ATTACHMENT I

RESONANT COLUMN TORSIONAL SHEAR TEST RESULTS

CONSISTS OF:

APPENDIX A – Results for TP-MM1 (pages 3 through 24 of 77)

APPENDIX B – Results for TP-MM2 (pages 25 through 50 of 77)

APPENDIX E – Results for B309-UD2 (pages 51 through 77 of 77)

APPENDIX F – Results for B325-UD4 (pages 3 through 29 of 29)

APPENDIX G – Results for B208-UD3 (pages 3 through 29 of 29)

APPENDIX A

Specimen VCS TP-MM1
SAND (Non-Plastic)

Washed Granitic Screenings from Stockpile
Specimen Prepared by Using Undercompaction in
Four (4) Layers
Depth = ---
Total Unit Weight = 131.9 lb/ft^3
Water Content = 10.7 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 12.1 psi

FUGRO JOB #: 0401-1659
Testing Station: RC6

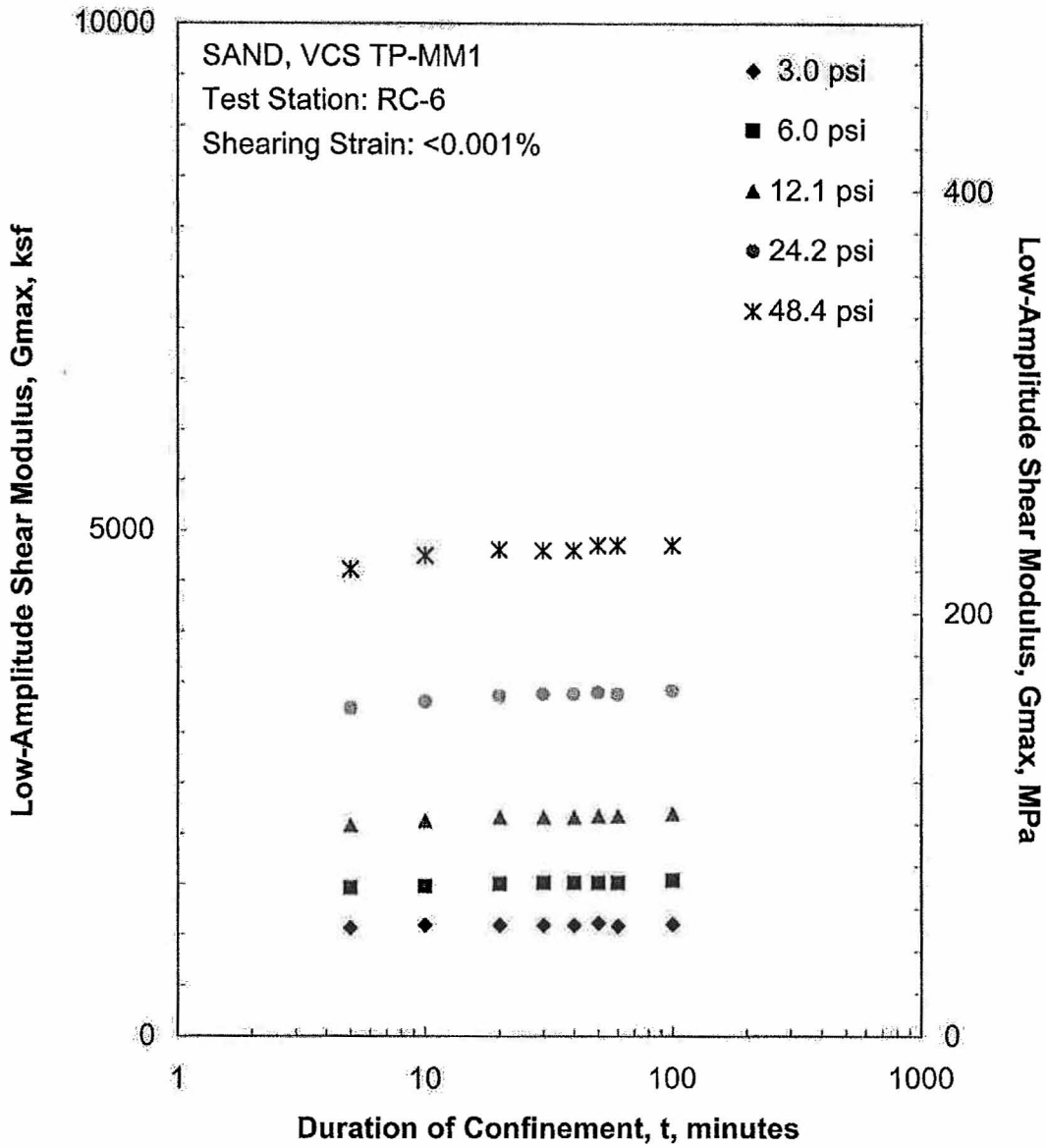

Figure A.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

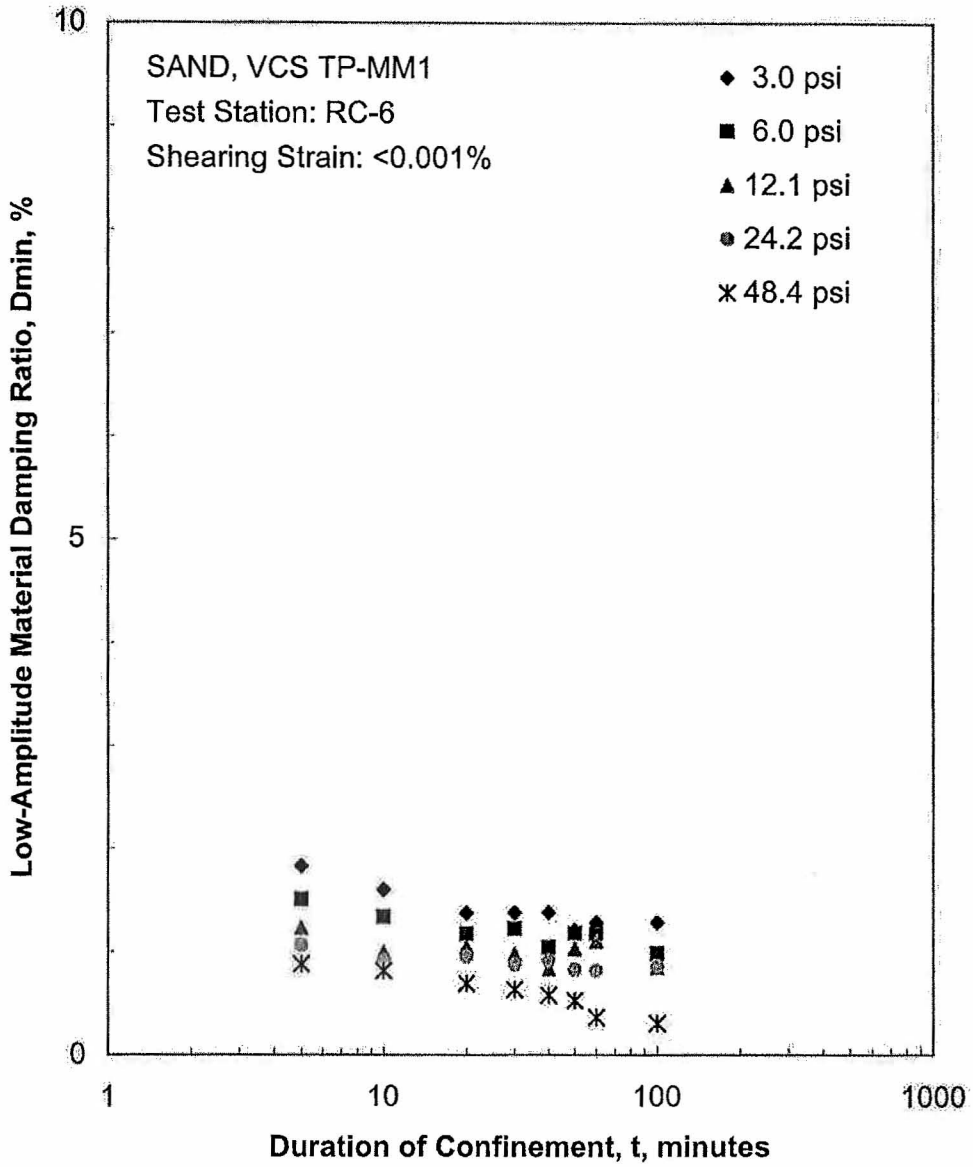

Figure A.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

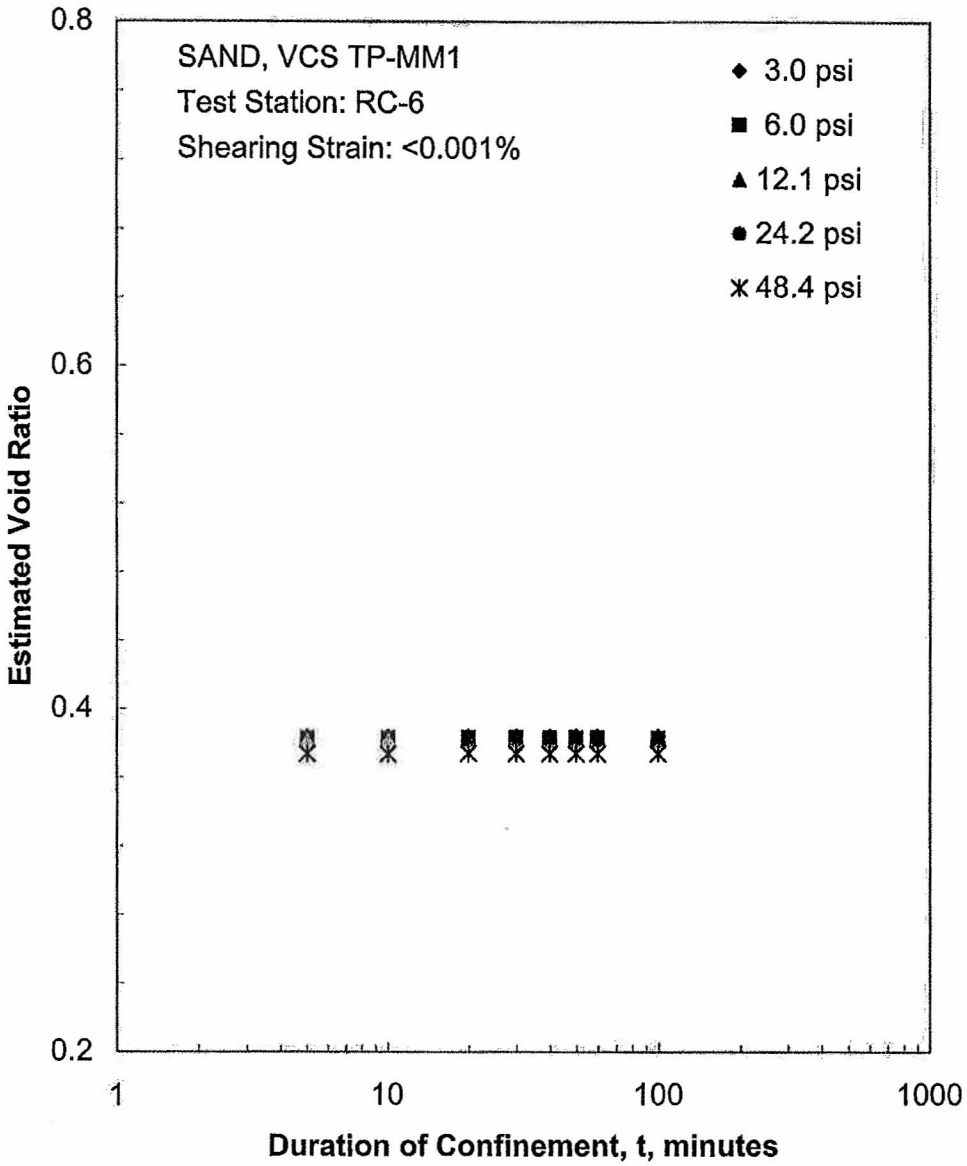

Figure A.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

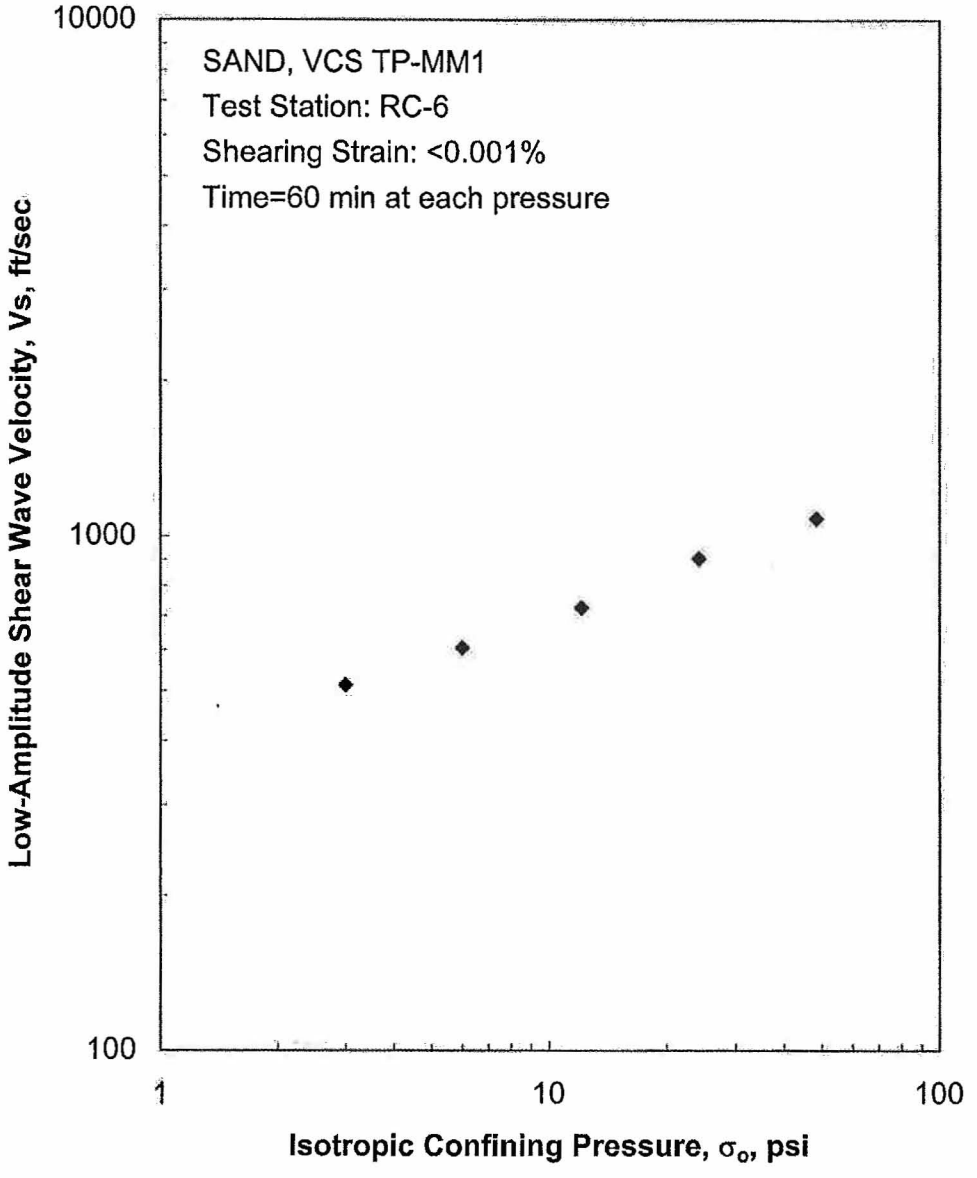

Figure A.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

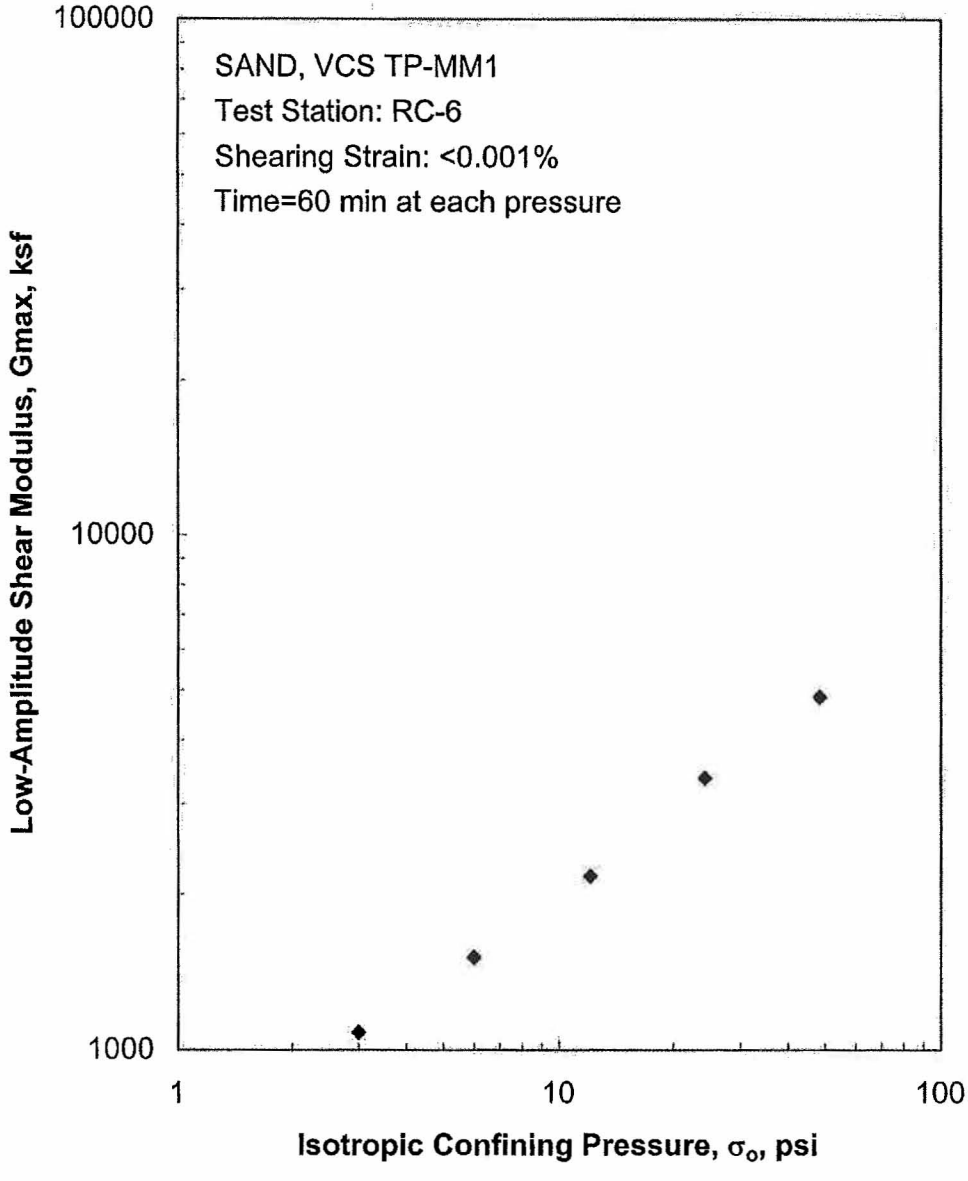

Figure A.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

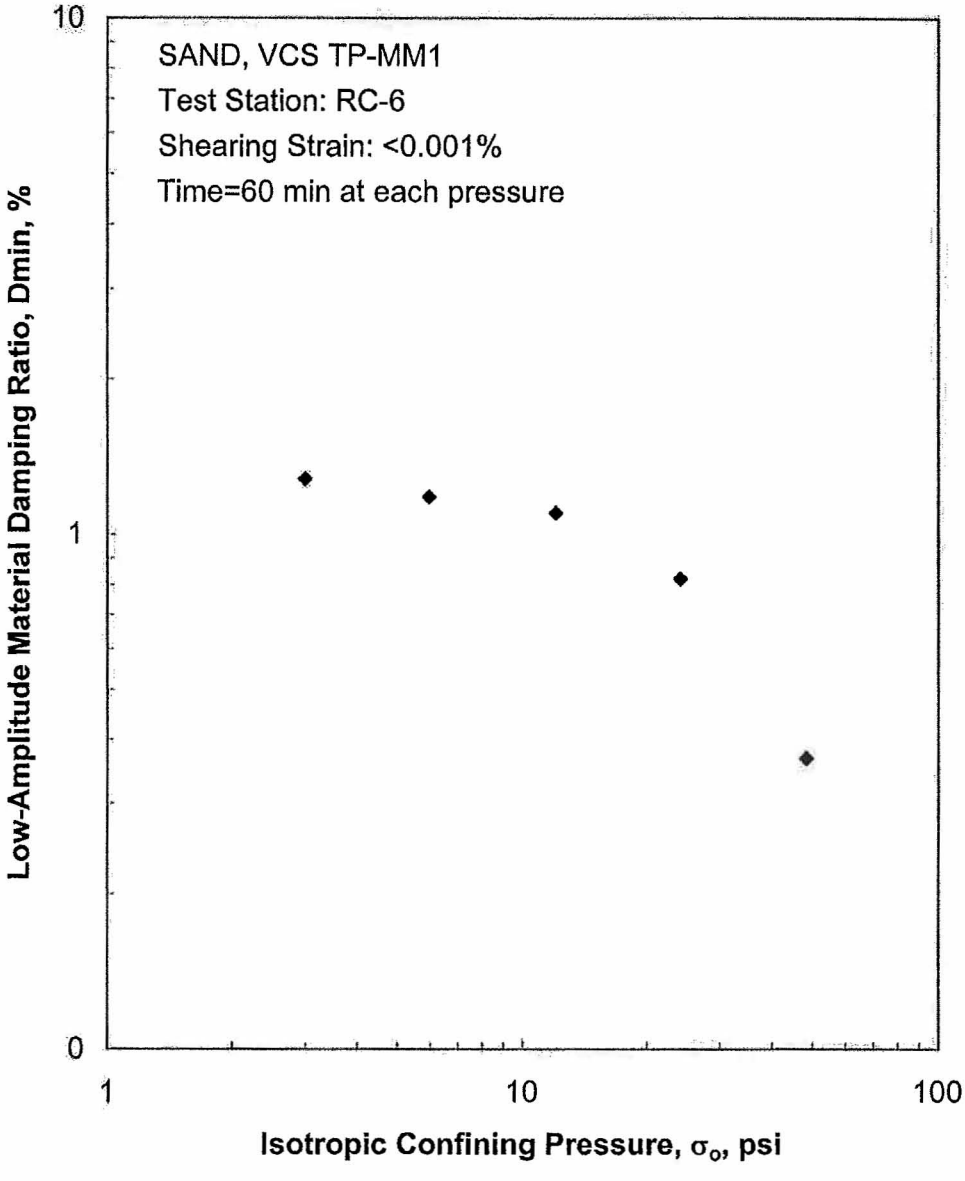

Figure A.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

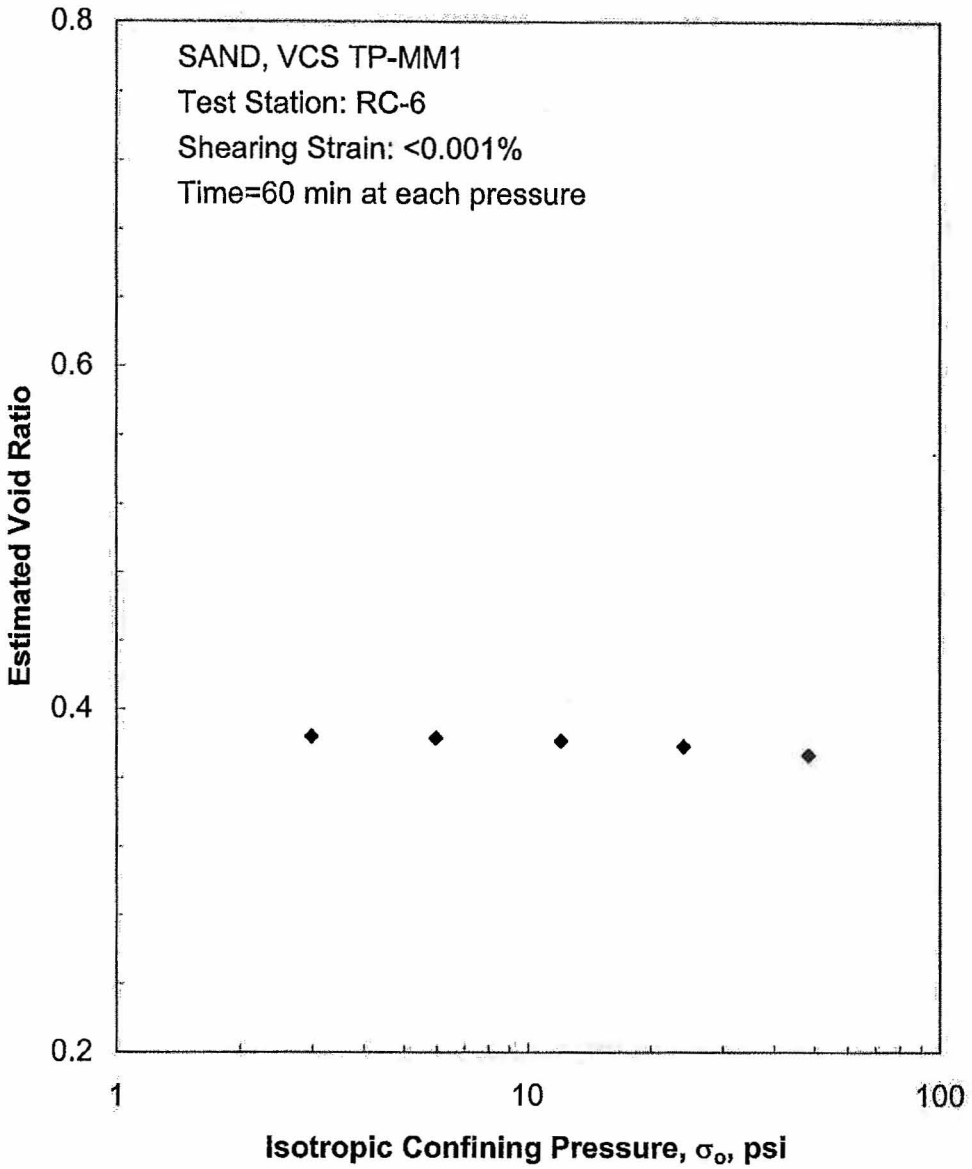

Figure A.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

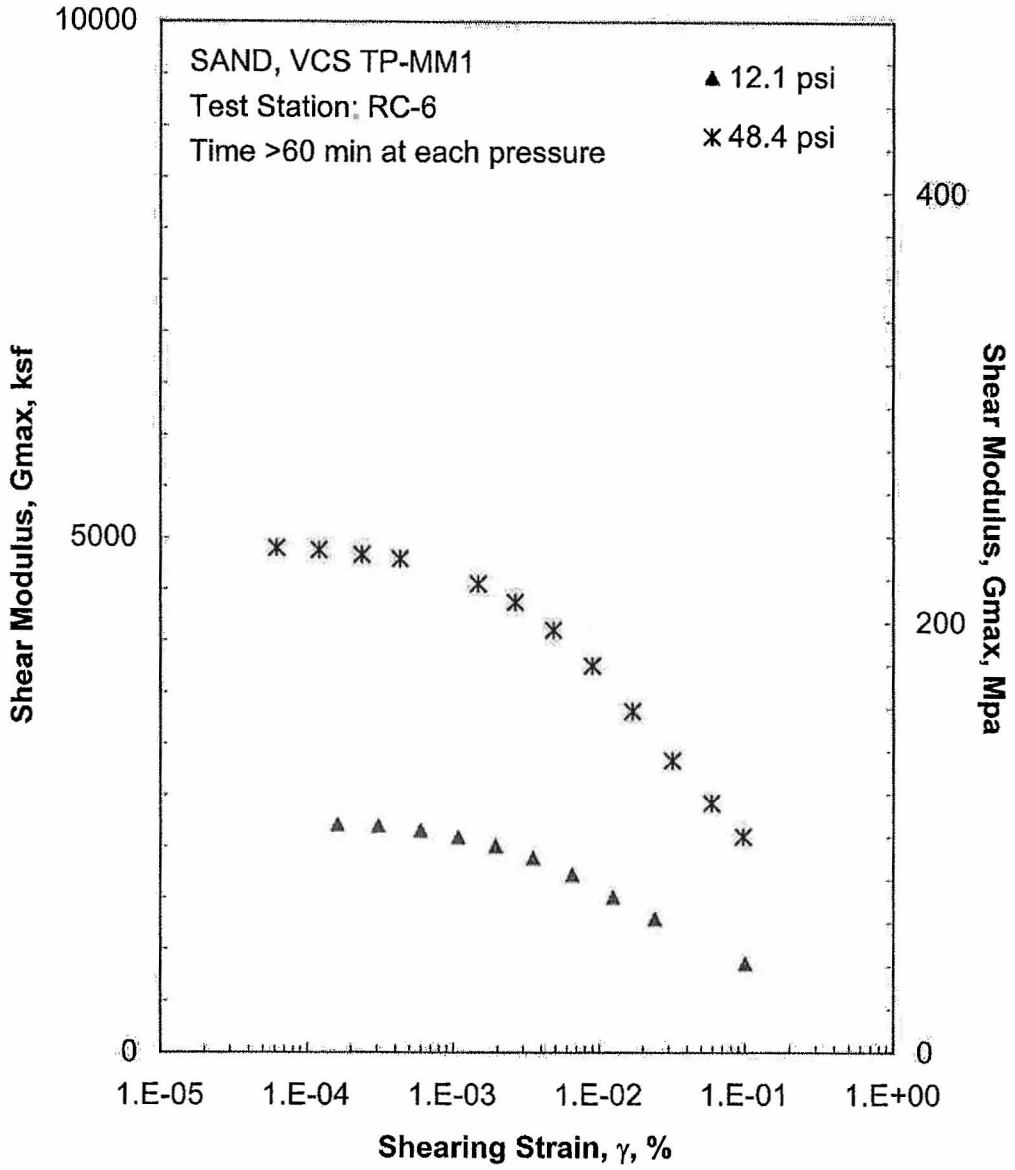

Figure A.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

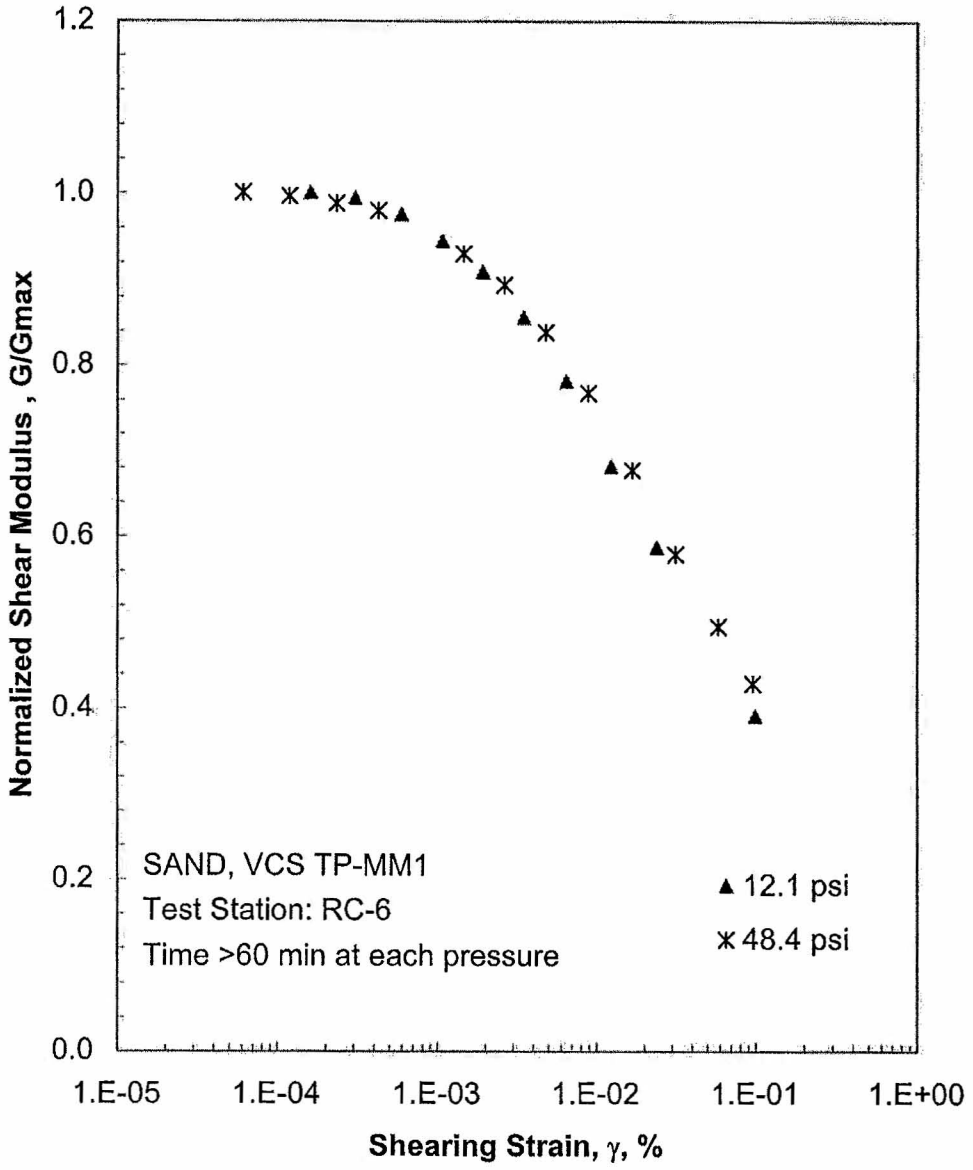

Figure A.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

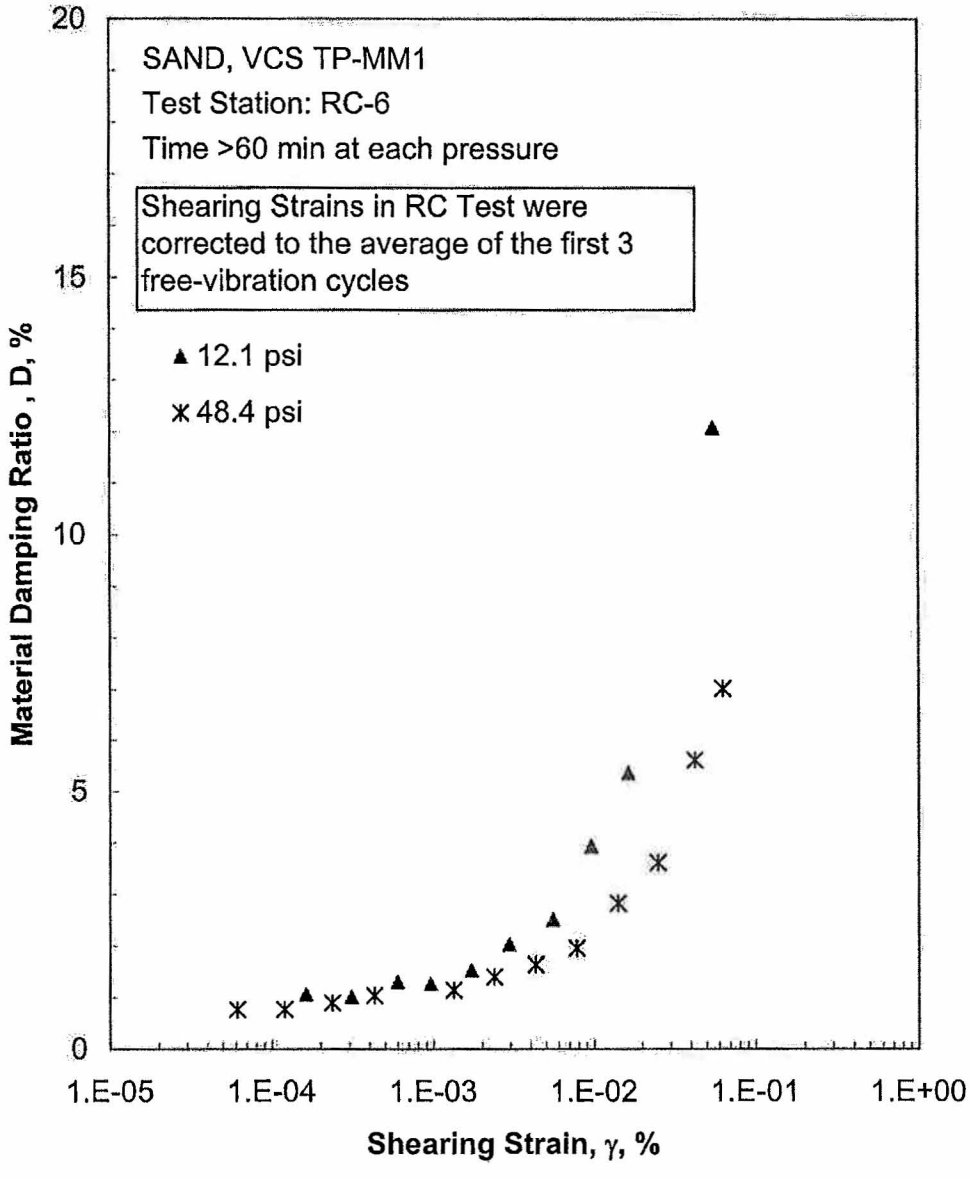

Figure A.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

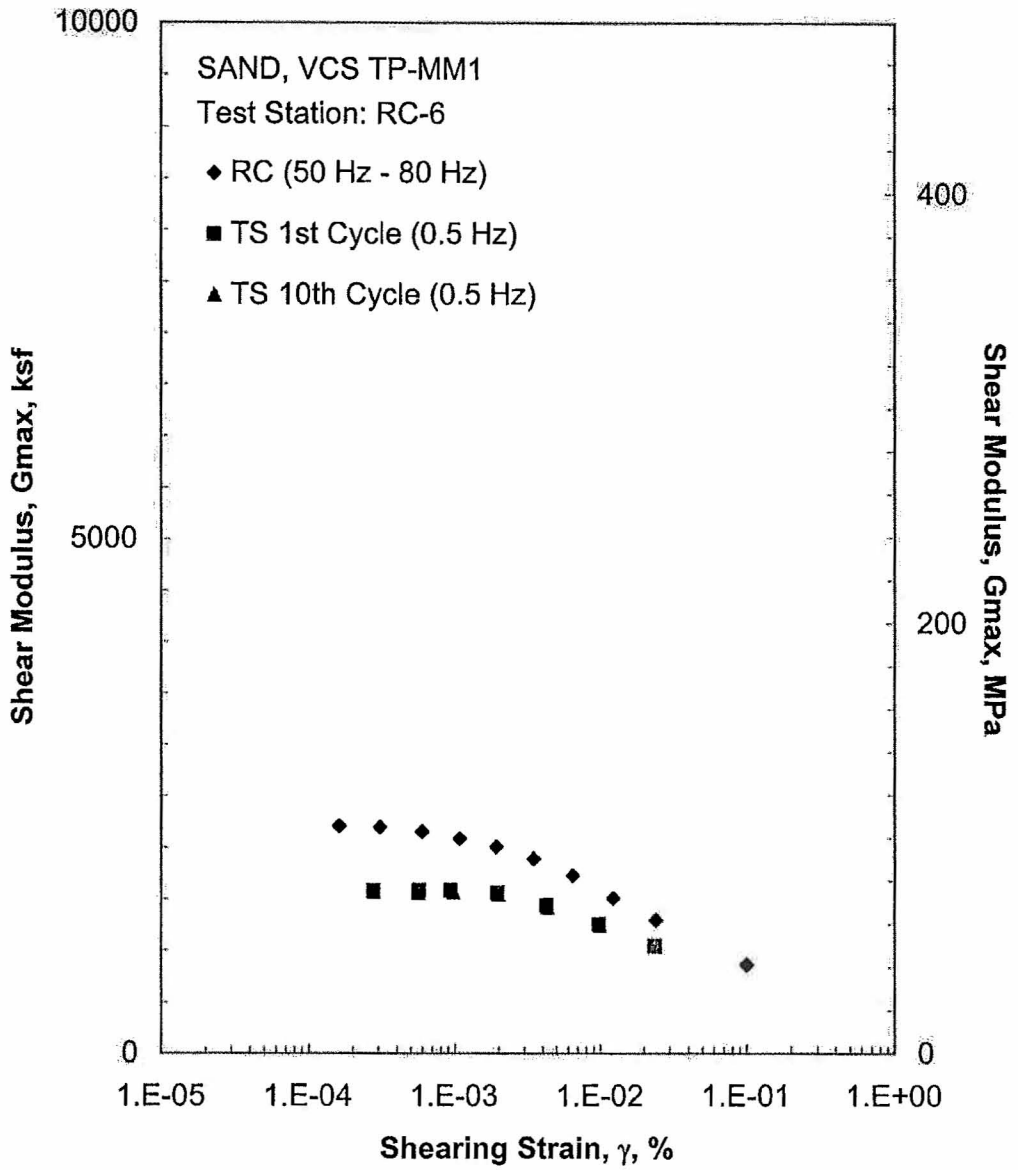

Figure A.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

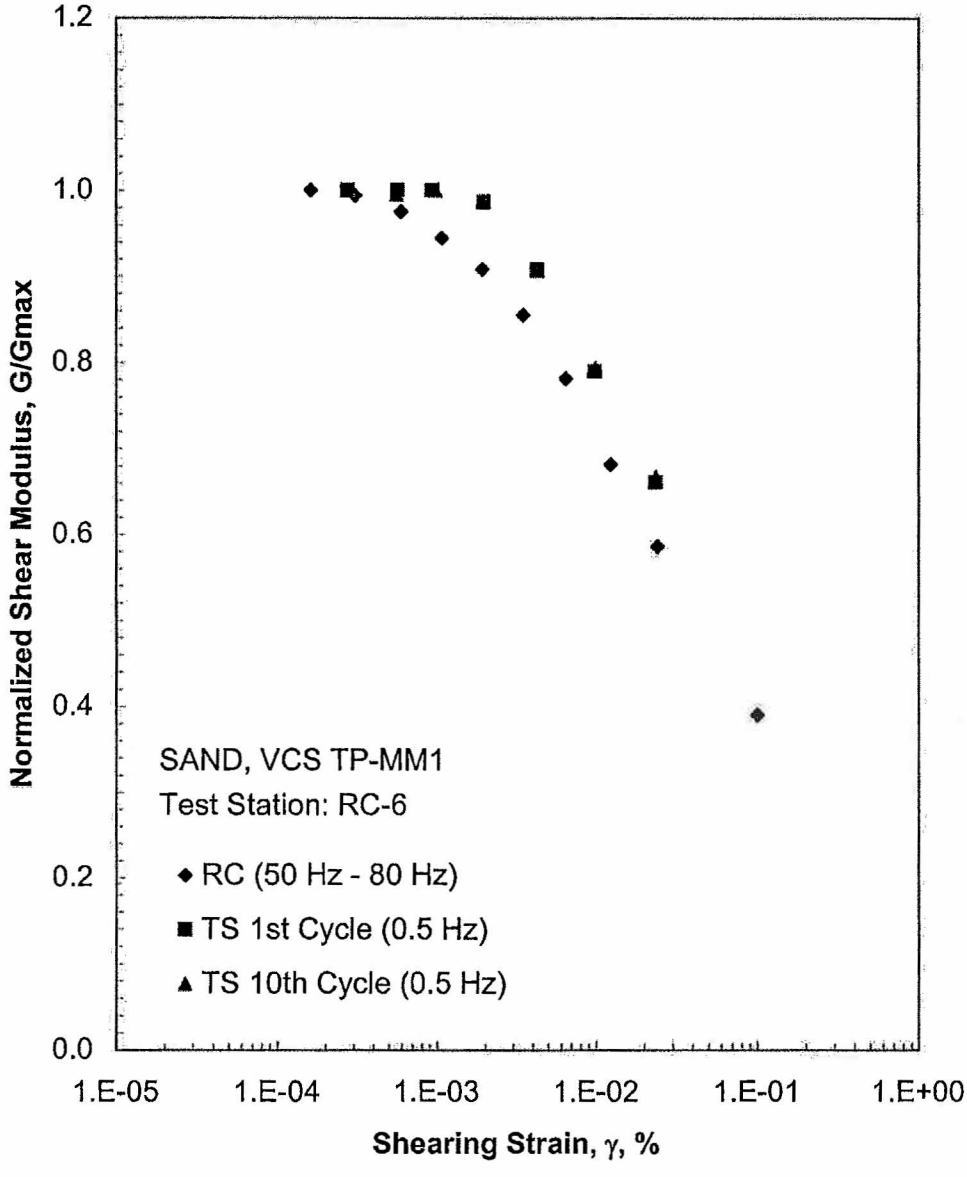

Figure A.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

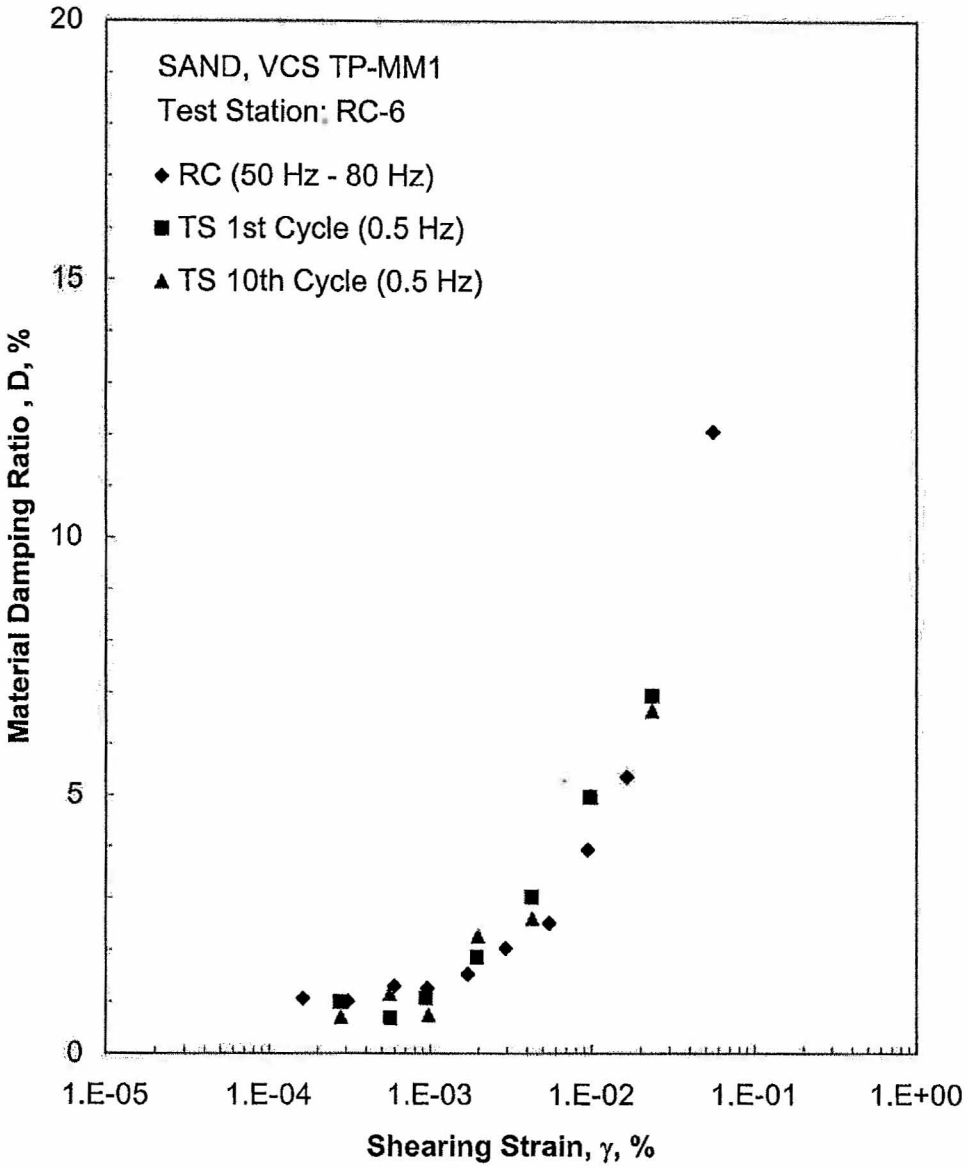

Figure A.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

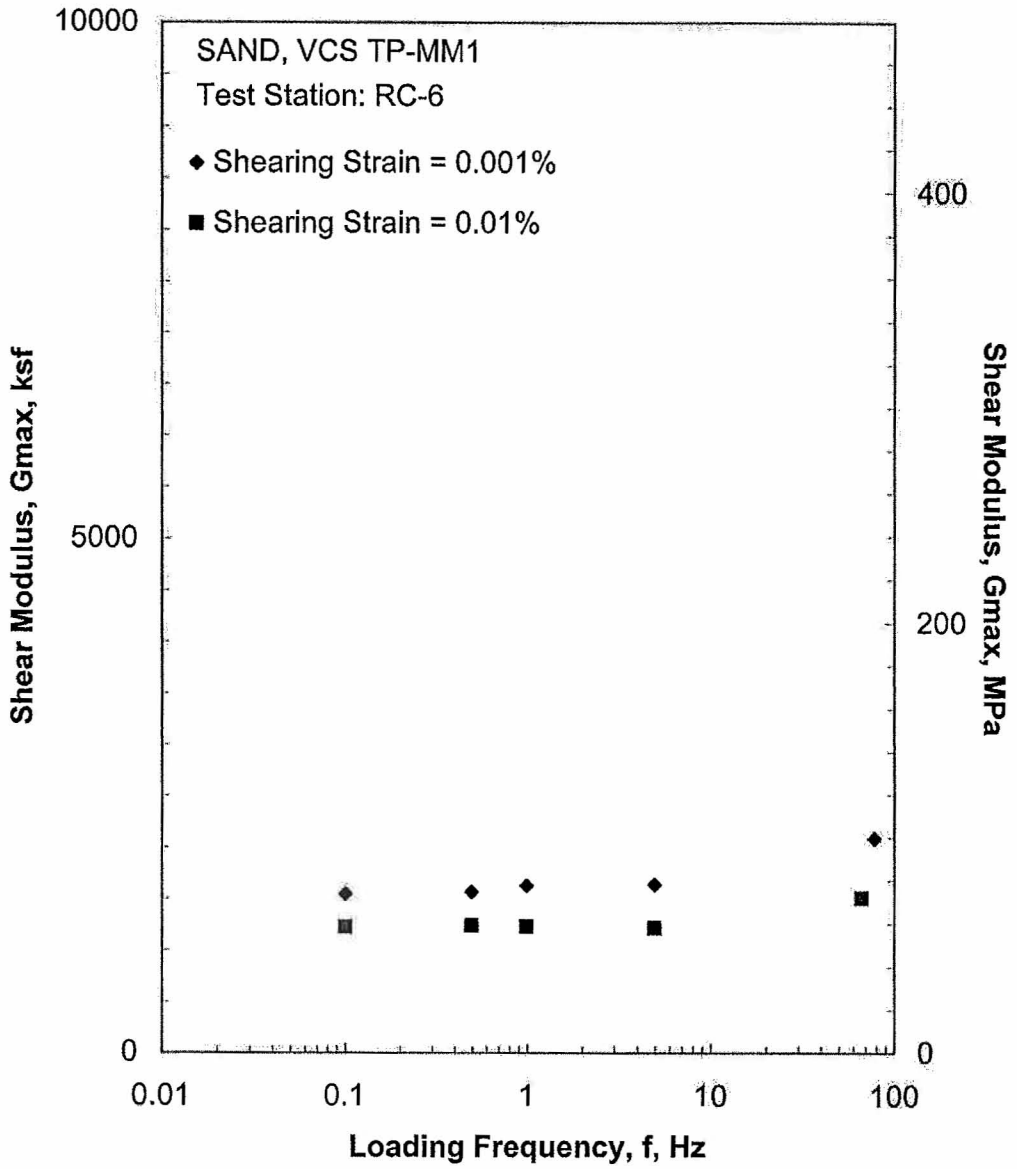

Figure A.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

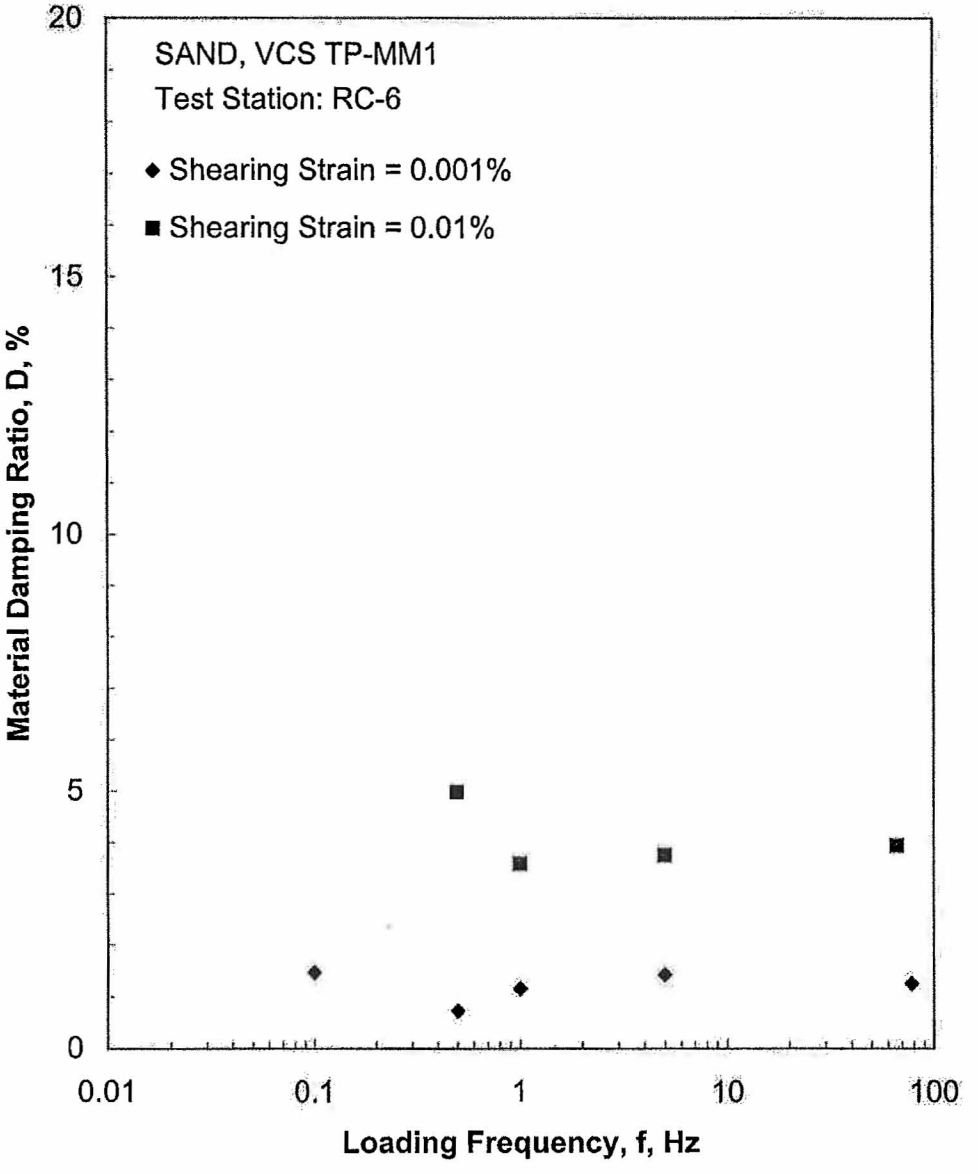

Figure A.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

Figures A.16 through A.20 are NOT available due to the lack of well defined patterns in the TS results.

Table A.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio and Estimated Void Ratio with Isotropic Confining Pressure from RC Tests of Specimen VCS TP-MM1

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, Vs	Low-Amplitude Material Damping Ratio, Dmin	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
3.0	432	21	1082	52	513	1.28	0.384
6.0	864	41	1511	73	606	1.18	0.383
12.1	1742	83	2170	104	726	1.10	0.381
24.2	3485	167	3374	162	904	0.82	0.378
48.4	6970	333	4846	233	1081	0.37	0.373

Table A.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS TP-MM1, Isoptropic Confining Pressure, σ_o=12.1 psi (1.7 ksf = 83 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
1.64E-04	2204	1.00	1.64E-04	1.05
3.12E-04	2190	0.99	3.12E-04	1.00
6.06E-04	2149	0.97	6.06E-04	1.29
1.09E-03	2081	0.94	9.71E-04	1.25
1.95E-03	2001	0.91	1.74E-03	1.52
3.52E-03	1884	0.85	2.99E-03	2.02
6.52E-03	1721	0.78	5.54E-03	2.51
1.25E-02	1501	0.68	9.59E-03	3.93
2.41E-02	1292	0.59	1.64E-02	5.36
1.00E-01	860	0.39	5.60E-02	12.06

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table A.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS TP-MM1; Isotropic Confining Pressure, σ_o=12.1 psi (1.7 ksf = 83 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
2.81E-04	1578	1.00	0.98	2.82E-04	1560	1.00	0.69
5.73E-04	1578	1.00	0.68	5.68E-04	1553	0.99	1.13
9.50E-04	1578	1.00	1.05	9.89E-04	1561	1.00	0.73
1.99E-03	1556	0.99	1.84	2.01E-03	1539	0.99	2.25
4.32E-03	1431	0.91	3.00	4.37E-03	1415	0.91	2.59
9.93E-03	1245	0.79	4.94	9.98E-03	1238	0.79	4.97
2.37E-02	1042	0.66	6.92	2.38E-02	1040	0.67	6.63

Table A.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS TP-MM1; Isoptropic Confining Pressure, σ_o= 48.4 psi (7.0 ksf = 333 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
6.20E-05	4898	1.00	6.20E-05	0.76
1.21E-04	4877	1.00	1.21E-04	0.76
2.38E-04	4836	0.99	2.38E-04	0.89
4.34E-04	4795	0.98	4.34E-04	1.03
1.48E-03	4552	0.93	1.35E-03	1.13
2.66E-03	4373	0.89	2.42E-03	1.39
4.85E-03	4103	0.84	4.31E-03	1.64
8.99E-03	3756	0.77	7.82E-03	1.96
1.70E-02	3316	0.68	1.41E-02	2.83
3.17E-02	2833	0.58	2.51E-02	3.61
5.86E-02	2419	0.49	4.28E-02	5.60
9.67E-02	2096	0.43	6.38E-02	6.99

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table A.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS TP-MM1; Isotropic Confining Pressure, σ_o= 48.4 psi (7.0 ksf = 333 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus,	Material Damping Ratio, D,	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus,	Material Damping Ratio, D, %
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---* Results are not available to establish well defined patterns.

APPENDIX B

Specimen VCS TP-MM2
SAND (Non-Plastic)

Washed Granitic Screenings from Stockpile
Specimen Prepared by Using Undercompaction in
Four (4) Layers
Depth = ---
Total Unit Weight = 128.9 lb/ft^3
Water Content = 8.1 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 12.1 psi

