

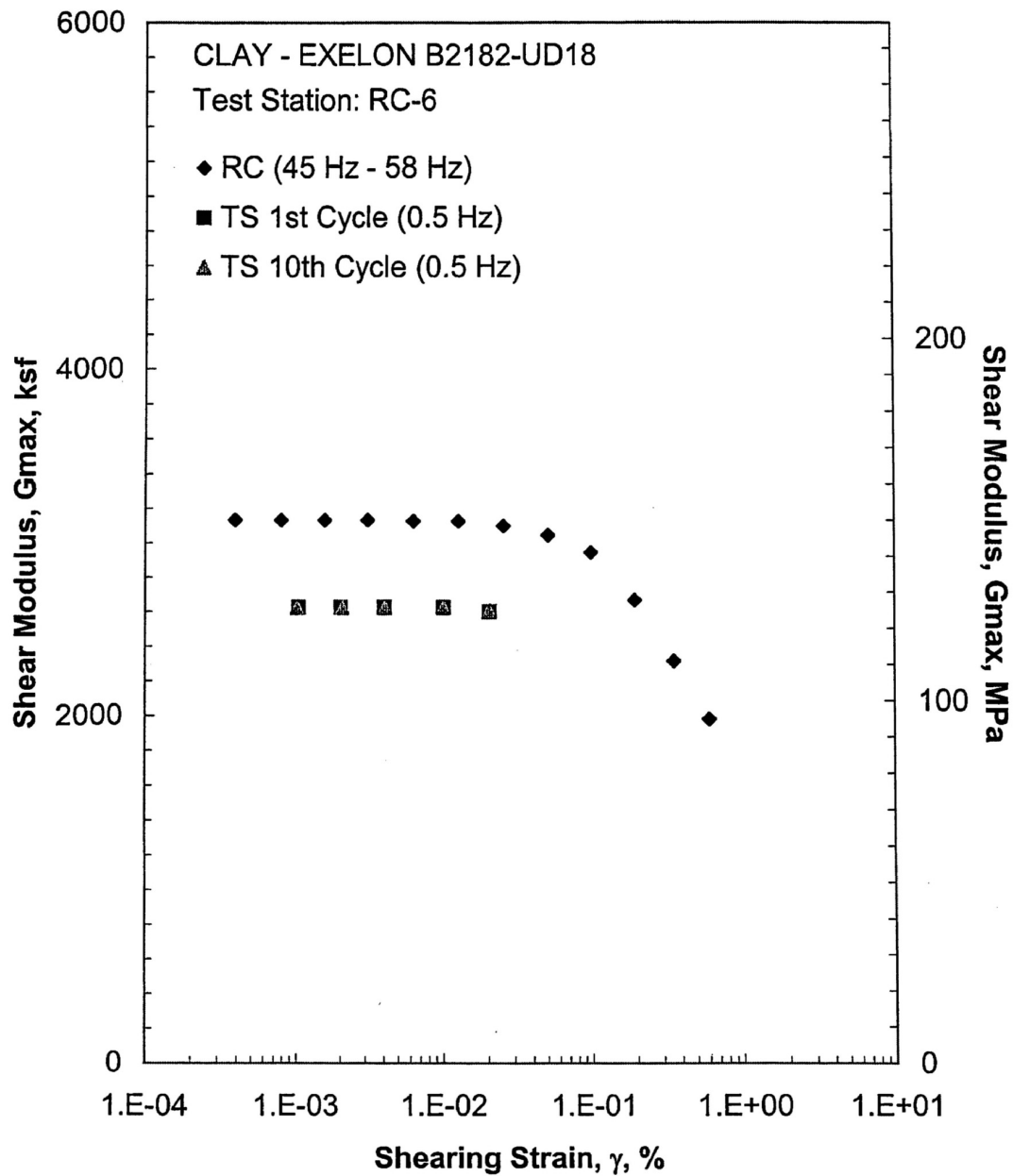


Figure D.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

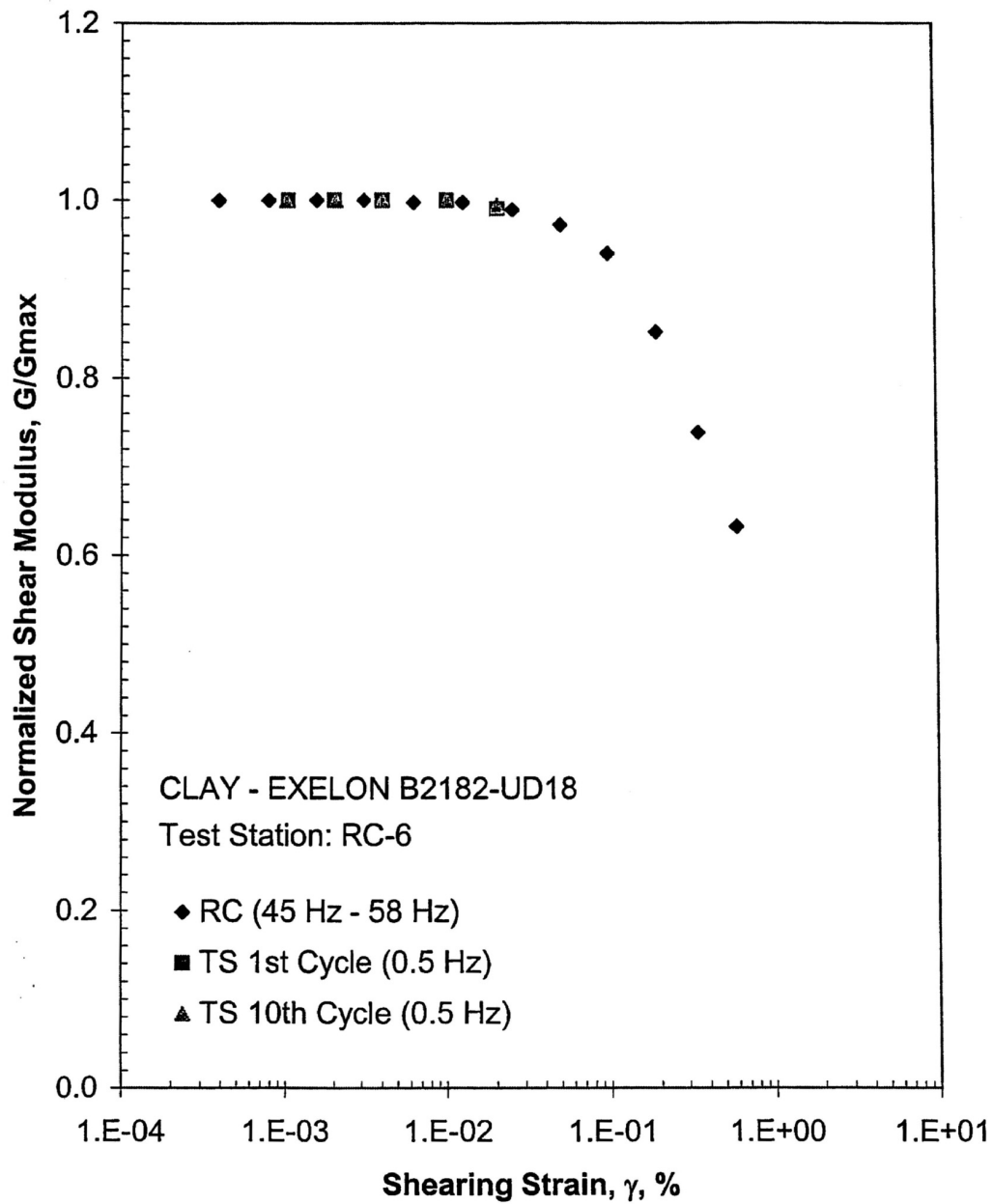


