277723	0.098839758	0.00010
NOAAseasia	1989	9	30	20.349	98.821	24	4.90	205	318	378.4	3.3832	1.7632	1.550110612	0.789147221	-0.3317265753	0.4658793112	0.00047	0.026763574	0.135246126	0.00014
NOAAseasia	1989	9	30	20.460	98.710	33	5.30	218	328	393.8	3.6219	2.0294	2.456759757	1.250714058	-0.1574766839	0.6958623126	0.00071	0.044172009	0.238240877	0.00024
NOAAseasia	1989	9	30	19.400	98.600	0	6.00	100	337	351.5	3.83	2.31	5.5	2.8	0.2228317839	1.6704434729	0.00170	0.114190204	0.696819985	0.00071
NOAAseasia	1989	9	30	20.234	98.860	13	5.30	193	315	369.4	3.5359	1.9534	2.456759757	1.250714058	-0.1426756807	0.7199864436	0.00073	0.044221672	0.238543578	0.00024
NOAAseasia	1989	9	30	20.236	98.848	13	5.30	193	316	370.3	3.5359	1.9534	2.456759757	1.250714058	-0.1464255279	0.7137965953	0.00073	0.043932094	0.236779199	0.00024
NOAAseasia	1989	9	30	20.380	98.890	18	5.80	209	312	375.5	3.8074	2.2624	4.368805291	2.224119057	0.1012663691	1.2626016982	0.00129	0.085945924	0.505445774	0.00052
NOAAseasia	1989	9	30	20.120	98.940	48	5.60	180	308	356.7	3.8364	2.2604	3.470265395	1.766680565	0.2097921441	1.6210340753	0.00165	0.098299477	0.588278346	0.00060
NOAAseasia	1989	9	30	19.100	99.600	296	5.50	67	251	259.8	4.8528	3.1448	3.092877289	1.574555711	1.6536211803	45.0423644574	0.04591	1.614123247	13.89851699	0.01417
USGSneic	1989	9	30	20.35	98.82	23	4.9	206	318	378.9	3.3789	1.7594	1.550110612	0.789147221	-0.3380977147	0.4590947066	0.00047	0.026434544	0.133368772	0.00014
USGSneic	1989	9	30	20.24	98.85	13	5.6	193	315	369.4	3.6859	2.1274	3.470265395	1.766680565	0.0061422481	1.0142435351	0.00103	0.065922097	0.374545902	0.00038
NOAAseasia	1989	10	8	19.600	100.300	33	4.40	122	190	225.8	3.1719	1.5074	0.871691256	0.443770094	0.1391027150	1.3775352312	0.00140	0.050260103	0.275665495	0.00028
NOAAseasia	1989	10	8	20.220	99.192	10	4.20	191	286	343.9	2.973	1.304	0.692408976	0.352499115	-0.5960057061	0.2535095322	0.00026	0.012003915	0.054655626	0.00006
NOAAseasia	1989	10	8	20.195	99.230	10	4.40	188	283	339.8	3.073	1.42	0.871691256	0.443770094	-0.4787360466	0.3320962361	0.00034	0.01616627	0.076511919	0.00008
USGSneic	1989	10	8	20.19	99.23	10	4.4	188	283	339.8	3.073	1.42	0.871691256	0.443770094	-0.4787360466	0.3320962361	0.00034	0.01616627	0.076511919	0.00008
NOAAseasia	1989	10	9	19.306	98.963	71	3.90	90	306	319.0	3.0853	1.3618	0.490188016	0.249550263	-0.3761575249	0.4205740524	0.00043	0.016583252	0.078745685	0.00008
NOAAseasia	1989	10	11	20.327	98.618	10	3.90	203	335	391.7	2.823	1.13	0.490188016	0.249550263	-0.9455967241	0.1133452373	0.00012	0.005667217	0.02340496	0.00002
NOAAseasia	1989	10	15	22.104	101.390	10	3.90	400	96	411.4	2.823	1.13	0.490188016	0.249550263	-1.0259814464	0.0941929836	0.00010	0.004928019	0.019985718	0.00002
USGSneic	1989	10	15	22	101.72	10	4.5	389	67	394.7	3.123	1.478	0.978053676	0.497918235	-0.6584419627	0.2195624343	0.00022	0.012353367	0.056456955	0.00006
NOAAseasia	1989	11	11	21.100	99.800	0	4.50	289	233	371.2	3.08	1.44	0.978053676	0.497918235	-0.6043507604	0.2486847990	0.00025	0.013409416	0.061940279	0.00006
NOAAseasia	1990	1	7	20.133	98.815	47	4.20	181	318	365.9	3.1321	1.4446	0.692408976	0.352499115	-0.5297834678	0.2952681019	0.00030	0.014093518	0.065522721	0.00007
NOAAseasia	1990	1	7	20.142	98.752	50	4.30	182	324	371.6	3.195	1.514	0.77689565	0.395510512	-0.4907827271	0.3230109707	0.00033	0.015858507	0.074868029	0.00008
USGSneic	1990	1	7	20.14	98.75	49	4.3	182	324	371.6	3.1907	1.5102	0.77689565	0.395510512	-0.4950827271	0.3198285823	0.00033	0.015720353	0.074131434	0.00008
NOAAseasia	1990	1	10	20.100	99.700	0	5.90	178	242	300.4	3.78	2.252	4.90188016	2.495502627	0.3940705212	2.4778243764	0.00253	0.147879228	0.933243788	0.00095
NOAAseasia	1990	1	24	20.656	99.954	9	4.30	240	220	325.6	3.0187	1.3582	0.77689565	0.395510512	-0.4718194073	0.3374275920	0.00034	0.015623862	0.073617467	0.00008
NOAAseasia	1990	1	26	21.100	99.400	0	4.70	289	268	394.1	3.18	1.556	1.231296626	0.626841919	-0.5992611969	0.2516163182	0.00026	0.014842373	0.069470236	0.00007