FUGRO JOB #: 0401-1659
Testing Station: RC6

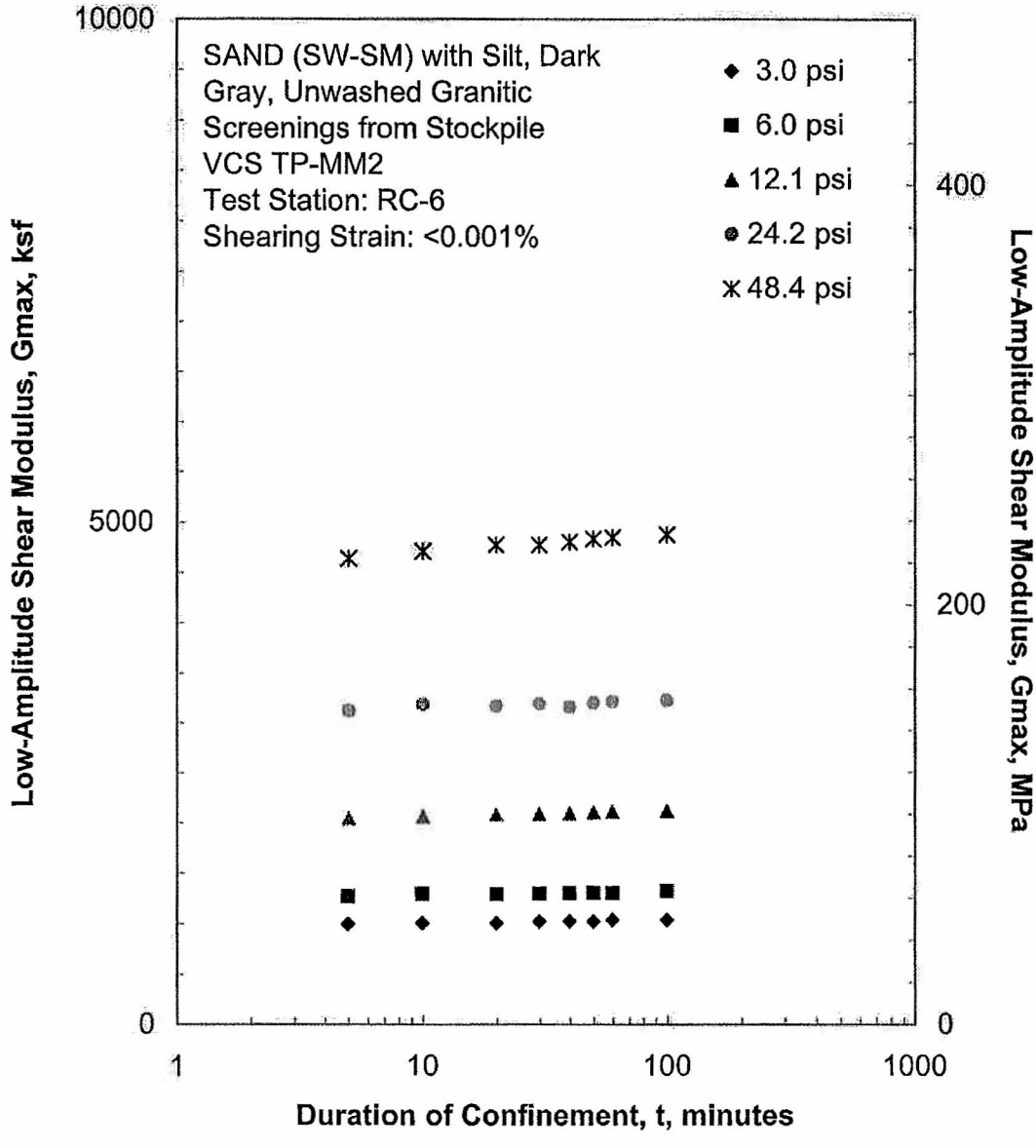


Figure B.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

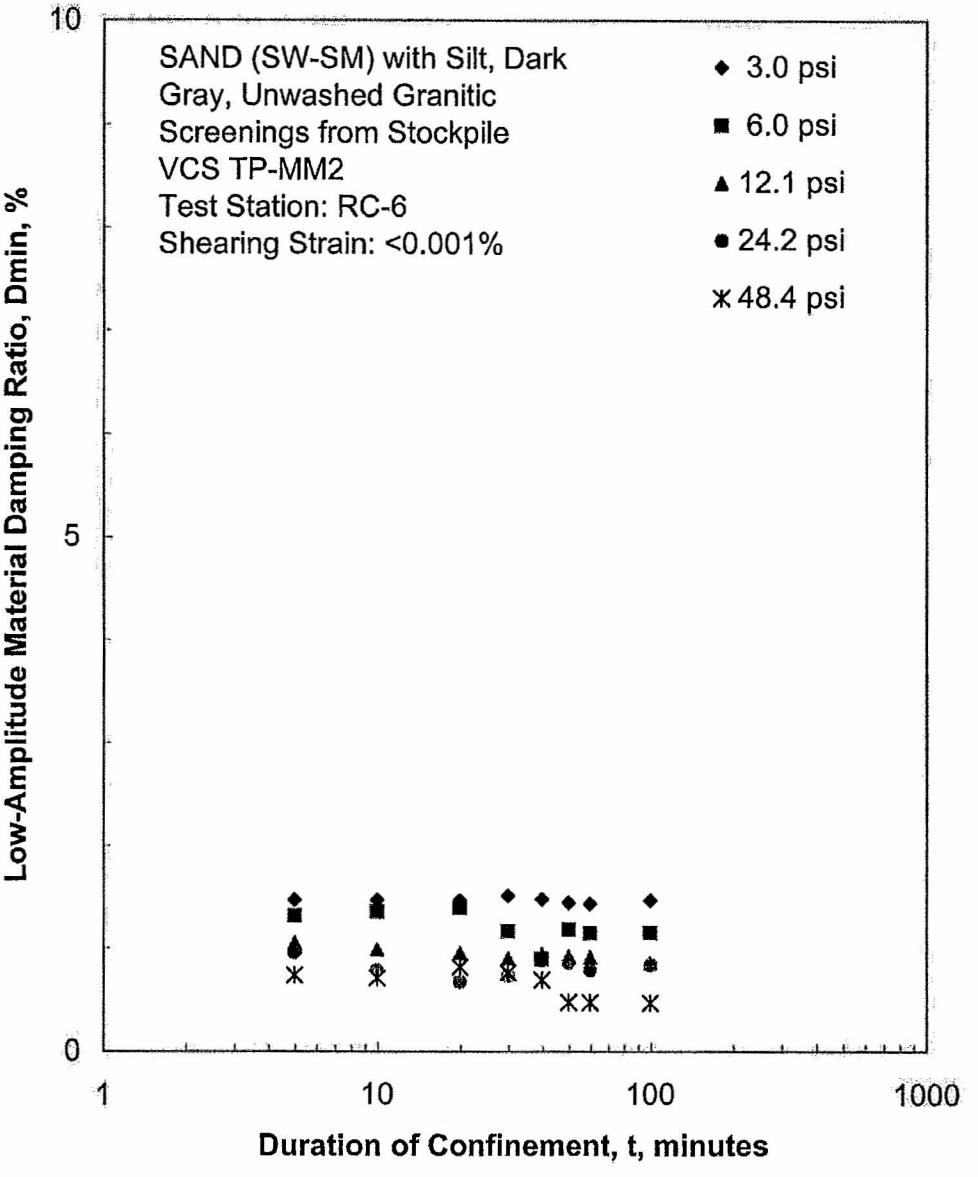


Figure B.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

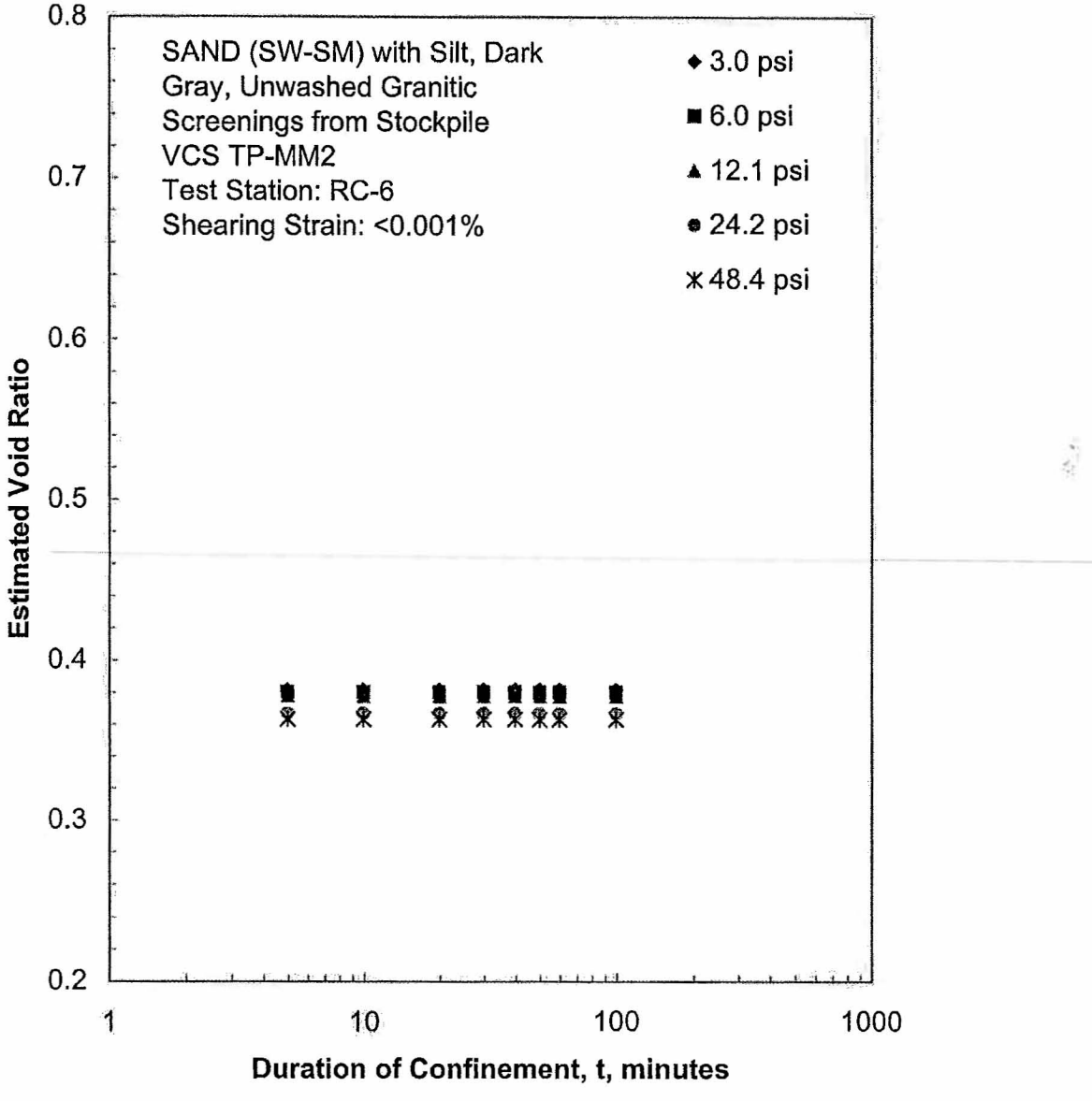


Figure B.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

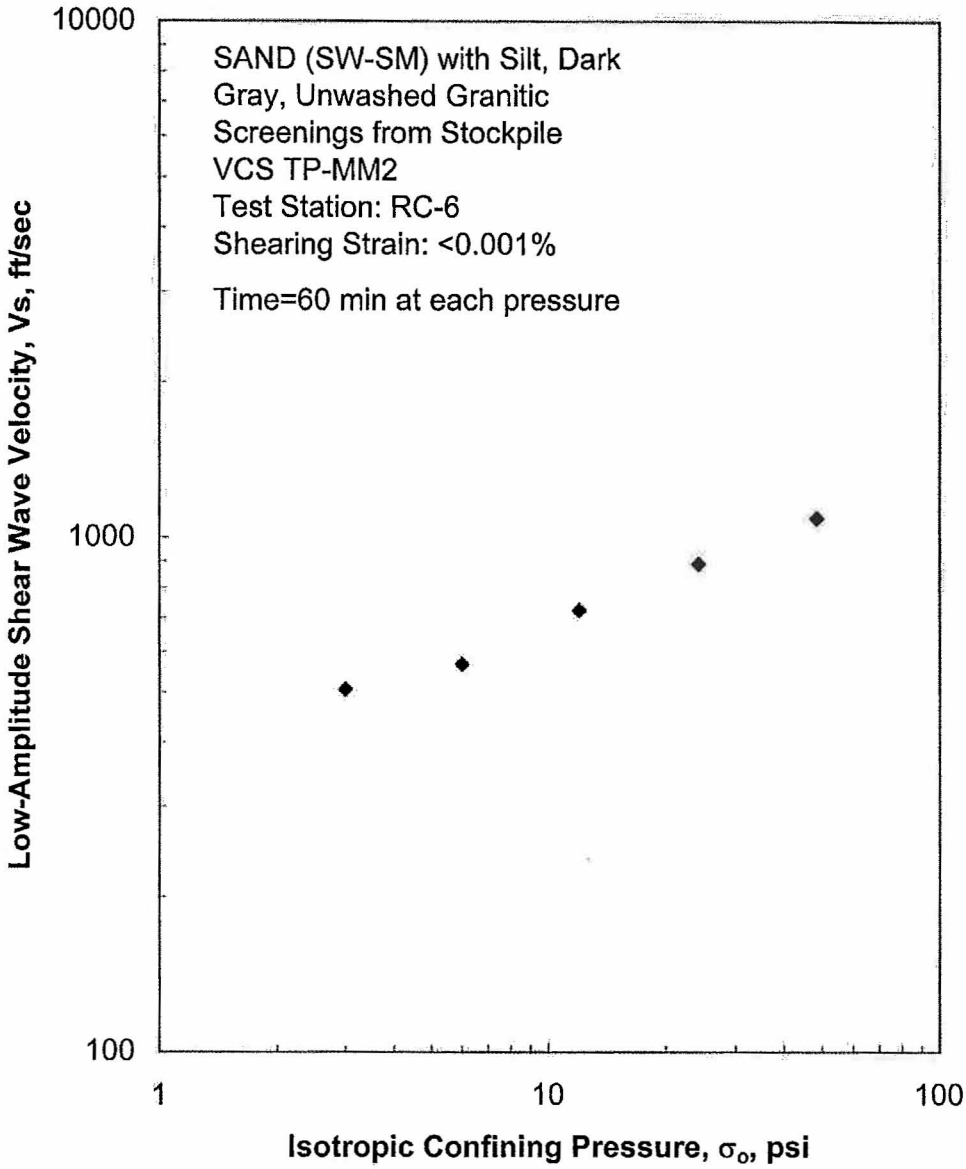


Figure B.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

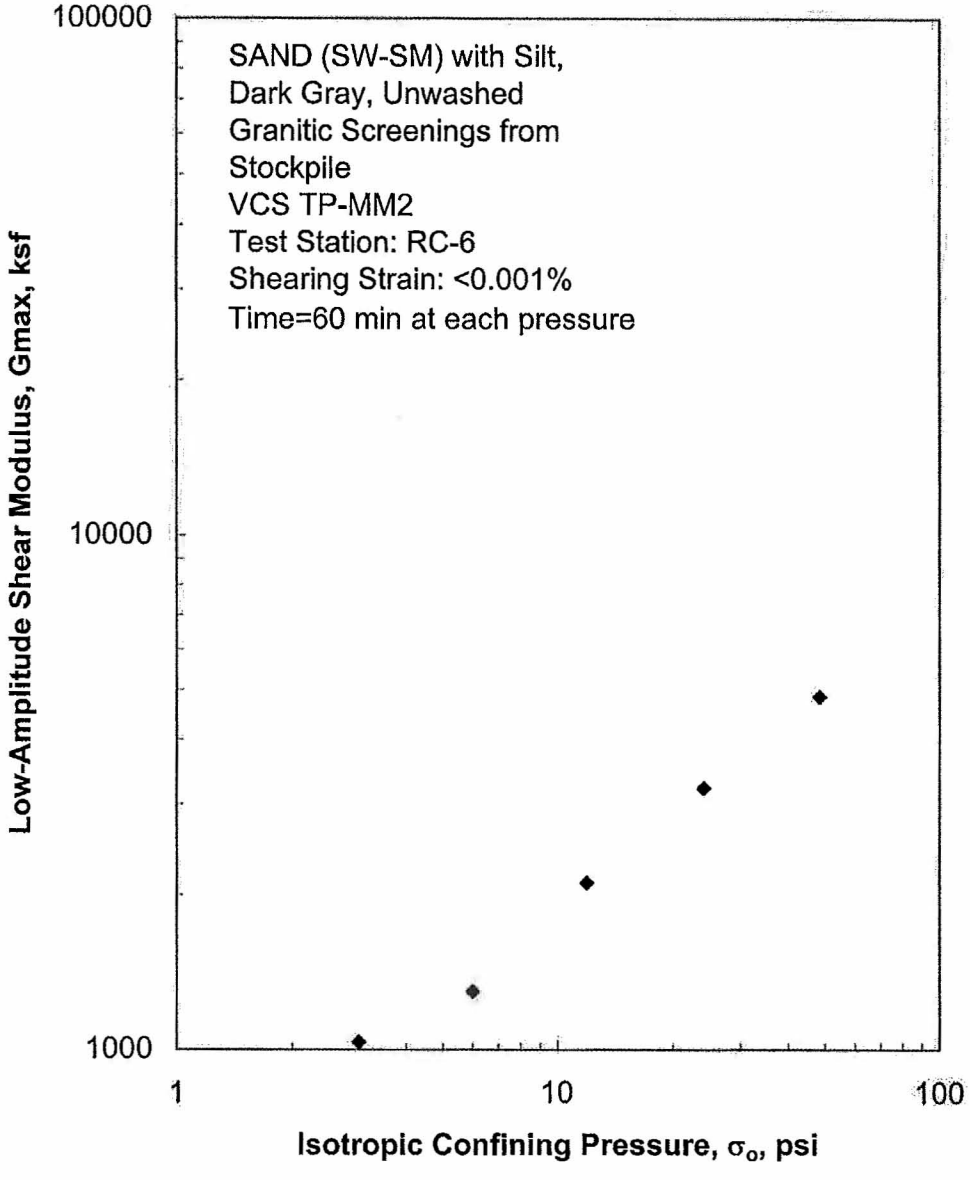


Figure B.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

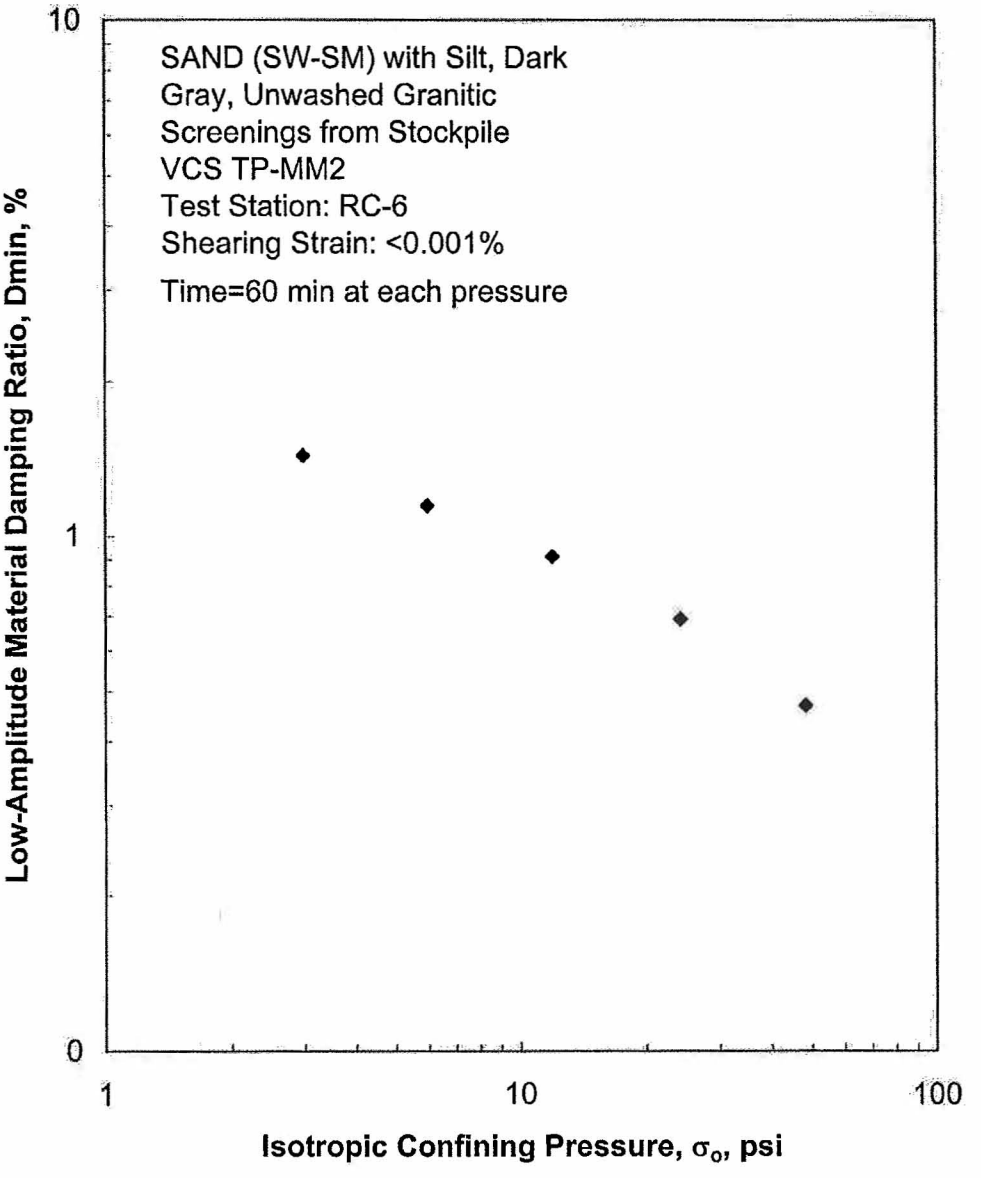


Figure B.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

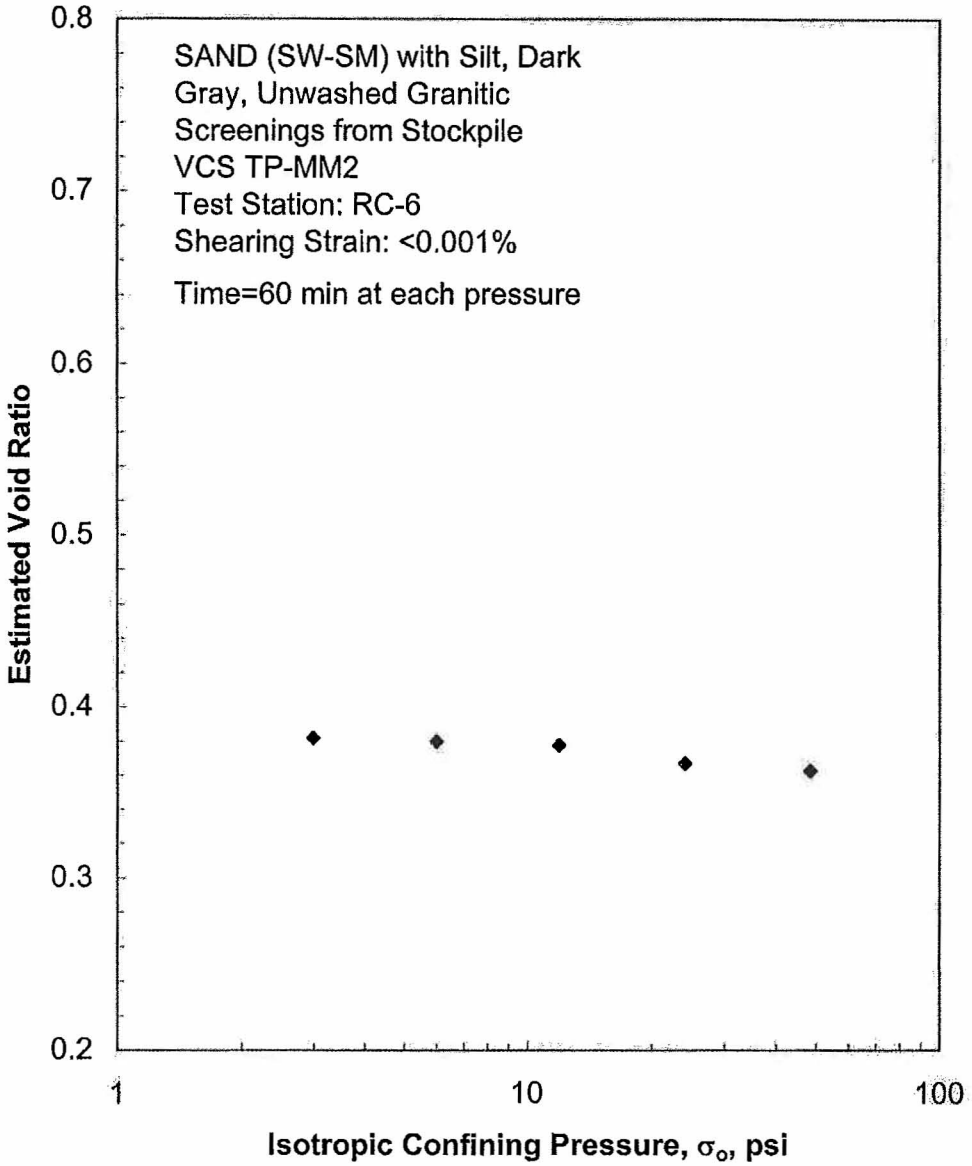


Figure B.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

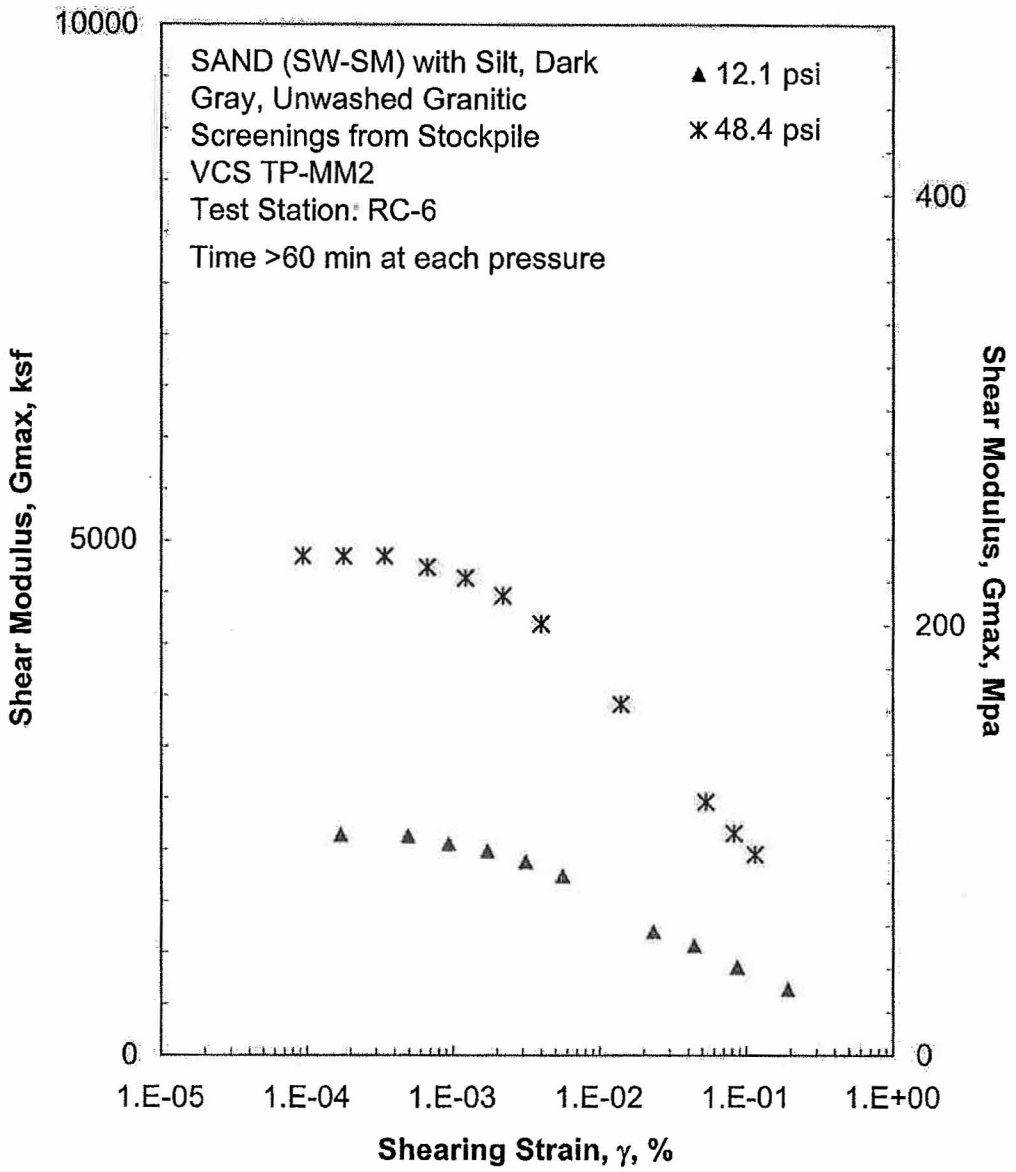


Figure B.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

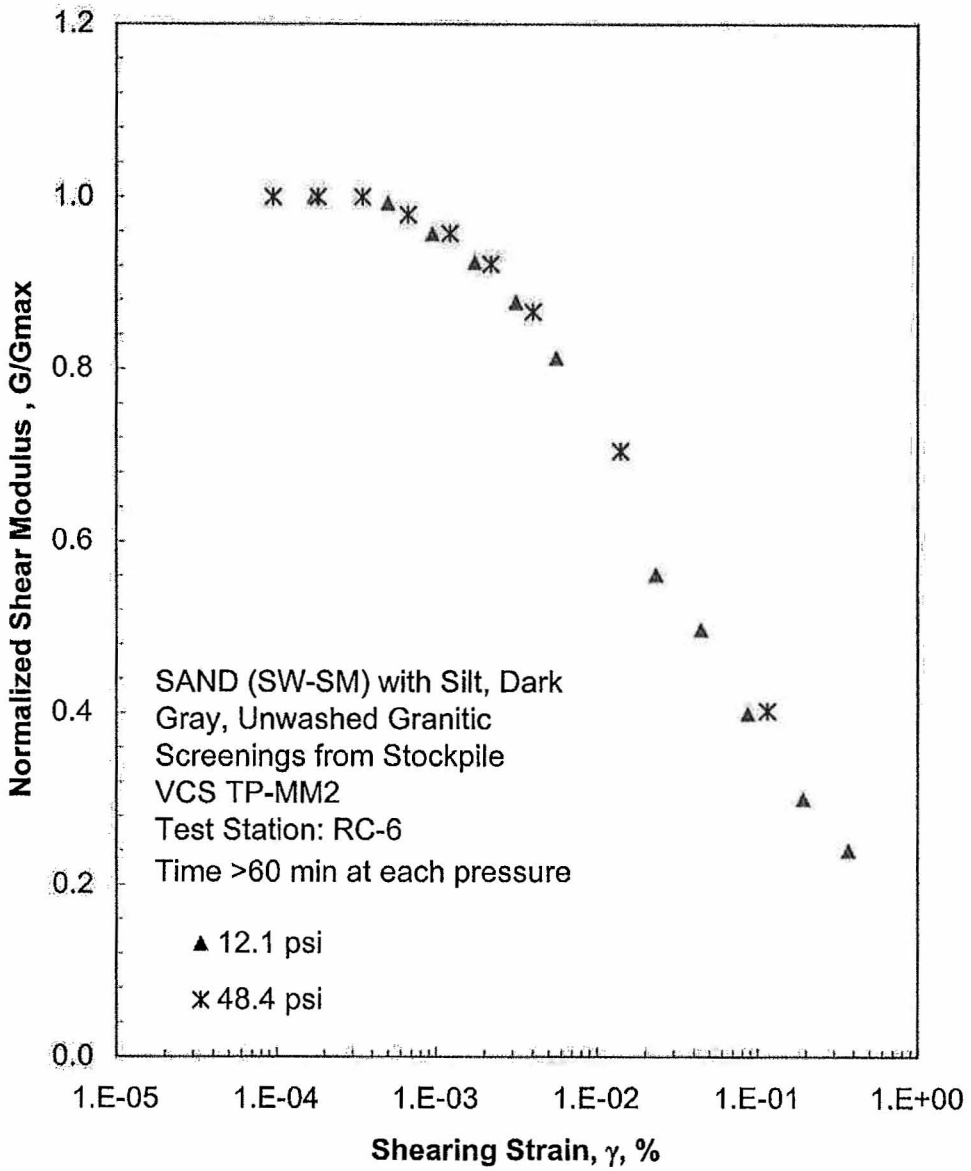


Figure B.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

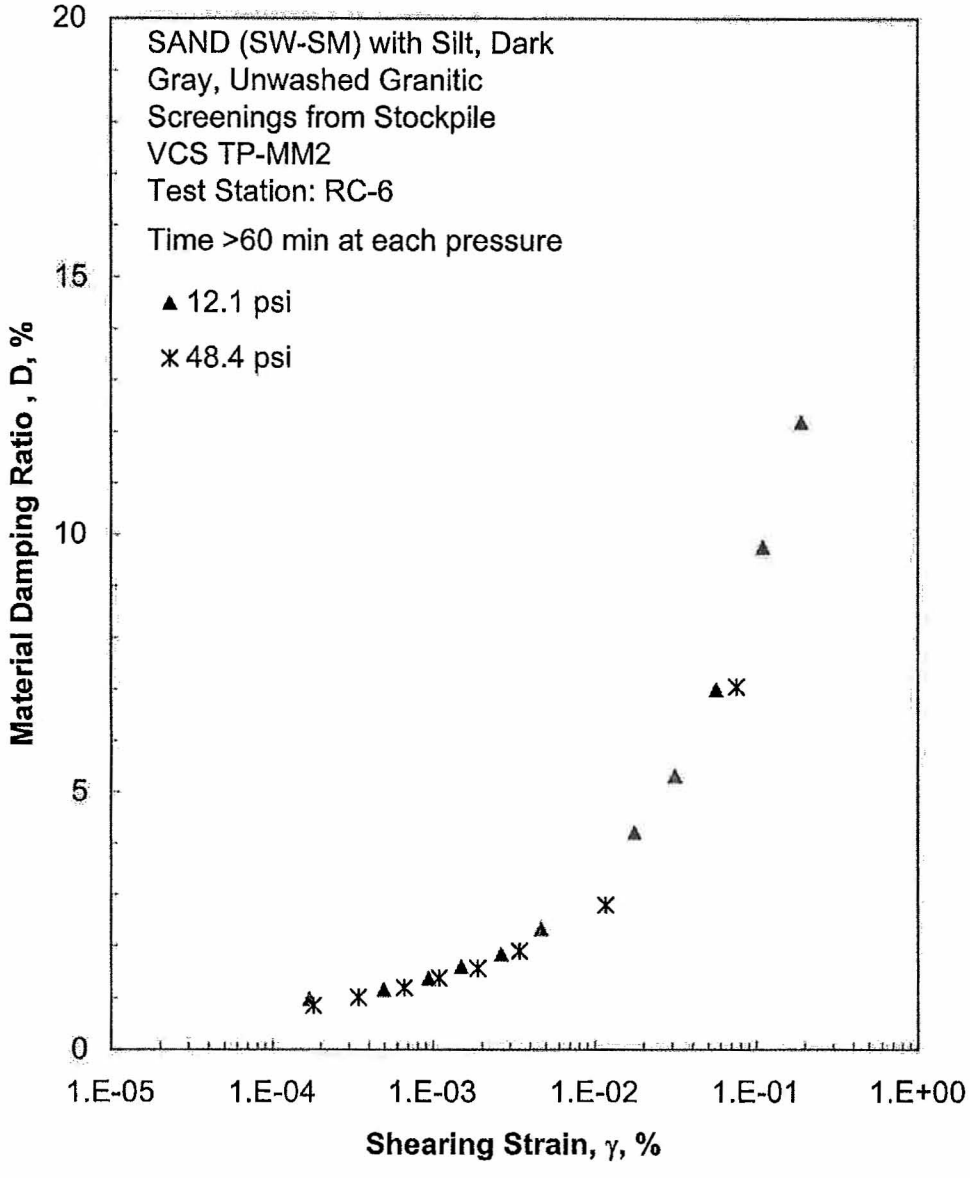


Figure B.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

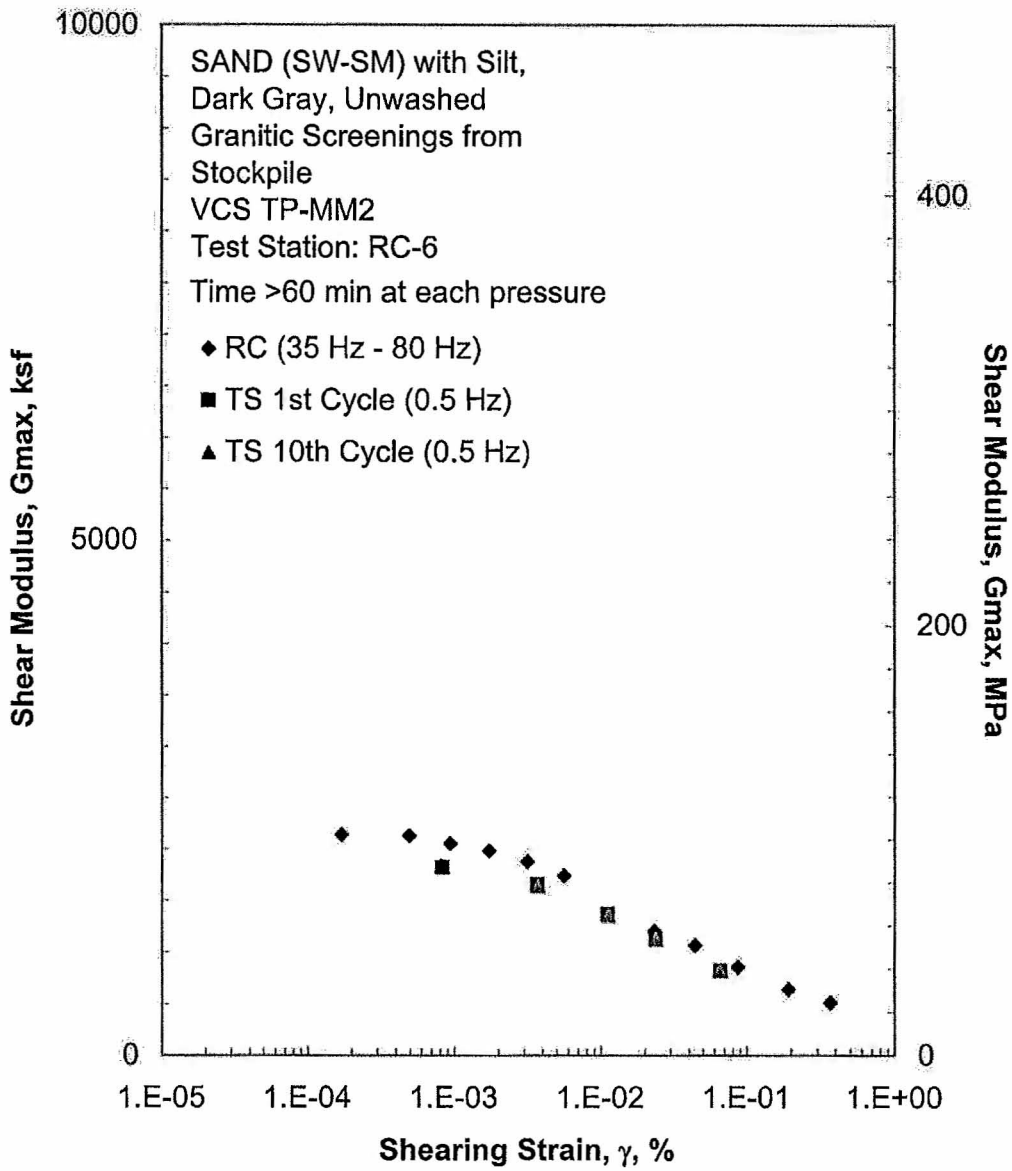


Figure B.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

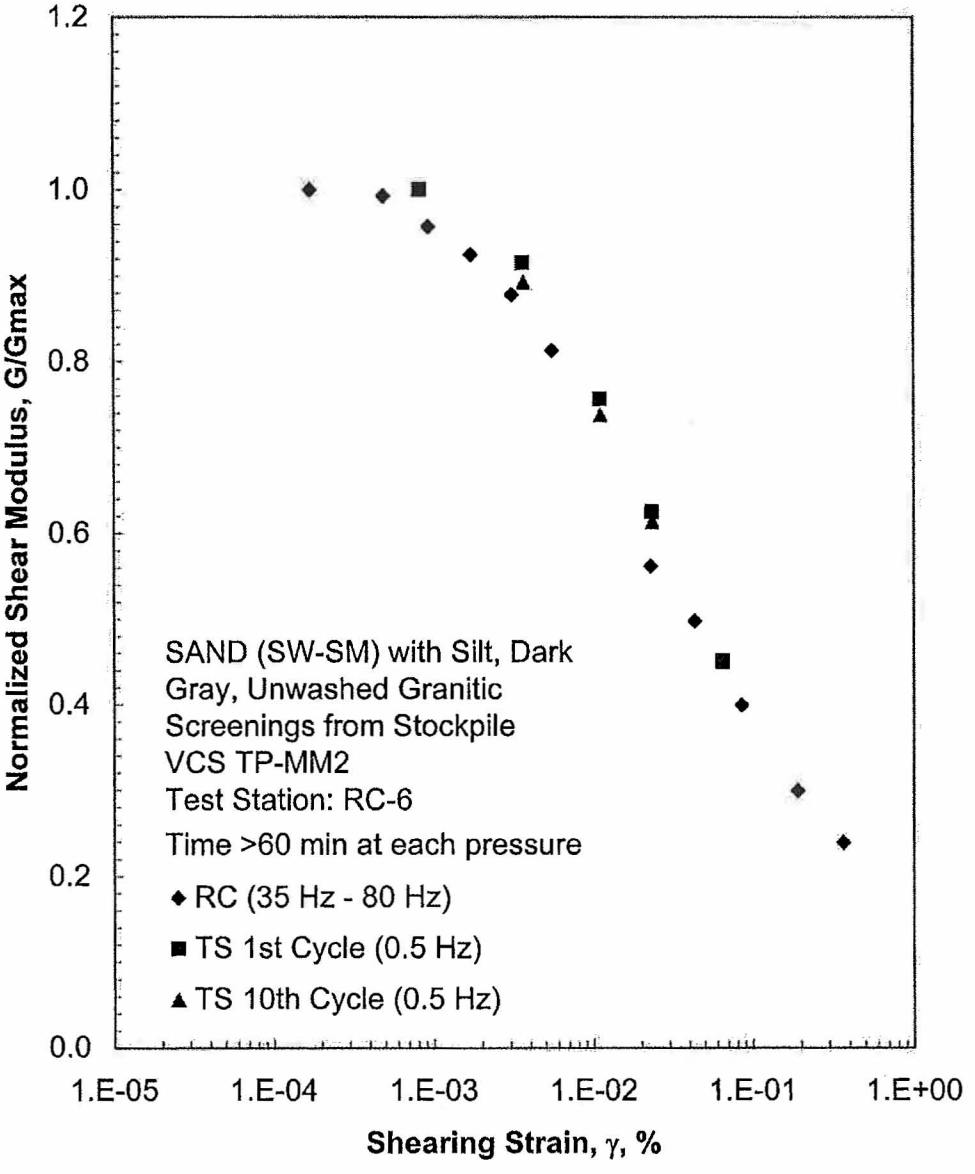


Figure B.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

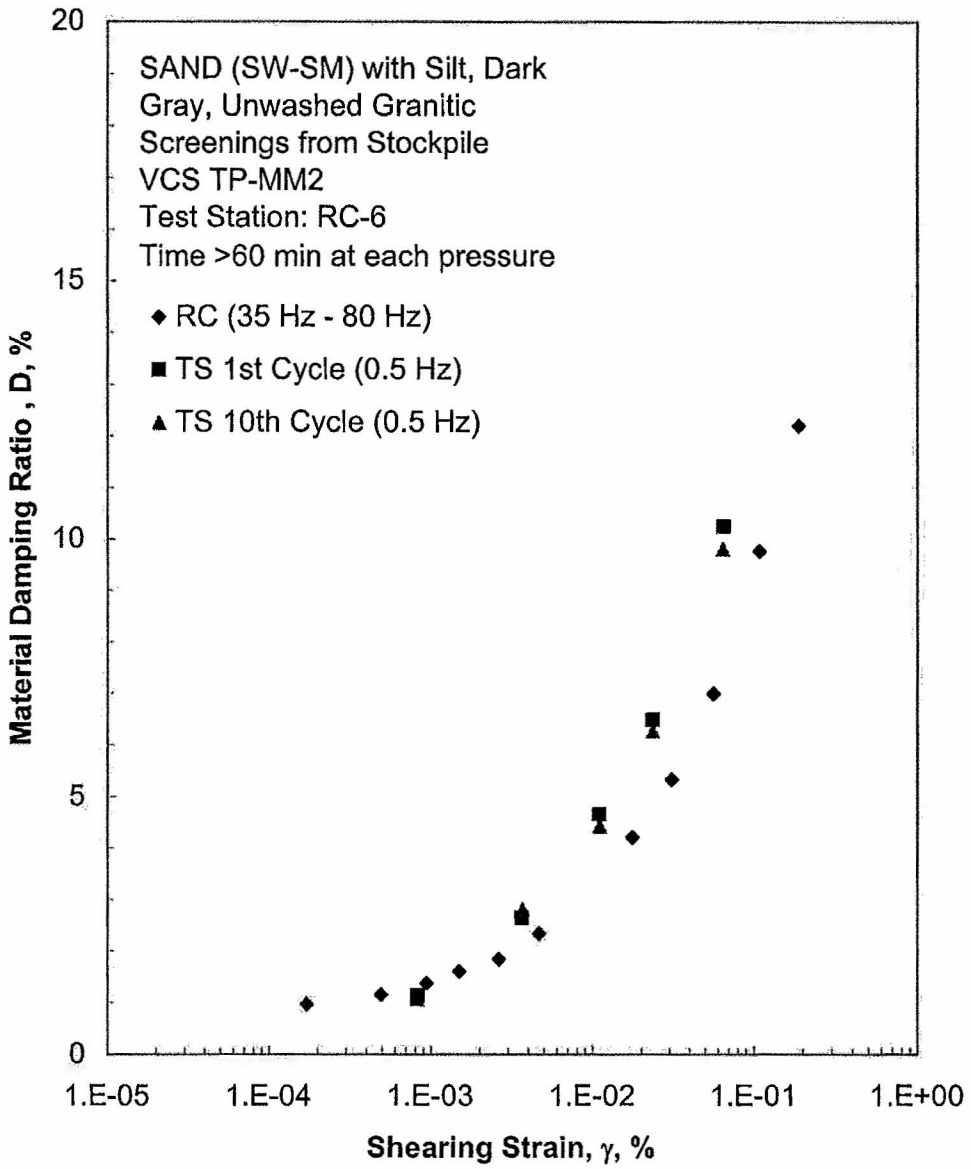


Figure B.13 Comparison of the Variation in Materail Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

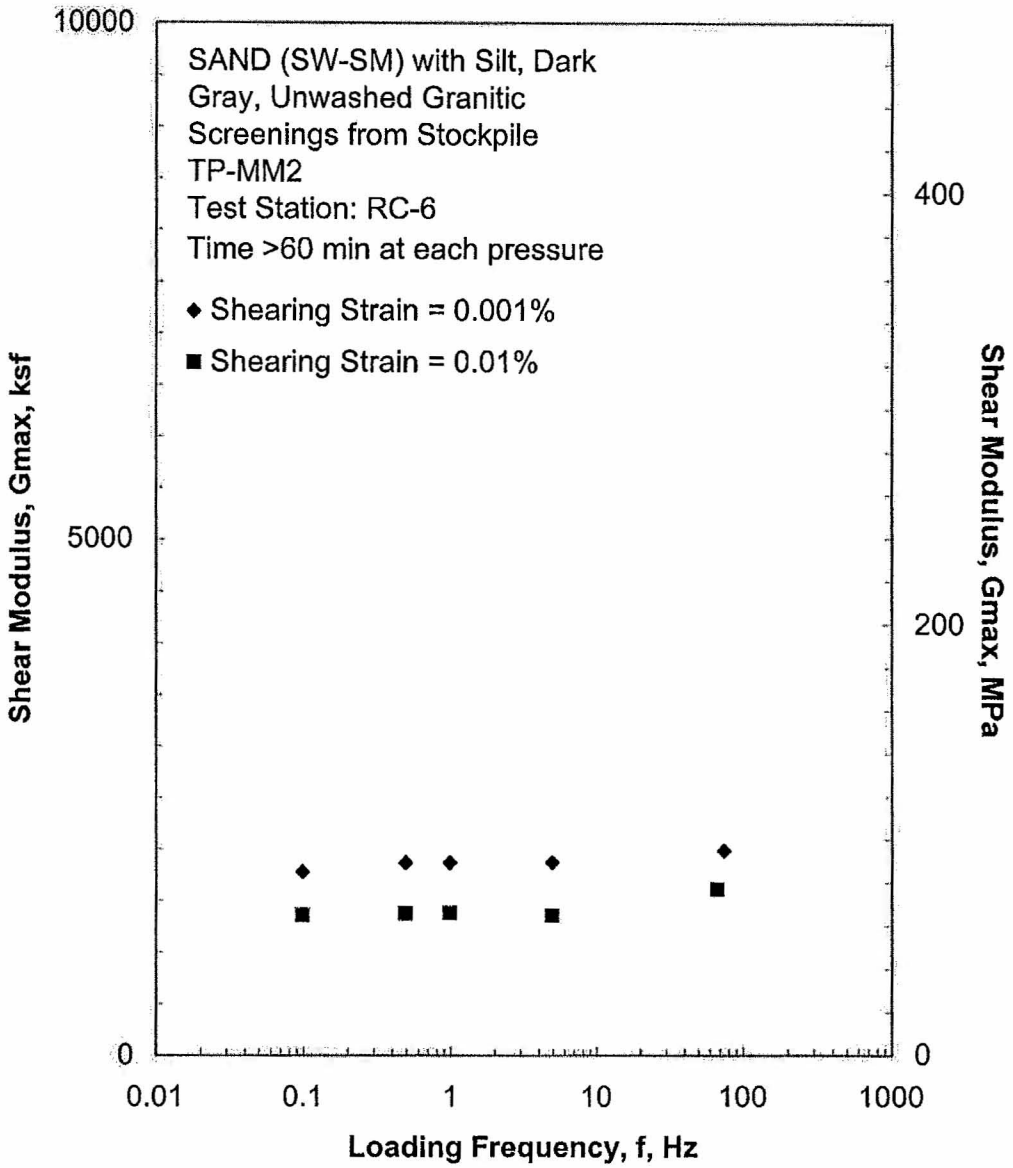


Figure B.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

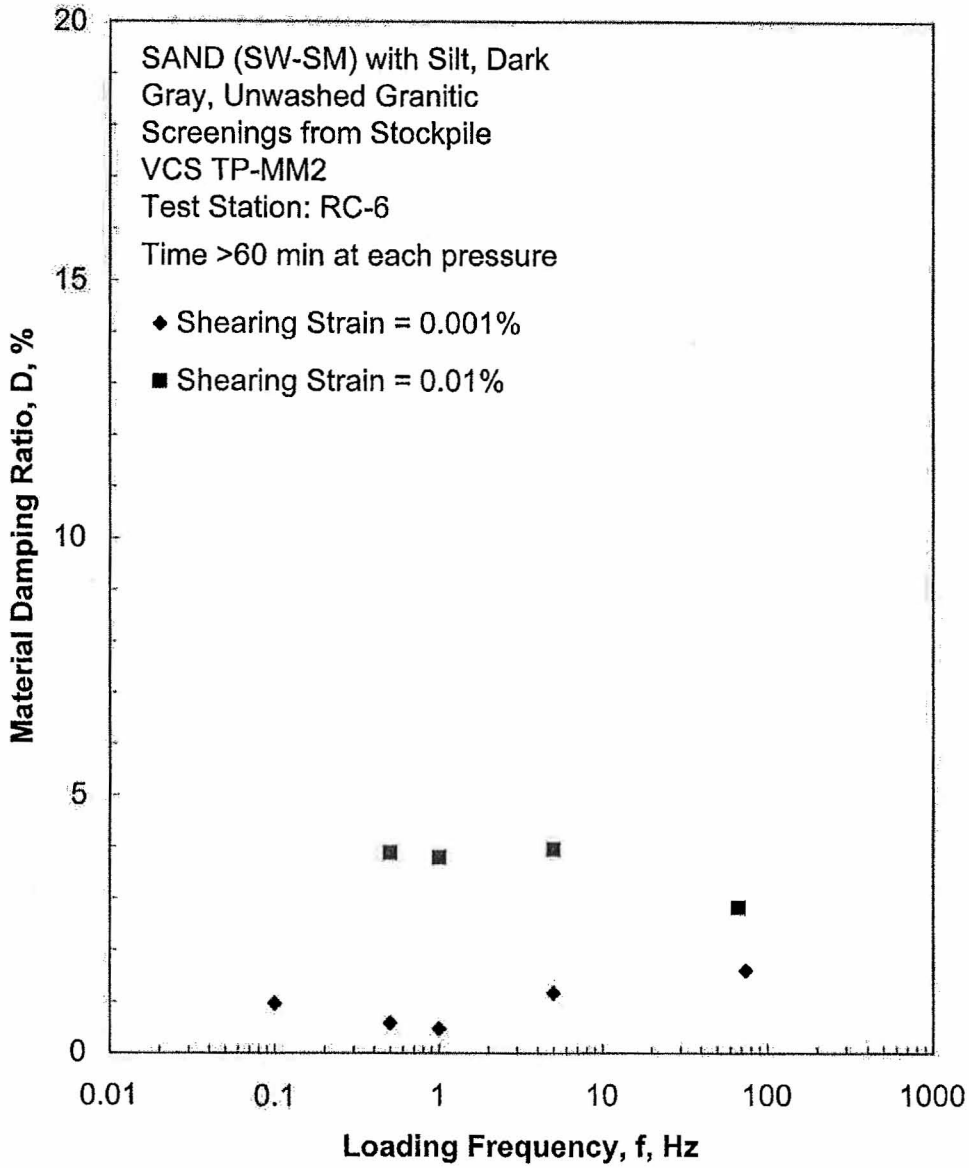


Figure B.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 12.1 psi from the Combined RCTS Tests

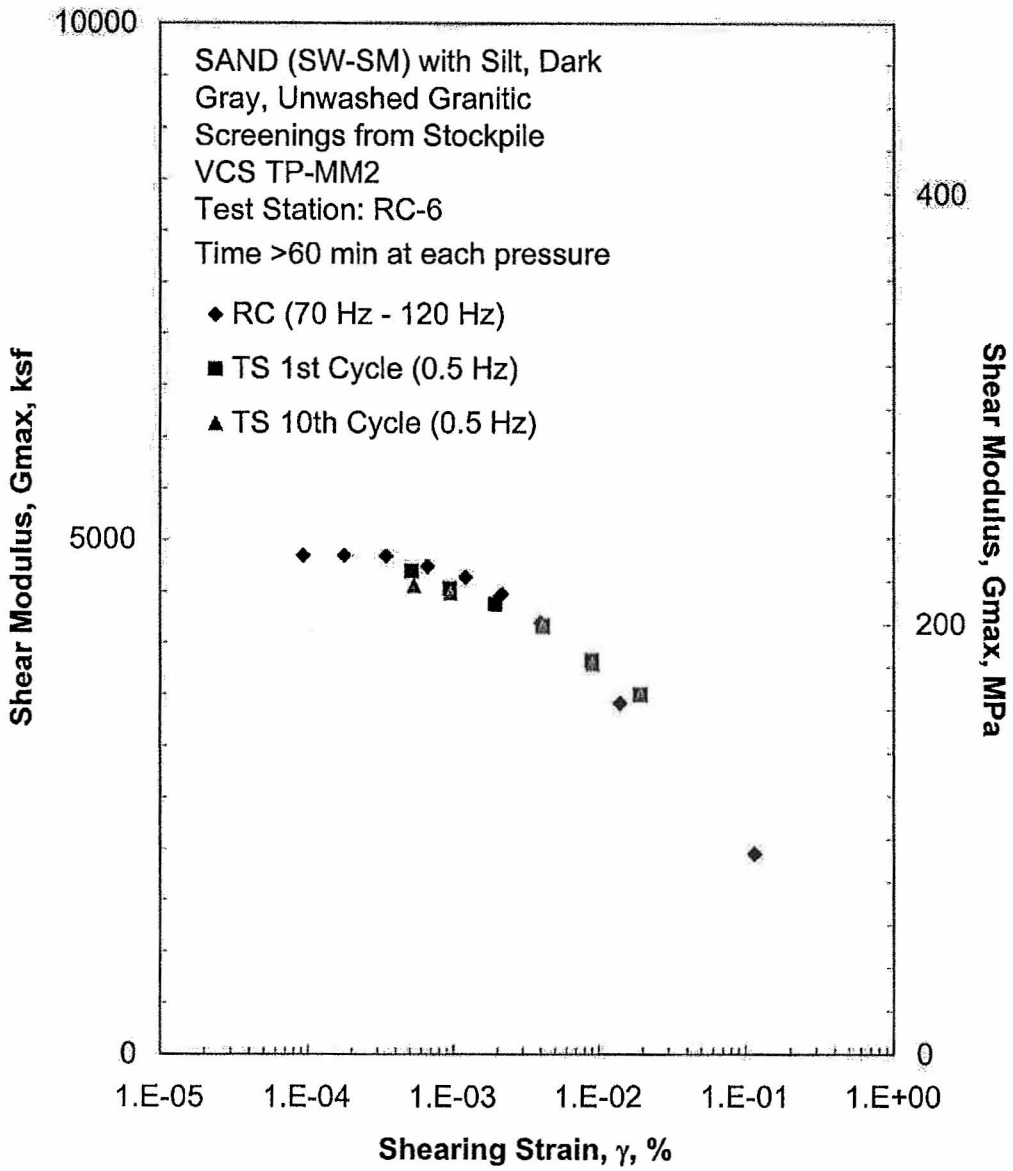


Figure B.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 48.4 psi from the Combined RCTS Tests

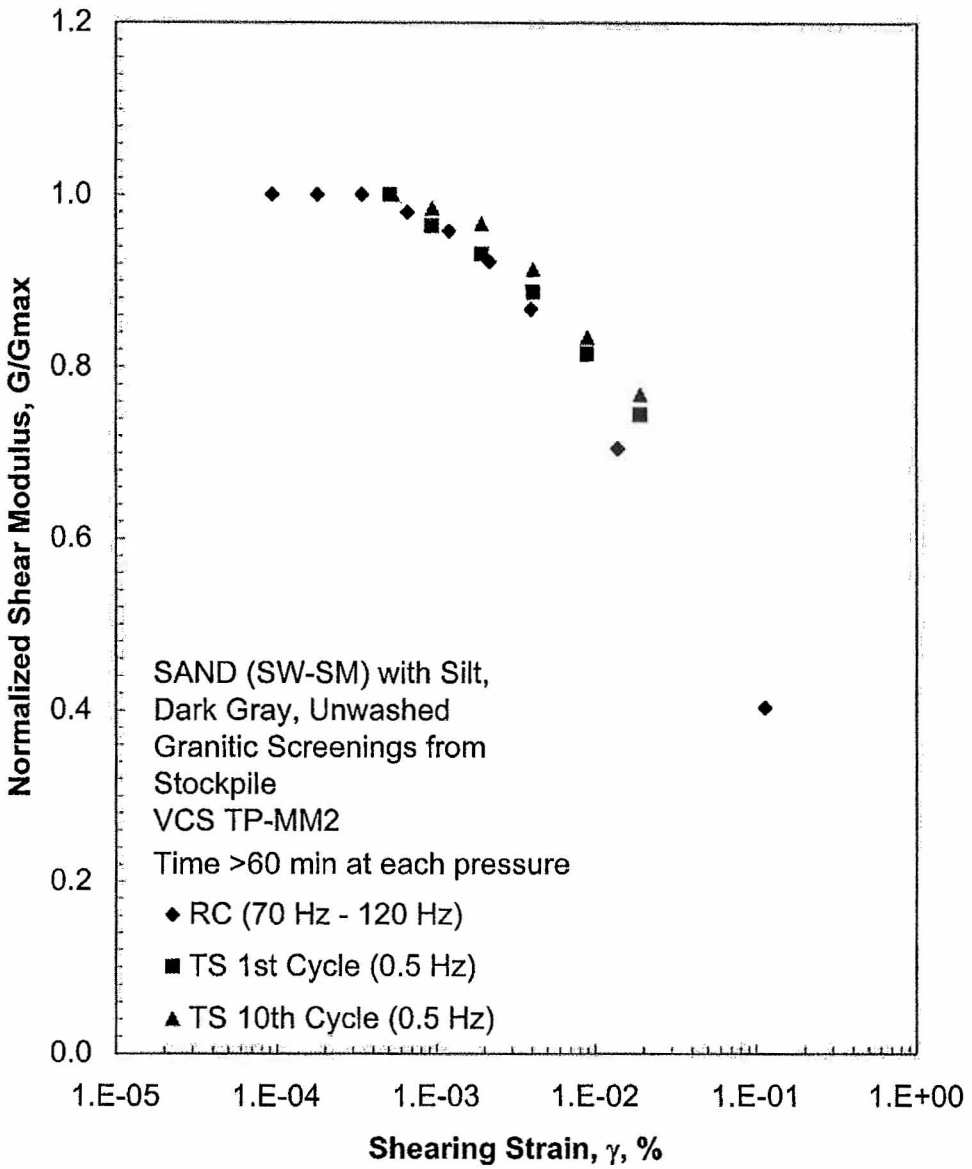


Figure B.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 48.4 psi from the Combined RCTS Tests

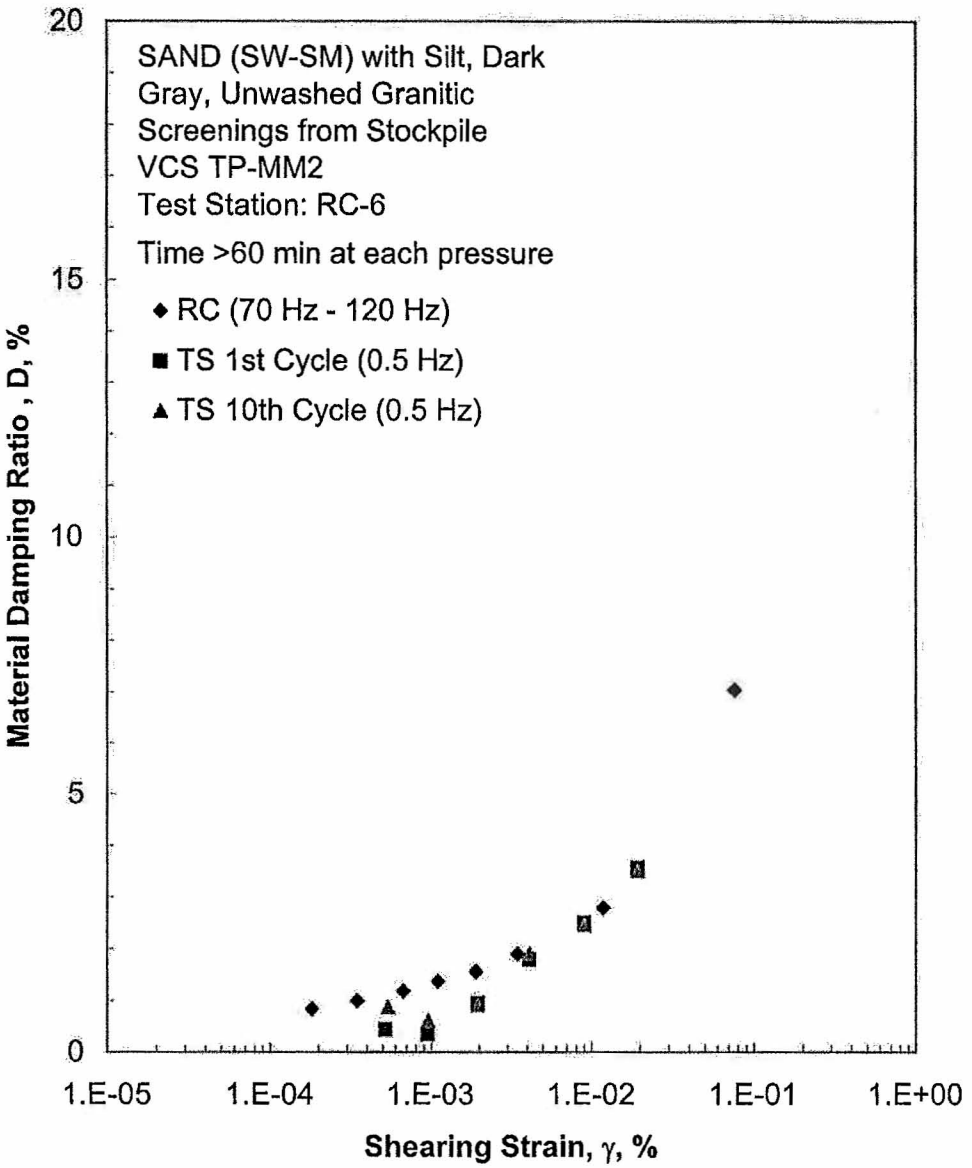


Figure B.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 48.4 psi from the Combined RCTS Tests

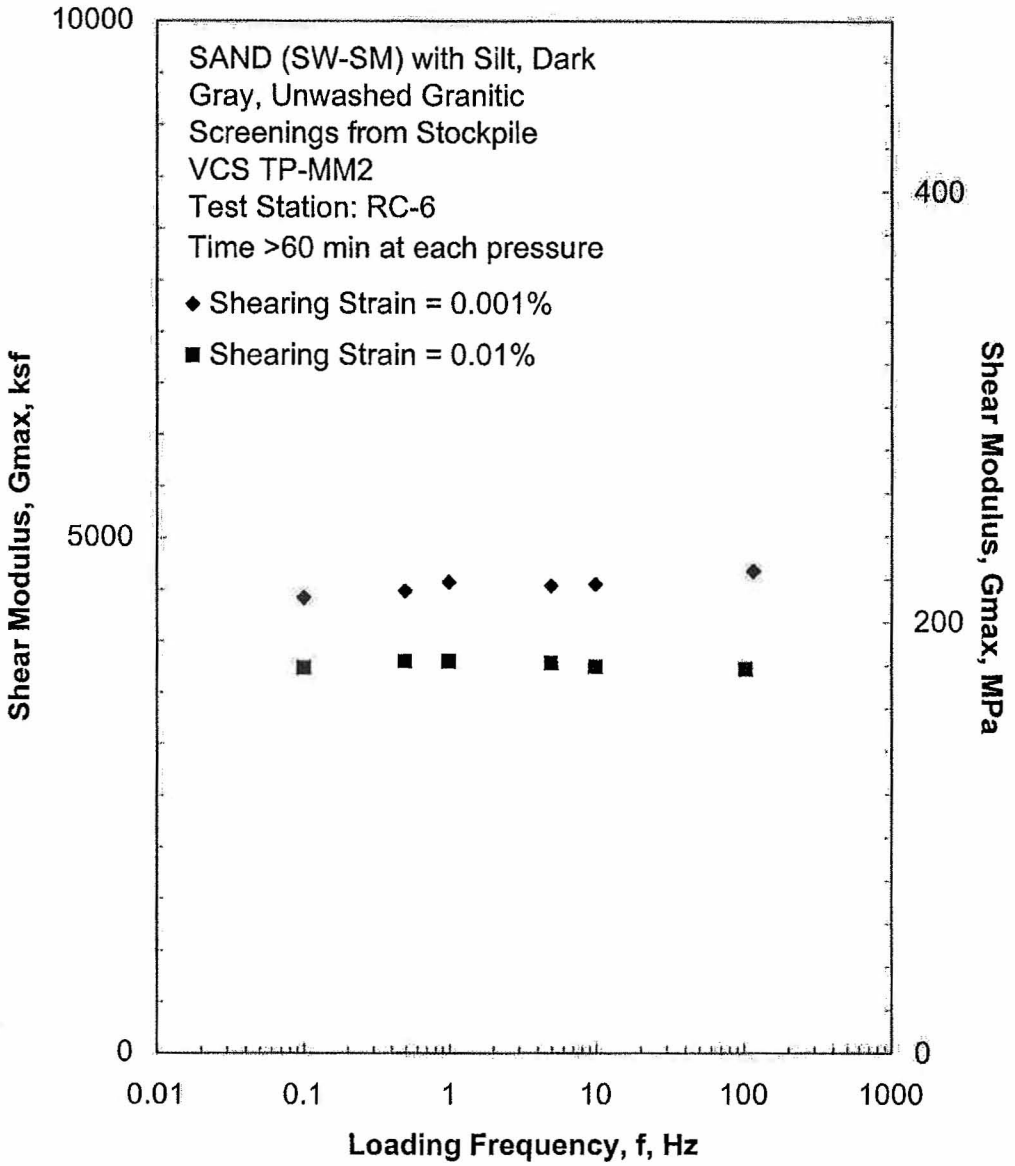


Figure B.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 48.4 psi from the Combined RCTS Tests

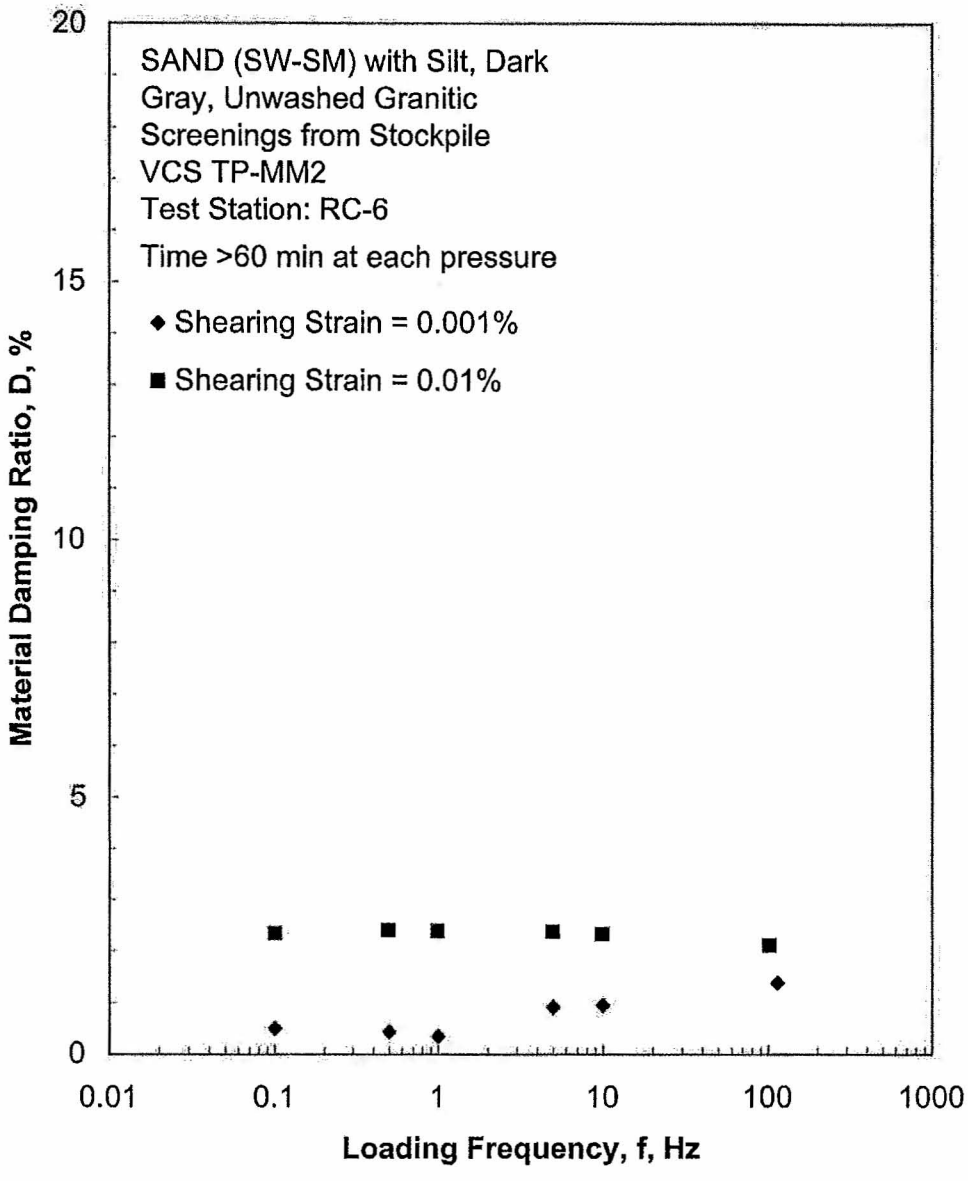


Figure B.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 48.4 psi from the Combined RCTS Tests

Table B.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio and Estimated Void Ratio with Isotropic Confining Pressure from RC Tests of Specimen VCS TP-MM2

