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APPENDICES

APPENDIX A

SHEAR WAVE VELOCITIES FROM MASWM

Table A-1 **Shear wave velocity profiles from MASWM at seven sites**

Depth	Vs (m/s)													
	CU		TMD		AIT		KirdKao		TMD KAN		CMU		CMJD	
(m)	$z=\lambda/2$	$z=\lambda/3$	$z=\lambda/2$	$z=\lambda/3$	$z=\lambda/2$	$z=\lambda/3$	$z=\lambda/2$	$z=\lambda/3$	$z=\lambda/2$	$z=\lambda/3$	$z=\lambda/2$	$z=\lambda/3$	$z=\lambda/2$	$z=\lambda/3$
1				88						207		291		190
2			86	82		91		351	207	204	296	321	194	215
3		105	82	82	91	85	351	347	204	204	324	351	216	253
4	105	105	81	86	87	83	352	343	203	208	343	386	245	262
5	105	104	82	87	83	90	342	370	206	212	363	409	259	246
6	105	106	87	87	84	96	344	397	208	219	386	421	261	248
7	104	110	87	96	86	97	361	431	210	229	402	430	250	255
8	105	121	90	96	96	113	380	460	213	238	414	449	242	260
9	107	124	91	104	96	127	400	486	218	250	420	483	247	262
10	108	126	96	116	93	142	423		224	263	427	512	253	256
11	113	128	96	127	103	157	442		231	273	435	544	257	252
12	122	137	96	139	113	172	460		238	283	449	579	261	245
13	124	148	103	151	123	186	477		246	294	467	610	262	237
14	124	158	110	163	132	198	490		254	304	491	647	261	
15	126	168	116	173	140	212			263	317	512	693	257	
16	127	179	124	182	152	230			271	331	532		252	
17	130	181	133	196	160	243			276	343	558		252	
18	137	183	140	207	170	262			284	353	583		245	

19	144	184	145	218	180	264			289	363	604		238	
20	152	189	153	229	190	264			299	368	622		235	
21	158	199	161		198	269			306		651			
22	165	208	169		209	272			314		685			
23	174	217	177		218	276			322		709			
24	179	225	184		226	281			331					
25	181	234	192		234	284			339					
26	183	244	198		243	286			346					
27	183	254	207		254	291			351					
28	183	264	215		260	294			358					
29	185	274	222		263	300			365					
30	189	284	229		264	307			368					
31	195	293			267									
32	200	302			271									
33	208	310			272									
34	214	322			275									
35	221	328			276									
36	227	340			281									
37	234	348			286									
38	241	360			283									
39	245	369			286									
40	251				289									
41	257				291									
42	264				294									
43	270				298									
44	278				302									

45	284				307									
46	290													
47	295													
48	302													
49	307													
50	314													
51	322													
52	328													
53	336													
54	340													
55	348													
56	353													
57	358													
58	363													
59	369													

APPENDIX B

DOWNHOLE TEST AND BORING LOG RESULTS

Table B-1 **Shear wave velocities from downhole test at seven sites**

Depth	Vs (m/s)						
(m)	CU	TMD	AIT	KirdKao	TMD KAN	CMU	CMJD
1	92	95	148	296	225	252	334
2	73	83	163	380	236	356	350
3	85	89	117		263	398	484
4	95	79	69		336	415	574
5	105	71	70		328	438	511
6	103	66	66		223	444	292
7	97	75	66		203	337	300
8	110	88	155		235	274	445
9	112	90	207		236	322	310
10	122	101	242		230	396	234
11	139	116	236		277	379	324
12	177	137	176		346	321	365
13	188	147	206		447	348	267
14	182	169	171		400	466	313
15	209	208	225		226	589	527
16	191	208	454		186	409	602
17	189	190	392		428	317	489
18	242	200	321			456	560
19	258	222	400			403	522
20	243	266	301			466	
21	267	365	271			539	
22	249	372	297				
23	221	259	323				
24	266	205	333				
25	287	196	231				
26	250	177	270				
27	228	295	443				
28	323	499	318				
29	343	366	147				
30		193					
31		258					
32		258					
33		256					
34		399					
35		397					
36		412					