NOAAseasia	1990	1	26	22.400	99.000	33	4.40	433	302	527.9	3.1719	1.5074	0.871691256	0.443770094	-1.1350681964	0.0732709468	0.00007	0.005354062	0.021948874	0.00002
NOAAseasia	1990	2	8	20.362	99.154	10	4.20	207	289	355.5	2.973	1.304	0.692408976	0.352499115	-0.6451846597	0.2263681597	0.00023	0.011008546	0.049562691	0.00005
NOAAseasia	1990	2	8	19.400	99.500	33	4.20	100	259	277.6	3.0719	1.3914	0.692408976	0.352499115	-0.2054013602	0.6231586673	0.00064	0.024673424	0.123372749	0.00013
NOAAseasia	1990	2	9	22.500	104.200	0	4.90	444	147	467.7	3.28	1.672	1.550110612	0.789147221	-0.7945043837	0.1605076057	0.00016	0.011638593	0.052779774	0.00005
NOAAseasia	1990	2	13	21.100	99.900	33	4.70	289	225	366.3	3.3219	1.6814	1.231296626	0.626841919	-0.3422943267	0.4546798136	0.00046	0.024222587	0.120828444	0.00012
NOAAseasia	1990	4	19	14.760	99.862	33	4.50	416	228	474.4	3.2219	1.5654	0.978053676	0.497918235	-0.8783391282	0.1323307798	0.00013	0.008709631	0.038036426	0.00004
NOAAseasia	1990	5	28	14.836	98.964	33	4.10	407	306	509.2	3.0219	1.3334	0.61711015	0.314165167	-1.2131144069	0.0612189101	0.00006	0.004053627	0.016027413	0.00002
NOAAseasia	1990	5	28	14.818	99.430	33	4.10	409	265	487.3	3.0219	1.3334	0.61711015	0.314165167	-1.1283460481	0.0744138804	0.00008	0.004685152	0.018876339	0.00002
NOAAseasia	1990	6	4	15.100	101.000	0	4.80	378	130	399.7	3.23	1.614	1.381537537	0.703328201	-0.5723326711	0.2677116858	0.00027	0.016296799	0.077210368	0.00008
NOAAseasia	1990	6	4	21.300	98.200	33	4.30	311	372	484.9	3.1219	1.4494	0.77689565	0.395510512	-1.0191474439	0.0956869157	0.00010	0.006217184	0.025987285	0.00003

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
NOAAseasia	1990	7	14	18.900	100.300	0	4.60	44	190	195.0	3.13	1.498	1.097394273	0.558673448	0.2525281772	1.7886615743	0.00182	0.065572678	0.372303309	0.00038
NOAAseasia	1990	7	14	19.600	100.900	33	4.60	122	138	184.2	3.2719	1.6234	1.097394273	0.558673448	0.4514306879	2.8276827851	0.00288	0.097363273	0.581951157	0.00059
NOAAseasia	1990	7	14	20.523	100.642	20	4.40	225	161	276.7	3.116	1.458	0.871691256	0.443770094	-0.1574751716	0.6958647358	0.00071	0.028966424	0.147890819	0.00015
NOAAseasia	1990	7	14	20.528	100.670	29	4.50	225	158	274.9	3.2047	1.5502	0.978053676	0.497918235	-0.0607171534	0.8695265488	0.00089	0.036344554	0.191115743	0.00019
USGSneic	1990	7	14	20.53	100.67	29	4.5	226	158	275.8	3.2047	1.5502	0.978053676	0.497918235	-0.0648316510	0.8613275707	0.00088	0.036076333	0.189522727	0.00019
NOAAseasia	1990	9	1	19.304	99.410	10	4.20	89	267	281.4	2.973	1.304	0.692408976	0.352499115	-0.3215913996	0.4768794418	0.00049	0.01955835	0.094886715	0.00010
NOAAseasia	1990	9	1	19.291	99.257	33	3.70	88	280	293.5	2.8219	1.1014	0.389370181	0.19822482	-0.5267838782	0.2973145216	0.00030	0.01113009	0.050181485	0.00005
USGSneic	1990	9	1	19.29	99.26	33	3.7	88	280	293.5	2.8219	1.1014	0.389370181	0.19822482	-0.5267838782	0.2973145216	0.00030	0.01113009	0.050181485	0.00005
NOAAseasia	1990	11	3	14.836	99.168	10	4.40	407	288	498.6	3.073	1.42	0.871691256	0.443770094	-1.1213108786	0.0756291329	0.00008	0.005304707	0.021720376	0.00002
NOAAseasia	1990	11	3	14.835	99.168	10	4.20	407	288	498.6	2.973	1.304	0.692408976	0.352499115	-1.2211549633	0.0600959267	0.00006	0.004062008	0.016064866	0.00002
NOAAseasia	1990	11	3	15.100	99.450	30	4.90	378	264	461.1	3.409	1.786	1.550110612	0.789147221	-0.6395526703	0.2293228496	0.00023	0.015822031	0.07467347	0.00008
NOAAseasia	1990	11	10	22.400	99.800	33	4.30	433	233	491.7	3.1219	1.4494	0.77689565	0.395510512	-1.0455858606	0.0900355744	0.00009	0.005942246	0.02469245	0.00003
NOAAseasia	1990	11	20	20.500	100.600	0	4.50	222	164	276.0	3.08	1.44	0.978053676	0.497918235	-0.1904453592	0.6449924646	0.00066	0.027945259	0.142013029	0.00014
NOAAseasia	1990	12	12	20.450	98.554	33	4.00	217	341	404.2	2.9719	1.2754	0.55	0.28	-0.8478868574	0.1419427263	0.00014	0.007246077	0.030897001	0.00003
NOAAseasia	1990	12	12	20.720	98.430	33	4.30	247	352	430.0	3.1219	1.4494	0.77689565	0.395510512	-0.8023524022	0.1576331658	0.00016	0.009026768	0.039605132	0.00004