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, Vs	Low-Amplitude Material Damping Ratio, Dmin	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
3.0	432	21	1034	50	507	1.43	0.381
6.0	864	41	1298	62	568	1.14	0.380
12.0	1728	83	2106	101	722	0.91	0.377
24.2	3485	167	3210	154	888	0.69	0.366
48.4	6970	333	4841	232	1089	0.47	0.363

Table B.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS TP-MM2; Isoptropic Confining Pressure, σ_o=12.0 psi (1.7 ksf = 83.0 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
1.71E-04	2139	1.00	1.71E-04	0.97
5.00E-04	2122	0.99	5.00E-04	1.14
9.48E-04	2046	0.96	9.48E-04	1.37
1.75E-03	1976	0.92	1.52E-03	1.59
3.14E-03	1877	0.88	2.66E-03	1.83
5.58E-03	1738	0.81	4.67E-03	2.33
2.33E-02	1200	0.56	1.78E-02	4.20
4.40E-02	1063	0.50	3.13E-02	5.31
8.67E-02	853	0.40	5.69E-02	6.97
1.92E-01	640	0.30	1.10E-01	9.75
3.68E-01	512	0.24	1.90E-01	12.18

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table B.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS TP-MM2; Isotropic Confining Pressure, σ_o=12.0 psi (1.7 ksf = 83 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
8.40E-04	1808	1.00	1.13	8.28E-04	1834	1.00	1.06
3.68E-03	1654	0.91	2.63	3.72E-03	1636	0.89	2.80
1.11E-02	1365	0.76	4.64	1.12E-02	1352	0.74	4.41
2.37E-02	1128	0.62	6.47	2.38E-02	1123	0.61	6.25
6.58E-02	814	0.45	10.23	6.50E-02	823	0.45	9.78

Table B.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS TP-MM2; Isoptropic Confining Pressure, σ_o= 48.4 psi (7.0 ksf = 333 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
9.50E-05	4841	1.00	9.50E-05	---
1.82E-04	4841	1.00	1.82E-04	0.84
3.47E-04	4841	1.00	3.47E-04	1.00
6.69E-04	4741	0.98	6.69E-04	1.18
1.22E-03	4636	0.96	1.10E-03	1.37
2.20E-03	4463	0.92	1.91E-03	1.56
4.00E-03	4195	0.87	3.47E-03	1.90
1.40E-02	3411	0.70	1.18E-02	2.79
5.29E-02	2460	0.51	3.90E-02	4.85
8.23E-02	2154	0.45	6.08E-02	5.76
1.14E-01	1948	0.40	7.63E-02	7.03

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table B.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS TP-MM2; Isotropic Confining Pressure, σ_o=48.4 psi (7.0 ksf = 333 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus,	Material Damping Ratio, D,	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus,	Material Damping Ratio, D, %
5.21E-04	4694	1.00	0.44	5.38E-04	4551	1.00	0.88
9.47E-04	4523	0.96	0.35	9.57E-04	4478	0.98	0.61
1.96E-03	4369	0.93	0.95	1.95E-03	4396	0.97	0.92
4.12E-03	4161	0.89	1.79	4.13E-03	4155	0.91	1.90
8.97E-03	3823	0.81	2.50	9.04E-03	3793	0.83	2.46
1.93E-02	3493	0.74	3.56	1.93E-02	3492	0.77	3.50

APPENDIX E

Specimen VCS B309-UD2
CLAY (LL=54, PI=15)

Borehole B309
Sample UD2
Depth = 20.5 ft (6.3 m)
Total Unit Weight = 104.9 lb/ft^3
Water Content = 17.6 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 9.8 psi