Table B-2 Boring Log reports at seven sites

Depth	CU			TMD BAN			AIT			KirdKao		TMD KAN		CMU		CMJD	
(m)	s_u (t/m^2)	SPT. N	Type	s_u (t/m^2)	SPT. N	Type	s_u (t/m^2)	SPT. N	Type	SPT. N	Type	SPT. N	Type	SPT. N	Type	SPT. N	Type
0.5			CH	3.4		CH	2.3		CH	31.0	CL-ML	8.0	SC	37.0	CL-ML	28.0	SC-SM
1.5	1.3		CH	3.4		CH	2.3		CH	125.0	SC-SM	5.6	SC	15.6	SC/CL	18.4	CL
2.5	1.4		CH	3.2		CH	3.0		CH		ROCK	10.4	SC	22.0	CL	11.4	CL
3.5	1.6		CH	2.7		CH	3.6		CH			20.0	CL	18.1	CL	23.2	SC
4.5	2.3		CH	1.9		CH	2.4		CH			15.2	CL	13.4	SC/CL	29.2	SC
5.5	2.3		CH	1.4		CH	1.8		CH			26.8	CL	12.5	SC/CL	25.9	SC
6.5	2.0		CH	1.2		CH	1.4		CH			22.4	CL	13.3	SC/CL	20.3	CL
7.5	2.0		CH	1.6		CH	0.8		CH/SC			24.4	CL	14.6	CL	21.6	CL
8.5	2.5		CH	2.1		CH	2.1		CH			23.6	CL	16.4	CL	27.1	CL
9.5	3.1		CH	2.7		CH	4.2		CH			21.9	CL	18.3	CL	31.5	CL
10.5	3.6		CH	3.5		CH	6.1		CL			21.2	CL	19.6	CL	24.2	CL
11.5	7.8		CL	4.1		CH		17.8	CL			20.5	CL	19.1	CL	25.7	CL
12.5		12.0	CL	4.1		CH		17.1	CL			19.1	CL	17.2	CL	32.3	CL
13.5		12.7	CL	3.4		CH		17.8	CL			14.4	CL	13.2	SC/CL	43.6	SM
14.5		13.9	CL	4.1		CH		15.7	CL			13.0	CL	12.5	SC/CL	61.9	SM
15.5		15.4	CL	5.1	19.0	CH		14.6	CL			14.1	SM	15.4	SC/CL	76.4	SM
16.5		17.4	CL		20.4	CH		22.6	CL			19.4	SM	27.4	SC	63.8	SM
17.5		18.5	CL		17.7	CH		33.9	CL			52.4	GP-GM	29.6	SC	61.2	SM
18.5		19.1	CL		15.1	CH		49.2	SM					30.3	SC	60.4	SM
19.5		19.8	CL		20.4	ML/SM		75.5	SM					41.6	SC	50.1	SM

20.5		26.5	CL		28.1	CL		71.4	SM					45.0	SC	60.1	SM
21.5		33.5	CL		40.3	CL		56.8	SP-SM						GM		
22.5		30.8	CL		67.0	SM		52.3	SP-SM								
23.5		31.9	CL		64.7	SM		38.4	SP-SM								
24.5		33.5	CL		51.1	SM		23.7	CL								
25.5		30.8	CL		41.8	SM		22.4	CL								
26.5		41.7	CL		36.7	SM		23.4	CL								
27.5		54.5	SM		31.7	SM		22.9	CL/SC								
28.5		51.8	SM		20.4	CH		12.2	CL/SC								
29.5		38.4	SM		15.6	CH		12.7	SC/CL								
30.5		26.1	SM		16.1	CH		17.0	SC/CL								
31.5		36.8	SM		26.8	CH											
32.5		49.3	SM		27.2	CH											
33.5					26.9	CH											
34.5					41.6	CH											
35.5					41.8	CH											
36.5					40.8	CH											
37.5					59.6	SM/ML											
38.5					68.1	SM/ML											
39.5					74.8	SM/ML											

Table B-3 **Shear wave velocities from Boring Log at seven sites**

Depth	Vs (m/s)						
(m)	CU	TMD	AIT	KirdKao	TMD KAN	CMU	CMJD
1		124	103	363	176	265	259
2	78	121	109		184	243	225
3	83	115	121		225	248	234
4	94	102	115		238	230	270
5	102	87	97		250	216	274
6	98	79	85		265	216	259
7	95	82	71		261	222	252
8	100	93	80		263	229	264
9	112	104	117		258	237	280
10	122	118	149		254	244	275
11	154	130	201		252	246	266
12	197	135	238		247	241	279
13	213	129	238		234	227	303
14	218	129	235		220	216	336
15	225	141	227		220	221	366
16	233	199	241		234	251	368
17	240	244	275		291	277	355
18	244	233	311			282	352
19	246	239	353			298	341
20	259	263	373			316	341
21	282	293	357				
22	288	336	340				
23	286	361	320				
24	290	346	283				
25	288	323	260				
26	298	307	259				
27	326	294	260				
28	337	268	236				
29	320	240	214				
30	287	231	226				
31	285	252					
32	315	273					
33		273					
34		293					
35		313					
36		312					
37		330					
38		357					
39		370					