USGSneic	1990	12	12	20.07	98.43	33	4.3	174	352	392.7	3.1219	1.4494	0.77689565	0.395510512	-0.6511192363	0.2232959076	0.00023	0.011735509	0.053276681	0.00005
NOAAseasia	1990	12	29	20.200	103.000	33	4.70	189	43	193.8	3.3219	1.6814	1.231296626	0.626841919	0.4503956919	2.8209519704	0.00288	0.101168143	0.607714319	0.00062
NOAAseasia	1991	1	3	22.800	98.200	33	4.30	478	372	605.7	3.1219	1.4494	0.77689565	0.395510512	-1.4780142606	0.0332648630	0.00003	0.002854033	0.010781237	0.00001
NOAAseasia	1991	1	23	21.300	98.200	33	5.30	311	372	484.9	3.6219	2.0294	2.456759757	1.250714058	-0.5206469942	0.3015456069	0.00031	0.023595494	0.117299686	0.00012
NOAAseasia	1991	3	5	22.996	102.196	33	4.40	500	26	500.7	3.1719	1.5074	0.871691256	0.443770094	-1.0305330169	0.0932109605	0.00010	0.006397903	0.026842475	0.00003
USGSneic	1991	3	5	23	102.2	33	5	500	26	500.7	3.4719	1.8554	1.739252713	0.885437745	-0.7312835610	0.1856591847	0.00019	0.014244758	0.06631782	0.00007
NOAAseasia	1991	10	6	21.384	104.231	10	4.50	320	150	353.4	3.123	1.478	0.978053676	0.497918235	-0.4866668186	0.3260867719	0.00033	0.016684838	0.079290992	0.00008
USGSneic	1991	10	6	21.38	104.23	10	4.5	320	150	353.4	3.123	1.478	0.978053676	0.497918235	-0.4866668186	0.3260867719	0.00033	0.016684838	0.079290992	0.00008
NOAAseasia	1991	10	11	21.926	105.213	10	4.10	381	234	447.1	2.923	1.246	0.61711015	0.314165167	-1.0693036919	0.0852503770	0.00009	0.00502447	0.02042829	0.00002
USGSneic	1991	10	11	21.93	105.21	10	4.1	381	234	447.1	2.923	1.246	0.61711015	0.314165167	-1.0693036919	0.0852503770	0.00009	0.00502447	0.02042829	0.00002
USGSneic	1991	11	5	19.03	97.95	10	3.9	59	393	397.4	2.823	1.13	0.490188016	0.249550263	-0.9689632296	0.1074080348	0.00011	0.00544126	0.022353238	0.00002
NOAAseasia	1992	3	28	21.328	98.668	33	4.20	314	331	456.2	3.0719	1.3914	0.692408976	0.352499115	-0.9565139425	0.1105314984	0.00011	0.006599473	0.027800044	0.00003
NOAAseasia	1992	4	10	21.818	98.861	33	3.90	369	314	484.5	2.9219	1.2174	0.490188016	0.249550263	-1.2173329523	0.0606271353	0.00006	0.00365496	0.014257958	0.00001
NOAAseasia	1992	4	23	22.437	98.904	12	5.80	437	311	536.4	3.7816	2.2396	4.368805291	2.224119057	-0.5606116310	0.2750352564	0.00028	0.027259269	0.138080086	0.00014
NOAAseasia	1992	4	23	22.330	98.880	33	6.20	426	313	528.6	4.0719	2.5514	6.924089765	3.524991153	-0.2426790117	0.5719011743	0.00058	0.058638971	0.328133498	0.00033
NOAAseasia	1992	4	23	22.418	98.852	10	5.90	435	315	537.1	3.823	2.29	4.90188016	2.495502627	-0.5223007931	0.3003995010	0.00031	0.030460125	0.156536925	0.00016
NOAAseasia	1992	4	23	22.480	98.860	33	6.20	442	315	542.8	4.0719	2.5514	6.924089765	3.524991153	-0.2966447688	0.5050742541	0.00051	0.053499403	0.295824605	0.00030
NOAAseasia	1992	4	23	22.270	98.910	33	5.10	419	310	521.2	3.5219	1.9134	1.951473641	0.99347749	-0.7603274530	0.1736491041	0.00018	0.014228809	0.066233922	0.00007
NOAAseasia	1992	4	23	22.309	98.856	33	4.70	423	315	527.4	3.3219	1.6814	1.231296626	0.626841919	-0.9834528711	0.1038836329	0.00011	0.008015747	0.034630337	0.00004
NOAAseasia	1992	4	23	22.246	99.290	33	4.20	416	277	499.8	3.0719	1.3914	0.692408976	0.352499115	-1.1268974949	0.0746624961	0.00008	0.004928305	0.019987029	0.00002
NOAAseasia	1992	4	23	22.180	98.830	33	5.10	409	317	517.5	3.5219	1.9134	1.951473641	0.99347749	-0.7461449827	0.1794134582	0.00018	0.014576616	0.068066289	0.00007
NOAAseasia	1992	4	23	22.303	98.997	33	4.80	423	303	520.3	3.3719	1.7394	1.381537537	0.703328201	-0.9064054672	0.1240493614	0.00013	0.009593112	0.042424256	0.00004
NOAAseasia	1992	4	28	22.430	98.935	33	4.60	437	308	534.6	3.2719	1.6234	1.097394273	0.558673448	-1.0608195339	0.0869321591	0.00009	0.006694489	0.028252748	0.00003
NOAAseasia	1992	4	28	22.730	98.910	33	4.90	470	310	563.0	3.4219	1.7974	1.550110612	0.789147221	-1.0188024968	0.0957629471	0.00010	0.008323065	0.036134339	0.00004
NOAAseasia	1992	5	5	22.590	98.230	33	3.90	454	369	585.0	2.9219	1.2174	0.490188016	0.249550263	-1.6006196213	0.0250830520	0.00003	0.001905719	0.006830721	0.00001
