

Appendix D

Laboratory Testing Results

Part of: The Use of Waste Rock Inclusions to Control the Effects
of Liquefaction in Tailings Impoundments

A Ph.D. Thesis by Michael James
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ANALYSE GRANULOMÉTRIQUE / GRAIN SIZE ANALYSIS

Provenance de l'échantillon:		Laronde				Manipulation		XX	
Site location of sample:		chaudière 1				Date:		21/06/2004	
ASTM : D421 - D422 - D1140 - D2217 - E11					Tamis sieve mm	Masse retenu mass retaining g	après sédimento after sédimento	passant passing materiel %	
Teneur en eau	Water content	alu 27	75.00	0.0				100.0	
Masse sol hum. + tare	Mass wet soil + container	547.5	50.00	0.0				100.0	
Masse sol sec + tare	Mass dry soil + container	451.40	25.00	0.0				100.0	
Masse sol sec	Mass dry soil	435.5	20.00	0.0				100.0	
Masse tare	Mass container	15.9	14.00	0.0				100.0	
Teneur en eau	Water content (%)	22.1	10.00	0.0				100.0	
Masse total	Total mass	1863.0	5.00	0.0				100.0	
Masse retenue 5mm	Retain mass on 5mm	0.0	2.50	0.0		0.00		100.0	
Masse passant 5mm hum.	Passing mass 5mm hum.	1863	1.250	0.0		0.000		100.0	
Masse passant 5mm sec	Passing mass 5mm dry	1863.0	0.630	0.0		0.000		100.0	
Masse utilisée pour petite granulo	Used mass for small sieving	487.8	0.315	0.1		0.100		99.8	
numéro de la tare	number of the container used	B3	0.160	3.5		3.500		93.7	
masse tare	Mass container	16.0	0.080	14.3		14.100		74.8	
Sédimentométrie	Hydrometer analysis	B3	Commentaires / comments:				D	%	
Masse sol sec + tare	Mass dry soil + container	217.82					mm	P	
Masse sol hum + tare	Mass wet soil + container	237.68					100.000	100.0	
Masse tare	Mass container	161.86					75.000	100.0	
Masse sol sec	Mass dry soil	55.96					50.000	100.0	
Masse sol humide	Mass wet soil	75.82					25.000	100.0	
Masse sol utilisée sec	Mass dry soil used	55.96					20.000	100.0	
Masse sol utilisée humide	Mass wet soil used	75.82					14.000	100.0	
Densité relative des grains	Specific gravity of soils	3.896					10.000	100.0	
k =	k =	0.00906966					5.000	100.0	
a =	a =	0.751					2.500	100.0	
Hydromètre utilisée	Hydrometer used	152 H					1.250	100.0	
							0.630	100.0	
							0.315	99.8	
TEMP.	T	R	dR	R-dR	L	0.160	93.7		
°C	min					0.080	74.8		
24.1	0.5	31.1	5.5	25.6	11.026	0.0426	34.3		
	1	22.2		16.7	12.485	0.0320	22.4		
	2	17.5		12.0	13.256	0.0233	16.1		
	4	14.5		9.0	13.748	0.0168	12.1		
	8	12.9		7.4	14.010	0.0120	9.9		
	15	11.1		5.6	14.306	0.0089	7.5		
	30	10.1		4.6	14.470	0.0063	6.2		
	60	9.8		4.3	14.519	0.0045	5.8		
	121	8.2		2.7	14.781	0.0032	3.6		
	240	7.9		2.4	14.830	0.0023	3.2		
	365	7.2		1.7	14.945	0.0018	2.3		
	3097	6.9		1.4	14.994	0.0006	1.9		

Analyse granulométrique (Grain size analysis)

Diamètre des grains (mm)	% Passant
0.001	0
0.002	2
0.004	4
0.0075	6
0.015	10
0.03	15
0.06	25
0.1	35
0.2	75
0.4	95
0.75	100
1.5	100
3	100
6	100
12	100
25	100
50	100
100	100
200	100
400	100
800	100
1600	100
3200	100
6400	100
12800	100
25600	100
51200	100
102400	100

ANALYSE GRANULOMÉTRIQUE / GRAIN SIZE ANALYSIS

Provenance de l'échantillon:		Laronde				Manipulation		XX	
Site location of sample:		chaudière 2				Date:		21/06/2004	
ASTM : D421 - D422 - D1140 - D2217 - E11					Tamis sieve mm	Masse retenu mass retaining g	après sédimento after sédimento	passant passing materiel %	
Teneur en eau	Water content	alu 4	75.00	0.0				100.0	
Masse sol hum. + tare	Mass wet soil + container	575.9	50.00	0.0				100.0	
Masse sol sec + tare	Mass dry soil + container	475.80	25.00	0.0				100.0	
Masse sol sec	Mass dry soil	459.8	20.00	0.0				100.0	
Masse tare	Mass container	16.0	14.00	0.0				100.0	
Teneur en eau	Water content (%)	21.8	10.00	0.0				100.0	
Masse total	Total mass	1863.0	5.00	0.0				100.0	
Masse retenue 5mm	Retain mass on 5mm	0.0	2.50	0.0		0.0		100.0	
Masse passant 5mm hum.	Passing mass 5mm hum.	1863	1.250	0.0		0.0		100.0	
Masse passant 5mm sec	Passing mass 5mm dry	1863.0	0.630	0.0		0.0		100.0	
Masse utilisée pour petite granulo	Used mass for small sieving	487.8	0.315	0.2		0.2		99.7	
numéro de la tare	number of the container used	B3	0.160	1.1		1.1		98.1	
masse tare	Mass container	16.0	0.080	11.8		11.8		79.4	
Sédimentométrie	Hydrometer analysis	B4	Commentaires / comments:				D	%	
Masse sol sec + tare	Mass dry soil + container	217.82					mm	P	
Masse sol hum + tare	Mass wet soil + container	237.2					100.000	100.0	
Masse tare	Mass container	160.55					75.000	100.0	
Masse sol sec	Mass dry soil	57.27					50.000	100.0	
Masse sol humide	Mass wet soil	76.65					25.000	100.0	
Masse sol utilisée sec	Mass dry soil used	57.27					20.000	100.0	
Masse sol utilisée humide	Mass wet soil used	76.65					14.000	100.0	
Densité relative des grains	Specific gravity of soils	4.257					10.000	100.0	
k =	k =	0.00793922					5.000	100.0	
a =	a =	0.679					2.500	100.0	
Hydromètre utilisée	Hydrometer used	152 H					1.250	100.0	
							0.630	100.0	
							0.315	99.7	
TEMP.	T	R	dR	R-dR	L	0.160	98.1		
°C	min					0.080	79.4		
24.3	0.5	33.3	5.5	27.8	10.665	0.0367	32.9		
	1	21.4		15.9	12.616	0.0282	18.8		
	2	16.9		11.4	13.354	0.0205	13.5		
	4	13.8		8.3	13.863	0.0148	9.8		
	8	11.9		6.4	14.174	0.0106	7.6		
	15	10.5		5.0	14.404	0.0078	5.9		
	30	9.8		4.3	14.519	0.0055	5.1		
	60	8.9		3.4	14.666	0.0039	4.0		
	120	7.5		2.0	14.896	0.0028	2.4		
	240	7.1		1.6	14.962	0.0020	1.9		
	362	6.8		1.3	15.011	0.0016	1.5		
	3094	6.2		0.7	15.109	0.0006	0.8		

Analyse granulométrique (Grain size analysis)

Diamètre des grains (mm)	% Passant
0.001	0
0.002	1
0.004	2
0.0075	4
0.015	6
0.03	10
0.06	18
0.12	33
0.25	80
0.5	98
1.0	100
2.0	100
4.0	100
8.0	100
16.0	100
32.0	100
64.0	100
128.0	100
256.0	100
512.0	100
1024.0	100
2048.0	100
4096.0	100
8192.0	100
16384.0	100
32768.0	100
65536.0	100
131072.0	100
262144.0	100
524288.0	100
1048576.0	100
2097152.0	100
4194304.0	100
8388608.0	100
16777216.0	100
33554432.0	100
67108864.0	100
134217728.0	100
268435456.0	100
536870912.0	100
1073741824.0	100
2147483648.0	100
4294967296.0	100
8589934592.0	100
17179869184.0	100
34359738368.0	100
68719476736.0	100
137438953472.0	100
274877906944.0	100
549755813888.0	100
1099511627776.0	100
2199023255552.0	100
4398046511104.0	100
8796093022208.0	100
17592186044416.0	100
35184372088832.0	100
70368744177664.0	100
140737488355328.0	100
281474976710656.0	100
562949953421312.0	100
1125899906842624.0	100
2251799813685248.0	100
4503599627370496.0	100
9007199254740992.0	100
18014398509481984.0	100
36028797018963968.0	100
72057594037927936.0	100
144115188075855872.0	100
288230376151711744.0	100
576460752303423488.0	100
1152921504606846976.0	100
2305843009213693952.0	100
4611686018427387904.0	100
9223372036854775808.0	100
18446744073709551616.0	100
36893488147419103232.0	100
73786976294838206464.0	100
147573952589676412928.0	100
295147905179352825856.0	100
590295810358705651712.0	100
1180591620717411303424.0	100
2361183241434822606848.0	100
4722366482869645213696.0	100
9444732965739290427392.0	100
18889465931478580854784.0	100
37778931862957161709568.0	100
75557863725914323419136.0	100
151115727451828646838272.0	100
302231454903657293676544.0	100
604462909807314587353088.0	100
1208925819614629174706176.0	100
2417851639229258349412352.0	100
4835703278458516698824704.0	100
9671406556917033397649408.0	100
19342813113834066795298816.0	100
38685626227668133590597632.0	100
77371252455336267181195264.0	100
154742504910672534362390528.0	100
309485009821345068724781056.0	100
618970019642690137449562112.0	100
1237940039285380274899124224.0	100
2475880078570760549798248448.0	100
4951760157141521099596496896.0	100
9903520314283042199192993792.0	100
19807040628566084398385987584.0	100
39614081257132168796771975168.0	100
79228162514264337593543950336.0	100
158456325028528675187087900672.0	100
316912650057057350374175801344.0	100
633825300114114700748351602688.0	100
1267650600228229401496703205376.0	100
2535301200456458802993406410752.0	100
5070602400912917605986812821504.0	100
10141204801825835211973625643008.0	100
20282409603651670423947251286016.0	100
40564819207303340847894502572032.0	100
81129638414606681695789005144064.0	100
162259276829213363391578010288128.0	100
324518553658426726783156020576256.0	100
649037107316853453566312041152512.0	100
1298074214633706907132624082305024.0	100
2596148429267413814265248164610048.0	100
5192296858534827628530496329220096.0	100
10384593717069655257060992658440192.0	100
20769187434139310514121985316880384.0	100
41538374868278621028243970633760768.0	100
83076749736557242056487941267521536.0	100
166153499473114484112975882535043072.0	100
332306998946228968225951765070086144.0	100
664613997892457936451903530140172288.0	100
1329227995784915872903807060280344576.0	100
2658455991569831745807614120560689152.0	100
5316911983139663491615228241121378304.0	100
10633823966279326983230456482242756608.0	100
21267647932558653966460912964485513216.0	100
42535295865117307932921825928971026432.0	100
85070591730234615865843651857942052864.0	100
170141183460469231731687303715884105728.0	100
340282366920938463463374607431768211456.0	100
680564733841876926926749214863536422912.0	100
1361129467683753853853498429727072845824.0	100
2722258935367507707706996859454145691648.0	100
5444517870735015415413993718908291383296.0	100
10889035741470030830827987437816582766592.0	100
21778071482940061661655974875633165533184.0	100
43556142965880123323311949751266331066368.0	100
87112285931760246646623899502532662132736.0	100
174224571863520493293247799005065324265472.0	100
348449143727040986586495598010130648530944.0	100
696898287454081973172991196020261297061888.0	100
1393796574908163946345982392040522594123776.0	100
2787593149816327892691964784081045188247552.0	100
5575186299632655785383929568162090376495104.0	100
11150372599265311570767859136324180752990208.0	100
22300745198530623141535718272648361505980416.0	100
44601490397061246283071436545296723011960832.0	100
89202980794122492566142873090593446023921664.0	100
178405961588244985132285746181186892047843328.0	100
356811923176489970264571492362373784095686656.0	100
713623846352979940529142984724747568191373312.0	100
1427247692705959881058285969449495136382746624.0	100
2854495385411919762116571938898990272765493248.0	100
5708990770823839524233143877797980545530986496.0	100
11417981541647679048466287755595961091061972992.0	100
22835963083295358096932575511191922182123945984.0	100
45671926166590716193865151022383844364247891968.0	100
91343852333181432387730302044767688728495783936.0	100
182687704666362864775460604089535377456991567872.0	100
365375409332725729550921208179070754913983135744.0	100
730750818665451459101842416358141509827966271488.0	100
1461501637330902918203684832716283019655932542976.0	100
2923003274661805836407369665432566039311865085952.0	100
5846006549323611672814739330865132078623730171904.0	100
11692013098647223345629478661730264157247460343808.0	100
23384026197294446691258957323460528314494920687616.0	100
46768052394588893382517914646921056628989841375232.0	100
93536104789177786765035829293842113257979682750464.0	100
187072209578355573530071658587684226515959365500928.0	100
374144419156711147060143317175368453031918731001856.0	100
748288838313422294120286634350736906063837462003712.0	100
1496577676626844588240573268701473812127674924007424.0	100
2993155353253689176481146537402947624255349848014848.0	100
5986310706507378352962293074805895248510699696029696.0	100
11972621413014756705924586149611790497021399392059392.0	100
23945242826029513411849172299223580994042798784118784.0	100
47890485652059026823698344598447161988085597568237568.0	100
95780971304118053647396689196894323976171195136475136.0	100
191561942608236107294793378393788647952342390272950272.0	100
383123885216472214589586756787577295904684780545900544.0	100
766247770432944429179173513575154591809369561091801088.0	100
1532495540865888858358347027150309183618739122183602176.0	100
3064991081731777716716694054300618367237478244367204352.0	100
6129982163463555433433388108601236734474956488734408704.0	100
12259964326927110866866776217202473468949912977468817408.0	100
24519928653854221733733552434404946937899825954937634816.0	100
49039857307708443467467104868809893875799651909875269632.0	100
98079714615416886934934209737619787751599303819750539264.0	100
196159429230833773869868419475239575503198607639501078528.0	100
392318858461667547739736838950479151006397215279002157056.0	100
7846377169233350954794736779	

ANALYSE GRANULOMÉTRIQUE / GRAIN SIZE ANALYSIS

Provenance de l'échantillon:		Laronde				Manipulation		XX	
Site location of sample:		chaudière 3				Date:		21/06/2004	
ASTM : D421 - D422 - D1140 - D2217 - E11					Tamis sieve mm	Masse retenu mass retaining g	après sédimento after sédimento	passant passing materiel %	
Teneur en eau	Water content	alu 21	75.00	0.0				100.0	
Masse sol hum. + tare	Mass wet soil + container	694	50.00	0.0				100.0	
Masse sol sec + tare	Mass dry soil + container	527.10	25.00	0.0				100.0	
Masse sol sec	Mass dry soil	511.2	20.00	0.0				100.0	
Masse tare	Mass container	15.9	14.00	0.0				100.0	
Teneur en eau	Water content (%)	32.6	10.00	0.0				100.0	
Masse total	Total mass	1863.0	5.00	0.0				100.0	
Masse retenue 5mm	Retain mass on 5mm	0.0	2.50	0.0		0.0		100.0	
Masse passant 5mm hum.	Passing mass 5mm hum.	1863	1.250	0.0		0.0		100.0	
Masse passant 5mm sec	Passing mass 5mm dry	1863.0	0.630	0.1		0.1		99.8	
Masse utilisée pour petite granulo	Used mass for small sieving	487.8	0.315	0.3		0.3		99.5	
numéro de la tare	number of the container used	B3	0.160	2.3		2.3		96.1	
masse tare	Mass container	16.0	0.080	8.2		8.2		86.0	
Sédimentométrie	Hydrometer analysis	B5	Commentaires / comments:				D	%	
Masse sol sec + tare	Mass dry soil + container	217.82					mm	P	
Masse sol hum + tare	Mass wet soil + container	229.04					100.000	100.0	
Masse tare	Mass container	159.11					75.000	100.0	
Masse sol sec	Mass dry soil	58.71					50.000	100.0	
Masse sol humide	Mass wet soil	69.93					25.000	100.0	
Masse sol utilisée sec	Mass dry soil used	58.71					20.000	100.0	
Masse sol utilisée humide	Mass wet soil used	69.93					14.000	100.0	
Densité relative des grains	Specific gravity of soils	3.753					10.000	100.0	
k =	k =	0.00943838					5.000	100.0	
a =	a =	0.779					2.500	100.0	
Hydromètre utilisée	Hydrometer used	152 H					1.250	100.0	
							0.630	99.8	
							0.315	99.5	
TEMP.	T	R	dR	R-dR	L	0.160	96.1		
°C	min					0.080	86.0		
24.5	0.75	31.0	4.0	27.0	11.042	0.0362	35.8		
	1	25.0		21.0	12.026	0.0327	27.9		
	2	21.8		17.8	12.551	0.0236	23.6		
	4	17.9		13.9	13.190	0.0171	18.5		
	8	15.0		11.0	13.666	0.0123	14.6		
	15	12.8		8.8	14.027	0.0091	11.7		
	30	11.7		7.7	14.207	0.0065	10.2		
	60	9.9		5.9	14.502	0.0046	7.8		
	122	9.0		5.0	14.650	0.0033	6.6		
	240	7.9		3.9	14.830	0.0023	5.2		
	365	7.2		3.2	14.945	0.0019	4.2		
	3097	5.9		1.9	15.158	0.0007	2.5		

Analyse granulométrique (Grain size analysis)

Diamètre des grains (mm)	% Passant
0.001	0
0.002	5
0.004	7
0.0075	8
0.015	10
0.03	15
0.06	20
0.12	25
0.25	35
0.5	85
1.0	95
2.0	98
4.0	99
8.0	100
16.0	100
32.0	100
63.0	100
125.0	100
250.0	100
500.0	100
1000.0	100
2000.0	100
4000.0	100
8000.0	100
16000.0	100
32000.0	100
63000.0	100
125000.0	100
250000.0	100
500000.0	100
1000000.0	100