APPENDIX C

COMPARISON COMPUTATIONS

Table C-1 **Shear wave velocity comparison at Chula**

CU	Vs (m/s)						Comparison (%)					
z (m)	MASW		Boring Log		Downhole		MASW-Downhole				MASW-Boring Log	
	Vs1	Vs2	Type	Vs3	Vs4	Vs5	Vs1-Vs4	Vs2-Vs4	Vs1-Vs5	Vs2-Vs5	Vs1-Vs3	Vs2-Vs3
	(z=λ/2)	(z=λ/3)										
3		105	CH	83	85	60		24		76		27
4	105	105	CH	94	95	60	11	11	76	75	12	11
5	105	104	CH	102	105	95	0	0	11	10	3	3
6	105	106	CH	98	103	95	2	3	10	12	7	8
7	104	110	CH	95	97	95	8	14	10	16	9	16
8	105	121	CH	100	110	95	4	10	11	27	5	20
9	107	124	CH	112	112	95	5	11	12	31	4	12
10	108	126	CH	122	122	95	11	3	14	32	11	3
11	113	128	CH	154	139	95	19	8	19	35	27	17
12	122	137	CL	197	177	205	31	23	40	33	38	31
13	124	148	CL	213	188	205	34	21	39	28	42	30
14	124	158	CL	218	182	205	32	13	39	23	43	28
15	126	168	CL	225	209	205	40	20	39	18	44	26
16	127	179	CL	233	191	205	33	6	38	13	45	23
17	130	181	CL	240	189	205	31	4	37	12	46	24
18	137	183	CL	244	242	205	43	24	33	11	44	25
19	144	184	CL	246	258	205	44	29	30	10	41	25

20	152	189	CL	259	243	255	38	22	41	26	42	27
21	158	199	CL	282	267	255	41	26	38	22	44	30
22	165	208	CL	288	249	255	34	16	35	18	43	28
23	174	217	CL	286	221	255	21	2	32	15	39	24
24	179	225	CL	290	266	255	33	15	30	12	38	22
25	181	234	CL	288	287	255	37	18	29	8	37	19
26	183	244	CL	298	250	255	27	3	28	4	39	18
27	183	254	CL	326	228	255	20	12	28	0	44	22
28	183	264	SM	337	323	255	43	18	28	4	46	22
29	185	274	SM	320	343	255	46	20	27	8	42	14
					Average =		**26**	**14**	**30**	**21**	**32**	**21**

Note: Vs4 is shear wave velocity from Chulalongkorn University research group

Vs5 is shear wave velocity from Ashford et al. (1997)

Table C-2 **Shear wave velocity comparison at TMD Bangkok**

TMD BKK	Vs (m/s)					Comparison (%)			
z (m)	MASW		Boring Log		Downhole	MASW-Downhole		MASW-Boring Log	
	Vs1	Vs2	Type	Vs3	Vs4	Vs1-Vs4	Vs2-Vs4	Vs1-Vs3	Vs2-Vs3
	(z=λ/2)	(z=λ/3)							
1		88	CH	124	95		8		29
2	86	82	CH	121	83	3	1	29	32
3	82	82	CH	115	89	8	8	29	29
4	81	86	CH	102	79	3	8	20	16
5	82	87	CH	87	71	16	22	6	0
6	87	87	CH	79	66	32	32	11	11
7	87	96	CH	82	75	16	29	7	18
8	90	96	CH	93	88	2	8	3	4
9	91	104	CH	104	90	1	16	13	0
10	96	116	CH	118	101	5	15	18	1
11	96	127	CH	130	116	17	9	26	2
12	96	139	CH	135	137	30	1	29	3
13	103	151	CH	129	147	30	3	21	17
14	110	163	CH	129	169	35	4	15	26
15	116	173	CH	141	208	44	17	18	23
16	124	182	CH	199	208	40	13	38	9
17	133	196	CH	244	190	30	3	46	20
18	140	207	CH	233	200	30	3	40	11
19	145	218	CH	239	222	35	2	39	8