NOAAseasia	1993	1	26	22.950	101.150	33	5.70	494	117	507.7	3.8219	2.2614	3.893701814	1.982248196	-0.4101251893	0.3889330154	0.00040	0.034570089	0.180605743	0.00018
NOAAseasia	1993	1	26	22.930	101.310	32	4.60	492	103	502.7	3.2676	1.6196	1.097394273	0.558673448	-0.9427559169	0.1140890813	0.00012	0.008173513	0.035401517	0.00004
NOAAseasia	1993	1	26	22.956	101.710	33	4.50	495	68	499.6	3.2219	1.5654	0.978053676	0.497918235	-0.9763718054	0.1055913141	0.00011	0.007364529	0.031468337	0.00003
NOAAseasia	1993	1	27	22.950	101.700	32	4.70	494	69	498.8	3.3176	1.6776	1.231296626	0.626841919	-0.8777971874	0.1324960138	0.00014	0.009583588	0.042376665	0.00004
NOAAseasia	1993	1	27	22.910	100.979	33	4.70	490	131	507.2	3.3219	1.6814	1.231296626	0.626841919	-0.9059322758	0.1241845947	0.00013	0.009147119	0.040202338	0.00004
NOAAseasia	1993	3	29	21.830	103.400	32	4.60	370	78	378.1	3.2676	1.6196	1.097394273	0.558673448	-0.4455653443	0.3584550108	0.00037	0.019282001	0.093373118	0.00010
NOAAseasia	1993	3	29	21.868	103.990	33	4.60	374	129	395.6	3.2719	1.6234	1.097394273	0.558673448	-0.5133593478	0.3066483641	0.00031	0.017152634	0.081807635	0.00008
NOAAseasia	1993	3	29	22.800	102.960	33	5.00	478	40	479.7	3.4719	1.8554	1.739252713	0.885437745	-0.6497414963	0.2240054082	0.00023	0.016376813	0.077638871	0.00008
USGSneic	1993	3	29	21.87	103.1	33	4.6	374	52	377.6	3.2719	1.6234	1.097394273	0.558673448	-0.4391923169	0.3637539208	0.00037	0.019522073	0.094687861	0.00010
NOAAseasia	1993	3	30	21.960	103.110	33	4.50	384	53	387.6	3.2219	1.5654	0.978053676	0.497918235	-0.5303782686	0.2948639855	0.00030	0.015894932	0.075062378	0.00008
NOAAseasia	1993	3	30	21.883	103.740	33	4.40	376	107	390.9	3.1719	1.5074	0.871691256	0.443770094	-0.5938330514	0.2547809476	0.00026	0.013584435	0.062854587	0.00006
USGSneic	1993	3	30	21.88	103.07	33	4.4	376	49	379.2	3.1719	1.5074	0.871691256	0.443770094	-0.5455655234	0.2847308185	0.00029	0.014778274	0.069131313	0.00007
NOAAseasia	1993	6	11	22.929	99.120	33	4.40	492	292	572.1	3.1719	1.5074	0.871691256	0.443770094	-1.3025331654	0.0498272403	0.00005	0.004030801	0.015925467	0.00002
NOAAseasia	1993	9	19	22.170	101.900	30	4.20	408	52	411.3	3.059	1.38	0.692408976	0.352499115	-0.7897892142	0.1622597438	0.00017	0.008767368	0.038321478	0.00004
NOAAseasia	1993	9	19	22.131	101.943	33	4.40	403	48	405.8	3.1719	1.5074	0.871691256	0.443770094	-0.6547439419	0.2214399925	0.00023	0.01221837	0.055760289	0.00006
USGSneic	1993	9	19	22.13	101.94	33	4.8	403	48	405.8	3.3719	1.7394	1.381537537	0.703328201	-0.4552880780	0.3505192890	0.00036	0.020832236	0.101899384	0.00010
NOAAseasia	1993	10	23	21.530	104.850	14	4.40	337	203	393.4	3.0902	1.4352	0.871691256	0.443770094	-0.6857955958	0.2061599994	0.00021	0.011299937	0.051047667	0.00005
NOAAseasia	1993	10	23	21.540	104.872	33	4.10	338	205	395.3	3.0219	1.3334	0.61711015	0.314165167	-0.7616042708	0.1731393286	0.00018	0.00882121	0.038587517	0.00004
USGSneic	1993	10	23	21.54	104.87	33	4.2	338	205	395.3	3.0719	1.3914	0.692408976	0.352499115	-0.7116868607	0.1942285819	0.00020	0.010080593	0.044868265	0.00005
NOAAseasia	1993	12	21	22.217	103.250	10	4.30	413	65	418.1	3.023	1.362	0.77689565	0.395510512	-0.8533864063	0.1401566130	0.00014	0.008018797	0.034645225	0.00004
NOAAseasia	1993	12	21	22.520	103.450	15	4.30	447	82	454.5	3.0445	1.381	0.77689565	0.395510512	-0.9772756113	0.1053717975	0.00011	0.00651761	0.027410682	0.00003

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
USGSneic	1993	12	21	22.22	103.25	10	4.5	413	65	418.1	3.123	1.478	0.978053676	0.497918235	-0.7535949182	0.1763620270	0.00018	0.010471356	0.046838537	0.00005
NOAAseasia	1994	5	7	18.343	99.174	33	3.60	17	287	287.5	2.7719	1.0434	0.347026539	0.176668056	-0.5497617476	0.2819929511	0.00029	0.010221046	0.045575323	0.00005
USGSneic	1994	5	7	18.34	99.17	33	3.6	18	288	288.6	2.7719	1.0434	0.347026539	0.176668056	-0.5547182296	0.2787929391	0.00028	0.010130664	0.04512018	0.00005
NOAAseasia	1994	9	11	19.586	99.516	33	5.10	121	258	285.0	3.5219	1.9134	1.951473641	0.99347749	0.2090915406	1.6184211325	0.00165	0.077098135	0.447053578	0.00046
