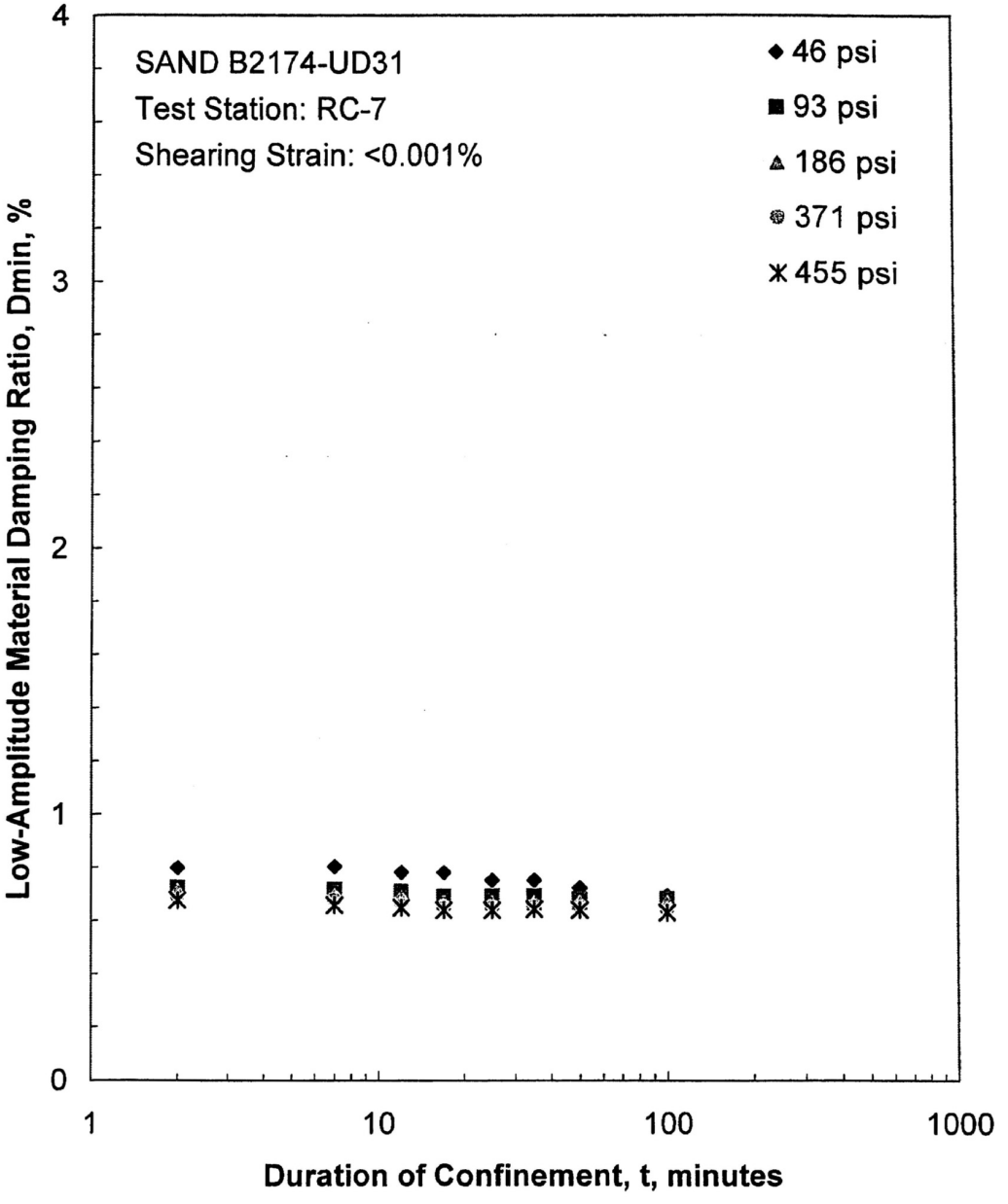

Figure L.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

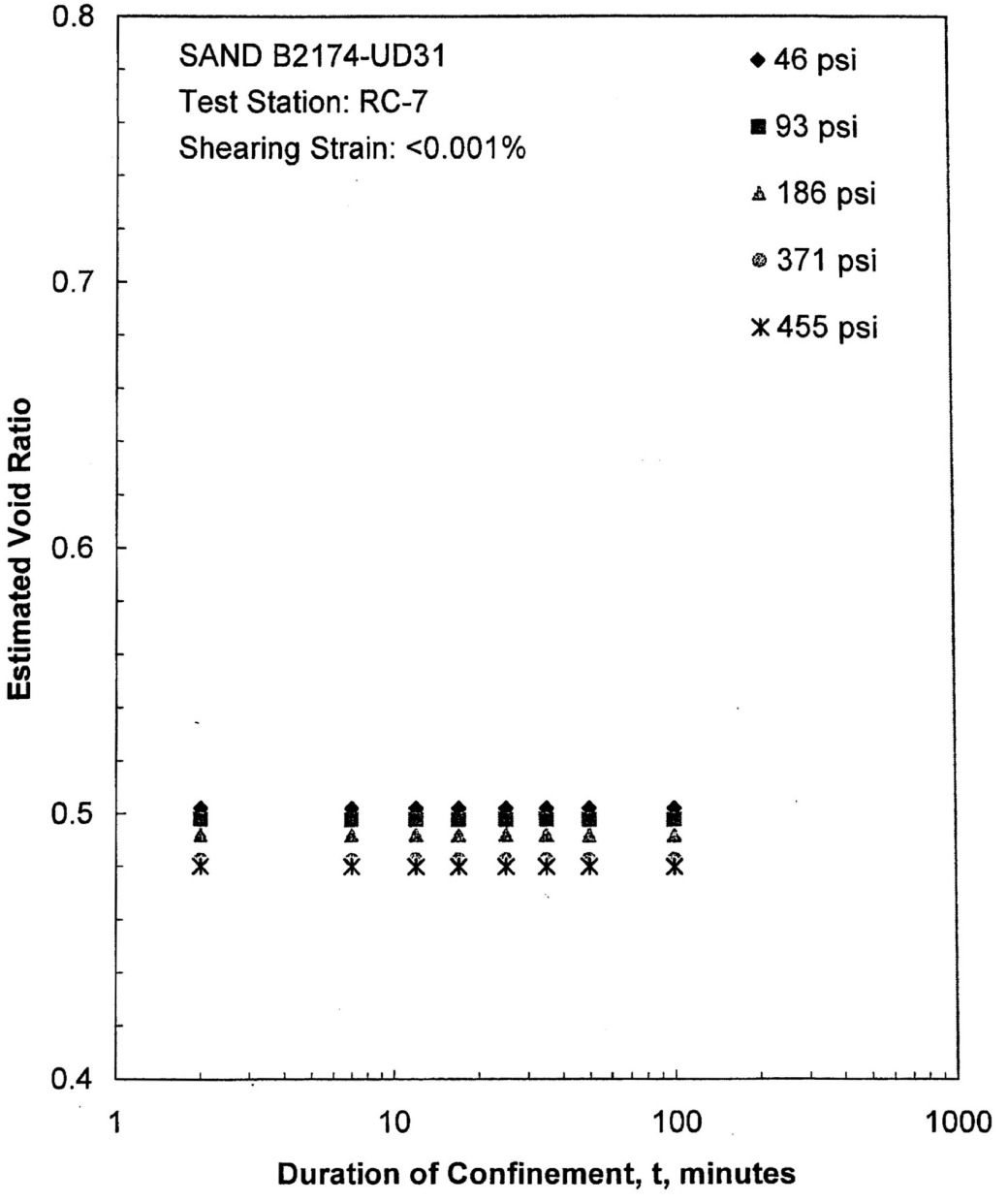

Figure L.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

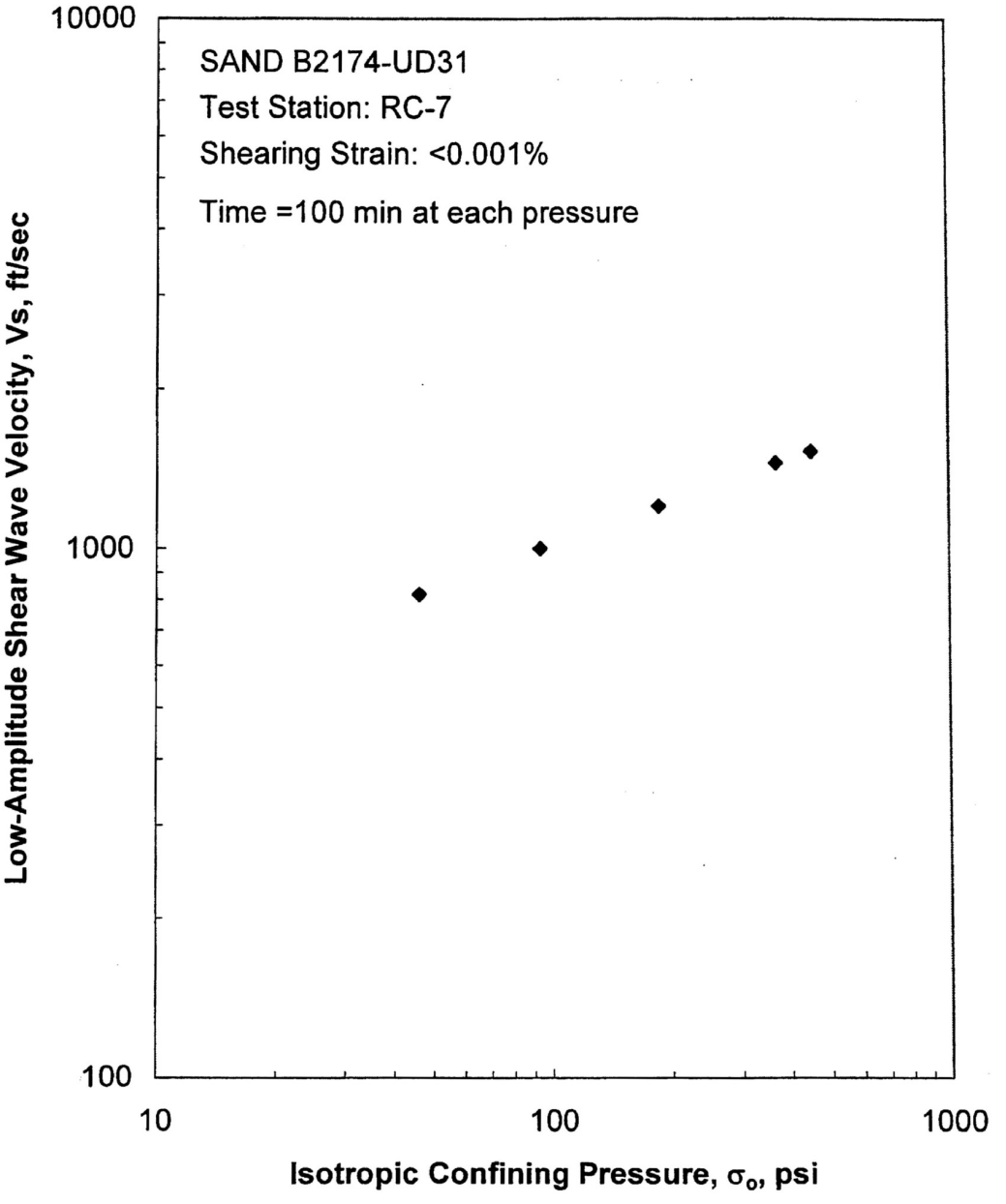

Figure L.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

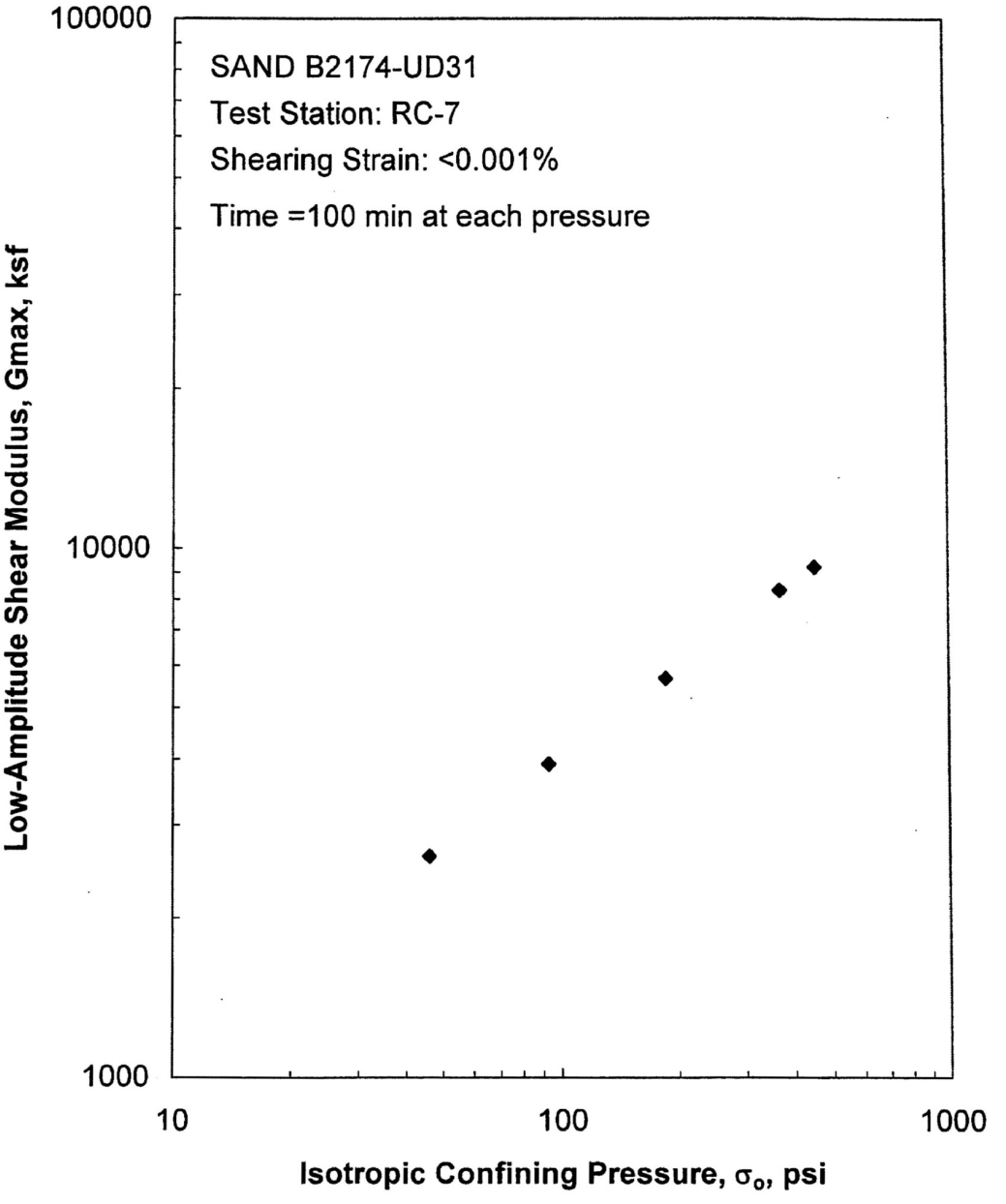

Figure L.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

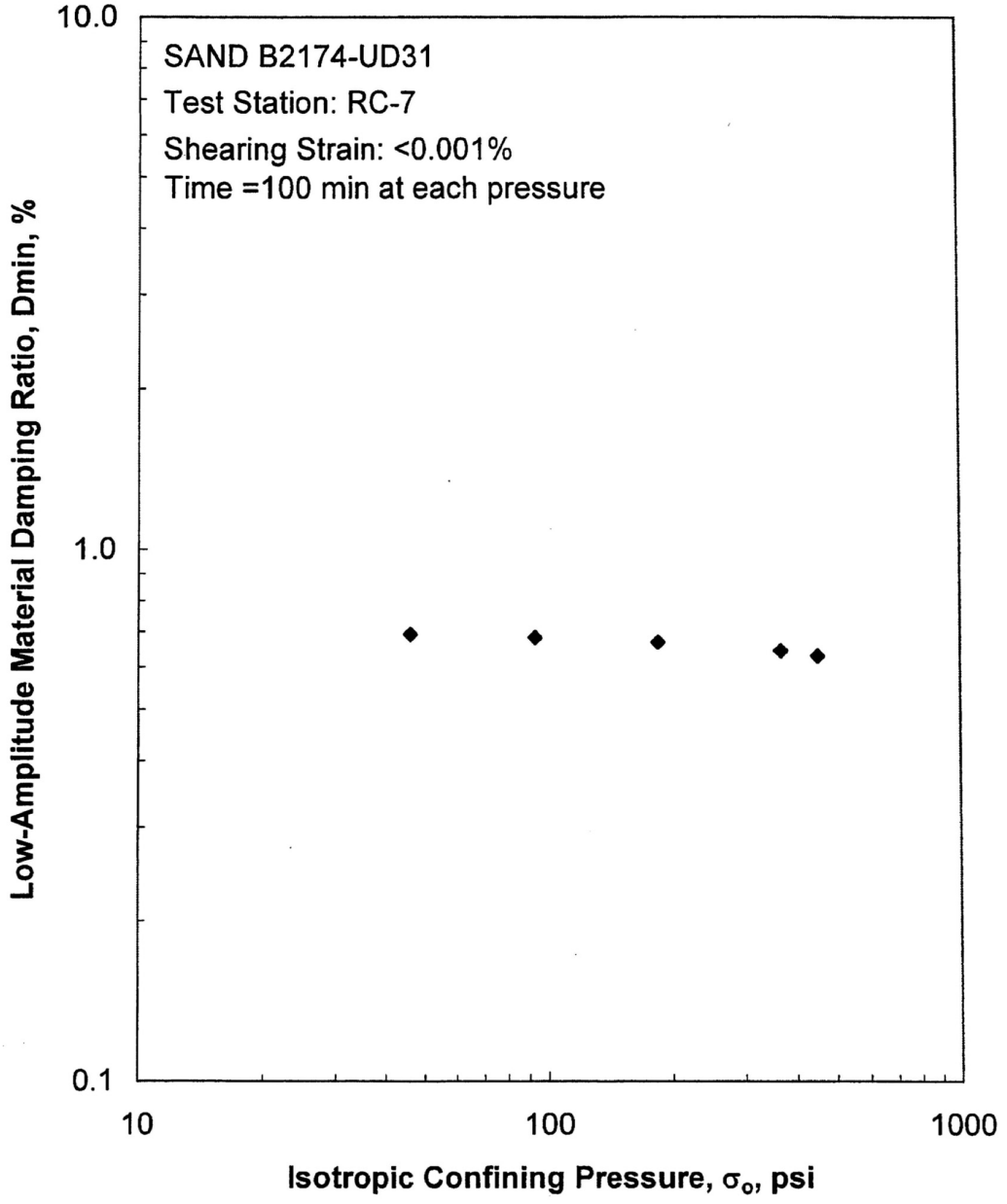

Figure L.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

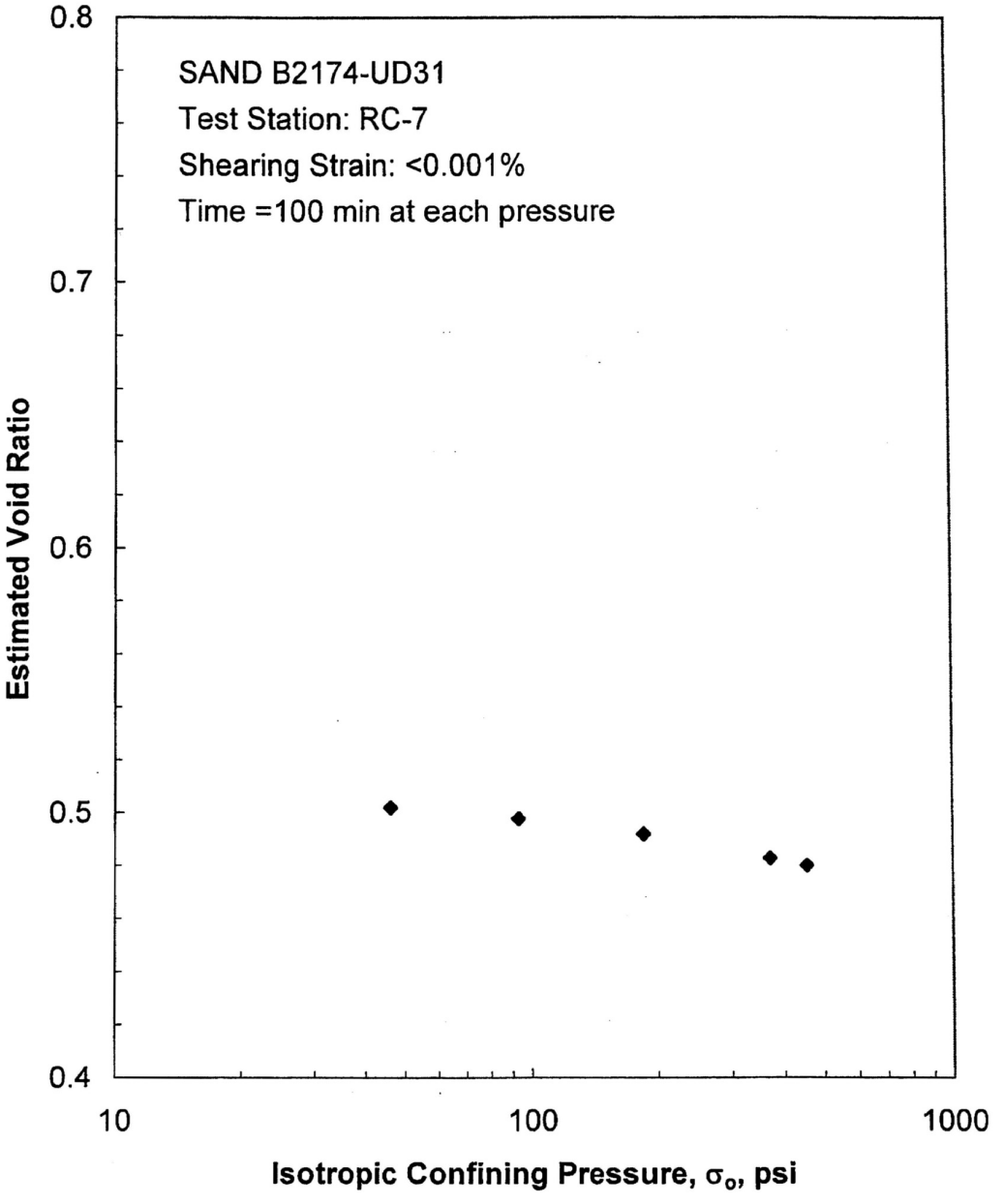

Figure L.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

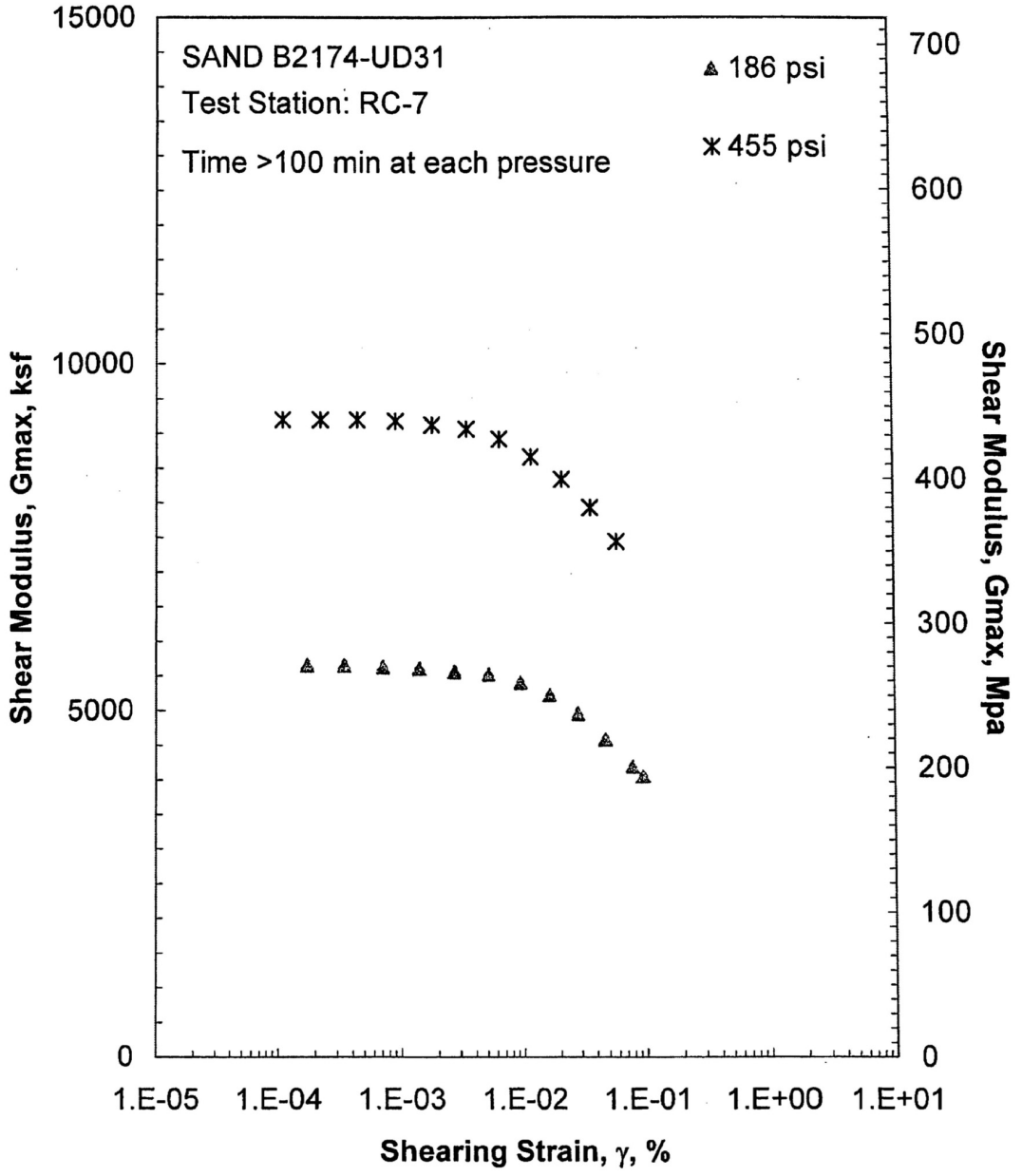

Figure L.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

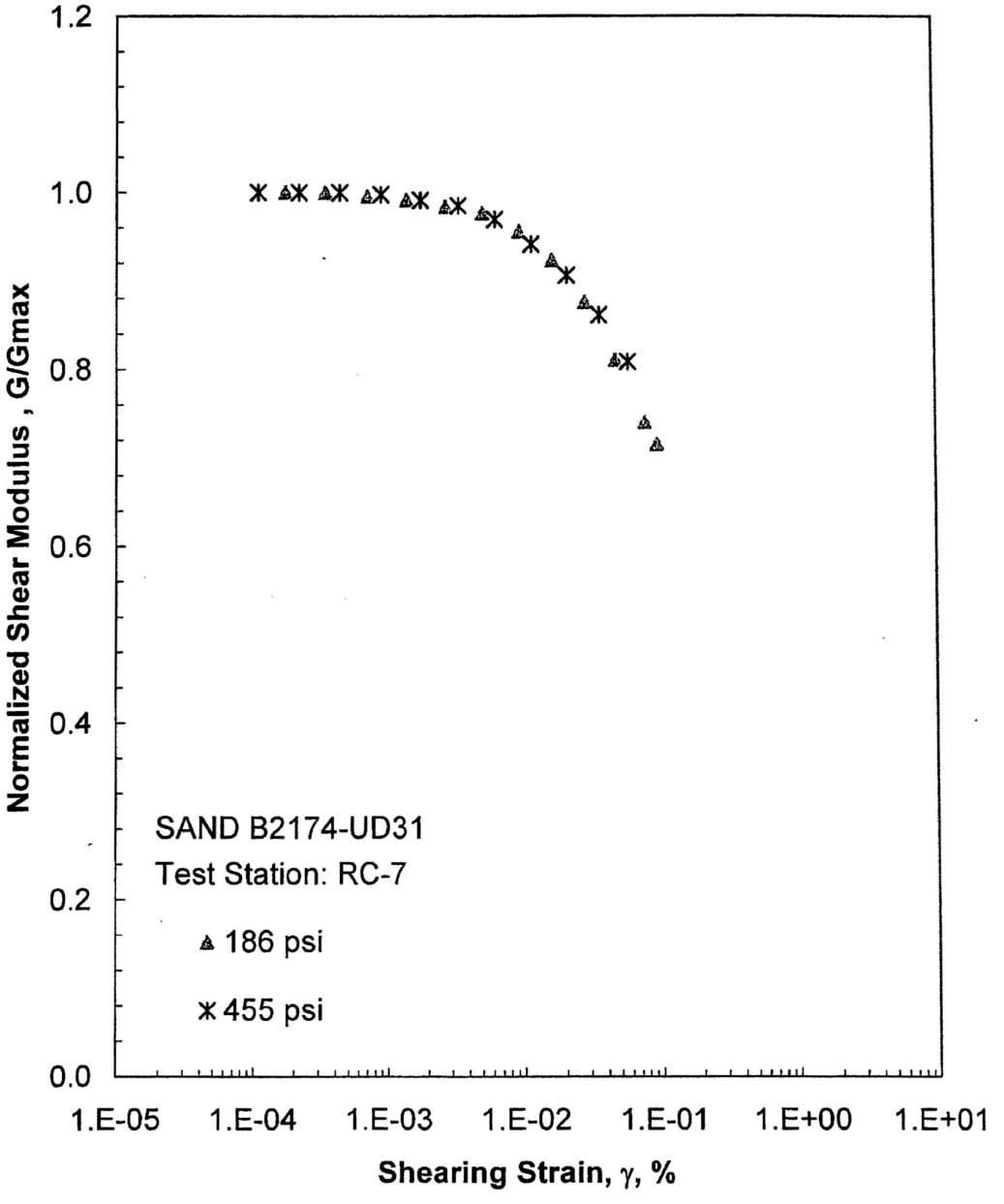

Figure L.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

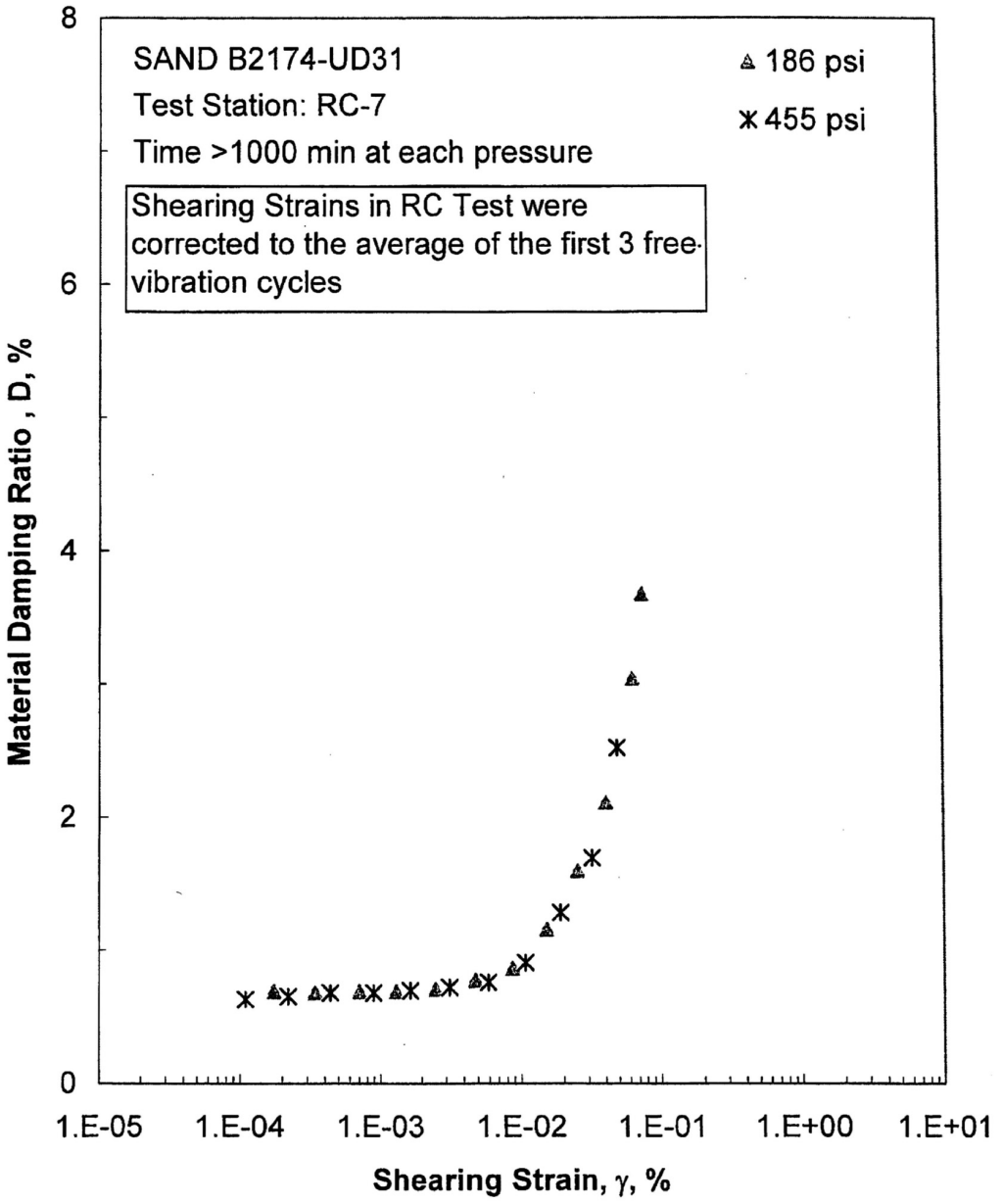

Figure L.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

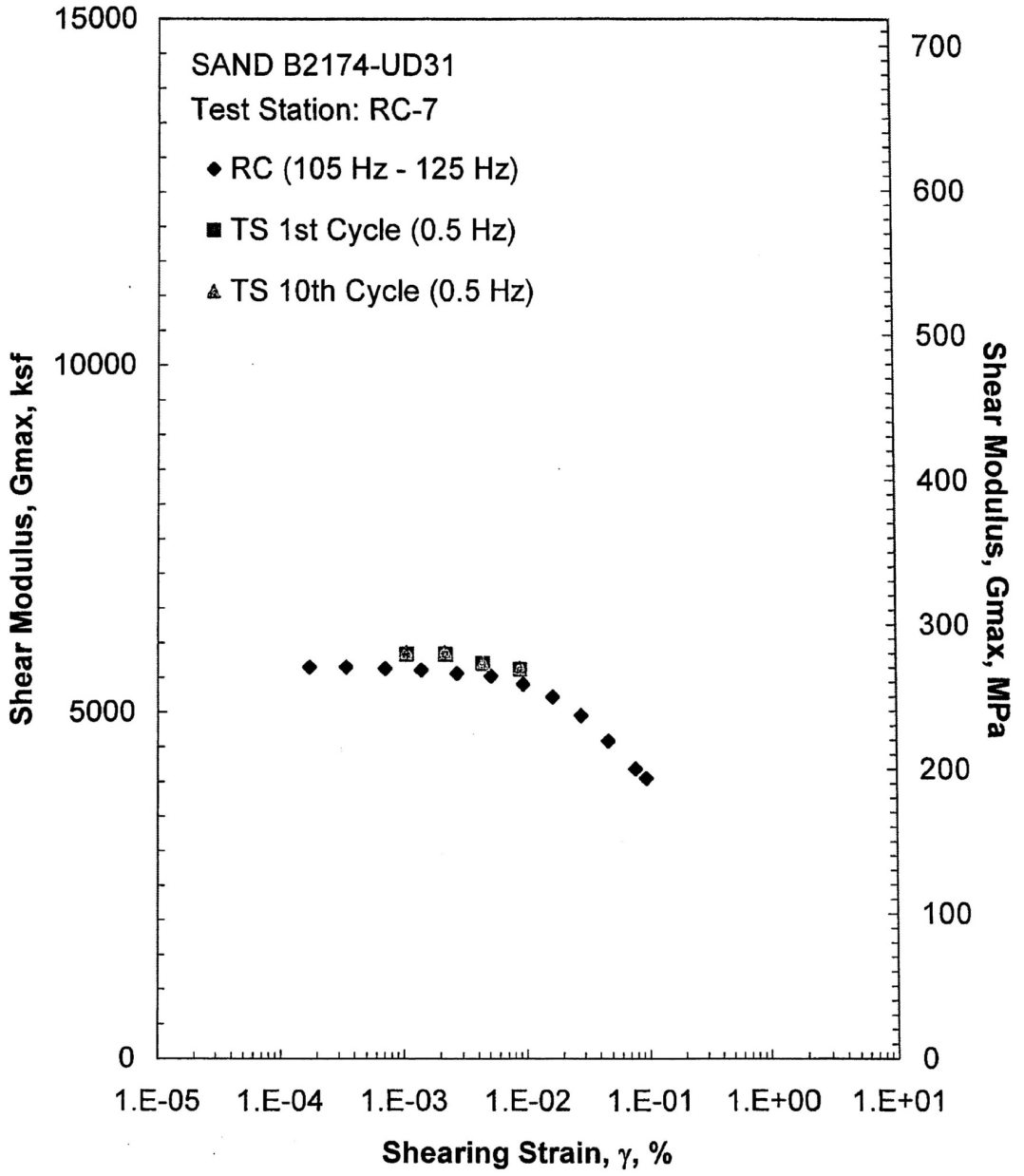

Figure L.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 186 psi from the Combined RCTS Tests