ANALYSE GRANULOMÉTRIQUE / GRAIN SIZE ANALYSIS

Provenance de l'échantillon: Site location of sample:		Laronde chaudière 4			Manipulation Date:	XX 21/06/2004
ASTM : D421 - D422 - D1140 - D2217 - E11			Tamis sieve mm	Masse retenu mass retaining g	après sédimento after sédimento	passant passing materiel %
Teneur en eau	Water content	alu 4	75.00	0.0		100.0
Masse sol hum. + tare	Mass wet soil + container	575.9	50.00	0.0		100.0
Masse sol sec + tare	Mass dry soil + container	475.80	25.00	0.0		100.0
Masse sol sec	Mass dry soil	459.8	20.00	0.0		100.0
Masse tare	Mass container	16.0	14.00	0.0		100.0
Teneur en eau	Water content (%)	21.8	10.00	0.0		100.0
Masse total	Total mass	1863.0	5.00	0.0		100.0
Masse retenue 5mm	Retain mass on 5mm	0.0	2.50	0.0	0.0	100.0
Masse passant 5mm hum.	Passing mass 5mm hum.	1863	1.250	0.0	0.0	100.0
Masse passant 5mm sec	Passing mass 5mm dry	1863.0	0.630	0.1	0.1	99.9
Masse utilisée pour petite granulo	Used mass for small sieving	487.8	0.315	0.2	0.2	99.7
numéro de la tare	number of the container used	B3	0.160	1.7	1.7	97.6
masse tare	Mass container	16.0	0.080	6.7	6.7	90.5
Sédimentométrie	Hydrometer analysis	B7	Commentaires / comments:			D %
Masse sol sec + tare	Mass dry soil + container	217.82				mm P
Masse sol hum + tare	Mass wet soil + container	222.39				100.000 100.0
Masse tare	Mass container	147.2				75.000 100.0
Masse sol sec	Mass dry soil	70.62				50.000 100.0
Masse sol humide	Mass wet soil	75.19				25.000 100.0
Masse sol utilisée sec	Mass dry soil used	70.62				20.000 100.0
Masse sol utilisée humide	Mass wet soil used	75.19				14.000 100.0
Densité relative des grains	Specific gravity of soils	3.619				10.000 100.0
k =	k =	0.00989524				5.000 100.0
a =	a =	0.806				2.500 100.0
Hydromètre utilisée	Hydrometer used	152 H				1.250 100.0
					0.630	99.9
					0.315	99.7
TEMP.	T	R	dR	R-dR	L	0.160 97.6
°C	min					0.080 90.5
24.2	0.75	35.0	4.0	31.0	10.386	0.0368 35.4
	1	32.0		28.0	10.878	0.0326 32.0
	2	25.8		21.8	11.895	0.0241 24.9
	4	21.2		17.2	12.649	0.0176 19.6
	8	17.5		13.5	13.256	0.0127 15.4
	15	14.8		10.8	13.699	0.0095 12.3
	30	12.4		8.4	14.092	0.0068 9.6
	60	10.5		6.5	14.404	0.0048 7.4
	120	9.2		5.2	14.617	0.0035 5.9
	240	8.1		4.1	14.798	0.0025 4.7
	362	7.7		3.7	14.863	0.0020 4.2
	3094	6.0		2.0	15.142	0.0007 2.3

Analyse granulométrique (Grain size analysis)

DENSITE RELATIVE DES GRAINS
SPECIFIC GRAVITY OF SOILS

Provenance de l'échantillon:	Echantillon no. 1
Site location of sample:	
Date:	

Nom du fichier / Name of file:	
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Pycnomètre no	Bottle no	3	5	8
Masse pycnomètre + eau +sol g	Mass bottle + water + soil g	774.86	784.65	785.41
Température ° C	Température ° C	22.1	22.6	22.8
Masse pycnomètre + eau g	Mass bottle + water g	682.71	685.43	686.58
No tare	Evaporating dish no	14	15	99
Masse de la tare + sol sec g	Mass dish + dry soil g	294.21	308.41	302.41
Masse de la tare g	Mass dish g	170.10	175.30	169.32
Masse du sol sec g	Mass dry soil) g	124.11	133.11	133.09
Masse volumique de l'eau @ 20° C	Solid relative density	0.99776	0.99764	0.99759
Masse volumique de l'eau @ 20° C	Specific grav. Of water @20°C	0.99823	0.99823	0.99823
Densité relative	Solid relative density	3.883	3.927	3.884
Densité relative corrigé @ 20°C)	Specific gravity of soil @ 20°C)	3.881	3.925	3.882

Moyenne	Average	3.896
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DENSITE RELATIVE DES GRAINS
SPECIFIC GRAVITY OF SOILS

Provenance de l'échantillon:	Echantillon no. 2
Site location of sample:	
Date:	

Nom du fichier / Name of file:	
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Pycnomètre no	Bottle no	9	10	11
Masse pycnomètre + eau + sol g	Mass bottle + water + soil g	757.87	763.42	761.31
Température ° C	Temperature ° C	21.9	22.0	22.4
Masse pycnomètre + eau g	Mass bottle + water g	659.91	665.55	665.10
No tare	Evaporating dish no	63	64	66
Masse de la tare + sol sec g	Mass dish + dry soil g	443.63	446.35	454.51
Masse de la tare g	Mass dish g	315.56	318.44	328.83
Masse du sol sec g	Mass dry soil) g	128.07	127.91	125.68
Masse volumique de l'eau @ 20° C	Solid relative density	0.99781	0.99778	0.99769
Masse volumique de l'eau @ 20° C	Specific grav. Of water @20°C	0.99823	0.99823	0.99823
Densité relative	Solid relative density	4.253	4.259	4.265
Densité relative corrigé @ 20°C)	Specific gravity of soil @ 20°C)	4.251	4.257	4.262

Moyenne	Average	4.257
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DENSITE RELATIVE DES GRAINS
SPECIFIC GRAVITY OF SOILS

Provenance de l'échantillon:	Echantillon no. 3
Site location of sample:	
Date:	

Nom du fichier / Name of file:	
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Pycnomètre no	<i>Bottle no</i>	9	10	11
Masse pycnomètre + eau +sol g	<i>Mass bottle + water + soil g</i>	759.88	764.33	765.05
Température ° C	<i>Température ° C</i>	22.1	22.6	22.8
Masse pycnomètre + eau g	<i>Mass bottle + water g</i>	659.88	665.43	665.02
No tare	<i>Evaporating dish no g</i>	21	61	65
Masse de la tare + sol sec g	<i>Mass dish + dry soil g</i>	304.99	451.09	501.07
Masse de la tare g	<i>Mass dish g</i>	168.43	316.45	364.85
Masse du sol sec g	<i>Mass dry soil) g</i>	136.56	134.64	136.22
Masse volumique de l'eau @ 20° C	<i>Solid relative density</i>	0.99776	0.99764	0.99759
Masse volumique de l'eau @ 20° C	<i>Specific grav. Of water @20°C</i>	0.99823	0.99823	0.99823
Densité relative	<i>Solid relative density</i>	3.735	3.767	3.764
Densité relative corrigé @ 20°C)	<i>Specific gravity of soil @ 20°C)</i>	3.733	3.765	3.762

Moyenne	Average	3.753
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DENSITE RELATIVE DES GRAINS
SPECIFIC GRAVITY OF SOILS

Provenance de l'échantillon:	Echantillon no. 4
Site location of sample:	
Date:	

Nom du fichier / Name of file:	
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Pycnomètre no	Bottle no	3	5	8
Masse pycnomètre + eau + sol g	Mass bottle + water + soil g	779.39	781.49	784.32
Température ° C	Température ° C	23.5	23.8	22.9
Masse pycnomètre + eau g	Mass bottle + water g	682.59	685.34	686.57
No tare	Evaporating dish no	C2	C4	C6
Masse de la tare + sol sec g	Mass dish + dry soil g	817.30	842.60	852.00
Masse de la tare g	Mass dish g	683.40	709.80	717.10
Masse du sol sec g	Mass dry soil) g	133.90	132.80	134.90
Masse volumique de l'eau @ 20° C	Solid relative density	0.99742	0.99735	0.99757
Masse volumique de l'eau @ 20° C	Specific grav. Of water @20°C	0.99823	0.99823	0.99823
Densité relative	Solid relative density	3.609	3.624	3.631
Densité relative corrigé @ 20°C)	Specific gravity of soil @ 20°C)	3.607	3.621	3.628

Moyenne	Average	3.619
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Direct Shear Test	Test No.	DS01	Date:	2005-09-21
			Operator:	M. James

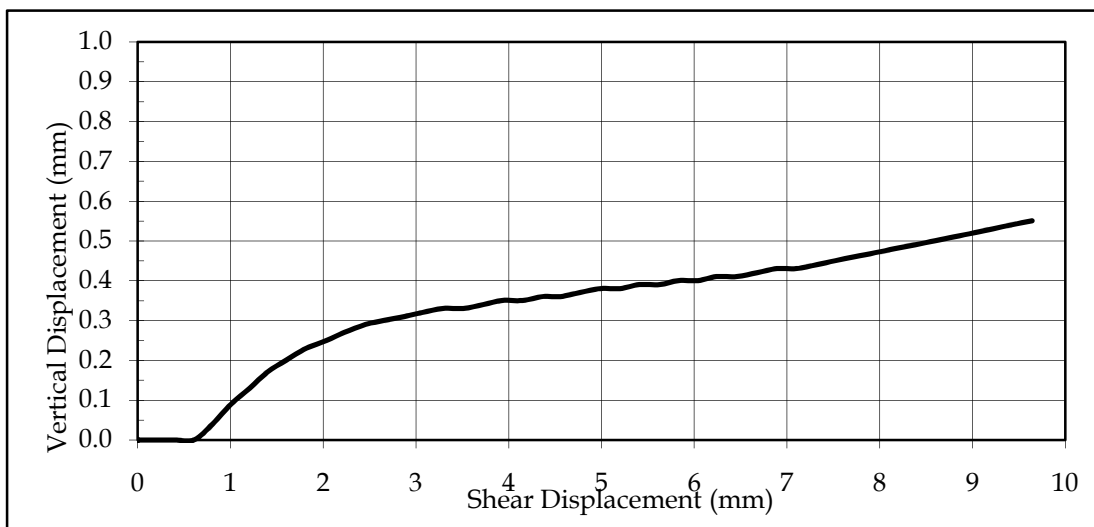
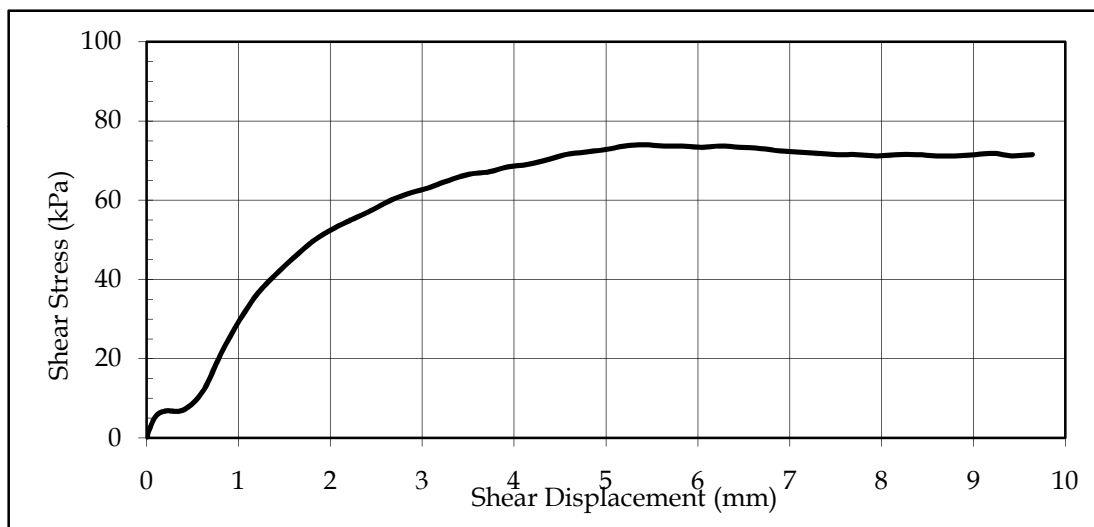
Sample Description:	Bulk sample of tailings from the Laronde Mine (Pressiac, QC)		
USCS Designation:	Silt (ML) - nonplastic.	Specific gravity, G _s :	3.88

Sample Preparation	
Wt. tare (g):	219.9
Wt. tare and dry soil (g):	451.2
Wt. tare and wet soil (g):	516.7
Moisture content, m (%):	28.3
Wt. tare and slurry left (g):	319.8
Wt. tare and dry soil (g):	297.7
Wt. soil in sample (g):	153.5

Test Results	
Max shear stress (kPa):	74.03
Friction angle, ϕ :	35.66

Testing Parameters	
Area of shear box (cm ²):	31.67
Consol. stress, σ_{vc} ' (kPa):	103.19
Strain rate (mm/min):	2.54
Vertical datum (mm):	23.33

Consolidation of Sample	
Init vertical reading (mm):	1.45
Init sample height (mm):	21.88
Final vertical reading (mm):	2.08
Consol sample height (mm):	21.25
Void ratio, e _c :	0.701



Direct Shear Test	Test No.	DS02	Date:	2005-09-22
			Operator:	M. James

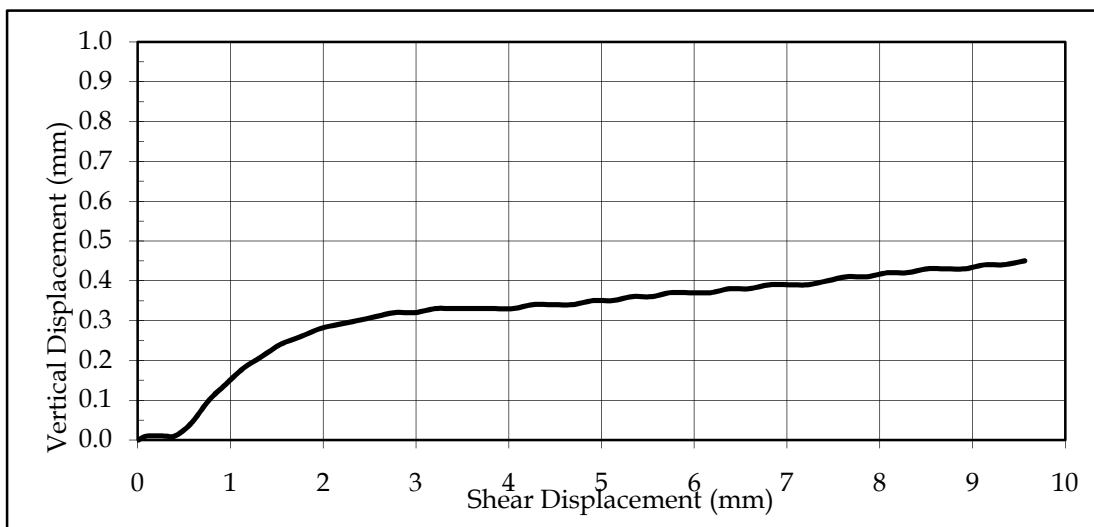
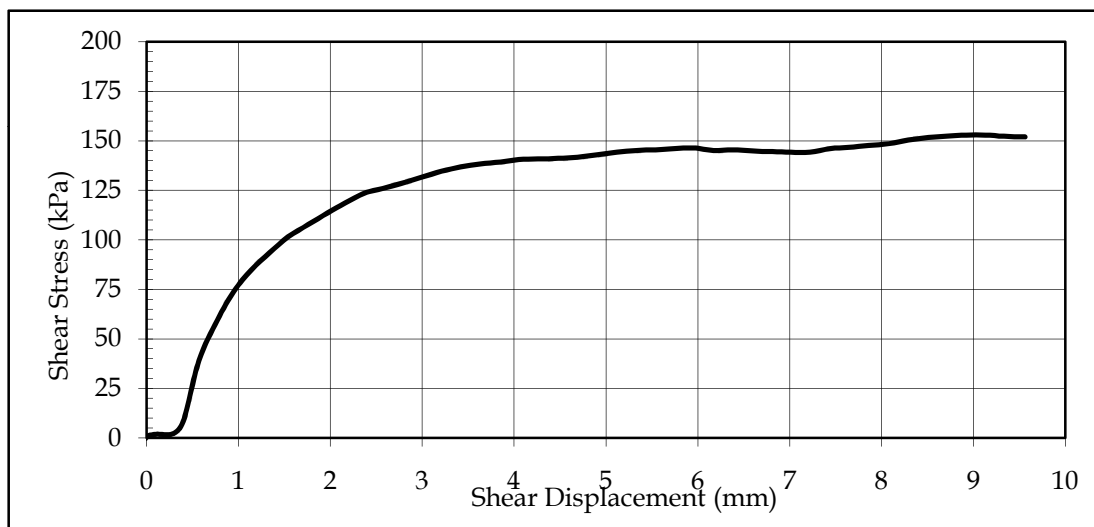
Sample Description:	Bulk sample of tailings from the Laronde Mine (Pressiac, QC)		
USCS Designation:	Silt (ML) - nonplastic.	Specific gravity, Gs:	3.88

Sample Preparation	
Wt. tare (g):	217.9
Wt. tare and dry soil (g):	467.2
Wt. tare and wet soil (g):	536.4
Moisture content, m (%):	27.8
Wt. tare and slurry left (g):	338.4
Wt. tare and dry soil (g):	312.3
Wt. soil in sample (g):	154.9

Test Results	
Max shear stress (kPa):	153.02
Friction angle, ϕ :	37.48

Testing Parameters	
Area of shear box (cm ²):	31.67
Consol. stress, σ_{vc}' (kPa):	199.56
Strain rate (mm/min):	2.54
Vertical datum (mm):	23.33

Consolidation of Sample	
Init vertical reading (mm):	2.52
Init sample height (mm):	20.81
Final vertical reading (mm):	3.40
Consol sample height (mm):	19.93
Void ratio, e_c :	0.581