USGSneic	1994	9	11	19.59	99.52	33	5.2	121	258	285.0	3.5719	1.9714	2.189589438	1.114700078	0.2587313072	1.8143927725	0.00185	0.088076455	0.519626877	0.00053
NOAAseasia	1994	9	23	22.166	98.520	33	4.50	407	344	532.9	3.2219	1.5654	0.978053676	0.497918235	-1.1042420685	0.0786607226	0.00008	0.005923095	0.024602544	0.00003
NOAAseasia	1995	2	18	22.943	99.482	33	4.80	494	261	558.7	3.3719	1.7394	1.381537537	0.703328201	-1.0524512569	0.0886234685	0.00009	0.007486433	0.032057577	0.00003
NOAAseasia	1995	4	24	22.736	102.906	33	4.70	471	35	472.3	3.3219	1.6814	1.231296626	0.626841919	-0.7703486877	0.1696880709	0.00017	0.011534693	0.052247657	0.00005
USGSneic	1995	4	24	22.74	102.91	33	5.2	471	35	472.3	3.5719	1.9714	2.189589438	1.114700078	-0.5212266882	0.3011433739	0.00031	0.022467682	0.110984118	0.00011
USGSneic	1995	5	29	18.9	97.8	33	4	44	406	408.4	2.9719	1.2754	0.55	0.28	-0.8649702125	0.1364676734	0.00014	0.007034231	0.029878224	0.00003
NOAAseasia	1995	6	21	20.106	103.238	10	4.20	178	64	189.2	2.973	1.304	0.692408976	0.352499115	0.1268923960	1.3393448004	0.00137	0.044449869	0.239935024	0.00024
NOAAseasia	1995	6	21	20.349	103.252	33	4.40	205	65	215.1	3.1719	1.5074	0.871691256	0.443770094	0.1922031708	1.5566937106	0.00159	0.055419745	0.307851244	0.00031
USGSneic	1995	6	21	20.11	103.24	10	4.2	179	64	190.1	2.973	1.304	0.692408976	0.352499115	0.1221389085	1.3247651917	0.00135	0.044056838	0.237539072	0.00024
USGSneic	1995	6	21	20.35	103.25	33	4.4	206	65	216.0	3.1719	1.5074	0.871691256	0.443770094	0.1876971337	1.5406256838	0.00157	0.054961036	0.304973461	0.00031
NOAAseasia	1995	6	29	21.925	98.943	33	4.90	381	307	489.3	3.4219	1.7974	1.550110612	0.789147221	-0.7369488932	0.1832530058	0.00019	0.013443889	0.062120244	0.00006
NOAAseasia	1995	7	9	21.984	99.159	10	5.70	387	289	483.0	3.723	2.174	3.893701814	1.982248196	-0.4134341568	0.3859809256	0.00039	0.033286962	0.173049281	0.00018
NOAAseasia	1995	7	9	21.725	99.860	10	5.00	358	228	424.4	3.373	1.768	1.739252713	0.885437745	-0.5297515400	0.2952898098	0.00030	0.019521783	0.094686273	0.00010
NOAAseasia	1995	7	9	21.885	99.116	10	4.90	376	292	476.1	3.323	1.71	1.550110612	0.789147221	-0.7844098827	0.1642820514	0.00017	0.012005564	0.054664112	0.00006
NOAAseasia	1995	7	10	21.984	99.119	10	4.70	387	292	484.8	3.223	1.594	1.231296626	0.626841919	-0.9180642353	0.1207635204	0.00012	0.008675134	0.037866235	0.00004
NOAAseasia	1995	7	11	21.966	99.196	13	6.10	385	286	479.6	3.9359	2.4174	6.171101499	3.141651672	-0.1893316751	0.6466485751	0.00066	0.059495652	0.333555655	0.00034
NOAAseasia	1995	7	11	22.690	100.990	10	4.20	466	130	483.8	2.973	1.304	0.692408976	0.352499115	-1.1636869769	0.0685982479	0.00007	0.004481442	0.017951558	0.00002
NOAAseasia	1995	7	11	21.808	98.945	10	4.50	368	307	479.2	3.123	1.478	0.978053676	0.497918235	-0.9960023069	0.1009247525	0.00010	0.006896554	0.02921826	0.00003
NOAAseasia	1995	7	11	21.467	98.548	10	4.40	330	342	475.3	3.073	1.42	0.871691256	0.443770094	-1.0306635727	0.0931829440	0.00009	0.006194794	0.025881556	0.00003
NOAAseasia	1995	7	12	21.123	99.340	10	4.20	291	273	399.0	2.973	1.304	0.692408976	0.352499115	-0.8257259001	0.1493736867	0.00015	0.00802867	0.034693432	0.00004
NOAAseasia	1995	7	12	21.886	99.157	10	4.30	376	289	474.2	3.023	1.362	0.77689565	0.395510512	-1.0762724847	0.0838933458	0.00009	0.005461053	0.022445139	0.00002
NOAAseasia	1995	7	12	22.410	99.309	10	4.20	434	276	514.3	2.973	1.304	0.692408976	0.352499115	-1.2817008276	0.0522756176	0.00005	0.003663413	0.014295228	0.00001
NOAAseasia	1995	7	12	21.841	99.161	10	4.30	371	289	470.3	3.023	1.362	0.77689565	0.395510512	-1.0609918044	0.0868976828	0.00009	0.005606088	0.023119889	0.00002
USGSneic	1995	7	12	21.12	99.03	10	4.1	291	300	417.9	2.923	1.246	0.61711015	0.314165167	-0.9524132179	0.1115801092	0.00011	0.006148954	0.025665246	0.00003
NOAAseasia	1995	7	14	21.806	99.115	10	4.60	367	293	469.6	3.173	1.536	1.097394273	0.558673448	-0.9085417941	0.1234406517	0.00013	0.008405345	0.036538252	0.00004