FUGRO JOB #: 0401-1659
Testing Station: RC6

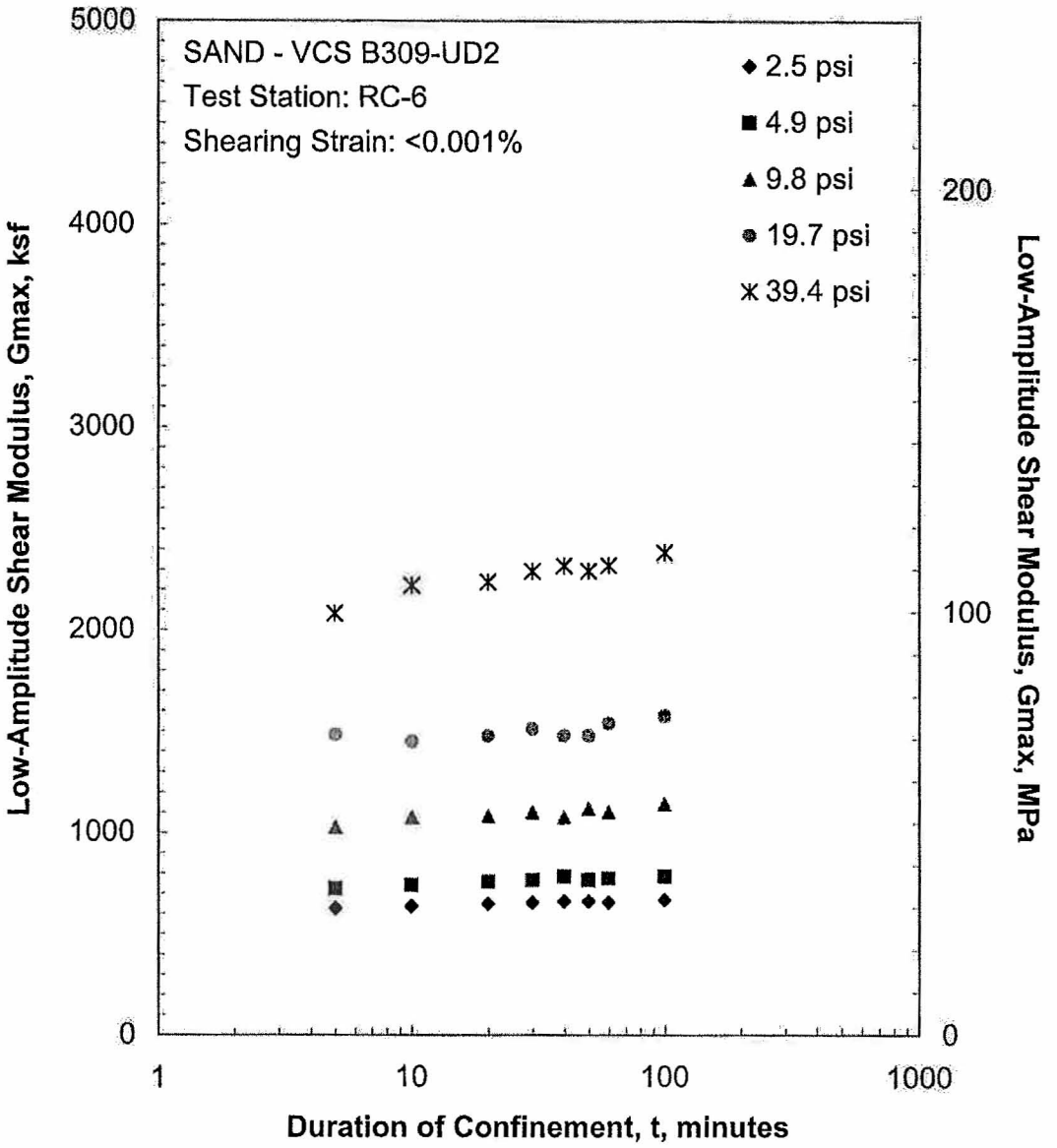


Figure E.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

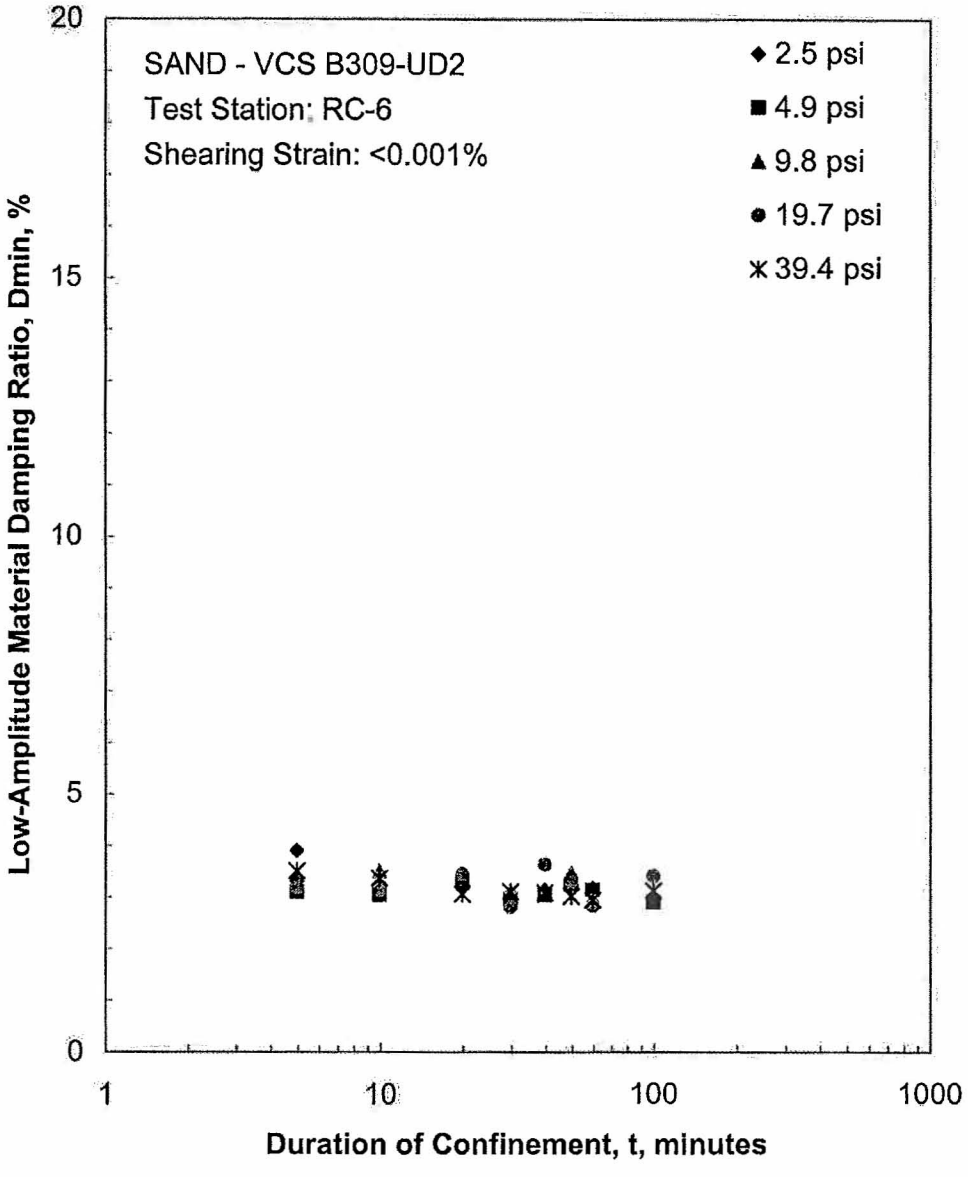


Figure E.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

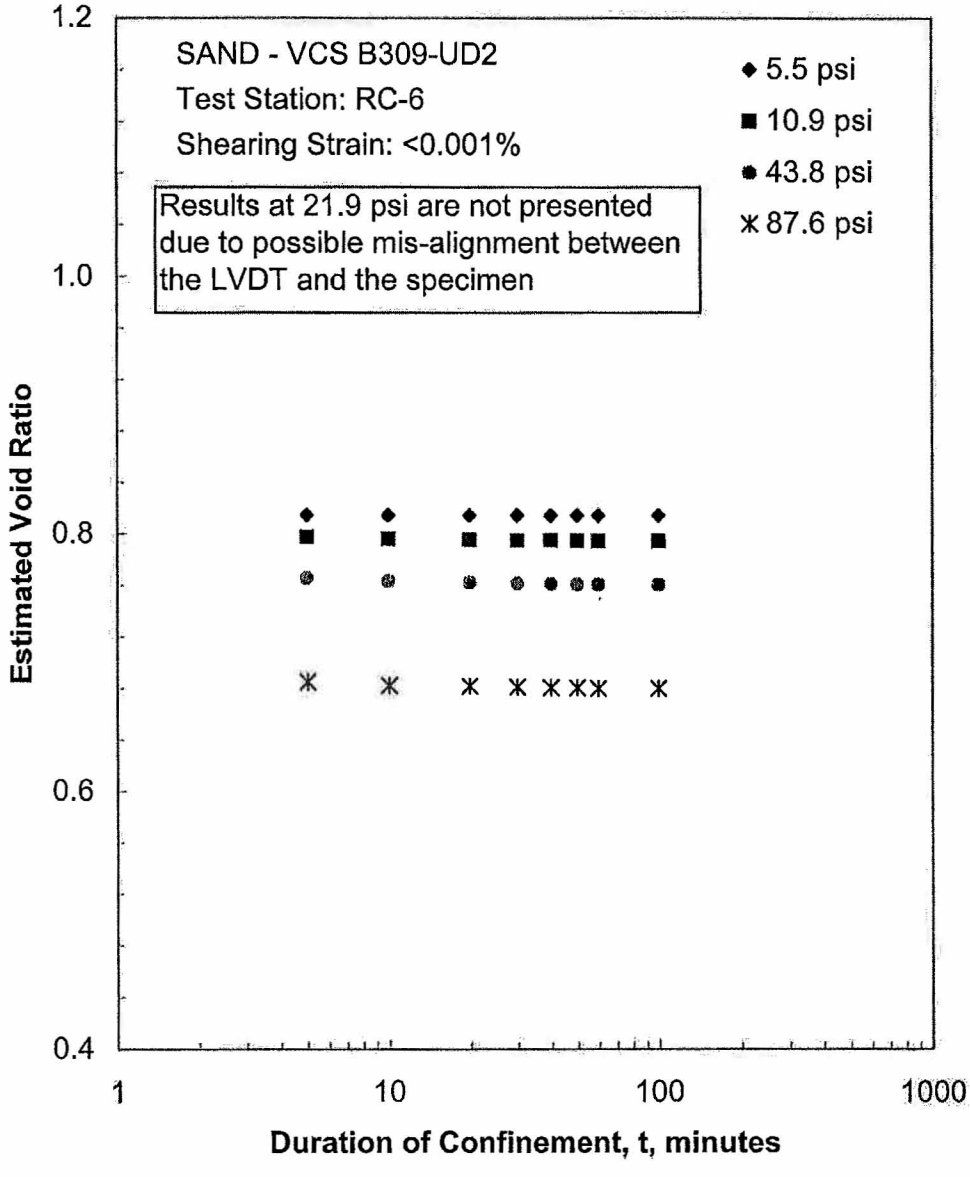


Figure E.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

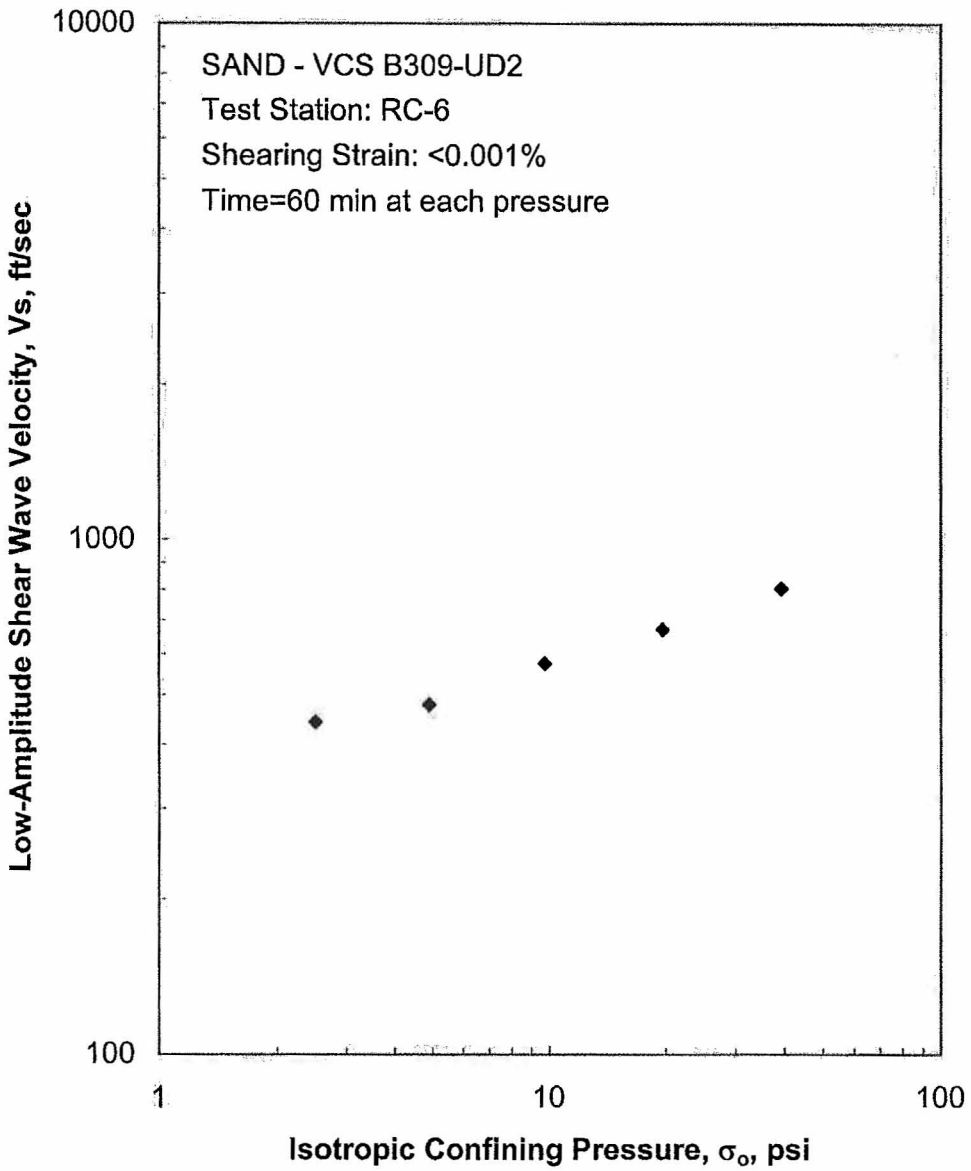


Figure E.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

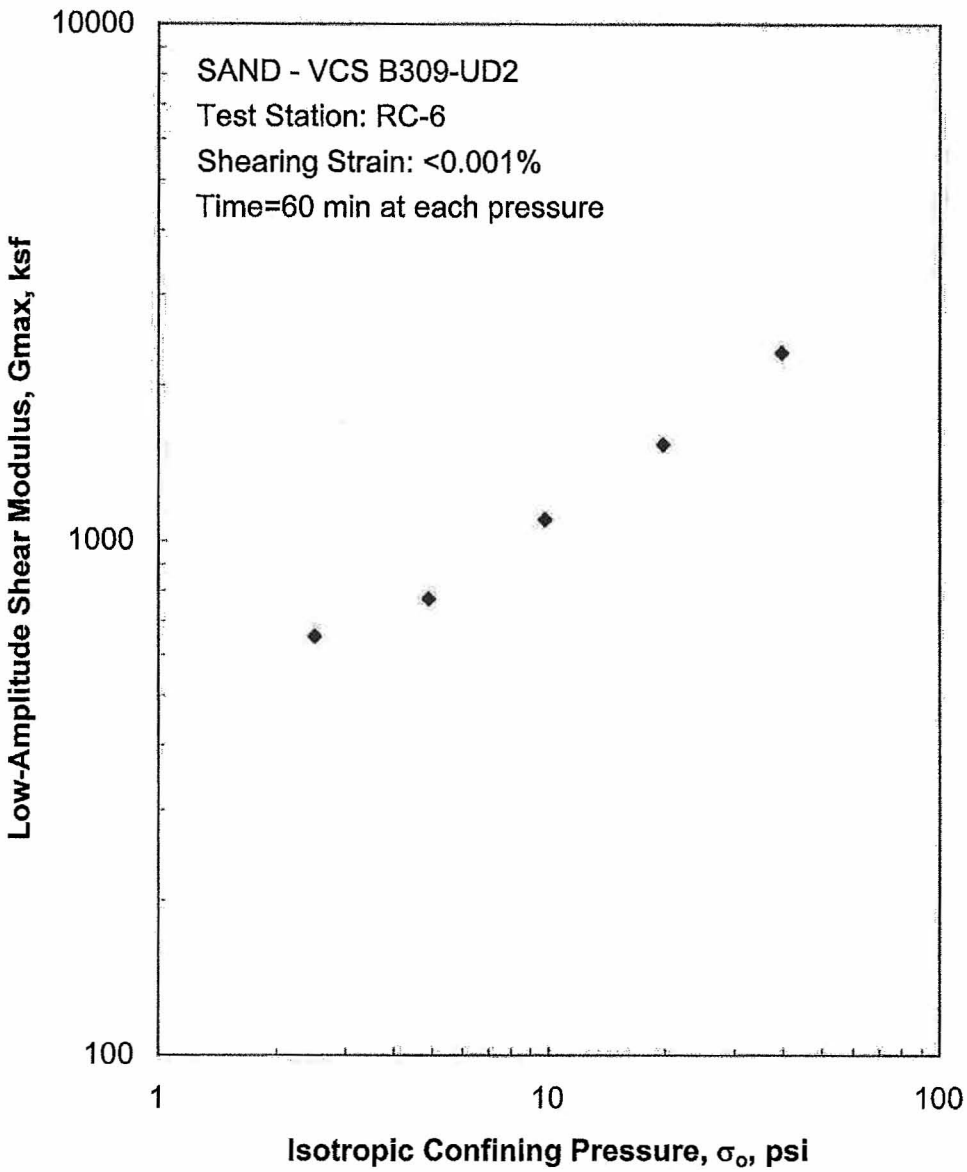


Figure E.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

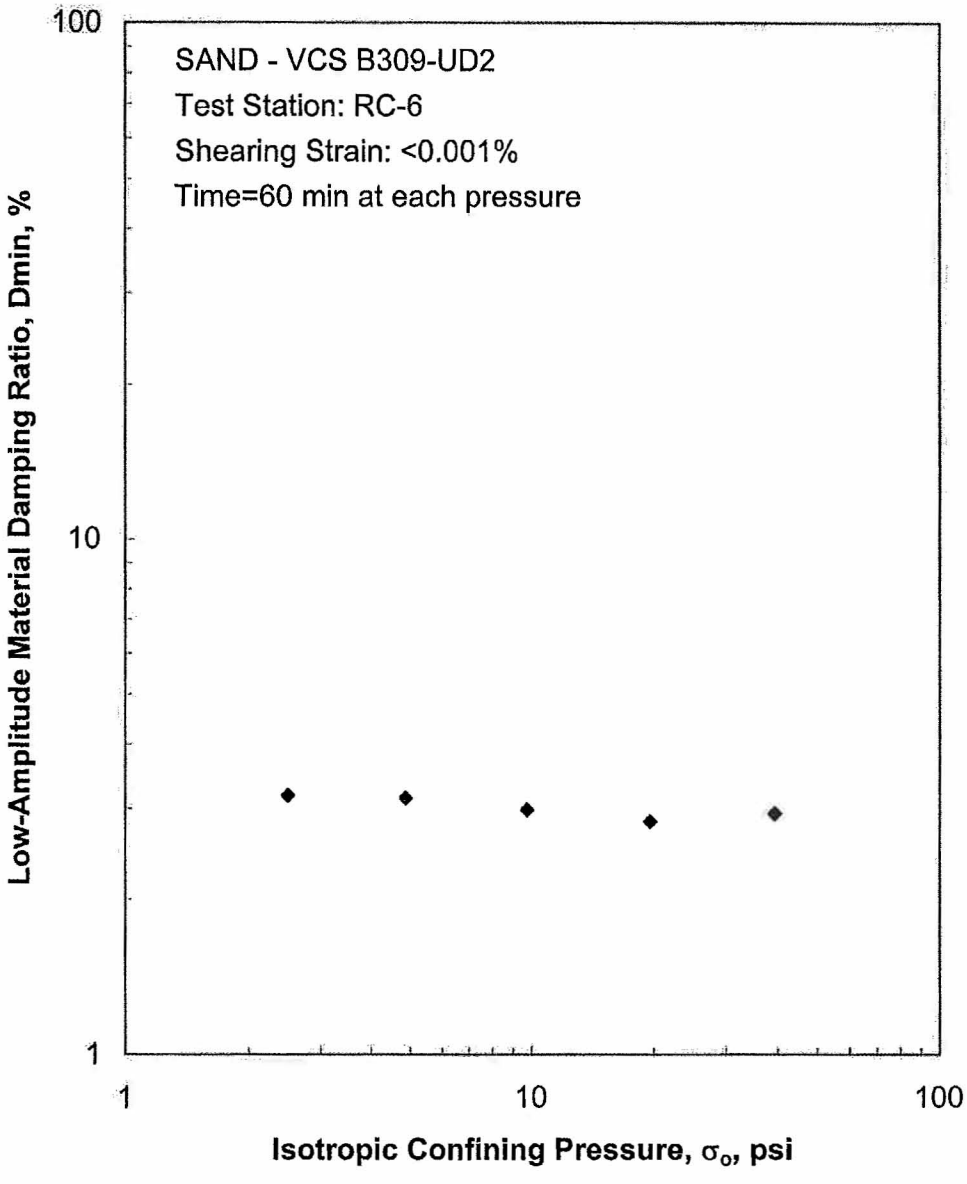


Figure E.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

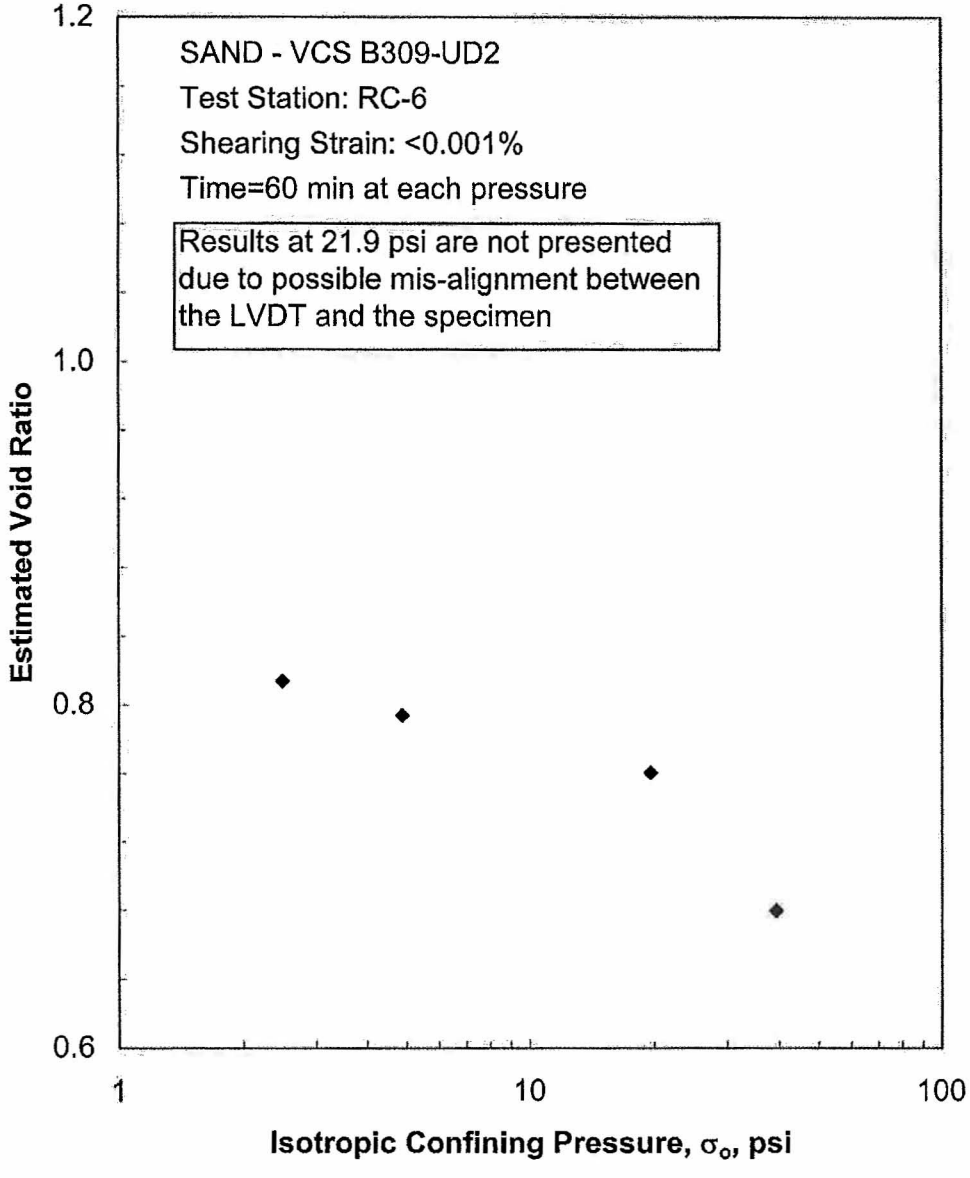


Figure E.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

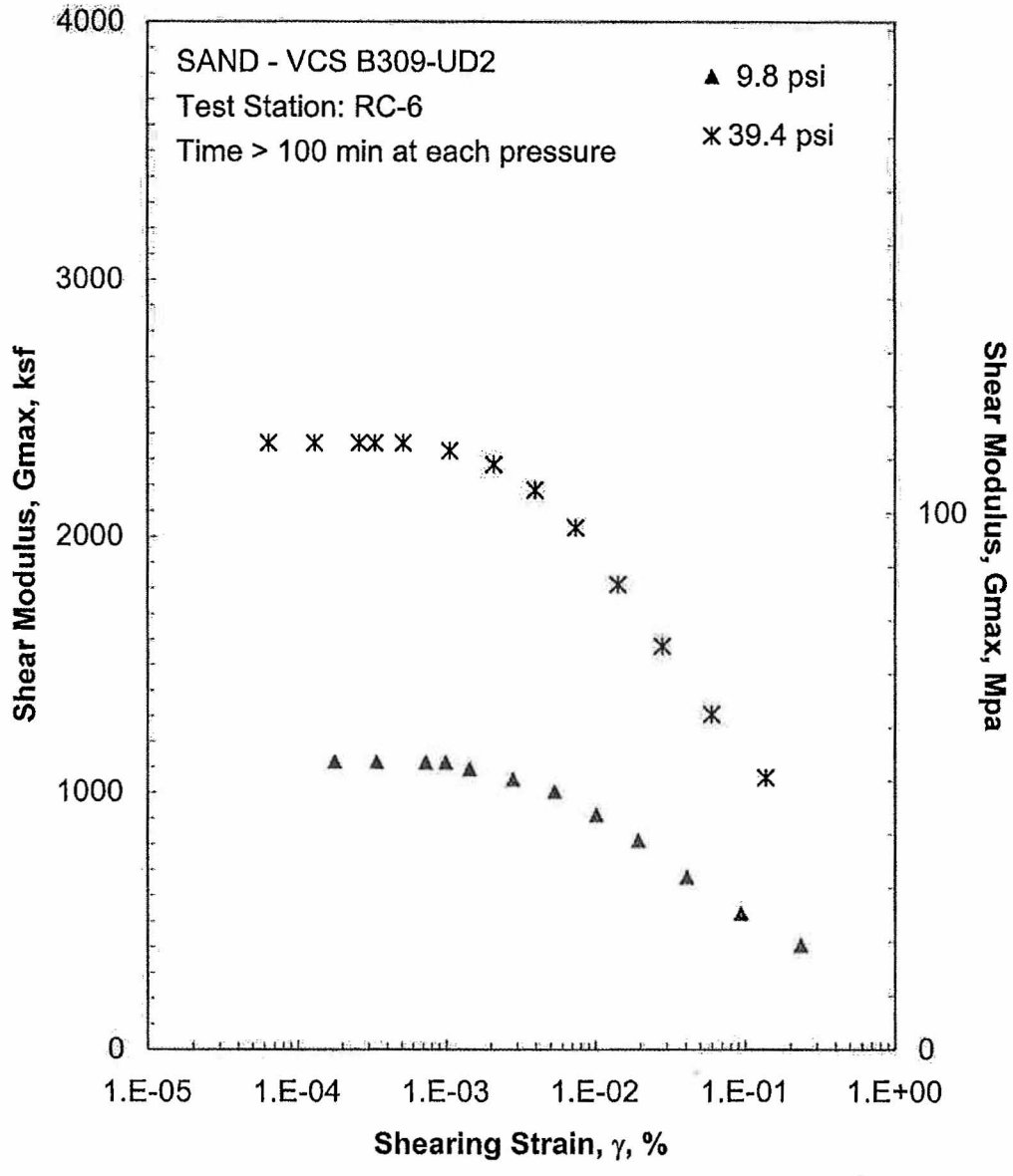


Figure E.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

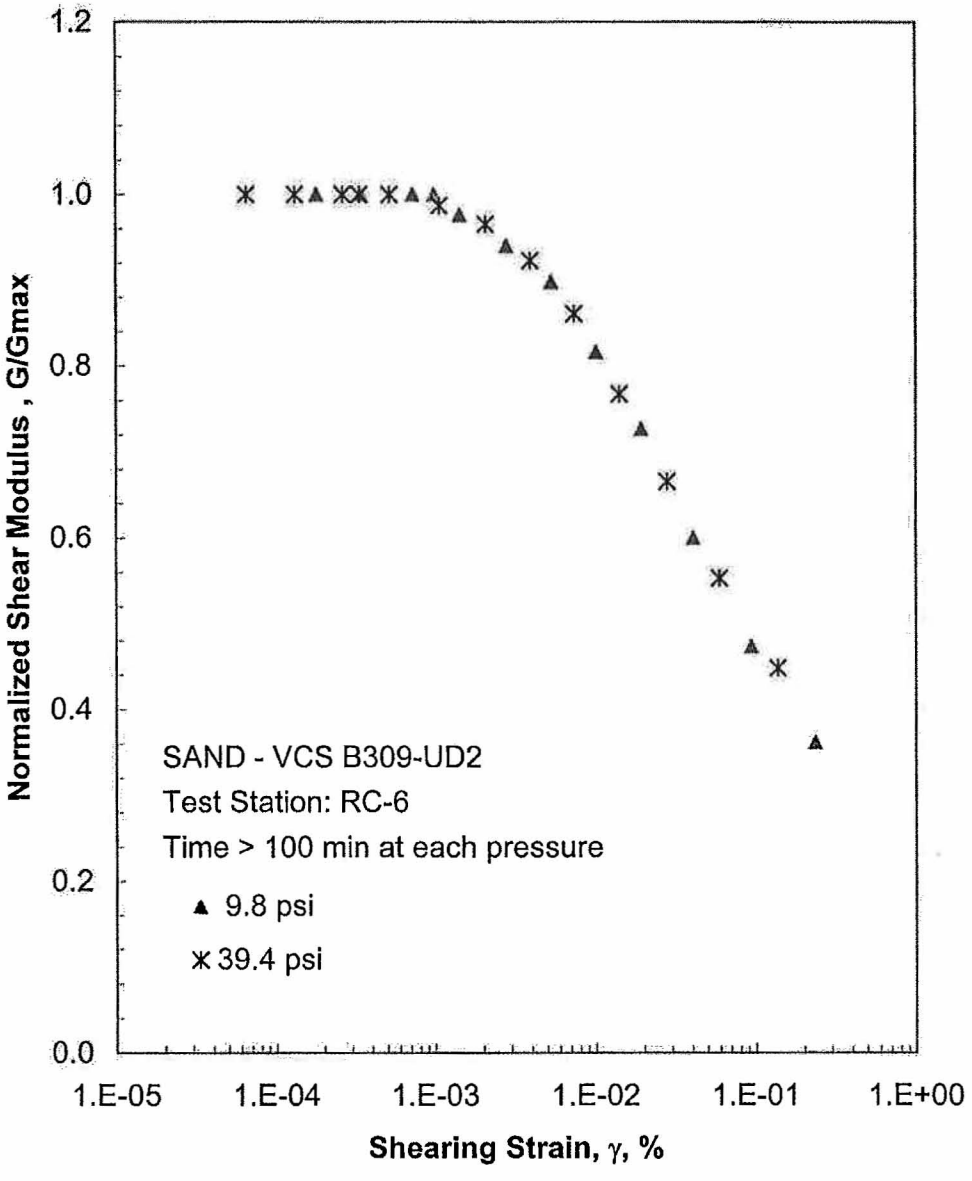


Figure E.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

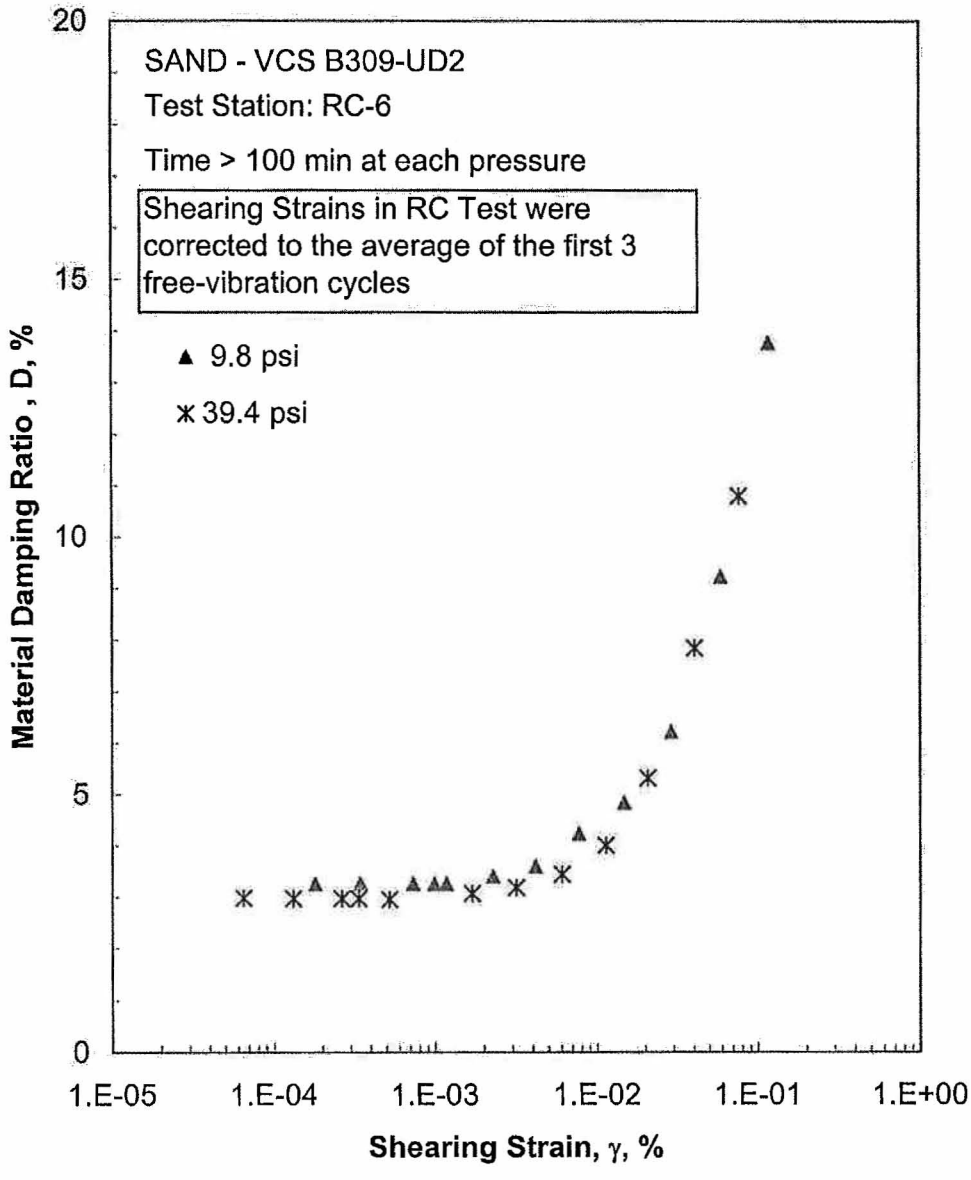


Figure E.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

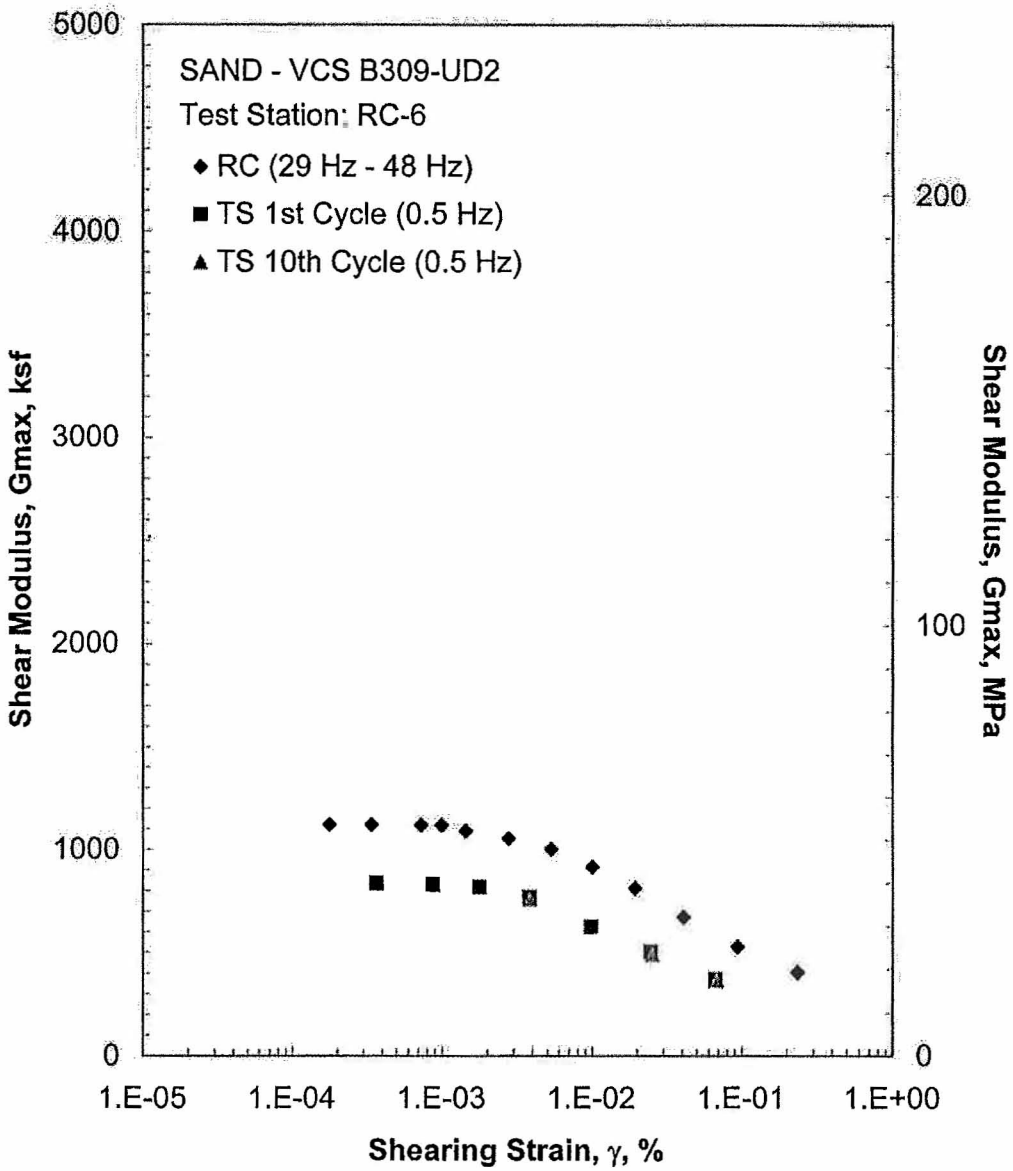


Figure E.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

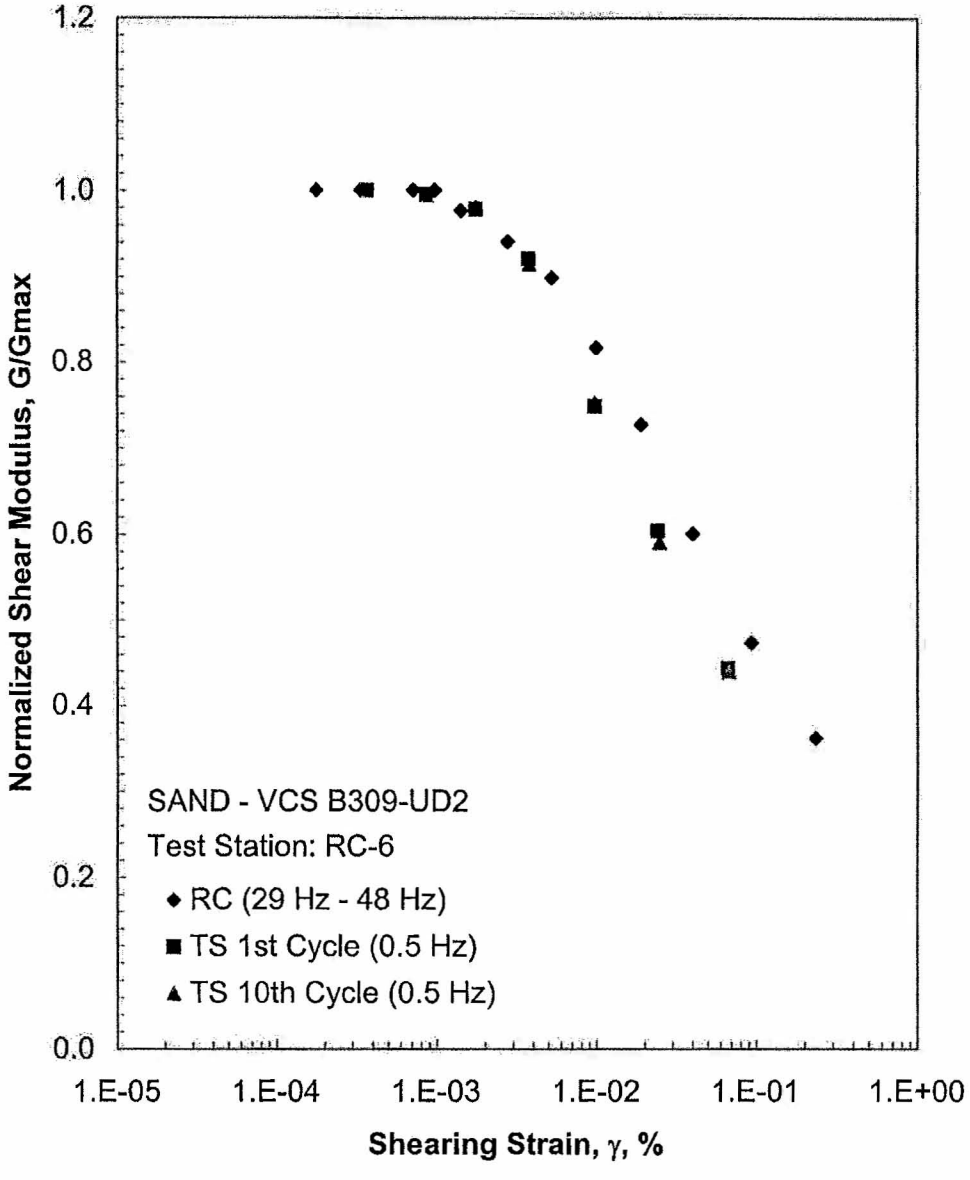


Figure E.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

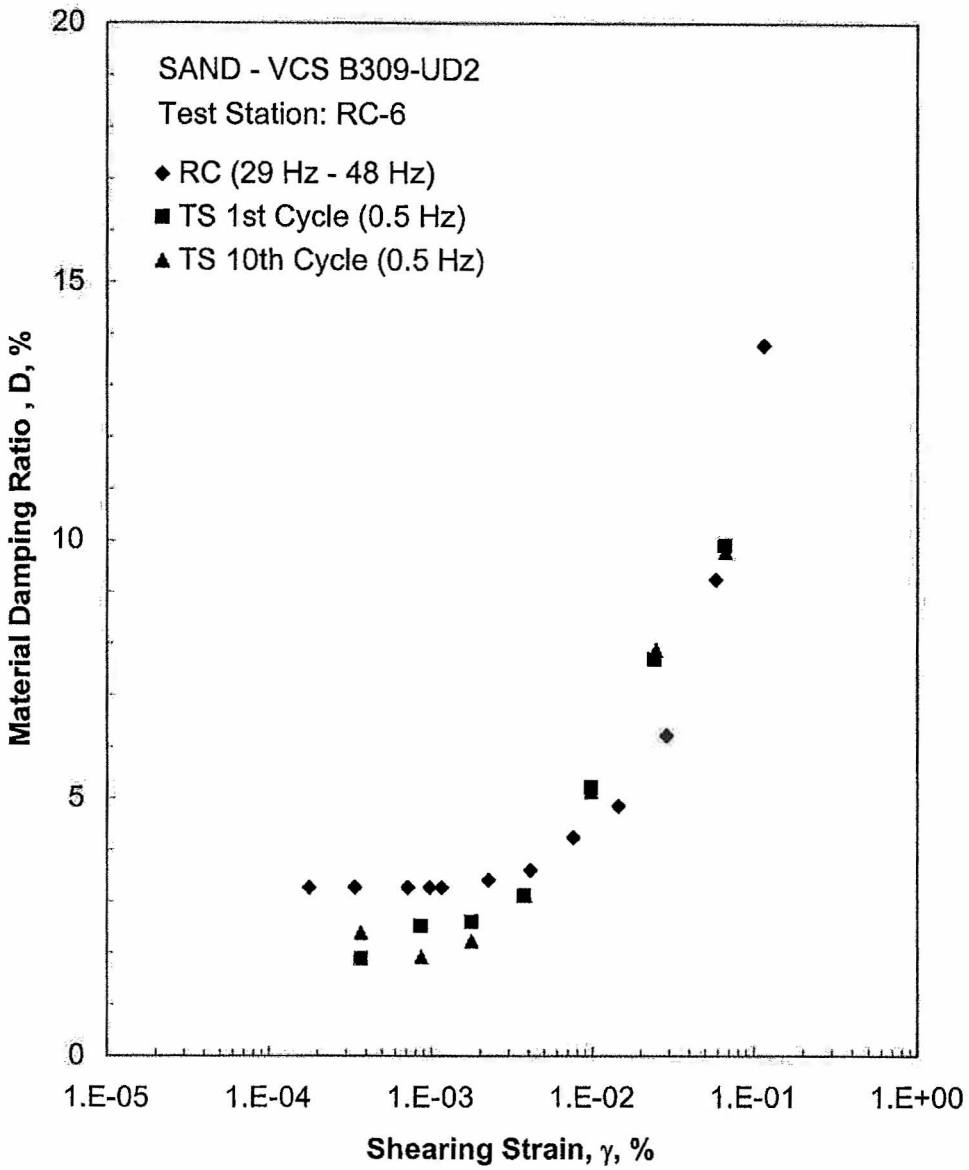


Figure E.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

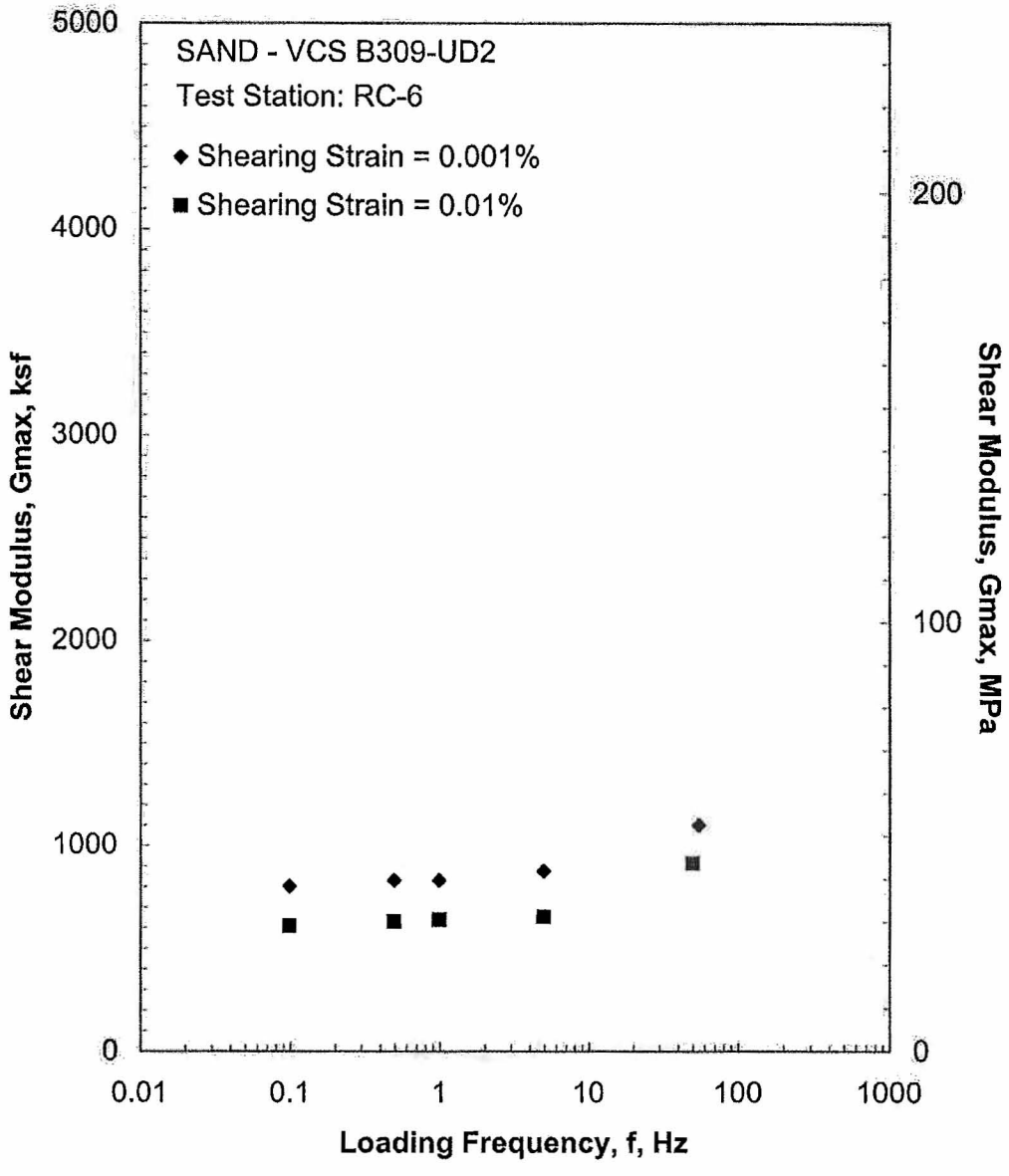


Figure E.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

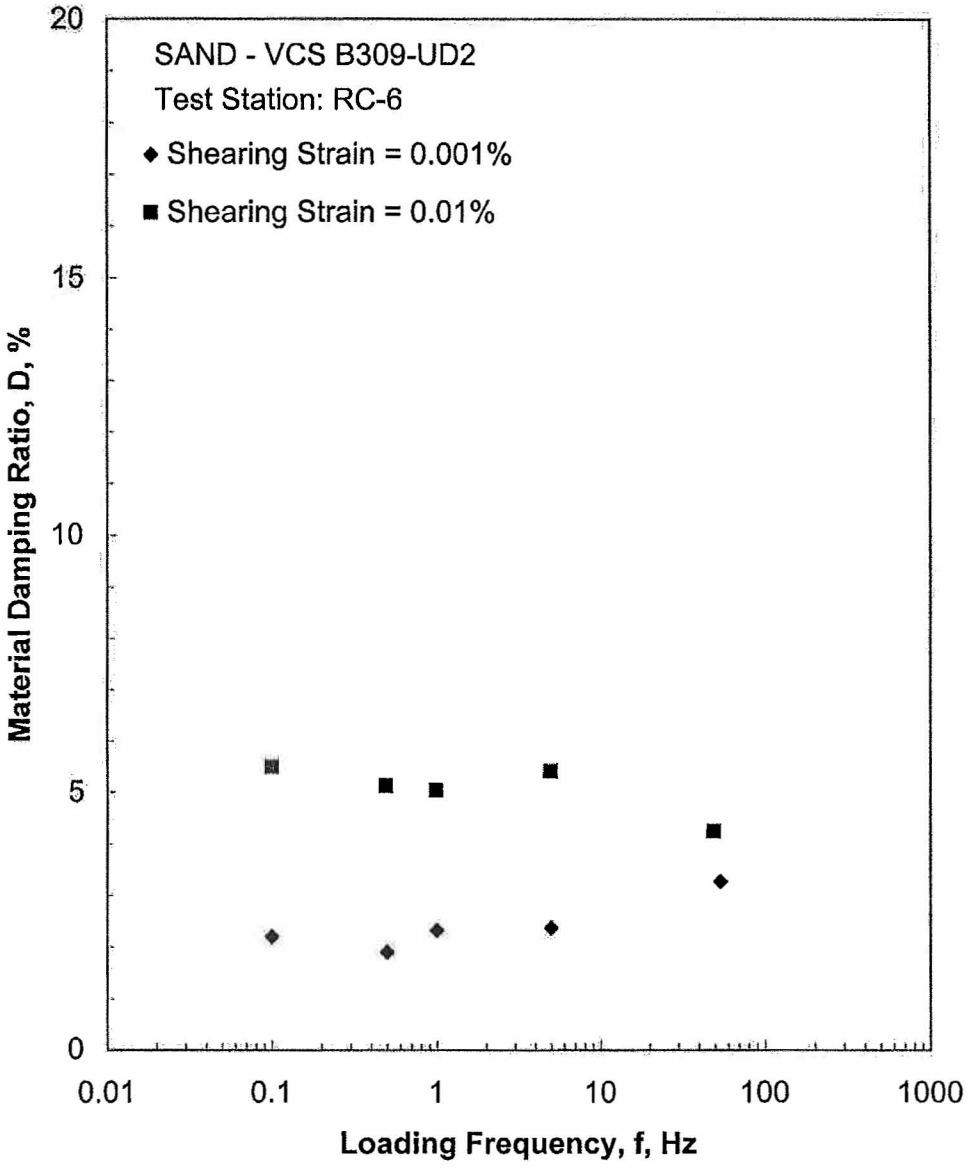


Figure E.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

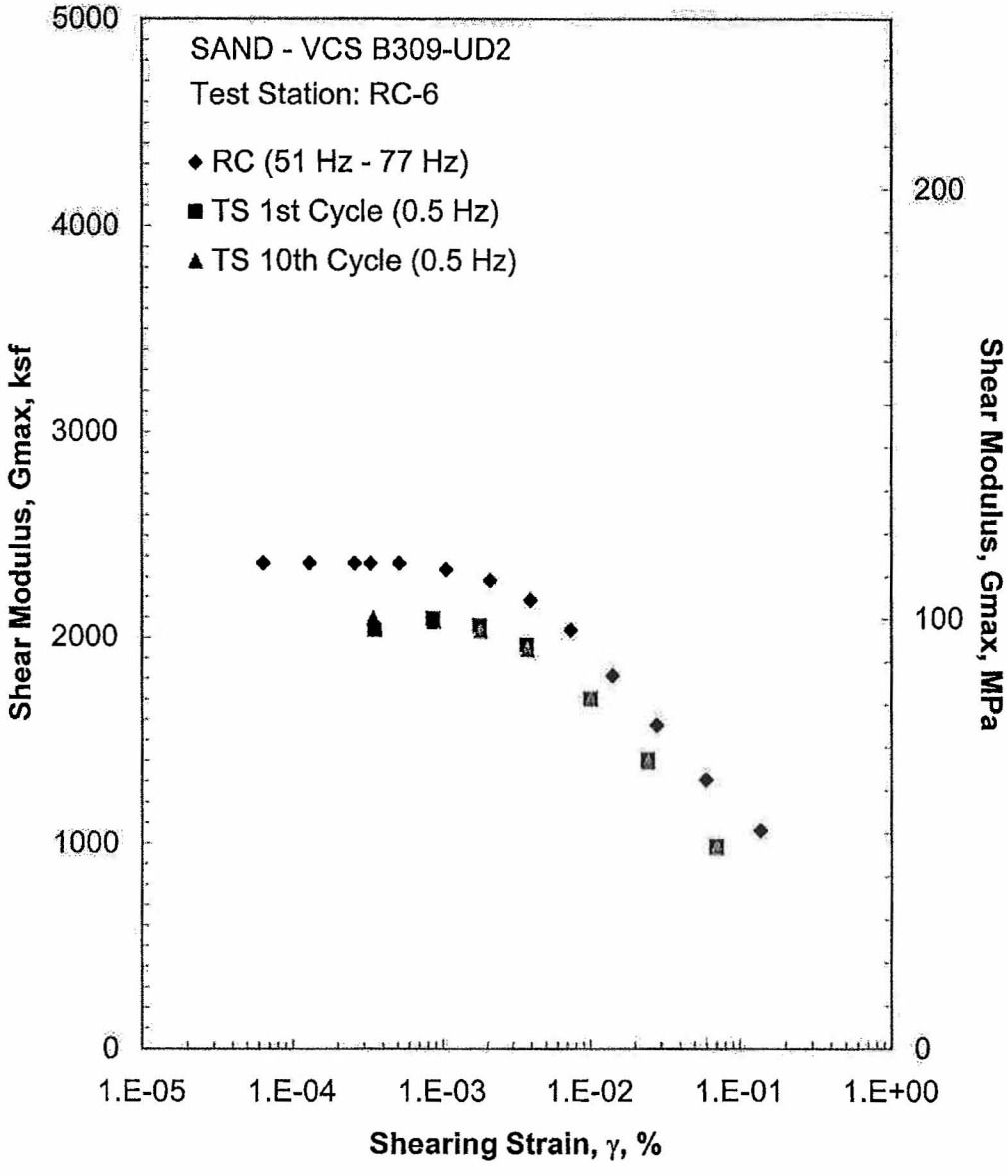


Figure E.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

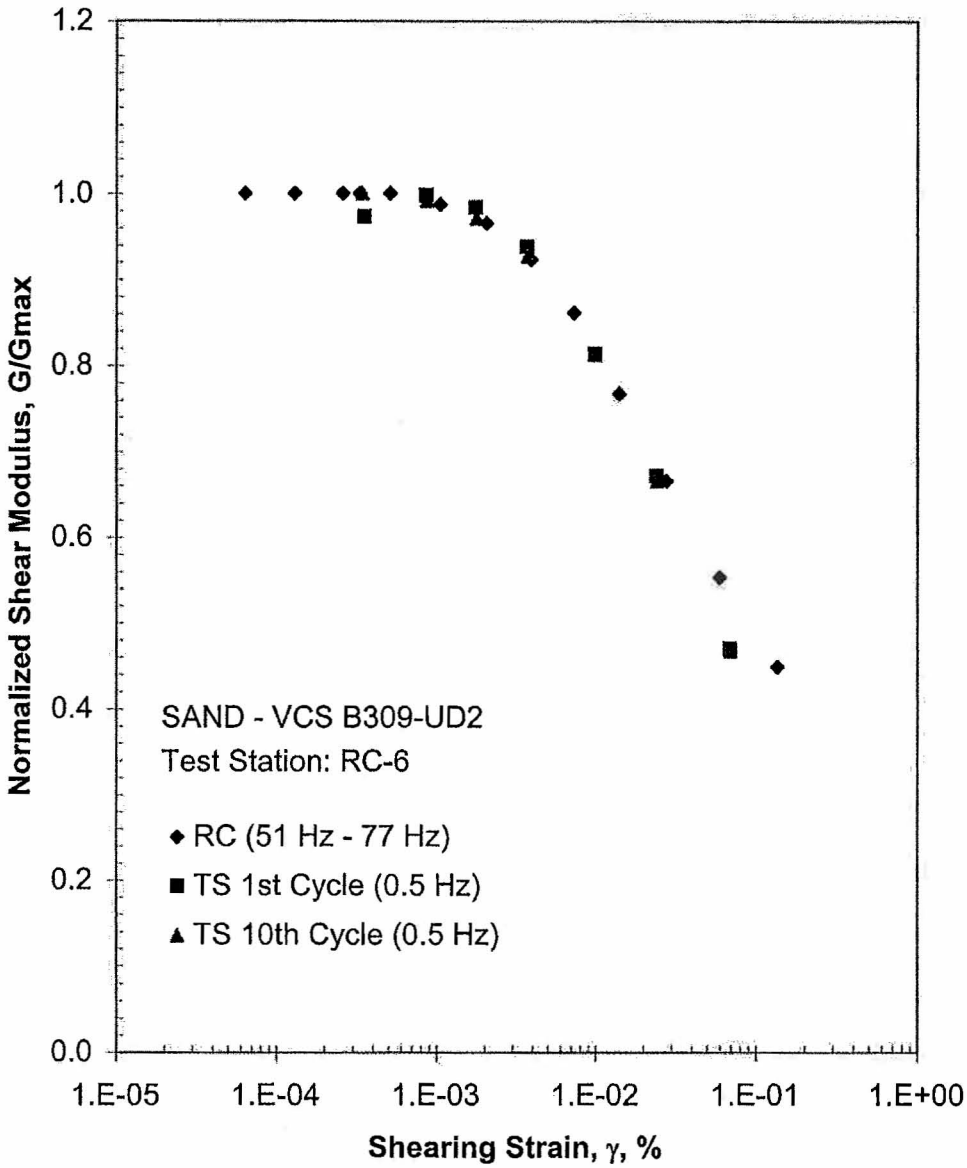


Figure E.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

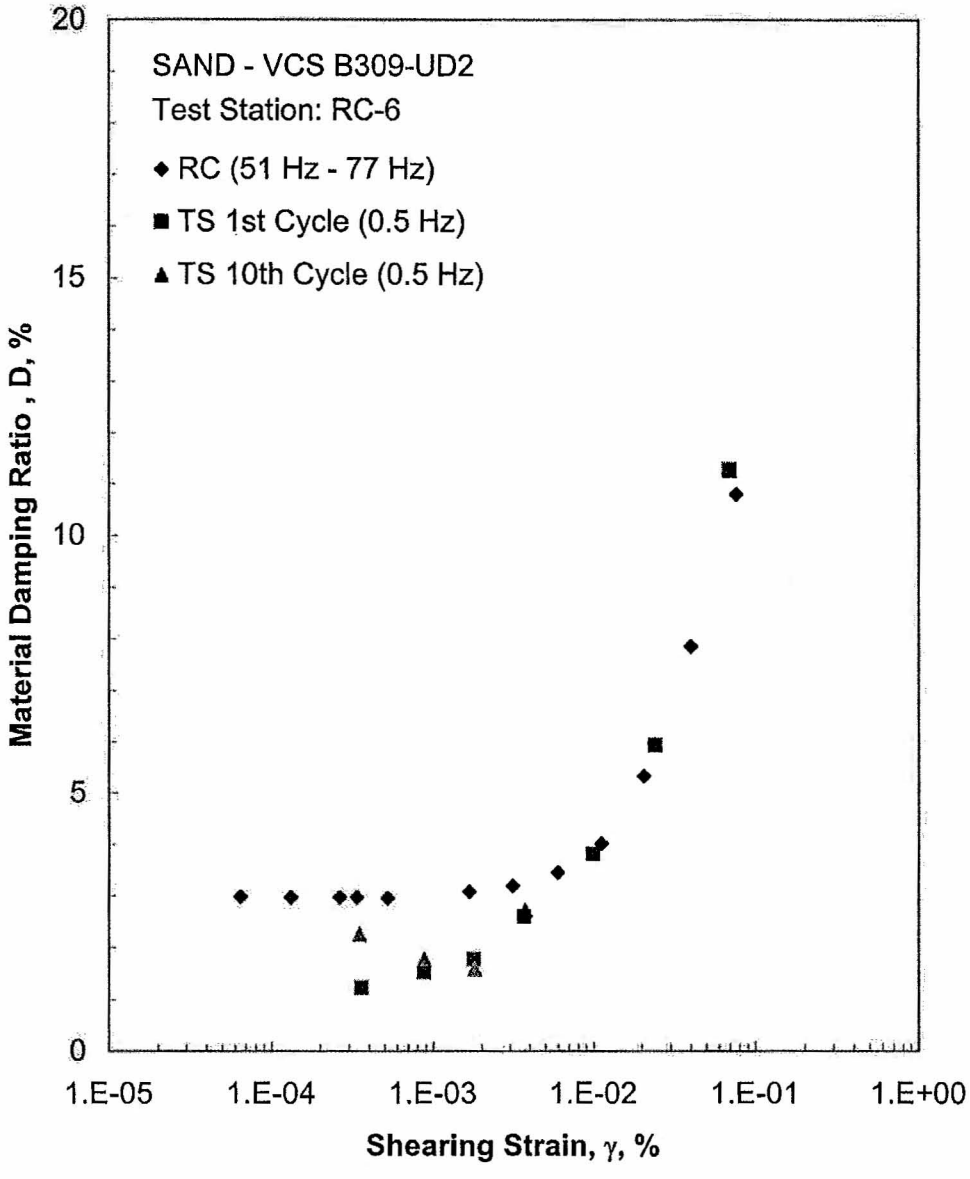


Figure E.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

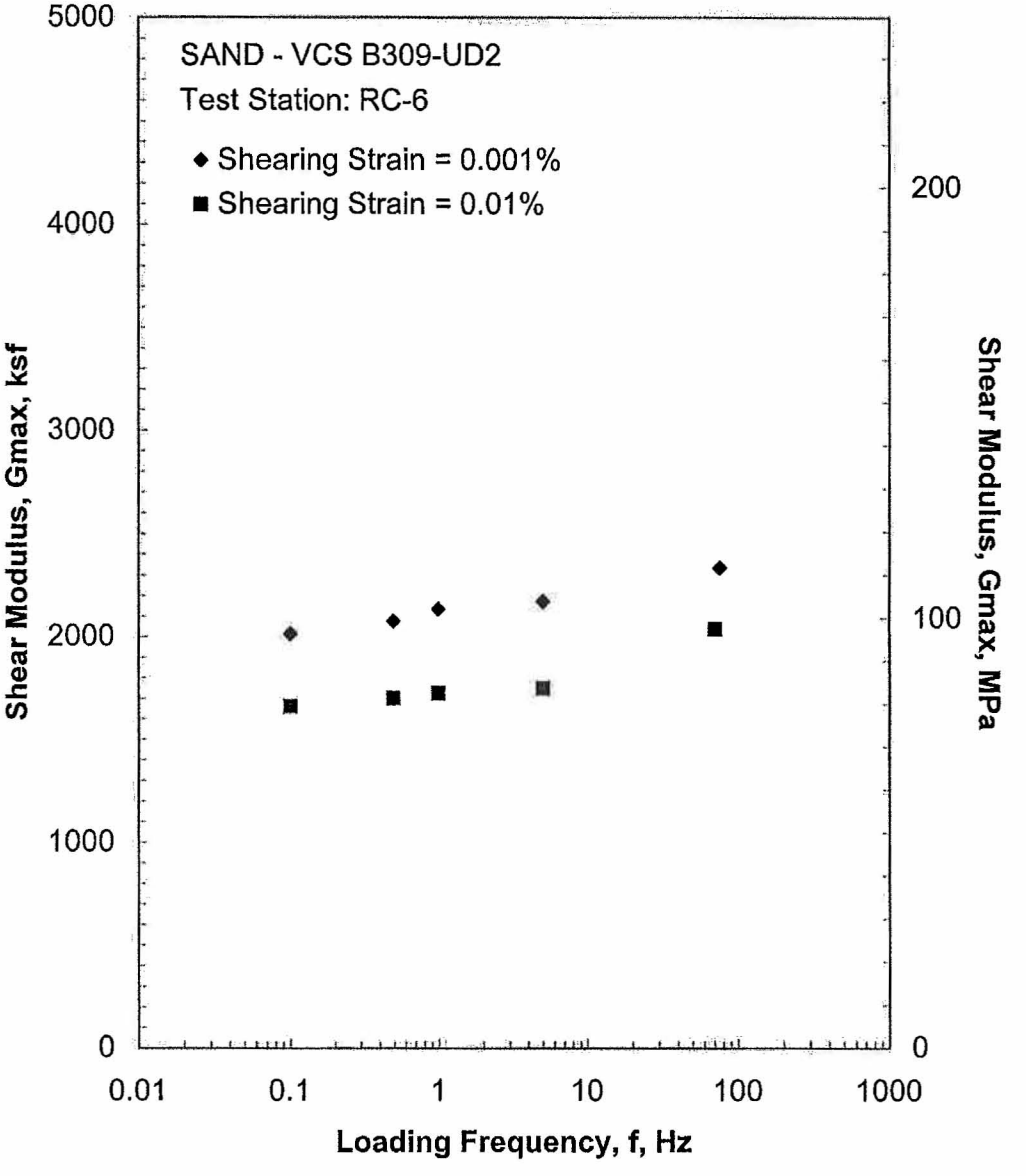


Figure E.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

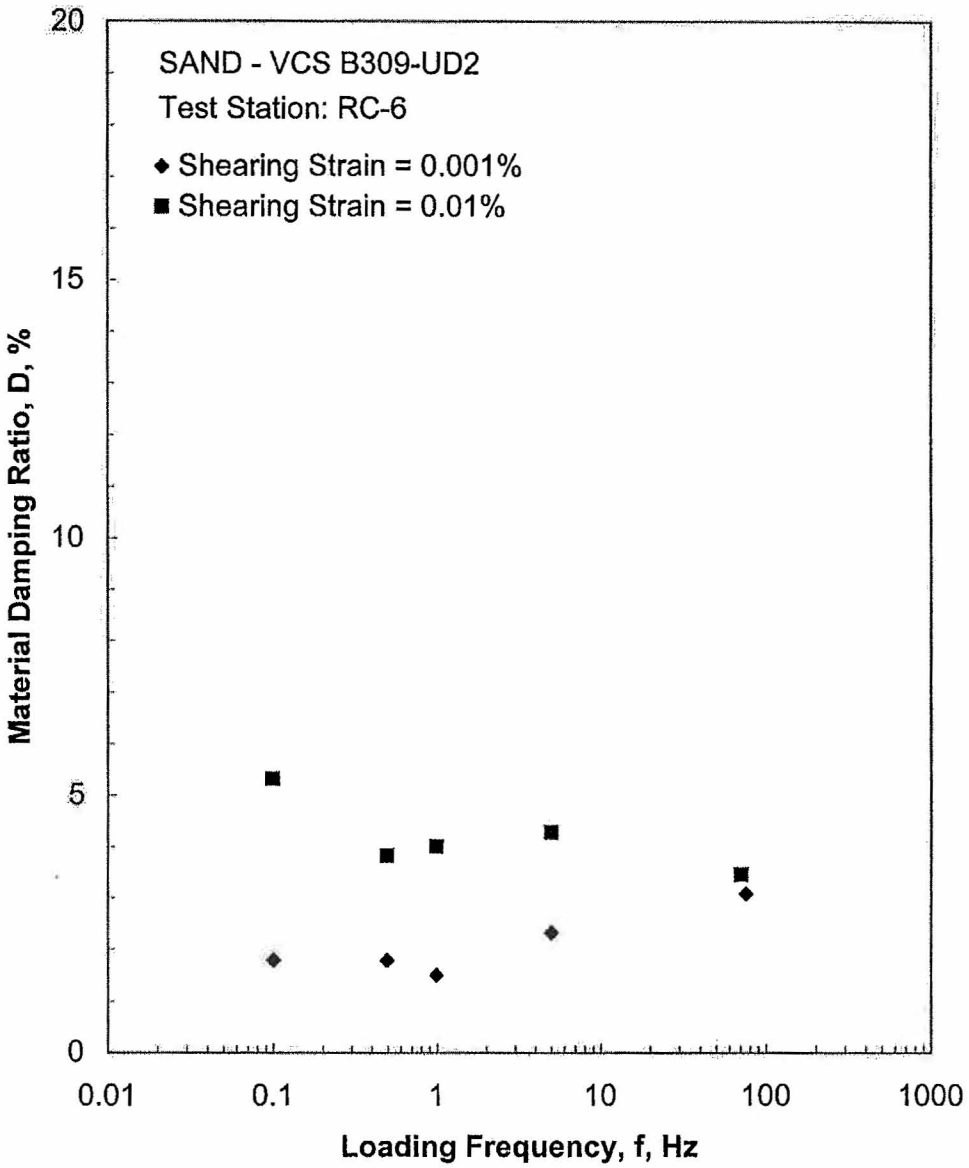


Figure E.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

Table E.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio and Estimated Void Ratio with Isotropic Confining Pressure from RC Tests of Specimen VCS B309-UD2

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, Vs	Low-Amplitude Material Damping Ratio, Dmin	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
2.5	360	17	652	31	442	3.18	0.814
4.9	706	34	772	37	478	3.14	0.794
9.8	1411	68	1098	53	574	2.98	---
19.7	2837	136	1536	74	669	2.83	0.760
39.4	5674	271	2316	111	802	2.93	0.680

Table E.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS B309-UD2; Isoptropic Confining Pressure, σ_o= 9.8 psi (1.4 ksf = 68 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average* Shearing Strain, %	Material Damping Ratio^x, D, %