Direct Shear Test	Test No.	DS03	Date:	2005-09-23
			Operator:	M. James

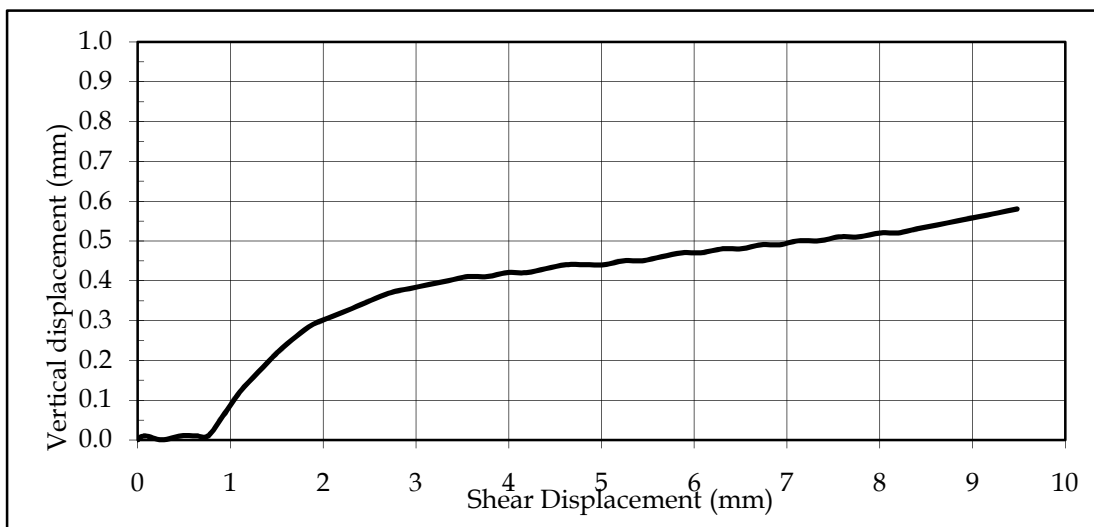
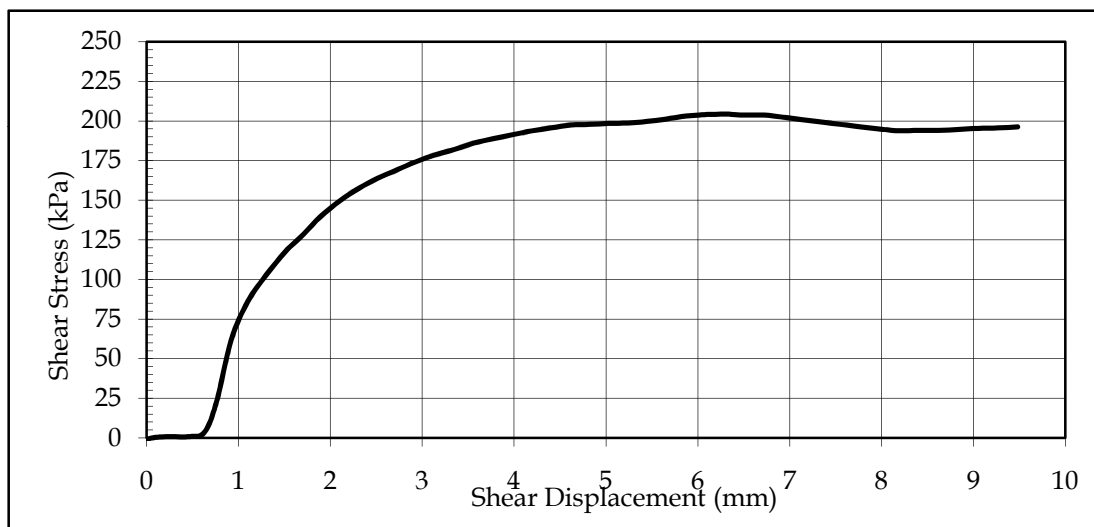
Sample Description:	Bulk sample of tailings from the Laronde Mine (Pressiac, QC)		
USCS Designation:	Silt (ML) - nonplastic.	Specific gravity, G _s :	3.88

Sample Preparation	
Wt. tare (g):	220.1
Wt. tare and dry soil (g):	425.5
Wt. tare and wet soil (g):	482.2
Moisture content, m (%):	27.6
Wt. tare and slurry left (g):	261.5
Wt. tare and dry soil (g):	252.3
Wt. soil in sample (g):	173.2

Test Results	
Max shear stress (kPa):	204.44
Friction angle, ϕ :	34.34

Testing Parameters	
Area of shear box (cm ²):	31.67
Consol. stress, σ_{vc} ' (kPa):	299.28
Strain rate (mm/min):	2.54
Vertical datum (mm):	23.33

Consolidation of Sample	
Init vertical reading (mm):	-2.41
Init sample height (mm):	25.74
Final vertical reading (mm):	0.20
Consol sample height (mm):	23.13
Void ratio, e _c :	0.641



Direct Shear Test	Test No.	DS04	Date:	2005-09-23
			Operator:	M. James

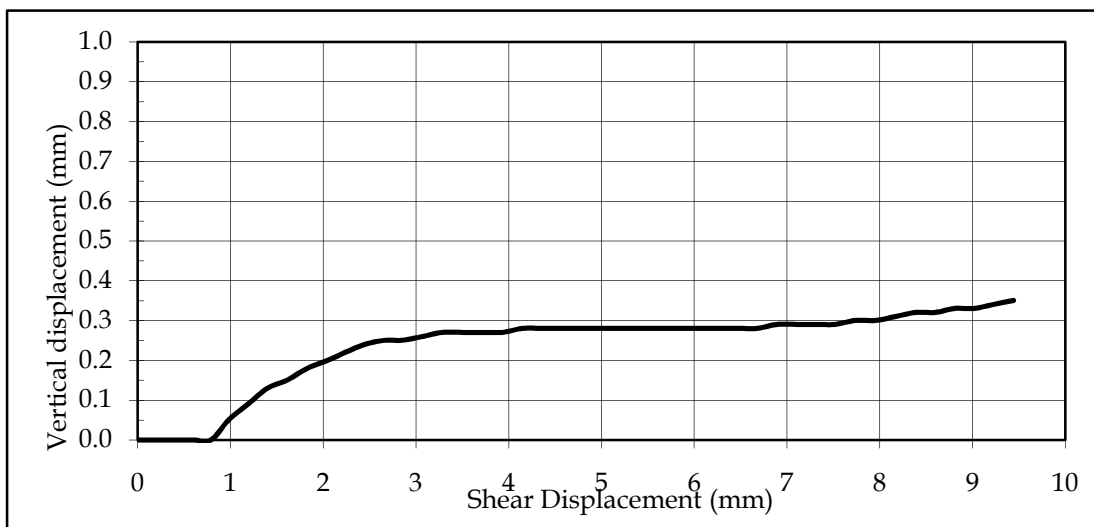
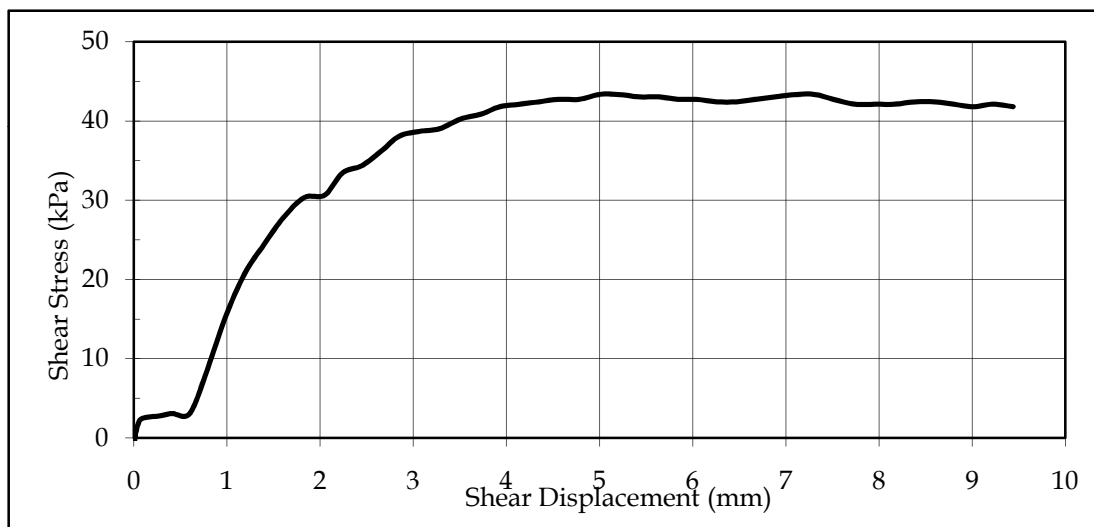
Sample Description:	Bulk sample of tailings from the Laronde Mine (Pressiac, QC)		
USCS Designation:	Silt (ML) - nonplastic.	Specific gravity, Gs:	3.88

Sample Preparation	
Wt. tare (g):	218.0
Wt. tare and dry soil (g):	476.6
Wt. tare and wet soil (g):	548.7
Moisture content, m (%):	27.9
Wt. tare and slurry left (g):	349.6
Wt. tare and dry soil (g):	320.7
Wt. soil in sample (g):	155.9

Test Results	
Max shear stress (kPa):	43.37
Friction angle, ϕ :	38.27

Testing Parameters	
Area of shear box (cm ²):	31.67
Consol. stress, σ_{vc} (kPa):	54.97
Strain rate (mm/min):	2.54
Vertical datum (mm):	23.33

Consolidation of Sample	
Init vertical reading (mm):	-0.13
Init sample height (mm):	23.46
Final vertical reading (mm):	1.47
Consol sample height (mm):	21.86
Void ratio, e_c :	0.723



Direct Shear Test	Test No.	DS05	Date:	2005-09-23
			Operator:	M. James

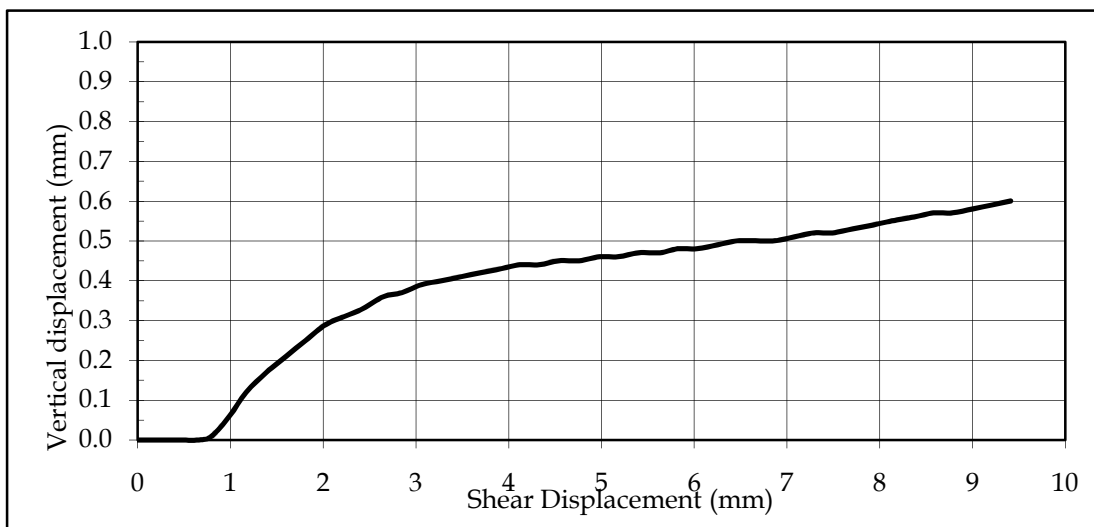
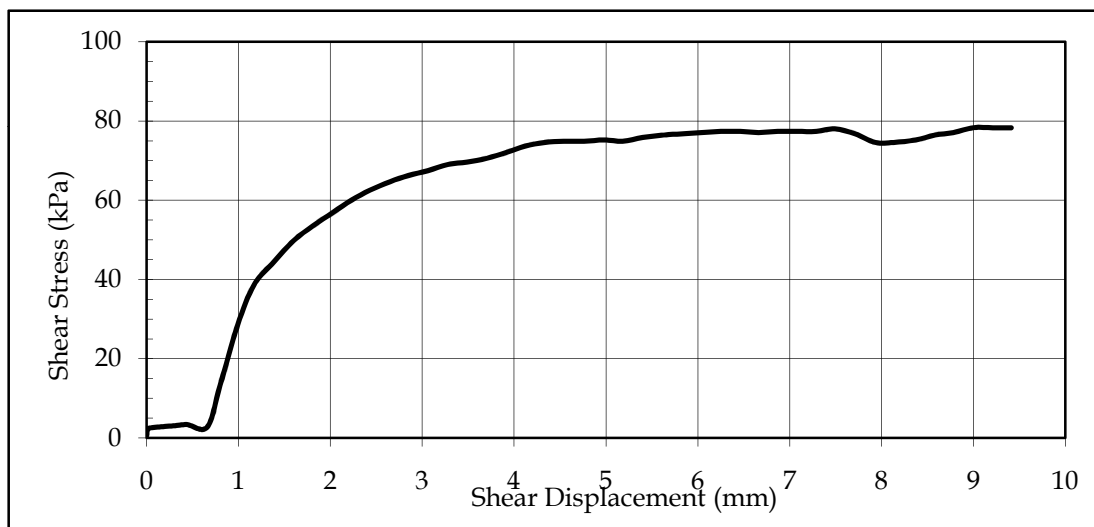
Sample Description:	Bulk sample of tailings from the Laronde Mine (Pressiac, QC)		
USCS Designation:	Silt (ML) - nonplastic.	Specific gravity, G _s :	3.88

Sample Preparation	
Wt. tare (g):	219.9
Wt. tare and dry soil (g):	418.8
Wt. tare and wet soil (g):	473.7
Moisture content, m (%):	27.6
Wt. tare and slurry left (g):	263.6
Wt. tare and dry soil (g):	253.8
Wt. soil in sample (g):	165.0

Test Results	
Max shear stress (kPa):	78.37
Friction angle, ϕ :	37.22

Testing Parameters	
Area of shear box (cm ²):	31.67
Consol. stress, σ_{vc} (kPa):	103.19
Strain rate (mm/min):	2.54
Vertical datum (mm):	23.33

Consolidation of Sample	
Init vertical reading (mm):	-1.28
Init sample height (mm):	24.61
Final vertical reading (mm):	0.73
Consol sample height (mm):	22.60
Void ratio, e _c :	0.683



CONSOLIDATION TEST SUMMARY

Start date:	12-Sep-05
End date:	16-Sep-05
Operator:	M. James

Sample Description:	Bulk sample of tailings from Laronde Mine - Pressiac, Quebec
Sample Preparation:	An oven-dried sample of the tailings was mixed with water to a water content of approximately 27.5%, poured into the sample mold and consolidated.

Sample Data

Area (cm ²):	31.67	Mass of solids, M_s (g):	151.70	Vol. of solids, V_s (cm ³):	39.10
Initial height (mm):	21.00	Specific gravity, G_s :	3.88	Initial void ratio, e_i :	0.70

Test Results (Consolidation)

Step No.	Type	Load	Sample Height		Void Ratio		Water Content		Strain	Dry Density
		$\sigma'_{v,c}$ (kPa)	Initial h_i (mm)	Final h_f (mm)	Initial e_i	Final e_f	Initial w_i	Final w_f	ε (%)	$\gamma_{\text{dry-final}}$ (kN/m ³)
1	Load	24.0	21.00	20.85	0.701	0.689	0.1807	0.1775	0.71	22.54
2	Load ¹	48.0	20.85	20.44	0.689	0.656	0.1775	0.1690	2.67	22.99
3	Load	96.2	20.44	20.25	0.656	0.640	0.1690	0.1650	3.57	23.21
4	Load	219.9	20.25	19.93	0.640	0.614	0.1650	0.1583	5.10	23.58
5	Load	410.1	19.93	19.66	0.614	0.592	0.1583	0.1527	6.38	23.90
6	Load	885.7	19.66	19.28	0.592	0.562	0.1527	0.1448	8.19	24.37
7	Unload	410.1	19.28	19.28	0.562	0.562	0.1448	0.1448	8.19	24.37
8	Unload	219.9	19.28	19.26	0.562	0.560	0.1448	0.1443	8.29	24.40
9	Unload	96.19	19.48	19.30	0.578	0.563	0.1489	0.1452	8.10	24.35

NOTE: The consolidation device was disturbed during the second load increment. This disturbance caused excessive consolidation during the second load increment and effected the time rate of settlement for the second and third load increments.

Compression Index, c_c :	0.08
Recompression Index, c_r :	0.00

CONSOLIDATION TEST SUMMARY

Sample Description:	Bulk sample of tailings from Laronde Mine - Pressiac, Quebec
Sample Preparation:	An oven-dried sample of the tailings was mixed with water to a water content of approximately 27.5%, poured into the sample mold and consolidated.

Start date:	12-Sep-05
End date:	16-Sep-05
Operator:	M. James

Test Results and Analysis (Coefficient of Consolidation and Hydraulic Conductivity)

Step No.	Type	Load	Sample Height		Void Ratio		Time	Coeff. Consol. c_v (cm ² /s)	Coeff. Compress. a_v (1/kPa)	Hydraulic Conduct. K (m/s)
		$\sigma'_{v,c}$ (kPa)	Initial h_i (mm)	Final h_f (mm)	Initial e_i	Final e_f	90% t_{90} (sec)			
1	Load	24.0	21.00	20.85	0.701	0.689	5760	9.349E-03	5.054E-04	2.725E-03
2	Load	48.0	20.85	20.44	0.689	0.656	<i>Note 1</i>	-	-	-
3	Load	96.2	20.44	20.25	0.656	0.640	<i>Note 1</i>	-	-	-
4	Load	219.9	20.25	19.93	0.640	0.614	6840	8.866E-03	2.096E-04	1.111E-03
5	Load	410.1	19.93	19.66	0.614	0.592	7290	8.591E-03	1.150E-04	6.003E-04
6	Load	885.7	19.66	19.28	0.592	0.562	2580	8.379E-03	6.471E-05	3.340E-04
Averages:								8.796E-03	2.237E-04	1.193E-03

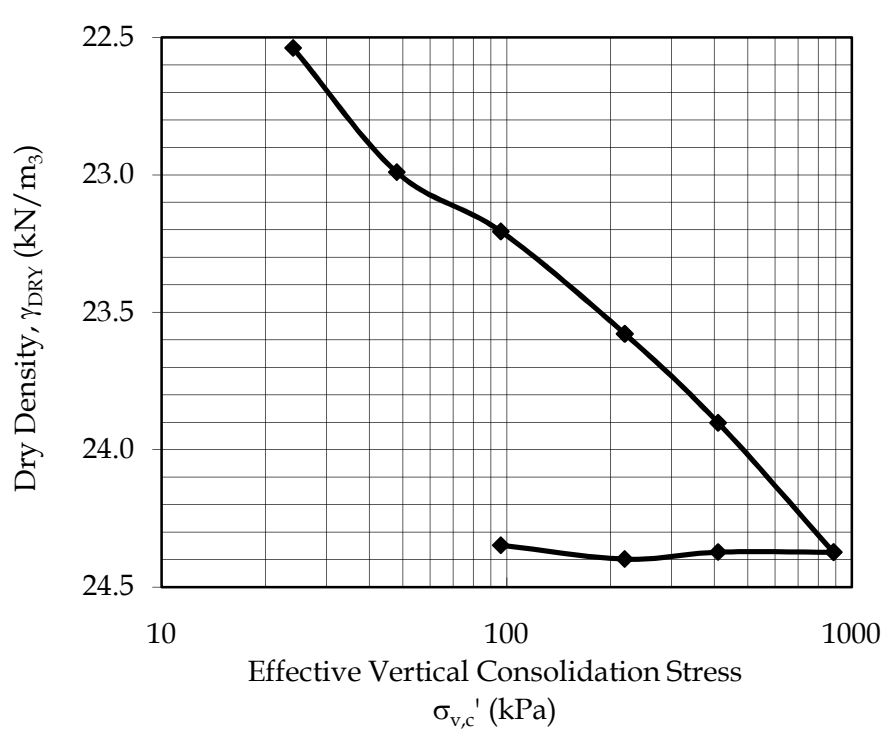
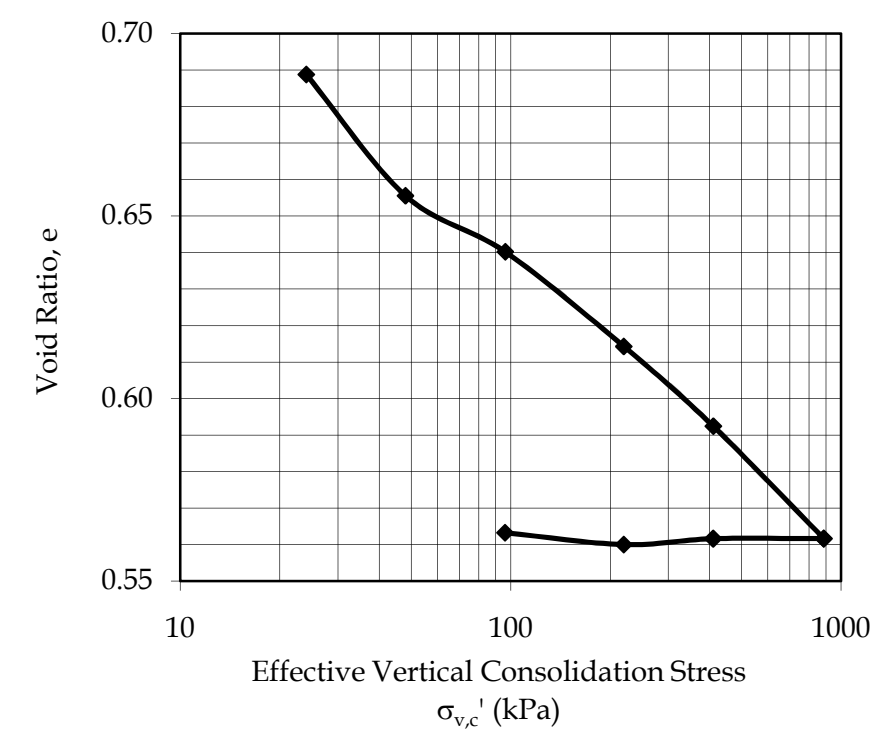
CONSOLIDATION TEST SUMMARY

Sample Description:	Bulk sample of tailings from Laronde Mine - Pressiac, Quebec
Sample Preparation:	An oven-dried sample of the tailings was mixed with water to a water content of approximately 27.5%, poured into the sample mold and consolidated.