Figure D.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

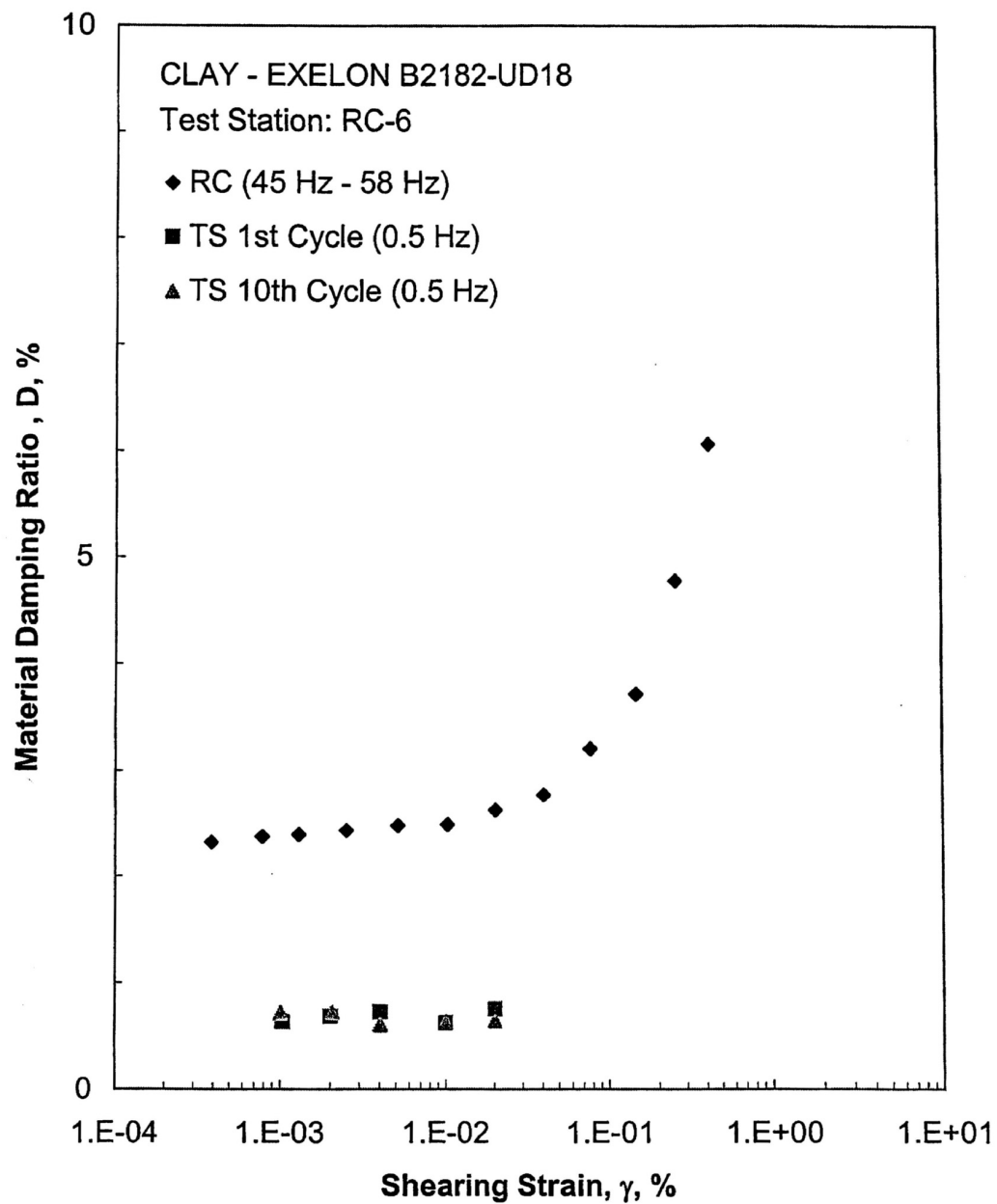


Figure D.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