NOAAseasia	1995	7	18	21.844	99.380	10	4.00	372	270	459.7	2.873	1.188	0.55	0.28	-1.1690937972	0.0677495169	0.00007	0.004035163	0.015944944	0.00002
NOAAseasia	1995	7	18	22.500	99.138	10	4.80	444	291	530.9	3.273	1.652	1.381537537	0.703328201	-1.0458414027	0.0899826123	0.00009	0.007321706	0.031261651	0.00003
NOAAseasia	1995	7	23	22.150	98.907	10	4.40	406	311	511.4	3.073	1.42	0.871691256	0.443770094	-1.1707003569	0.0674993581	0.00007	0.004875987	0.019747436	0.00002
NOAAseasia	1995	7	30	21.987	99.520	33	4.10	387	258	465.1	3.0219	1.3334	0.61711015	0.314165167	-1.0415221939	0.0908819854	0.00009	0.005437013	0.022333524	0.00002
NOAAseasia	1995	8	7	21.931	99.218	33	4.10	381	284	475.2	3.0219	1.3334	0.61711015	0.314165167	-1.0811400550	0.0829583193	0.00008	0.005079682	0.020682131	0.00002
NOAAseasia	1995	8	10	21.965	99.147	39	4.00	385	290	482.0	2.9977	1.2982	0.55	0.28	-1.1318423200	0.0738172191	0.00008	0.00447611	0.017927422	0.00002
NOAAseasia	1995	8	18	21.574	99.373	33	3.90	342	270	435.7	2.9219	1.2174	0.490188016	0.249550263	-1.0248758920	0.0944330698	0.00010	0.005088195	0.020721303	0.00002
USGSneic	1995	8	18	21.57	99.37	33	3.9	341	270	434.9	2.9219	1.2174	0.490188016	0.249550263	-1.0216786375	0.0951308468	0.00010	0.005116364	0.020850979	0.00002
NOAAseasia	1995	8	29	22.560	99.116	33	3.80	451	292	537.3	2.8719	1.1594	0.436880529	0.222411906	-1.4705698235	0.0338399861	0.00003	0.002261536	0.008288499	0.00001
USGSneic	1995	11	9	22.06	102.72	33	4.7	396	19	396.5	3.3219	1.6814	1.231296626	0.626841919	-0.4671897660	0.3410438591	0.00035	0.019474699	0.094428253	0.00010
USGSneic	1995	12	9	18.38	100.4	10	4.7	13	181	181.5	3.223	1.594	1.231296626	0.626841919	0.4166870641	2.6102798093	0.00266	0.093460057	0.555657817	0.00057
USGSneic	1995	12	21	19.46	99.07	41	4.5	107	296	314.7	3.2563	1.5958	0.978053676	0.497918235	-0.1870443903	0.6500632425	0.00066	0.029364098	0.150187167	0.00015
USGSneic	1996	2	2	22.13	103.18	33	4.3	403	59	407.3	3.1219	1.4494	0.77689565	0.395510512	-0.7107420067	0.1946516069	0.00020	0.010579474	0.047385384	0.00005
USGSneic	1996	4	9	20.28	98.72	33	4	198	327	382.3	2.9719	1.2754	0.55	0.28	-0.7580286514	0.1745706981	0.00018	0.008473791	0.036874645	0.00004
USGSneic	1996	4	27	22.35	102.22	33	3.7	428	24	428.7	2.8219	1.1014	0.389370181	0.19822482	-1.0967477559	0.0800298944	0.00008	0.00408927	0.016186751	0.00002
USGSneic	1996	9	28	19.53	102.62	33	4.8	114	10	114.4	3.3719	1.7394	1.381537537	0.703328201	0.9650606875	9.2270035448	0.00941	0.281521857	1.931740095	0.00197
USGSneic	1996	11	13	22.35	102.76	33	4.3	428	22	428.6	3.1219	1.4494	0.77689565	0.395510512	-0.7967386718	0.1596839725	0.00016	0.009114802	0.040041874	0.00004
USGSneic	1996	12	21	20.34	100.47	33	4.7	204	175	268.8	3.3219	1.6814	1.231296626	0.626841919	0.0840858982	1.2136288678	0.00124	0.05168436	0.284508881	0.00029
USGSneic	1997	1	25	22.07	101.13	33	4.5	397	118	414.2	3.2219	1.5654	0.978053676	0.497918235	-0.6389343886	0.2296495567	0.00023	0.013160371	0.060641928	0.00006
USGSneic	1997	1	30	22.5	101.32	10	5	444	102	455.6	3.373	1.768	1.739252713	0.885437745	-0.6540384778	0.2217999900	0.00023	0.015753355	0.074307315	0.00008
USGSneic	1997	9	21	20.87	98.49	33	4.2	263	347	435.4	3.0719	1.3914	0.692408976	0.352499115	-0.8738785270	0.1336969417	0.00014	0.00760957	0.032654041	0.00003
USGSneic	1997	11	19	22.03	101.71	33	3.8	392	68	397.9	2.8719	1.1594	0.436880529	0.222411906	-0.9220505180	0.1196601332	0.00012	0.005802075	0.024035281	0.00002
USGSneic	1998	5	23	19.38	98.76	33	4	98	323	337.5	2.9719	1.2754	0.55	0.28	-0.5695809403	0.2694133175	0.00027	0.01179685	0.053591468	0.00005
USGSneic	1999	3	31	19.53	101.64	10	4.5	114	74	135.9	3.123	1.478	0.978053676	0.497918235	0.5789661788	3.7928544655	0.00387	0.117867008	0.722226221	0.00074
USGSneic	1999	6	28	21.41	99.48	33	4.8	323	261	415.3	3.3719	1.7394	1.381537537	0.703328201	-0.4938042580	0.3207714756	0.00033	0.019485125	0.094485379	0.00010
USGSneic	1999	7	15	21.42	99.35	33	4.8	324	272	423.0	3.3719	1.7394	1.381537537	0.703328201	-0.5248564819	0.2986369339	0.00030	0.018464524	0.088912348	0.00009