Start date:	12-Sep-05
End date:	16-Sep-05
Operator:	M. James

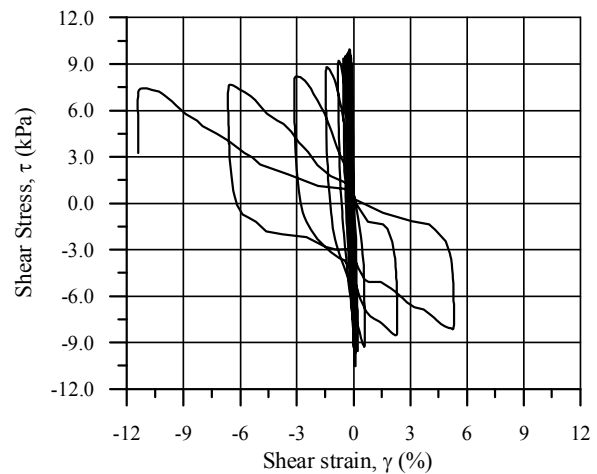
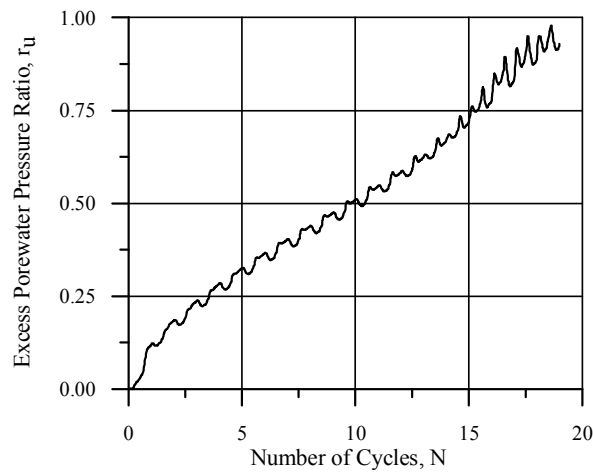
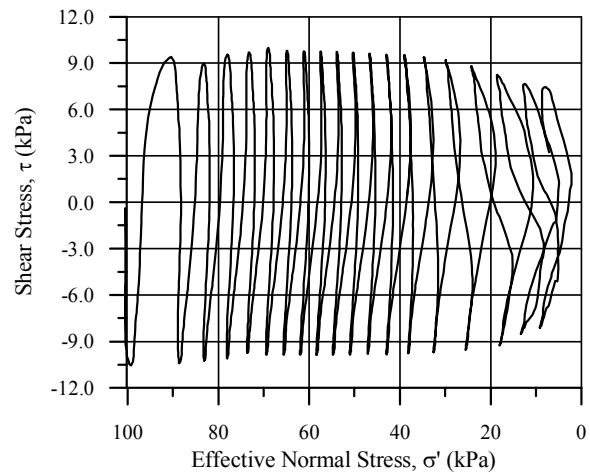
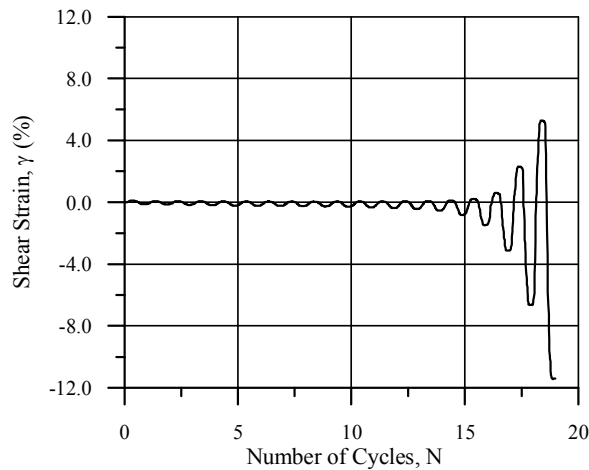
Sample Data

Area (cm ²):	31.67	Mass of solids, M _s (g):	151.70	Vol. of solids, V _s (cm ³):	39.10
Initial height (mm):	21.00	Specific gravity, G _s :	3.88	Initial void ratio, e _i :	0.70



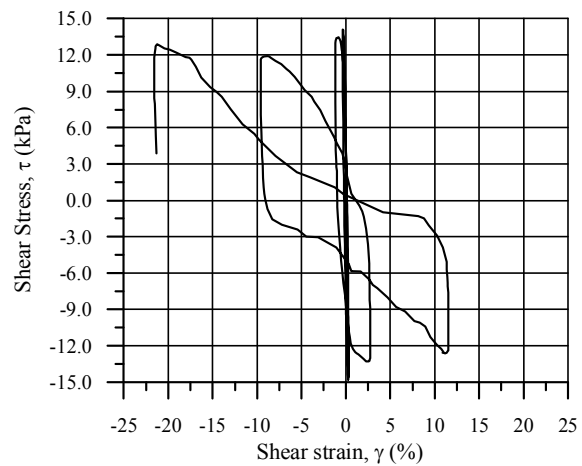
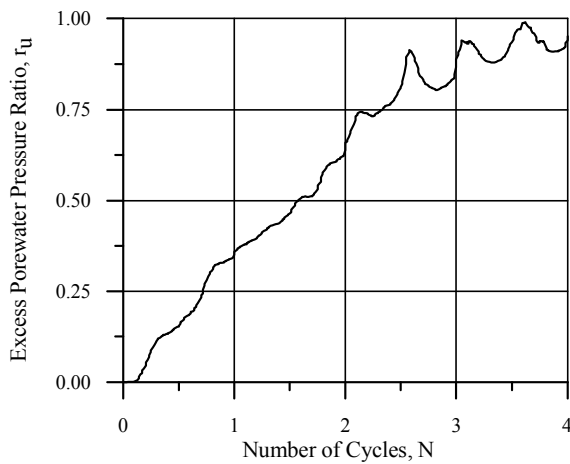
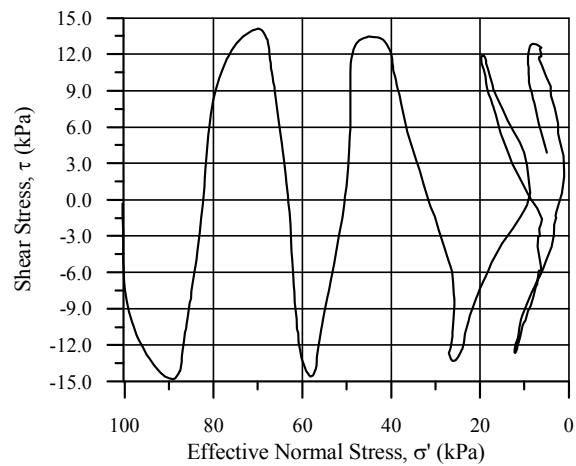
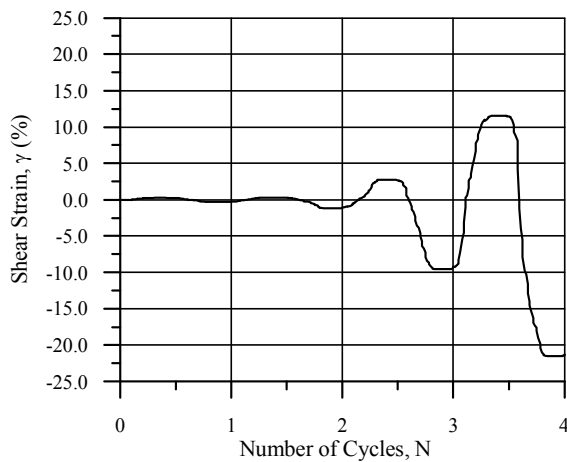
Cyclic Direct Simple Shear Testing

Test No:	TL-01	$\sigma'_{v,c}$ (kPa):	102.2
By:	M. James/L. Weerasekara	e_c :	0.622
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.102
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		17.7
	$r_u(\gamma=3.75\%)$		0.91
	$N_{LIQ}(r_u=1.0)$		18.6



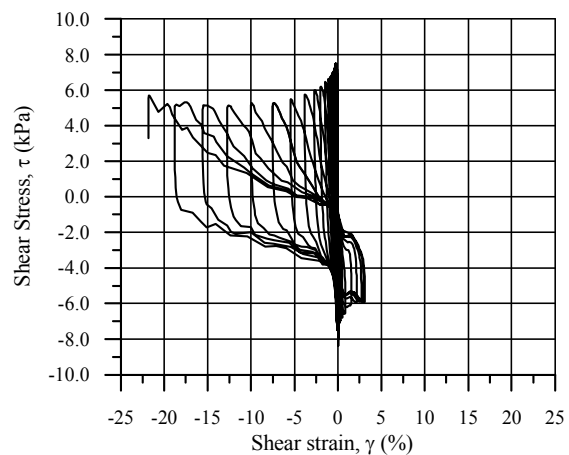
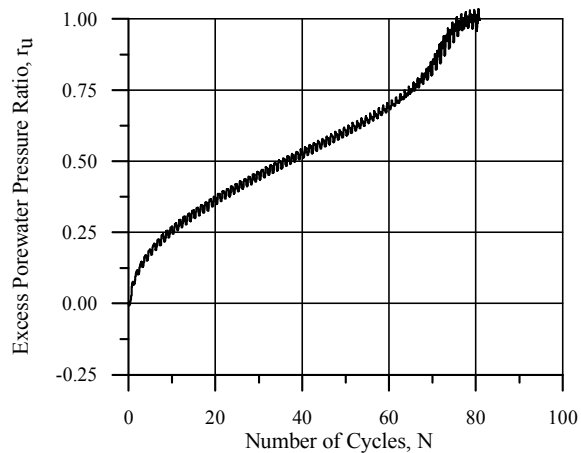
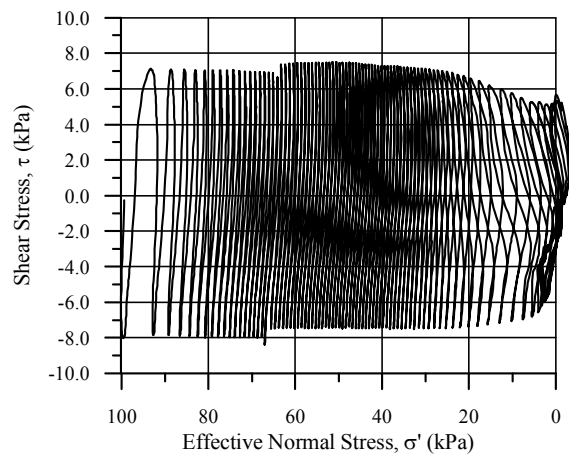
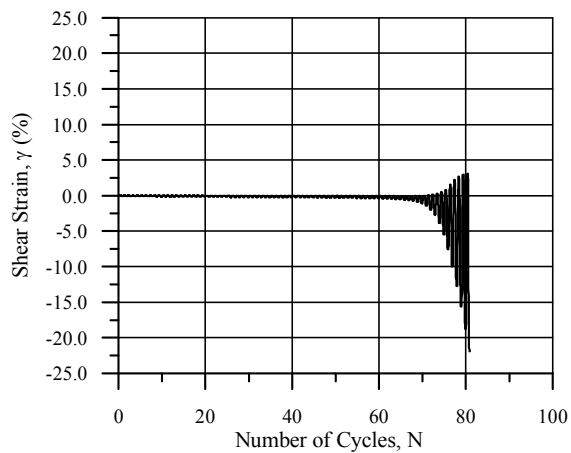
Cyclic Direct Simple Shear Testing

Test No:	TL-02	$\sigma'_{v,c}$ (kPa):	98.0
By:	M. James/L. Weerasekara	e_c :	0.618
Date:	Sept. 2005	$\tau_{eye}/\sigma'_{v,c}$:	0.144
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		2.7
	$r_u(\gamma=3.75\%)$		0.74
	$N_{LIQ}(r_u=1.0)$		3.6



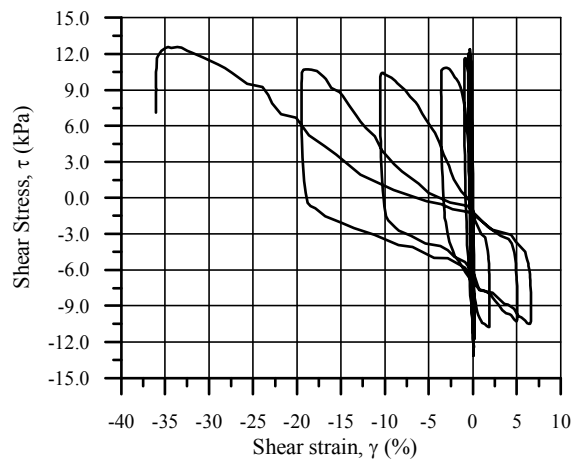
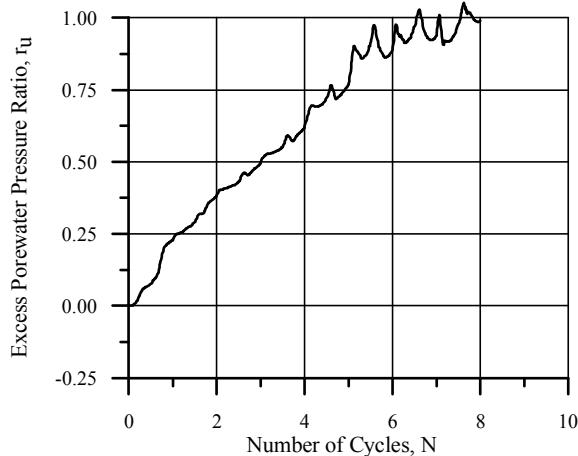
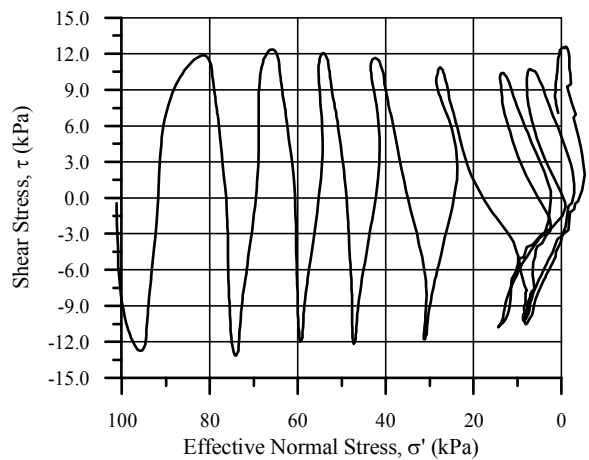
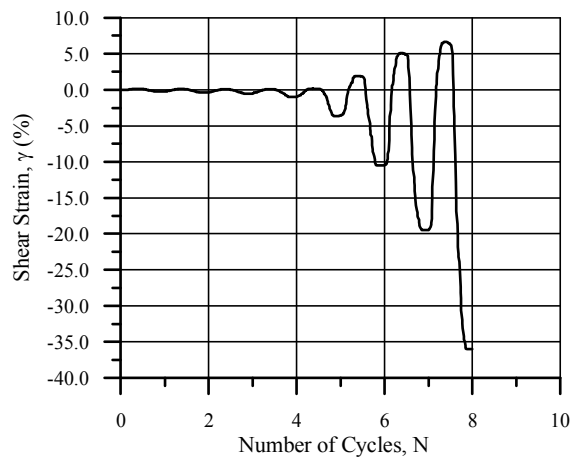
Cyclic Direct Simple Shear Testing

Test No:	TL-03	$\sigma'_{v,c}$ (kPa):	99.5
By:	M. James/L. Weerasekara	e_c :	0.677
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.076
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		73.8
	$r_u(\gamma=3.75\%)$		0.97
	$N_{LIQ}(r_u=1.0)$		80.5