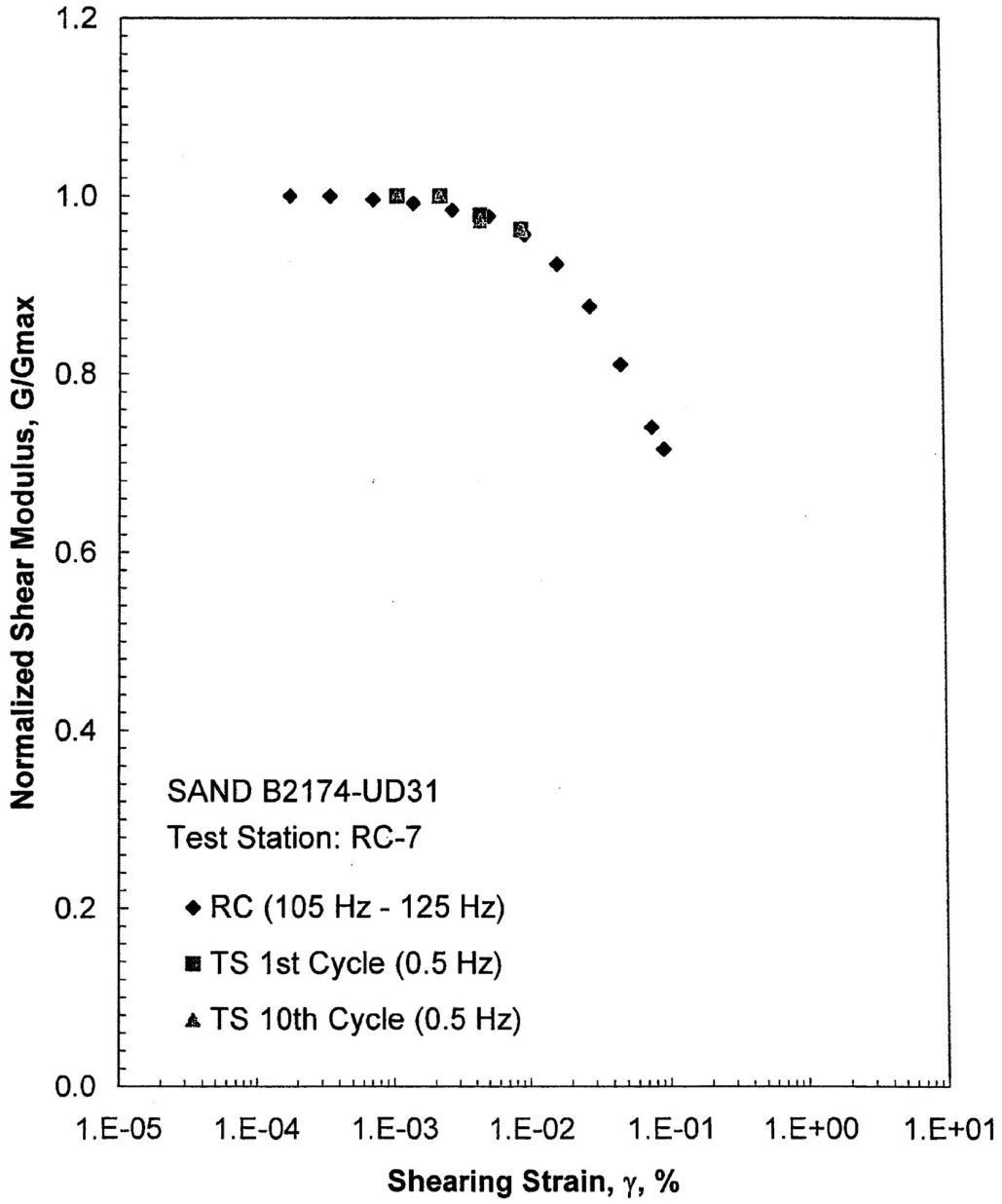

Figure L.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 186 psi from the Combined RCTS Tests

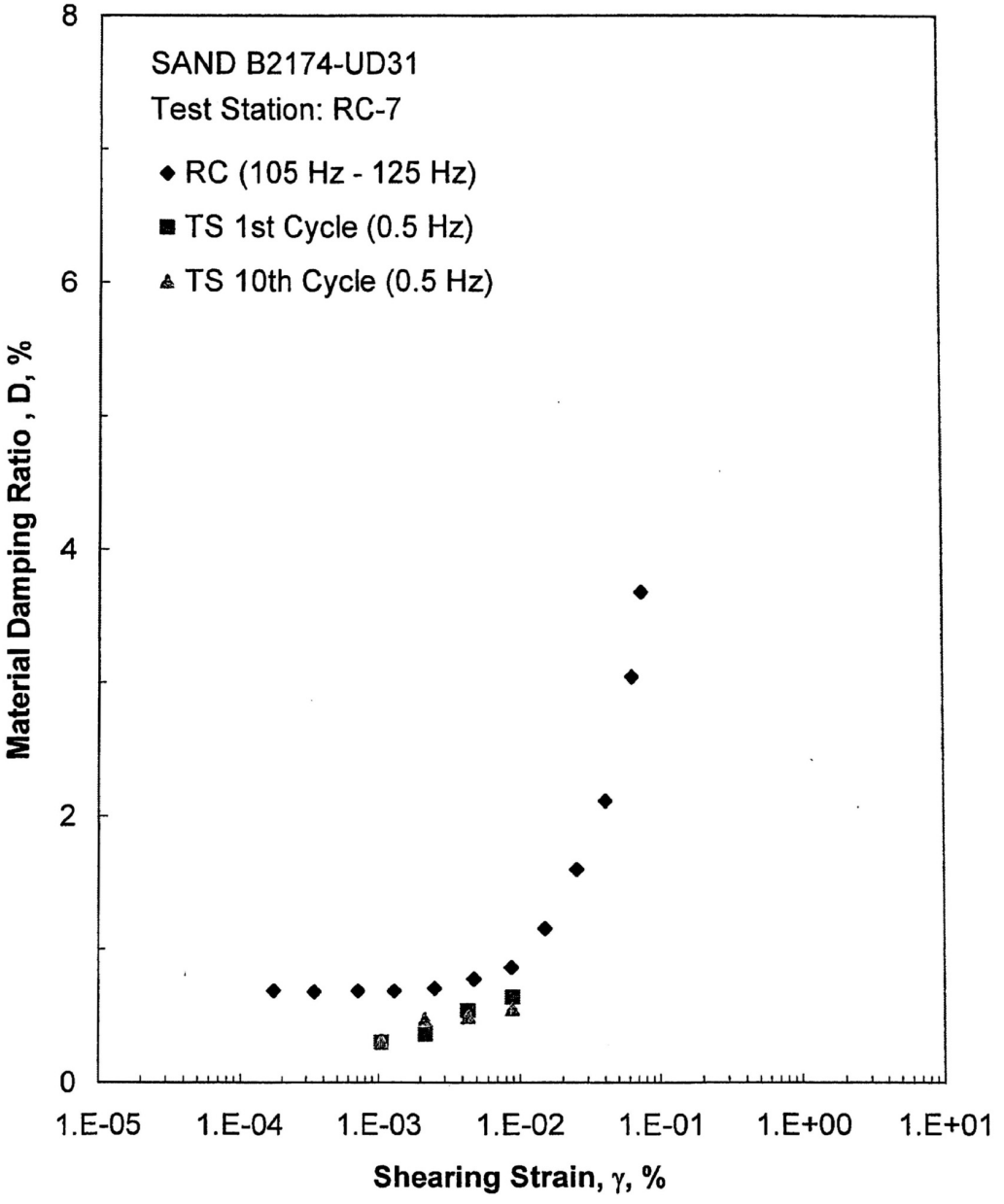

Figure L.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 186 psi from the Combined RCTS Tests

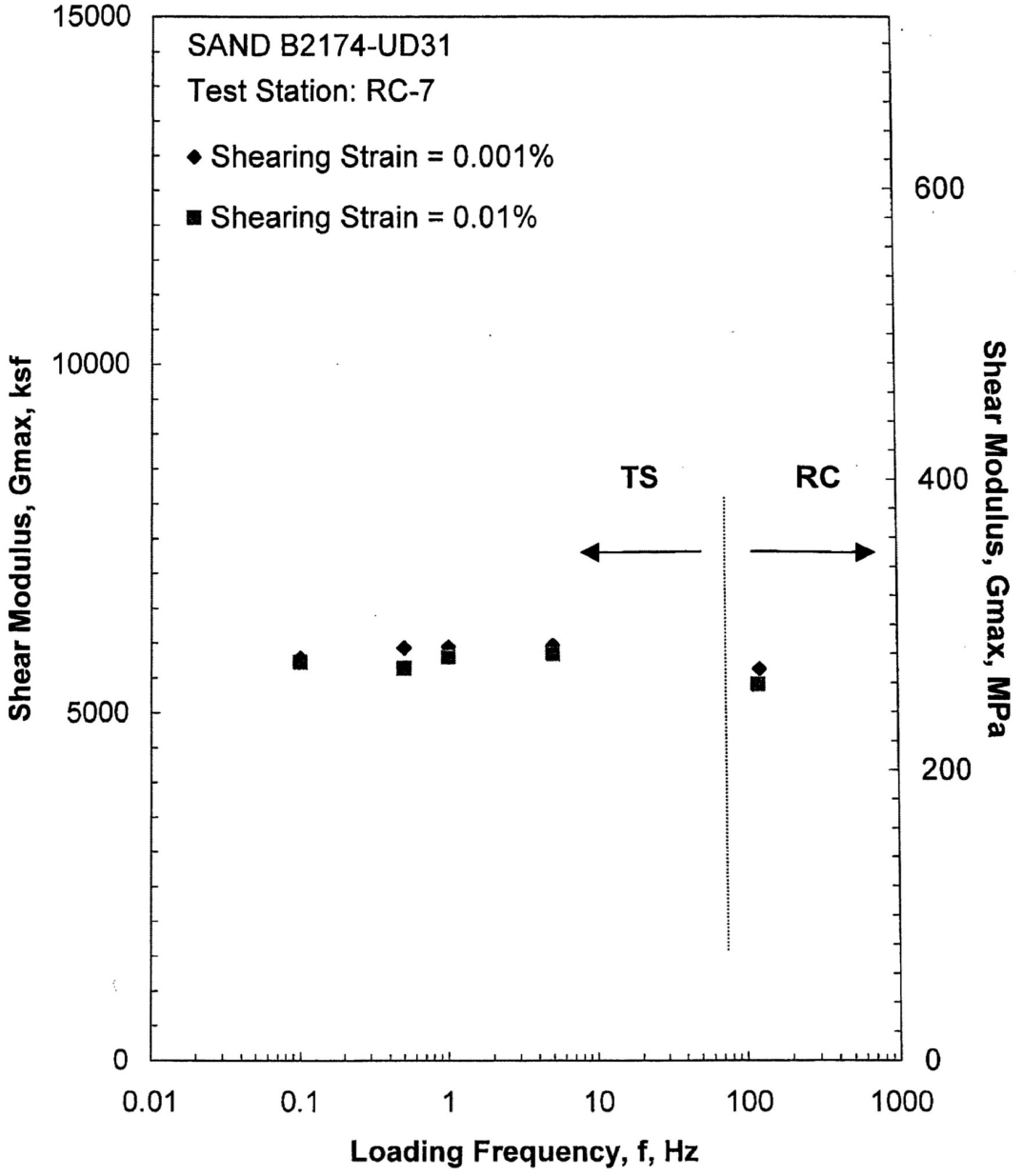

Figure L.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 186 psi from the Combined RCTS Tests

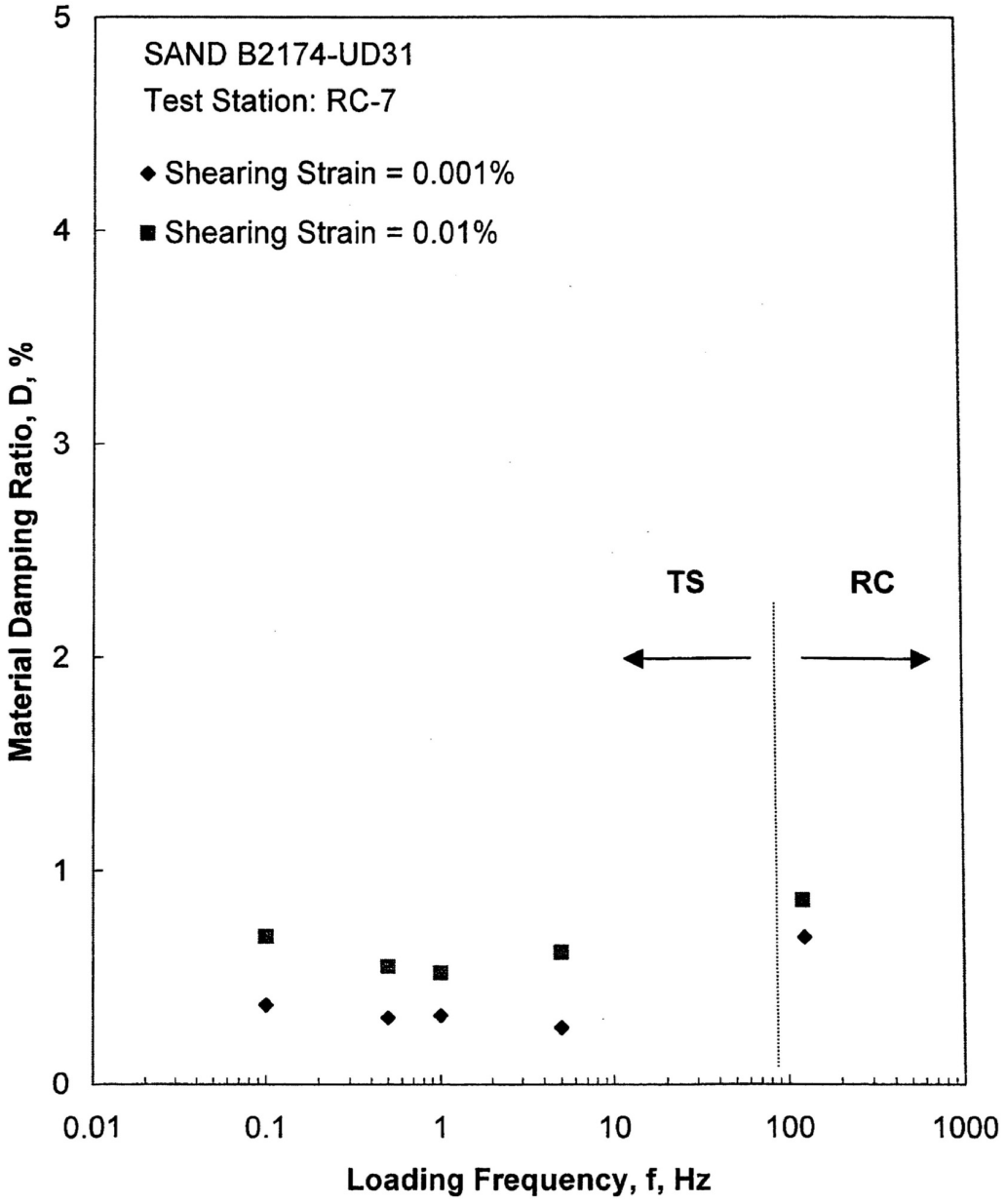

Figure L.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 186 psi from the Combined RCTS Tests

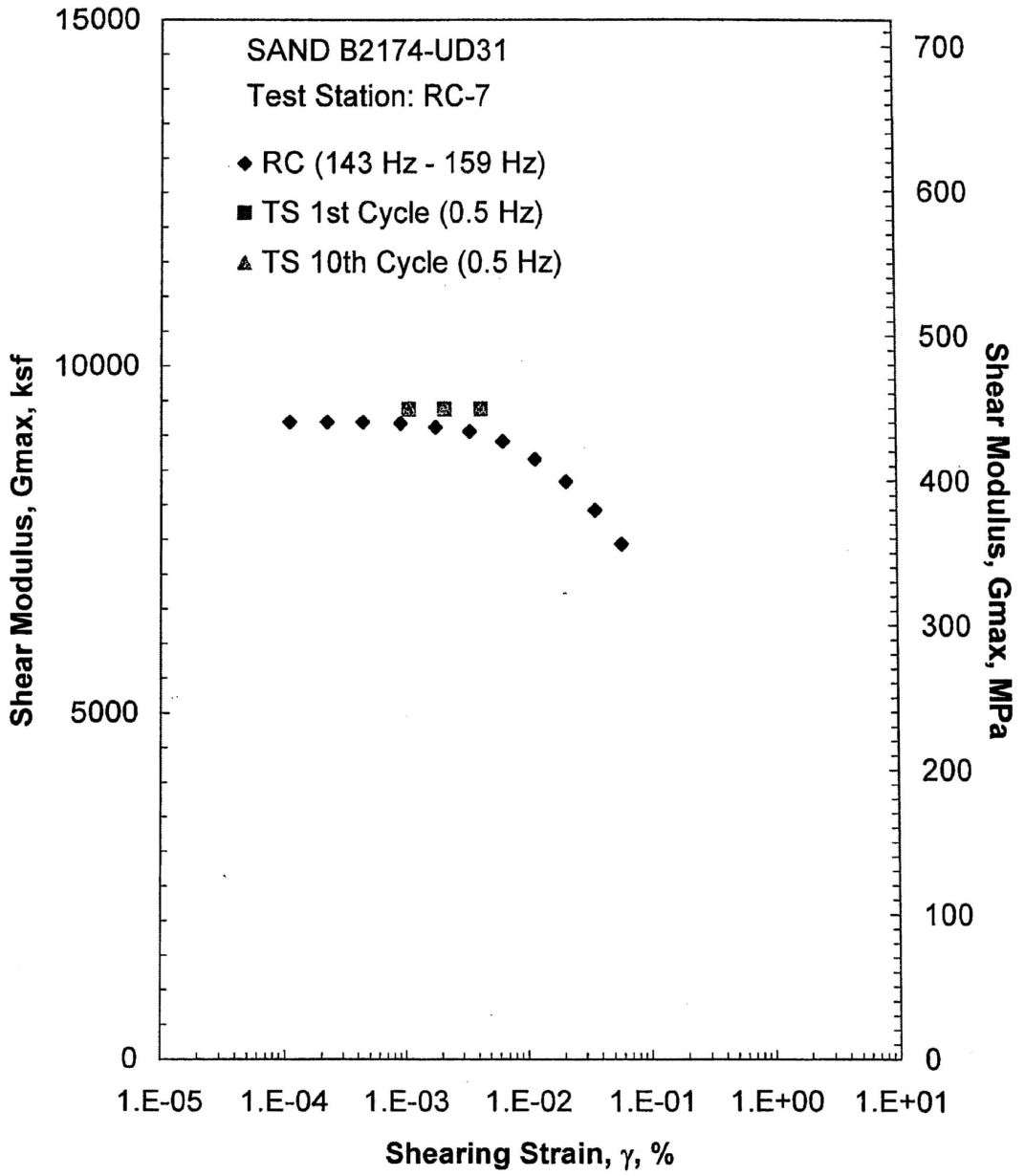

Figure L.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

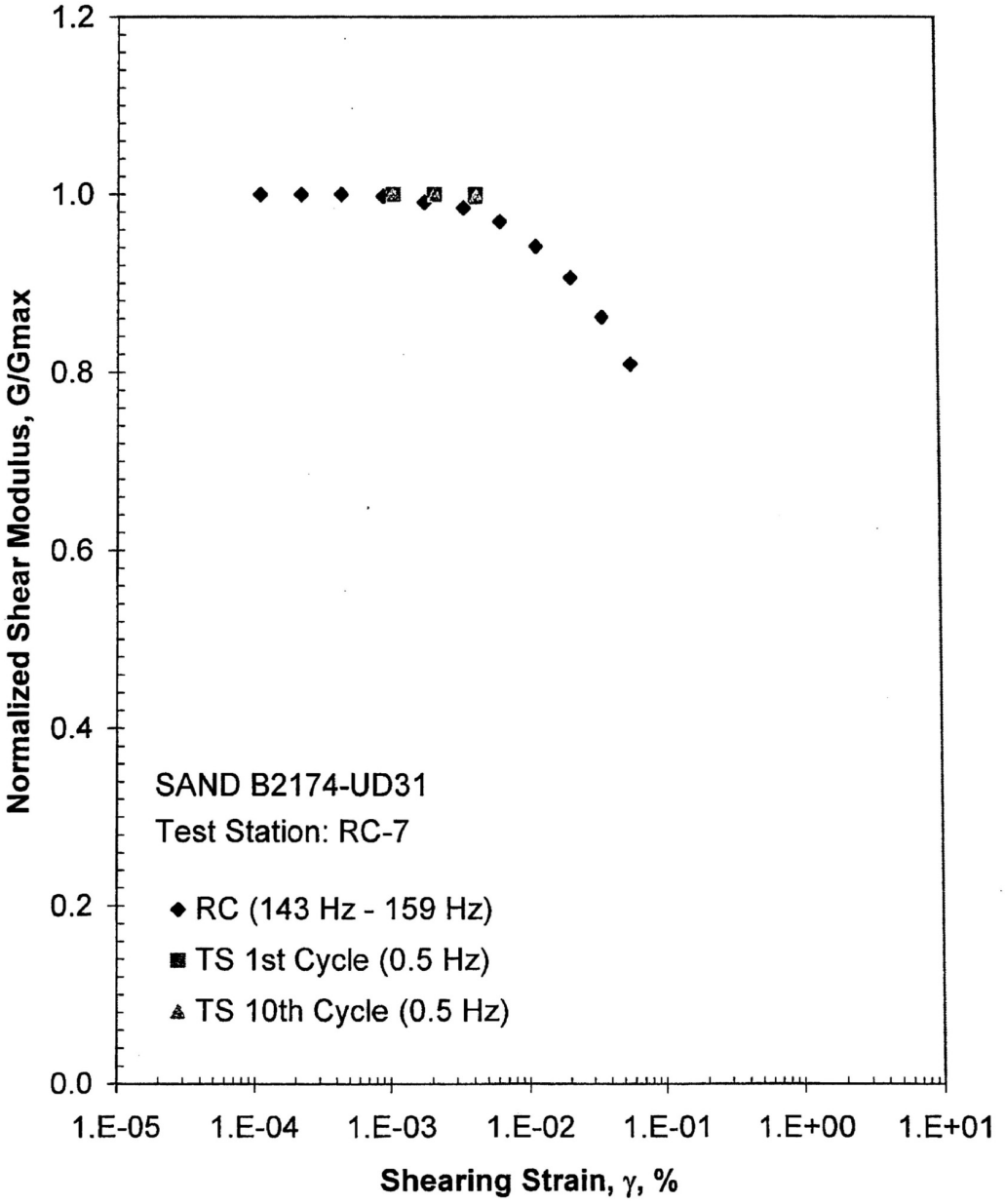

Figure L.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

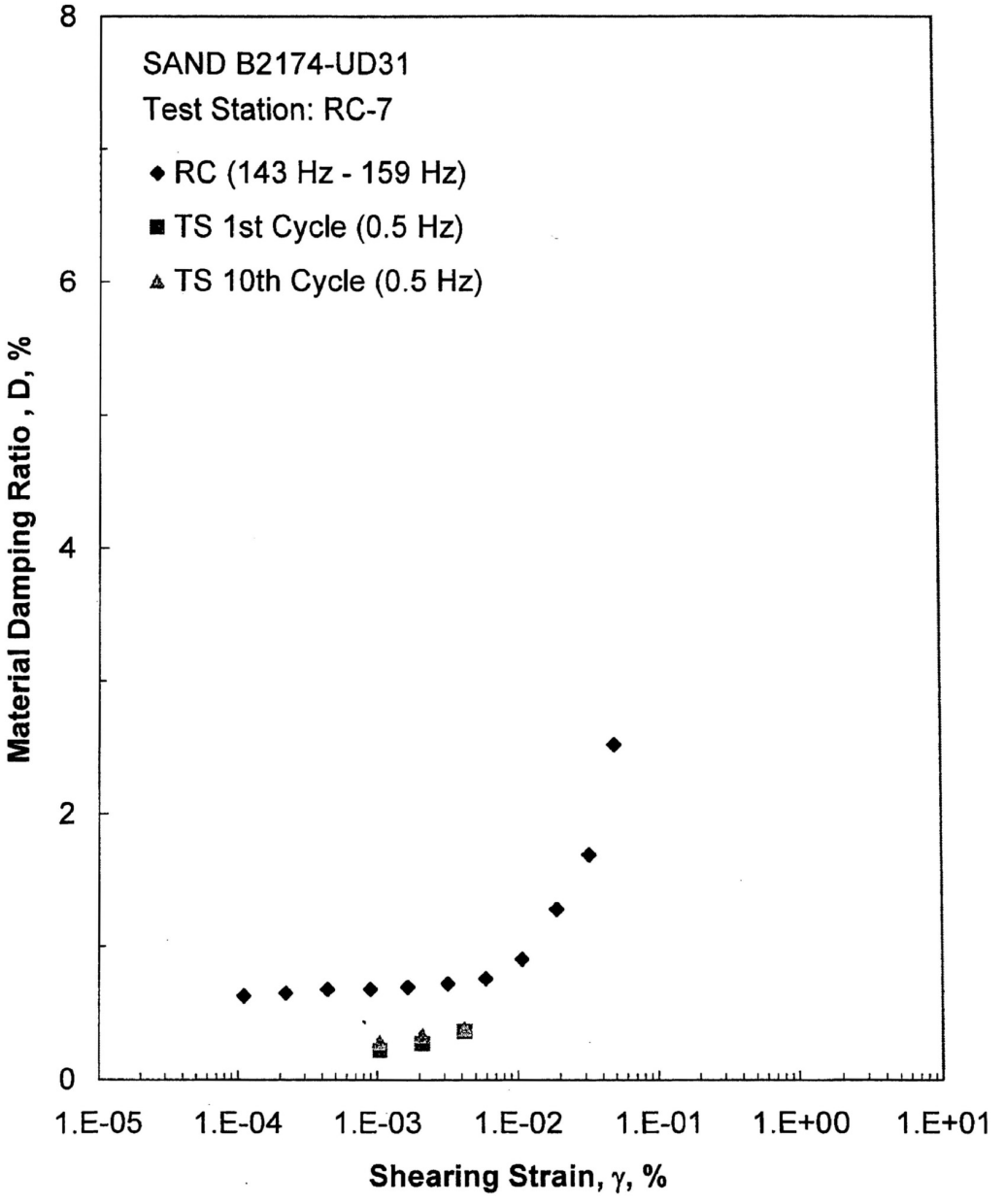

Figure L.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

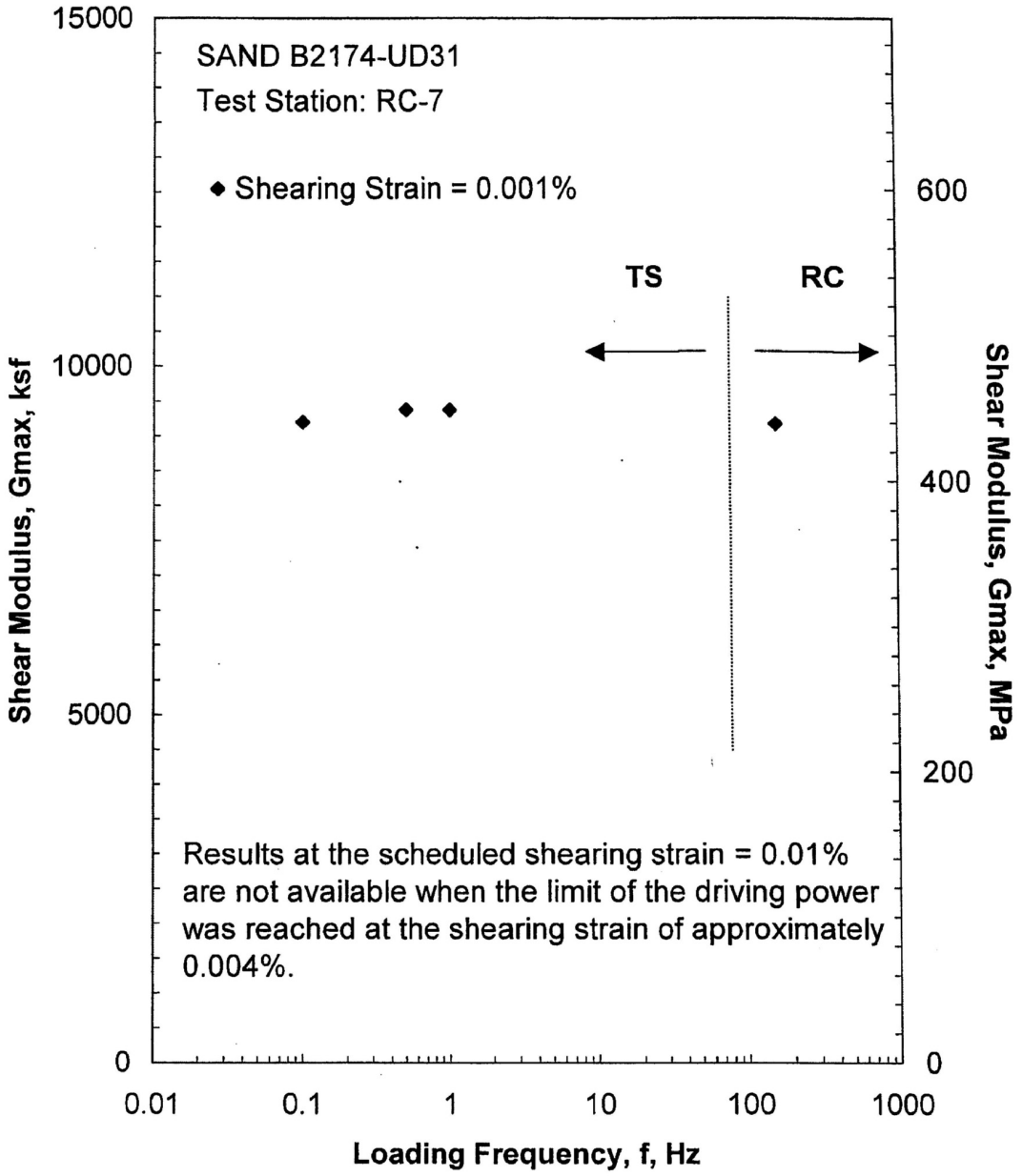

Figure L.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

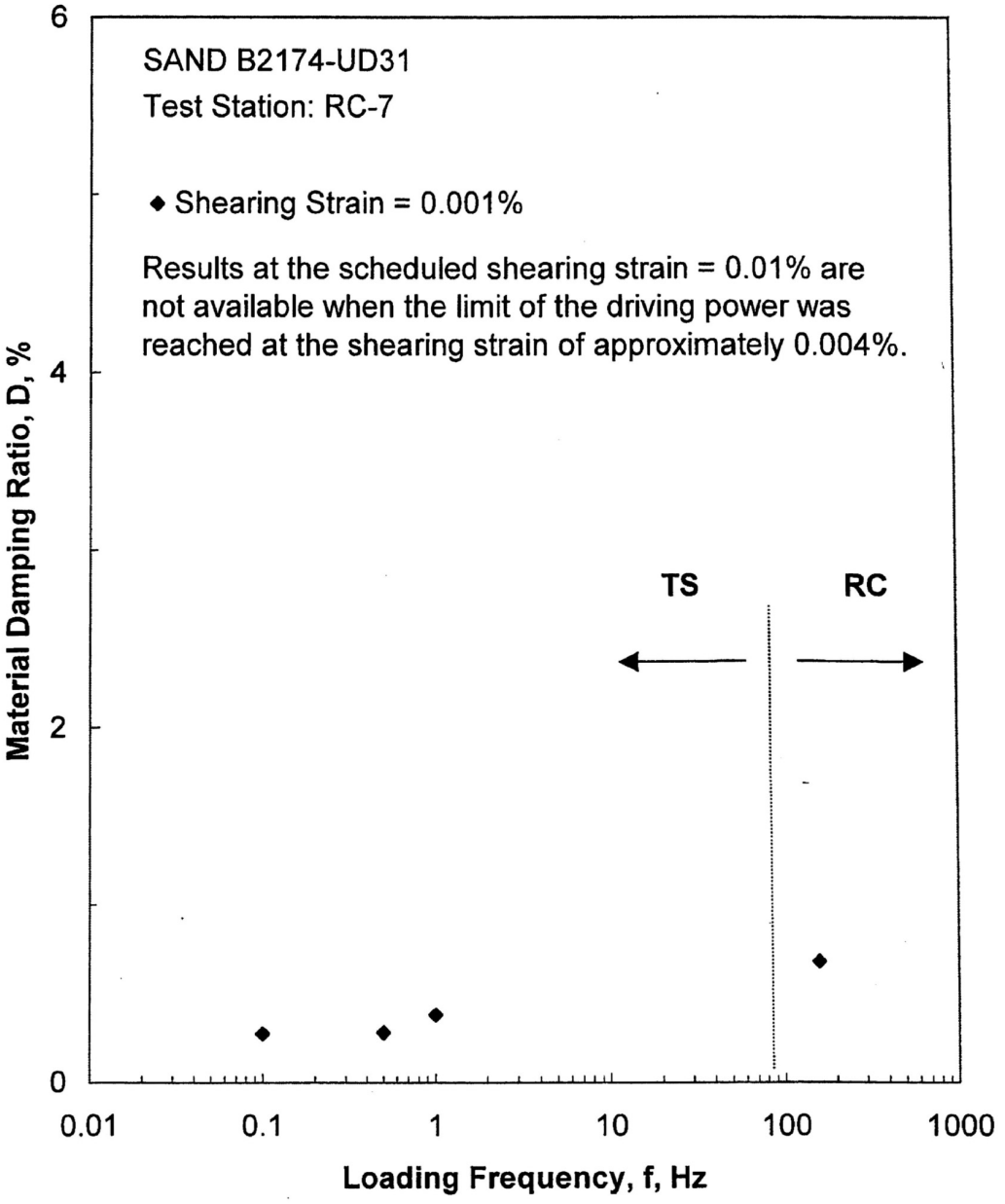

Figure L.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

Table L.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 B2174-UD31

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)	(%)	
46	6624	317	2620	126	819	0.69	0.50
93	13392	641	3910	188	999	0.68	0.50
186	26784	1282	5670	272	1201	0.67	0.49
371	53424	2556	8316	399	1449	0.64	0.48
455	65520	3135	9207	442	1524	0.63	0.48

Table L.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2174-UD31; Isoptropic Confining Pressure, σ_o= 186 psi (26.8 ksf = 1282 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
1.74E-04	5651	1.00	1.74E-04	0.69
3.43E-04	5651	1.00	3.43E-04	0.68
7.08E-04	5628	1.00	7.08E-04	0.69
1.39E-03	5605	0.99	1.30E-03	0.69
2.69E-03	5560	0.98	2.53E-03	0.71
5.11E-03	5518	0.98	4.80E-03	0.77
9.41E-03	5402	0.96	8.75E-03	0.86
1.65E-02	5217	0.92	1.51E-02	1.15
2.83E-02	4948	0.88	2.52E-02	1.59
4.73E-02	4580	0.81	4.06E-02	2.11
7.80E-02	4183	0.74	6.39E-02	3.04
9.51E-02	4042	0.72	7.52E-02	3.67

[+] 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 L.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2174-UD31; Isotropic Confining Pressure, σ_o= 186 psi (26.8 ksf =1282 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, %
1.06E-03	5833	1.00	0.30	1.05E-03	5864	1.00	0.31
2.18E-03	5833	1.00	0.36	2.16E-03	5864	1.00	0.47
4.39E-03	5706	0.98	0.54	4.39E-03	5698	0.97	0.49
8.92E-03	5614	0.96	0.64	8.89E-03	5638	0.96	0.55