20	153	229	ML/SM	263	266	42	14	42	13
21	161		CL	293	365	56		45	
22	169		CL	336	372	55		50	
23	177		SM	361	259	31		51	
24	184		SM	346	205	10		47	
25	192		SM	323	196	2		41	
26	198		SM	307	177	12		35	
27	207		SM	294	295	30		30	
28	215		SM	268	499	57		20	
29	222		CH	240	366	39		7	
30	229		CH	231	193	19		1	
				Average =		**25**	**11**	**27**	**14**

Table C-3 **Shear wave velocity comparison at AIT**

AIT	Vs (m/s)							Comparison (%)							
z (m)	MASW		Boring Log		Downhole		SCPT	MASW-Downhole				MASW-Boring Log		MASW-SCPT	
	Vs1 $(z=\lambda/2)$	Vs2 $(z=\lambda/3)$	Type	Vs3	Vs4	Vs5	Vs6	Vs1-Vs4	Vs2-Vs4	Vs1-Vs5	Vs2-Vs5	Vs1-Vs3	Vs2-Vs3	Vs1-Vs6	Vs2-Vs6
2		91	CH	109	163	80	275		44		14		17		67
3	91	85	CH	121	117	80	170	22	27	14	6	25	30	46	50
4	87	83	CH	115	69	80	75	25	21	8	4	24	27	15	11
5	83	90	CH	97	70	80	75	19	28	4	12	14	7	11	20
6	84	96	CH	85	66	80	85	28	45	5	20	1	12	1	13
7	86	97	CH	71	66	80	90	31	48	7	22	20	36	5	8
8	96	113	CH/SC	80	155	80	130	38	27	20	41	20	41	26	13
9	96	127	CH	117	207	80	185	54	39	20	59	18	9	48	31
10	93	142	CH	149	242	170		61	41	45	16	37	5		
11	103	157	CL	201	236	170		56	34	39	8	49	22		
12	113	172	CL	238	176	170		36	2	33	1	52	28		
13	123	186	CL	238	206	170		40	10	27	9	48	22		
14	132	198	CL	235	171	170		23	16	23	17	44	16		
15	140	212	CL	227	225	170		38	6	17	24	38	7		
16	152	230	CL	241	454	170		67	49	11	35	37	5		
17	160	243	CL	275	392	170		59	38	6	43	42	12		
18	170	262	CL	311	321	170		47	19	0	54	45	16		
19	180	264	SM	353	400	260		55	34	31	2	49	25		
20	190	264	SM	373	301	260		37	12	27	2	49	29		

21	198	269	SM	357	271	260		27	1	24	4	45	25		
22	209	272	SP-SM	340	297	260		30	8	20	5	39	20		
23	218	276	SP-SM	320	323	260		32	15	16	6	32	14		
24	226	281	SP-SM	283	333	260		32	15	13	8	20	1		
25	234	284	CL	260	231	260		1	23	10	9	10	10		
26	243	286	CL	259	270	260		10	6	7	10	6	11		
27	254	291	CL	260	443	260		43	34	2	12	2	12		
28	260	294	CL/SC	236	318	260		18	8	0	13	10	25		
29	263	300	CL/SC	214	147	260		79	104	1	15	23	40		
						Average =		**37**	**27**	**16**	**17**	**30**	**19**	**22**	**27**

Note: *Vs4 is shear wave velocity from Chulalongkorn University research group*

Vs5 is shear wave velocity from Ashford et al. (1997)

Table C-4 **Shear wave velocities profiles at Kirdkao Observatory**

KIRDKAO	Vs (m/s)				
z (m)	MASW		Boring Log		Downhole
	Vs1 (z=λ/2)	Vs2 (z=λ/3)	Type	Vs3	Vs4
1			CL-ML	332	296
2		351	SC-SM	331	380
3	351	347	ROCK	331	
4	352	343			
5	342	370			
6	344	397			
7	361	431			
8	380	460			
9	400	486			
10	423				
11	442				
12	460				
13	477				
14	490				