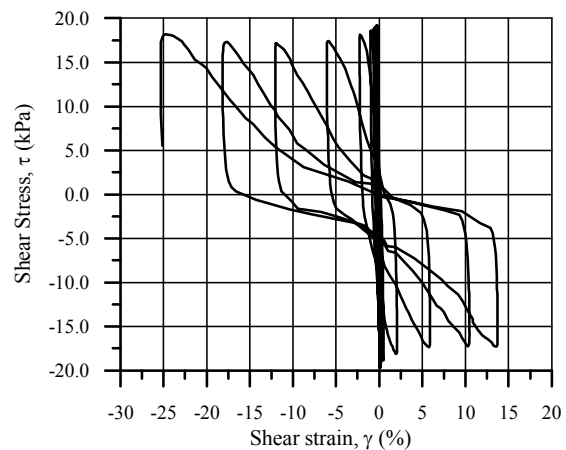
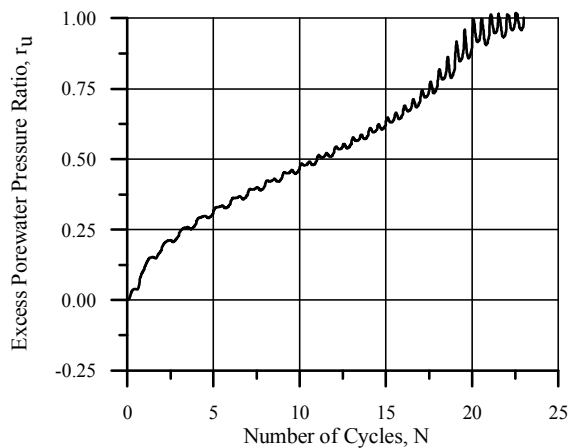
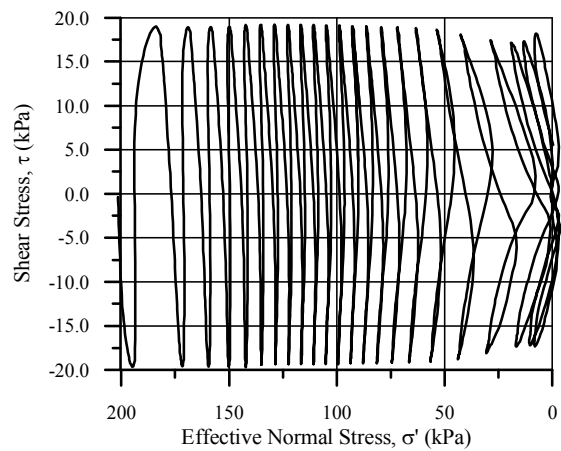
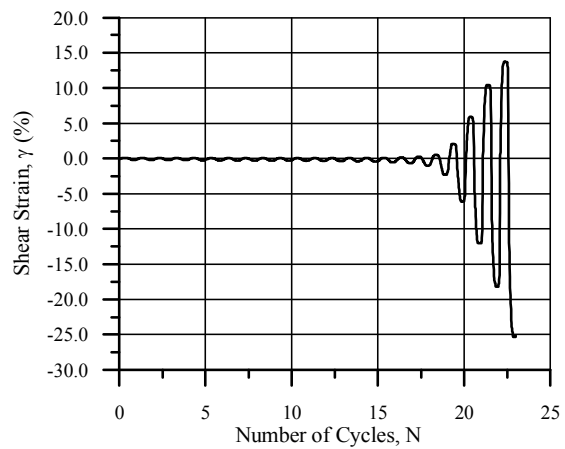
Cyclic Direct Simple Shear Testing

Test No:	TL-04	$\sigma'_{v,c}$ (kPa):	96.3
By:	M. James/L. Weerasekara	e_c :	0.632
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.127
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		5.6
	$r_u(\gamma=3.75\%)$		0.93
	$N_{LIQ}(r_u=1.0)$		7.0



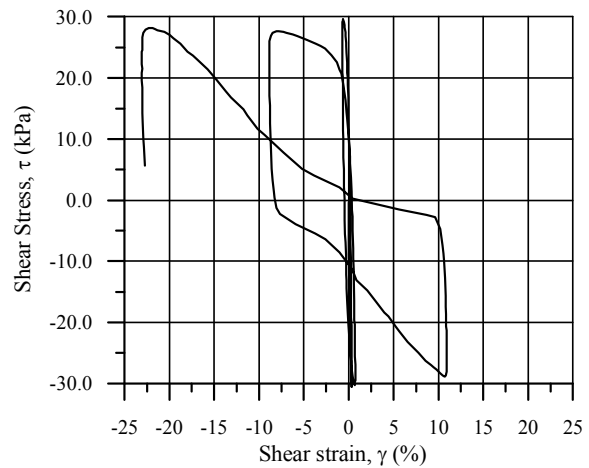
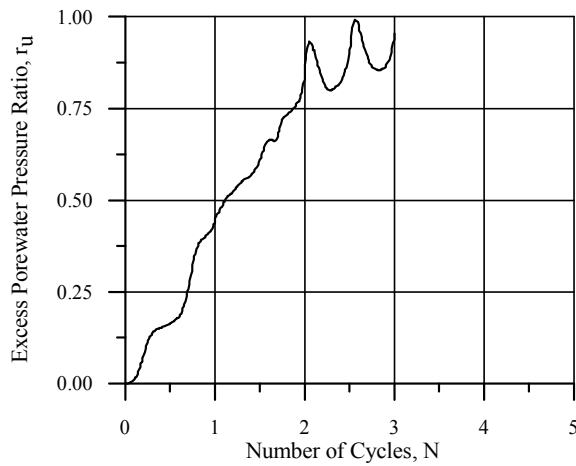
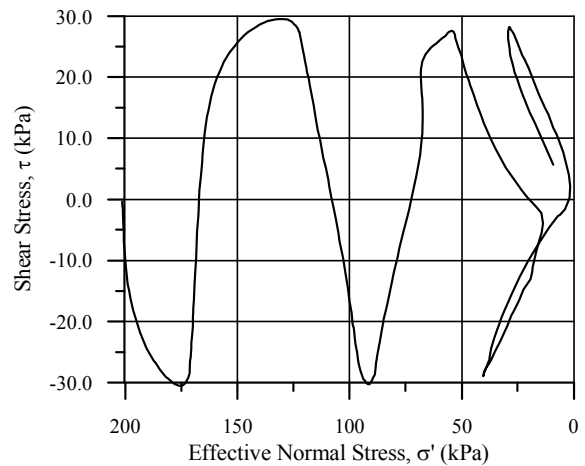
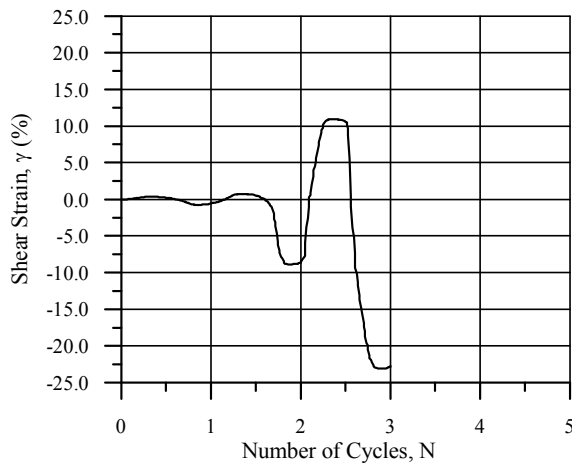
Cyclic Direct Simple Shear Testing

Test No:	TL-05	$\sigma'_{v,c}$ (kPa):	200.6
By:	M. James/L.Weerasekara	e_c :	0.610
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.960
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		19.7
	$r_u(\gamma=3.75\%)$		0.893
	$N_{LIQ}(r_u=1.0)$		23.0



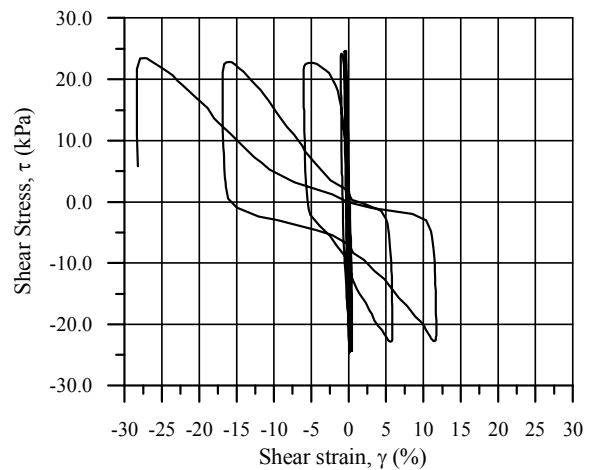
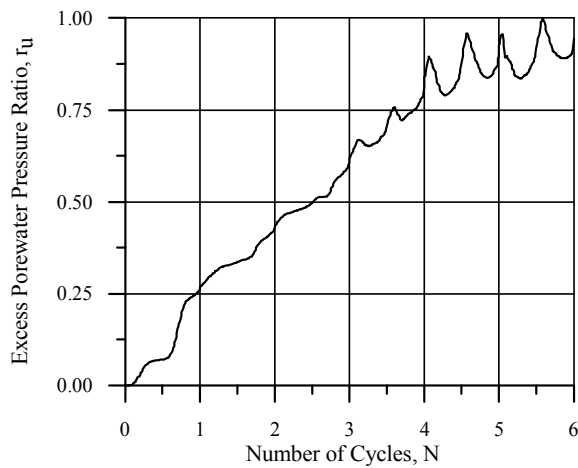
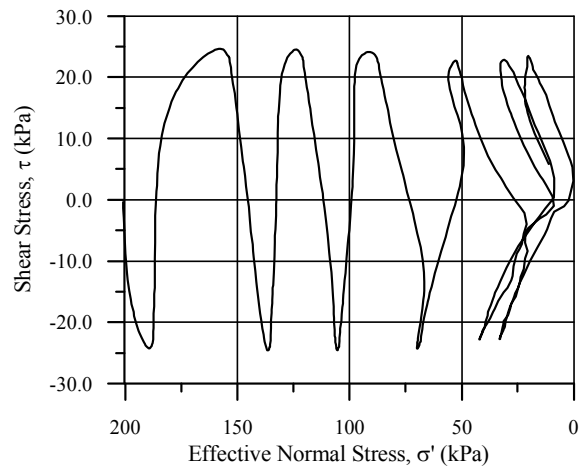
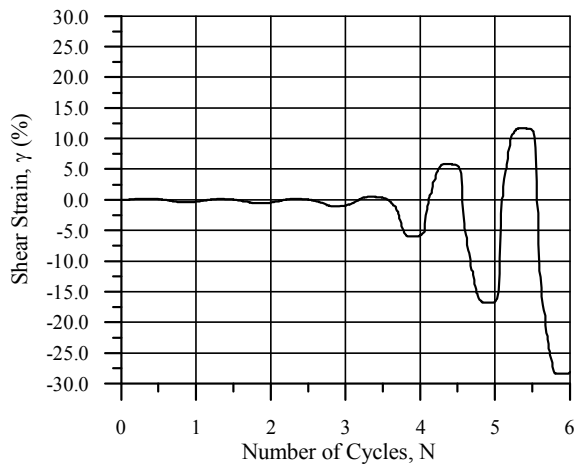
Cyclic Direct Simple Shear Testing

Test No:	TL-06	$\sigma'_{v,c}$ (kPa):	198.8
By:	M. James/L. Weerasekara	e_c :	0.604
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.149
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		1.7
	$r_u(\gamma=3.75\%)$		0.70
	$N_{LIQ}(r_u=1.0)$		3.0



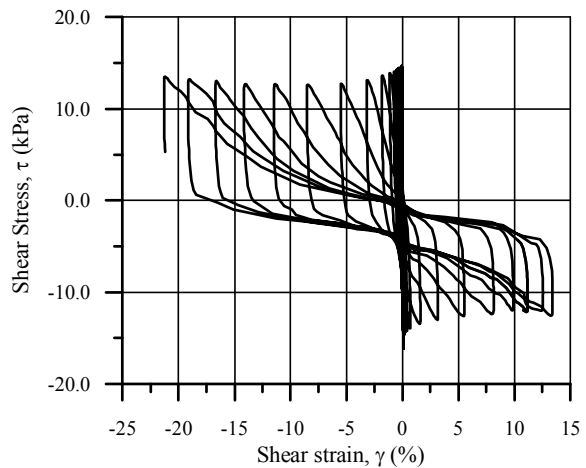
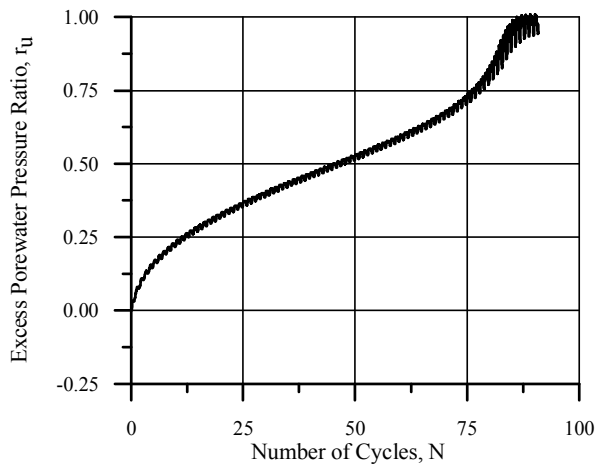
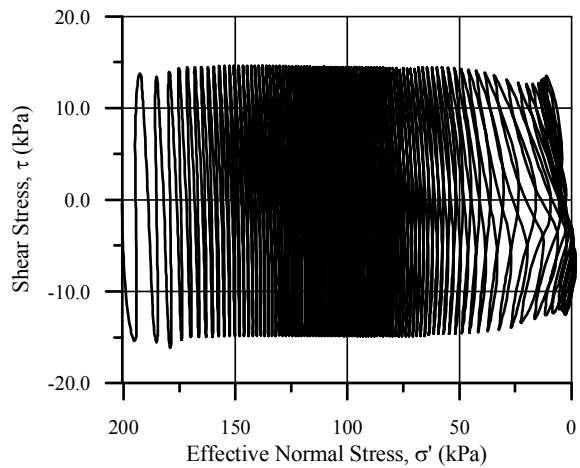
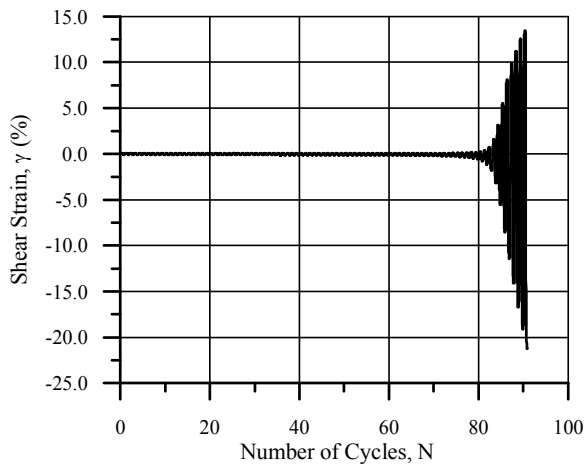
Cyclic Direct Simple Shear Testing

Test No:	TL-07a	$\sigma'_{v,c}$ (kPa):	201.0
By:	M. James/L. Weerasekara	e_c :	0.650
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.123
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		3.8
	$r_u(\gamma=3.75\%)$		0.73
	$N_{LIQ}(r_u=1.0)$		5.6



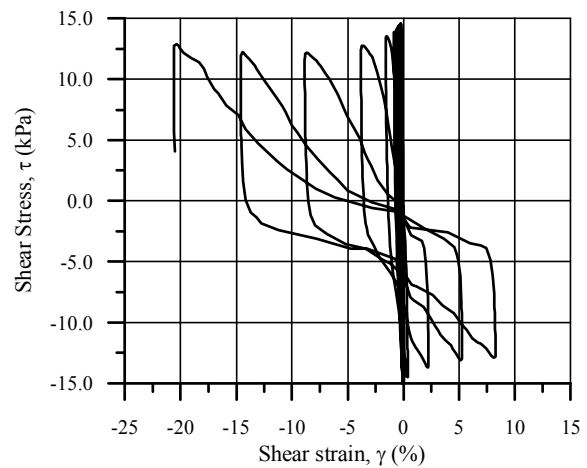
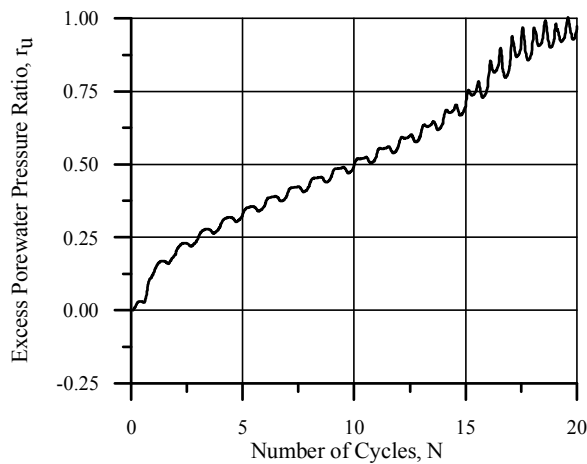
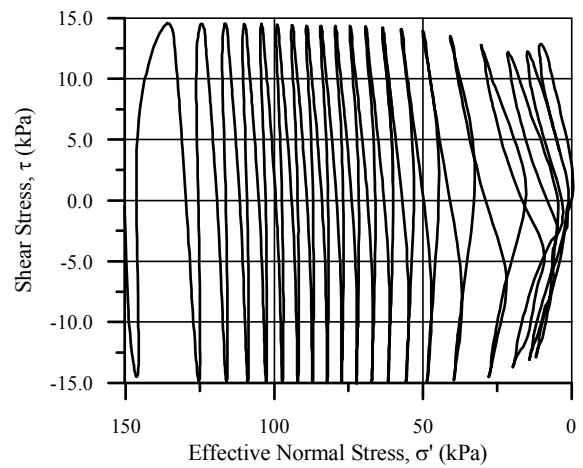
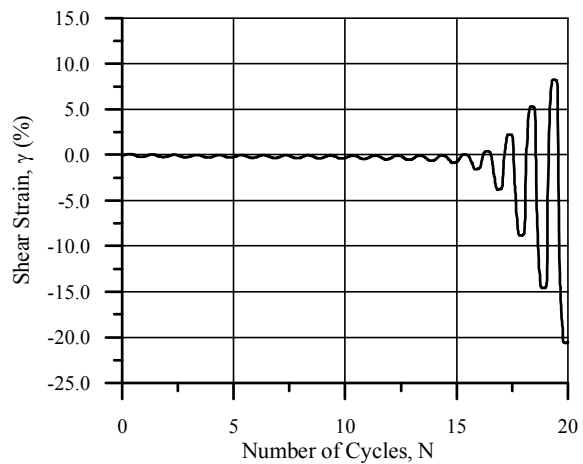
Cyclic Direct Simple Shear Testing

Test No:	TL-08	$\sigma'_{v,c}$ (kPa):	200.4
By:	M. James/L. Weerasekara	e_c :	0.655
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.074
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.		$N_{LIQ}(\gamma=3.75\%)$	84.7
		$r_u(\gamma=3.75\%)$	0.92
		$N_{LIQ}(r_u=1.0)$	90.5



Cyclic Direct Simple Shear Testing

Test No:	TL-09	$\sigma'_{v,c}$ (kPa):	150.3
By:	M. James/L. Weerasekara	e_c :	0.686
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.098
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		16.8
	$r_u(\gamma=3.75\%)$		0.80
	$N_{LIQ}(r_u=1.0)$		19.6