9.92E-04	1117	1.00	9.92E-04	3.26
1.80E-04	1117	1.00	1.80E-04	3.26
3.44E-04	1117	1.00	3.44E-04	3.26
7.29E-04	1117	1.00	7.29E-04	3.26
1.44E-03	1090	0.98	1.18E-03	3.26
2.82E-03	1050	0.94	2.28E-03	3.40
5.33E-03	1003	0.90	4.16E-03	3.60
1.01E-02	912	0.82	7.70E-03	4.23
1.93E-02	812	0.73	1.47E-02	4.84
4.08E-02	671	0.60	2.90E-02	6.21
9.36E-02	529	0.47	5.90E-02	9.23
2.35E-01	404	0.36	1.17E-01	13.77

* Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

^x Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table E.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS B309-UD2; Isotropic Confining Pressure, σ_o = 9.8 psi (1.4 ksf = 68 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.74E-04	833	1.00	1.87	3.75E-04	831	1.00	2.37
8.77E-04	829	1.00	2.50	8.80E-04	827	0.99	1.90
1.79E-03	815	0.98	2.59	1.79E-03	814	0.98	2.21
3.81E-03	767	0.92	3.09	3.84E-03	759	0.91	3.11
9.91E-03	624	0.75	5.20	9.89E-03	625	0.75	5.11
2.46E-02	503	0.60	7.68	2.52E-02	491	0.59	7.86
6.69E-02	370	0.44	9.89	6.77E-02	366	0.44	9.76

Table E.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS B309-UD2; Isoptropic Confining Pressure, σ_o= 39.4 psi (5.7 ksf = 271 kPa)

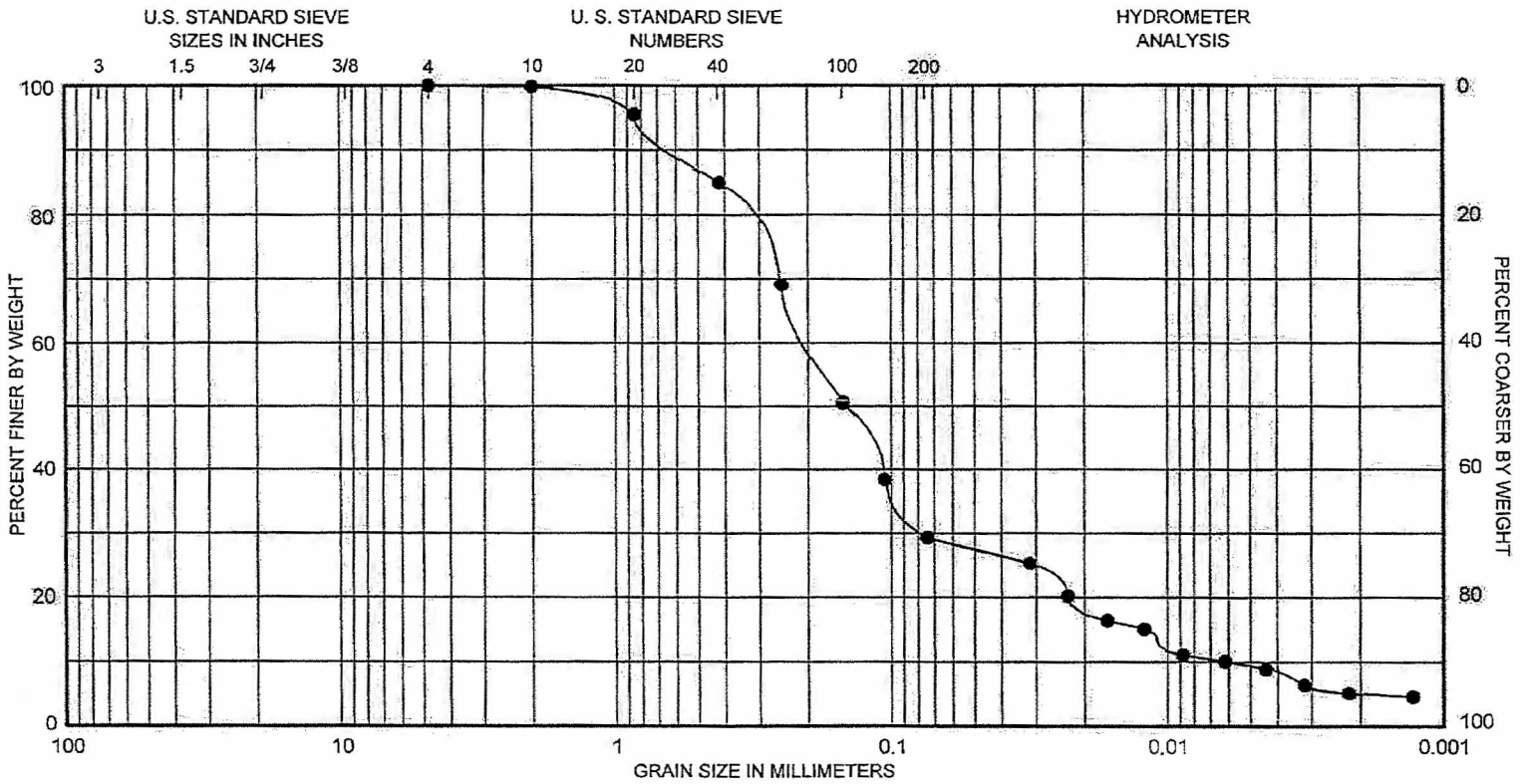
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
3.37E-04	2362	1.00	3.37E-04	2.97
6.50E-05	2362	1.00	6.50E-05	2.98
1.32E-04	2362	1.00	1.32E-04	2.97
2.64E-04	2362	1.00	2.64E-04	2.97
5.22E-04	2362	1.00	5.22E-04	2.95
1.07E-03	2331	0.99	1.07E-03	---
2.09E-03	2280	0.97	1.69E-03	3.07
3.97E-03	2180	0.92	3.17E-03	3.19
7.40E-03	2034	0.86	6.07E-03	3.44
1.41E-02	1813	0.77	1.13E-02	4.01
2.80E-02	1572	0.67	2.07E-02	5.31
5.95E-02	1306	0.55	4.05E-02	7.84
1.37E-01	1059	0.45	7.68E-02	10.80

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table E.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS B309-UD2; Isotropic Confining Pressure, σ_o= 39.4 psi (5.7 ksf = 271 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus,	Material Damping Ratio, D,	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus,	Material Damping Ratio, D, %
3.60E-04	2033	0.97	1.22	3.51E-04	2090	1.00	2.25
8.77E-04	2086	1.00	1.52	8.82E-04	2074	0.99	1.77
1.78E-03	2056	0.98	1.77	1.80E-03	2029	0.97	1.58
3.73E-03	1961	0.94	2.59	3.78E-03	1938	0.93	2.72
1.00E-02	1700	0.81	3.81	1.01E-02	1699	0.81	3.81
2.43E-02	1403	0.67	5.92	2.45E-02	1392	0.67	5.94
6.96E-02	981	0.47	11.29	6.99E-02	977	0.47	11.26



GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	BORING	DEPTH, FT	C_c	C_u	D_{50}	D_{90}	CLASSIFICATION
●	B-309	205	4.90	32.37	0.1479	0.59	

B309-UD2

GRAIN SIZE CURVE

PLATE

APPENDIX F

Specimen VCS B325-UD4
(Non-Plastic; Gs=2.72)

Borehole B325
Sample UD4
Depth = 20.5 ft (6.3 m)
Total Unit Weight = 111.6 lb/ft^3
Water Content = 15.0 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 9.8 psi