USGSneic	2000	1	19	19.83	101.29	33	5.4	148	105	181.5	3.6719	2.0874	2.756529785	1.403324254	0.8619771124	7.2774145113	0.00742	0.289853401	1.996464505	0.00204
USGSneic	2001	2	19	21.4	102.71	10	4.9	322	18	322.5	3.323	1.71	1.550110612	0.789147221	-0.1551121740	0.6996612570	0.00071	0.035926001	0.188630549	0.00019
USGSneic	2001	2	19	21.29	102.88	10	4	310	33	311.8	2.873	1.188	0.55	0.28	-0.5570415103	0.2773055041	0.00028	0.011752603	0.053364383	0.00005
USGSneic	2001	3	4	21.36	102.93	10	4.7	318	37	320.1	3.223	1.594	1.231296626	0.626841919	-0.2442530265	0.5698321828	0.00058	0.028032685	0.142515172	0.00015
USGSneic	2001	3	12	22.28	99.95	33	4.5	420	220	474.1	3.2219	1.5654	0.978053676	0.497918235	-0.8771649686	0.1326890337	0.00014	0.008727185	0.038123065	0.00004
USGSneic	2001	4	2	22.12	103.16	33	4.4	402	57	406.0	3.1719	1.5074	0.871691256	0.443770094	-0.6555574742	0.2210255734	0.00023	0.012201115	0.055671313	0.00006

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※1	※1'		※2	※2				※3	※4	※3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)
USGSneic	2001	6	4	21.89	102.54	10	4.6	377	3	377.0	3.173	1.536	1.097394273	0.558673448	-0.5356036844	0.2913374507	0.00030	0.016033028	0.075799714	0.00008
USGSneic	2001	8	25	20.75	98.43	33	4.4	250	352	431.7	3.1719	1.5074	0.871691256	0.443770094	-0.7592580945	0.1740772052	0.00018	0.010194636	0.045442275	0.00005
USGSneic	2001	11	11	19.5	99.87	33	4.4	111	227	252.7	3.1719	1.5074	0.871691256	0.443770094	0.0096992327	1.0225845640	0.00104	0.039685582	0.211083854	0.00022
USGSneic	2001	11	28	22.46	103.06	33	4	440	48	442.6	2.9719	1.2754	0.55	0.28	-1.0024507536	0.0994372823	0.00010	0.005545158	0.022836142	0.00002
USGSneic	2002	1	19	21.32	101.49	33	4.4	313	87	324.9	3.1719	1.5074	0.871691256	0.443770094	-0.3157133425	0.4833777518	0.00049	0.022144073	0.10917947	0.00011
USGSneic	2002	4	12	22.36	102.64	10	4.5	429	12	429.2	3.123	1.478	0.978053676	0.497918235	-0.7982482503	0.1591298853	0.00016	0.009692521	0.042921365	0.00004
USGSneic	2002	7	2	19.69	100.79	33	4.5	132	148	198.3	3.2219	1.5654	0.978053676	0.497918235	0.3275405272	2.1258887180	0.00217	0.074197311	0.428093496	0.00044
USGSneic	2002	12	18	19.19	98.96	40	4.3	77	306	315.5	3.152	1.476	0.77689565	0.395510512	-0.2945674674	0.5074958937	0.00052	0.022154224	0.109236027	0.00011
USGSneic	2003	4	3	20.64	103.17	10	4.7	238	58	245.0	3.223	1.594	1.231296626	0.626841919	0.0966567480	1.2492712571	0.00127	0.05172782	0.284779235	0.00029
USGSneic	2003	11	23	20.53	101.03	37	4.6	226	127	259.2	3.2891	1.6386	1.097394273	0.558673448	0.0960301794	1.2474701987	0.00127	0.050772663	0.278844341	0.00028
USGSneic	2004	3	27	18.49	100.8	13	3.8	1	147	147.0	2.7859	1.0834	0.436880529	0.222411906	0.1762938665	1.5006999446	0.00153	0.041824049	0.223981145	0.00023
USGSneic	2005	1	25	22.53	100.71	12	4.8	448	155	474.1	3.2816	1.6596	1.381537537	0.703328201	-0.8178336584	0.1521130035	0.00016	0.01083643	0.048687946	0.00005
USGSneic	2005	8	17	21.11	99.74	20	4.3	290	239	375.8	3.066	1.4	0.77689565	0.395510512	-0.6372536710	0.2305400213	0.00024	0.011830045	0.053761902	0.00005
USGSneic	2005	9	26	22.5	102.18	10	4	444	28	444.9	2.873	1.188	0.55	0.28	-1.1104989633	0.0775355794	0.00008	0.004463385	0.017869842	0.00002
USGSneic	2006	10	31	22.13	101.09	23	4.2	403	122	421.1	3.0289	1.3534	0.692408976	0.352499115	-0.8594987594	0.1381978353	0.00014	0.007699302	0.033089488	0.00003
USGSneic	2006	11	23	22.66	102.38	10	4.5	462	10	462.1	3.123	1.478	0.978053676	0.497918235	-0.9289541993	0.1177730170	0.00012	0.007737423	0.033274677	0.00003
USGSneic	2006	12	12	18.9	98.92	9	4.6	44	309	312.1	3.1687	1.5322	1.097394273	0.558673448	-0.2634181402	0.5452326565	0.00056	0.025877929	0.130199812	0.00013
USGSneic	2007	5	2	20.73	103.13	10	4.5	248	54	253.8	3.123	1.478	0.978053676	0.497918235	-0.0445620156	0.9024808275	0.00092	0.036733067	0.193425902	0.00020
USGSneic	2007	5	15	20.41	100.8	10	4.3	212	147	258.0	3.023	1.362	0.77689565	0.395510512	-0.1639254987	0.6856058291	0.00070	0.027146575	0.137435204	0.00014