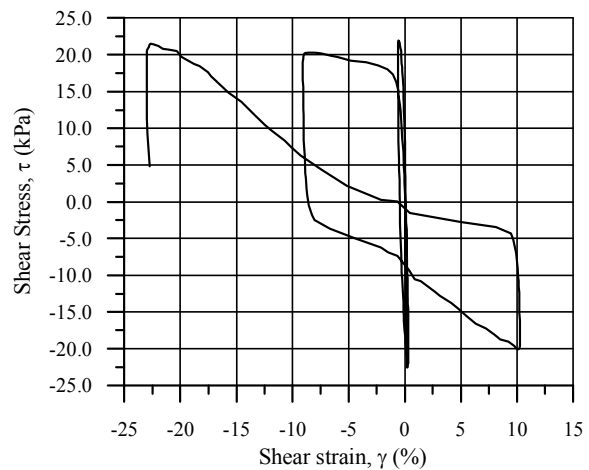
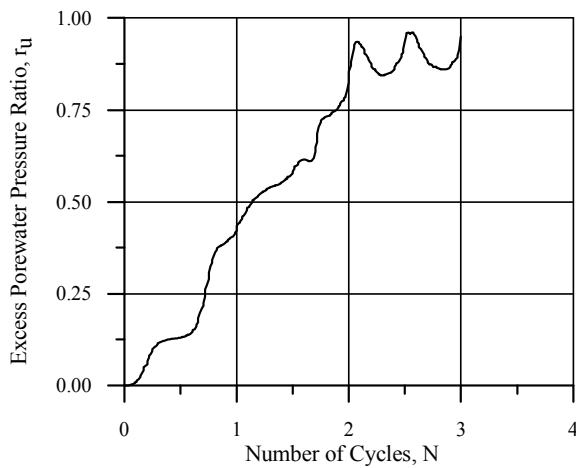
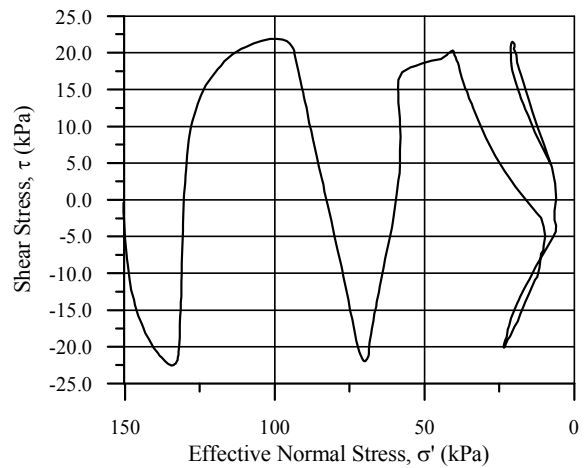
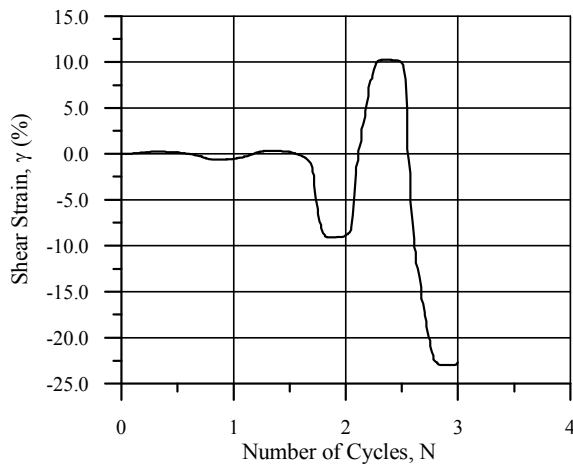


Cyclic Direct Simple Shear Testing

Test No:	TL-10	$\sigma'_{v,c}$ (kPa):	149.7
By:	M. James/L. Weerasekara	e_c :	0.633
Date:	Sept. 2005	$\tau_{cyc} / \sigma'_{v,c}$:	0.121
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.		$N_{LIQ}(\gamma=3.75\%)$	5.6
		$r_u(\gamma=3.75\%)$	0.93
		$N_{LIQ}(r_u=1.0)$	7.5
The data recorded during this test was lost during processing. However, the testing results were retained for use in the research.			

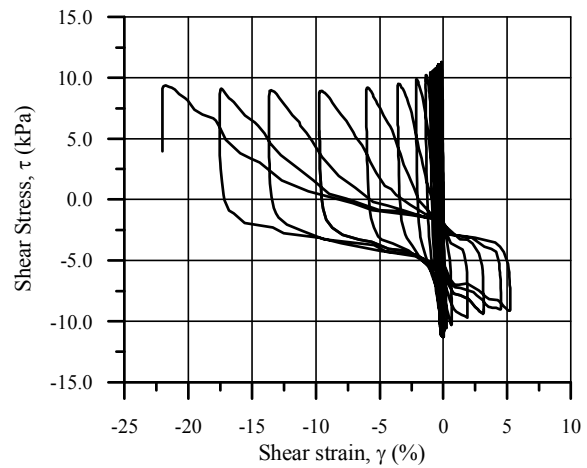
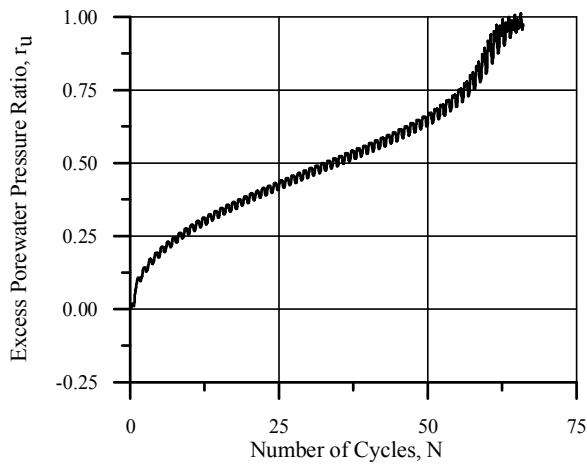
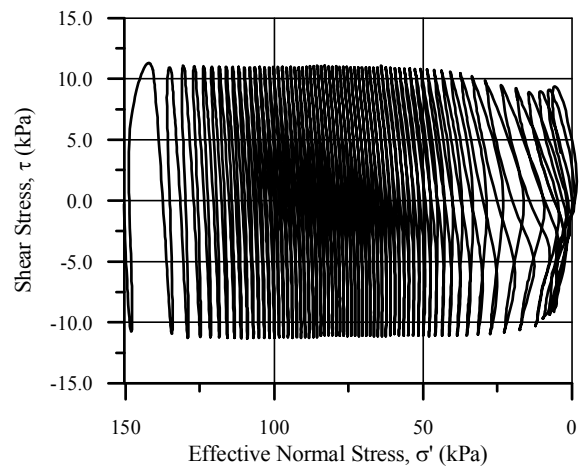
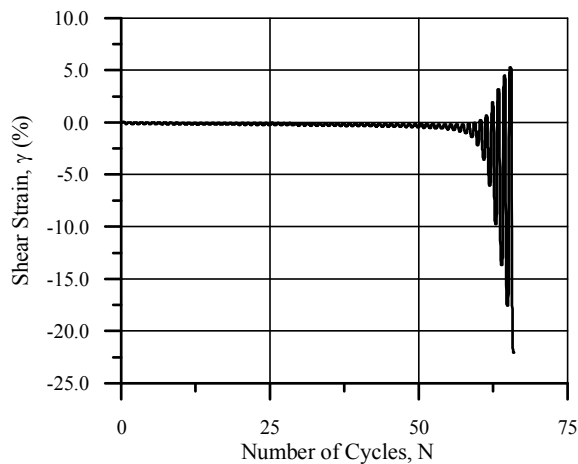
Cyclic Direct Simple Shear Testing

Test No:	TL-11	$\sigma'_{v,c}$ (kPa):	152.6
By:	M. James/L. Weerasekara	e_c :	0.677
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.148
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		1.7
	$r_u(\gamma=3.75\%)$		0.70
	$N_{LIQ}(r_u=1.0)$		2.6



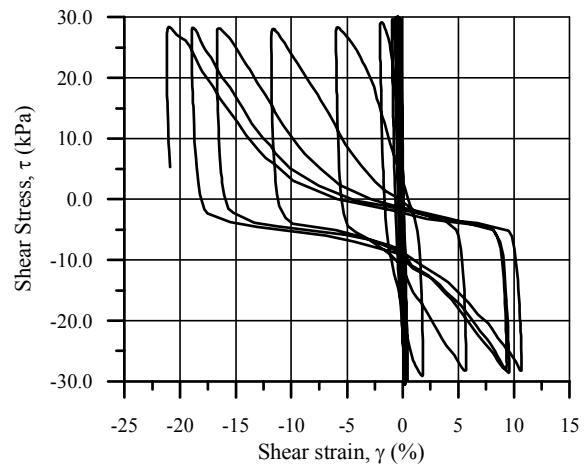
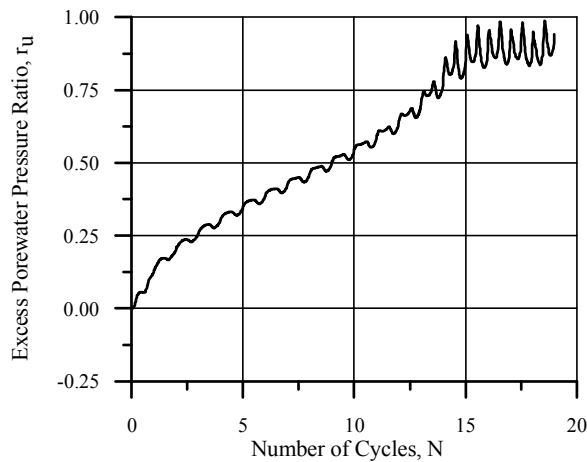
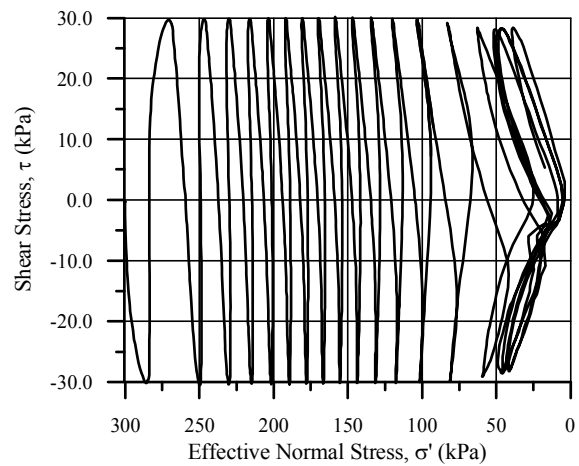
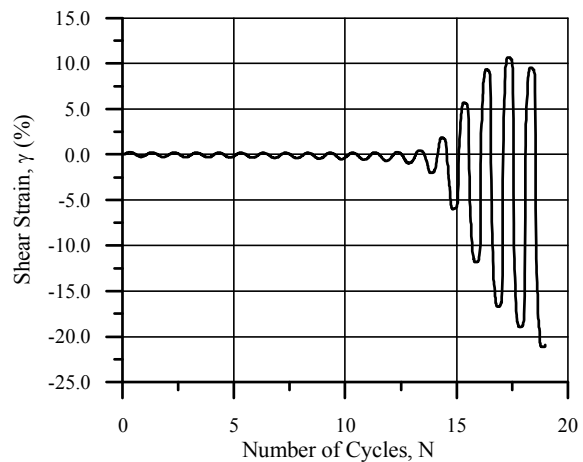
Cyclic Direct Simple Shear Testing

Test No:	TL-12	$\sigma'_{v,c}$ (kPa):	149.7
By:	M. James/L. Weerasekara	e_c :	0.680
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.075
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		61.7
	$r_u(\gamma=3.75\%)$		0.92
	$N_{LIQ}(r_u=1.0)$		64.6



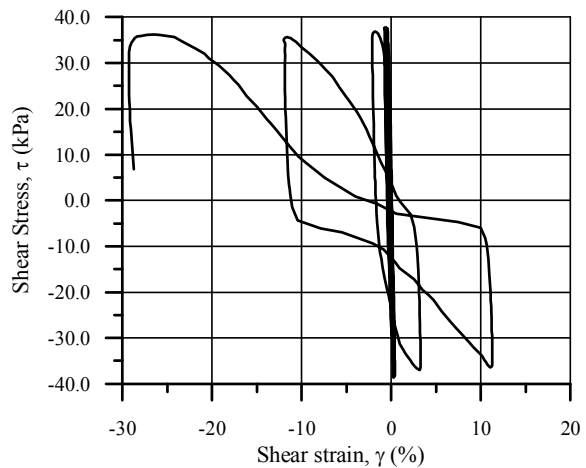
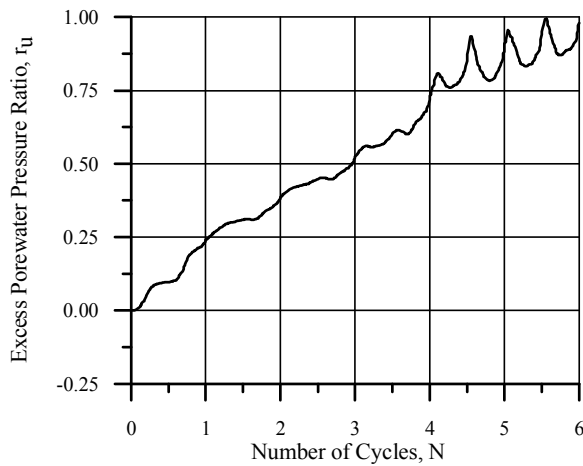
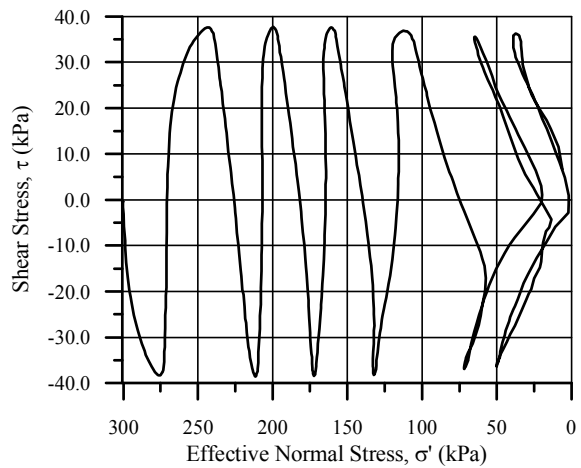
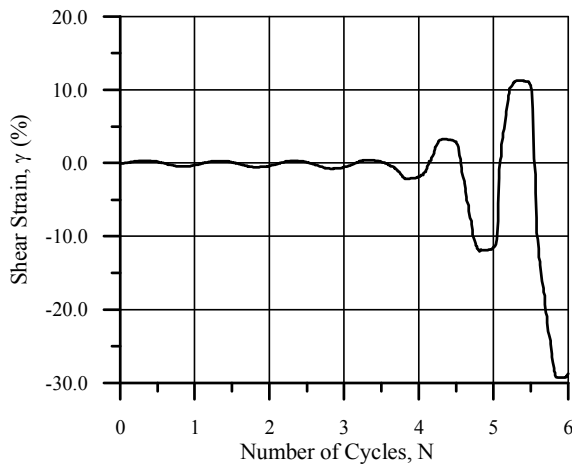
Cyclic Direct Simple Shear Testing

Test No:	TL-13	$\sigma'_{v,c}$ (kPa):	299.6
By:	M. James/L. Weerasekara	e_c :	0.639
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.101
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		14.7
	$r_u(\gamma=3.75\%)$		0.82
	$N_{LIQ}(r_u=1.0)$		18.6



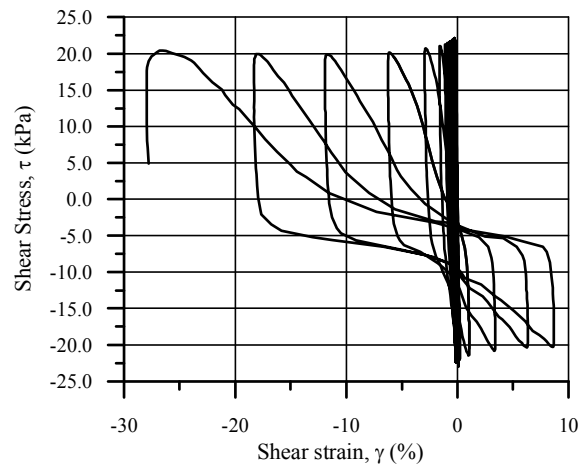
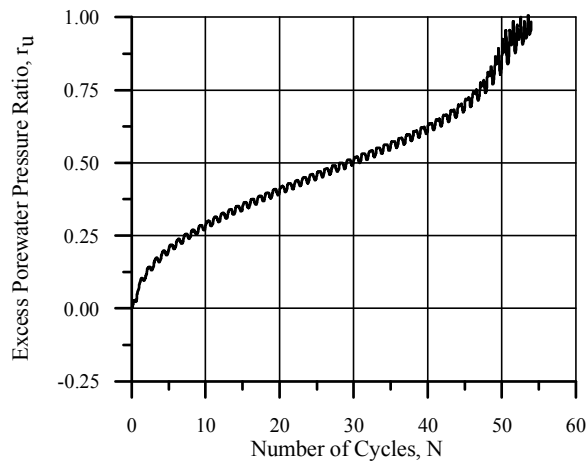
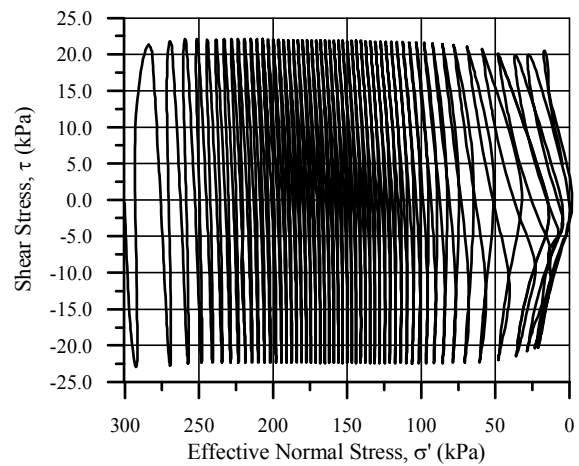
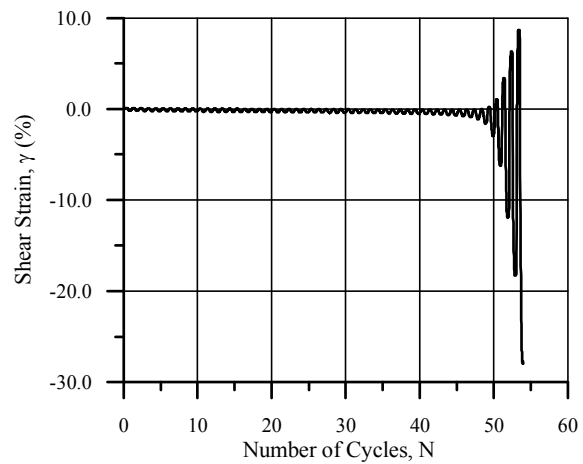
Cyclic Direct Simple Shear Testing

Test No:	TL-14a	$\sigma'_{v,c}$ (kPa):	300.0
By:	M. James/L. Weerasekara	e_c :	0.619
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.127
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		4.6
	$r_u(\gamma=3.75\%)$		0.86
	$N_{LIQ}(r_u=1.0)$		6.0