FUGRO JOB #: 0401-1659
Testing Station: RC6

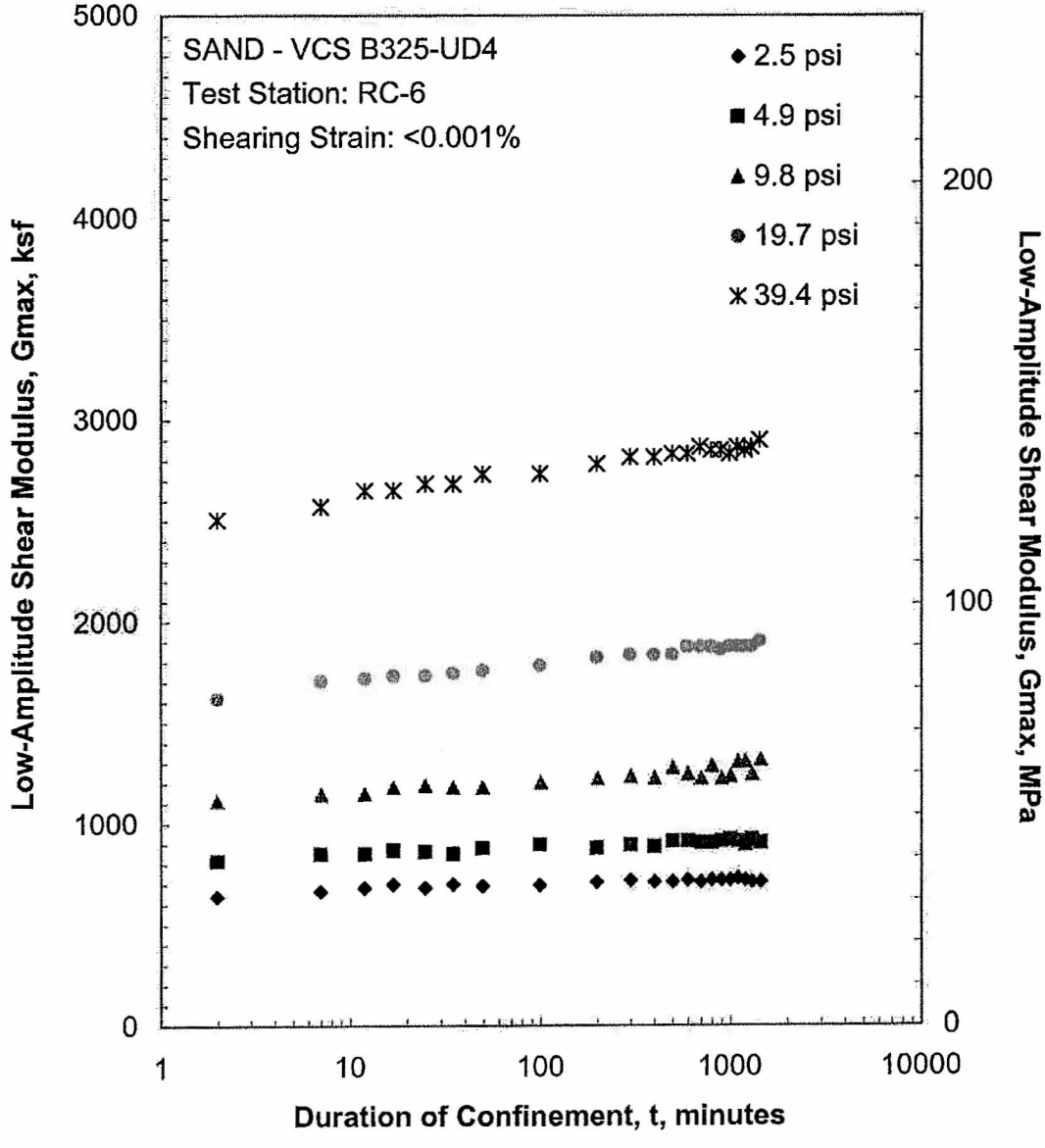


Figure F.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

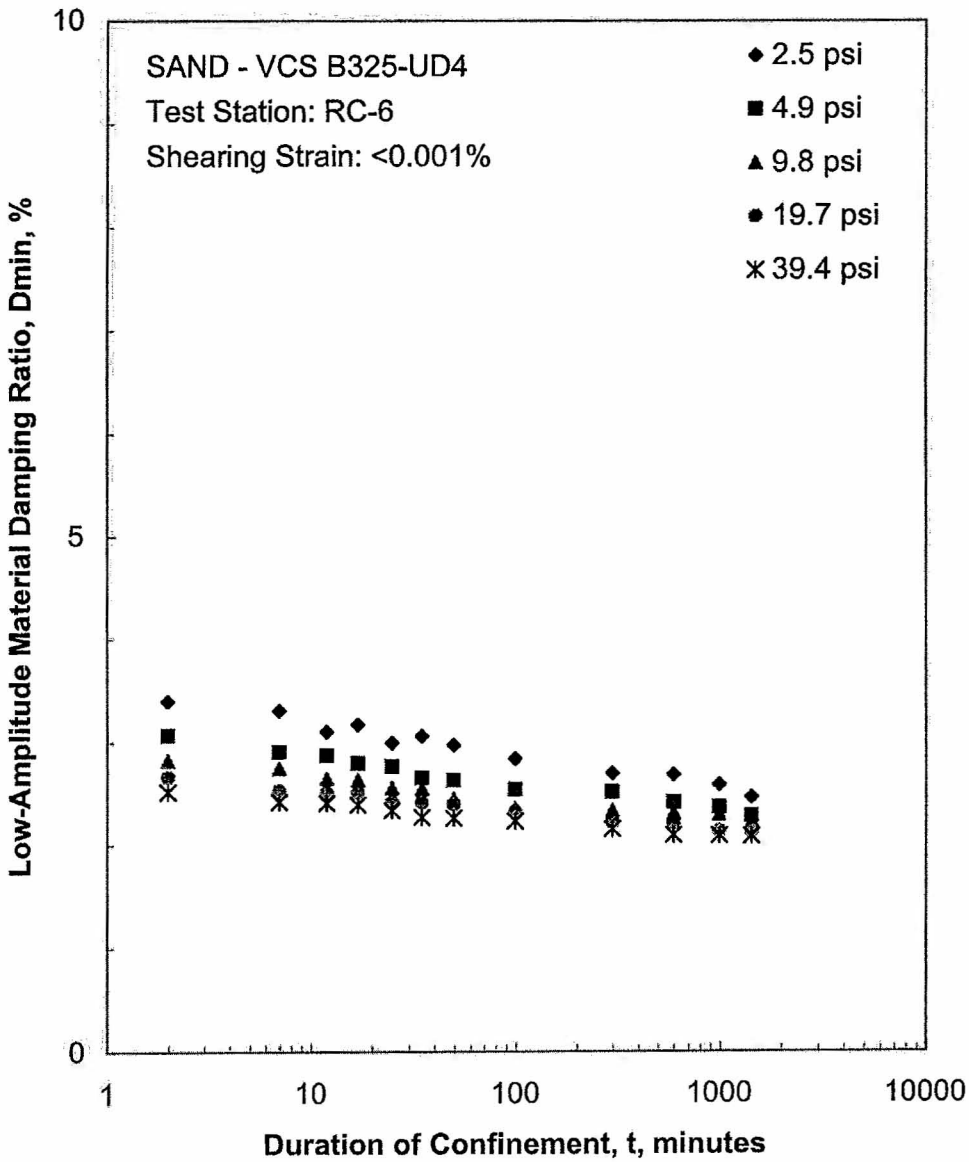


Figure F.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

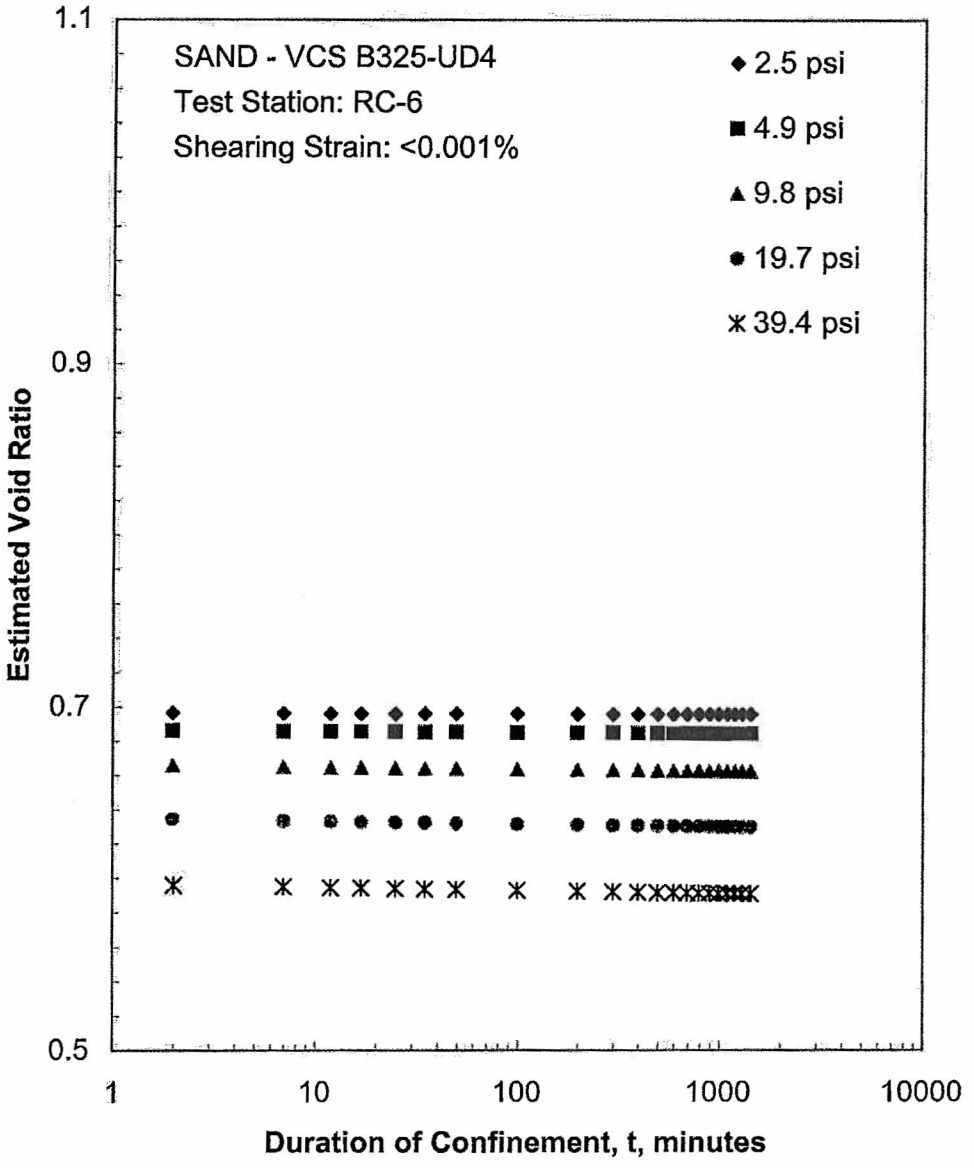


Figure F.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

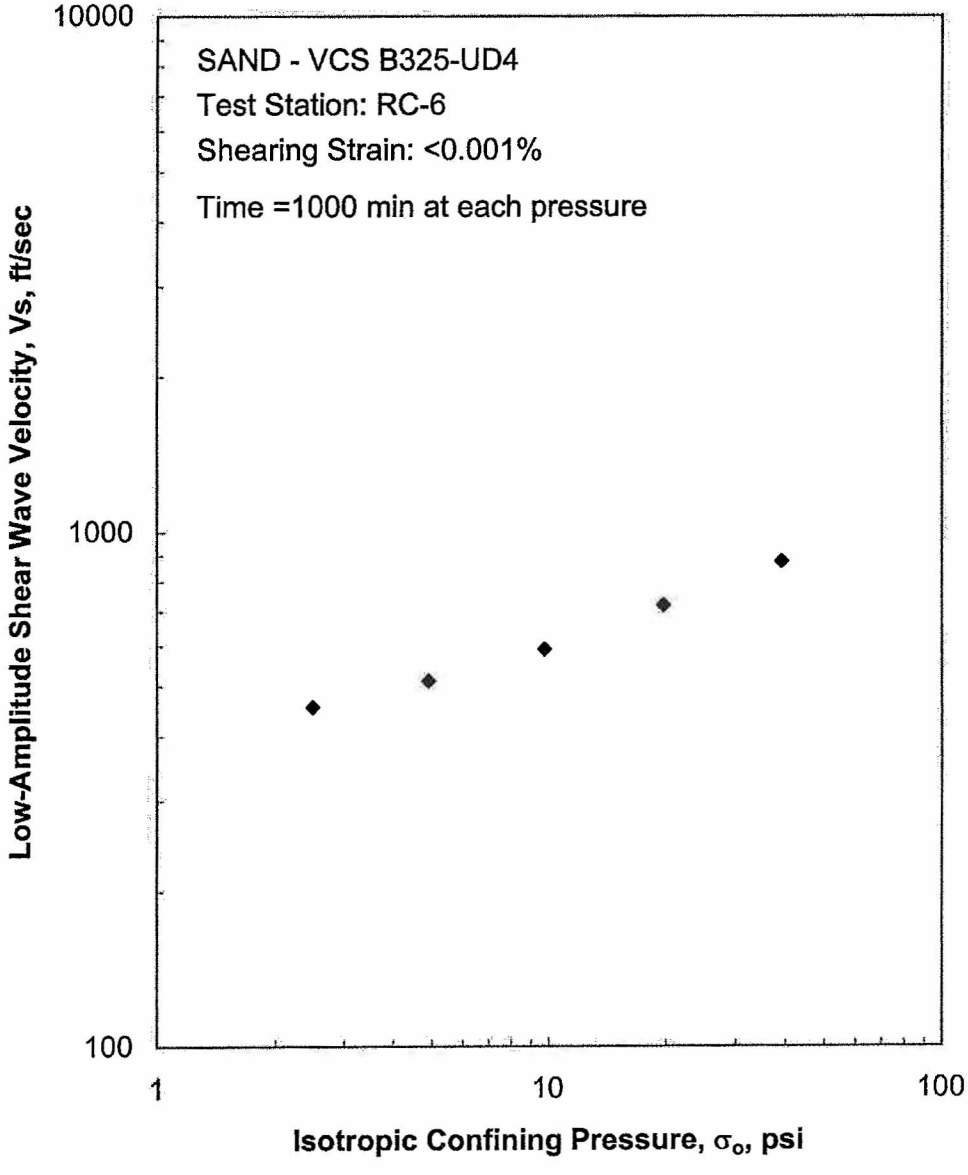


Figure F.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

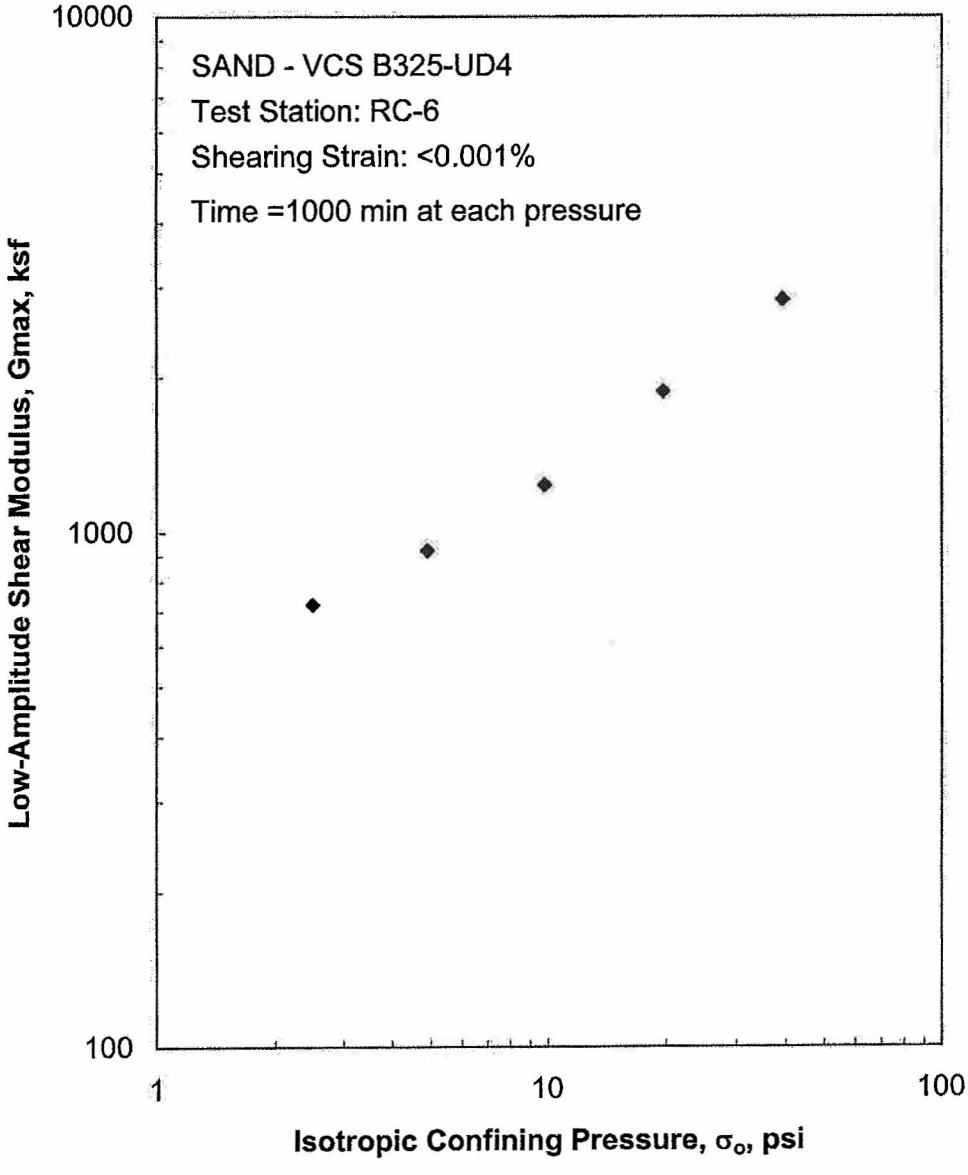


Figure F.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

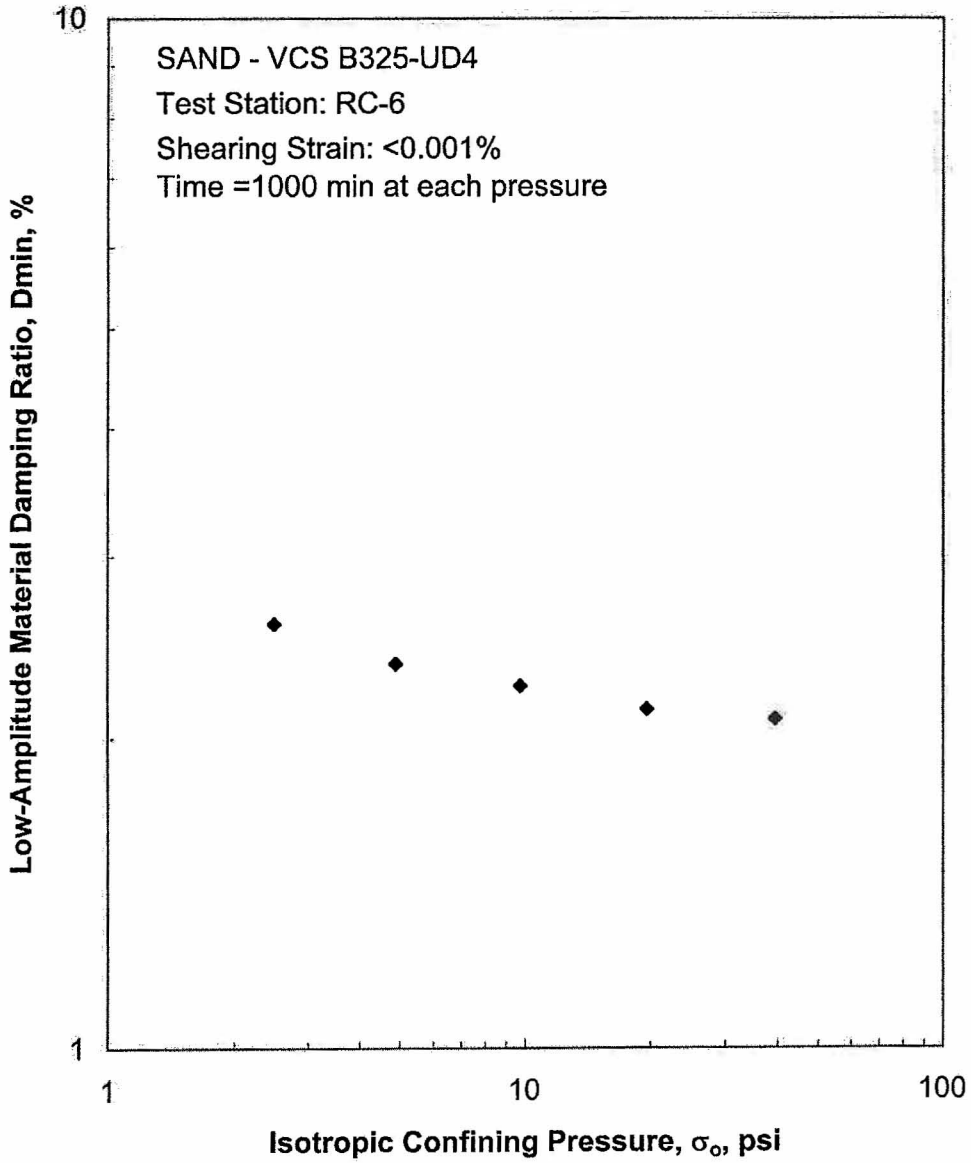


Figure F.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

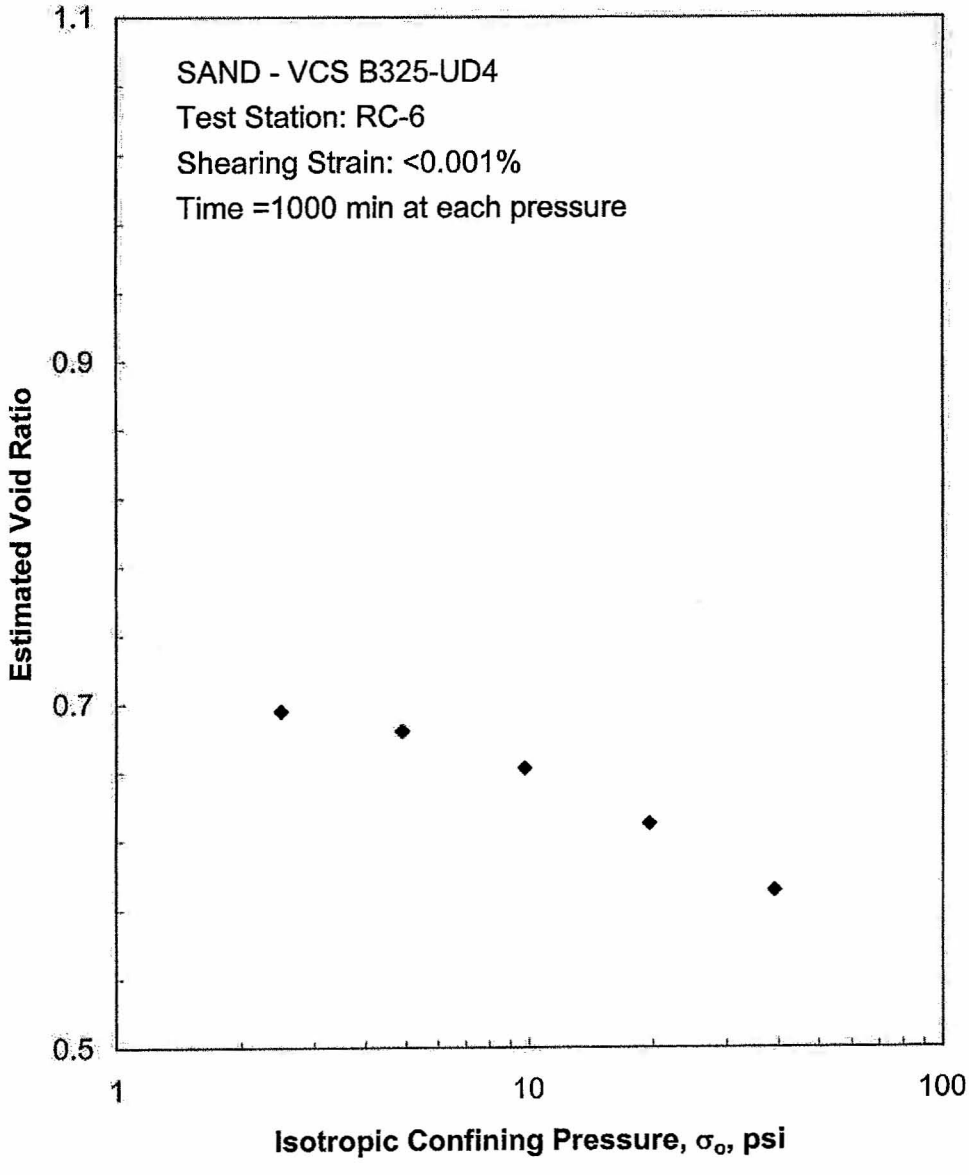


Figure F.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

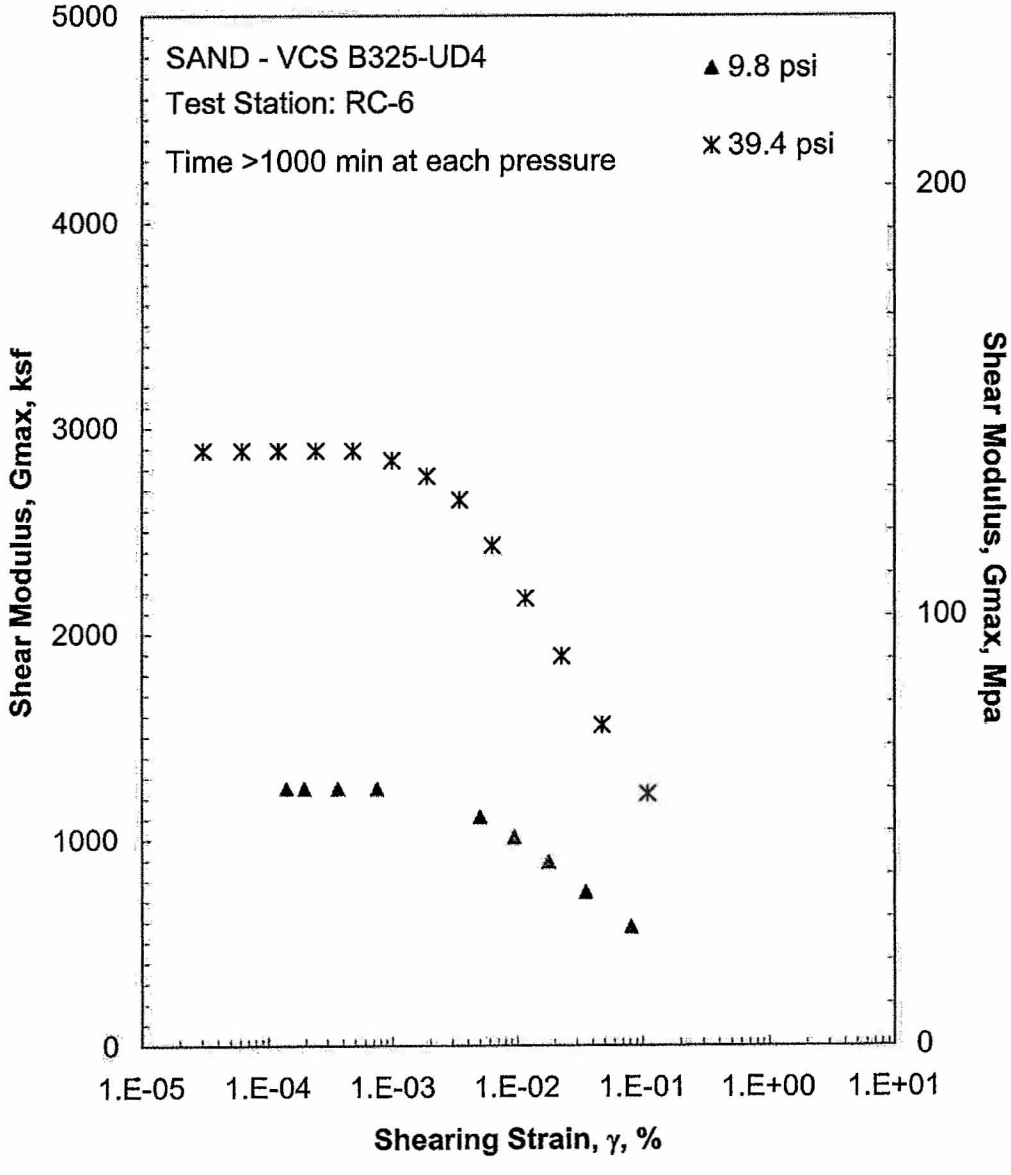


Figure F.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

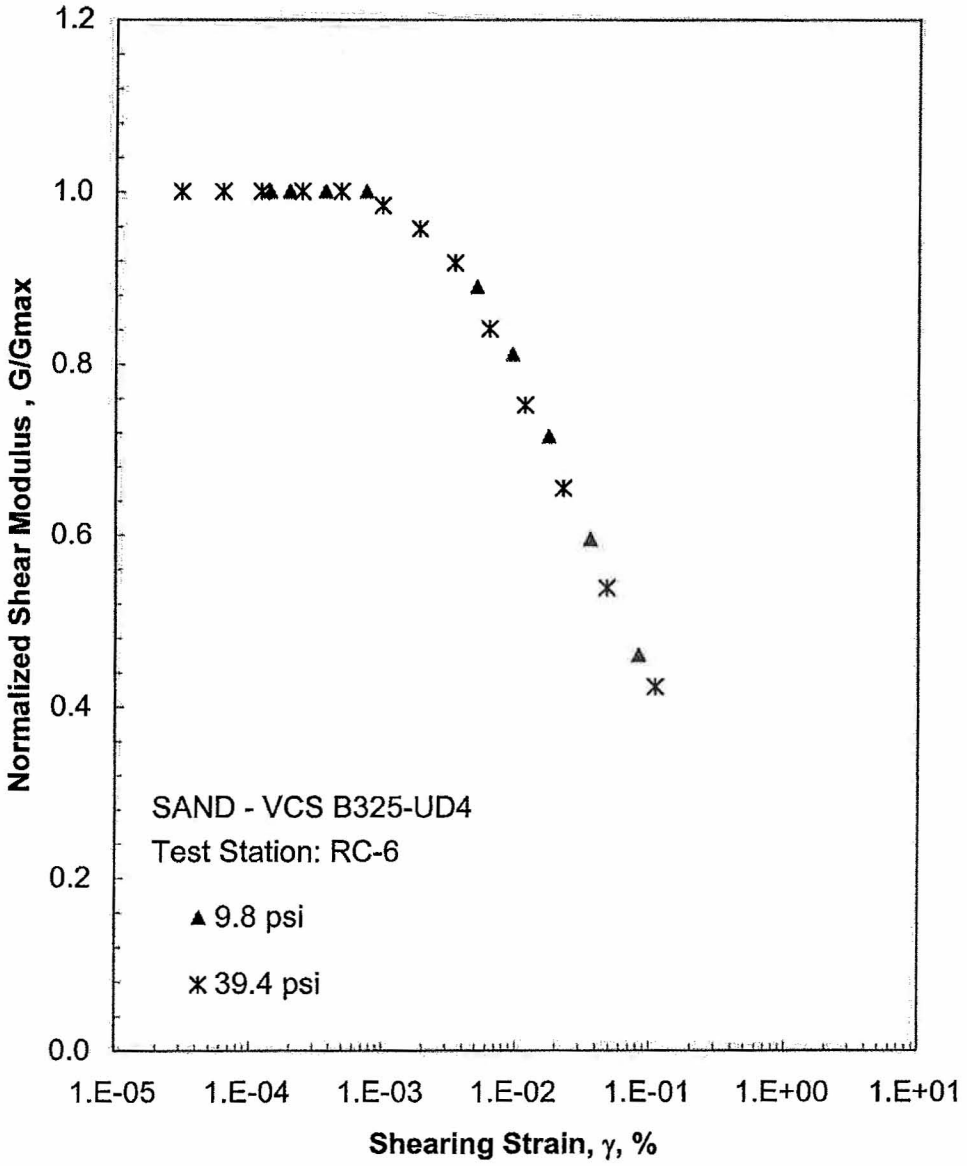


Figure F.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

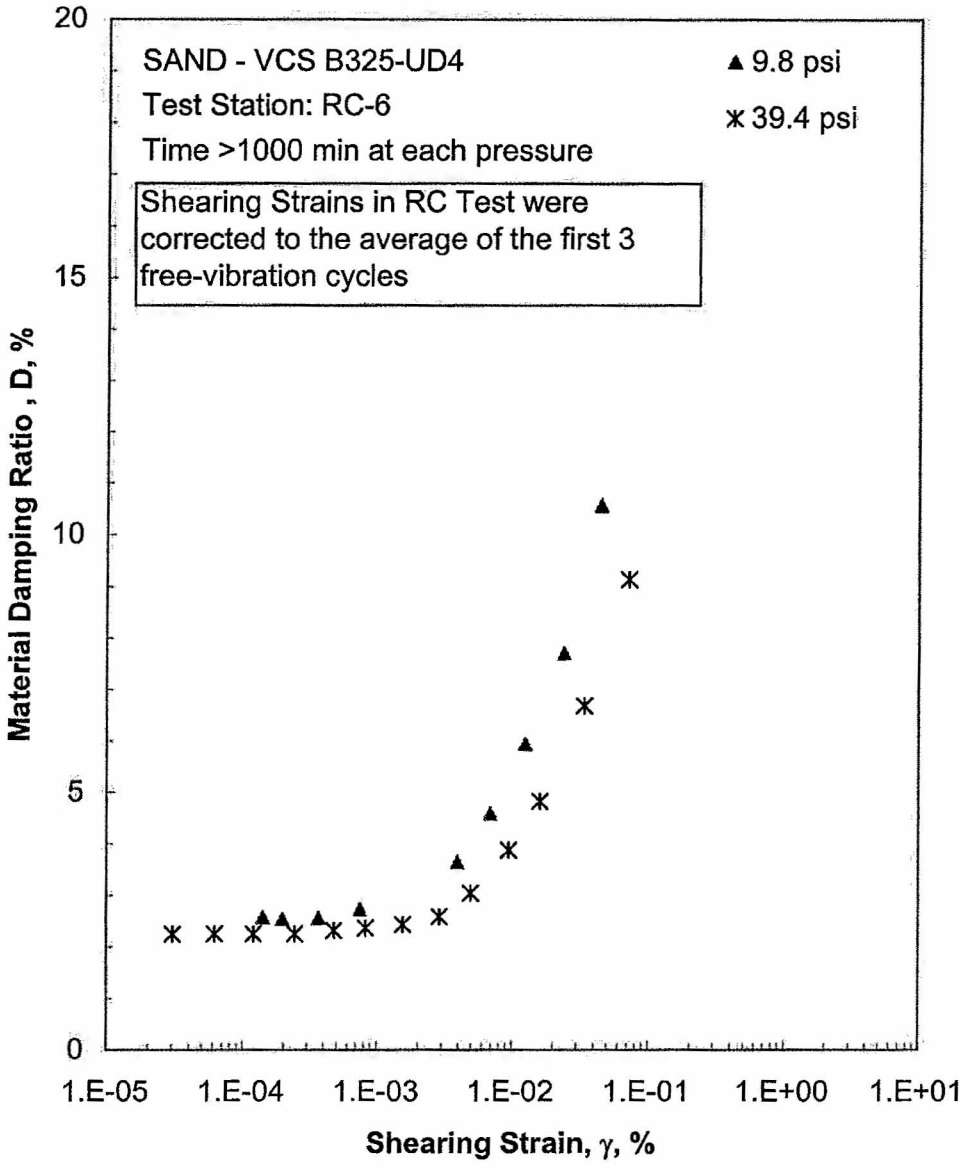


Figure F.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

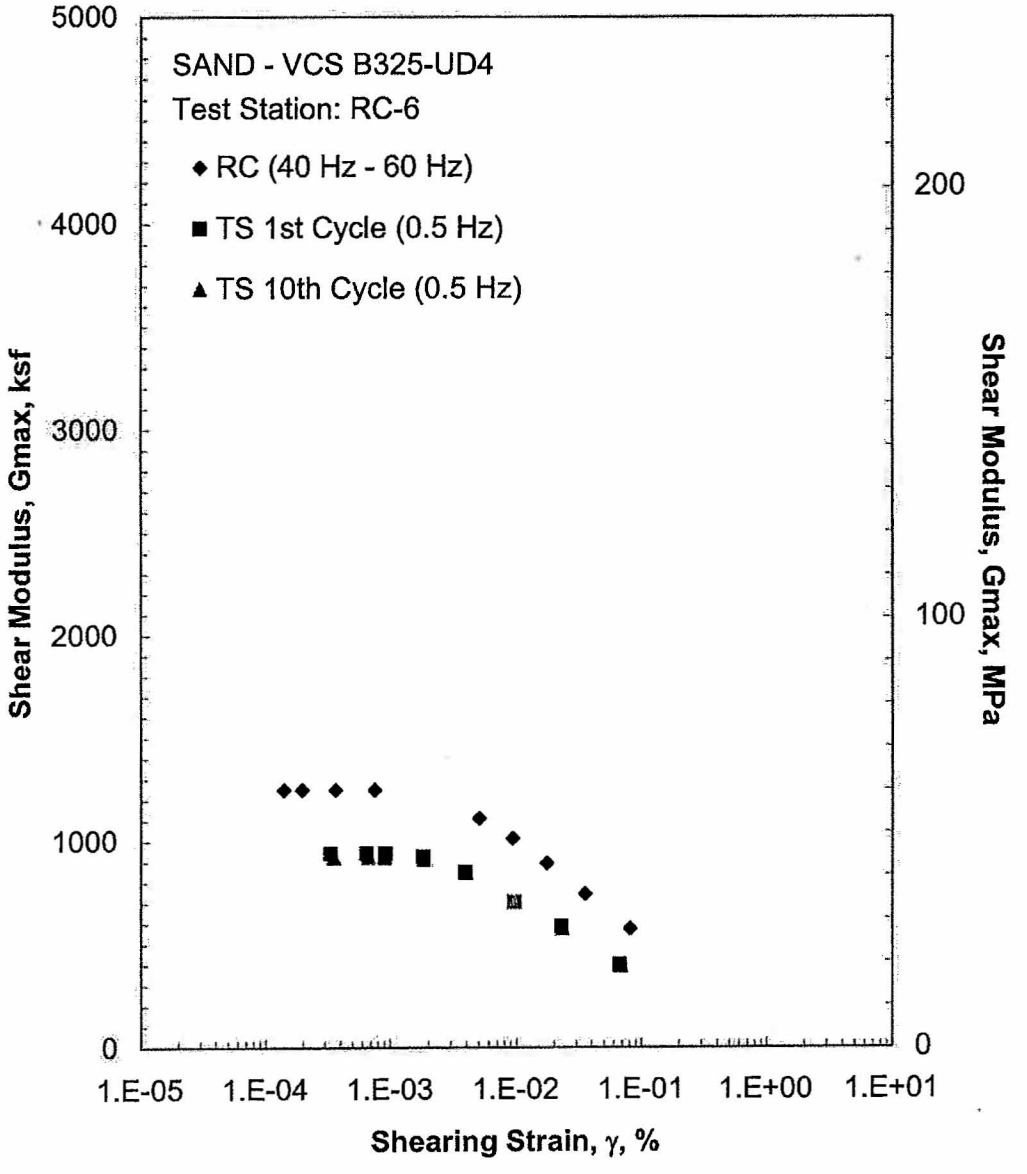


Figure F.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

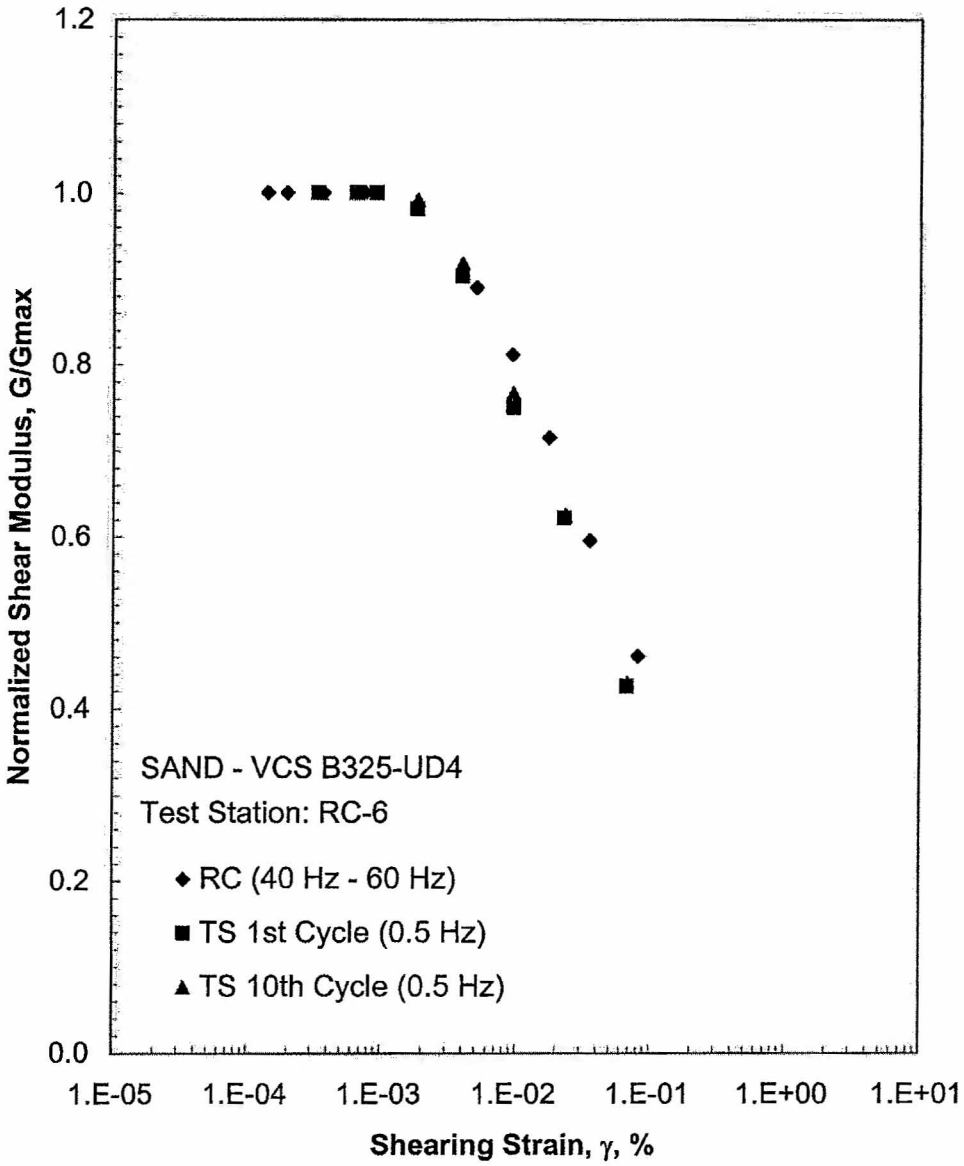


Figure F.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

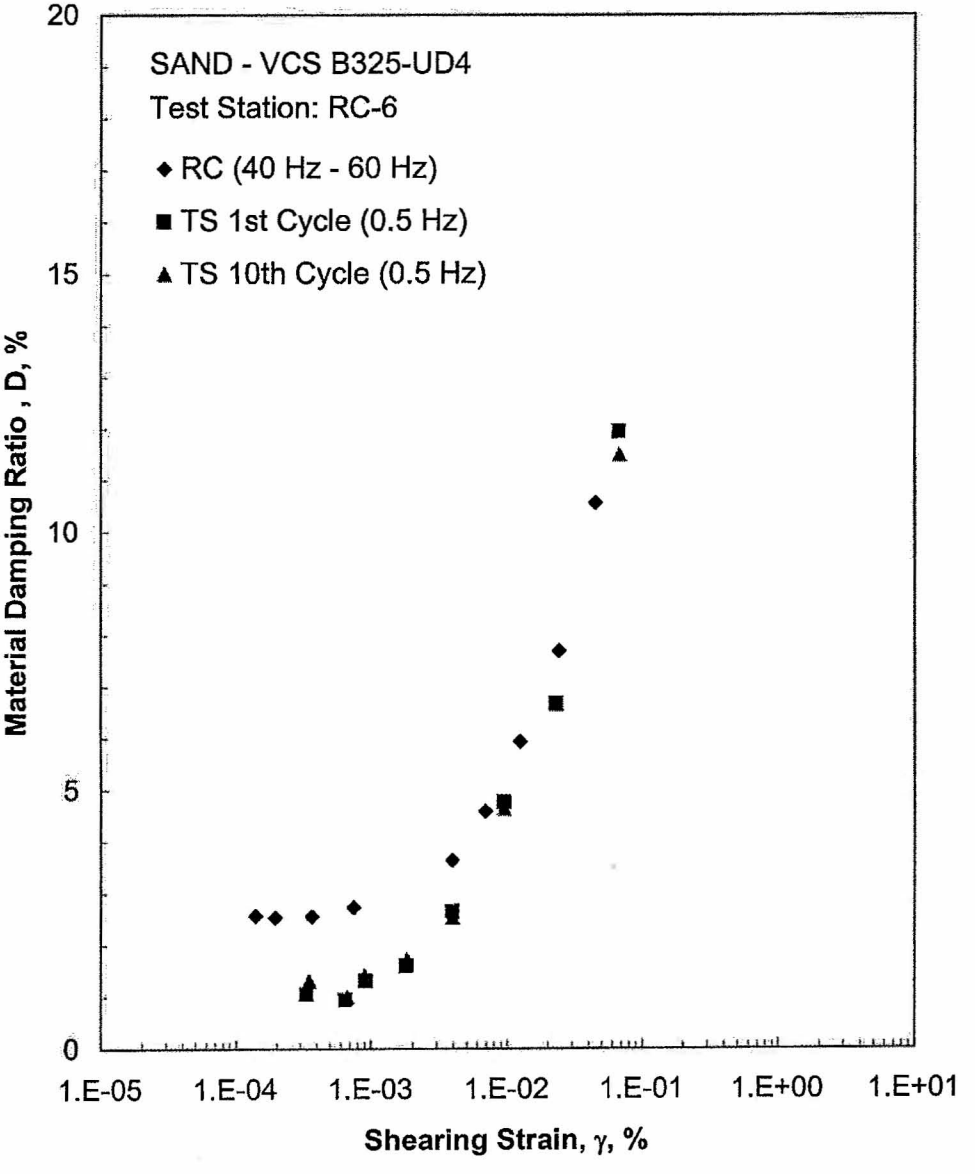


Figure F.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

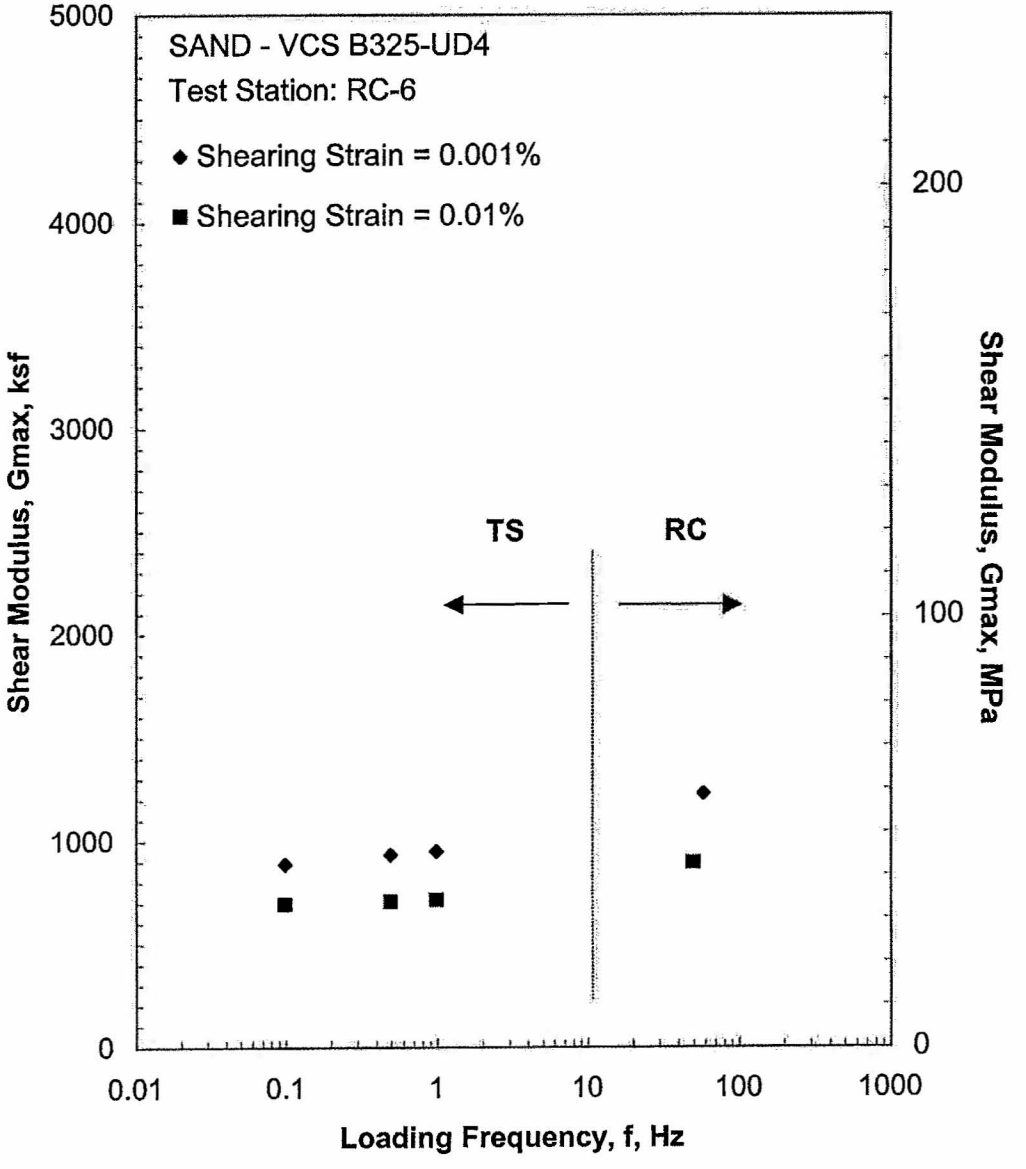


Figure F.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

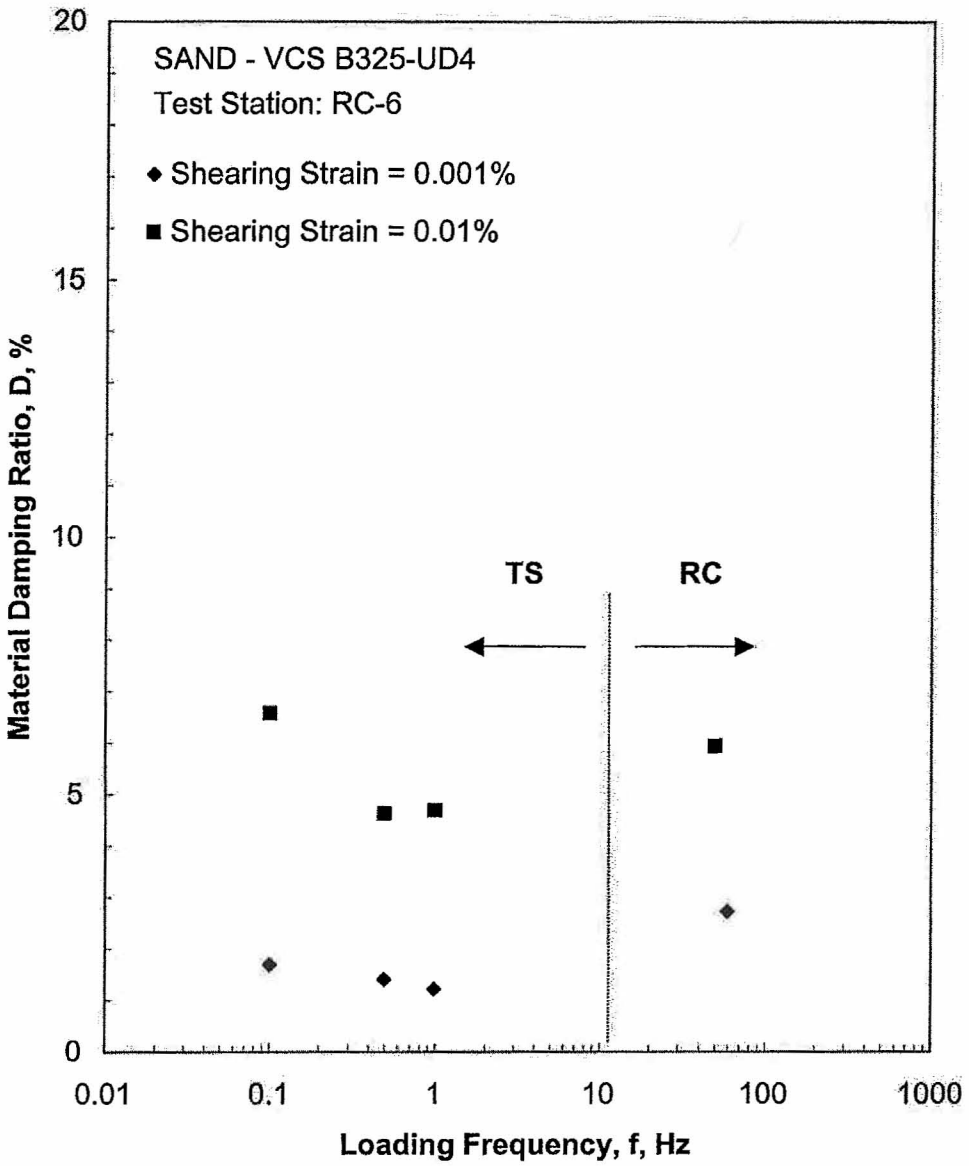


Figure F.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 9.8 psi from the Combined RCTS Tests

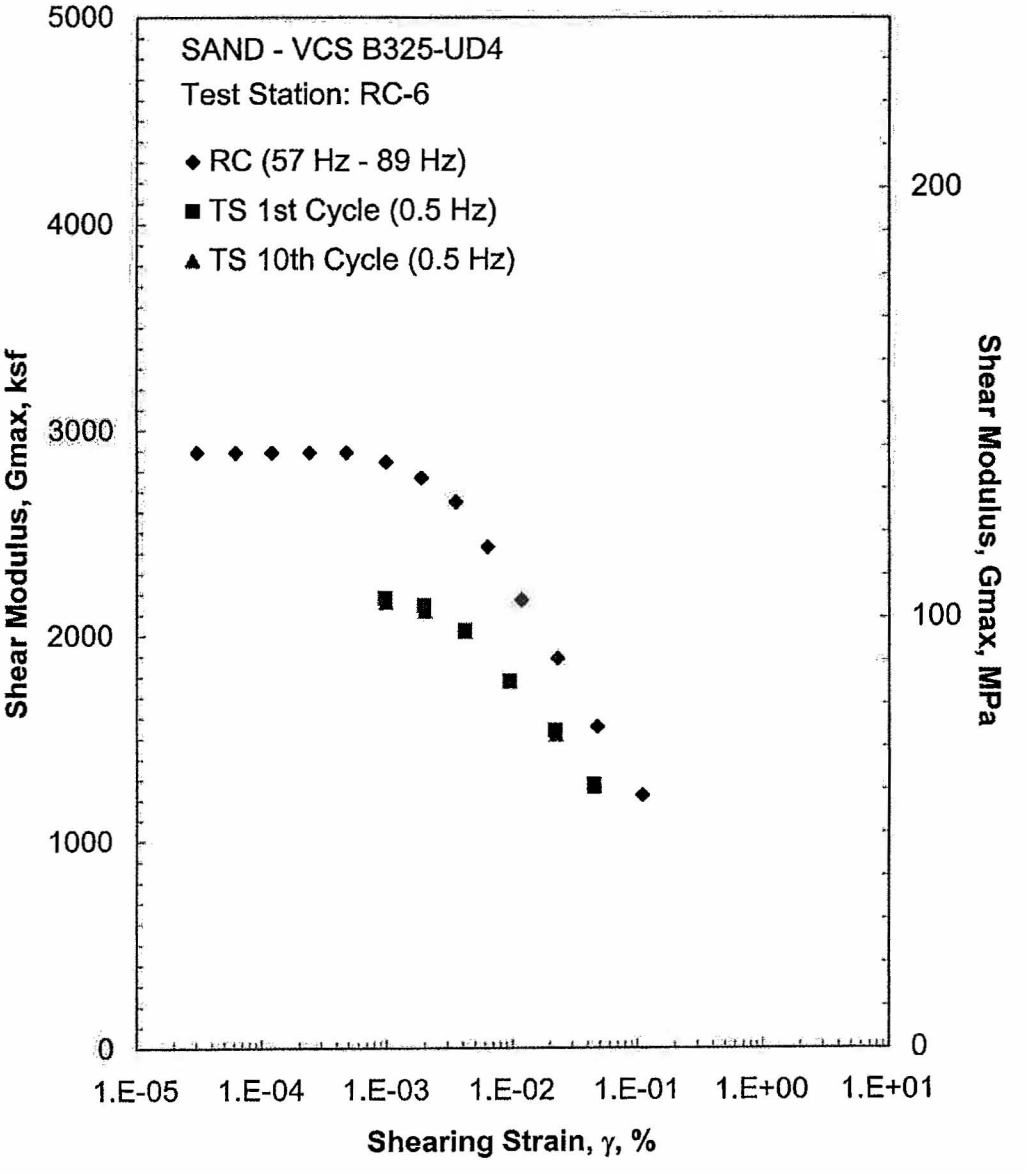


Figure F.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

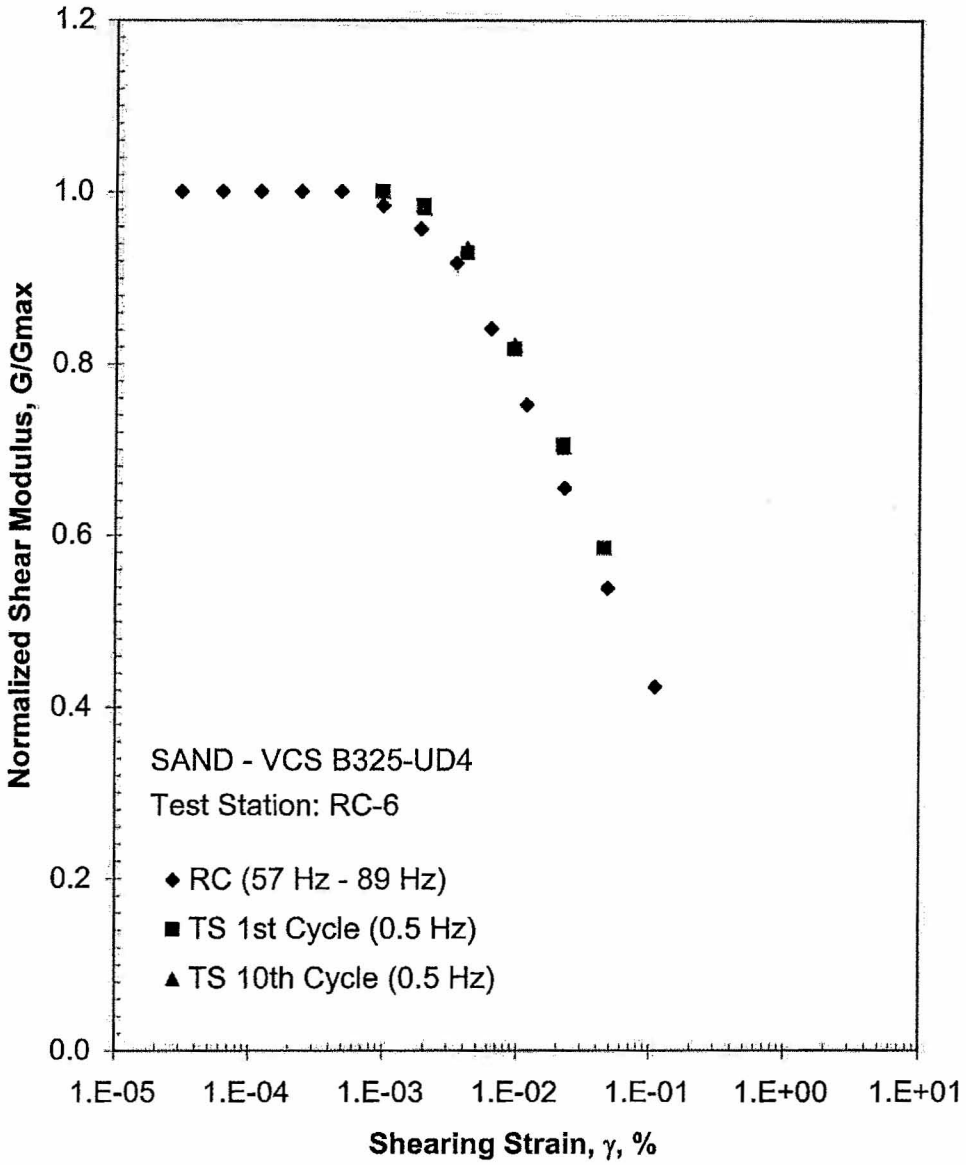


Figure F.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

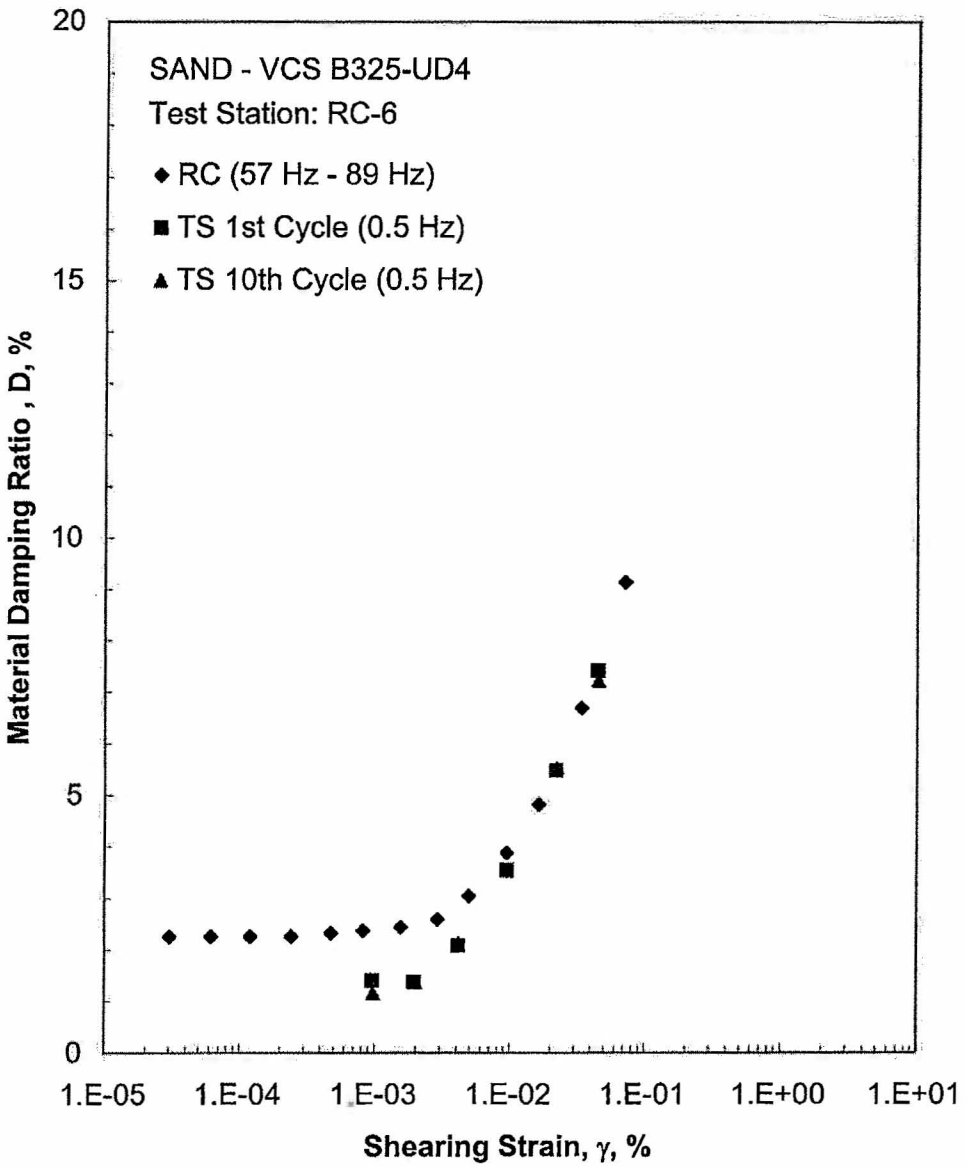


Figure F.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

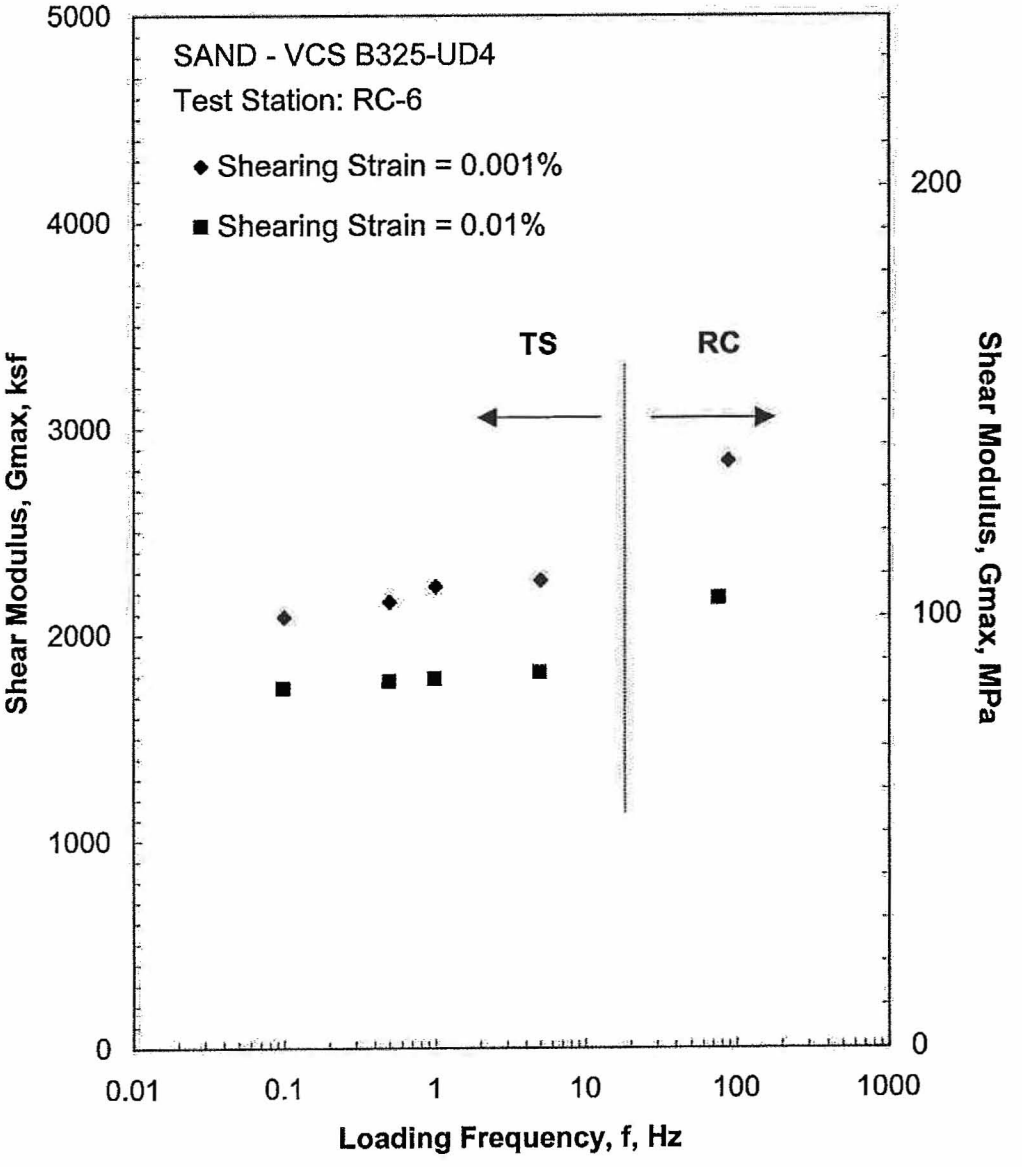


Figure F.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

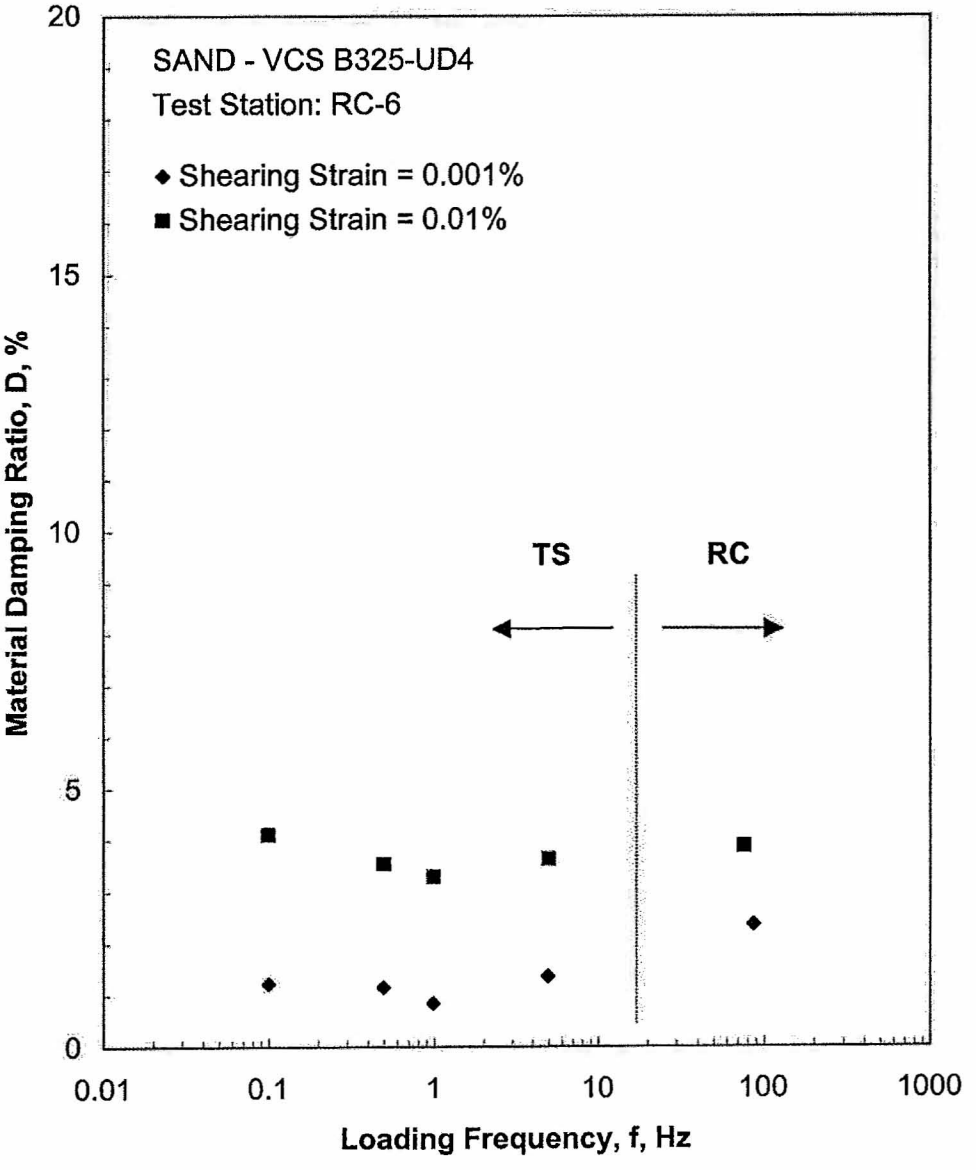


Figure F.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 39.4 psi from the Combined RCTS Tests