Table L.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2174-UD31; Isoptropic Confining Pressure, σ_o= 455 psi (65.5 ksf = 3135 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
1.10E-04	9195	1.00	1.10E-04	0.63
2.20E-04	9195	1.00	2.20E-04	0.65
4.37E-04	9195	1.00	4.37E-04	0.68
8.96E-04	9176	1.00	8.96E-04	0.68
1.76E-03	9117	0.99	1.66E-03	0.69
3.39E-03	9059	0.99	3.18E-03	0.72
6.30E-03	8914	0.97	5.92E-03	0.76
1.16E-02	8658	0.94	1.08E-02	0.90
2.09E-02	8333	0.91	1.90E-02	1.28
3.61E-02	7922	0.86	3.22E-02	1.69
5.87E-02	7436	0.81	4.93E-02	2.52

[+] 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 L.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2174-UD31; Isotropic Confining Pressure, σ_o=455 psi (65.5 ksf = 3135 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, %
1.05E-03	9382	1.00	0.22	1.05E-03	9400	1.00	0.28
2.09E-03	9382	1.00	0.27	2.09E-03	9400	1.00	0.33
4.18E-03	9382	1.00	0.36	4.20E-03	9382	1.00	0.38

APPENDIX M

Specimen B2174-UD30
(Index properties not available)

Borehole B2174
Sample UD30
Depth = 571.6 ft (174.2 m)
Total Unit Weight = 126.4 lb/ft^3
Water Content = 23.1 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 180 psi