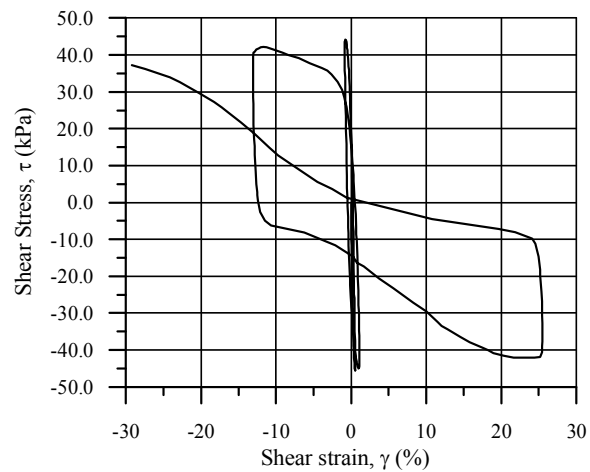
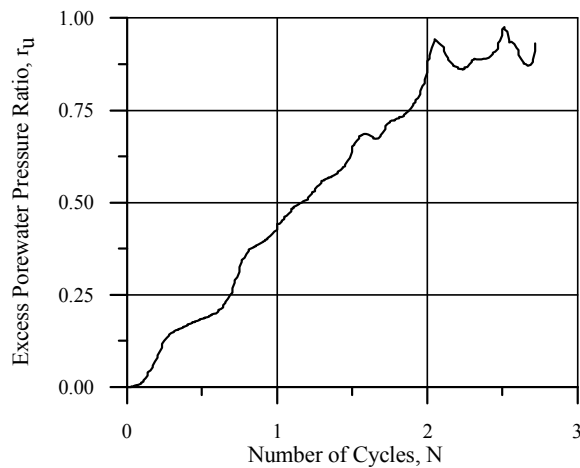
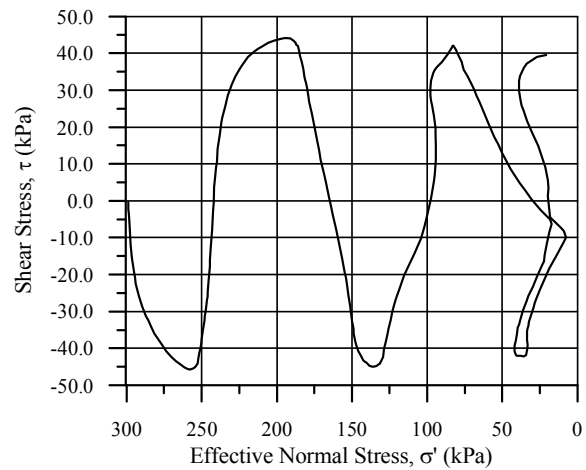
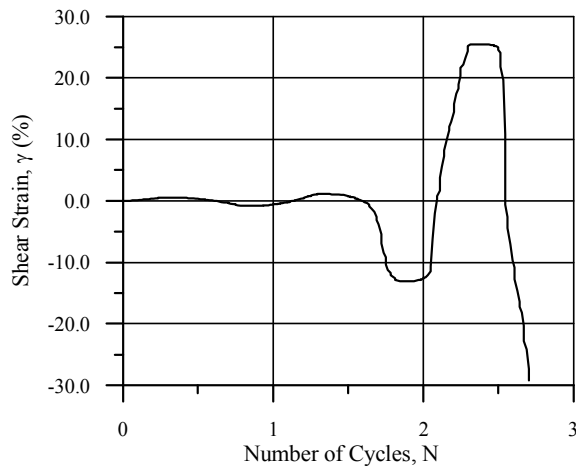
Cyclic Direct Simple Shear Testing

Test No:	TL-15	$\sigma'_{v,c}$ (kPa):	300.7
By:	M. James/L. Weerasekara	e_c :	0.638
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.075
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		50.7
	$r_u(\gamma=3.75\%)$		0.88
	$N_{LIQ}(r_u=1.0)$		53.5



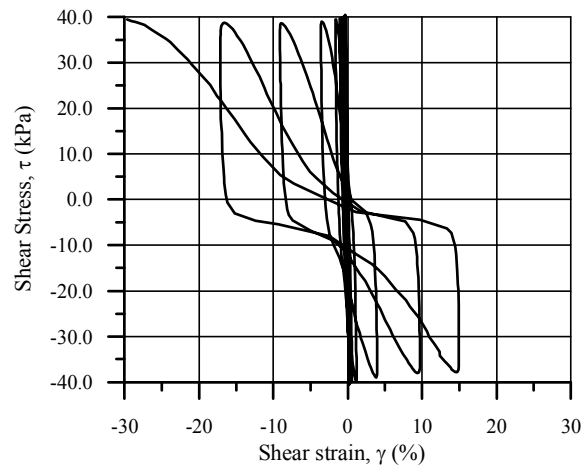
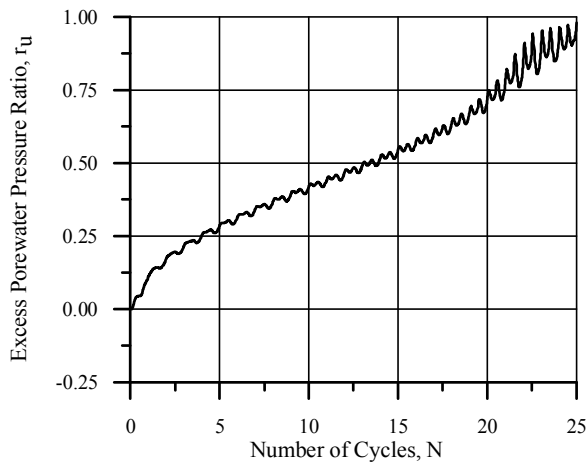
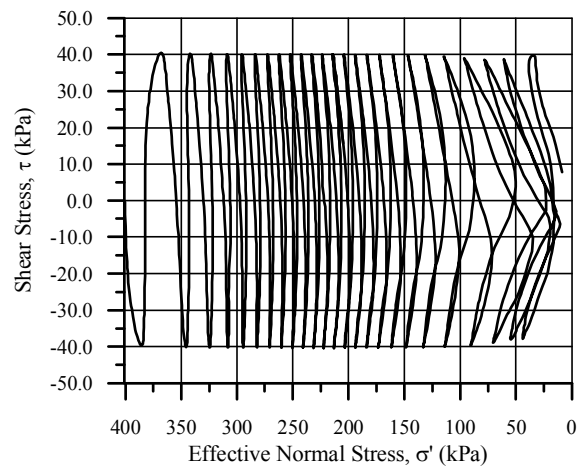
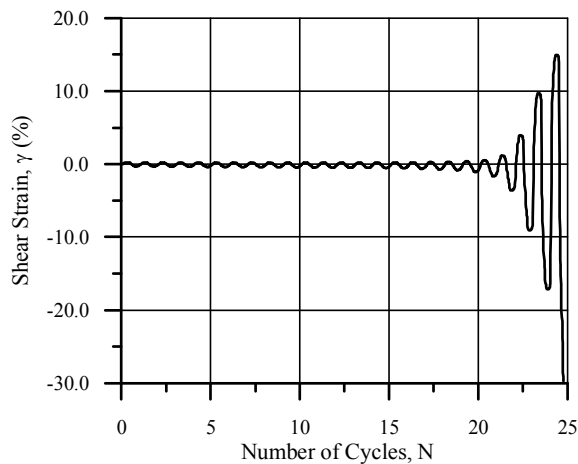
Cyclic Direct Simple Shear Testing

Test No:	TL-16	$\sigma'_{v,c}$ (kPa):	300.9
By:	M. James/L. Weerasekara	e_c :	0.635
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.155
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		1.7
	$r_u(\gamma=3.75\%)$		0.69
	$N_{LIQ}(r_u=1.0)$		2.7



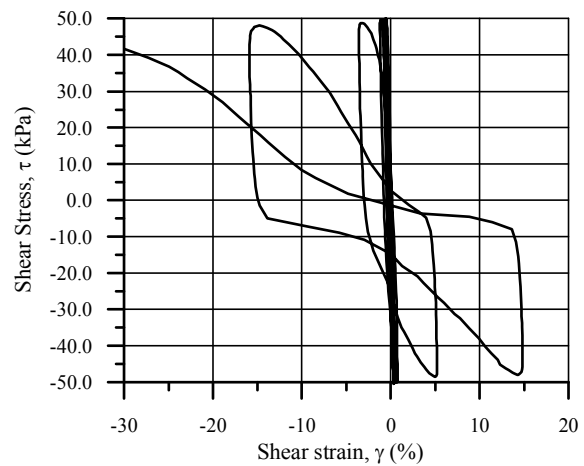
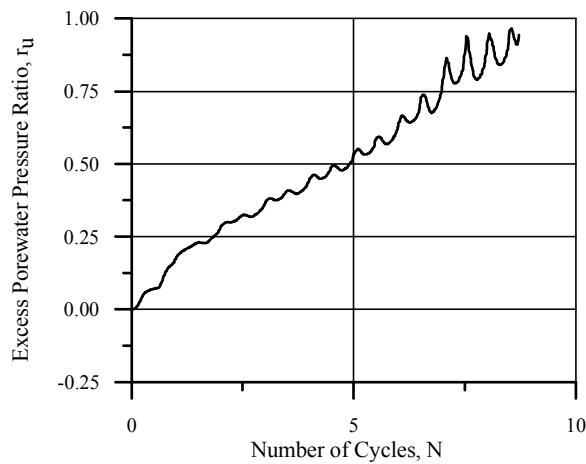
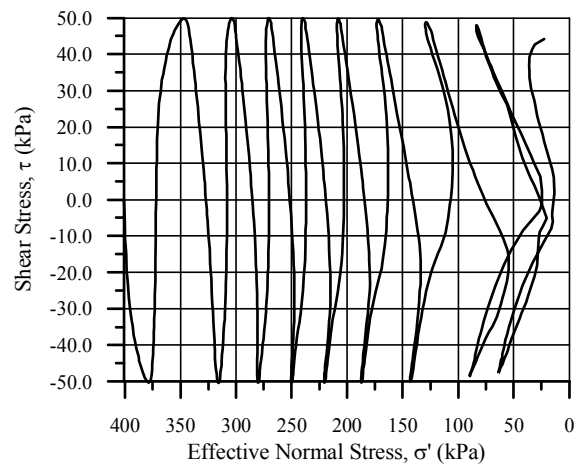
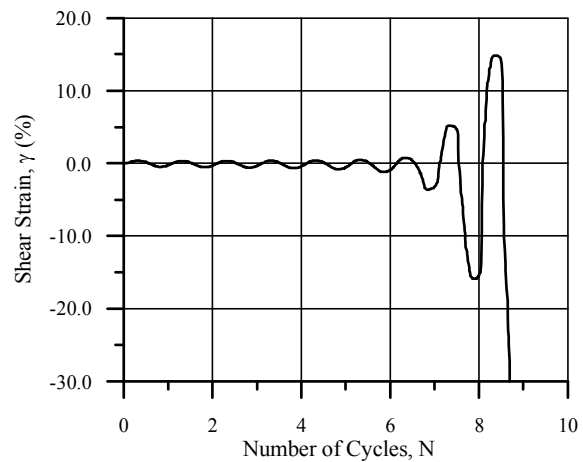
Cyclic Direct Simple Shear Testing

Test No:	TL-17	$\sigma'_{v,c}$ (kPa):	400.6
By:	M. James/L. Weerasekara	e_c :	0.611
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.101
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		22.3
	$r_u(\gamma=3.75\%)$		0.82
	$N_{LIQ}(r_u=1.0)$		25.0



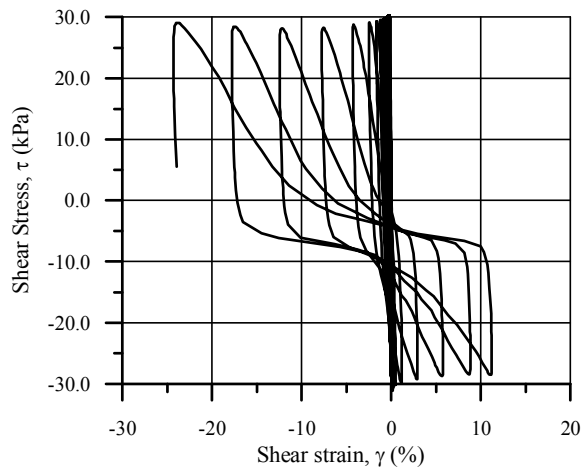
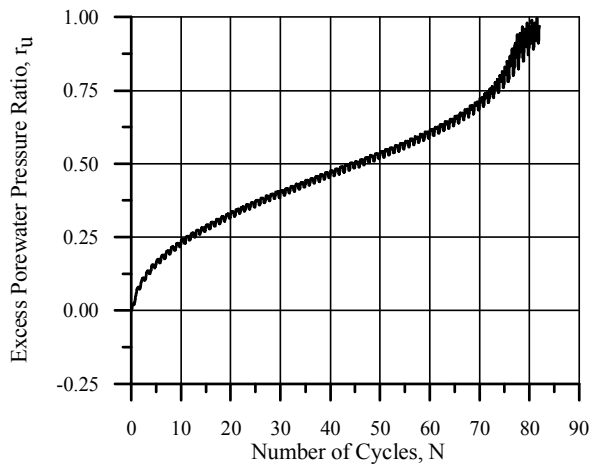
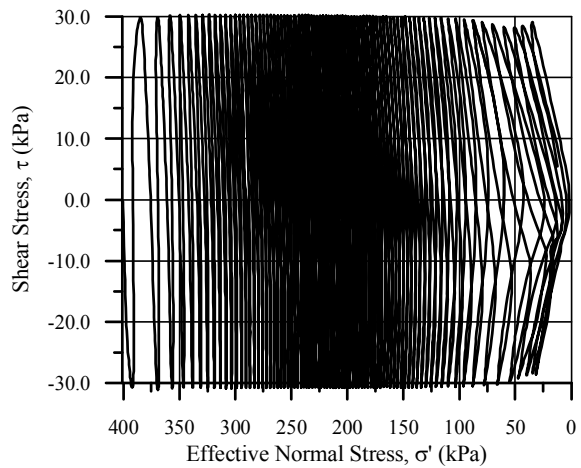
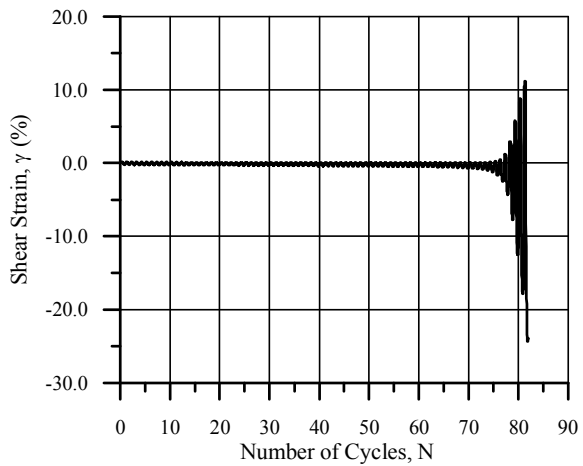
Cyclic Direct Simple Shear Testing

Test No:	TL-18	$\sigma'_{v,c}$ (kPa):	400.4
By:	M. James/L. Weerasekara	e_c :	0.590
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.125
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		7.2
	$r_u(\gamma=3.75\%)$		0.79
	$N_{LIQ}(r_u=1.0)$		8.7



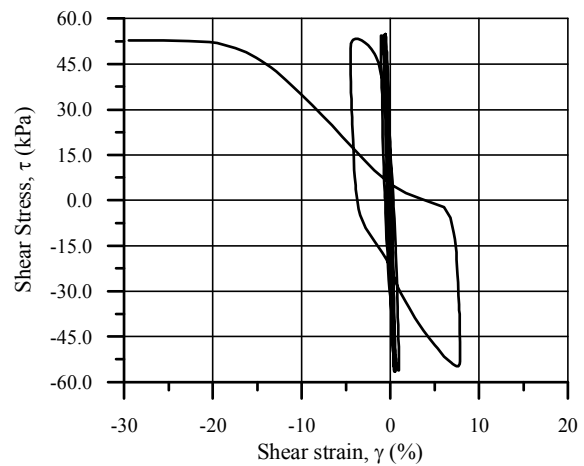
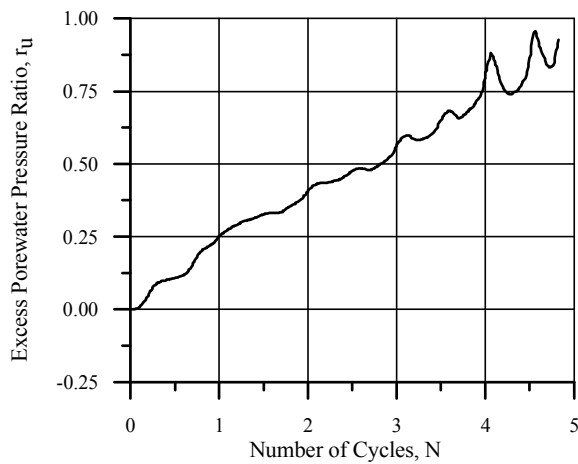
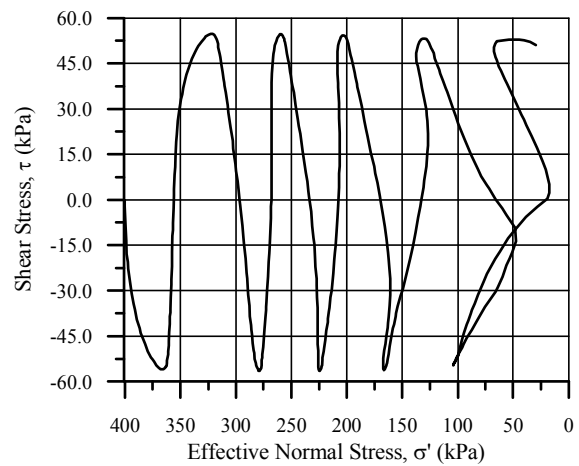
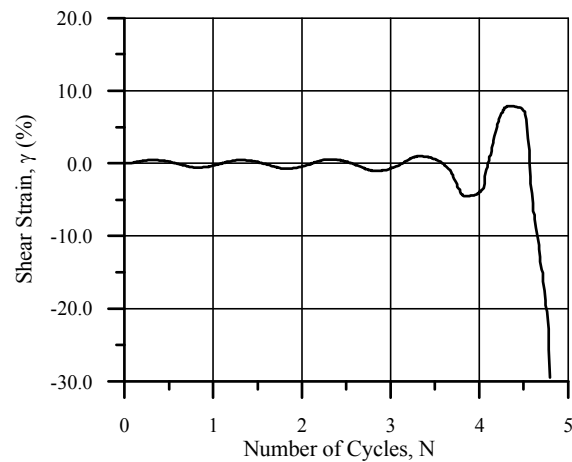
Cyclic Direct Simple Shear Testing

Test No:	TL-19	$\sigma'_{v,c}$ (kPa):	400.5
By:	M. James/L. Weerasekara	e_c :	0.582
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.077
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		77.7
	$r_u(\gamma=3.75\%)$		0.83
	$N_{LIQ}(r_u=1.0)$		81.6



Cyclic Direct Simple Shear Testing

Test No:	TL-20	$\sigma'_{v,c}$ (kPa):	400.7
By:	M. James/L. Weerasekara	e_c :	0.618
Date:	Sept. 2005	$\tau_{cyc}/\sigma'_{v,c}$:	0.139
Testing was conducted at the Civil Engineering Laboratory of the University of British Columbia under the supervision of Dr. Dharma Wijewickreme.	$N_{LIQ}(\gamma=3.75\%)$		3.8
	$r_u(\gamma=3.75\%)$		0.68
	$N_{LIQ}(r_u=1.0)$		4.8



Cyclic Direct Simple Shear Testing



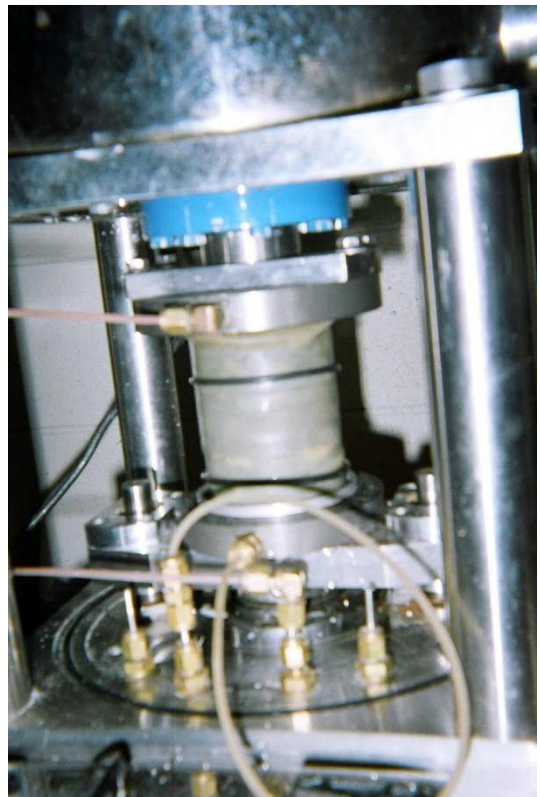
CDSS Testing Device.