Table F.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio and Estimated Void Ratio with Isotropic Confining Pressure from RC Tests of Specimen VCS B325-UD4

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, Vs	Low-Amplitude Material Damping Ratio, Dmin	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
2.5	360	17	721	35	455	2.58	0.696
4.9	706	34	922	44	513	2.36	0.684
9.8	1411	68	1235	59	589	2.25	0.662
19.7	2837	136	1875	90	719	2.13	0.630
39.4	5674	271	2830	136	873	2.09	0.591

Table F.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS B325-UD4; Isoptropic Confining Pressure, σ_o=9.8 psi (1.4 ksf = 68 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
1.42E-04	1250	1.00	1.42E-04	2.57
1.98E-04	1250	1.00	1.98E-04	2.53
3.69E-04	1250	1.00	3.69E-04	2.55
7.55E-04	1250	1.00	7.55E-04	2.73
5.12E-03	1111	0.89	4.00E-03	3.63
9.46E-03	1014	0.81	7.00E-03	4.58
1.78E-02	893	0.71	1.27E-02	5.93
3.60E-02	744	0.60	2.45E-02	7.69
8.27E-02	575	0.46	4.55E-02	10.55

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table F.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS B325-UD4; Isotropic Confining Pressure, σ_o = 9.8 psi (1.4 ksf =68 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.37E-04	941	1.00	1.06	3.54E-04	922	1.00	1.30
6.53E-04	941	1.00	0.94	6.74E-04	922	1.00	0.99
9.23E-04	941	1.00	1.31	9.08E-04	922	1.00	1.41
1.84E-03	923	0.98	1.60	1.86E-03	914	0.99	1.72
3.99E-03	850	0.90	2.65	4.01E-03	846	0.92	2.53
9.62E-03	706	0.75	4.76	9.60E-03	707	0.77	4.62
2.32E-02	585	0.62	6.66	2.36E-02	576	0.62	6.65
6.79E-02	400	0.43	11.94	6.86E-02	396	0.43	11.48

Table F.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS B325-UD4; Isoptropic Confining Pressure, σ_o= 39.4 psi (5.7 ksf = 271 kPa)

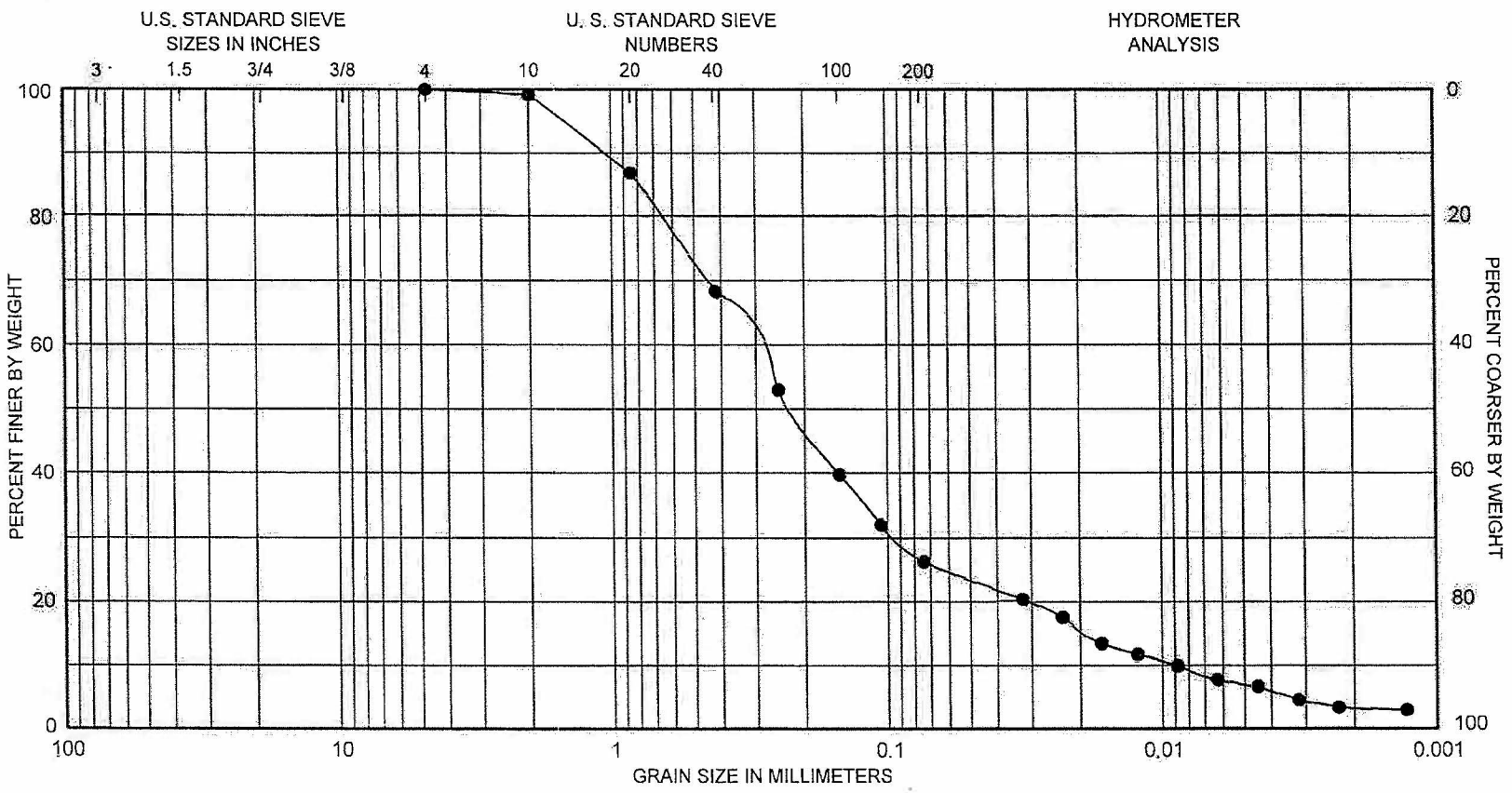
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
3.10E-05	2890	1.00	3.10E-05	2.24
6.30E-05	2890	1.00	6.30E-05	2.25
1.22E-04	2890	1.00	1.22E-04	2.25
2.45E-04	2890	1.00	2.45E-04	2.25
4.84E-04	2890	1.00	4.84E-04	2.31
9.90E-04	2843	0.98	8.32E-04	2.36
1.90E-03	2765	0.96	1.57E-03	2.43
3.50E-03	2651	0.92	2.94E-03	2.58
6.38E-03	2430	0.84	5.04E-03	3.03
1.18E-02	2173	0.75	9.58E-03	3.87
2.29E-02	1891	0.65	1.63E-02	4.82
4.85E-02	1556	0.54	3.44E-02	6.68
1.12E-01	1223	0.42	7.25E-02	9.12

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table F.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS B325-UD4; Isotropic Confining Pressure, σ_o=39.4 psi (5.7 ksf = 271 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
9.78E-04	2180	1.00	1.40	9.86E-04	2160	1.00	1.16
1.99E-03	2145	0.98	1.37	2.01E-03	2118	0.98	1.36
4.21E-03	2026	0.93	2.07	4.22E-03	2020	0.93	2.12
9.58E-03	1780	0.82	3.54	9.61E-03	1775	0.82	3.53
2.22E-02	1536	0.70	5.47	2.25E-02	1516	0.70	5.51
4.55E-02	1275	0.58	7.40	4.59E-02	1264	0.59	7.20



GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	BORING	DEPTH, FT	C_c	C_u	D_{50}	D_{90}	CLASSIFICATION
●	B-325-UD4	20.5	3.07	35.44	0.2235	1.06	Sand, red and gray, with mica

GRAIN SIZE CURVE

APPENDIX G

Specimen VCS B208-UD3
(LL=66, PI=18; Gs=2.75)

Borehole B208
Sample UD3
Depth = 30.5 ft (9.3 m)
Total Unit Weight = 103.5 lb/ft^3
Water Content = 36.4 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 15.2 psi

FUGRO JOB #: 0401-1659
Testing Station: RC6

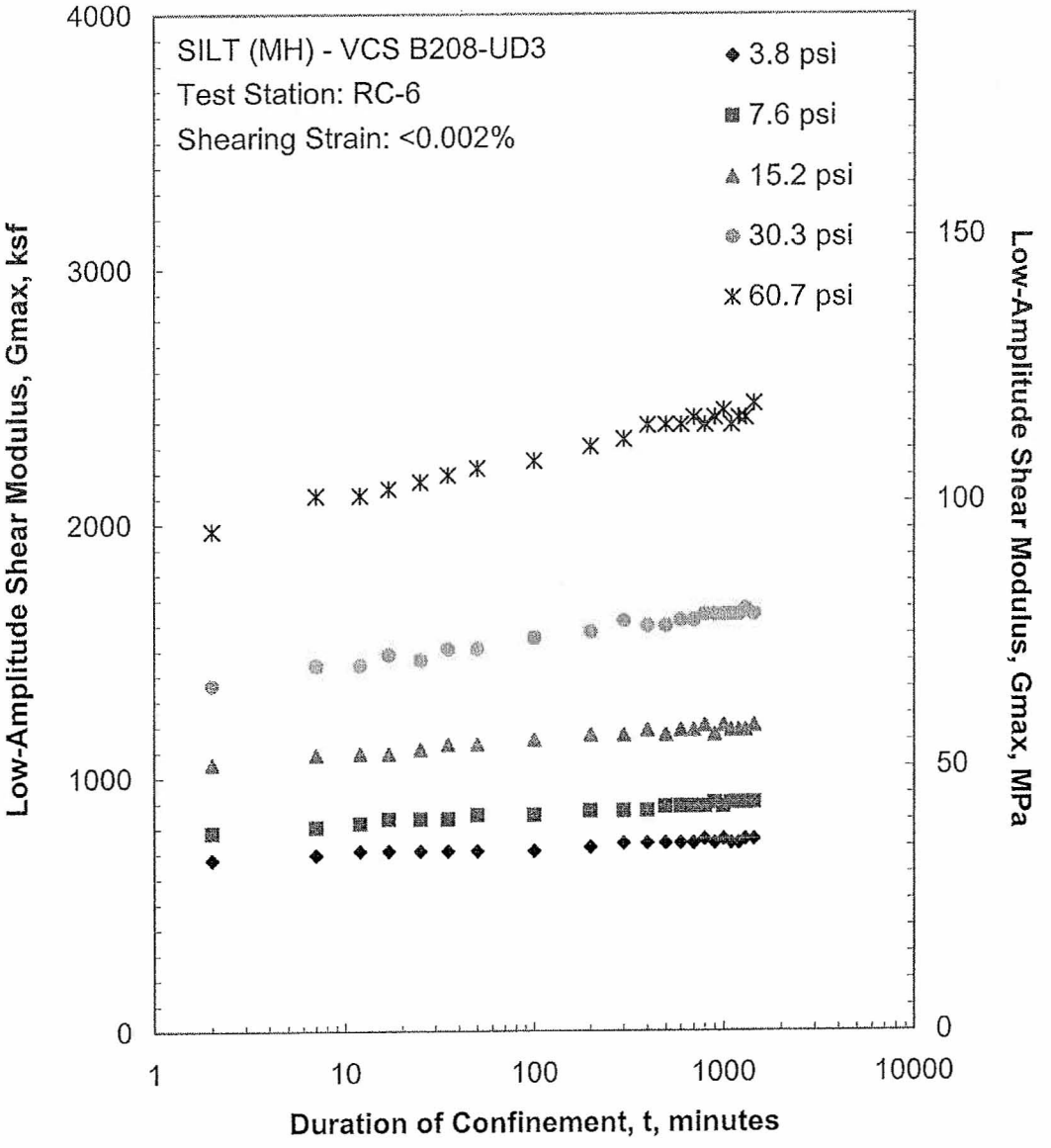


Figure G.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

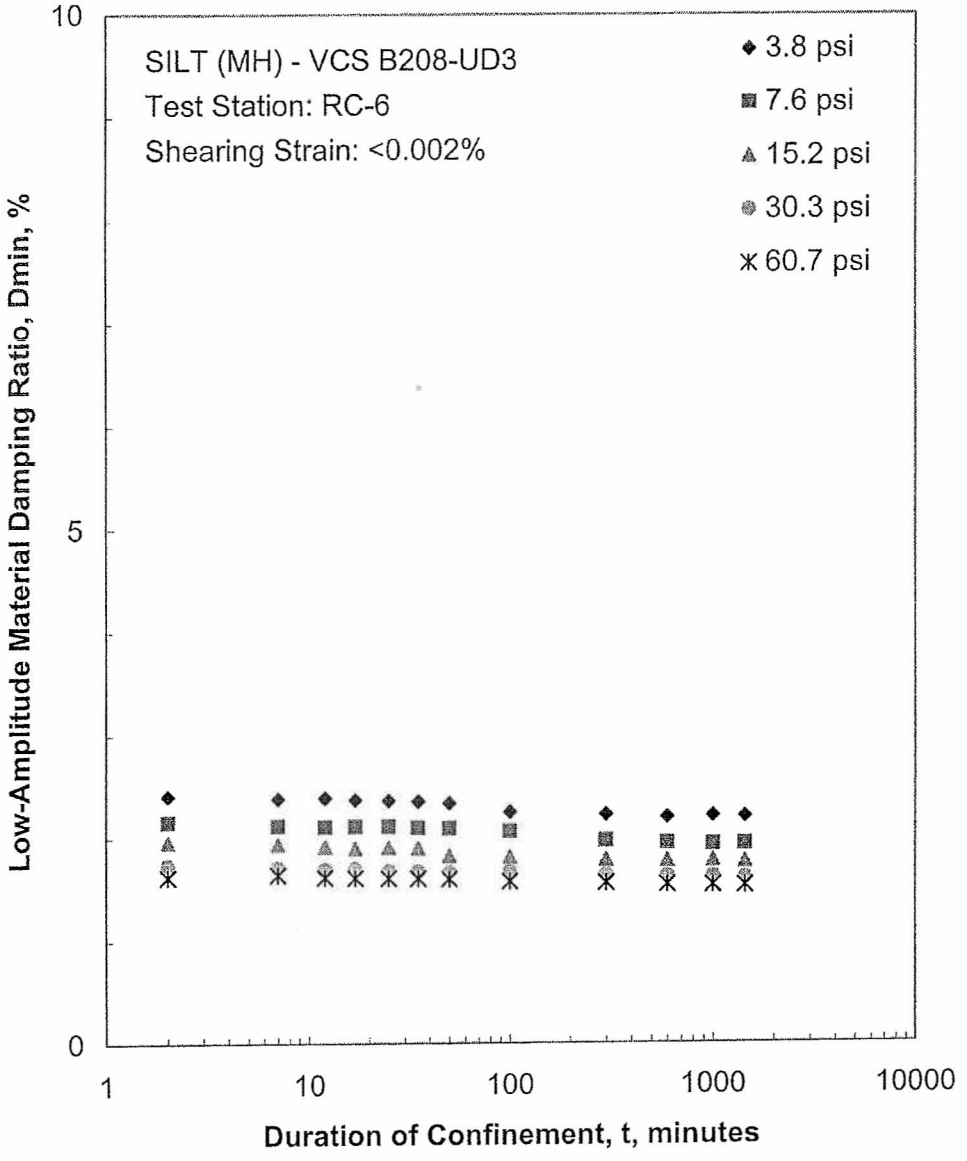


Figure G.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

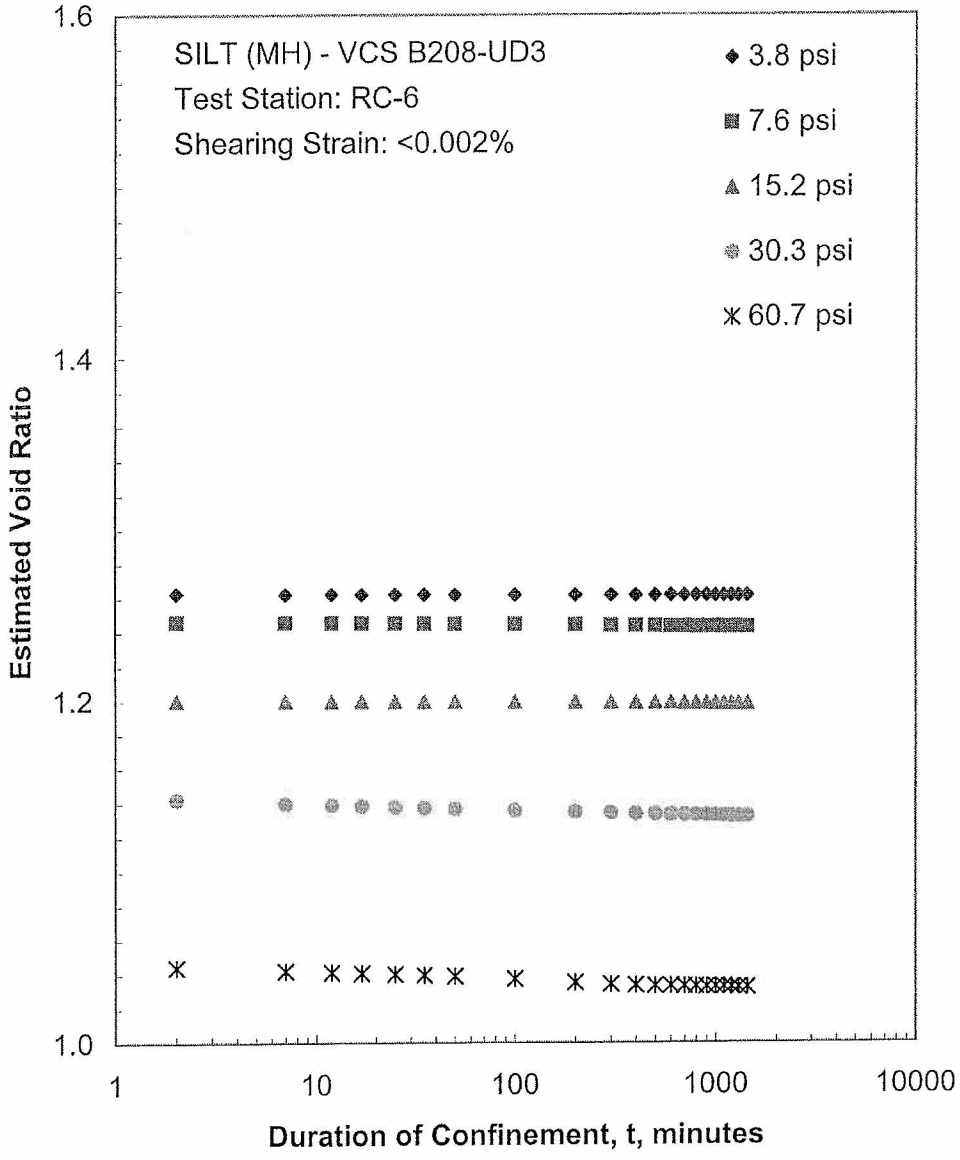


Figure G.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

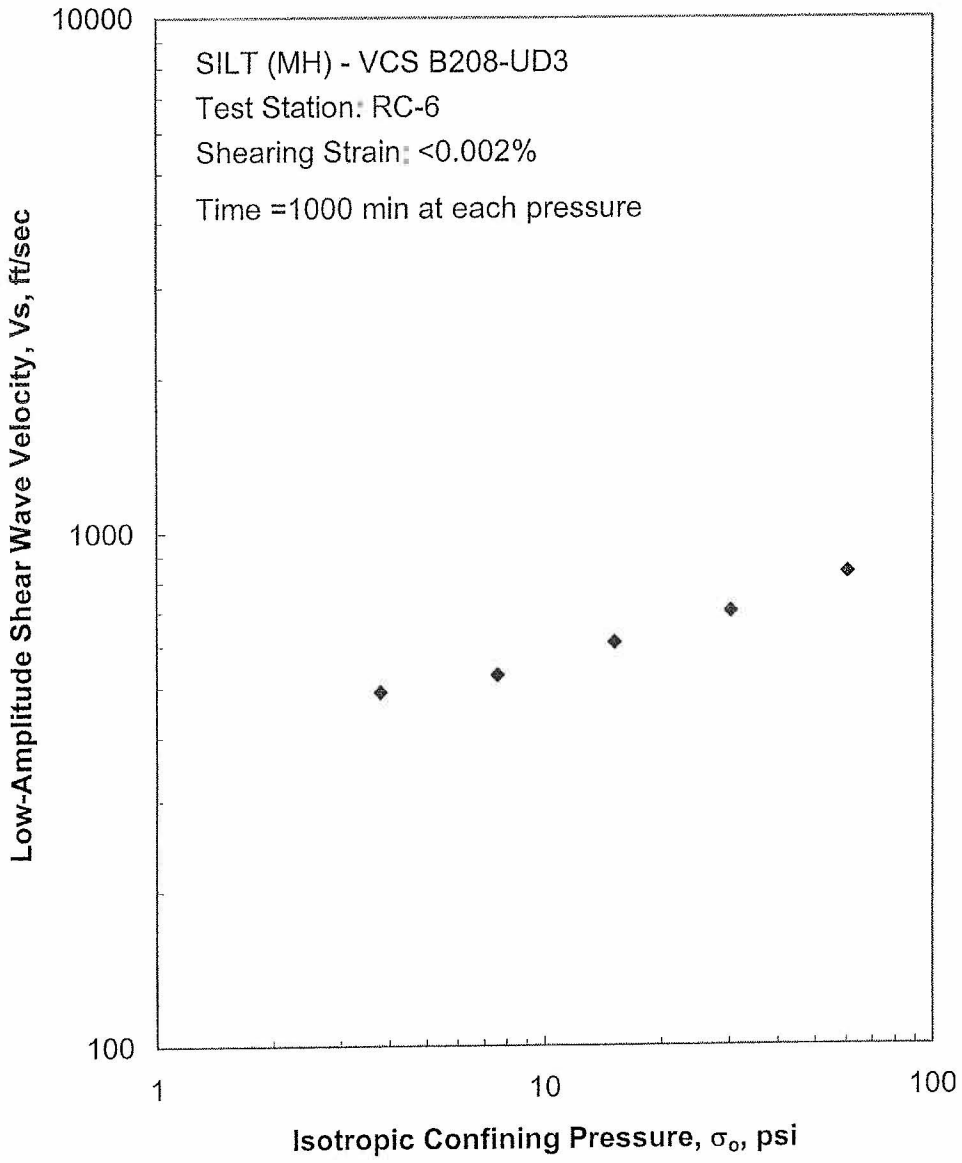


Figure G.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

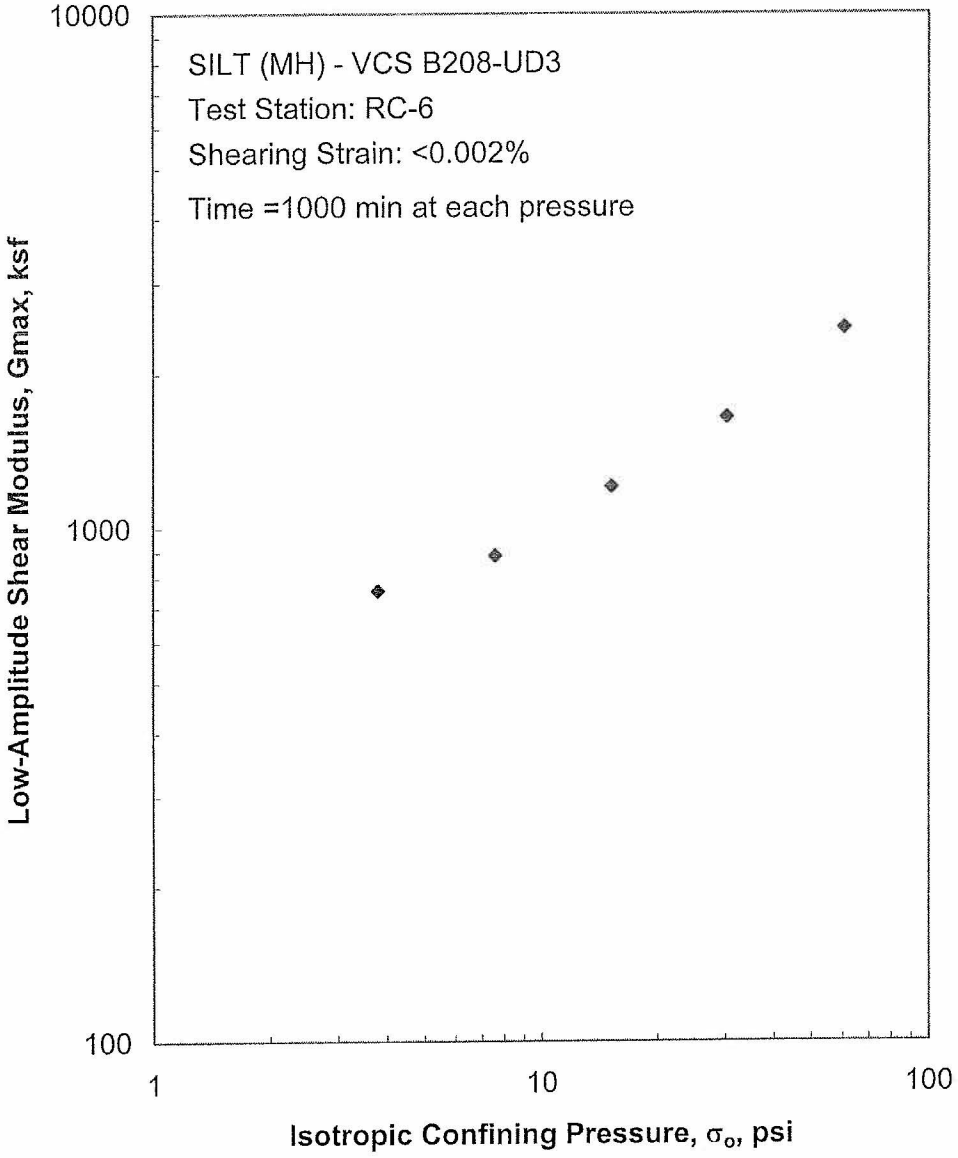


Figure G.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

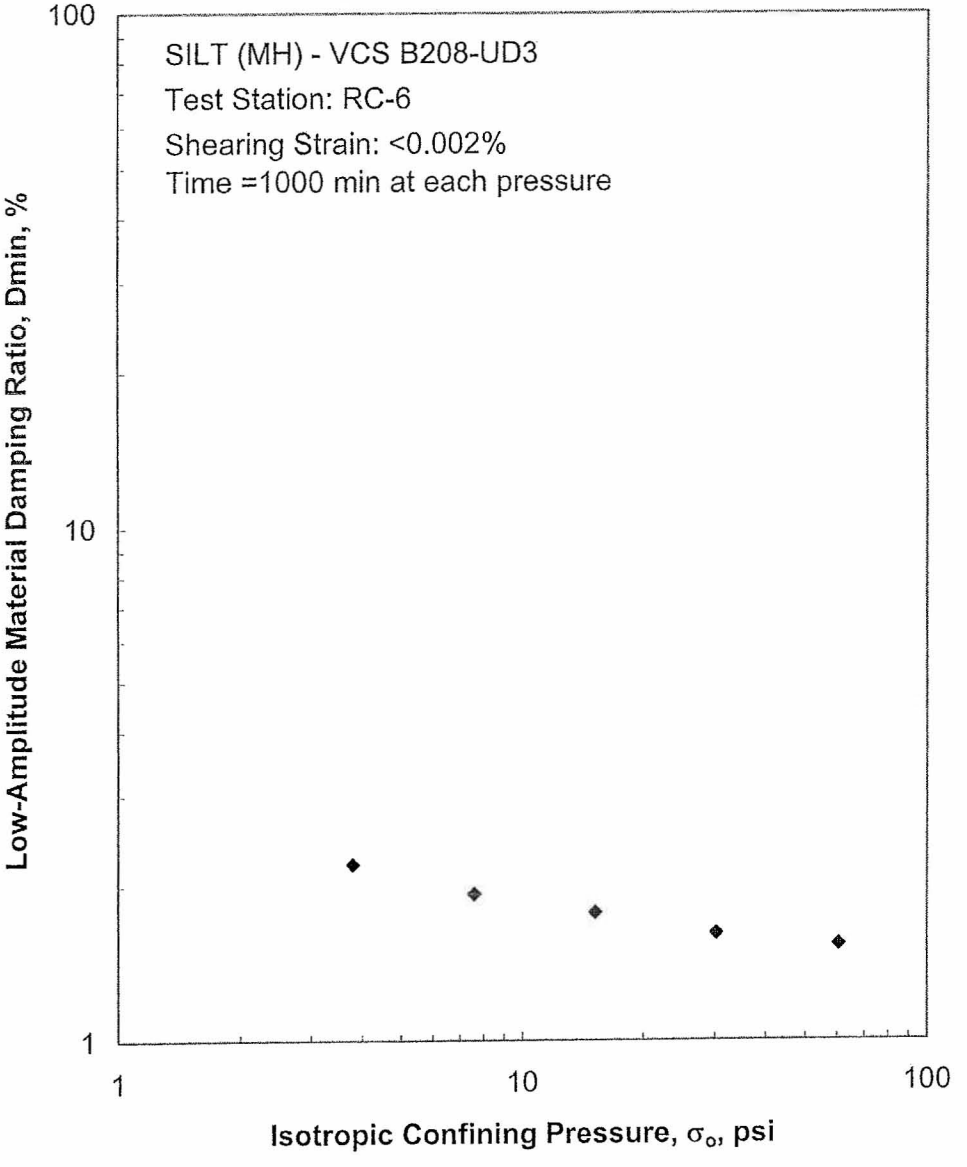


Figure G.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

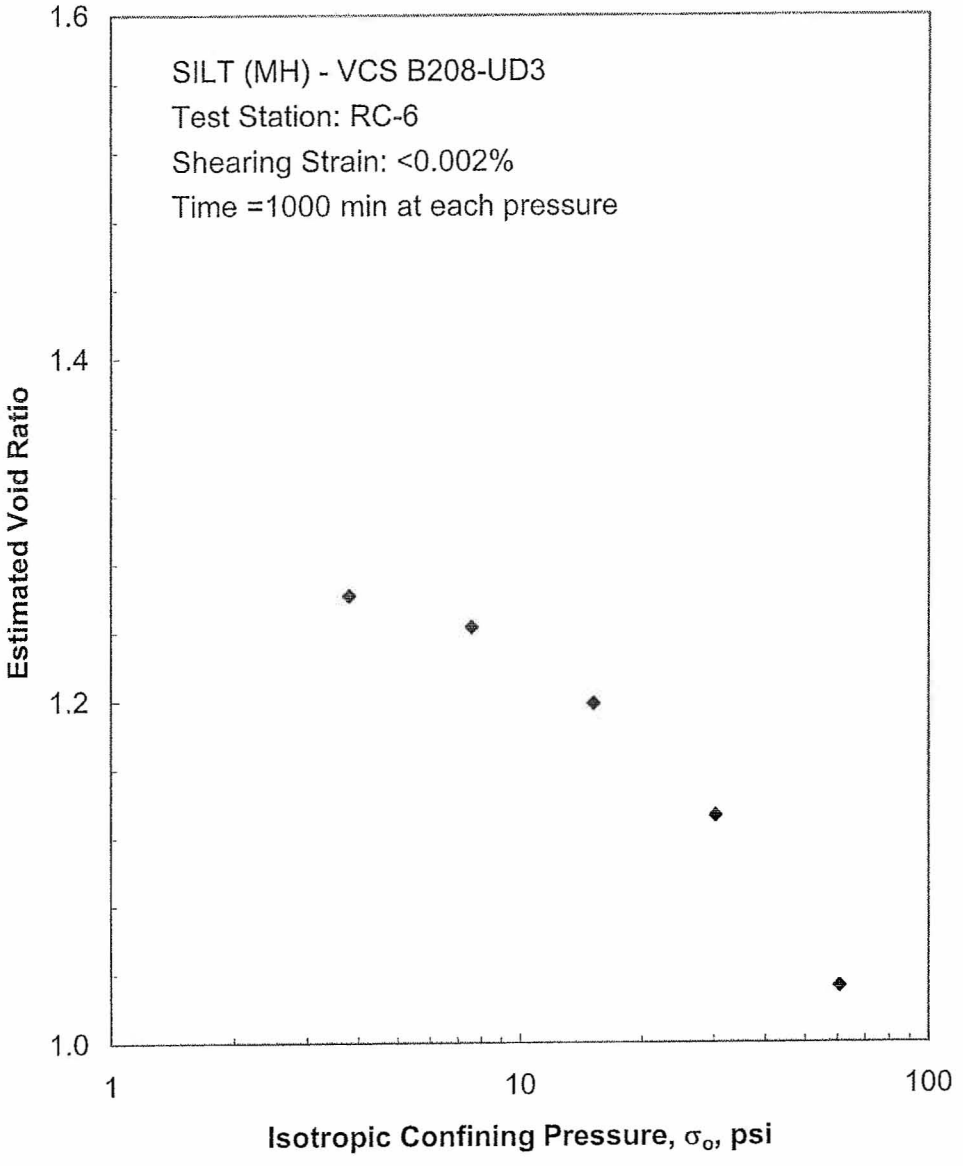


Figure G.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

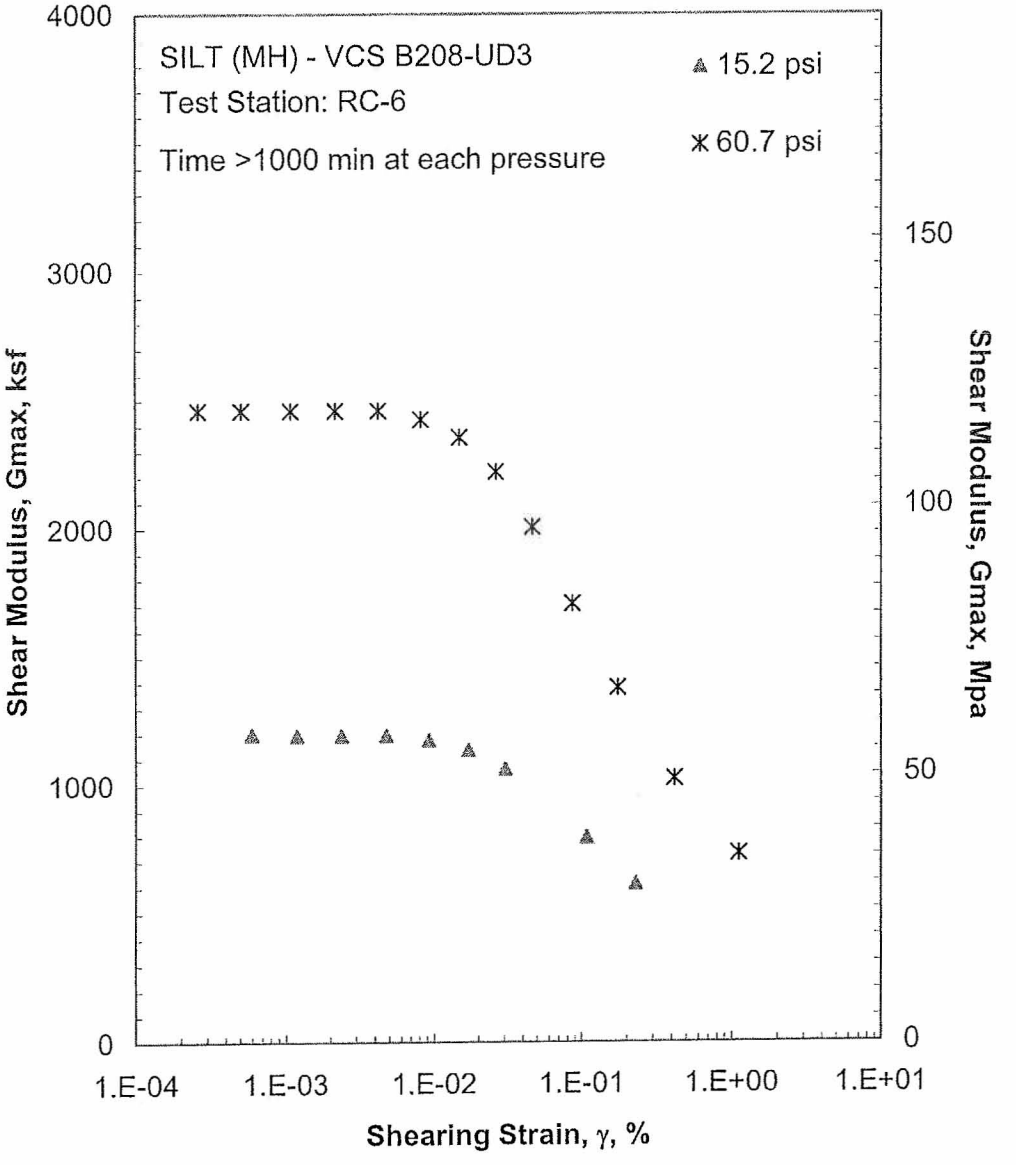


Figure G.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

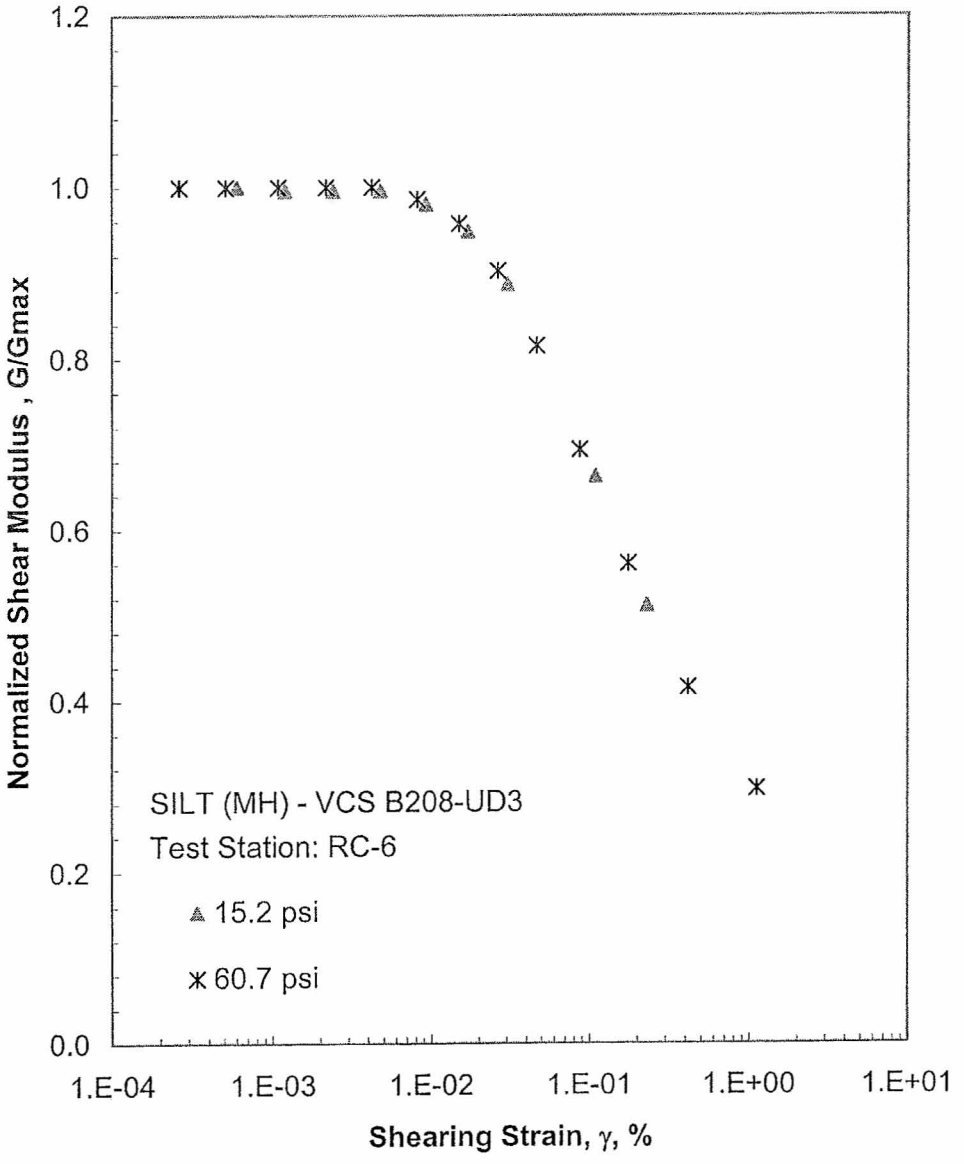


Figure G.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

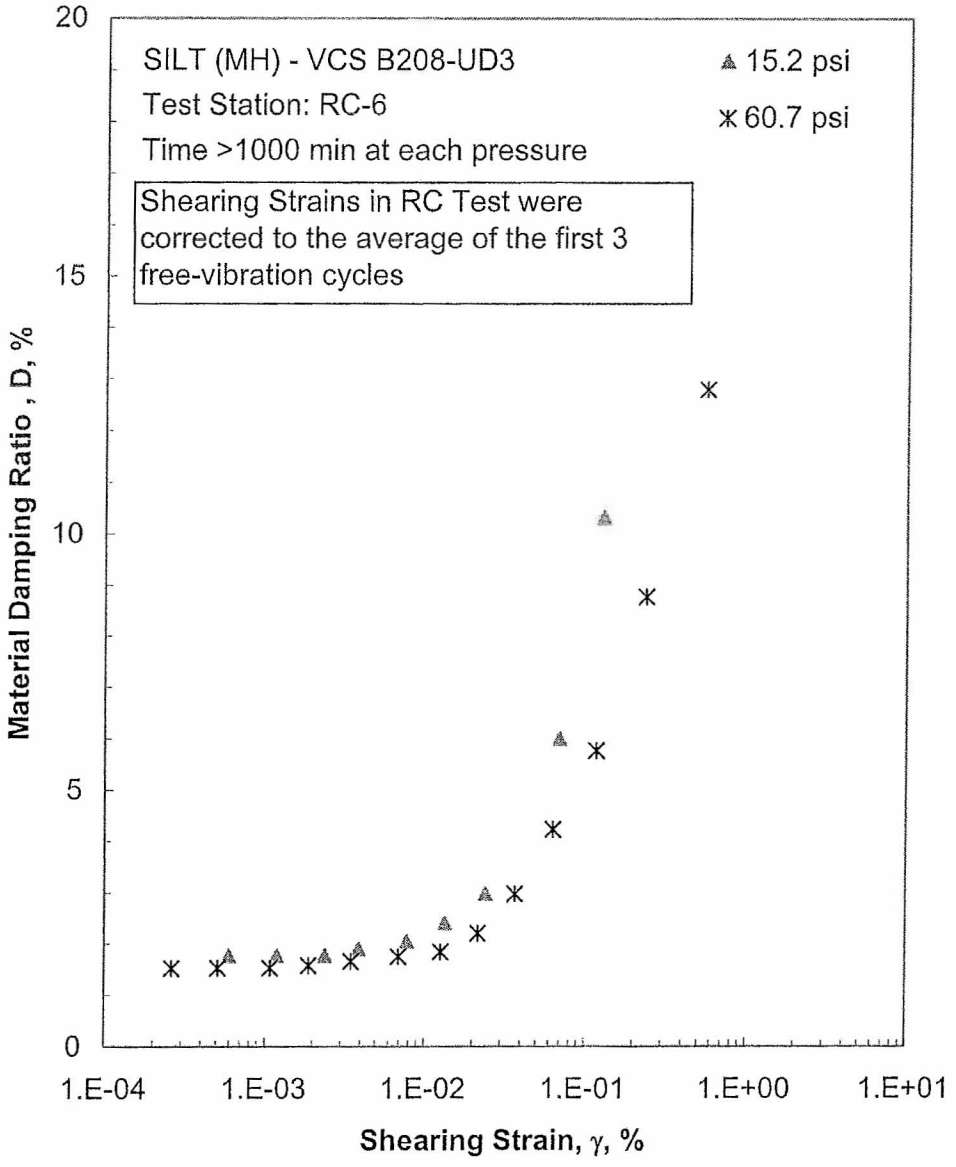


Figure G.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

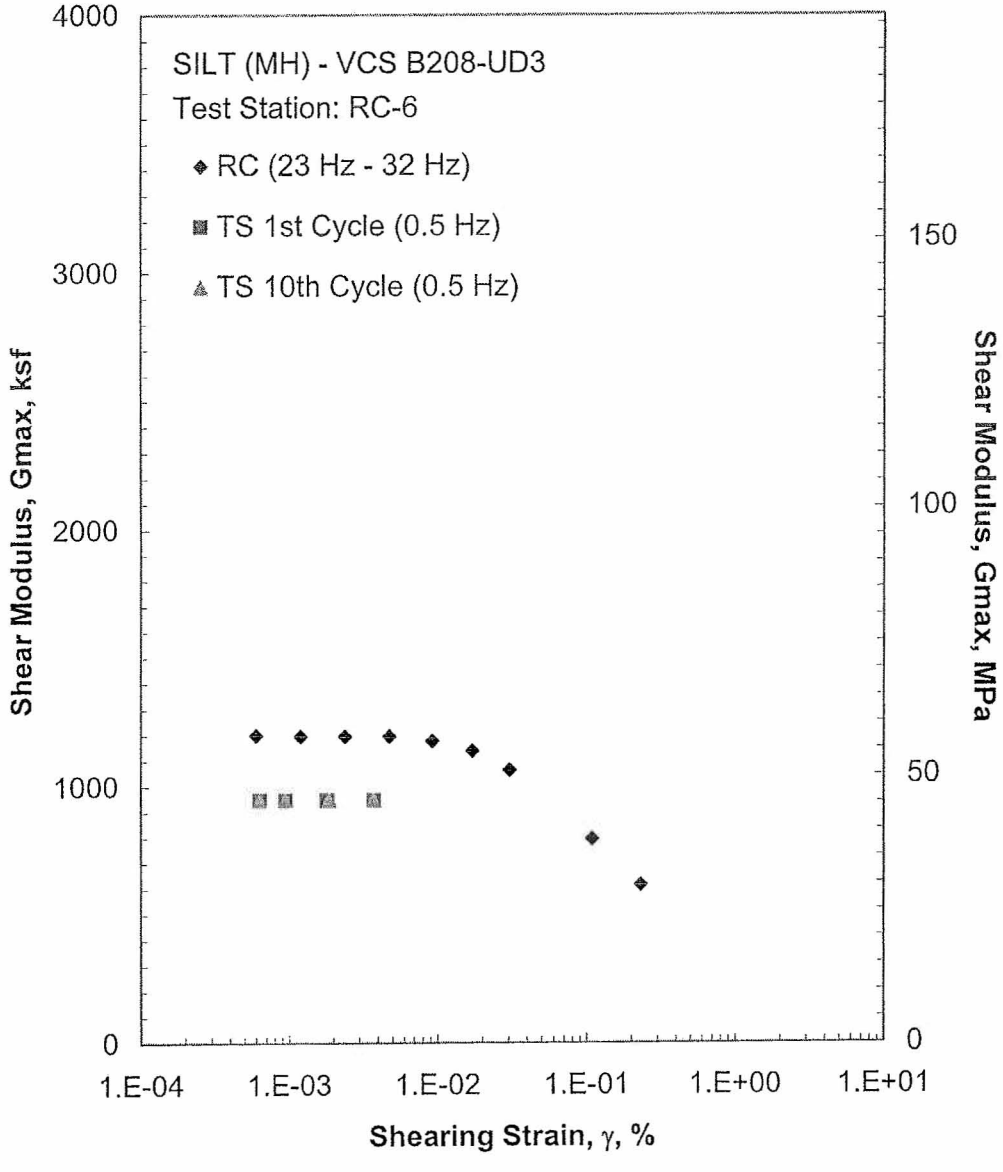


Figure G.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 15.2 psi from the Combined RCTS Tests