FUGRO JOB #: 0411-08-1686
Testing Station: RC9

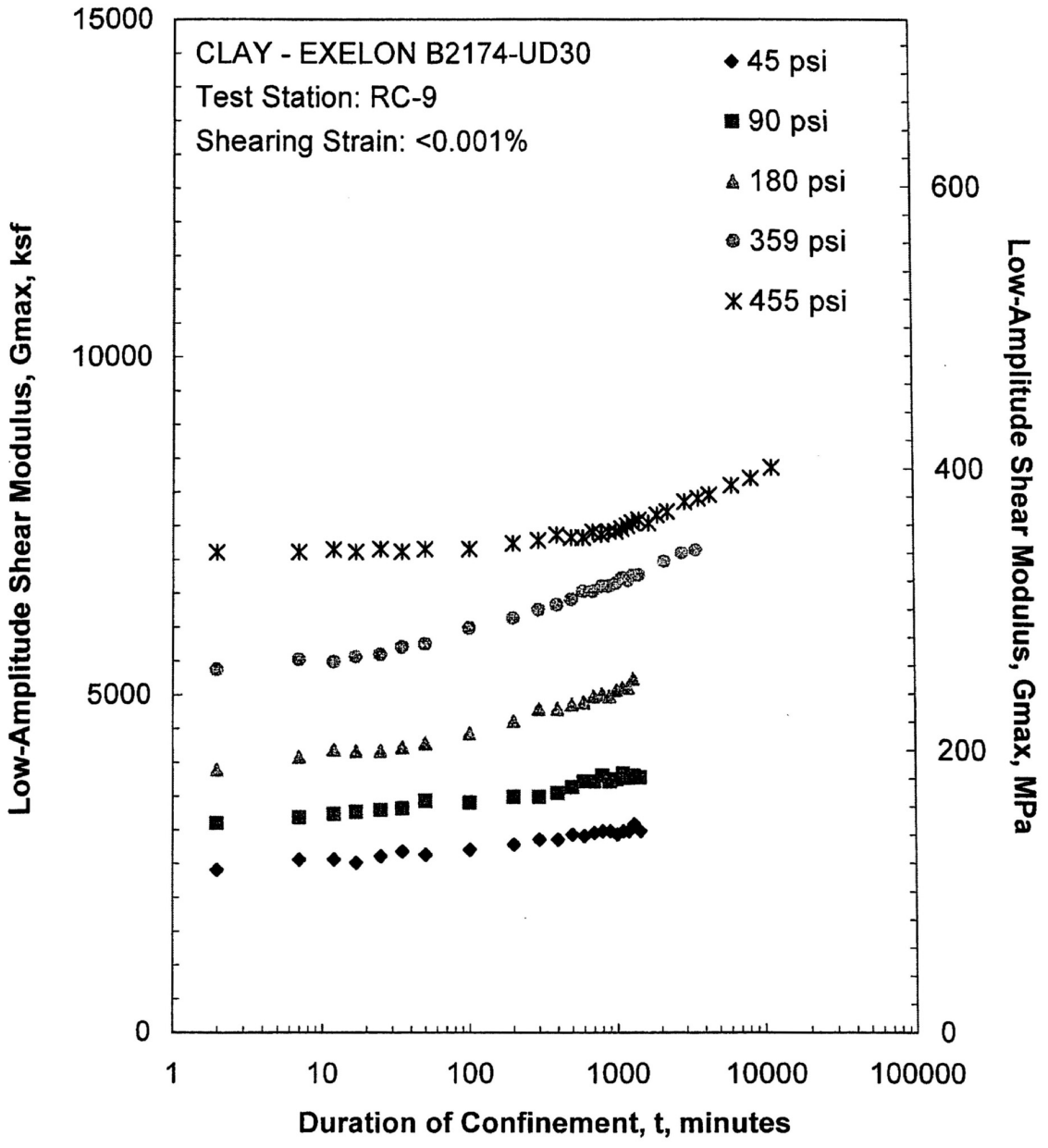

Figure M.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

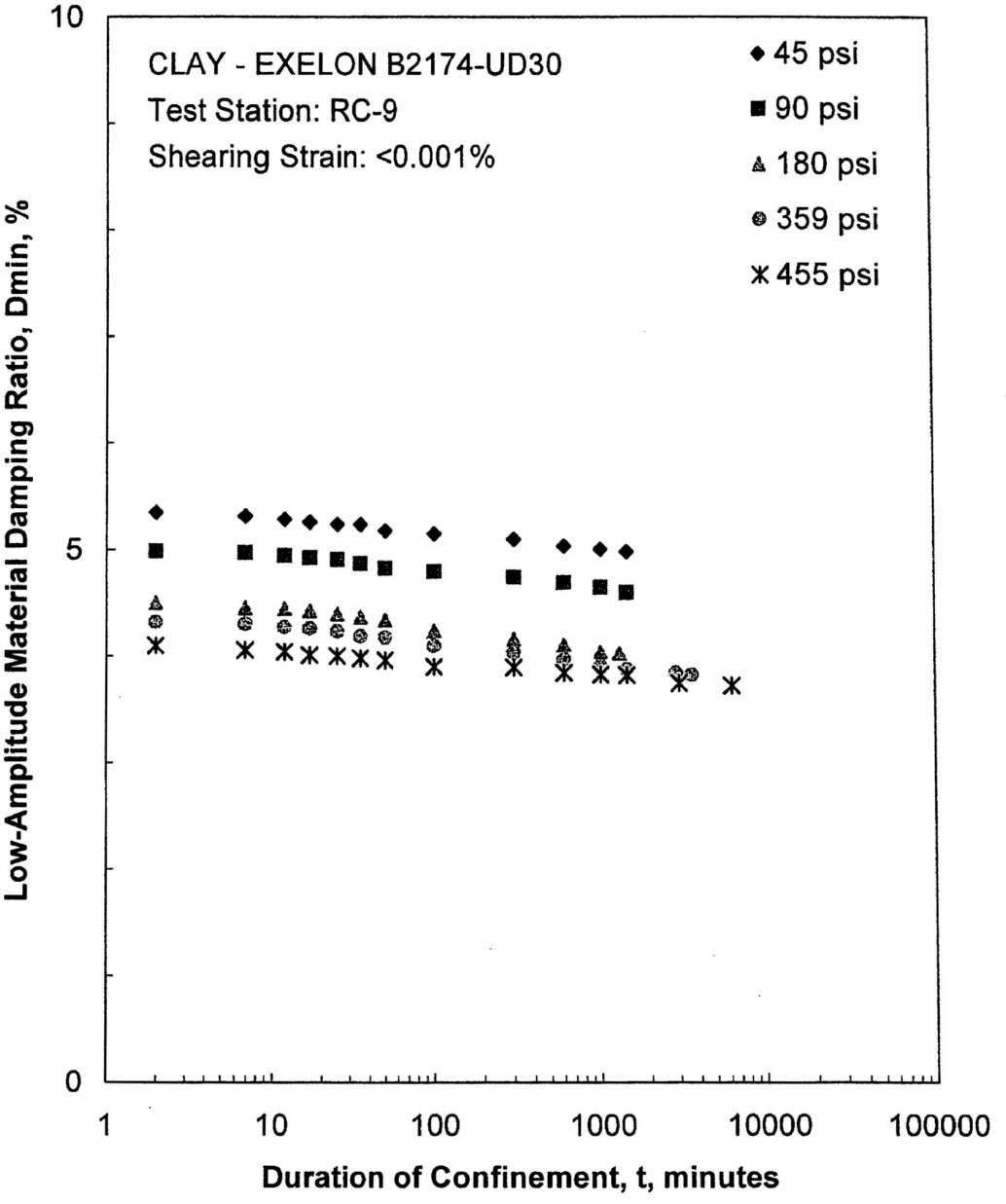

Figure M.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

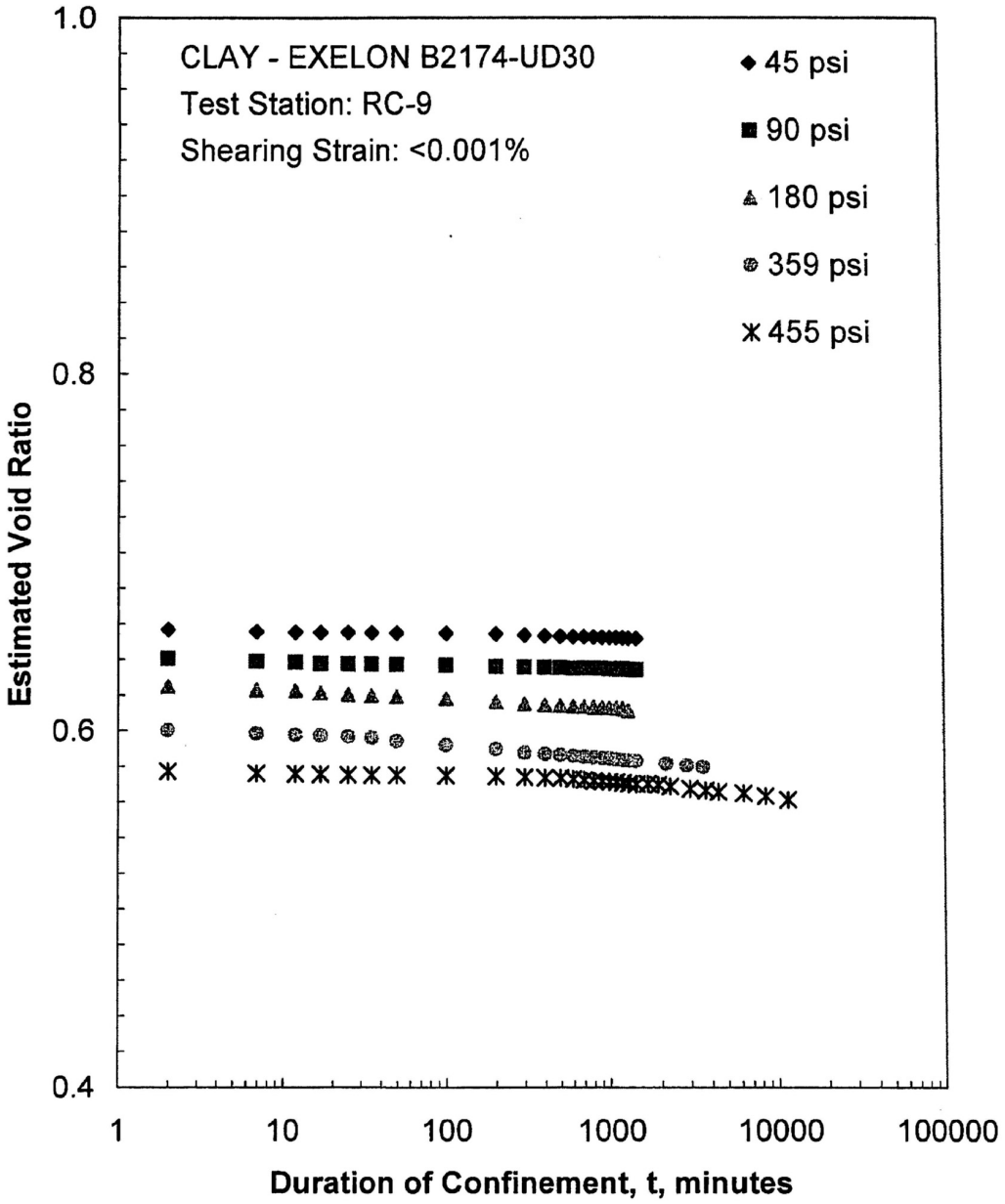

Figure M.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

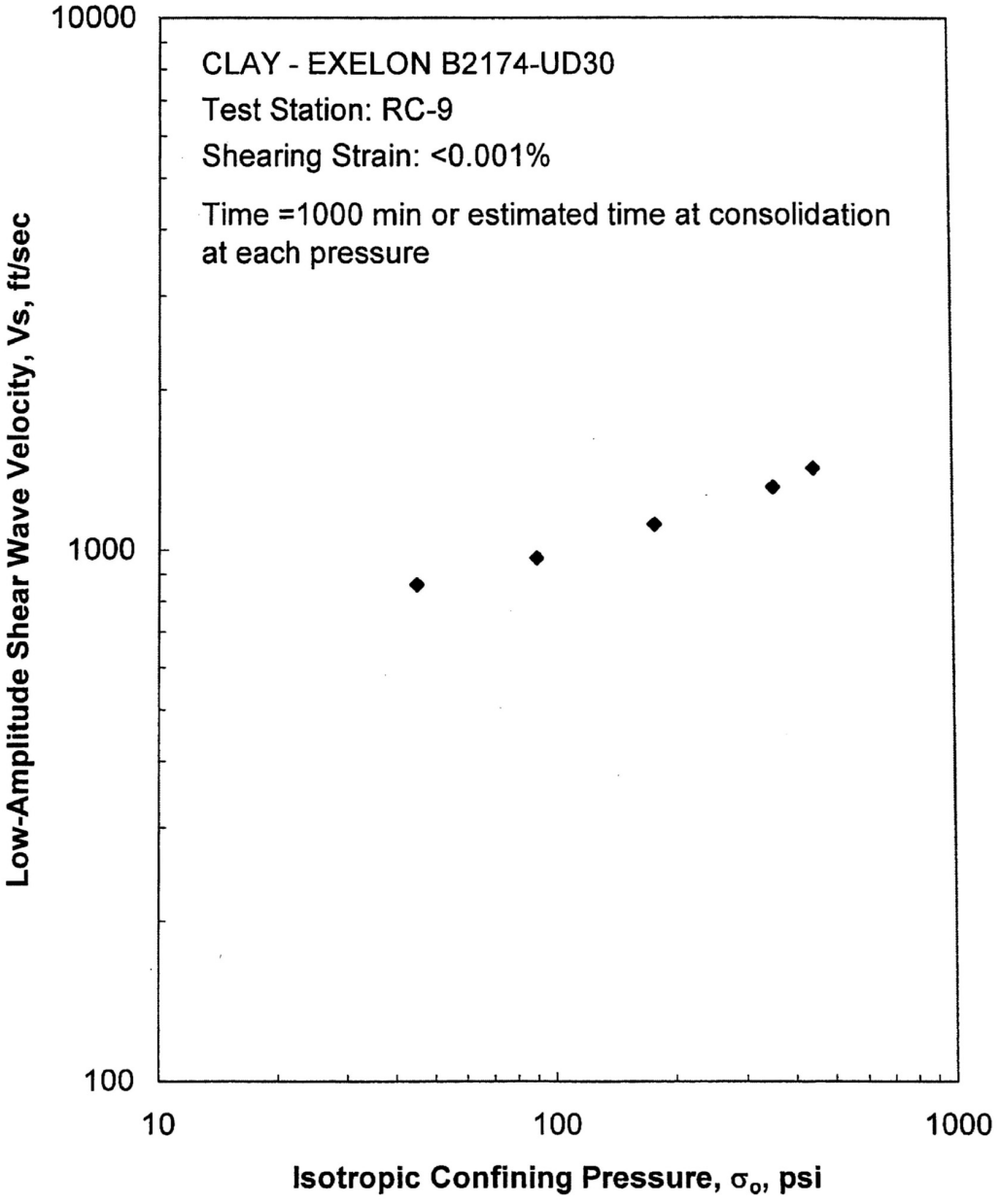

Figure M.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

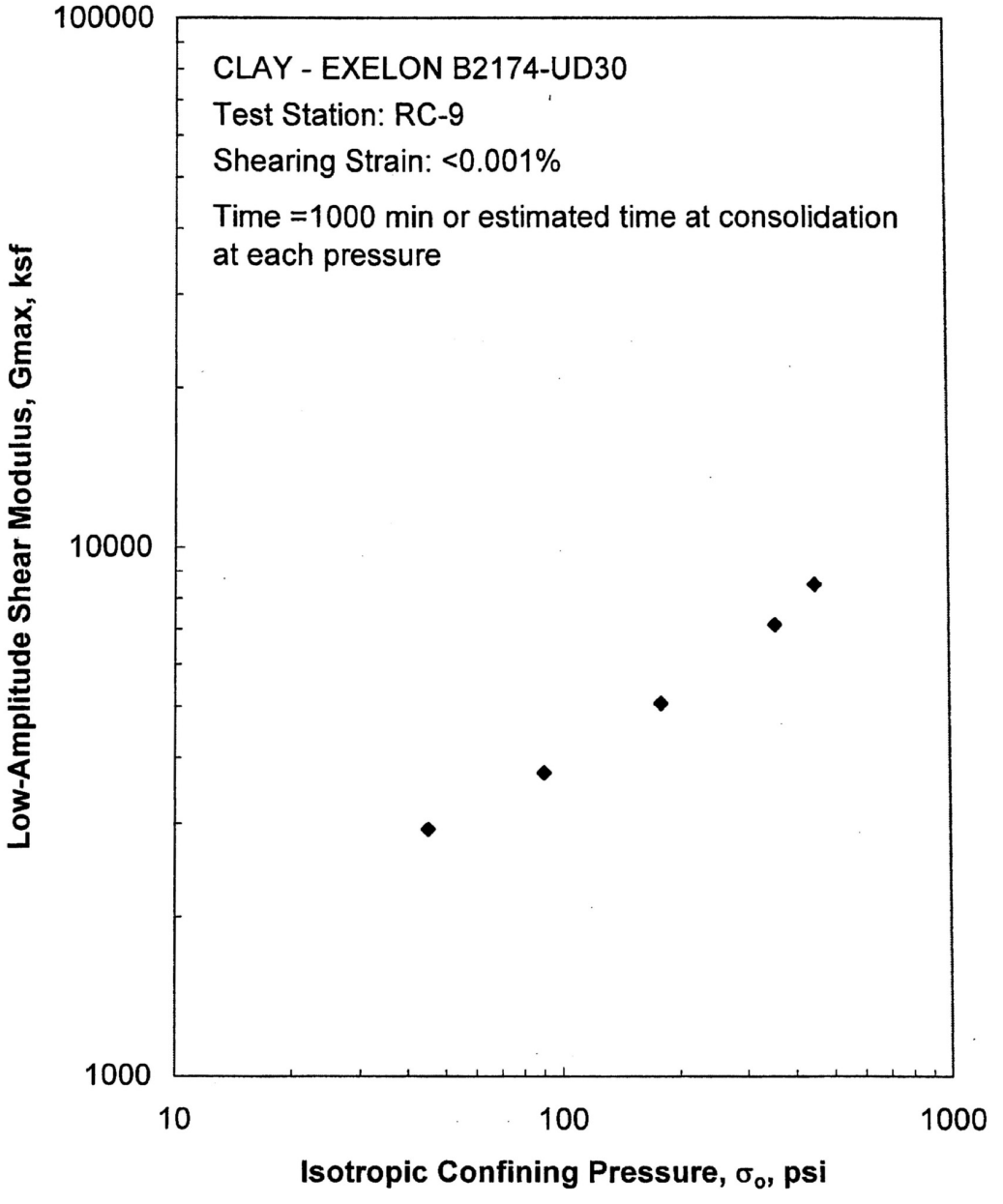

Figure M.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

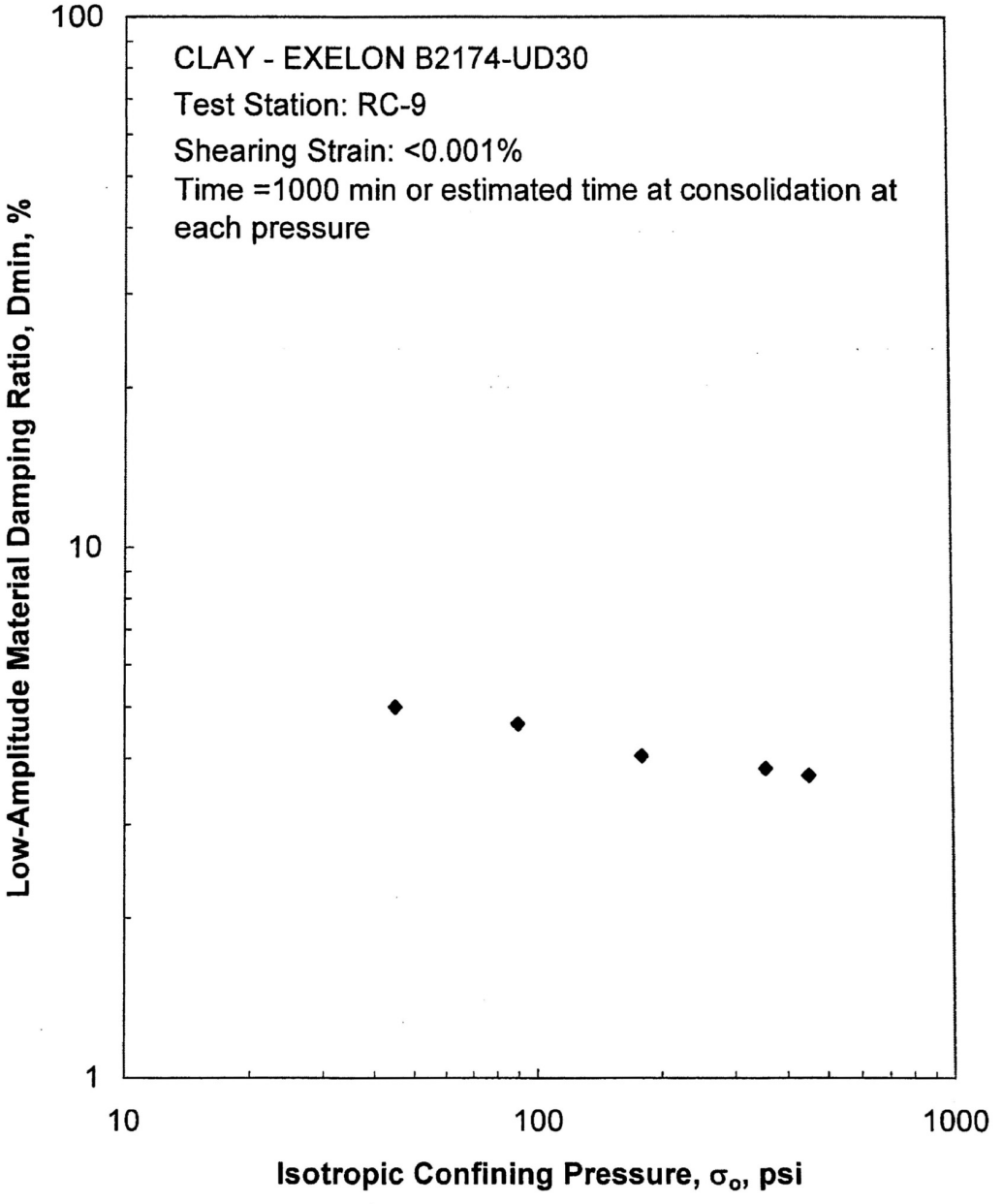

Figure M.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

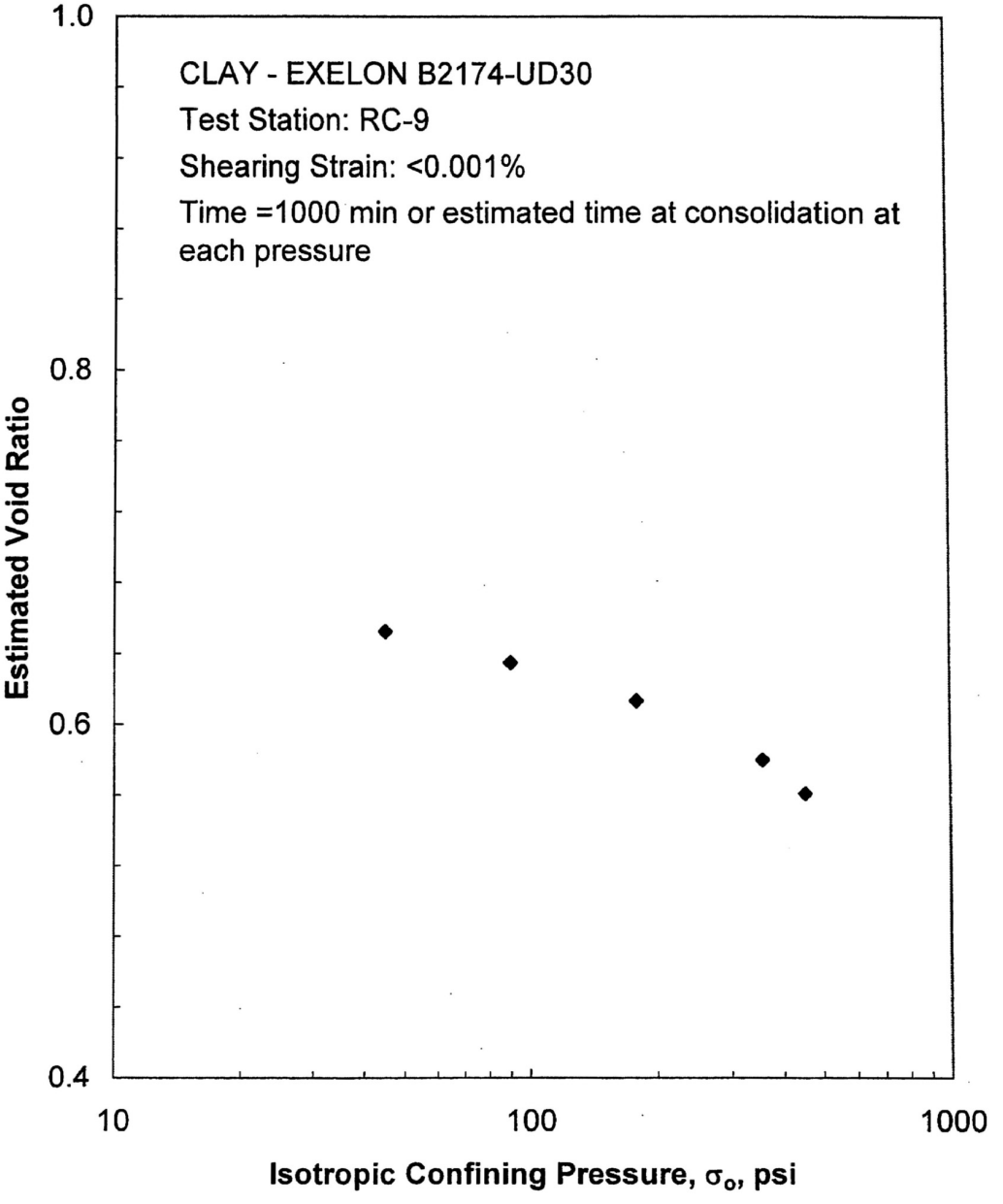

Figure M.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

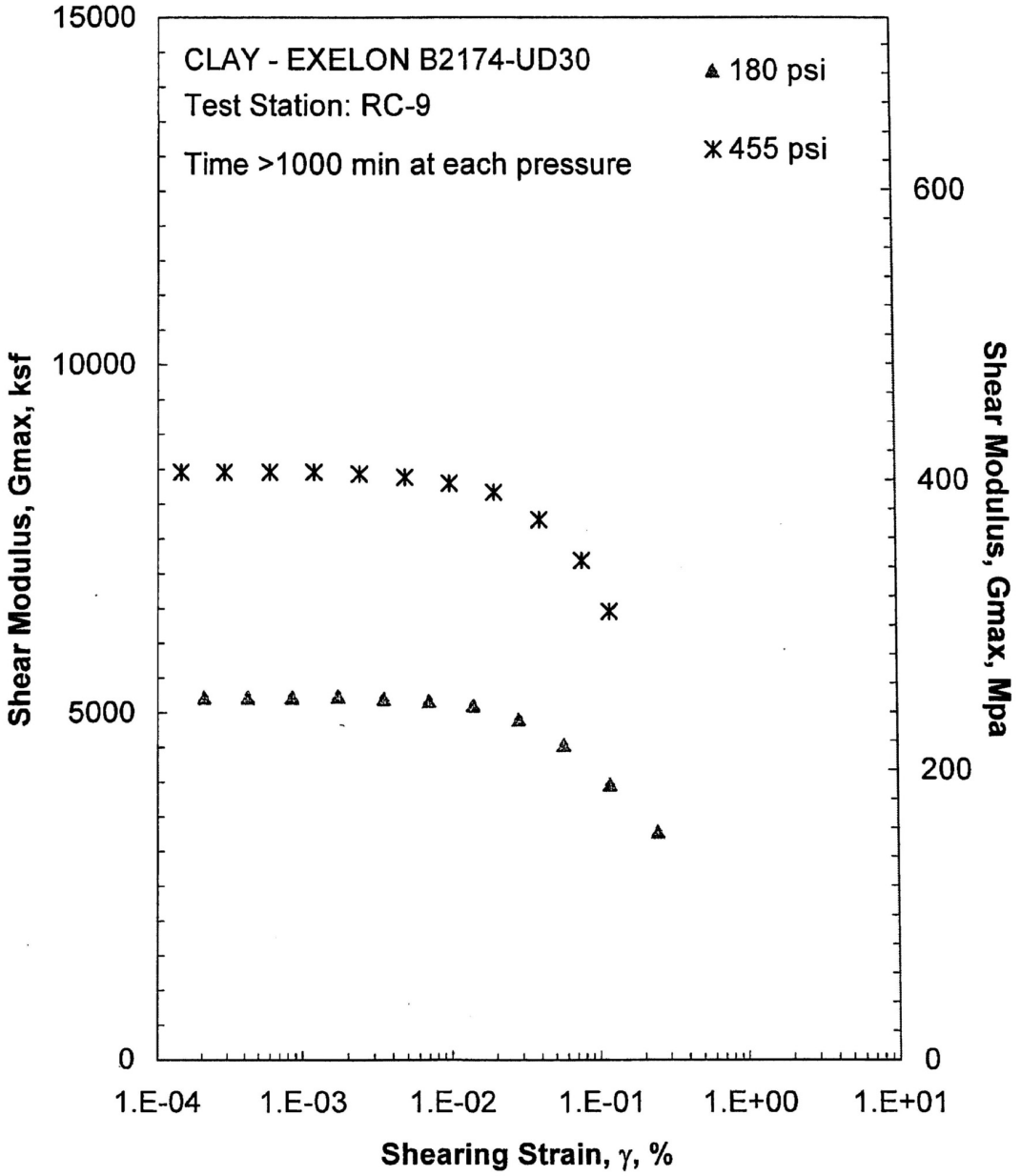

Figure M.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

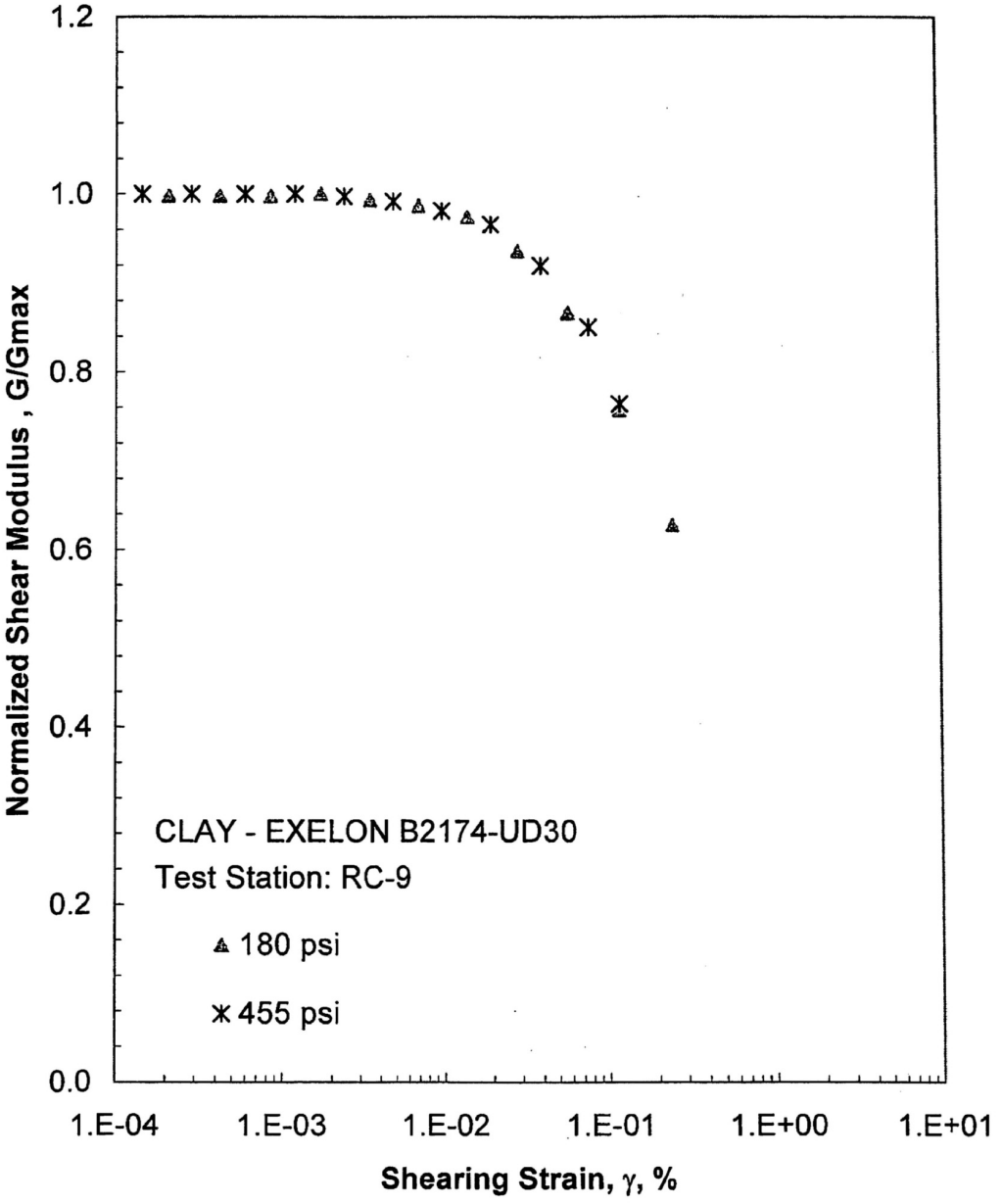

Figure M.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

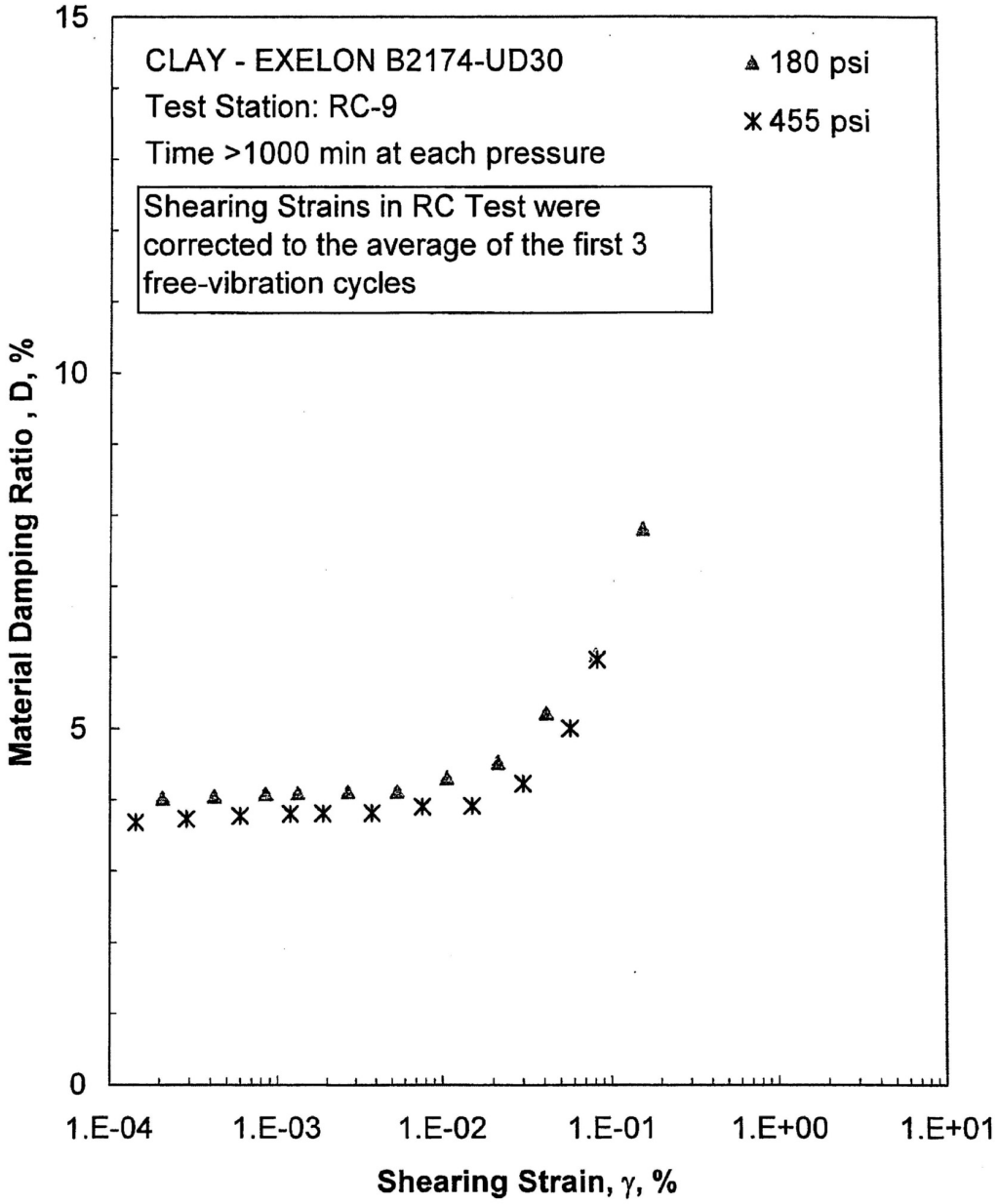

Figure M.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

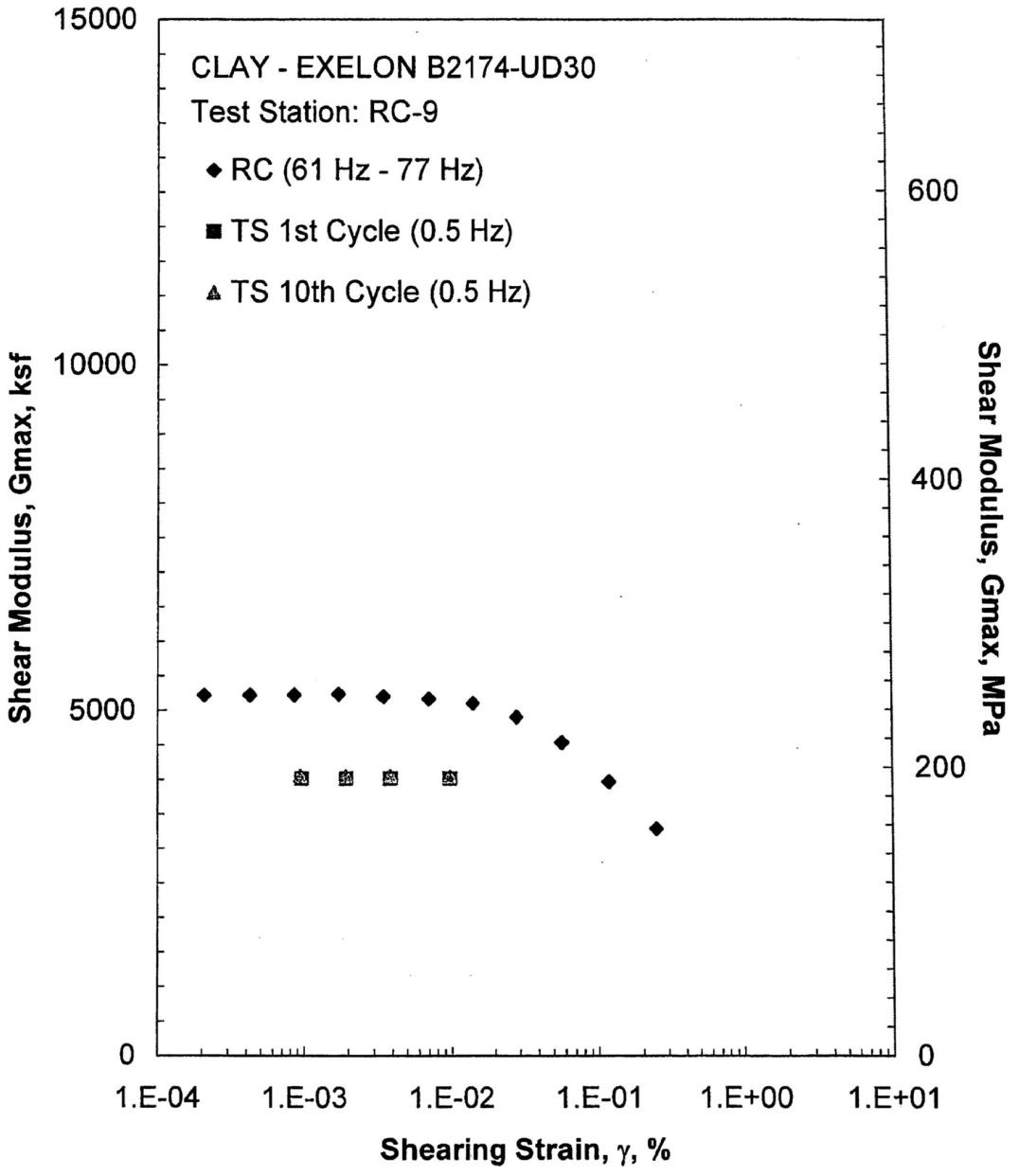

Figure M.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 180 psi from the Combined RCTS Tests

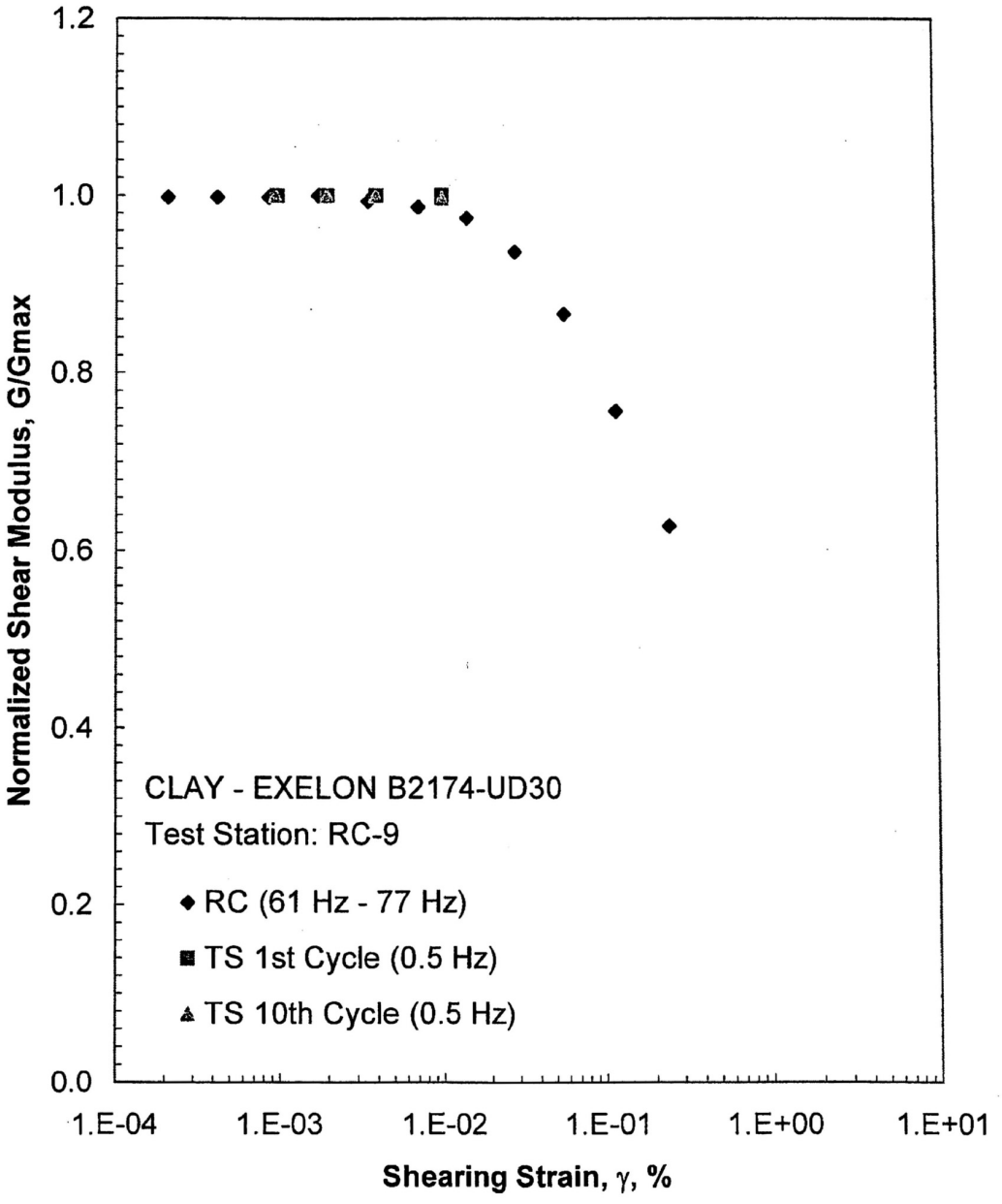

Figure M.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 180 psi from the Combined RCTS Tests

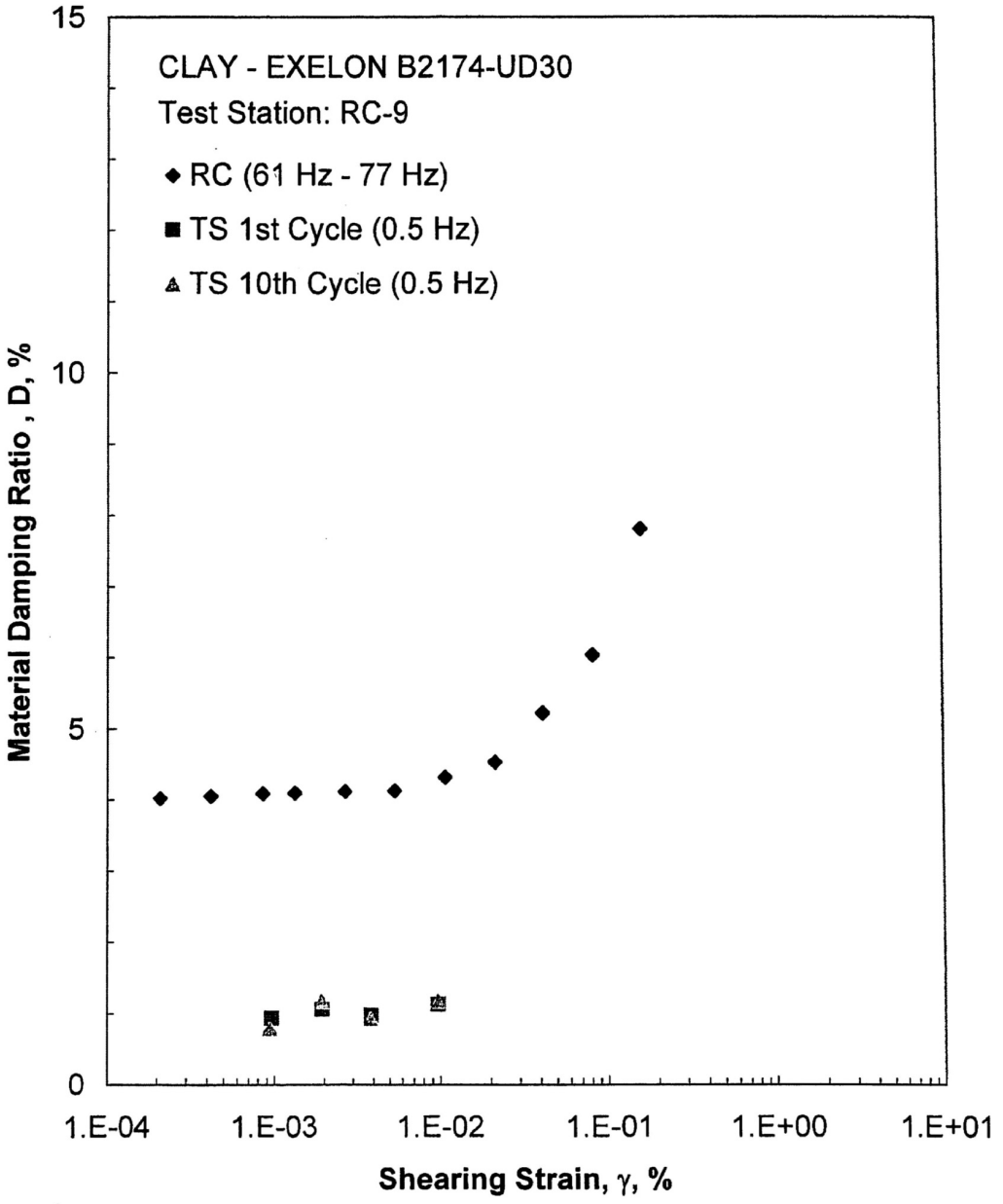

Figure M.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 180 psi from the Combined RCTS Tests

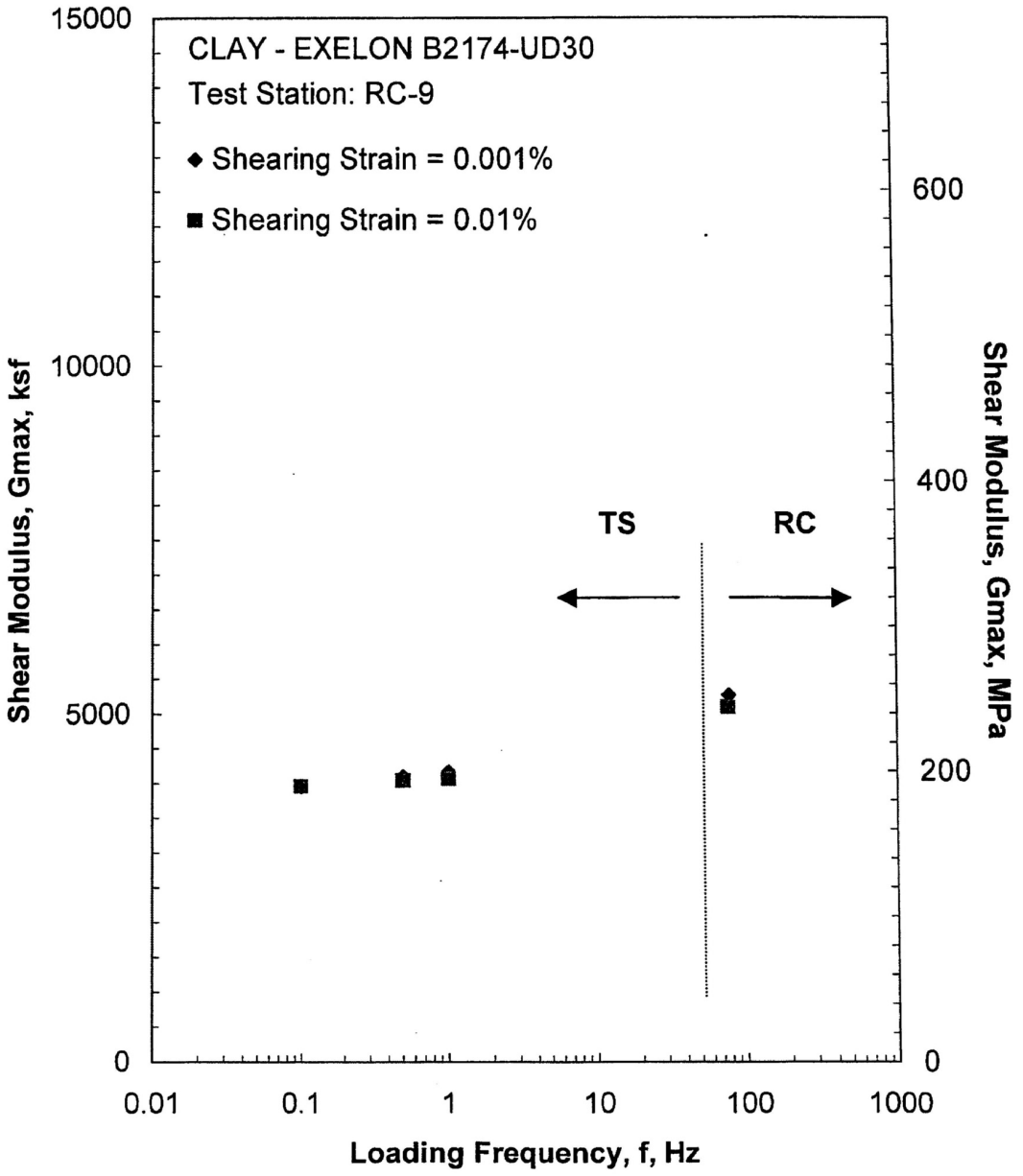

Figure M.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 180 psi from the Combined RCTS Tests

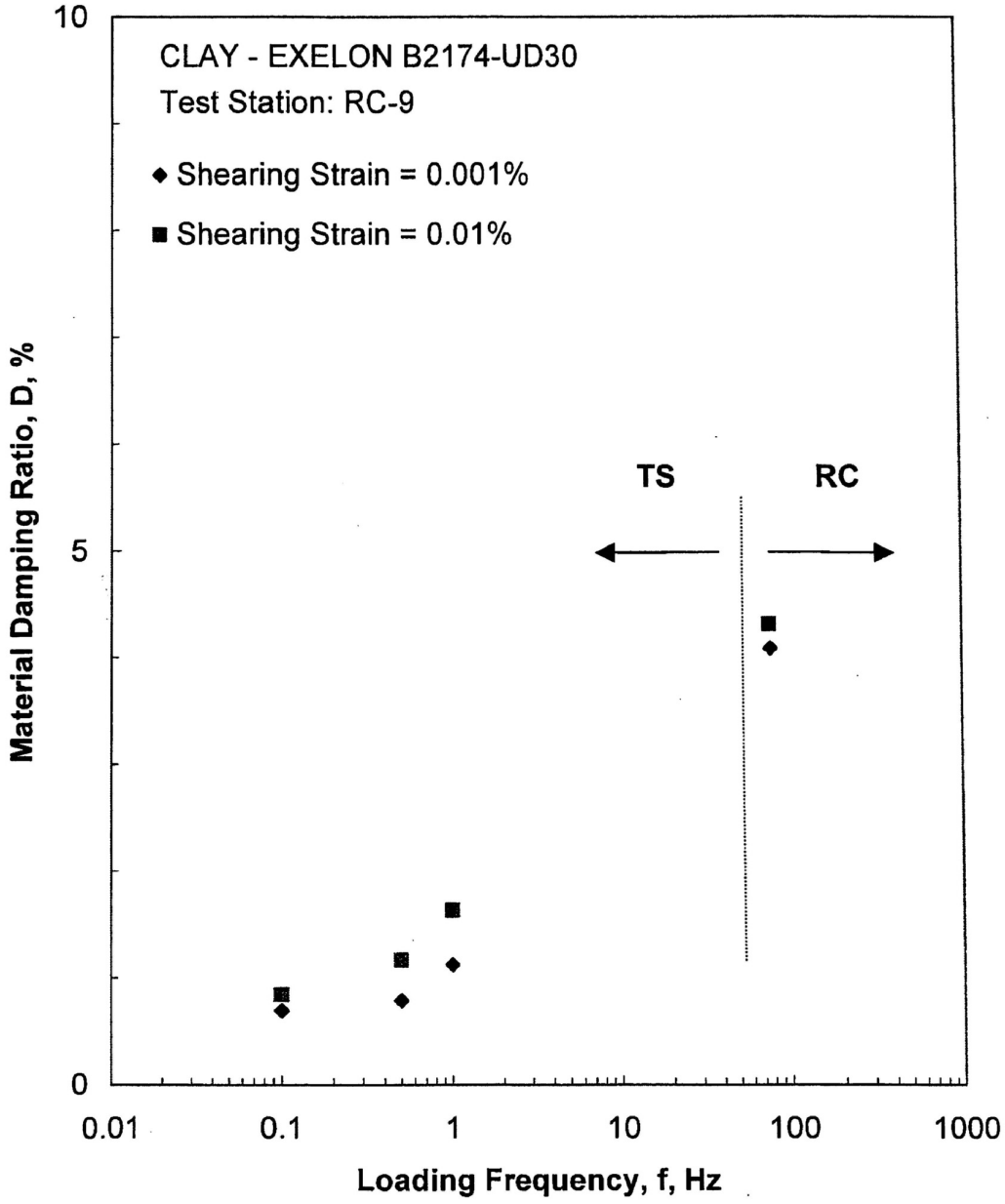

Figure M.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 180 psi from the Combined RCTS Tests

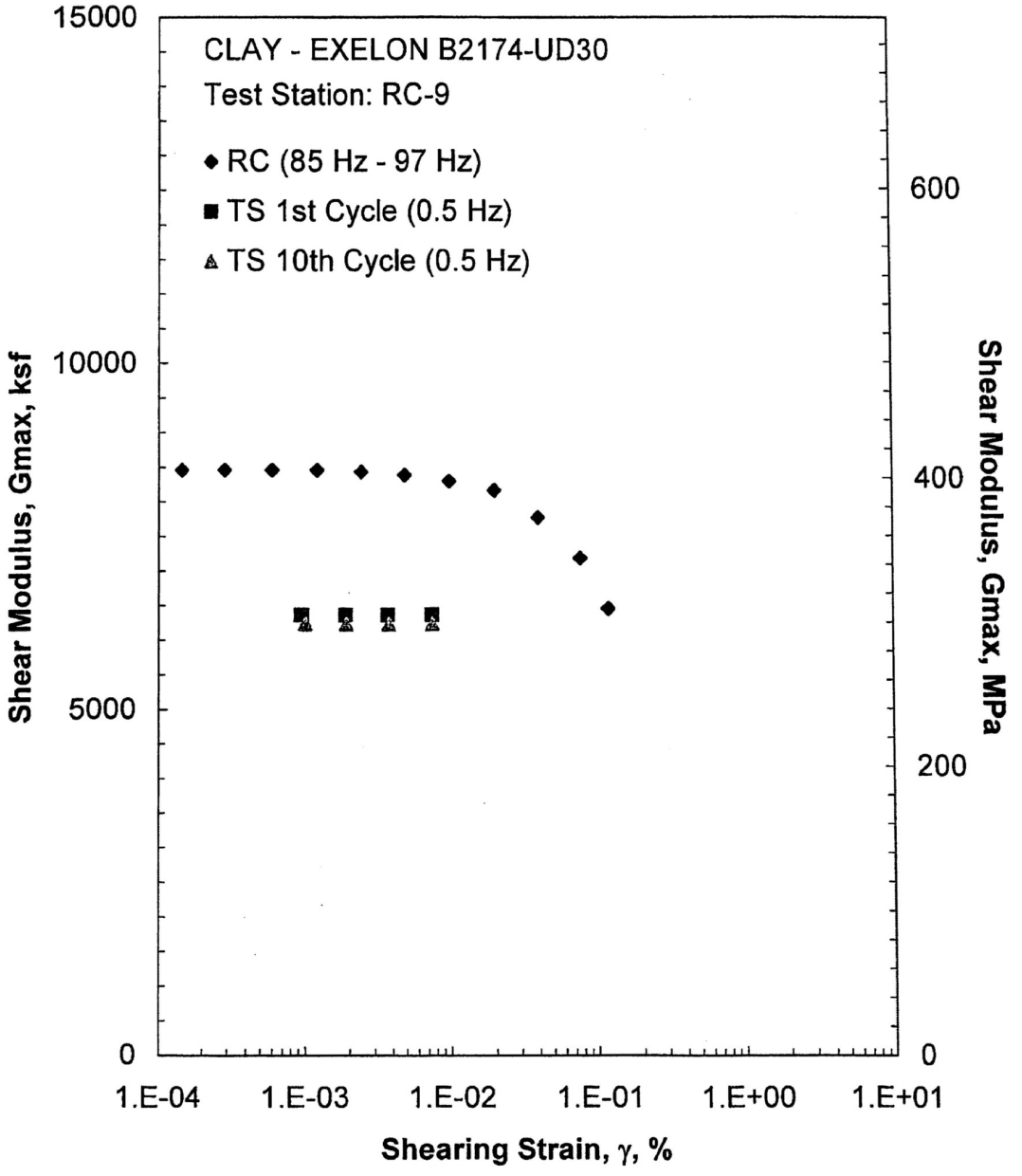

Figure M.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

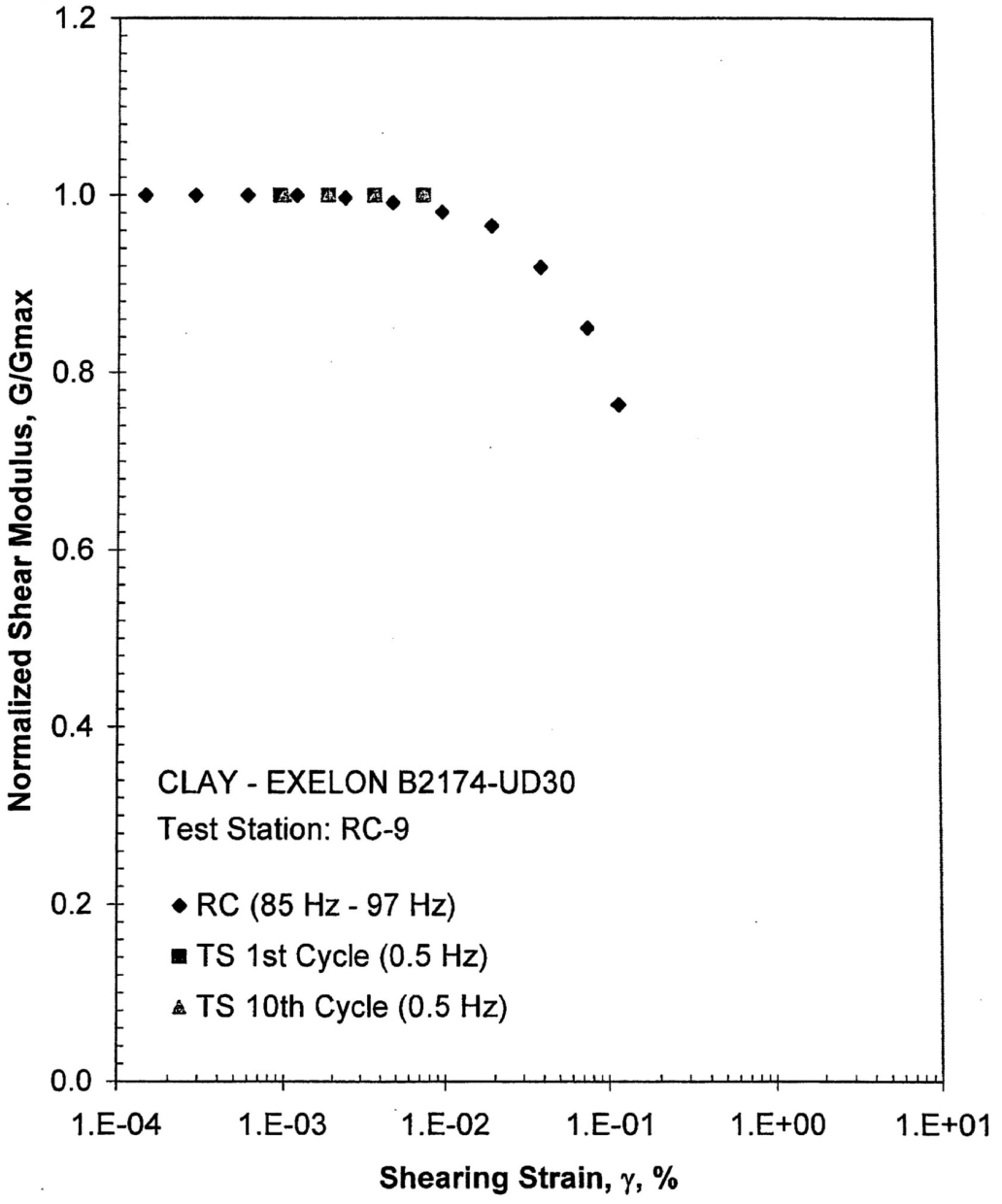

Figure M.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

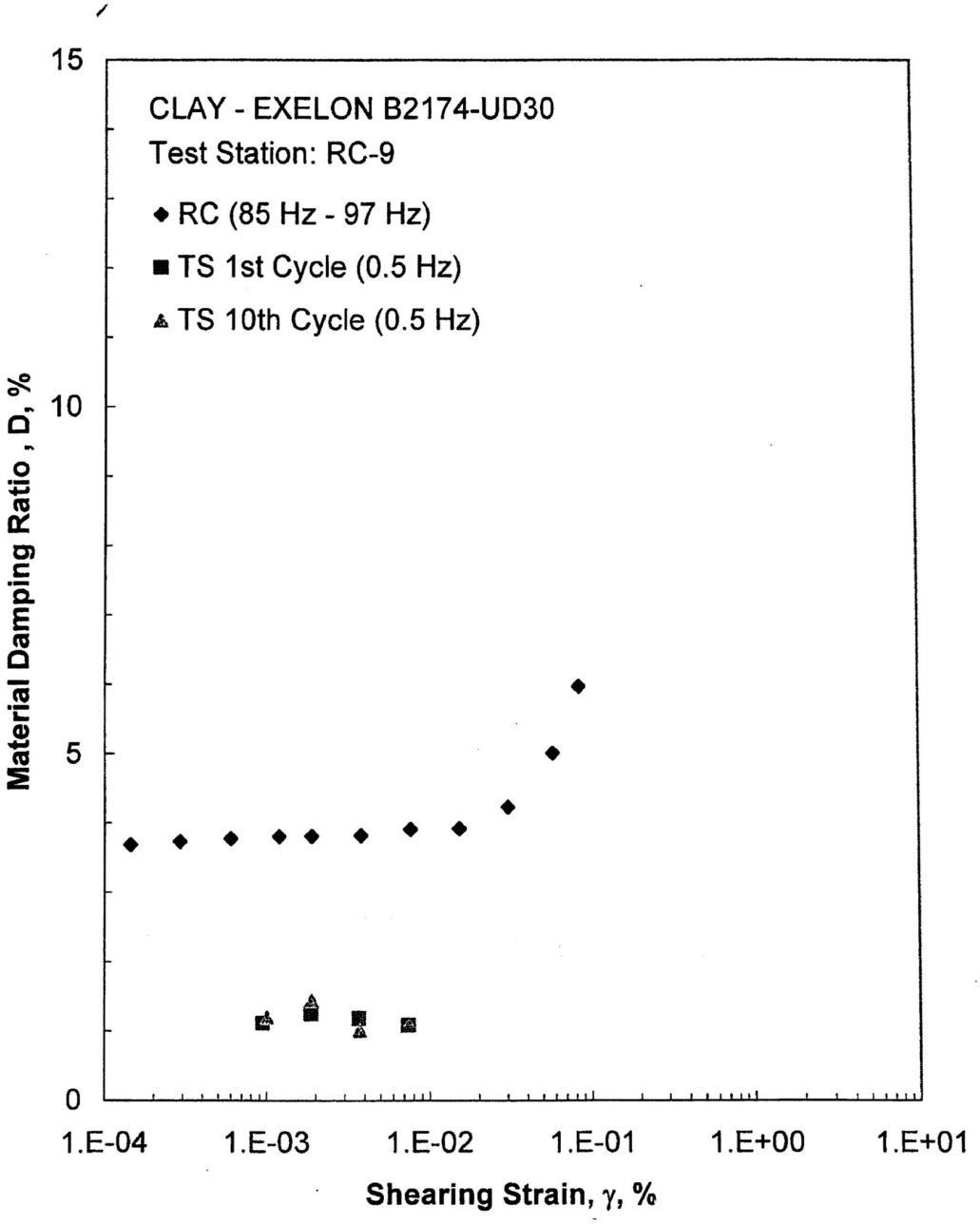

Figure M.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

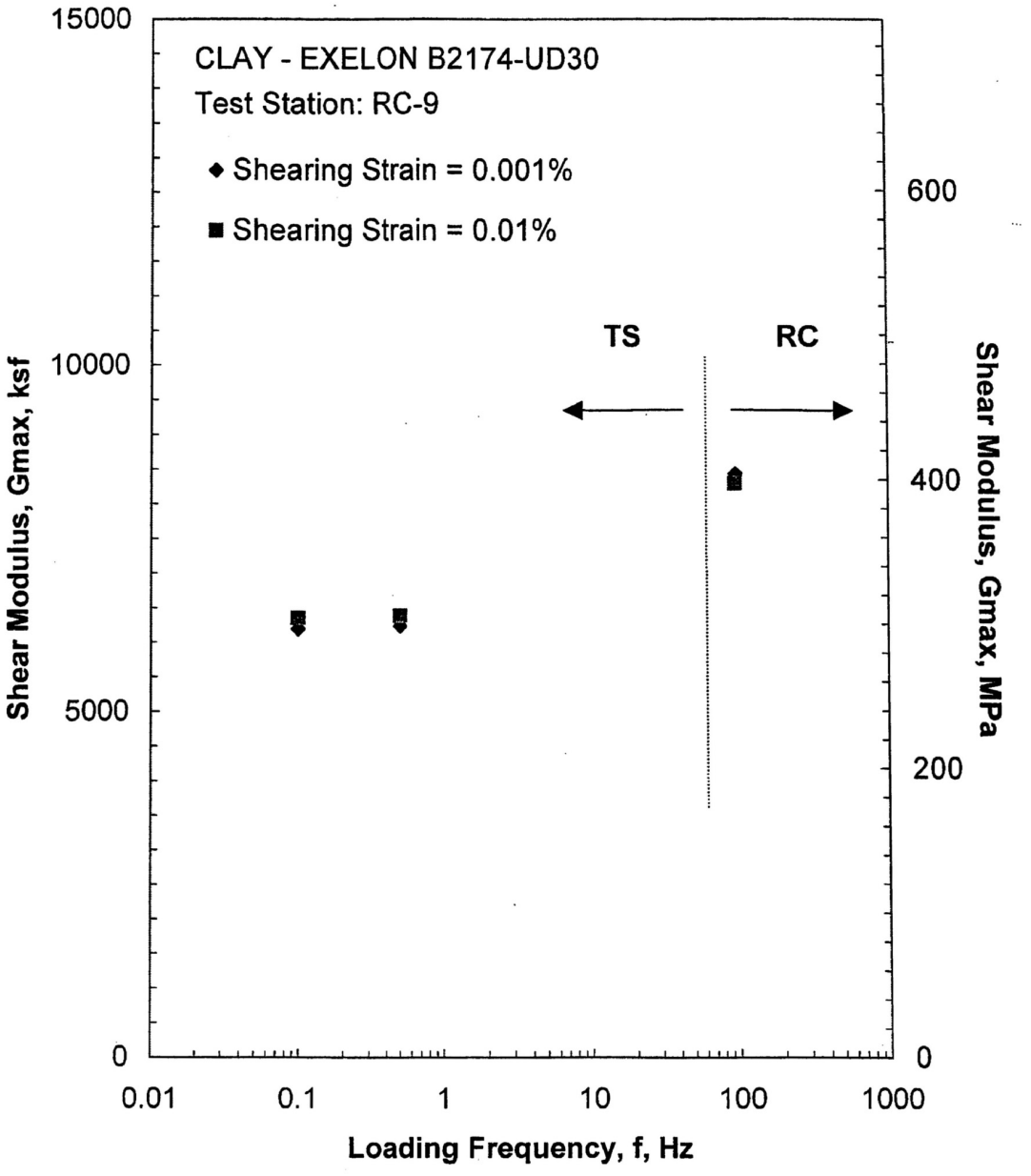

Figure M.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

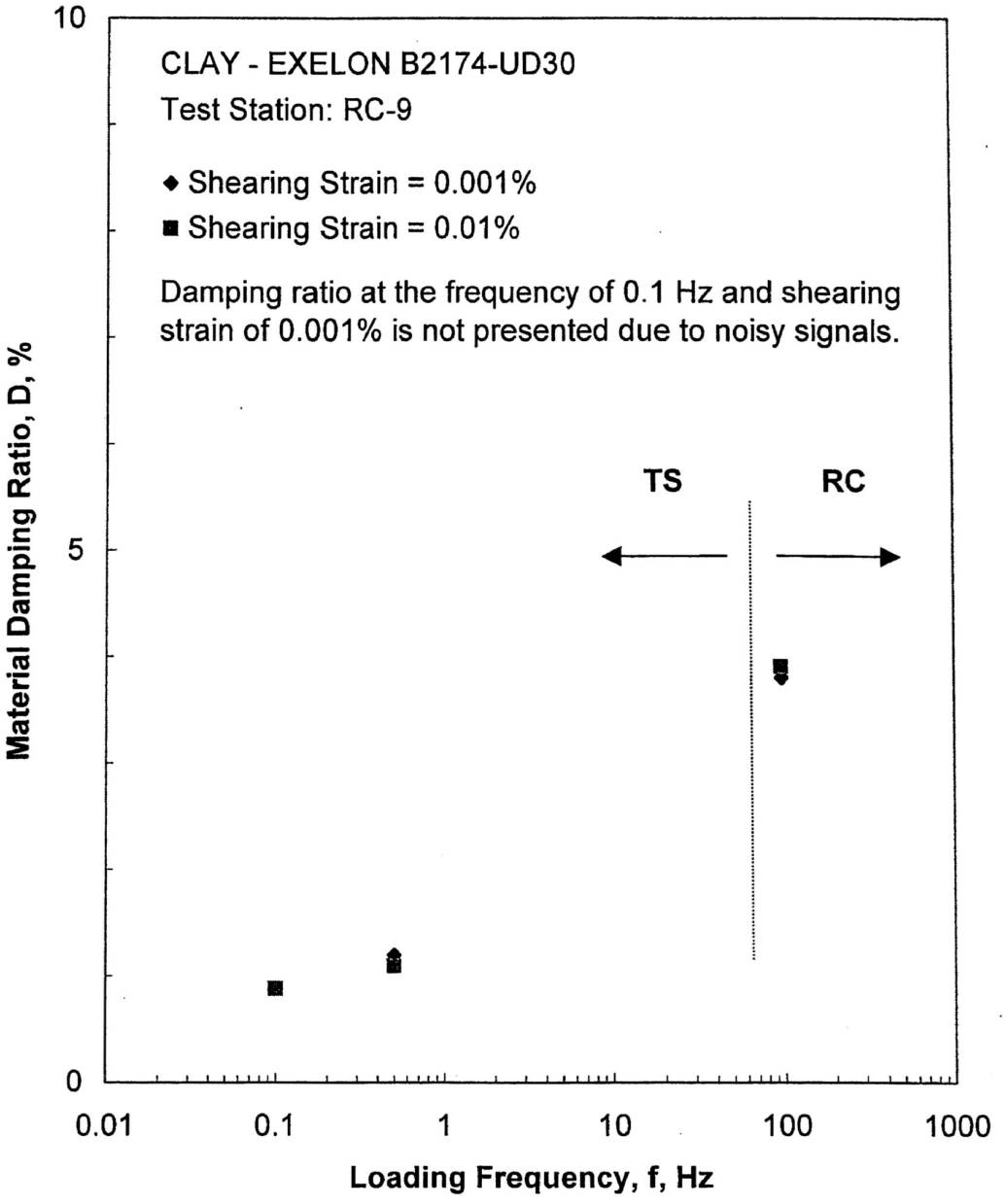

Figure M.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

Table M.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 B2174-UD30

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)	(%)	
45	6480	310	2930	141	858	5.00	0.65
90	12960	620	3744	180	965	4.64	0.63
180	25920	1240	5066	243	1115	4.04	0.61
359	51696	2474	7137	343	1310	3.82	0.58
455	65520	3135	8508	408	1422	3.72	0.56