Sample in-place, device set-up.



Sample preparation
(slurry deposition)



Sample prior to testing.

INTRODUCTION AND OBJECTIVES

Sample Preparation

The samples were prepared for polished thin sections by impregnating the loose sands with resin. The cutting was done with water, and the polishing with silica diamond. At first, the polishing was performed with 17 micron size, and finally, with 1 micron size.

CONCLUSIONS

Detailed mineralogy of individual samples is presented in the "Petrography" section and the salient features are demonstrated with four photomicrographs for each sample. The mineralogy of individual samples is summarized in Table 1.

The sulfides

The sulfides in tailings from the Rouyn-Noranda and Val d'Or regions (LA) are almost exclusively pyrite. Pyrite are angular, broken fragments with sharp terminations. Several grains are cusped-shaped. The grain sizes range from a few microns to 0.3mm. Other sulfides are rare, and only a few small grains occur among the pyrite. These include chalcopyrite, possibly arsenopyrite and sphalerite. The visually estimated % pyrite in each sample, as well as the ranges in grain size are listed below:

Sample	%	Grain size	Other sulfides
LA	60	15 μ m – 0.3mm	chalcopyrite (ca. 20 grains) +arsenopyrite? (few grains) +sphalerite? (few grains)

Table 1. Summary of Visually Estimated % Minerals in Tailings from the Rouyn-Noranda and Val d'Or areas, Quebec and from Sudbury, Ontario.

Sample Number	LA
Quartz	35
Plagioclase	
Albite	x
K-feldspars	
Amphibole	
Biotite	
Muscovite/sericite	5
Epidote	
Carbonate	x
Clays & chlorite	
Apatite	
Titanite	
Zircon	
Tourmaline?	
Orthopyroxene	
Fragments	
Pyrite	60
Pyrrhotite	
Chalcopyrite	x
Pentlandite	x
Sphalerite?	x
Arsenopyrite?	x
Magnetite	x
Ilmenite	
Rutile	x
Oxyhydroxide	

X = present in trace amount

PETROGRAPHY

Ppl = Plane polarized light

XN = Crossed nicols

Refl. light = Reflected light

Sample Number: LA

Source Rock: Altered felsic rock + pyrite

Petrographic Description:

The minerals and lithic fragments in this sample are more coarse-grained than in the previous samples (BH & LV). The texture however, is comparable, as the pyrite-rich zones are sand-size particles which occur in a silicate rich matrix. Pyrite, which makes up ca. 40% of the thin section are angular, fractured and fragmented grains with sharp terminations. The color of some grains is brighter and appear to be slightly anisotropic. Some sulfides have lozenge shape, which would imply, together with the anisotropism, that they may be arsenopyrite. However, this should be checked by a microprobe or SEM for positive identification. The type of silicates and sulfides in the thin section have a wider range than in samples BH & LV, as the sulfides contain a few grains of chalcopyrite that form rims on the pyrite, as well as a few poorly crystalline sphalerite, magnetite, rutile and oxyhydroxide. The silicates include quartz aggregates, muscovite aggregates and single grains, albite laths, a few grains of carbonate and rutile.

Figure A shows the texture of the sample. Note the numerous, anhedral quartz grains, and the plagioclase lath in the centre.

Figure B shows well developed muscovite aggregates within dark (pyrite-rich) matrix.

Figure C shows a typical fragment that consists of semi-granoblastic quartz. The dark background consists of disseminated pyrite and semi anisotropic sphalerite.

Figure D demonstrates the relationship between pyrite and chalcopyrite, as the chalcopyrite forms a rim on pyrite.

Figure E shows the texture and shape of the angular pyrite. Note the anhedral magnetite grains among the pyrite.

Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Pyrite	60	15µm-0.3mm	Fractured and fragmented pyrite are localized and occur in aggregates (sand-size particles). Their angular shape, and the sharp terminations of grains are comparable to the previous two samples (BH & LV). Some pyrite are rimmed by chalcopyrite, and some by magnetite.
Quartz	35	10µm p to 0.3mm	Quartz occur as broken, angular to subrounded clasts within the pyrite-rich zones, and as part of the matrix interstitial to the sand-size pyrite-rich particles. The quartz often have resorbed grain boundaries and occurs in aggregates

(lithic fragments), some of which contain muscovite and apatite inclusions.

Muscovite	5	20µm-0.3
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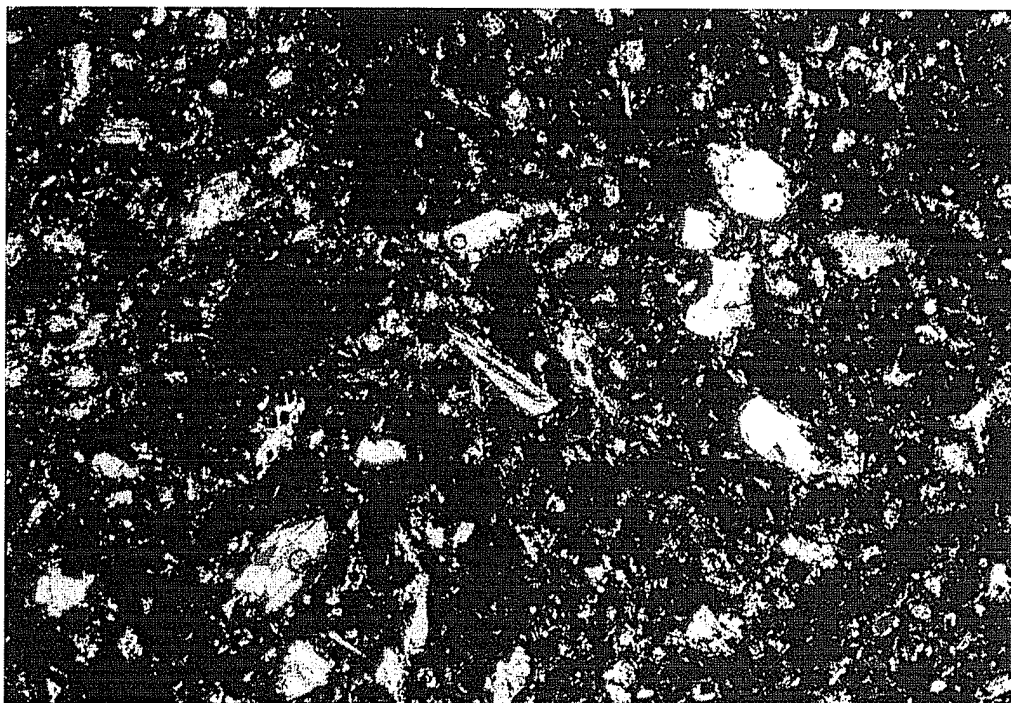
Muscovite occurs in aggregates, as well as single grains. The subhedral/anhydral grains are often intergrown with quartz.

Sericite	2	
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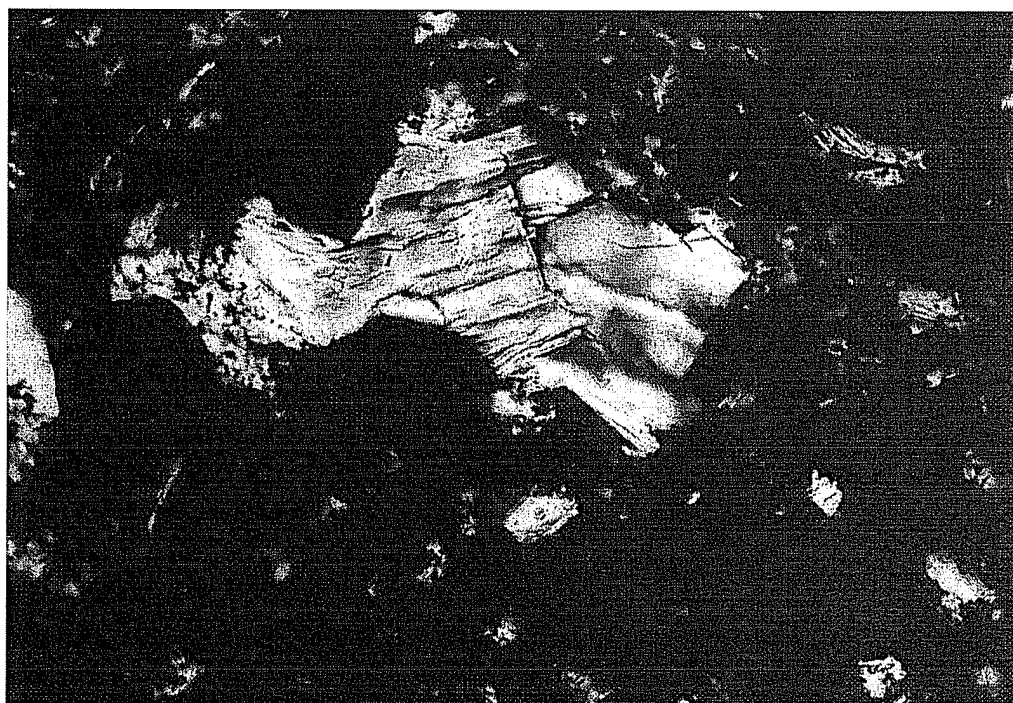
Fine-grained sericite aggregates are common as alteration in lithic fragments. They also occur as slightly fibrous aggregates disseminated through the silicate-rich matrix.

Accessory minerals: albite, rutile, magnetite, sphalerite (?), chalcopryite, carbonate

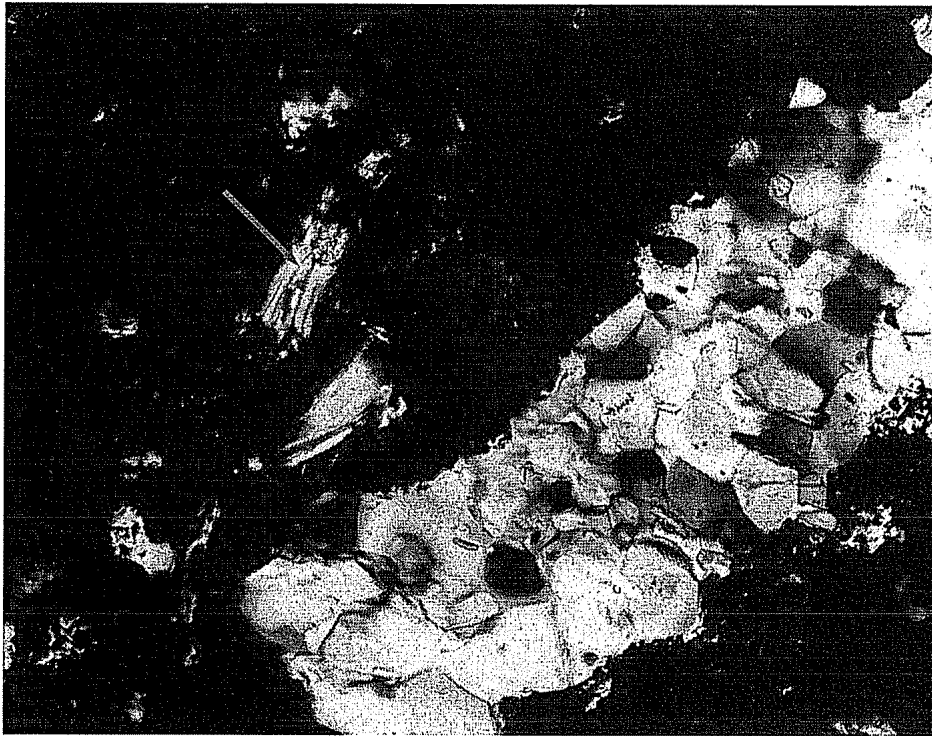
Twinned albite clasts occur within the matrix, and also as part of some lithic fragments. Small, anhydral grains, optically resembling sphalerite were identified among the pyrite aggregates. Anhydral carbonate is interstitial to the silicate-rich matrix, and also occurs in some lithic fragments.



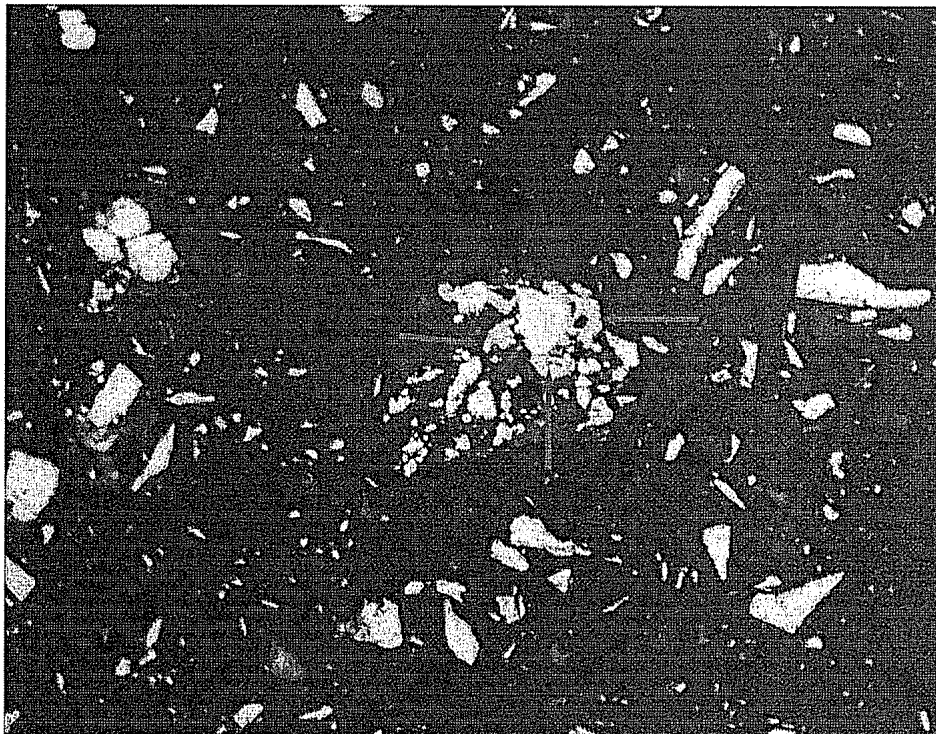
LA-A. Quartz (light colored grains) in dark matrix consisting of pyrite and epoxy. Note small feldspar lath in center. Width of photo: 2.3mm. XN.



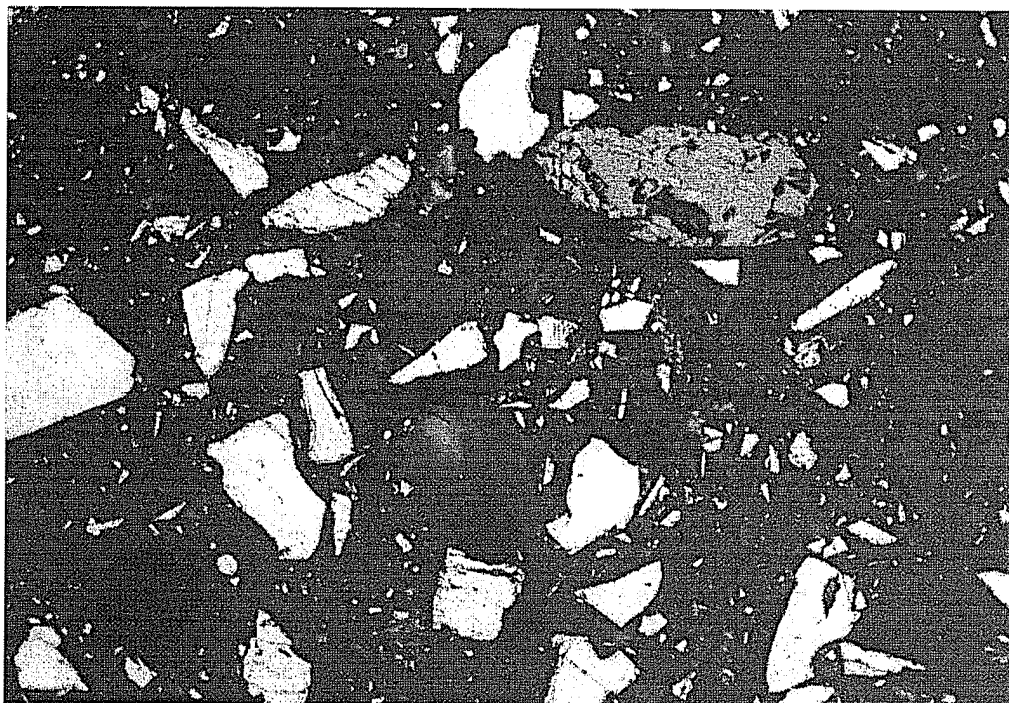
LA-B. Muscovite aggregate (multi-color) is intergrown with feldspar(?). Small light grains are quartz. Width of photo: 0.45mm. XN.



LA-C. Semi-granoblastic quartz and albite aggregate (lithic fragment colored small muscovite (arrow). Width of photo: 0.45mm.



LA-D. Pyrite (in center) is rimmed by chalcopyrite (arrows). Other light are all pyrite. Width of photo: 0.45mm. Refl. light.



LA-E. Angular pyrite fragments and one large grain of sphalerite (?).
Width of photo: 0.45mm. Refl. light.