Table C-5 Shear wave velocity comparison at TMD Kanchanaburi

TMD KAN	Vs (m/s)					Comparison (%)			
z (m)	MASW		Boring Log		Downhole	MASW-Downhole		MASW-Boring Log	
	Vs1 (z=λ/2)	Vs2 (z=λ/3)	Type	Vs3	Vs4	Vs1-Vs4	Vs2-Vs4	Vs1-Vs3	Vs2-Vs3
1		207	SC	176	225		8		17
2	207	204	SC	184	236	12	13	12	11
3	204	204	SC	225	263	22	22	9	9
4	203	208	CL	238	336	40	38	15	13
5	206	212	CL	250	328	37	35	17	15
6	208	219	CL	265	223	7	2	21	17
7	210	229	CL	261	203	4	13	19	12
8	213	238	CL	263	235	9	1	19	9
9	218	250	CL	258	236	8	6	16	3
10	224	263	CL	254	230	2	14	12	3
11	231	273	CL	252	277	16	1	8	9
12	238	283	CL	247	346	31	18	4	15
13	246	294	CL	234	447	45	34	5	26
14	254	304	CL	220	400	37	24	15	38
15	263	317	CL	220	226	17	40	20	44
16	271	331	SM	234	186	45	77	16	41
17	276	343	SM	291	428	36	20	5	18
				Average =		**23**	**22**	**13**	**18**

Table C-6 **Shear wave velocity comparison at Chiang Mai University**

CMU	Vs (m/s)					Comparison (%)			
z (m)	MASW		Boring Log		Downhole	MASW-Downhole		MASW-Boring Log	
	Vs1	Vs2	Type	Vs3	Vs4	Vs1-Vs4	Vs2-Vs4	Vs1-Vs3	Vs2-Vs3
	(z=λ/2)	(z=λ/3)							
1		291	CL-ML	265	252		16		10
2	296	321	SC/CL	243	356	17	10	22	32
3	324	351	CL	248	398	19	12	31	42
4	343	386	CL	230	415	17	7	49	68
5	363	409	SC/CL	216	438	17	7	68	89
6	386	421	SC/CL	216	444	13	5	78	95
7	402	430	SC/CL	222	337	19	28	81	94
8	414	449	CL	229	274	51	64	81	96
9	420	483	CL	237	322	31	50	77	103
10	427	512	CL	244	396	8	29	75	110
11	435	544	CL	246	379	15	43	77	121
12	449	579	CL	241	321	40	80	87	141
13	467	610	CL	227	348	34	75	106	168
14	491	647	SC/CL	216	466	5	39	127	200
15	512	693	SC/CL	221	589	13	18	131	213
16	532		SC/CL	251	409	30		112	
17	558		SC	277	317	76		101	
18	583		SC	282	456	28		107	

19	604		SC	298	403	50		103	
20	622		SC	316	466	33		97	
21	651		SC		539	21			
				Average =		**27**	**32**	**85**	**105**

Table C-7 **Shear wave velocity comparison at Wat Chediluang, Chiang Mai**

WatChedi	Vs (m/s)					Comparison (%)			
z (m)	MASW		Boring Log		Downhole	MASW-Downhole		MASW-Boring Log	
	Vs1 (z=λ/2)	Vs2 (z=λ/3)	Type	Vs3	Vs4	Vs1-Vs4	Vs2-Vs4	Vs1-Vs3	Vs2-Vs3
1		190	SC-SM	259	334		43		26
2	194	215	CL	225	350	45	39	14	4
3	216	253	CL	234	484	55	48	8	8
4	245	262	SC	270	574	57	54	9	3
5	259	246	SC	274	511	49	52	6	10
6	261	248	SC	259	292	10	15	1	5
7	250	255	CL	252	300	17	15	1	1
8	242	260	CL	264	445	46	41	8	1
9	247	262	CL	280	310	20	15	12	6
10	253	256	CL	275	234	8	9	8	7
11	257	252	CL	266	324	21	22	4	5
12	261	245	CL	279	365	29	33	6	12
13	262	237	CL	303	267	2	11	14	22
14	261		SM	336	313	16		22	
15	257		SM	366	527	51		30	
16	252		SM	368	602	58		31	
17	252		SM	355	489	48		29	
18	245		SM	352	560	56		30	
19	238		SM	341	522	54		30	
				Average =		36	31	15	9

BIOGRAPHY

Sochan Seng

Sochan Seng was born on September, 19 1983 in Siem Reap Province, Cambodia. After he finished high school at 10 January High School in 2000, he quickly moved to capital city, Phnom Penh, for attending the University Diploma of Technology degree in Civil Engineering at Institute of Technology of Cambodia (ITC) for three years. At the same year of his graduation, 2003, he was awarded to pursue his study in Diploma of Engineering degree at ITC for three years more. During the last year of his degree, he applied for the scholarship to study Master's Degree Program under support of AUN/SEED-Net (JICA). Shortly, after his successful graduation in June 2006, he attained the scholarship award for further study in Master's program in Civil Engineering department at Chulalongkorn University, Thailand. He already submitted one paper to the 13th National Convention on Civil Engineering, Thailand, while this thesis is a partial fulfillment of the requirements for the degree.