Table M.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2174-UD30; Isoptropic Confining Pressure, σ_o=180 psi (25.9 ksf = 1240 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
2.09E-04	5223	1.00	2.09E-04	4.02
4.23E-04	5223	1.00	4.23E-04	4.05
8.54E-04	5223	1.00	8.54E-04	4.09
1.72E-03	5234	1.00	1.34E-03	4.10
3.46E-03	5200	0.99	2.70E-03	4.12
6.94E-03	5166	0.99	5.41E-03	4.13
1.40E-02	5098	0.97	1.08E-02	4.31
2.84E-02	4898	0.94	2.16E-02	4.53
5.73E-02	4531	0.87	4.18E-02	5.22
1.18E-01	3959	0.76	8.27E-02	6.03
2.48E-01	3283	0.63	1.61E-01	7.80

[+] 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 M.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2174-UD30; Isotropic Confining Pressure, σ_o= 180 psi (25.9 ksf =1240 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, %
9.62E-04	4010	1.00	0.93	9.38E-04	4052	1.00	0.78
1.95E-03	4010	1.00	1.05	1.94E-03	4052	1.00	1.16
3.87E-03	4010	1.00	0.97	3.85E-03	4052	1.00	0.92
9.72E-03	4010	1.00	1.12	9.69E-03	4039	1.00	1.16

Table M.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2174-UD30; Isoptropic Confining Pressure, σ_o= 455 psi (65.5 ksf = 3135 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
1.44E-04	8457	1.00	1.44E-04	3.69
2.88E-04	8457	1.00	2.88E-04	3.74
6.00E-04	8457	1.00	6.00E-04	3.77
1.20E-03	8457	1.00	1.20E-03	3.80
2.40E-03	8433	1.00	1.89E-03	3.81
4.81E-03	8386	0.99	3.80E-03	3.82
9.69E-03	8295	0.98	7.66E-03	3.91
1.95E-02	8166	0.97	1.52E-02	3.91
3.93E-02	7774	0.92	3.03E-02	4.23
7.68E-02	7187	0.85	5.76E-02	5.01
1.18E-01	6456	0.76	8.41E-02	5.97

[+] 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 M.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2174-UD30; Isotropic Confining Pressure, σ_o=455 psi (65.5 ksf = 3135 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, %
9.48E-04	6366	1.00	1.11	1.01E-03	6234	1.00	1.19
1.88E-03	6366	1.00	1.24	1.89E-03	6234	1.00	1.43
3.69E-03	6366	1.00	1.18	3.74E-03	6234	1.00	1.00
7.43E-03	6366	1.00	1.08	7.46E-03	6234	1.00	1.09

FUGRO CONSULTANTS, INC.

6100 Hillcroft (77081)
P.O. Box 740010
Houston, Texas 77274
Tel: 713-369-5400
Fax: 713-369-5518

June 19, 2008

Ms. Siesta Williams
MACTEC
3301 Atlantic Avenue
Raleigh, NC 27604

RE: Two (2) Reports For The EXELON COL Project

Dear Ms. Williams:

Fugro has completed two (2) RCTS tests, which are B2182-UD14 and B2274-UD24 for the EXELON project. Fugro has incorporated, as needed, Dr. Kenneth Stokoe's comments into the final reports. The final reports and the associated RCTS Test Approvals by Dr. Kenneth Stokoe have been attached.

Please let us know if you have questions. Thanks.

Very truly yours,

Fugro Consultants, Inc.

Jiewu Meng, PhD, P.E.
Project Engineer

Bill DeGroff, P.E.
Laboratory Department Manager

Enclosures

Cc: Kathryn White, in PDF

RCTS TEST APROVAL

PROJECT SITE/NAME	EXELON

Test ID	Sample ID	Depth B.S. (Ft)	Approved By (Initials)	Date
RCTS#N	B2182-UD14	124.7	KHS (F)	15 June 08
RCTS#O	B2274-UD24	481.1	KHS (X)	15 June 08

Two RCTS tests for the site referenced above were tested, and two reports were prepared, by Fugro Consultants, Inc.

I have reviewed the data and associated results listed above and found them to be reasonable.

Approved By:

K. H. Stokoe II

Dr. Kenneth Stokoe

(F) very nice results

(X) see notes on some figures for minor comments and suggestions

APPENDIX N

Specimen B2182-UD14
(Index properties not available)

Borehole B2182
Sample UD14
Depth = 124.7 ft (38.0 m)
Total Unit Weight = 124.9 lb/ft^3
Water Content = 22.2 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 50 psi