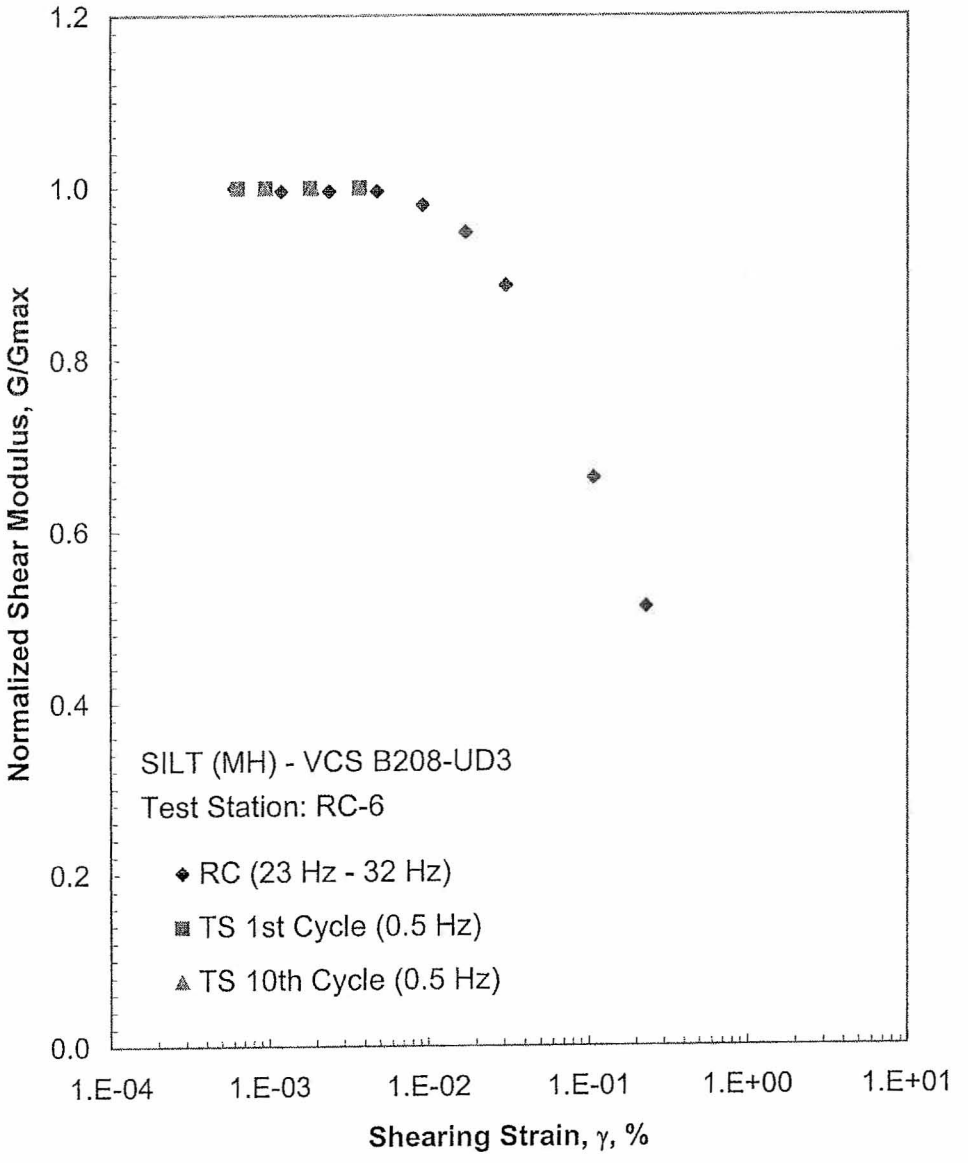


Figure G.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 15.2 psi from the Combined RCTS Tests

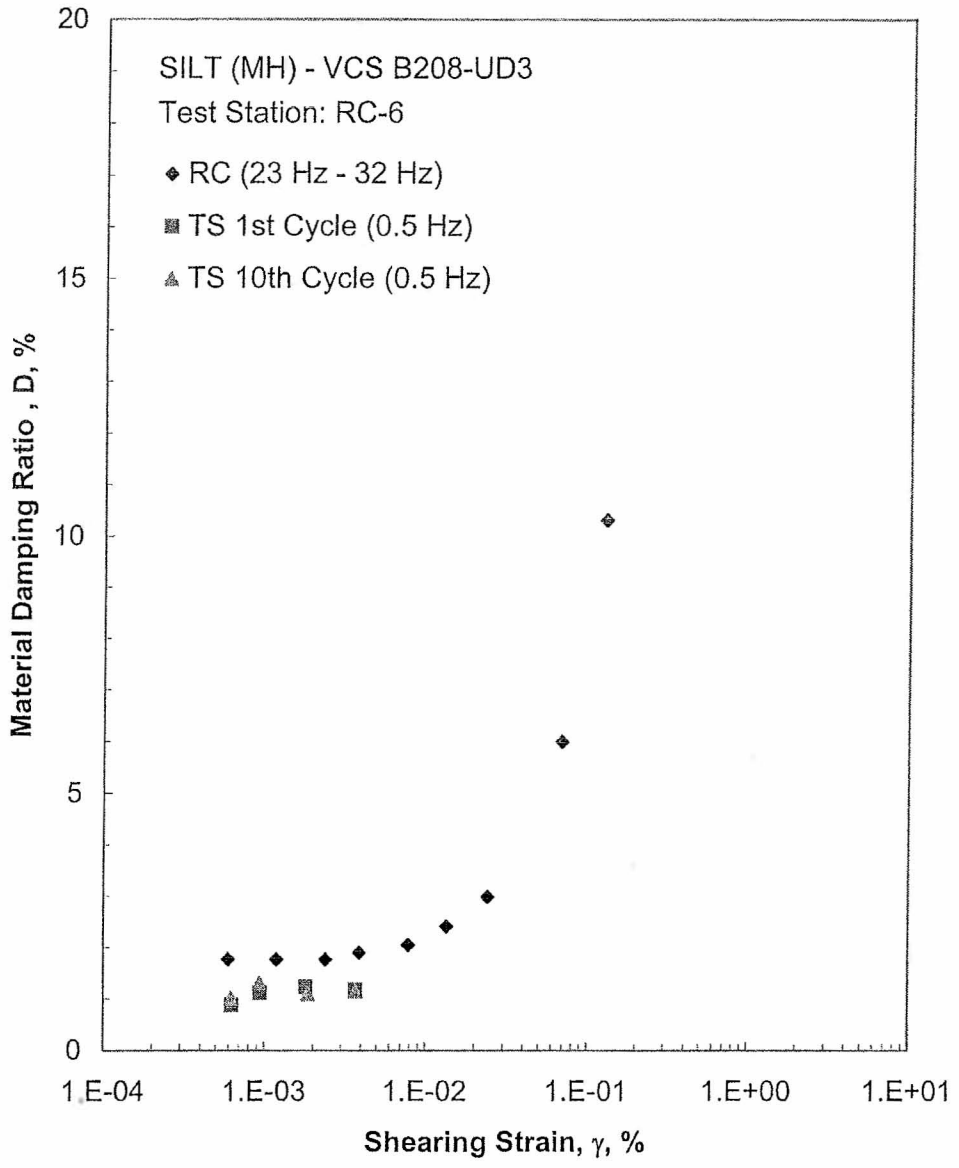


Figure G.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 15.2 psi from the Combined RCTS Tests

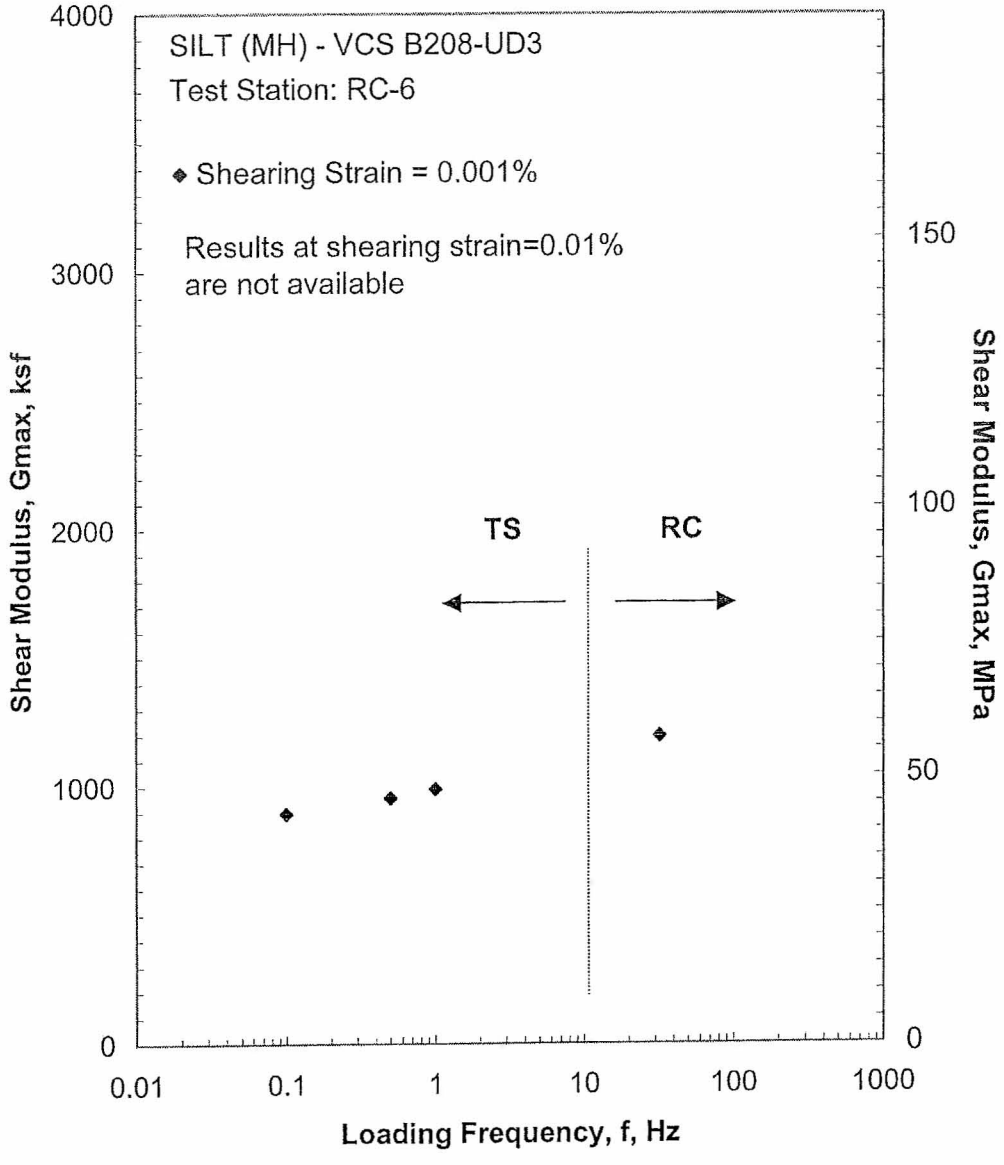


Figure G.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 15.2 psi from the Combined RCTS Tests

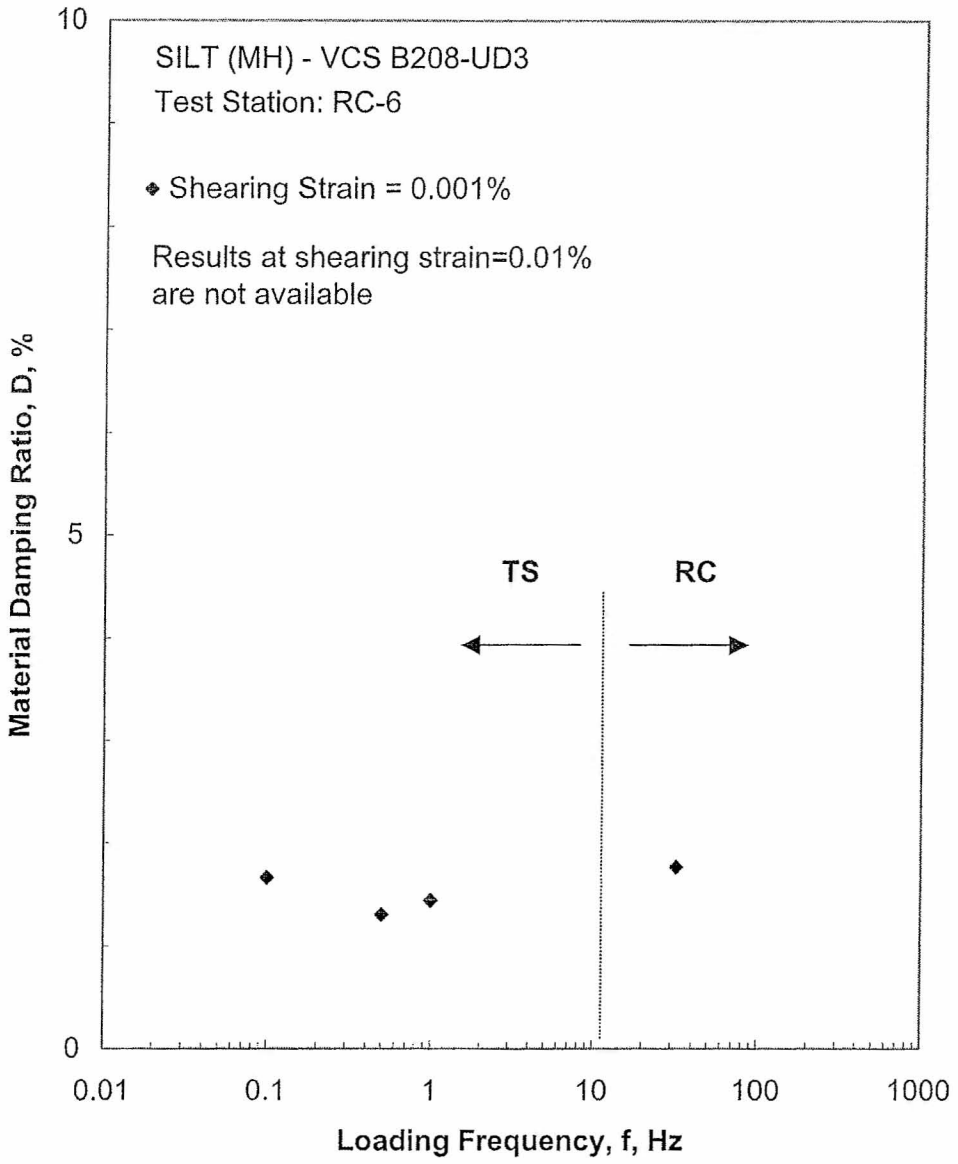


Figure G.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 15.2 psi from the Combined RCTS Tests

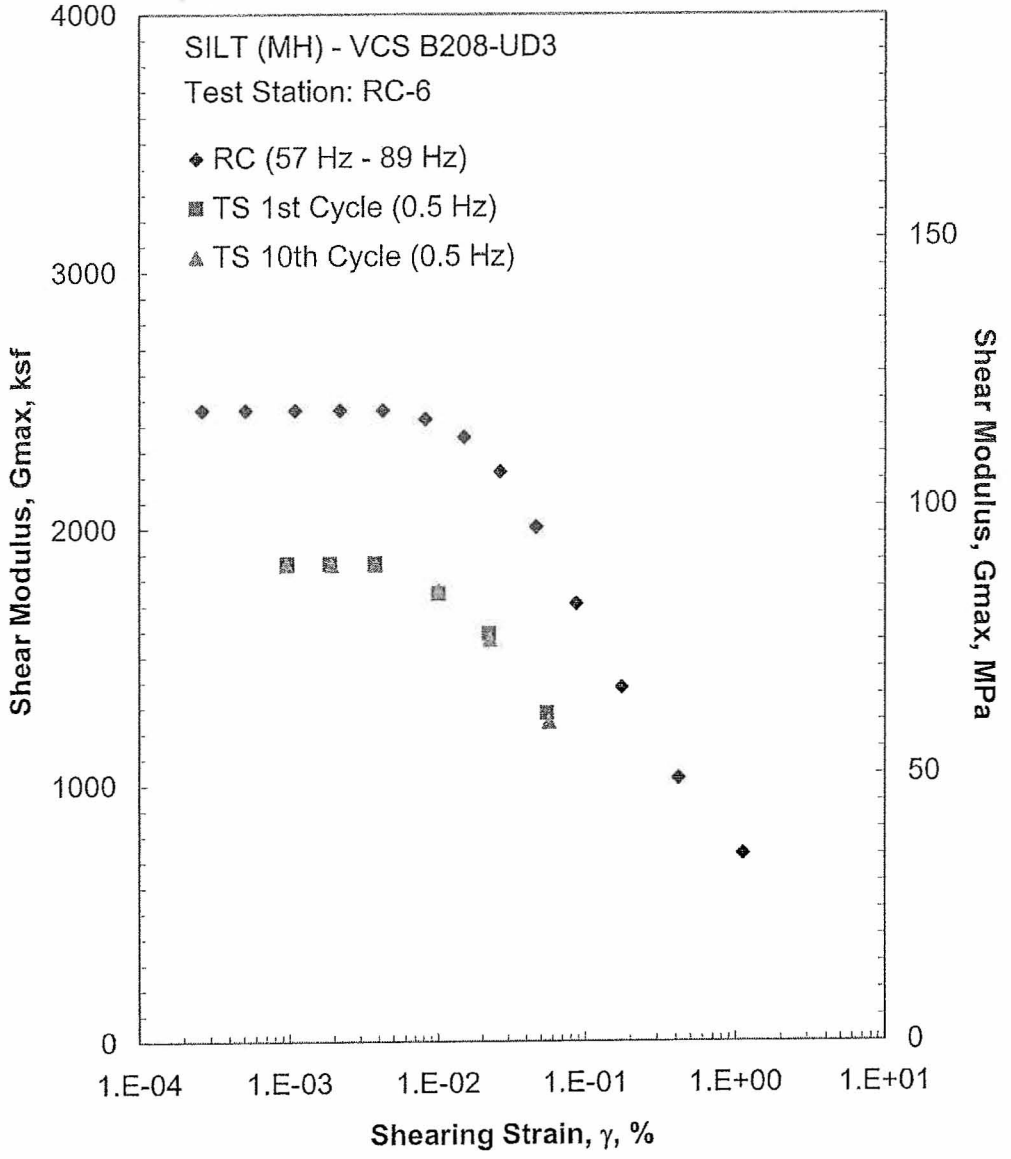


Figure G.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 60.7 psi from the Combined RCTS Tests

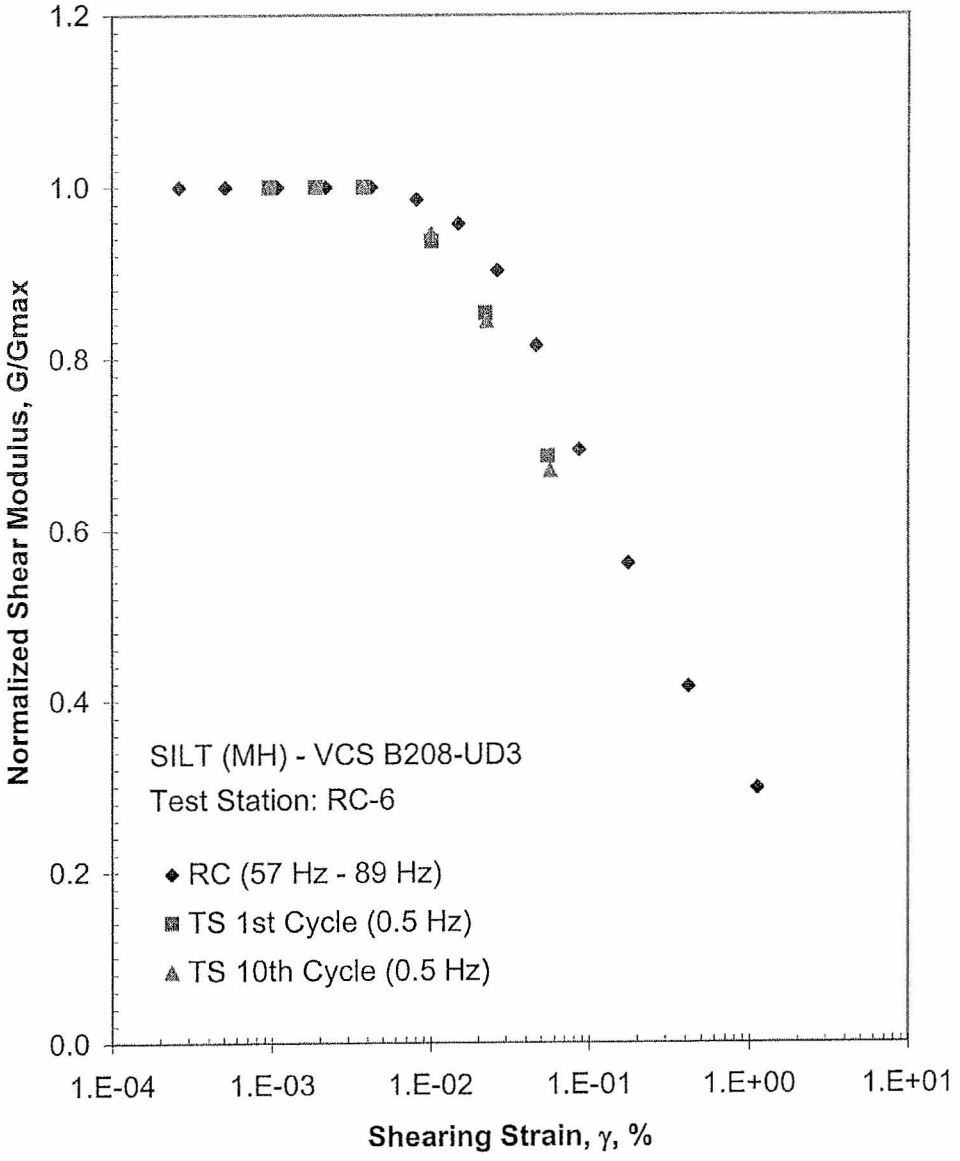


Figure G.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 60.7 psi from the Combined RCTS Tests

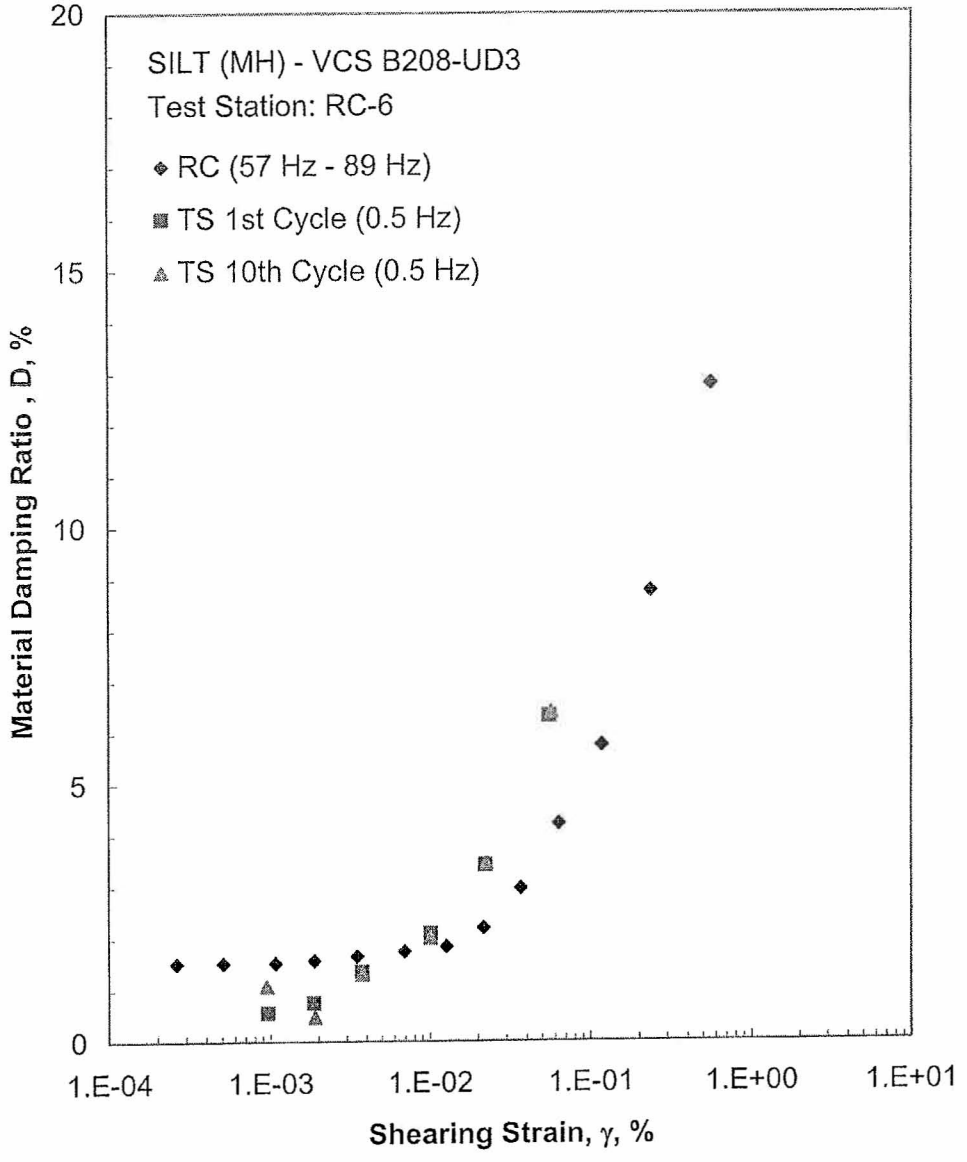


Figure G.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 60.7 psi from the Combined RCTS Tests

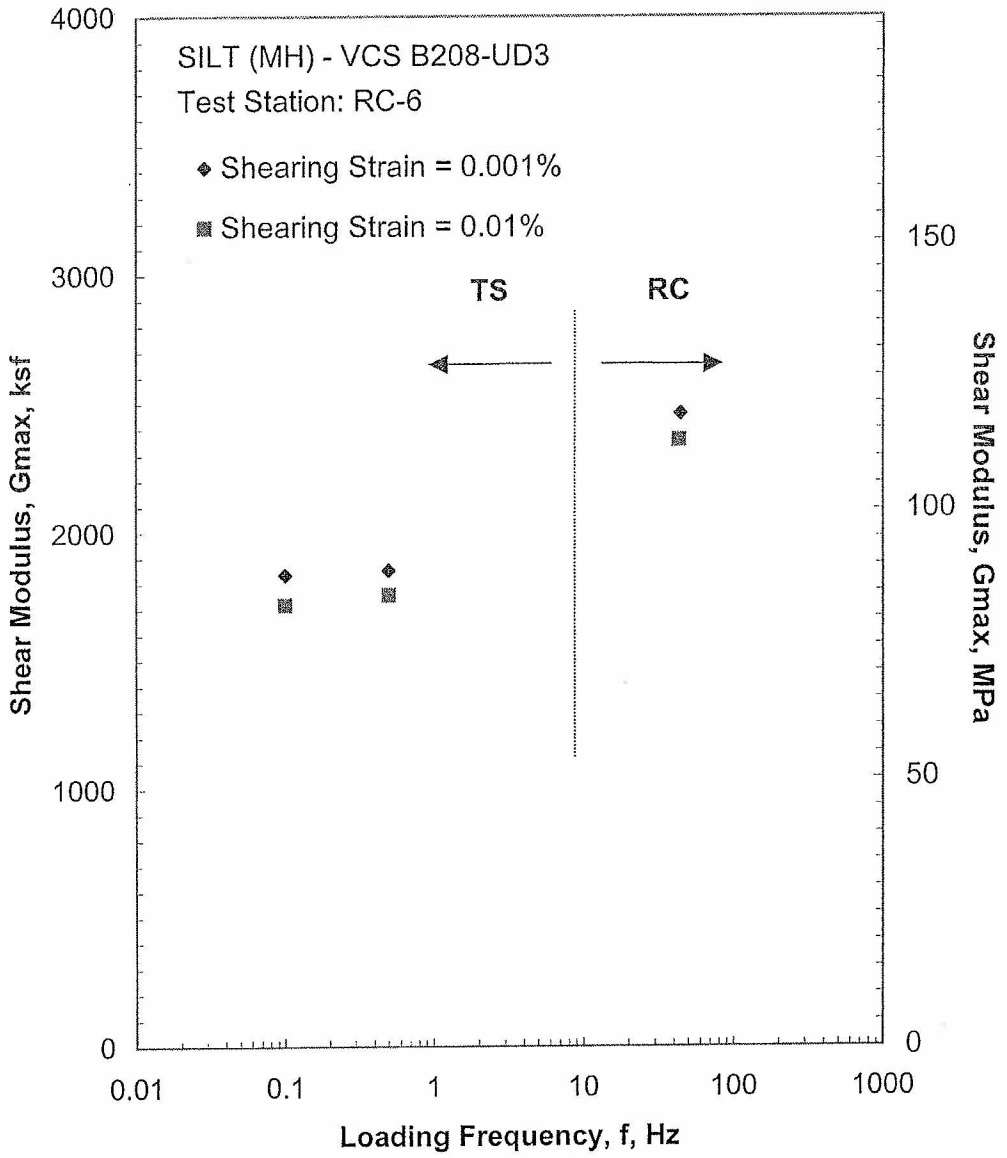


Figure G.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 60.7 psi from the Combined RCTS Tests

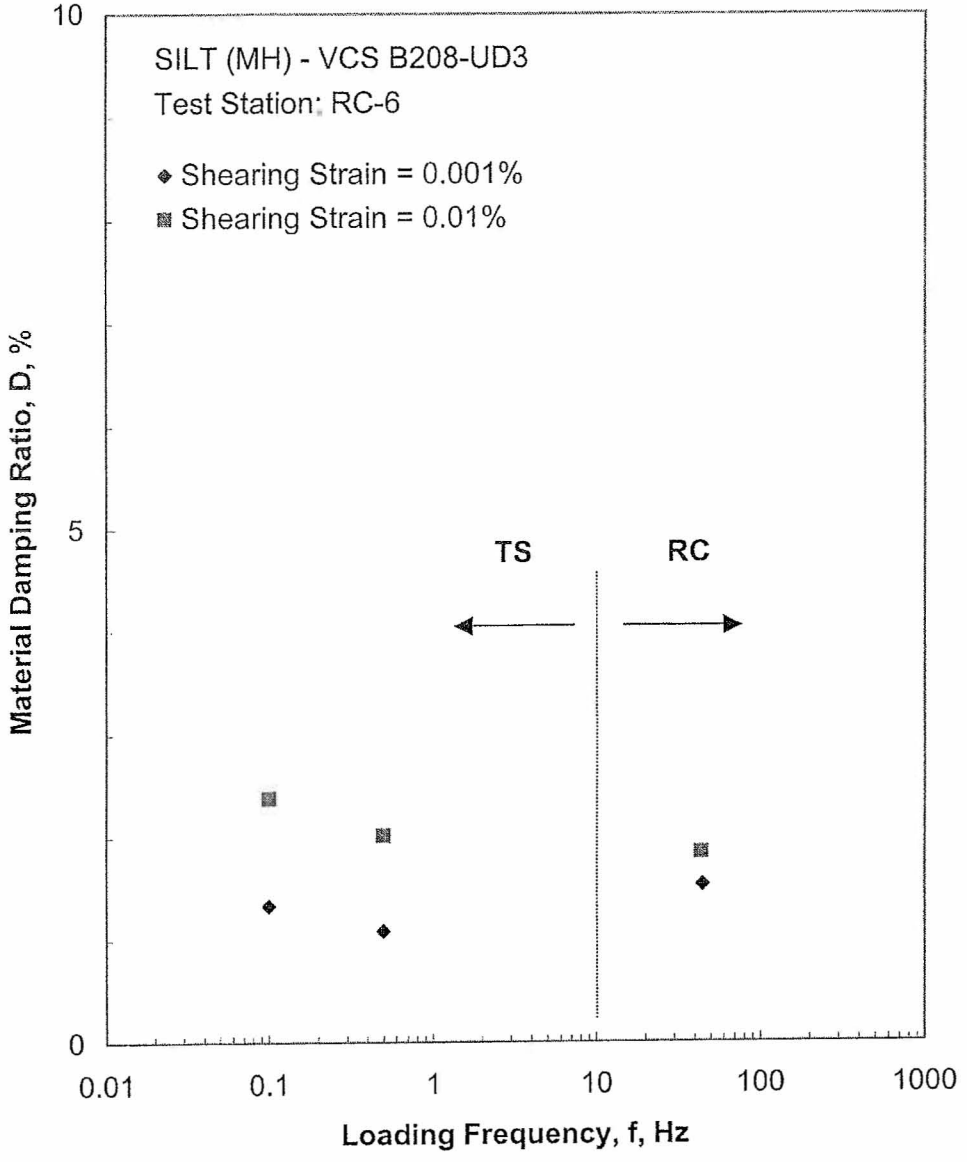


Figure G.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 60.7 psi from the Combined RCTS Tests

Table G.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio and Estimated Void Ratio with Isotropic Confining Pressure from RC Tests of Specimen VCS B208-UD3

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, Vs	Low-Amplitude Material Damping Ratio, Dmin	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
3.8	547	26	756	36	489	2.21	1.262
7.6	1094	52	884	42	527	1.93	1.243
15.2	2189	105	1205	58	609	1.78	1.198
30.3	4363	209	1641	79	700	1.62	1.133
60.7	8741	418	2444	117	834	1.54	1.033

Table G.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS B208-UD3; Isoptropic Confining Pressure, σ_o=15.2 psi (2.2 ksf = 105 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
5.98E-04	1200	1.00	5.98E-04	1.77
1.19E-03	1195	1.00	1.19E-03	1.77
2.40E-03	1195	1.00	2.40E-03	1.77
4.77E-03	1195	1.00	3.91E-03	1.90
9.23E-03	1176	0.98	7.84E-03	2.05
1.71E-02	1138	0.95	1.35E-02	2.41
3.05E-02	1064	0.89	2.41E-02	2.98
1.08E-01	795	0.66	6.94E-02	6.00
2.31E-01	615	0.51	1.29E-01	10.31

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table G.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS B208-UD3; Isotropic Confining Pressure, σ_o = 15.2 psi (2.2 ksf =105 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
6.32E-04	947	1.00	0.88	6.27E-04	948	1.00	1.02
9.47E-04	947	1.00	1.11	9.37E-04	948	1.00	1.31
1.81E-03	947	1.00	1.23	1.87E-03	948	1.00	1.10
3.73E-03	947	1.00	1.18	3.72E-03	948	1.00	1.15

Table G.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen VCS B208-UD3; Isoptropic Confining Pressure, σ_o= 60.7 psi (8.7 ksf = 418 kPa)

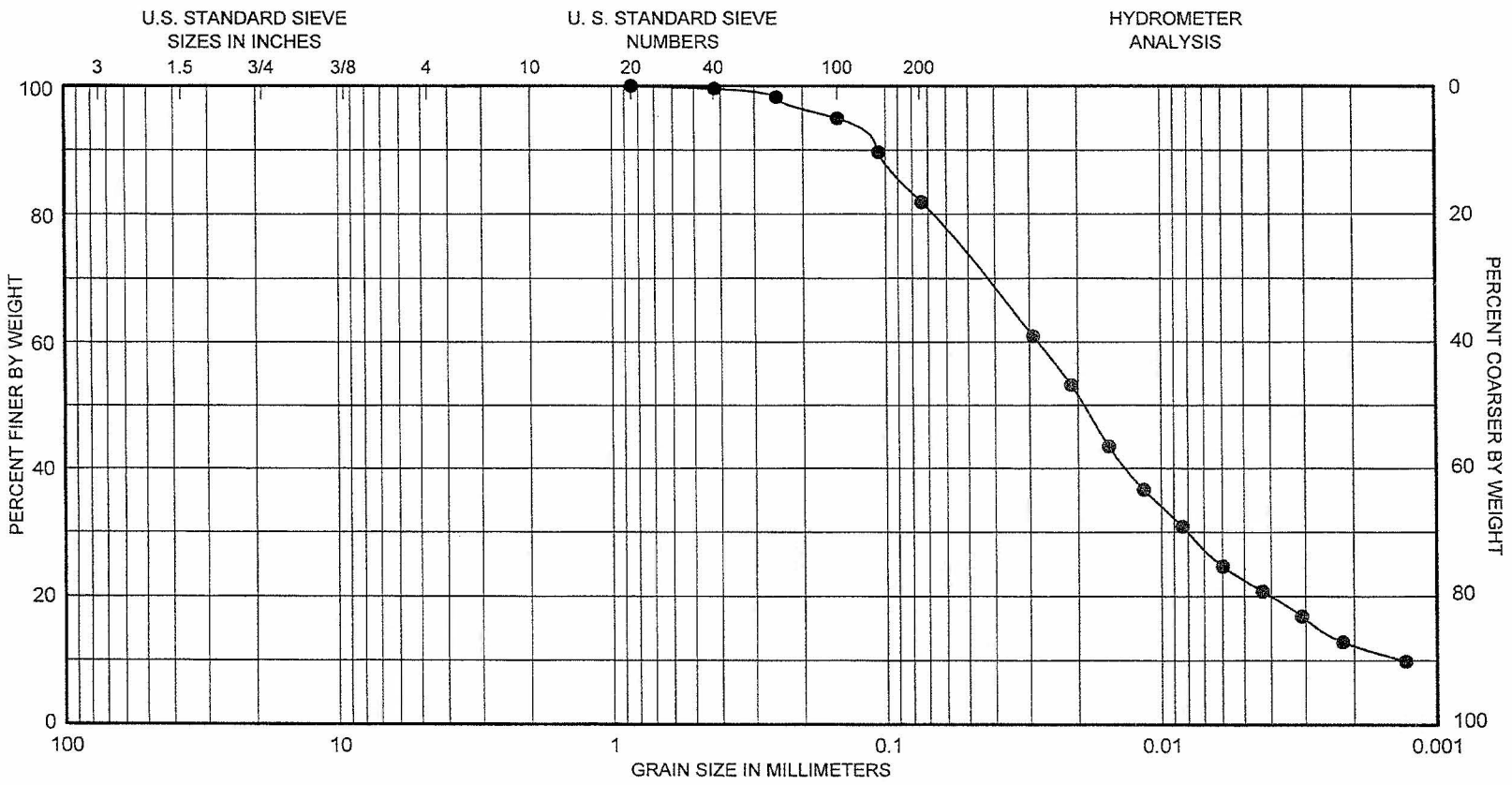
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
2.62E-04	2461	1.00	2.62E-04	1.53
5.10E-04	2461	1.00	5.10E-04	1.53
1.08E-03	2461	1.00	1.08E-03	1.53
2.17E-03	2461	1.00	1.89E-03	1.58
4.22E-03	2461	1.00	3.50E-03	1.66
8.17E-03	2426	0.99	6.94E-03	1.75
1.50E-02	2357	0.96	1.27E-02	1.85
2.65E-02	2222	0.90	2.17E-02	2.21
4.66E-02	2007	0.82	3.68E-02	2.97
8.69E-02	1708	0.69	6.35E-02	4.24
1.75E-01	1380	0.56	1.17E-01	5.76
4.17E-01	1025	0.42	2.38E-01	8.77
1.12E+00	732	0.30	5.62E-01	12.80

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table G.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen VCS B208-UD3; Isotropic Confining Pressure, σ_o=60.7 psi (8.7 ksf = 418 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
9.64E-04	1866	1.00	0.57	9.51E-04	1859	1.00	1.09
1.88E-03	1866	1.00	0.76	1.91E-03	1859	1.00	0.49
3.76E-03	1866	1.00	1.36	3.78E-03	1859	1.00	1.32
1.01E-02	1747	0.94	2.10	1.01E-02	1758	0.95	2.02
2.23E-02	1591	0.85	3.43	2.26E-02	1568	0.84	3.46
5.54E-02	1280	0.69	6.34	5.69E-02	1244	0.67	6.41



GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	BORING	DEPTH, FT	C_c	C_u	D_{50}	D_{90}	CLASSIFICATION
●	B-208-UD3	30.5	1.72	21.20	0.0191	0.11	Elastic Silt (MH); reddish yellow, with ironore feldspar rich areas and black seams. SAPROLITE

GRAIN SIZE CURVE