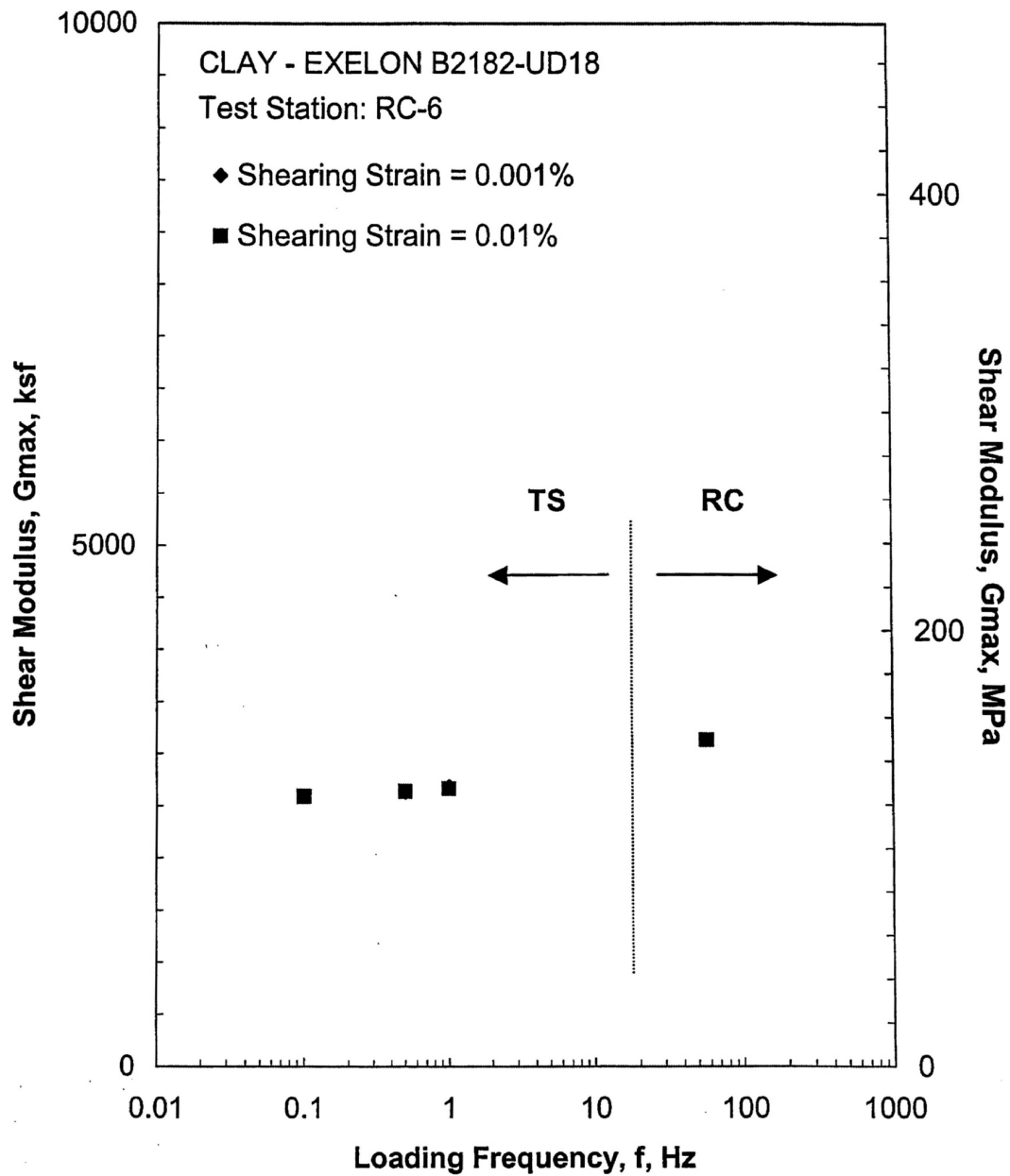


Figure D.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

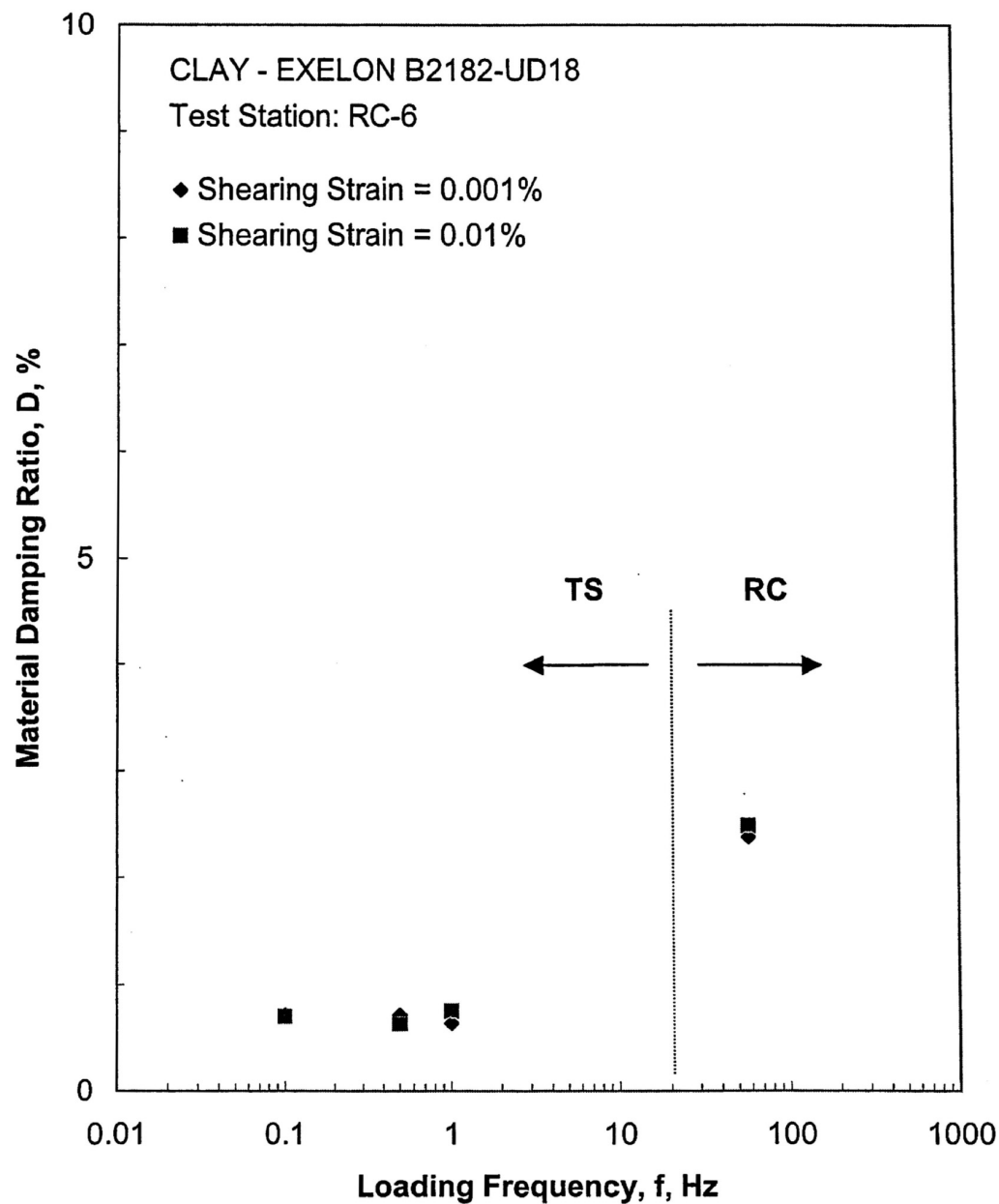


Figure D.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

Table D.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 EXELON B2182-UD18

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
19	2736	131	2002	96	746	2.81	1.01
39	5616	269	2138	103	770	2.64	1.00
78	11232	537	2238	107	785	2.48	0.98
155	22320	1068	2566	123	836	2.37	0.96
310	44640	2136	3002	144	887	2.28	0.89