FUGRO JOB #: 0401-1686
Testing Station: RC7

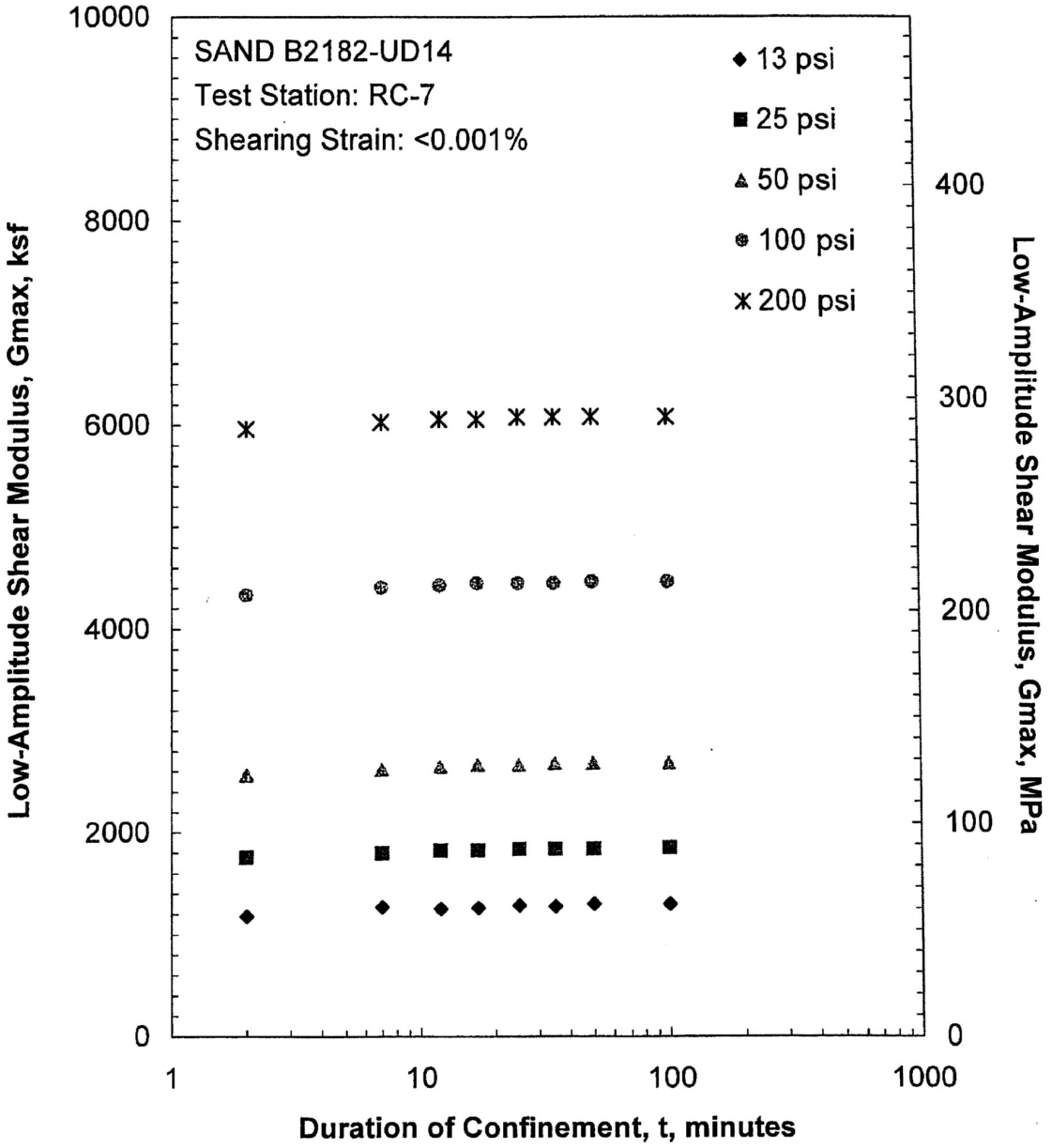

Figure N.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

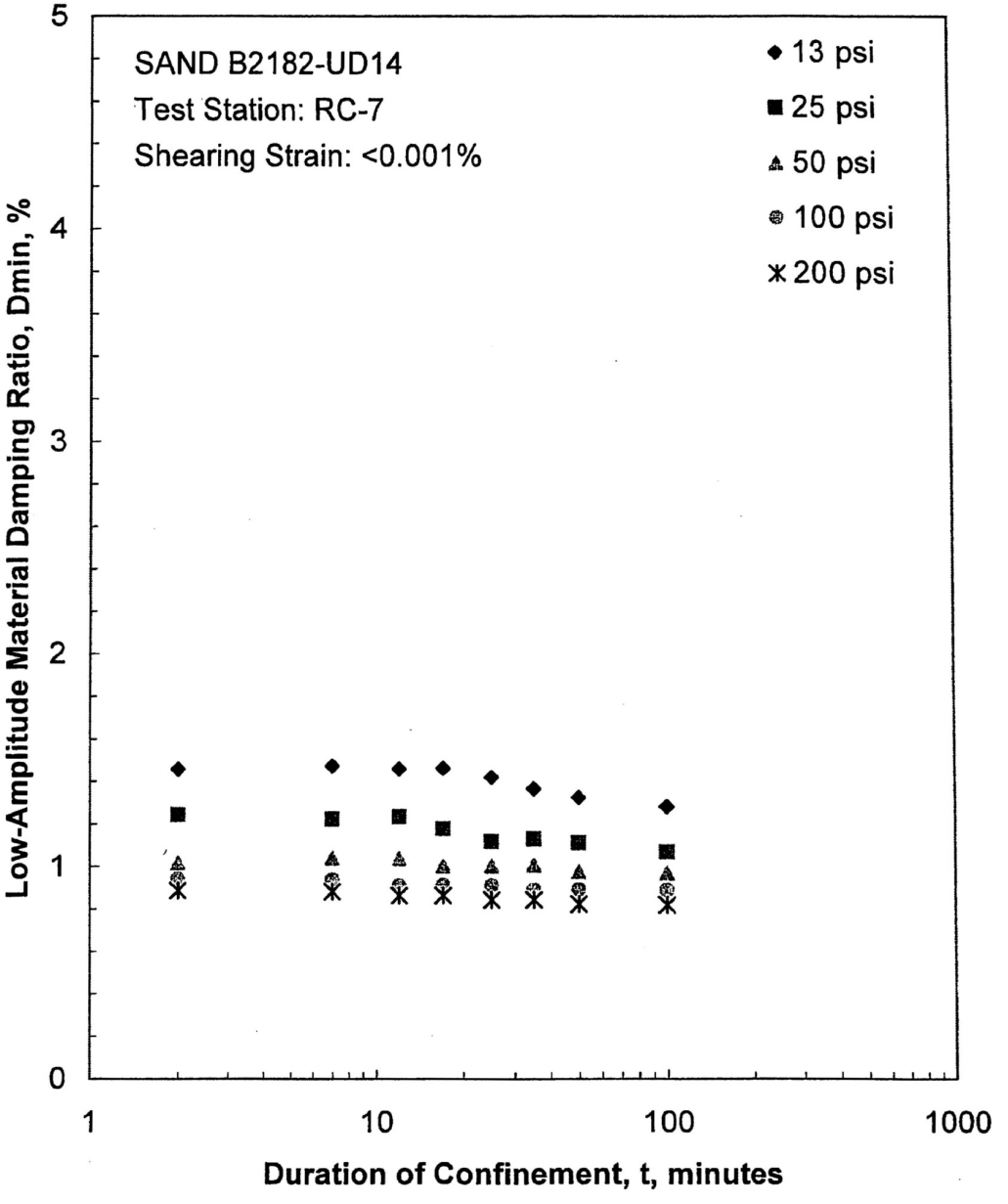

Figure N.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

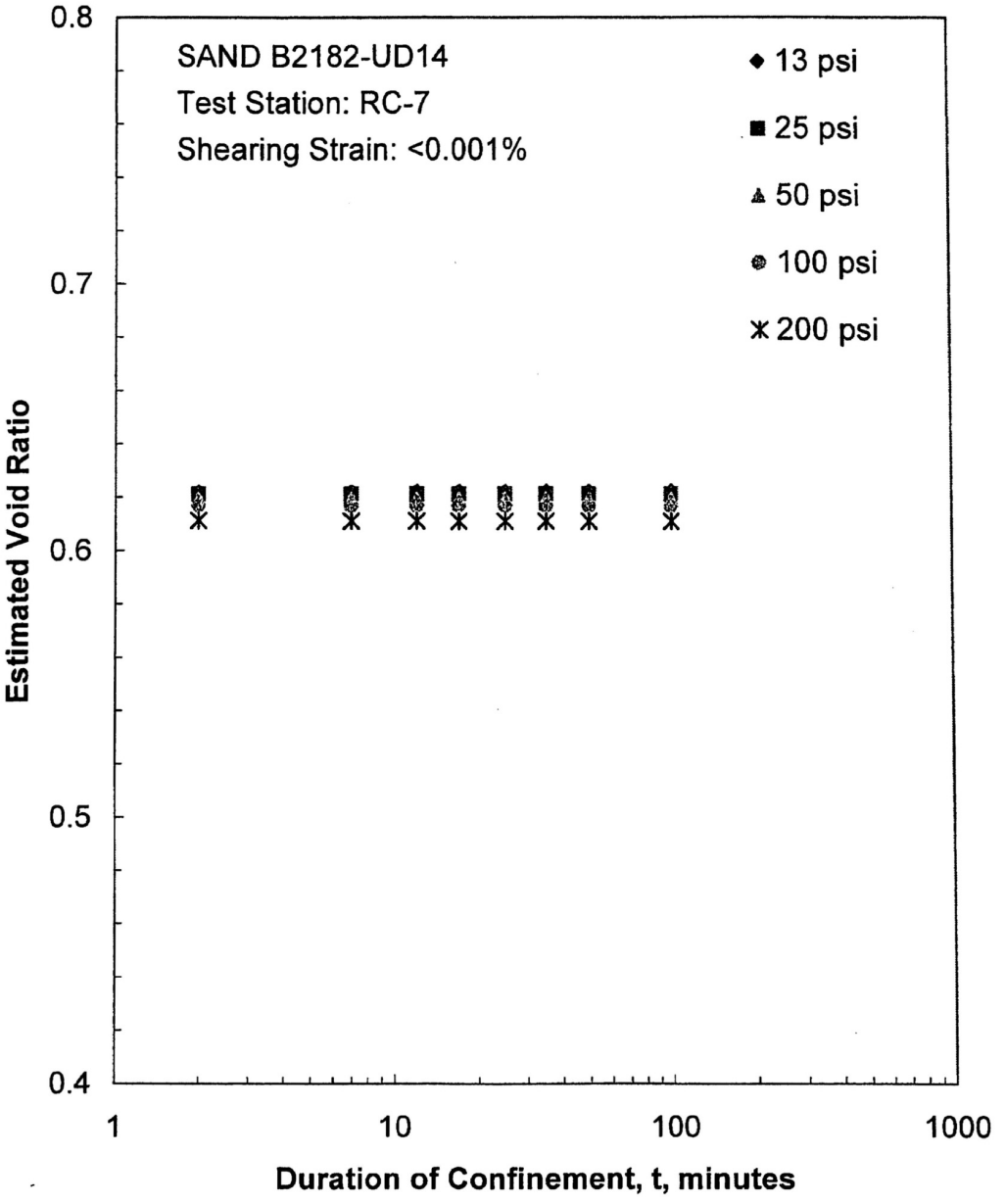

Figure N.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

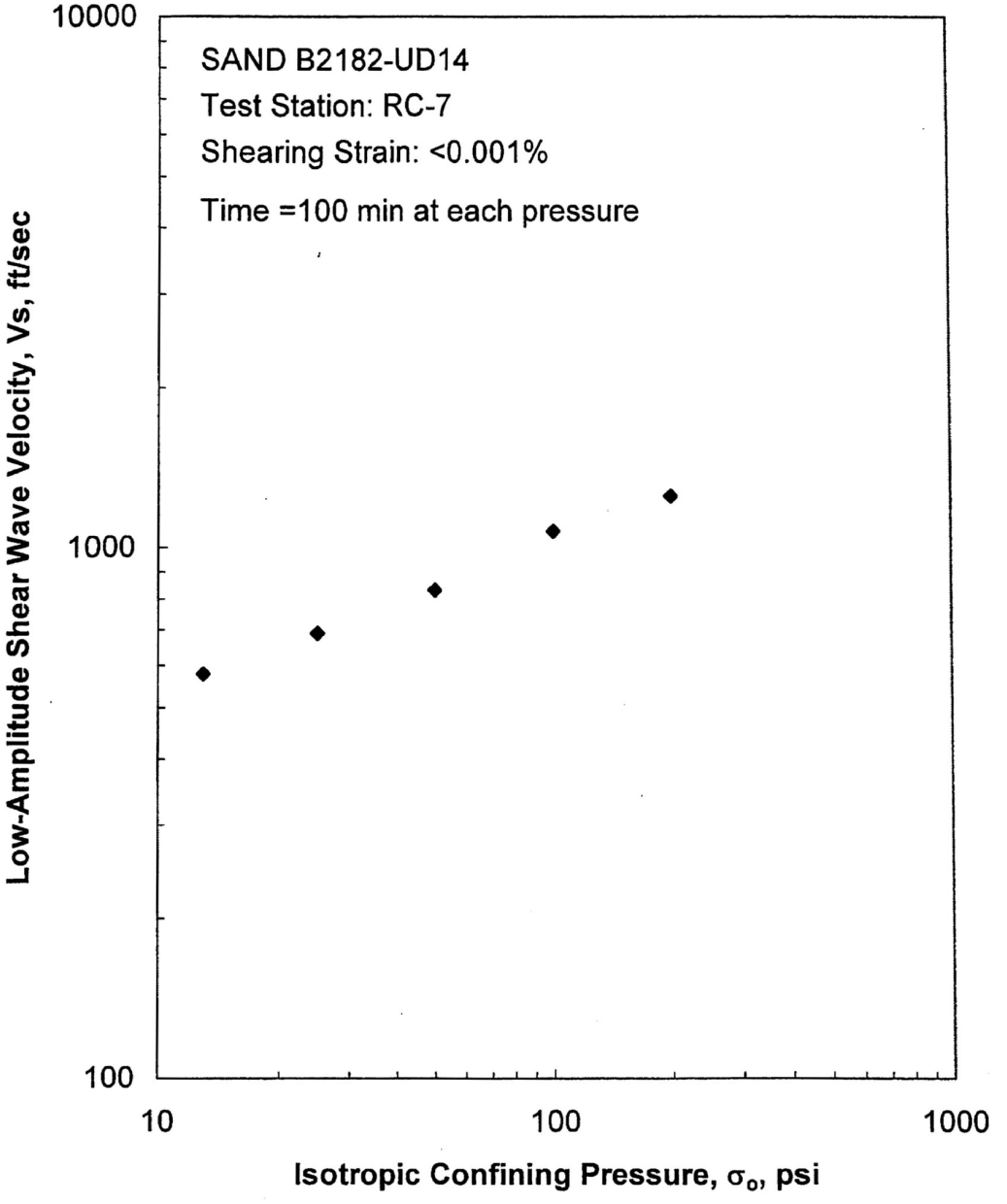

Figure N.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

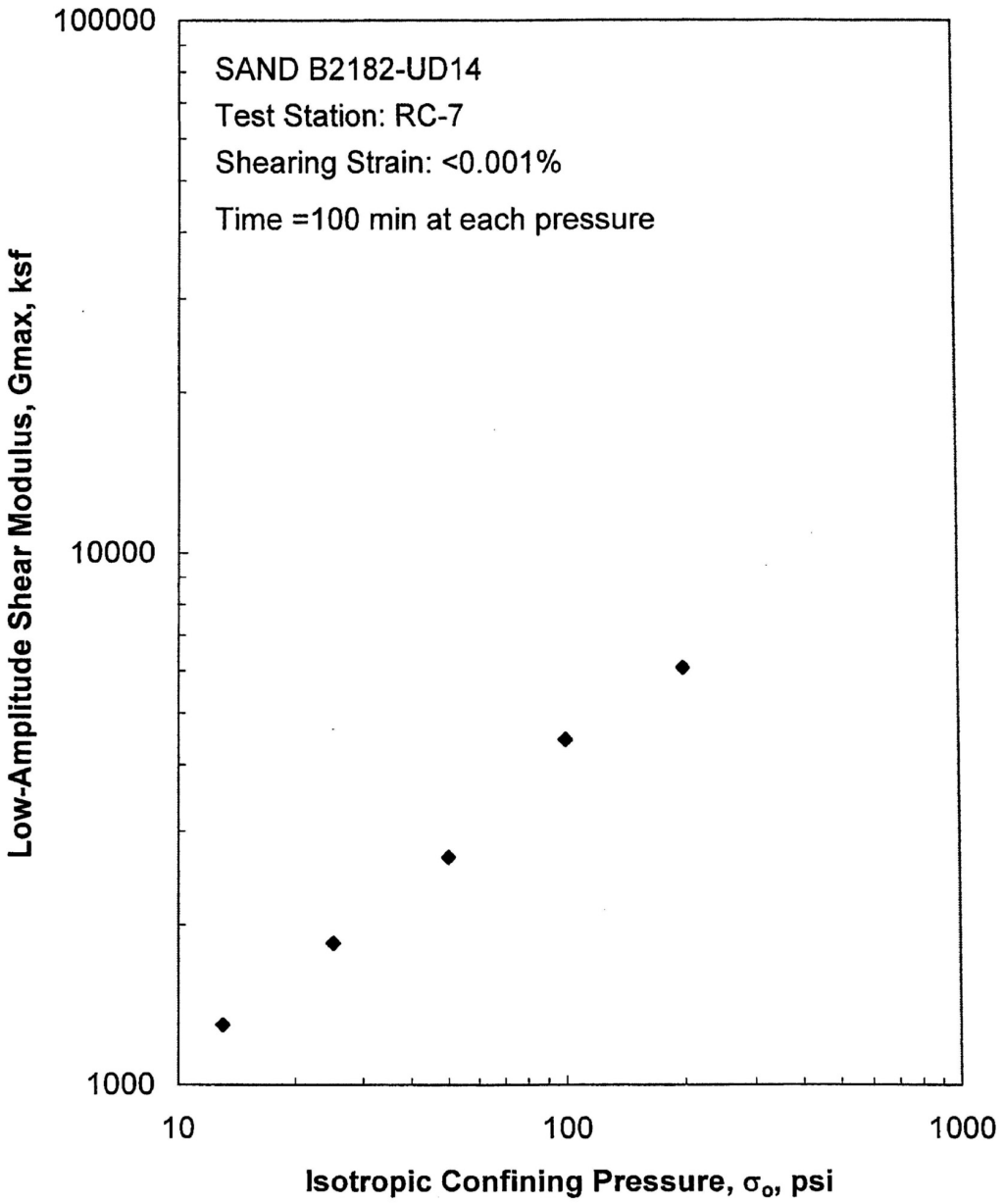

Figure N.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

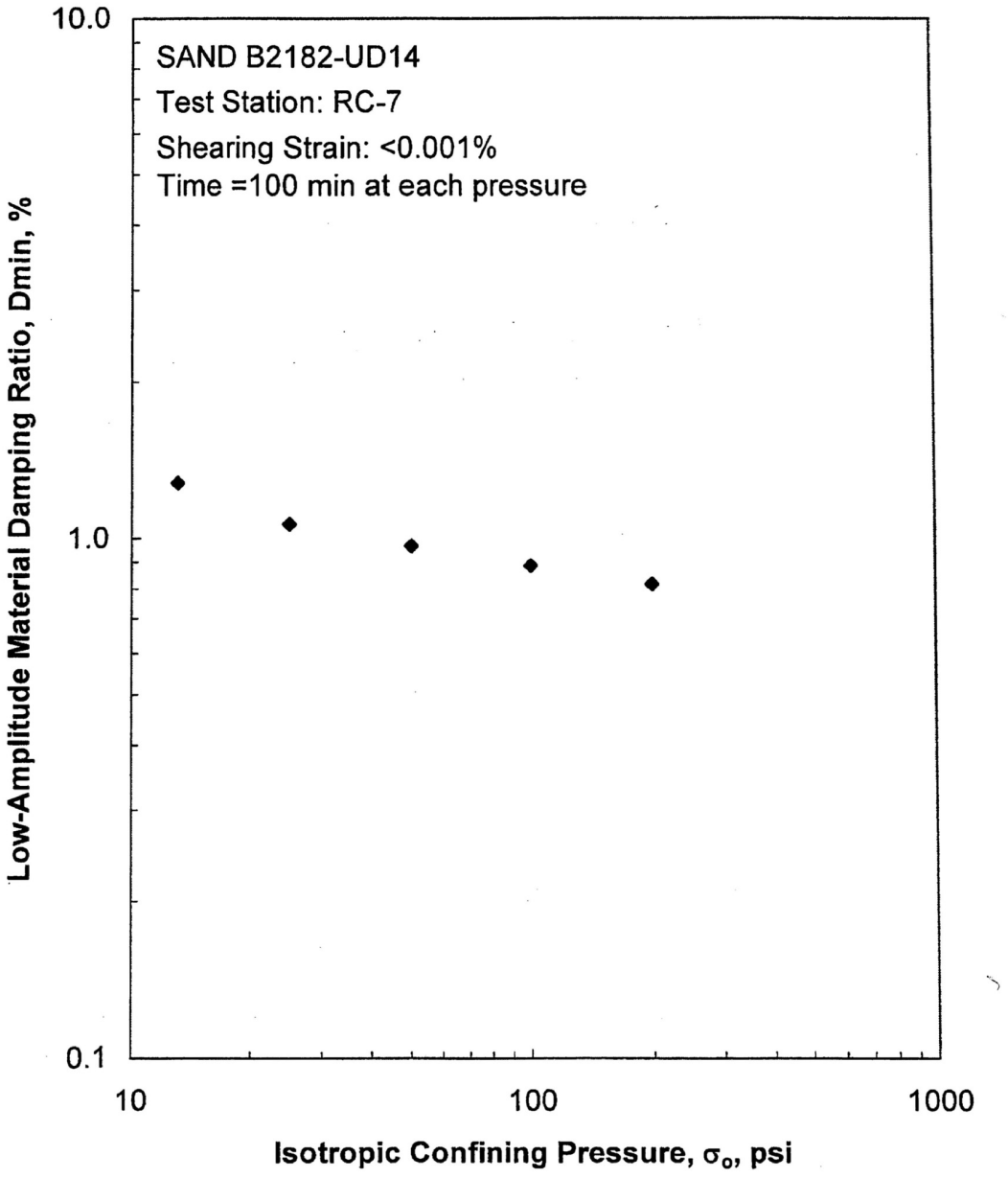

Figure N.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

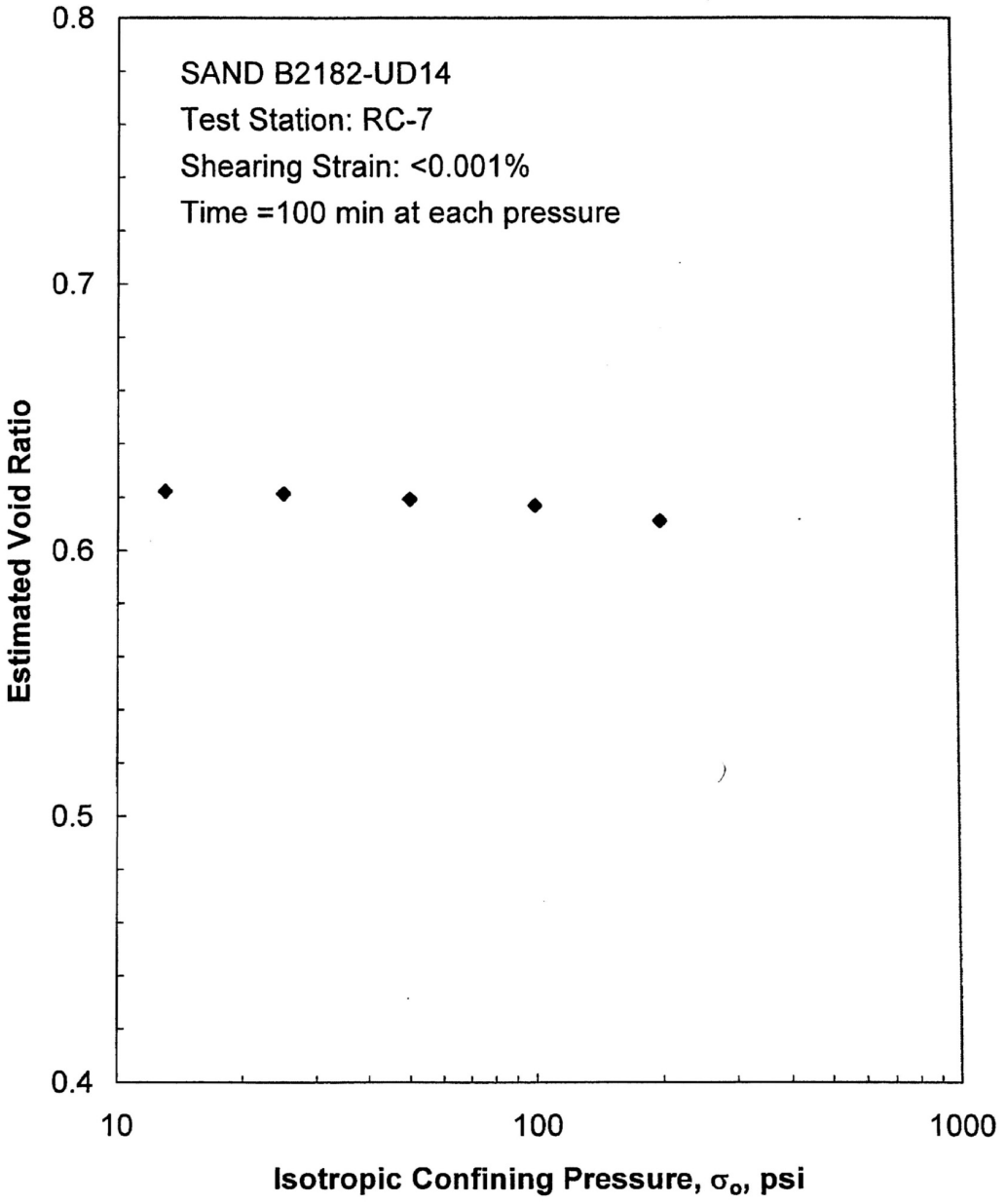

Figure N.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

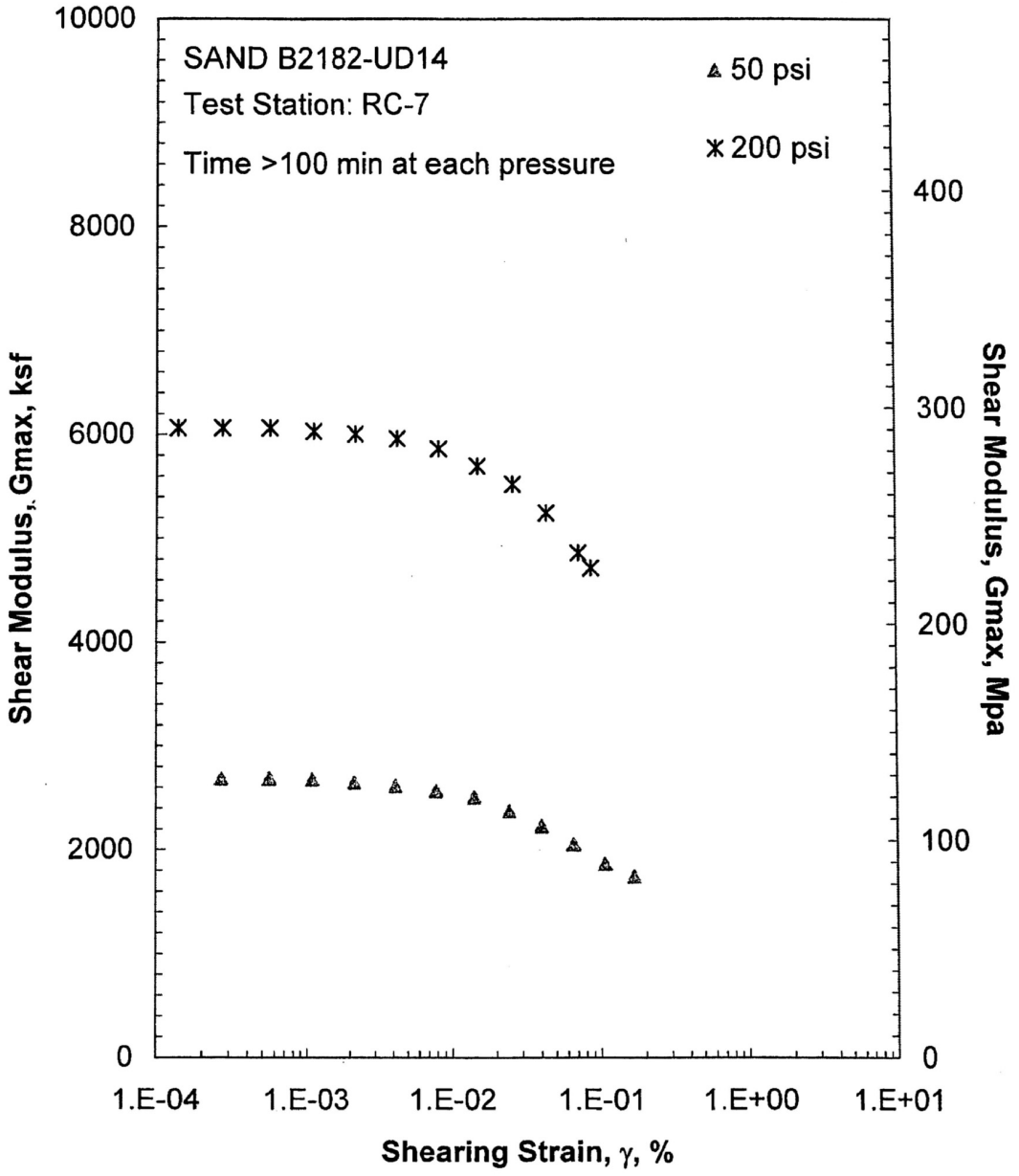

Figure N.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

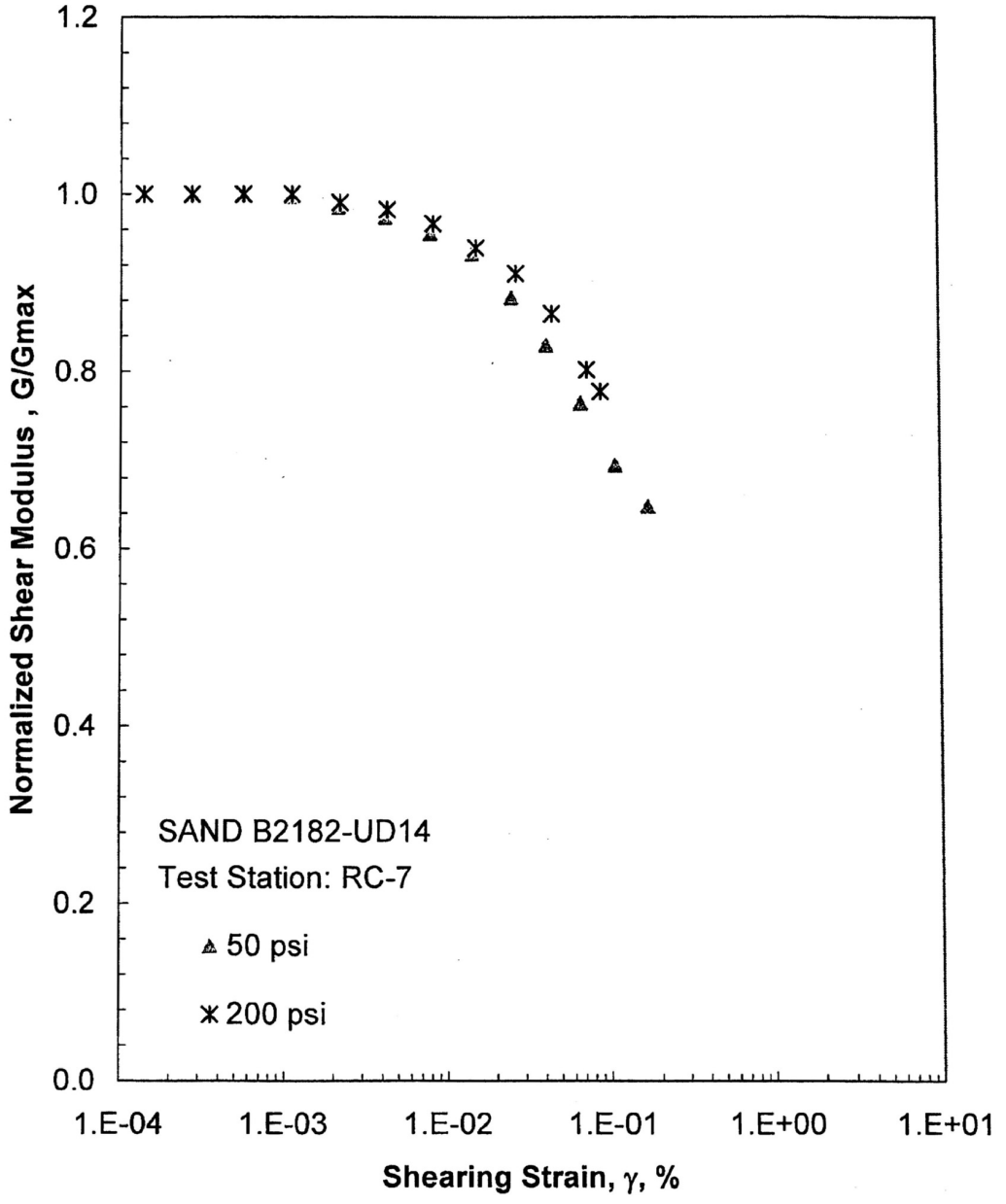

Figure N.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

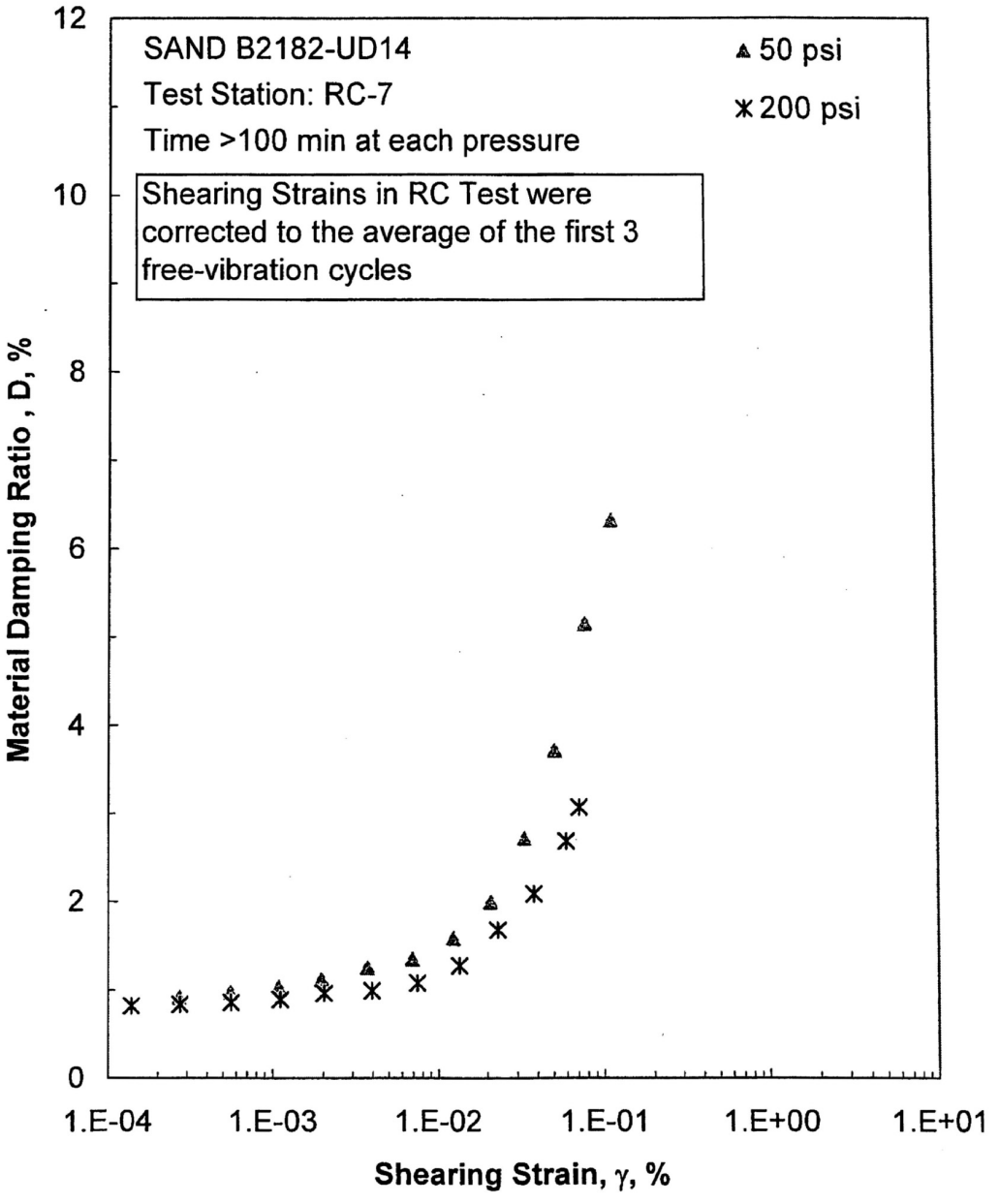

Figure N.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

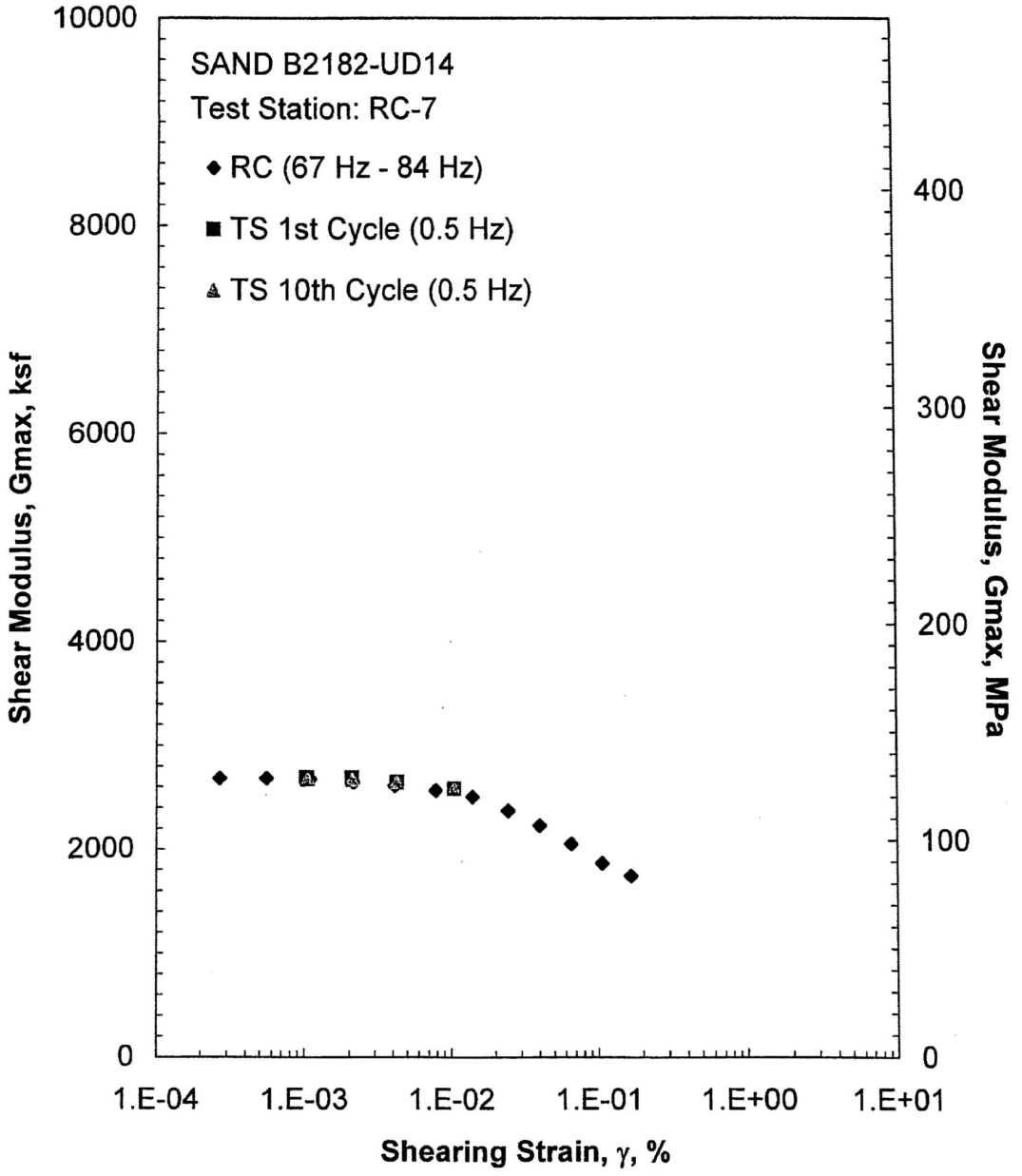

Figure N.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 50 psi from the Combined RCTS Tests

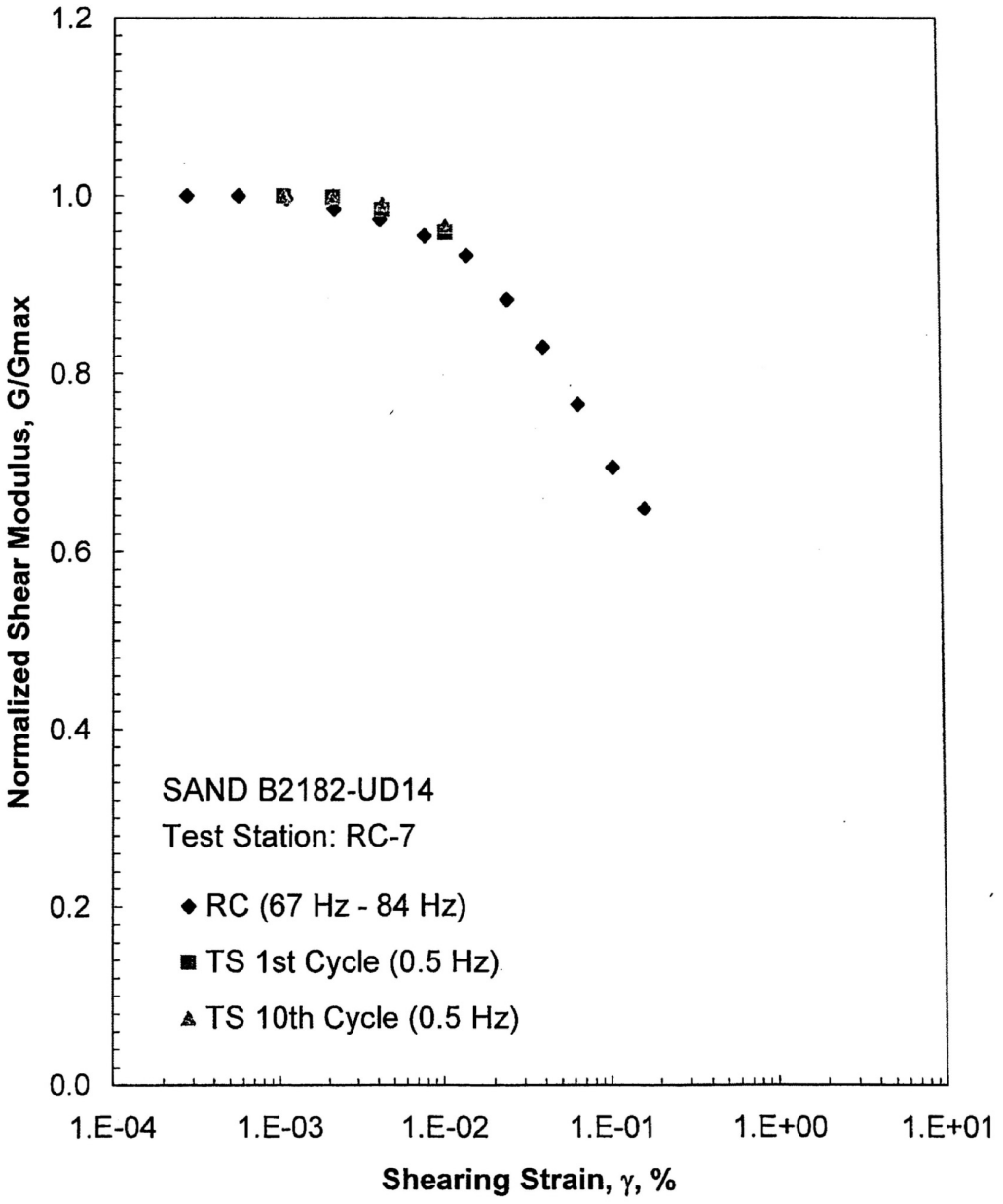

Figure N.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 50 psi from the Combined RCTS Tests

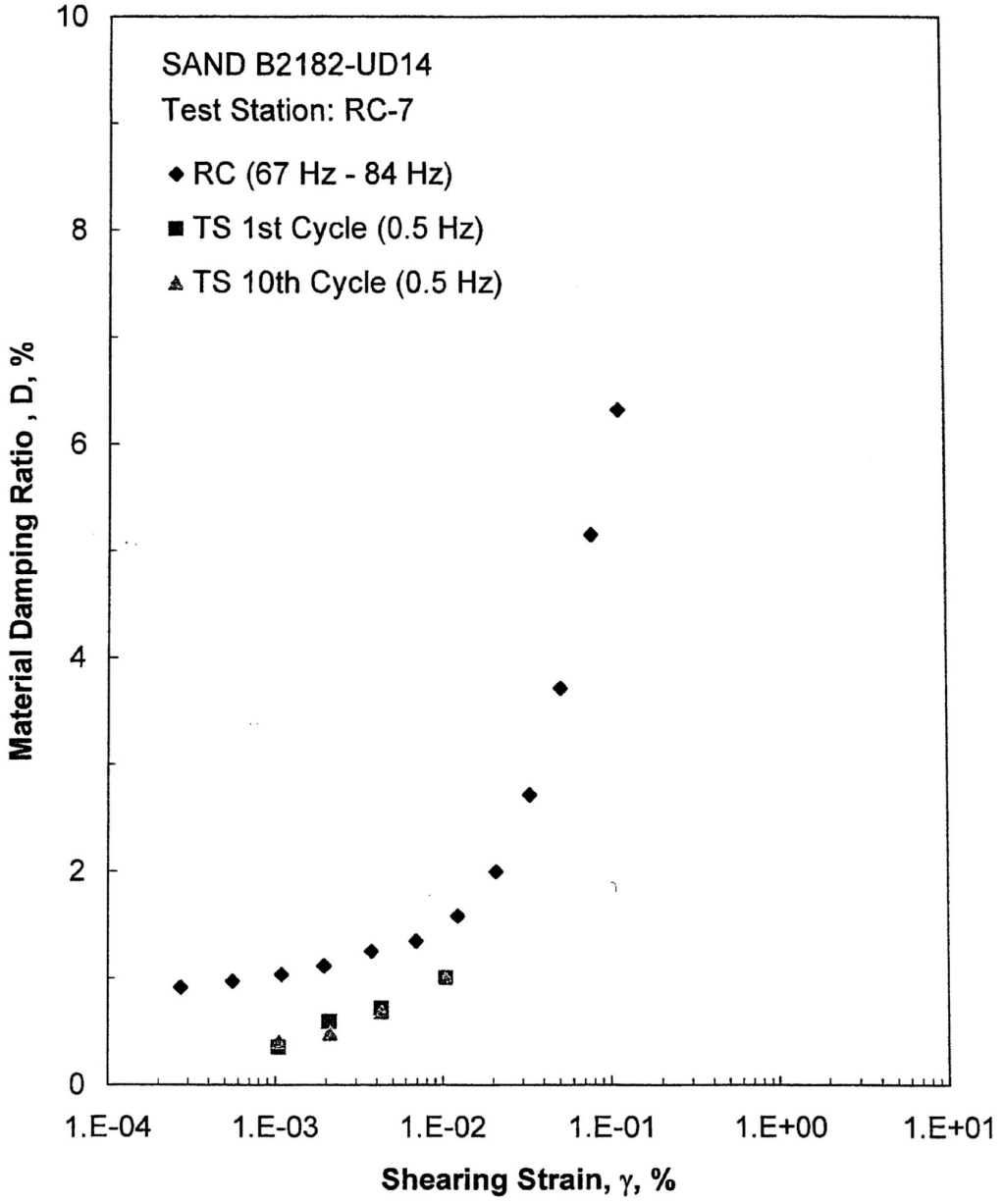

Figure N.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 50 psi from the Combined RCTS Tests

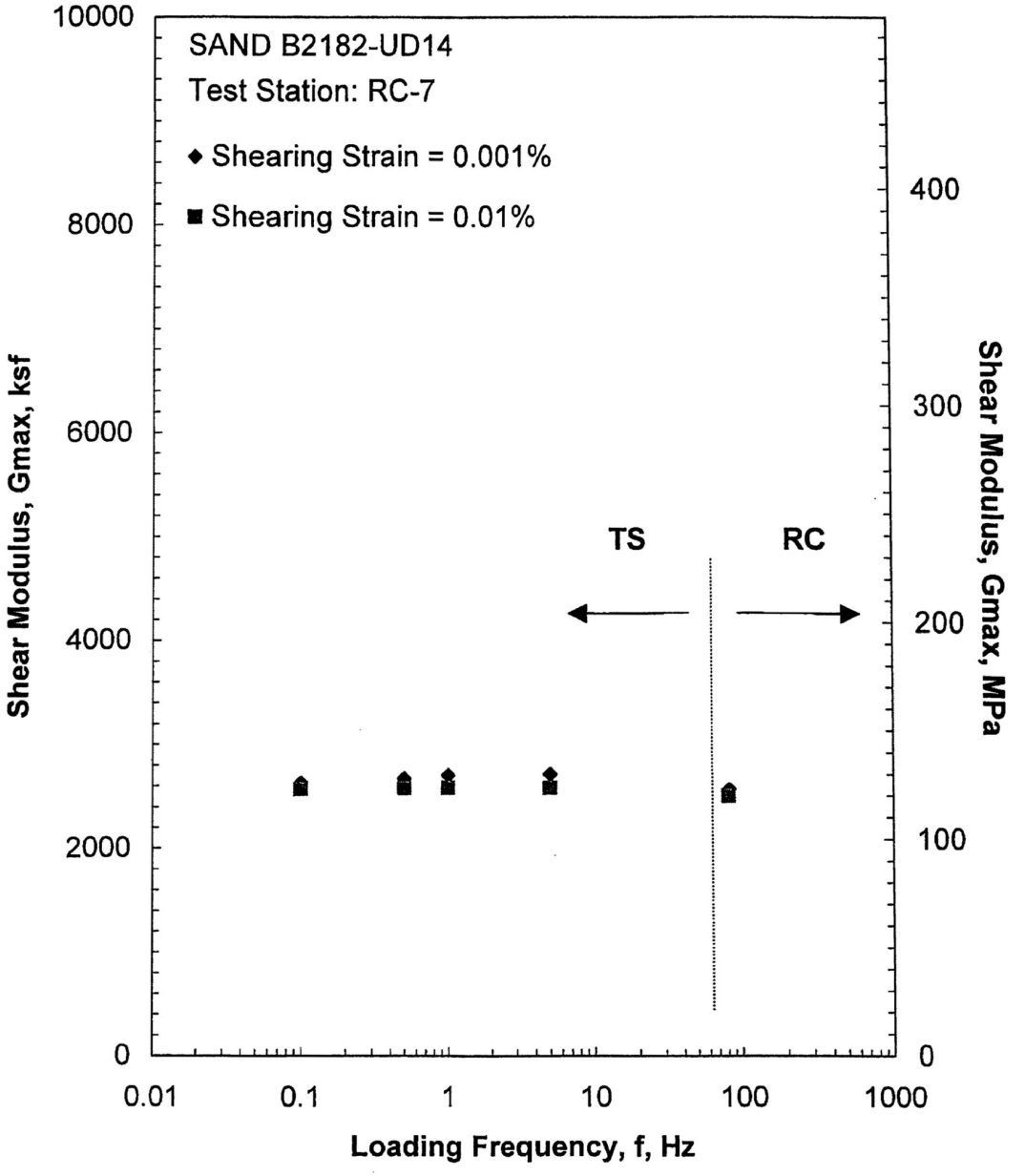

Figure N.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 50 psi from the Combined RCTS Tests

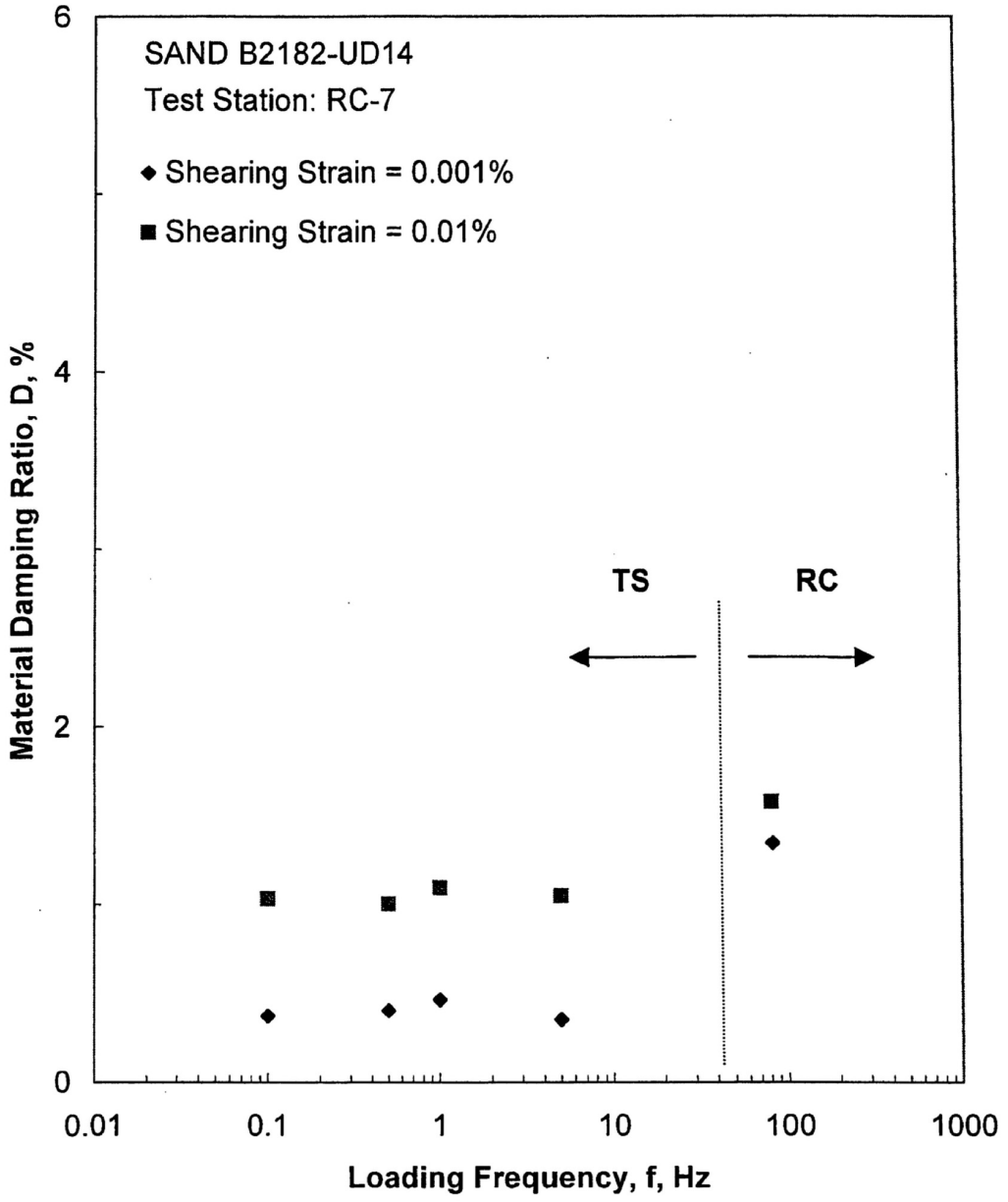

Figure N.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 50 psi from the Combined RCTS Tests

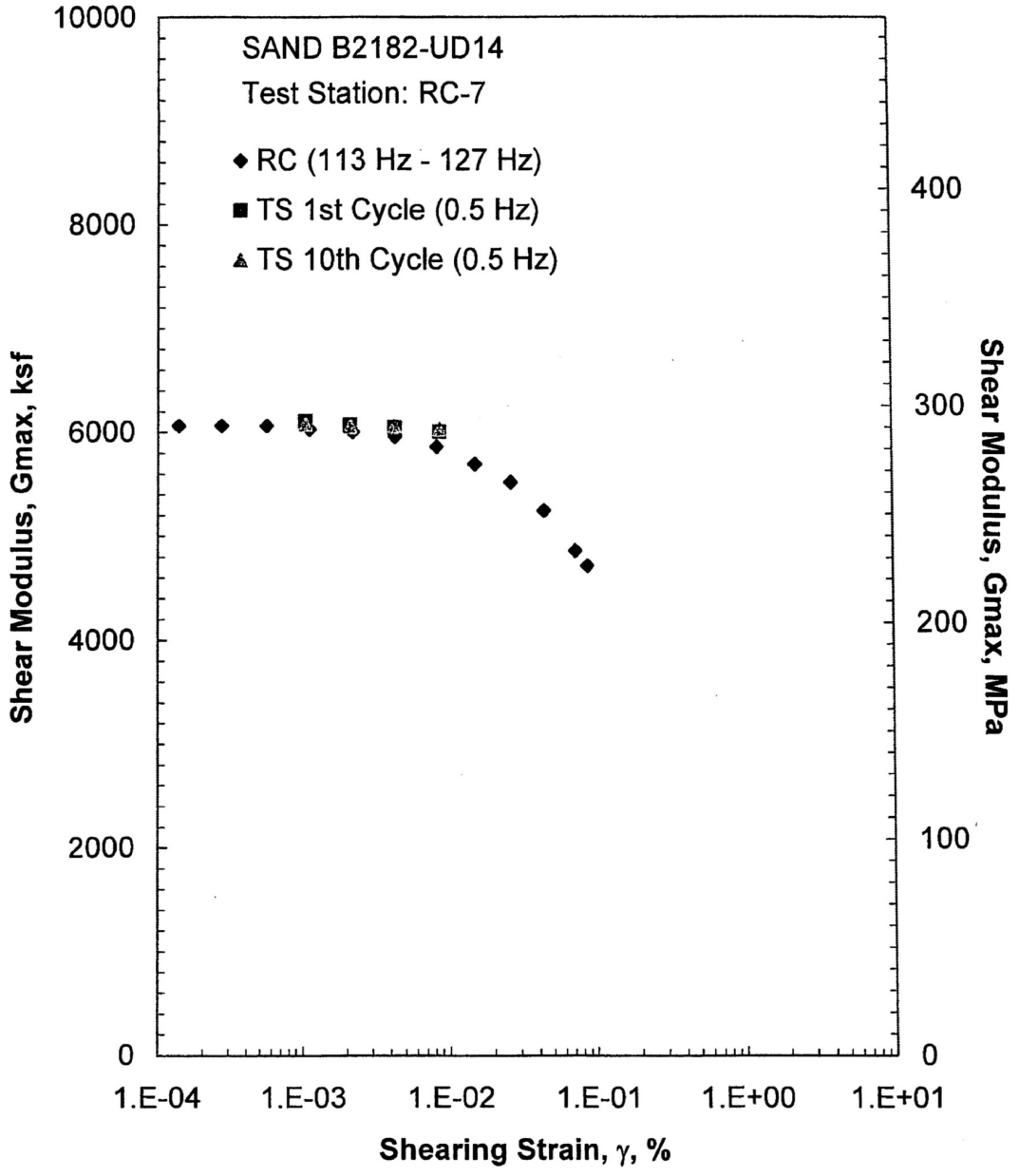

Figure N.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 200 psi from the Combined RCTS Tests

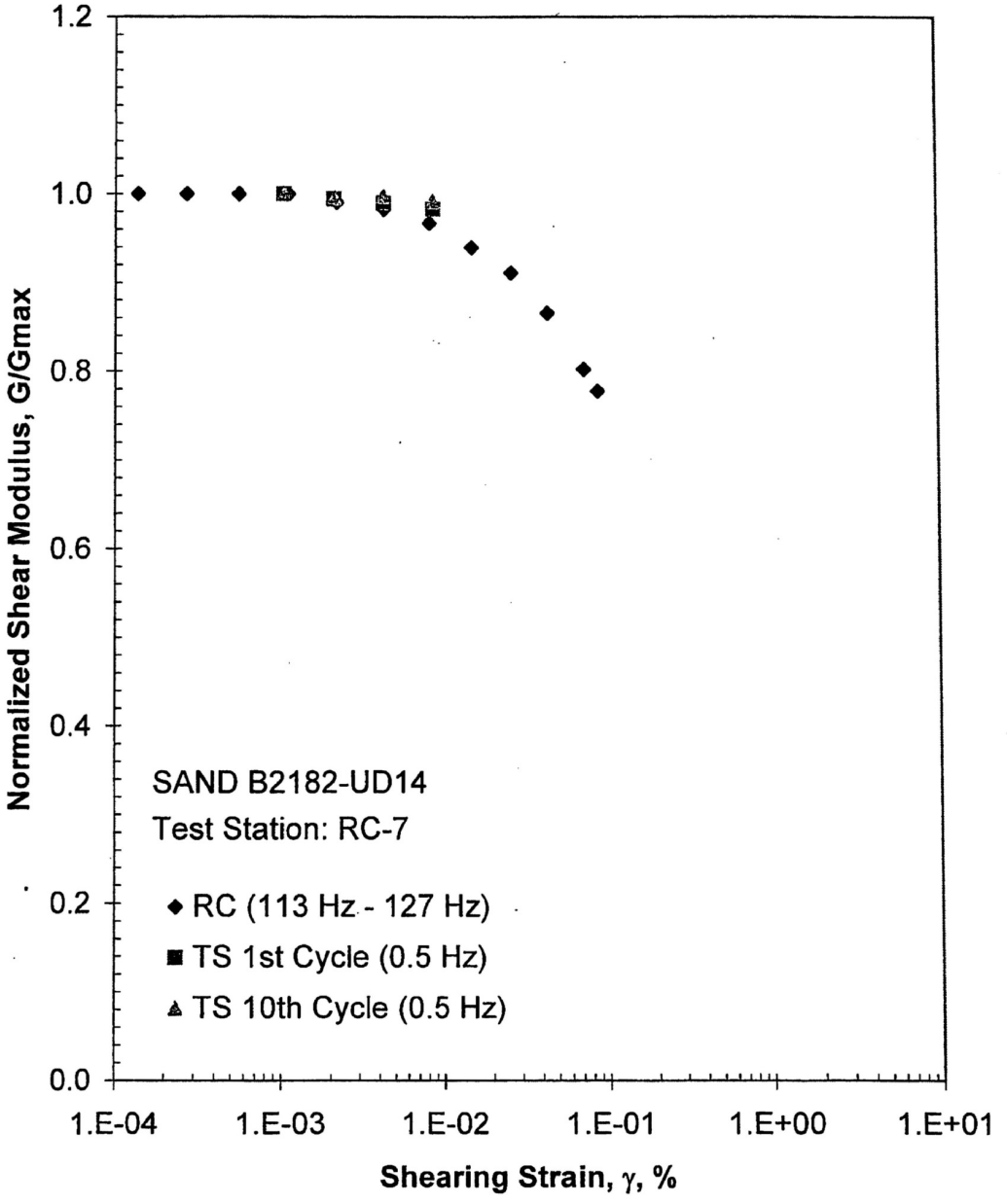

Figure N.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 200 psi from the Combined RCTS Tests