USGSneic	2007	5	16	20.5	100.73	9	6.3	222	153	269.6	4.0187	2.5182	7.768956495	3.955105125	0.7668421474	5.8457756962	0.00596	0.348301365	2.457023718	0.00250
USGSneic	2007	5	16	20.41	100.82	10	4	212	145	256.8	2.873	1.188	0.55	0.28	-0.3079241726	0.4921254528	0.00050	0.018379416	0.088449388	0.00009
USGSneic	2007	5	16	20.02	100.59	10	4	169	165	236.2	2.873	1.188	0.55	0.28	-0.2098899877	0.6167512130	0.00063	0.021968762	0.108203251	0.00011
USGSneic	2007	5	16	20.45	100.93	10	4.1	217	136	256.1	2.923	1.246	0.61711015	0.314165167	-0.2547548153	0.5562181864	0.00057	0.02112798	0.103535557	0.00011
USGSneic	2007	5	17	20.47	100.69	10	4	219	156	268.9	2.873	1.188	0.55	0.28	-0.3641781879	0.4323364101	0.00044	0.016601878	0.078845634	0.00008
USGSneic	2007	5	18	20.56	100.61	10	3.9	229	163	281.1	2.823	1.13	0.490188016	0.249550263	-0.4699175178	0.3389085163	0.00035	0.013138742	0.060529316	0.00006
USGSneic	2007	6	2	22.85	101.2	5	4.1	483	112	495.8	2.9015	1.227	0.61711015	0.314165167	-1.2817467420	0.0522700912	0.00005	0.003465919	0.013427488	0.00001
USGSneic	2007	6	7	20.54	100.79	10	4.6	227	148	271.0	3.173	1.536	1.097394273	0.558673448	-0.0747243828	0.8419292874	0.00086	0.036319204	0.190965117	0.00019
USGSneic	2007	6	23	21.5	99.84	16	4.3	333	230	404.7	3.0488	1.3848	0.77689565	0.395510512	-0.7732661129	0.1685519911	0.00017	0.009286297	0.040894236	0.00004
USGSneic	2007	6	23	21.47	99.78	22	5.6	330	235	405.1	3.7246	2.1616	3.470265395	1.766680565	-0.1019667567	0.7907391532	0.00081	0.055201118	0.306479265	0.00031
USGSneic	2007	6	23	21.55	99.91	12	5.4	339	224	406.3	3.5816	2.0076	2.756529785	1.403324254	-0.2490833297	0.5635295189	0.00057	0.038428705	0.203545261	0.00021
USGSneic	2007	6	23	21.35	99.99	10	4.3	317	217	384.2	3.023	1.362	0.77689565	0.395510512	-0.7150346662	0.1927371061	0.00020	0.010199897	0.045468774	0.00005
USGSneic	2007	10	16	20.53	100.71	10	4.6	226	155	274.0	3.173	1.536	1.097394273	0.558673448	-0.0884864768	0.8156681853	0.00083	0.035429484	0.185687325	0.00019
USGSneic	2007	11	1	20.46	100.78	32	4.7	218	149	264.1	3.3176	1.6776	1.231296626	0.626841919	0.1015115207	1.2633146157	0.00129	0.053284638	0.294483037	0.00030
USGSneic	2008	3	2	22.42	102.35	10	4	436	13	436.2	2.873	1.188	0.55	0.28	-1.0758329137	0.0839783015	0.00009	0.004738443	0.019119137	0.00002
USGSneic	2008	6	10	20.56	100.82	35	4.4	229	145	271.0	3.1805	1.515	0.871691256	0.443770094	-0.0668639889	0.8573062920	0.00087	0.034619447	0.180897155	0.00018
USGSneic	2008	7	1	19.29	99.35	10	3.7	88	272	285.9	2.723	1.014	0.389370181	0.19822482	-0.5915052231	0.2561502457	0.00026	0.009675754	0.042837475	0.00004
USGSneic	2008	11	29	20.53	100.74	35	4.3	226	152	272.4	3.1305	1.457	0.77689565	0.395510512	-0.1231439654	0.7531058733	0.00077	0.029947652	0.153564186	0.00016
USGSneic	2009	1	20	22.23	101.39	11	4	414	96	425.0	2.8773	1.1918	0.55	0.28	-1.0266505949	0.0940479655	0.00010	0.005165651	0.021078092	0.00002

DATA (within 500km, M>3)								calculation												
								horizontal distance			Shi et Midorikawa,1999								& Japan Cabinet Office, 1997	
								※ 1	※1'		※ 2	※ 2				※ 3	※ 4	※ 3		※4
source	Year	Month	Day	Latitude	Longitude	Depth (Km)	Magnitude	ΔLatitude (km)	Δ Longitude (km)	distance (Km)	b(acc)=a*M+h*D+d+e (intra)	b(vel)=a*M+h*D+d+e (intra)	c(acc)=0.0055*10^(0.50*M	c(vel)=0.0028*10^(0.50*M	logA(gal)	A(gal)=10^(b-Log(X+c)-k*X) A(gal)=Max acceleration b=b(acc), c=c(acc)		A(kine)=10^(b-Log(X+c)-k*X) A(kine)=Max velocity	A'(gal)=10^0.908*A(vel)^1.13	
						D	M			X	b(acc)	b(vel)	c(acc)	c(vel)		A (gal)	A(G)	A (kine)	A' (gal)	A' (G)

※ 1	Latitude (degree)=	111.111 X (km)	(40,000km/360deg)
※ 1	Longitude (degree)=	86.420 X (km)	(40,000km/360deg*(90-20)/90)

※ 2

	a	h	d (crustal)	d (Inter plate)	d (Intra plate)	e
Max acceleration (gal)	0.5	0.0043	0	0.01	0.22	0.61
Max velocity (kine)	0.58	0.0038	0	-0.02	0.12	-1.29

※ 3

	k
Max acceleration (gal)	0.003
Max velocity (kine)	0.002

※ 4 A' (g)= A (gal) / 981

※5

	Cd	Cm	Ch	C0
Max acceleration (gal)	2.136	0.606	0.00459	1.73
Max velocity (kine)	1.918	0.725	0.00318	-0.519