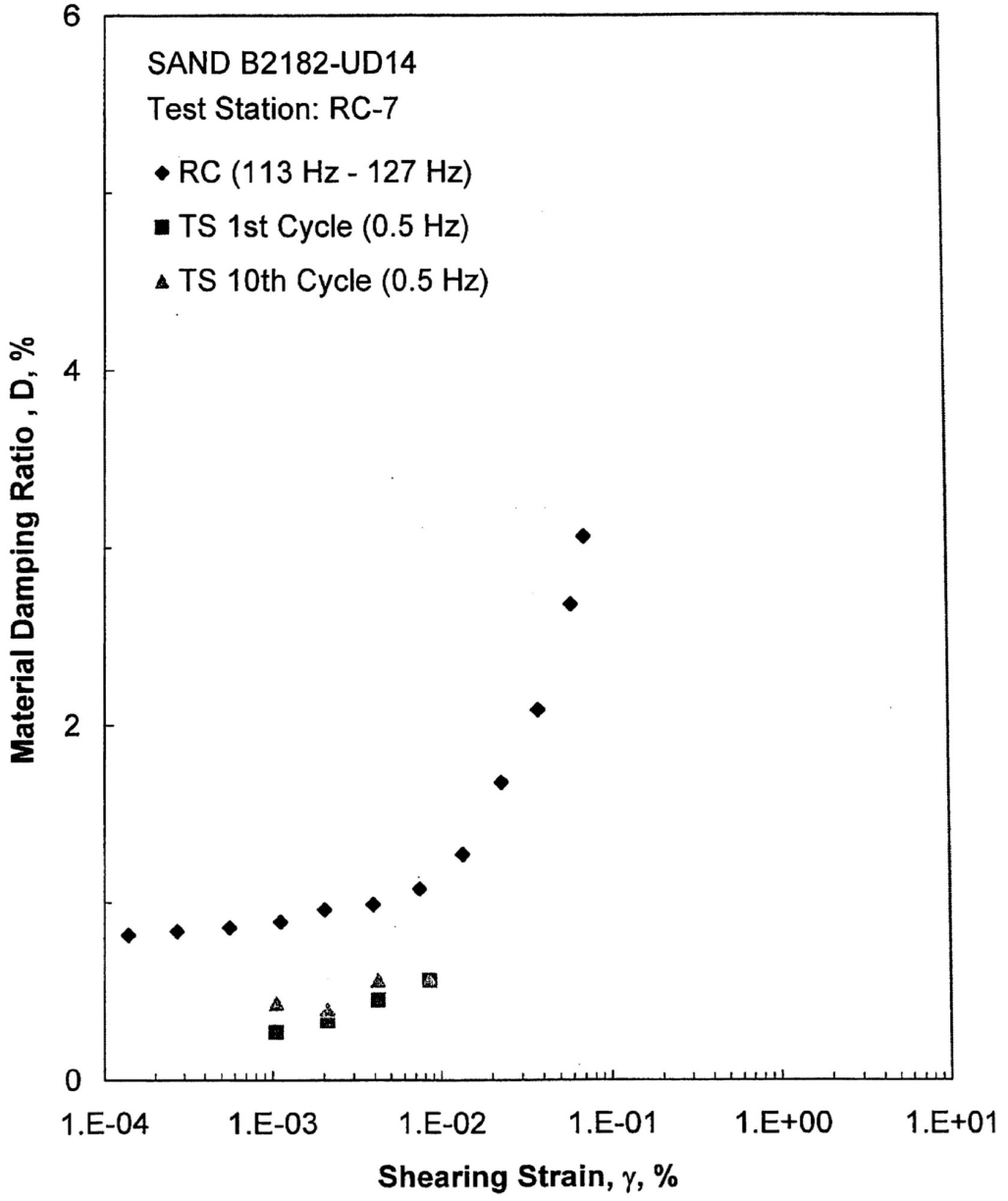

Figure N.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 200 psi from the Combined RCTS Tests

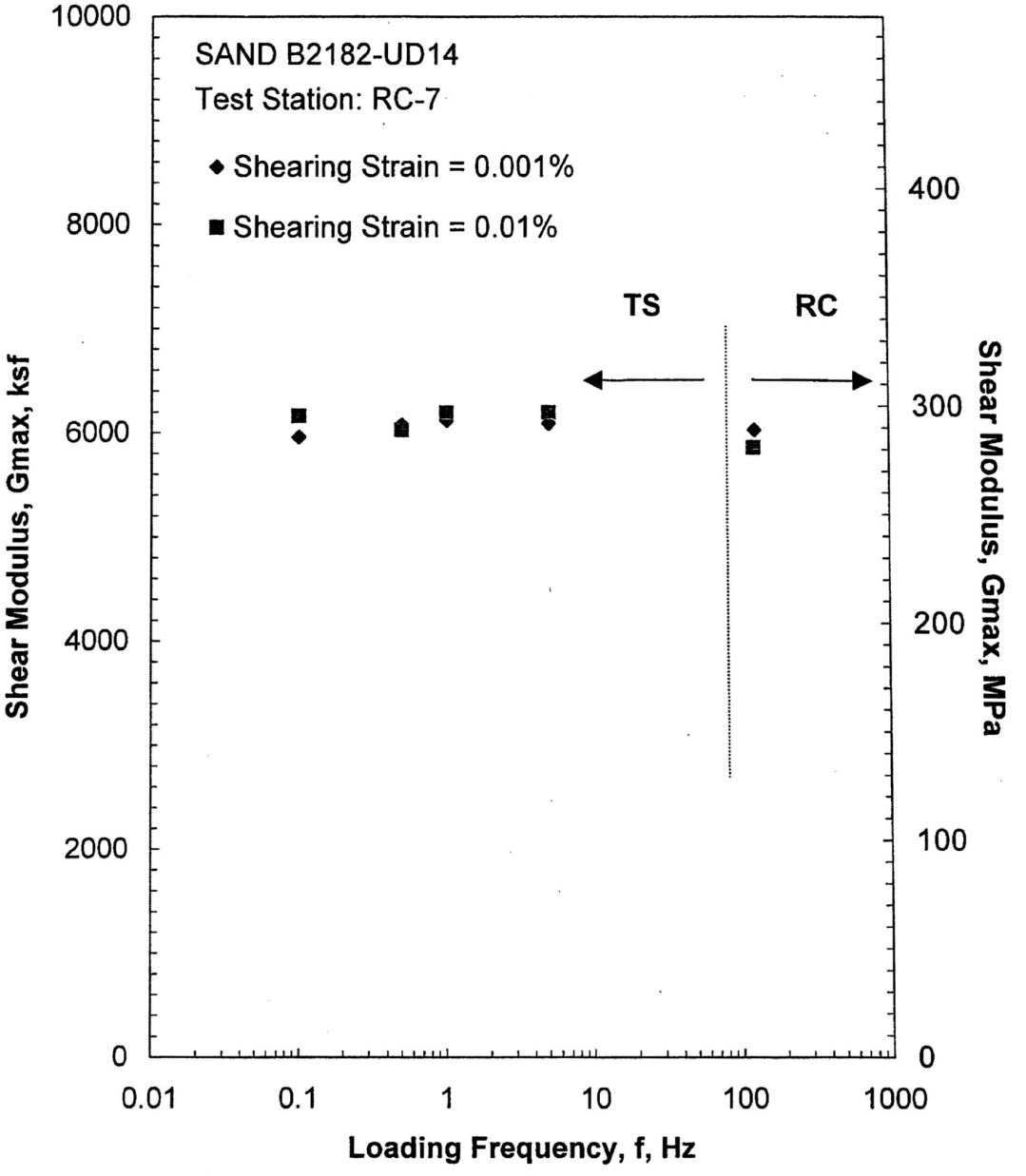

Figure N.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 200 psi from the Combined RCTS Tests

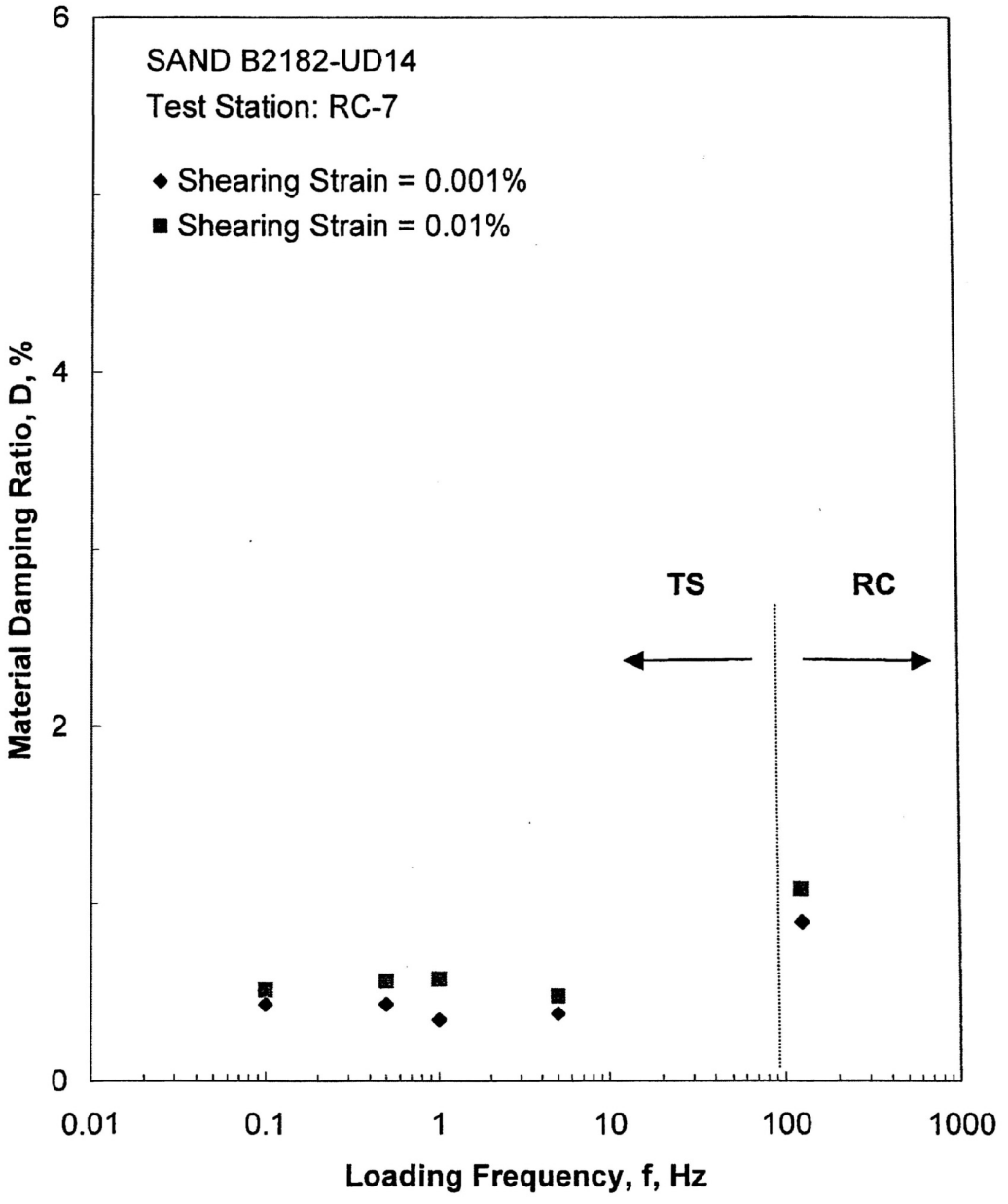

Figure N.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 200 psi from the Combined RCTS Tests

Table N.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 B2182-UD14

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)	(%)	
13	1872	90	1295	62	578	1.28	0.62
25	3600	172	1846	89	690	1.07	0.62
50	7200	345	2675	128	830	0.97	0.62
100	14400	689	4457	214	1071	0.89	0.62
200	28800	1378	6076	292	1248	0.82	0.61

Table N.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2182-UD14; Isoptropic Confining Pressure, σ_o=50 psi (7.2 ksf = 345 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
2.70E-04	2683	1.00	2.70E-04	0.91
5.57E-04	2683	1.00	5.57E-04	0.97
1.09E-03	2675	1.00	1.09E-03	1.03
2.14E-03	2643	0.99	1.95E-03	1.11
4.12E-03	2611	0.97	3.71E-03	1.25
7.78E-03	2563	0.96	6.93E-03	1.34
1.40E-02	2502	0.93	1.23E-02	1.58
2.43E-02	2369	0.88	2.09E-02	1.99
4.01E-02	2227	0.83	3.33E-02	2.71
6.54E-02	2052	0.76	5.10E-02	3.71
1.07E-01	1862	0.69	7.80E-02	5.15
1.67E-01	1738	0.65	1.13E-01	6.32

[+] 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 N.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2182-UD14; Isotropic Confining Pressure, σ_o= 50 psi (7.2 ksf =345 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, %
1.05E-03	2692	1.00	0.35	1.06E-03	2671	1.00	0.40
2.10E-03	2688	1.00	0.59	2.11E-03	2670	1.00	0.48
4.26E-03	2649	0.98	0.72	4.27E-03	2646	0.99	0.68
1.04E-02	2582	0.96	1.00	1.04E-02	2580	0.97	1.00

Table N.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2174-UD6; Isoptropic Confining Pressure, σ_o= 200 psi (28.8 ksf = 1378 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
1.38E-04	6061	1.00	1.38E-04	0.82
2.72E-04	6061	1.00	2.72E-04	0.84
5.61E-04	6061	1.00	5.61E-04	0.86
1.11E-03	6028	1.00	1.11E-03	0.89
2.18E-03	6004	0.99	2.03E-03	0.96
4.24E-03	5956	0.98	3.94E-03	0.99
8.09E-03	5860	0.97	7.44E-03	1.08
1.48E-02	5694	0.94	1.35E-02	1.27
2.59E-02	5520	0.91	2.31E-02	1.68
4.37E-02	5244	0.87	3.80E-02	2.09
7.18E-02	4860	0.80	5.96E-02	2.68
8.69E-02	4712	0.78	7.13E-02	3.07

[+] 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 N.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2182-UD14; Isotropic Confining Pressure, σ_o=200 psi (28.8 ksf = 1378 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, %
1.04E-03	6109	1.00	0.27	1.05E-03	6076	1.00	0.43
2.10E-03	6075	0.99	0.33	2.11E-03	6053	1.00	0.39
4.22E-03	6045	0.99	0.45	4.21E-03	6059	1.00	0.56
8.51E-03	6005	0.98	0.56	8.48E-03	6026	0.99	0.56

APPENDIX O

Specimen B2274-UD24
(Index properties not available)

Borehole B2274
Sample UD24
Depth = 481.1 ft (146.7 m)
Total Unit Weight = 123.5 lb/ft^3
Water Content = 26.2 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 154 psi

FUGRO JOB #: 0401-1686
Testing Station: RC8

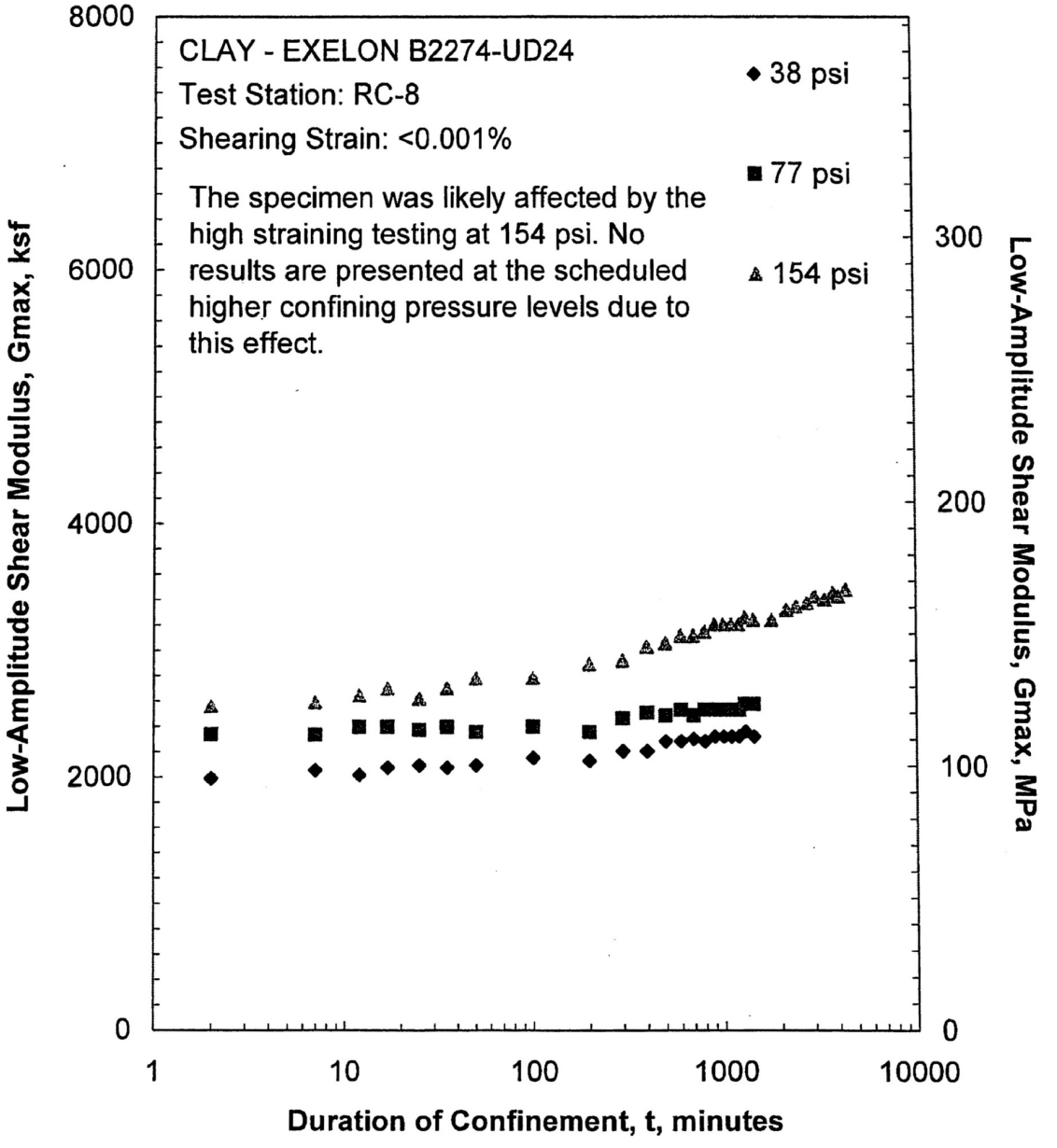

Figure O.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

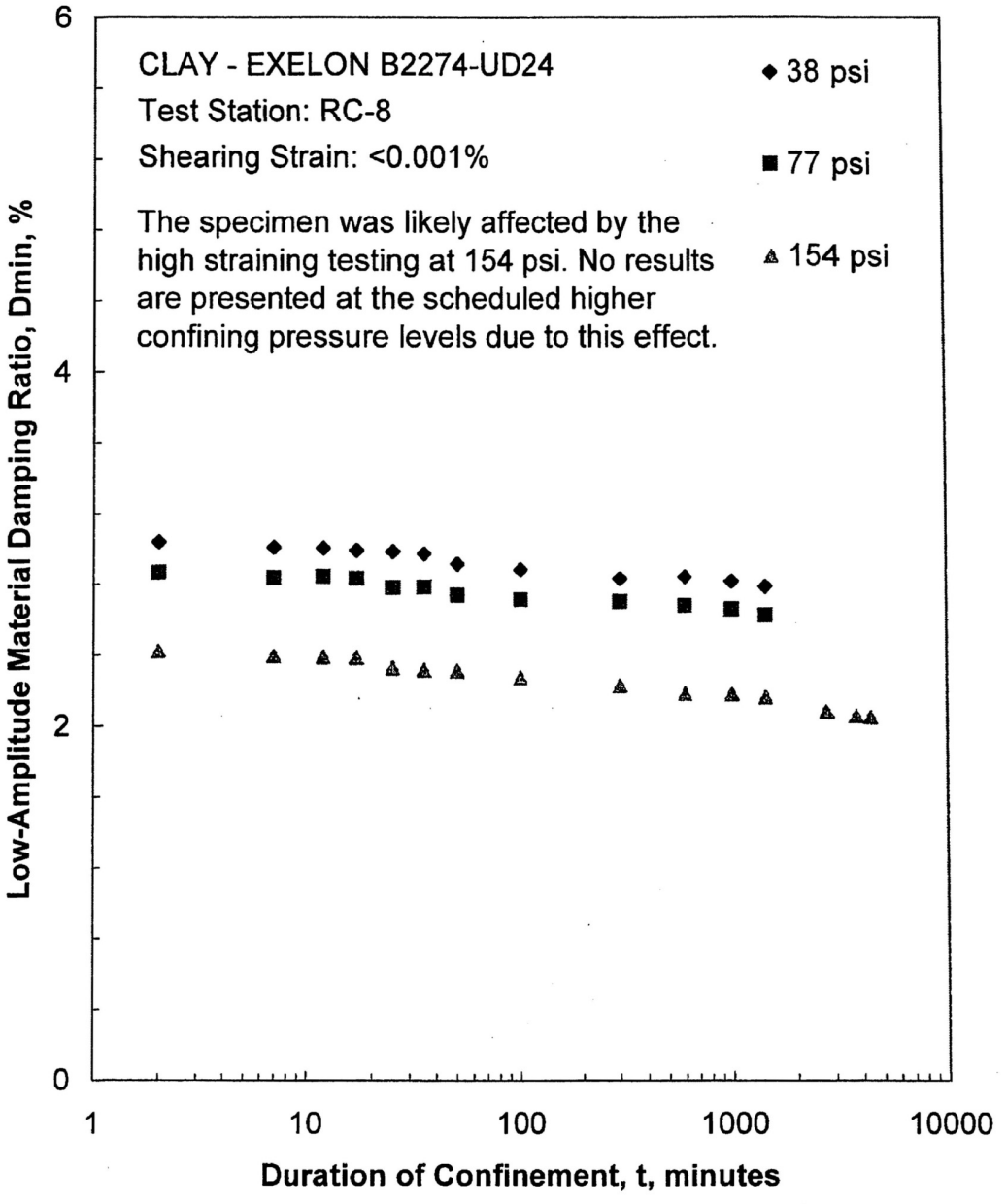

Figure O.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

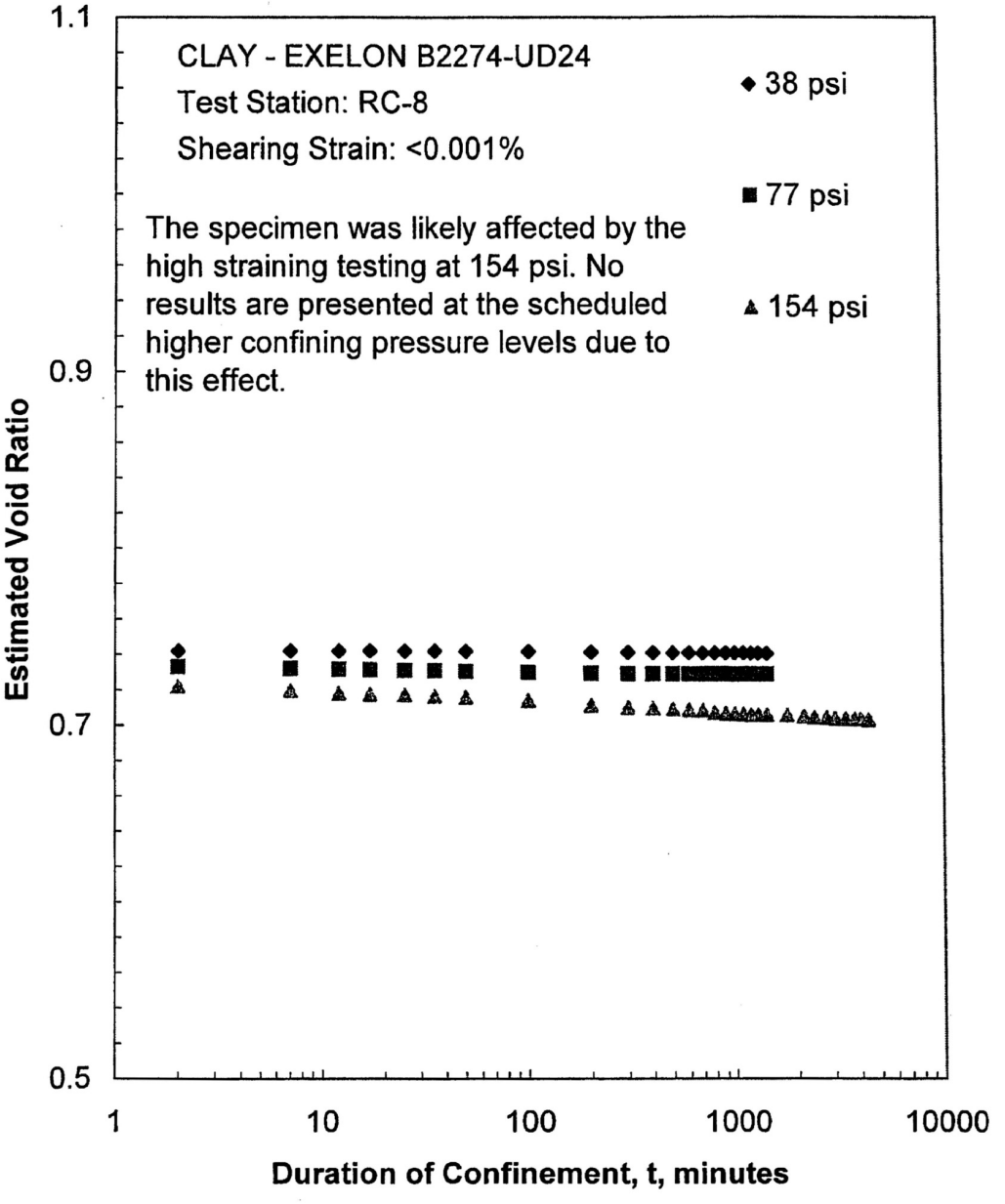

Figure O.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

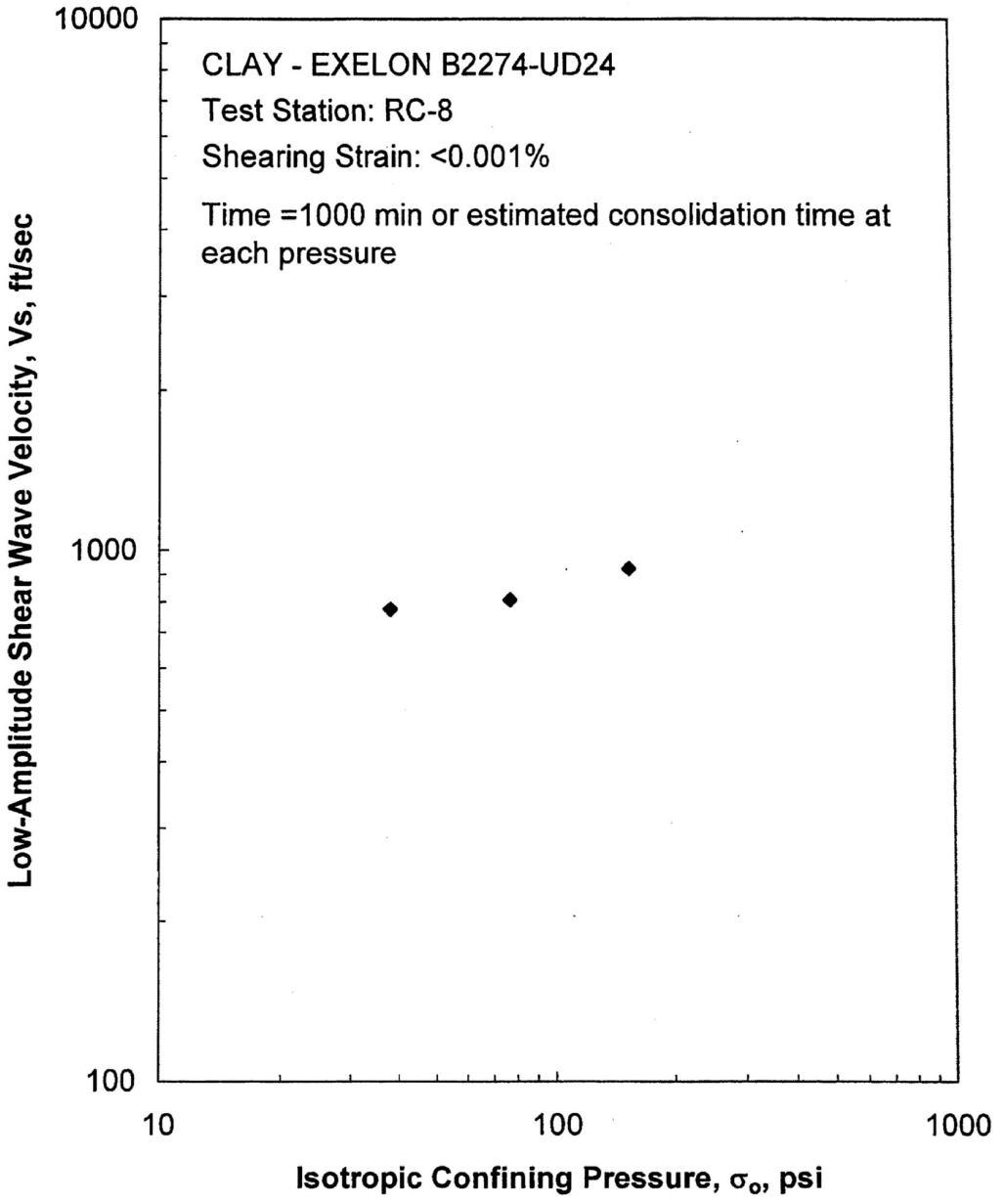

Figure O.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

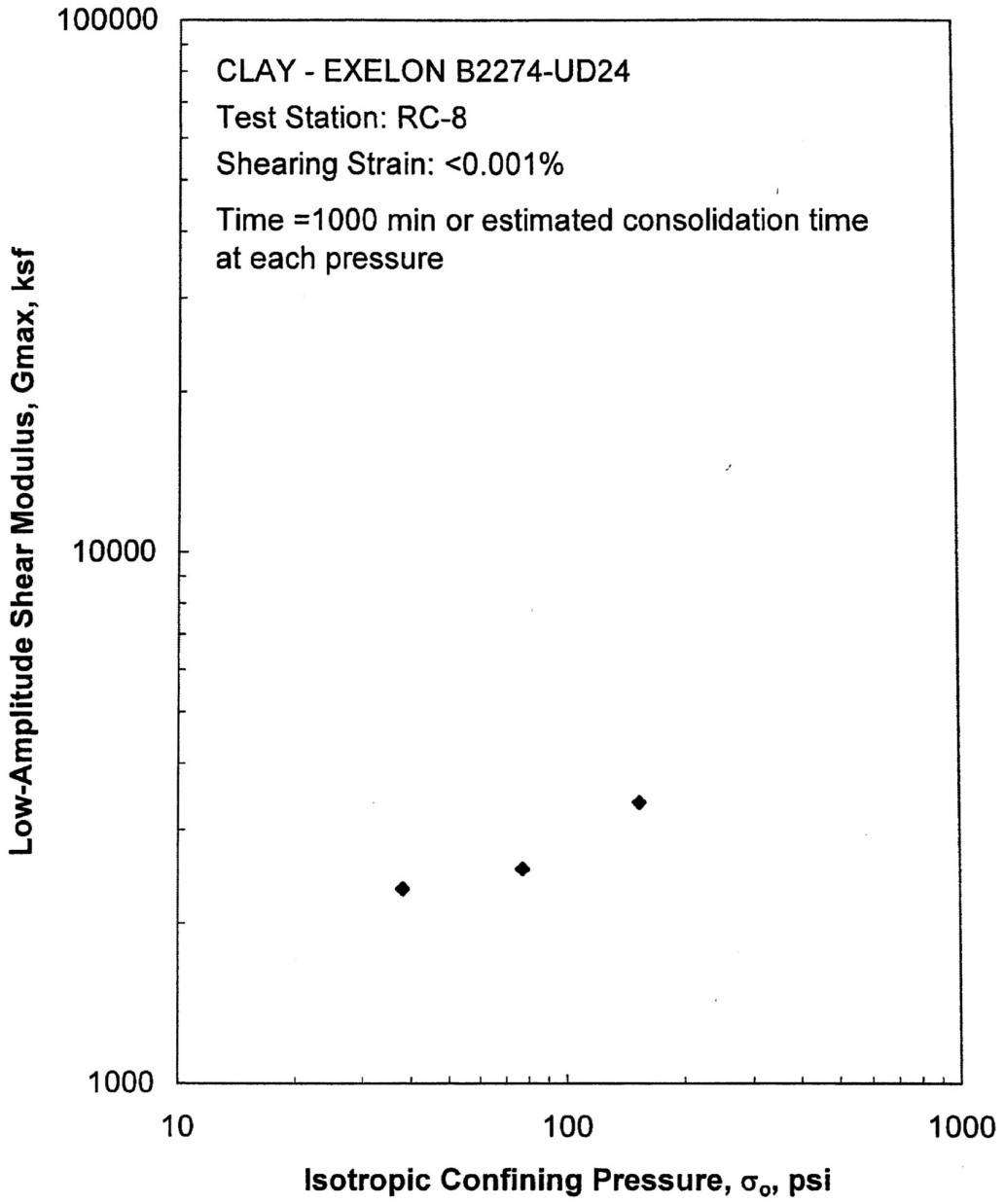

Figure O.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

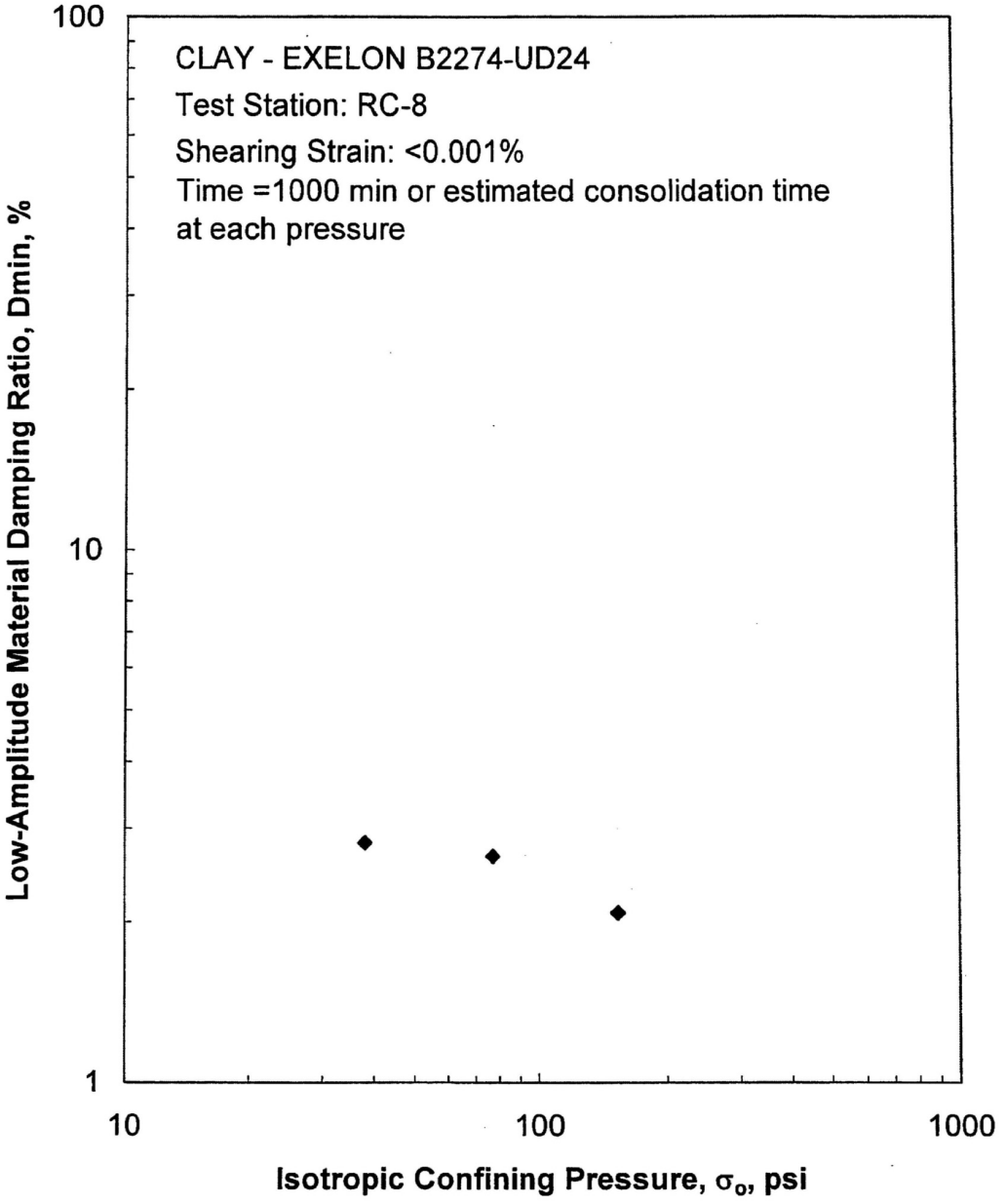

Figure O.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

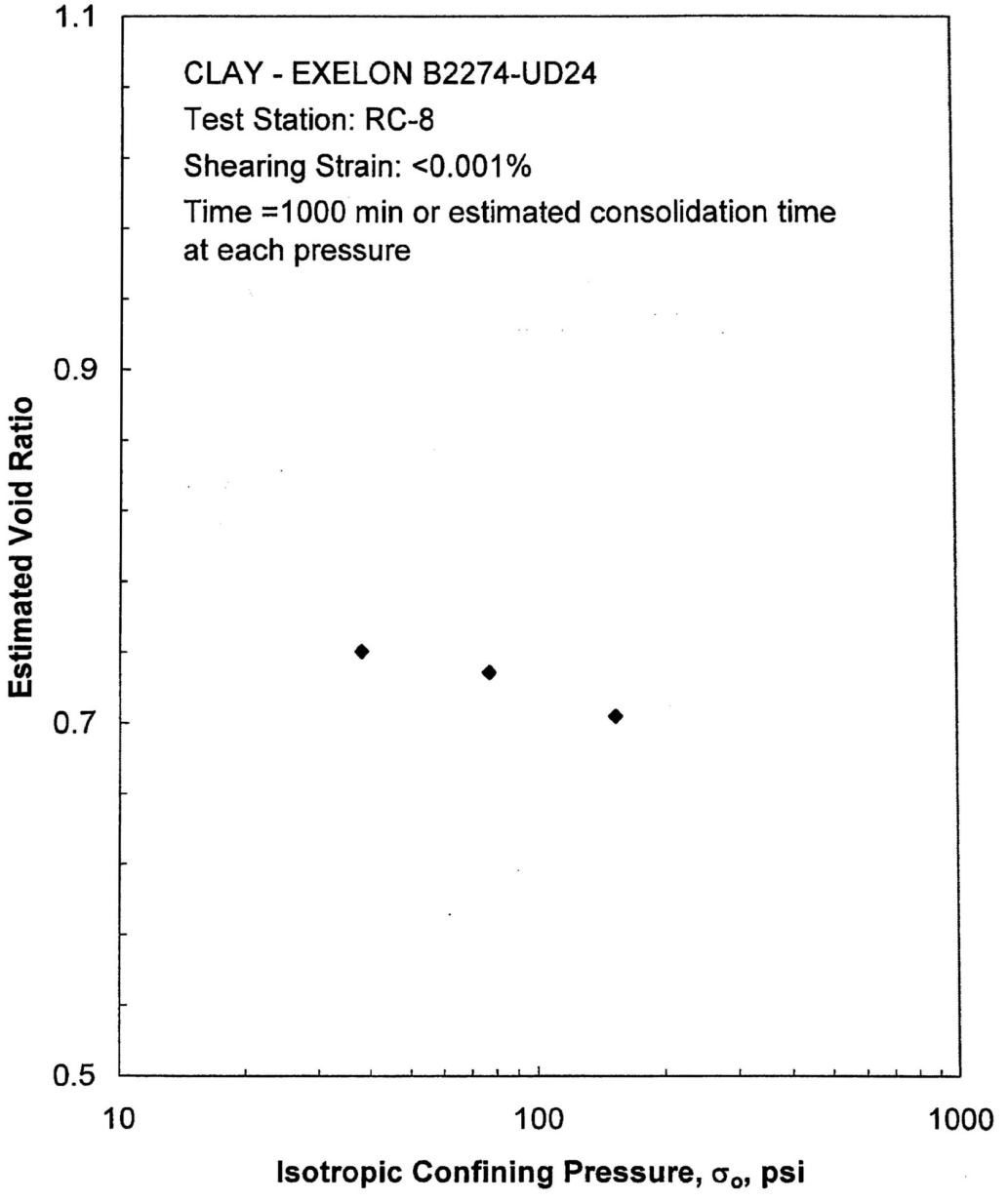

Figure O.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

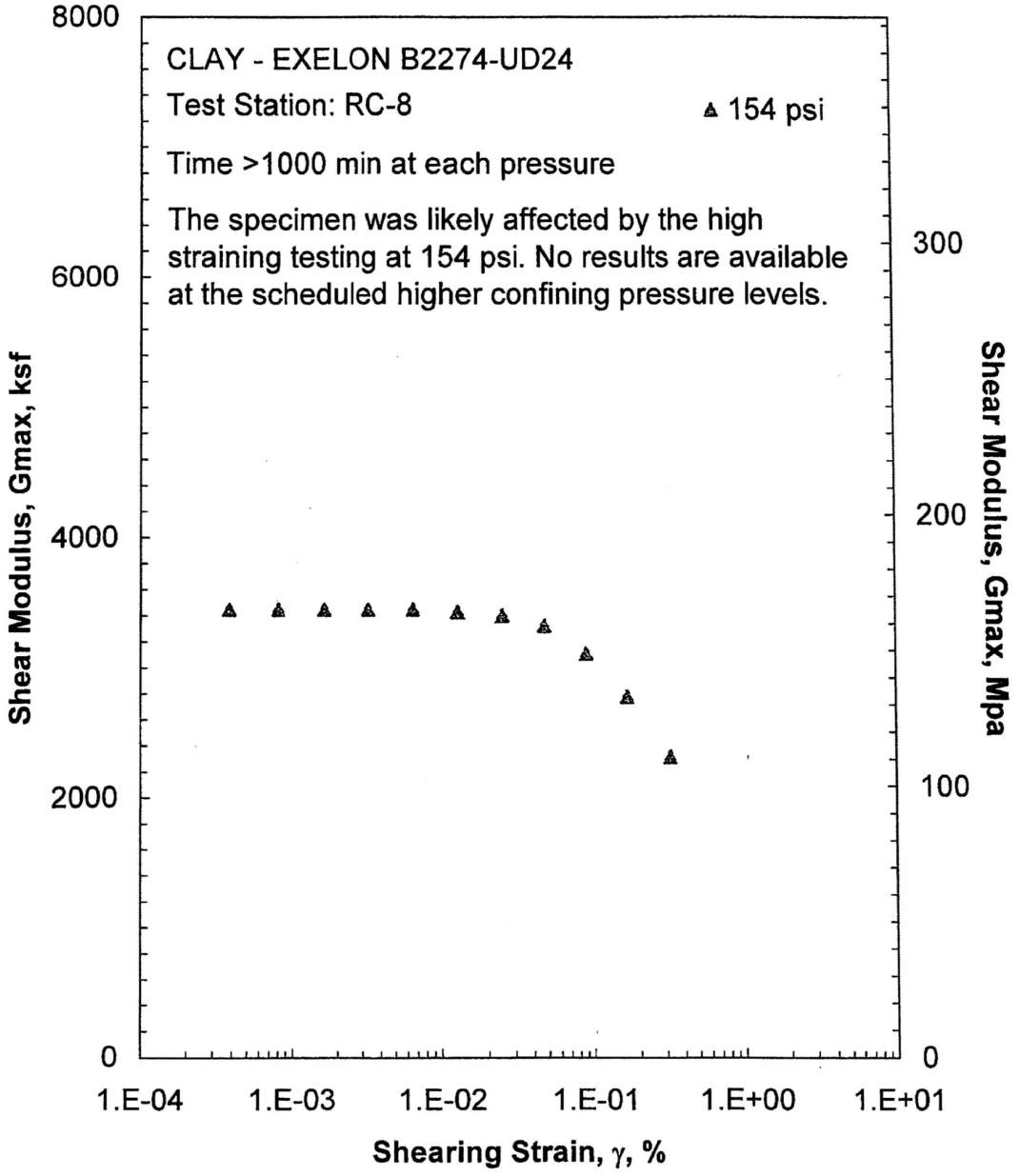

Figure O.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

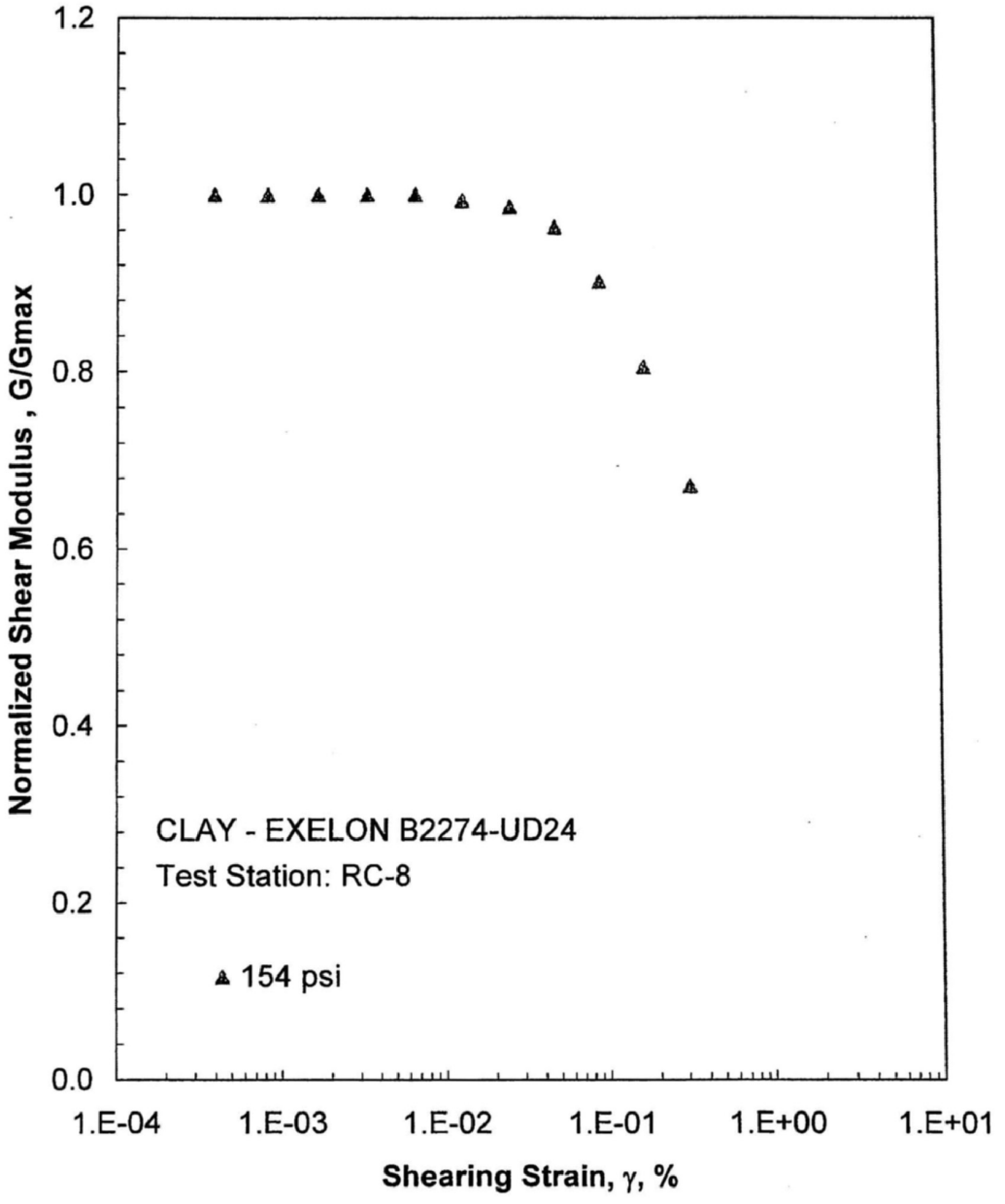

Figure O.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

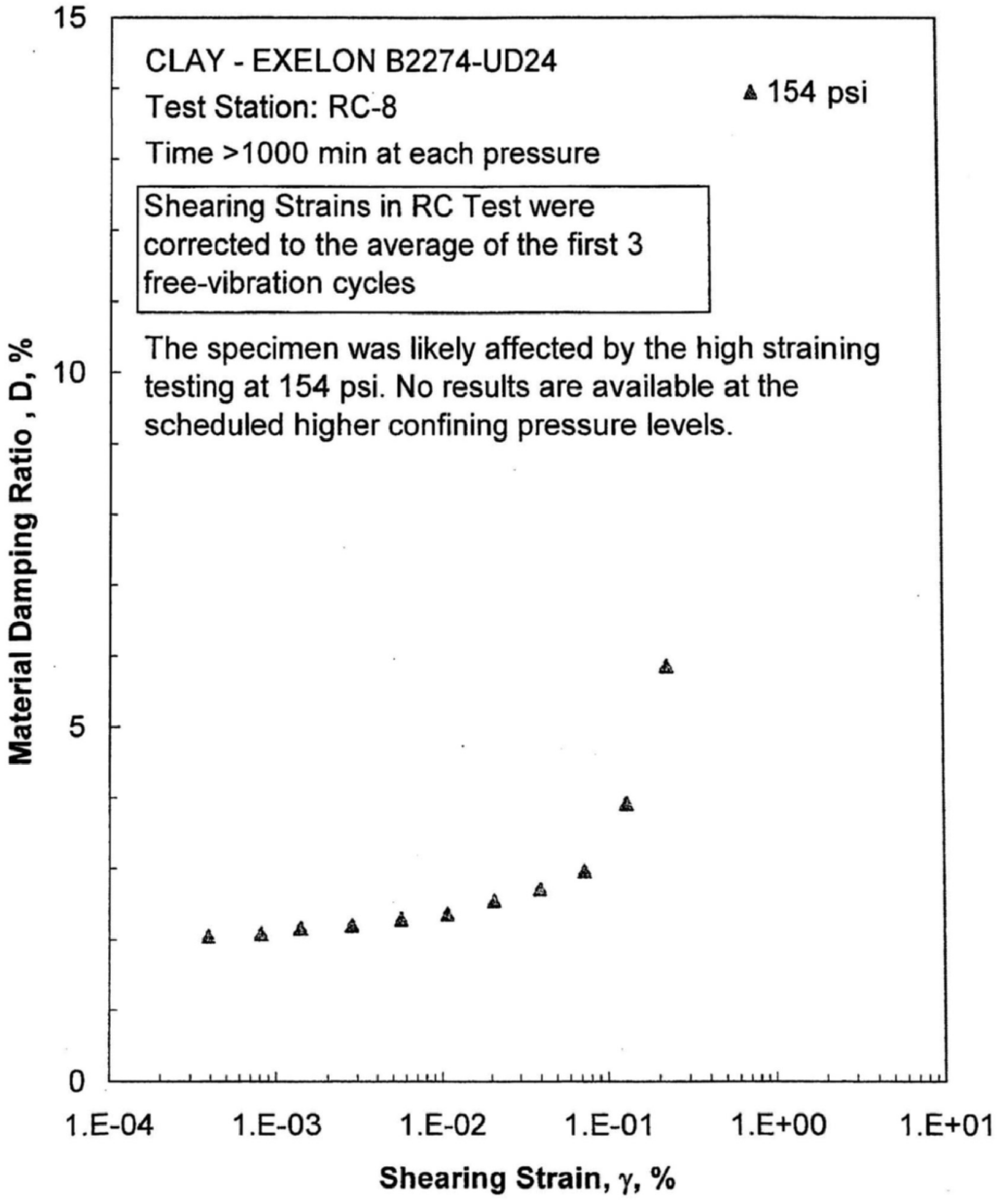

Figure O.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

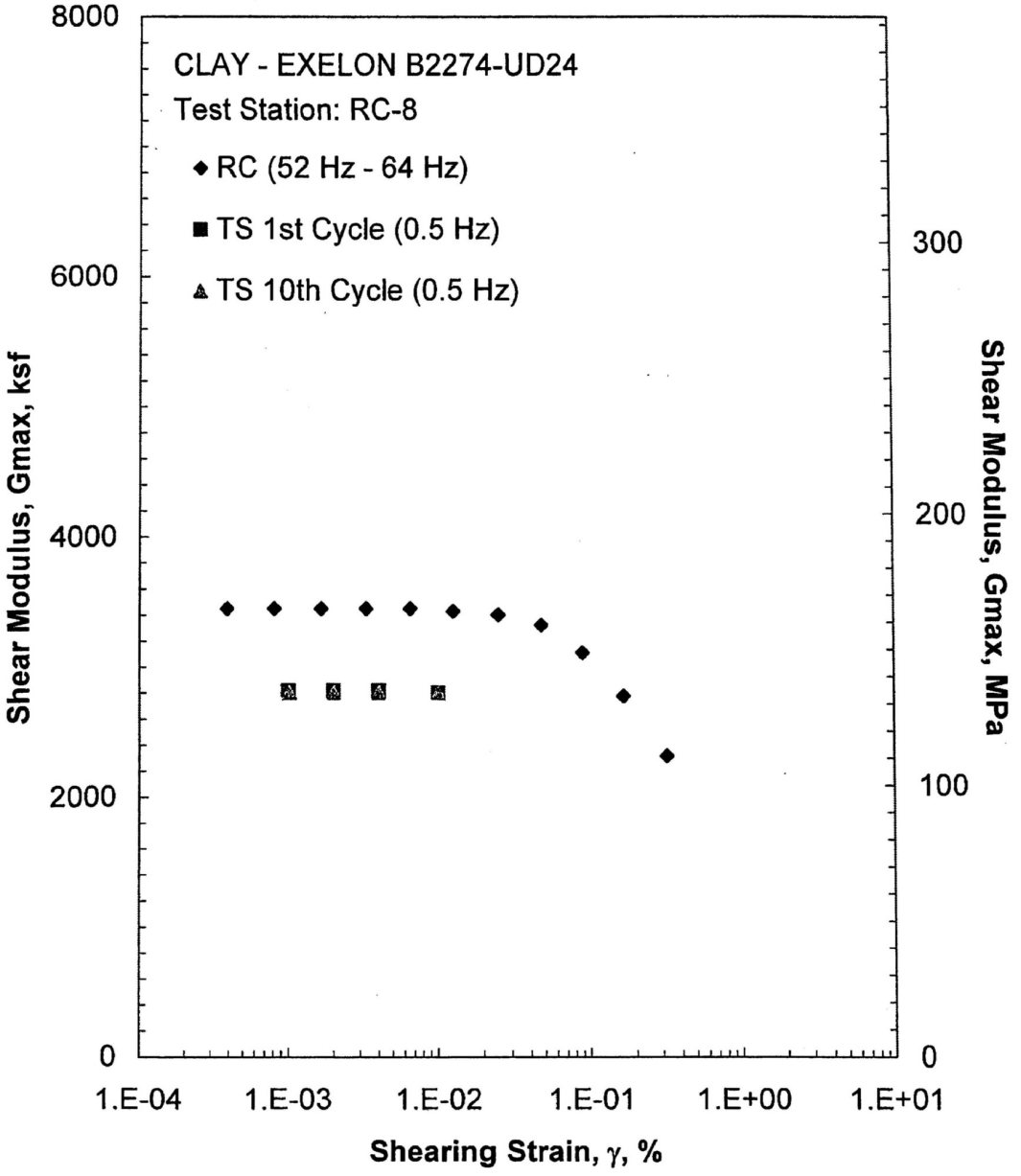

Figure O.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 154 psi from the Combined RCTS Tests

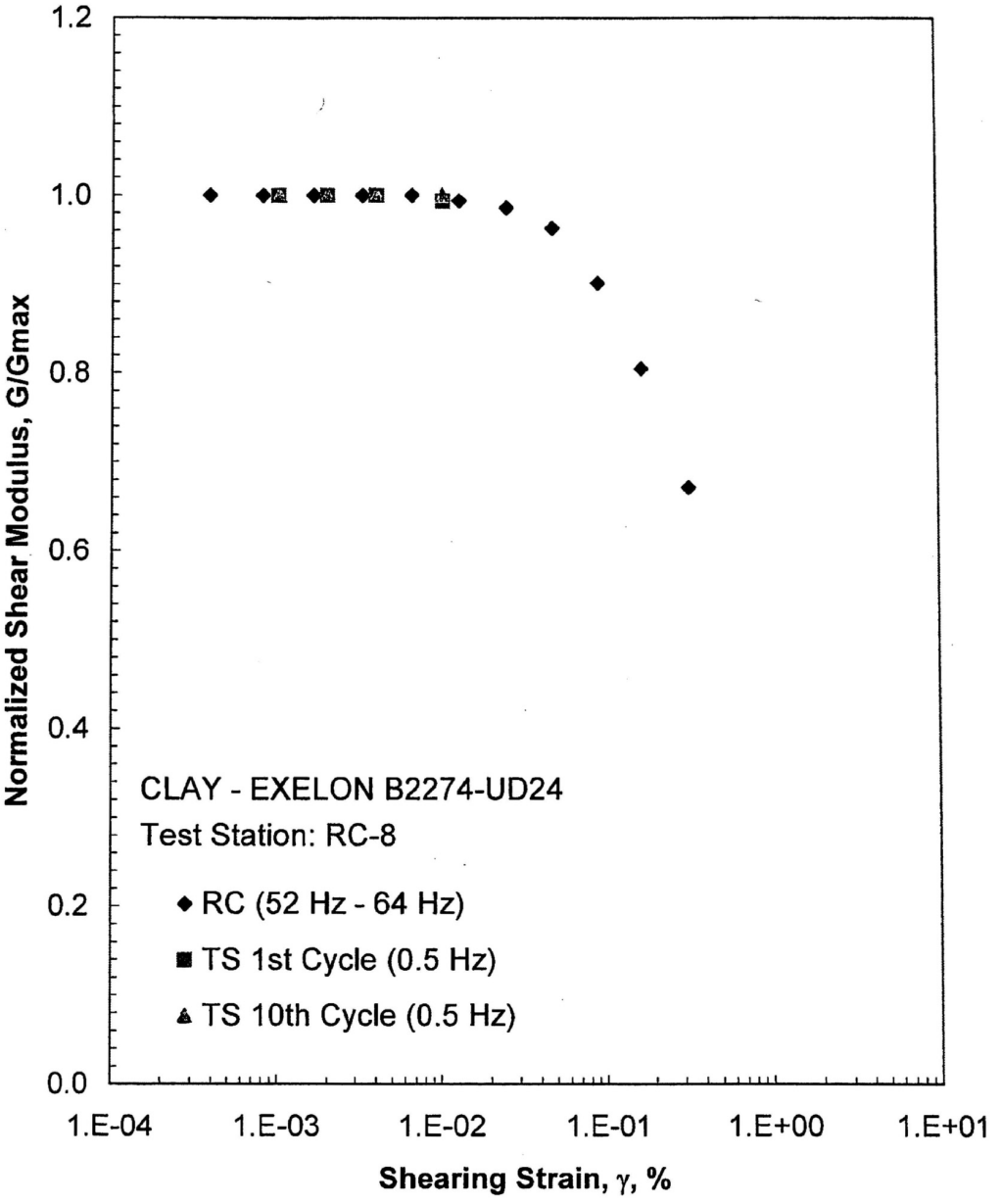

Figure O.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 154 psi from the Combined RCTS Tests

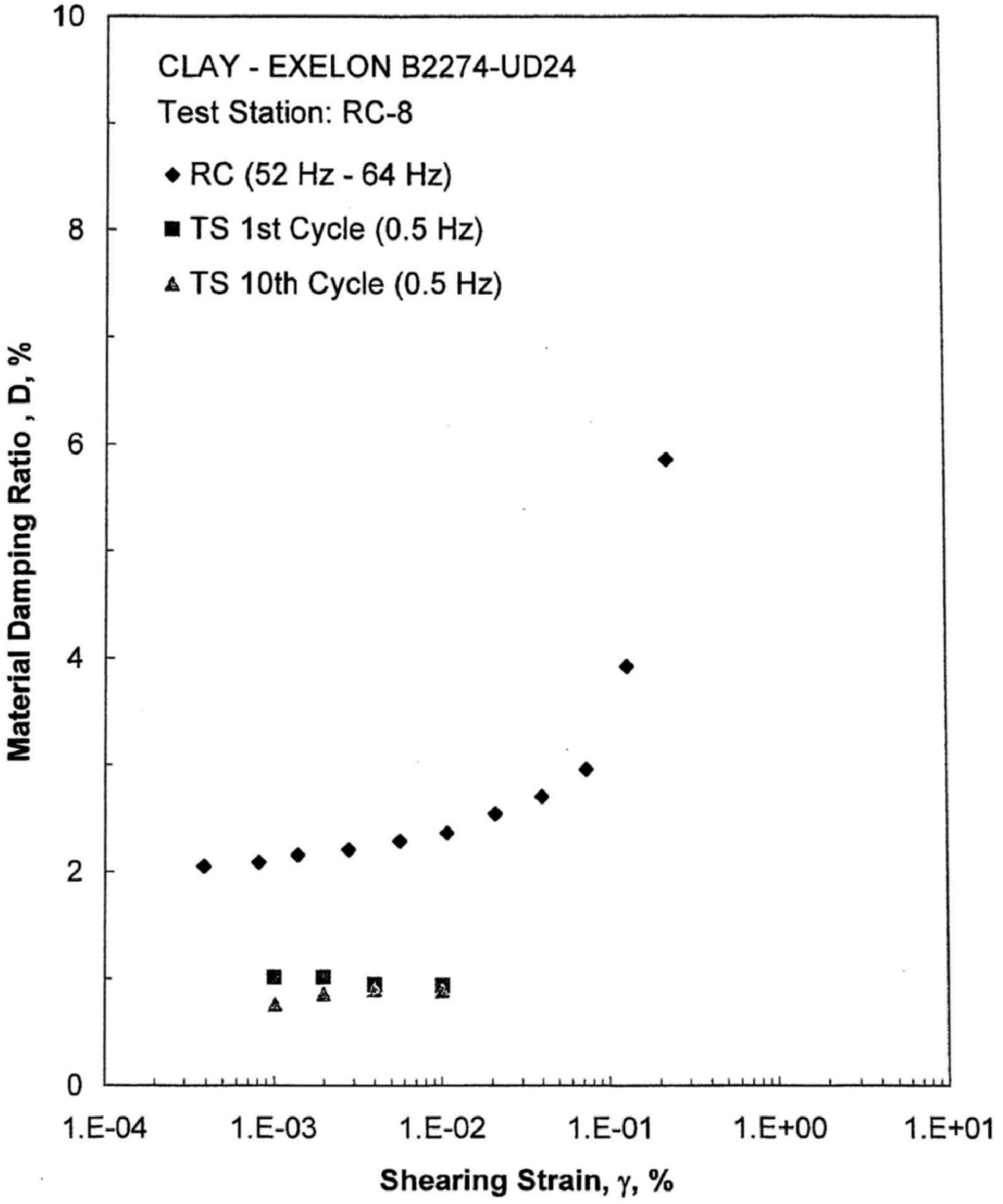

Figure O.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 154 psi from the Combined RCTS Tests

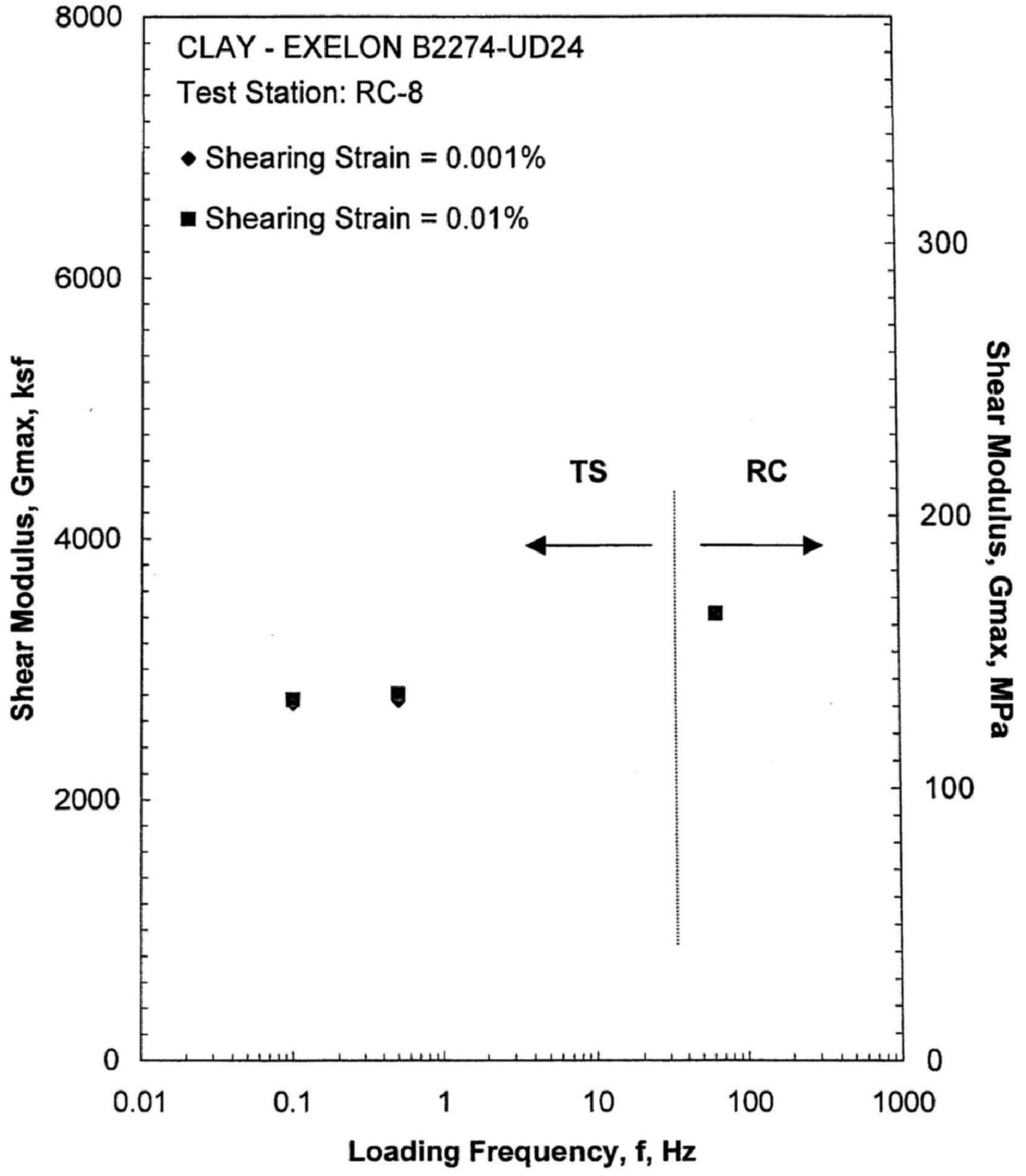

Figure O.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 154 psi from the Combined RCTS Tests

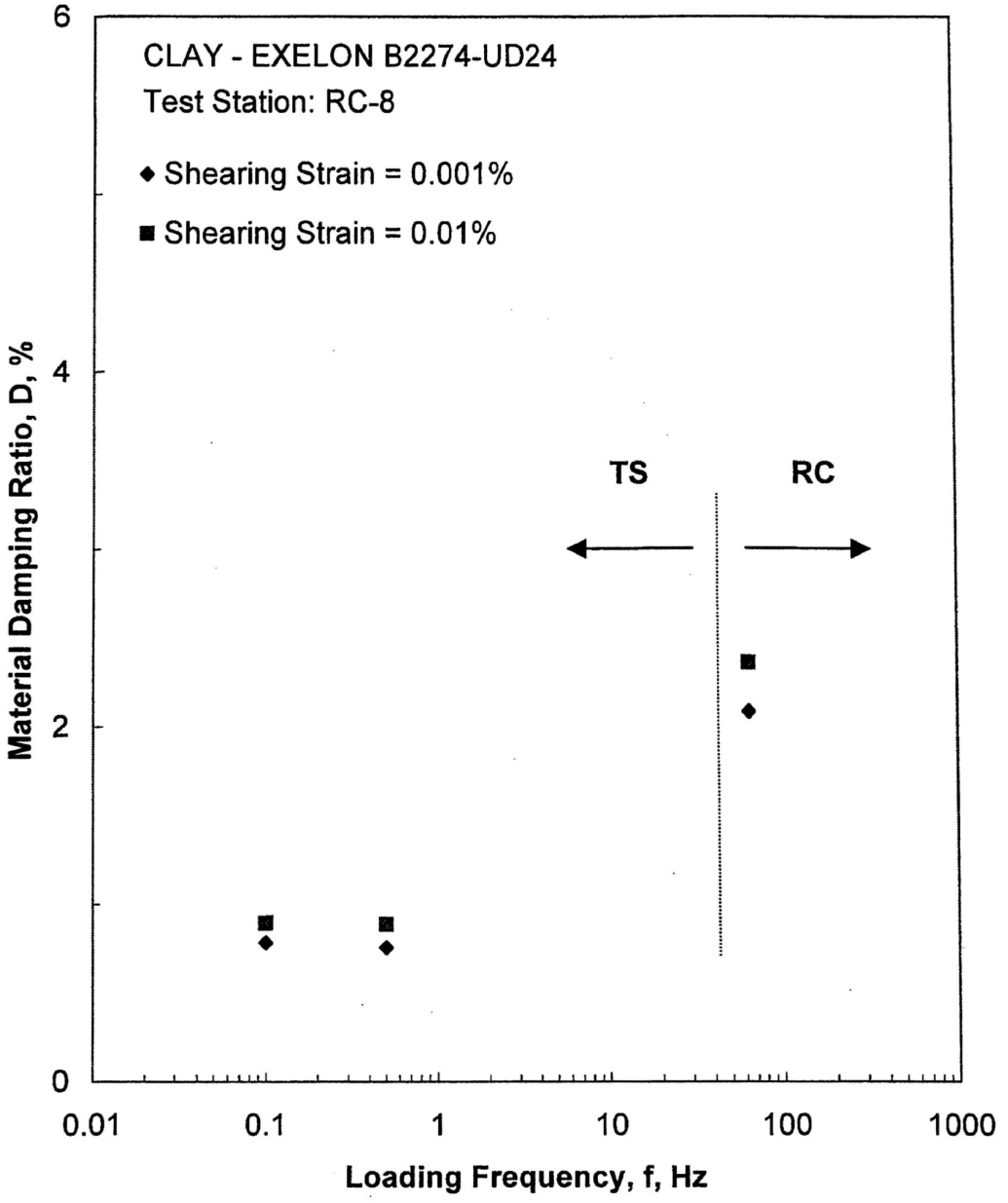

Figure O.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 154 psi from the Combined RCTS Tests

Table O.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 B2274-UD24

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)	(%)	
38	5472	262	2319	111	774	2.82	0.74
77	11088	531	2531	121	806	2.66	0.73
154	22176	1061	3372	162	923	2.08	0.70

Table O.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2274-UD24; Isoptropic Confining Pressure, σ_o=154 psi (22.2 ksf = 1061 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
3.88E-04	3449	1.00	3.88E-04	2.05
8.13E-04	3449	1.00	8.13E-04	2.08
1.65E-03	3449	1.00	1.40E-03	2.15
3.29E-03	3449	1.00	2.79E-03	2.20
6.54E-03	3449	1.00	5.62E-03	2.28
1.27E-02	3427	0.99	1.08E-02	2.36
2.48E-02	3400	0.99	2.08E-02	2.54
4.72E-02	3321	0.96	3.96E-02	2.70
8.93E-02	3108	0.90	7.32E-02	2.96
1.67E-01	2776	0.80	1.30E-01	3.92
3.22E-01	2314	0.67	2.25E-01	5.85

[+] 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 O.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2274-UD24; Isotropic Confining Pressure, σ_o= 154 psi (22.2 ksf =1061 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, %
1.01E-03	2819	1.00	1.01	1.02E-03	2804	1.00	0.75
1.99E-03	2819	1.00	1.01	2.00E-03	2804	1.00	0.85
3.99E-03	2819	1.00	0.94	4.00E-03	2804	1.00	0.89
1.01E-02	2800	0.99	0.93	1.00E-02	2804	1.00	0.88

Table O.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2274-UD24; Isoptropic Confining Pressure, σ_o= 455 psi (65.5 ksf = 3135 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
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[+] 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

* The specimen was likely affected by the high straining testing at 154 psi. No results are presented at the scheduled higher confining pressure levels.

Table O.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2274-UD24; Isotropic Confining Pressure, σ_o=455 psi (65.5 ksf = 3135 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, %
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* The specimen was likely affected by the high straining testing at 154 psi. No results are presented at the scheduled higher confining pressure levels.

COLLEGE OF ENGINEERING
THE UNIVERSITY OF TEXAS AT AUSTIN

Department of Civil Engineering • Austin, Texas 78712-1076
Geotechnical Engineering • (512) 471-4929 • FAX (512) 471-6548

10 July 2008

Kathryn A. White, P.E.
Principal - Chief Engineer
MACTEC Engineering and Consulting, Inc.
1540 N. 107th East Avenue
Tulsa, Oklahoma 74116

Dear Ms. White:

The dynamic properties of one undisturbed soil specimen for the Exelon COL project were evaluated in the Soil Dynamics Laboratory at the University of Texas at Austin (UT). Resonant column and torsional shear (RCTS) tests were performed for the evaluation. All tests and test equipment were managed and tested in accordance with the procedures described in MACTEC Work Instruction No. 227.

The undisturbed sample was recovered from a depth of about 301 ft (92 m) at Borehole 2182UD. The sample was designated as UD-24 in the field and was later named UTA-60-A (1C) at the University of Texas at Austin. Dynamic testing on the specimen was conducted at various frequencies and shearing strains as described in the Geotechnical Engineering Report GR06-4 (DCN: UTSD RCTS GR06-4, Revision 0, April 25, 2006). Five isotropic confining pressures were used which ranged from below to above the estimated in-situ mean effective stress. The estimated in-situ mean effective stress for the specimen (102 lb/in^2 (703 kPa)) was calculated based on the specimen depth, unit weight of the specimens (125 lb/ft^3 (2.0 g/cm^3)), the depth to the ground water table (50 ft (15 m)) and an assumption of the value of the in-situ coefficient of lateral earth pressure at rest, K_o (0.5) as given in MACTEC Work Instruction No. 227.

Final graphical and tabular presentations were produced based on the measured and estimated dynamic properties of Specimen UTA-60-A (1C) as seen in Appendix A. The figures in the appendix illustrate the effects of various factors (mainly confinement pressure and its duration, loading frequency, number of loading cycles, and shearing strain) on the dynamic properties of the specimen. The dynamic properties are shear wave velocity (V_S), shear modulus (G) and material damping ratio (D).