Table D.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen EXELON B2182-UD18; Isotropic Confining Pressure, $\sigma_o=78$ psi (11.2 ksf = 537 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average ⁺ Shearing Strain, %	Material Damping Ratio ^x , D, %
2.66E-04	2272	1.00	2.66E-04	2.43
5.48E-04	2272	1.00	5.48E-04	2.46
1.08E-03	2260	0.99	1.08E-03	2.48
2.18E-03	2260	0.99	2.18E-03	2.56
4.39E-03	2260	0.99	3.51E-03	2.62
8.79E-03	2261	0.99	7.03E-03	2.74
1.76E-02	2238	0.99	1.46E-02	2.89
3.49E-02	2238	0.98	2.79E-02	3.13
6.95E-02	2154	0.95	5.35E-02	3.61
1.34E-01	1963	0.86	1.00E-01	4.21
2.31E-01	1734	0.76	1.64E-01	5.21
3.73E-01	1529	0.67	2.54E-01	6.38

⁺ 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 D.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen EXELON B2182-UD18; Isotropic Confining Pressure, $\sigma_o = 78$ psi (11.2 ksf = 537 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	1854	1.00	0.56	1.00E-03	1851	1.00	0.46
2.02E-03	1854	1.00	0.61	2.04E-03	1851	1.00	0.50
3.97E-03	1854	1.00	0.59	4.00E-03	1851	1.00	0.60
1.02E-02	1854	1.00	0.70	1.02E-02	1851	1.00	0.79

Table D.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen EXELON B2182-UD18; Isotropic Confining Pressure, $\sigma_o = 310$ psi (44.6 ksf = 2136 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average ⁺ Shearing Strain, %	Material Damping Ratio ^x , D, %
3.89E-04	3135	1.00	3.89E-04	2.32
7.88E-04	3135	1.00	7.88E-04	2.38
1.57E-03	3135	1.00	1.30E-03	2.40
3.10E-03	3135	1.00	2.51E-03	2.43
6.27E-03	3128	1.00	5.14E-03	2.48
1.25E-02	3128	1.00	1.03E-02	2.49
2.52E-02	3100	0.99	2.04E-02	2.63
5.02E-02	3046	0.97	4.06E-02	2.77
9.79E-02	2947	0.94	7.73E-02	3.20
1.93E-01	2669	0.85	1.47E-01	3.72
3.55E-01	2315	0.74	2.56E-01	4.78
6.03E-01	1982	0.63	4.22E-01	6.06

⁺ 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 D.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen EXELON B2182-UD18; Isotropic Confining Pressure, $\sigma_o=310$ psi (44.6 ksf = 2136 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	2627	1.00	0.63	1.01E-03	2626	1.00	0.72
2.02E-03	2627	1.00	0.68	2.06E-03	2626	1.00	0.72
4.04E-03	2627	1.00	0.72	4.04E-03	2626	1.00	0.60
9.98E-03	2627	1.00	0.62	1.00E-02	2626	1.00	0.63
2.03E-02	2602	0.99	0.75	2.02E-02	2610	0.99	0.64

APPENDIX E

Specimen B2182-UD9
(Index Properties Not Available)

Borehole B2182
Sample UD9
Depth = 85.8 ft (26.2)
Total Unit Weight = 115.0 lb/ft³
Water Content = 35.1 %
Estimated In-Situ K_o = 0.5
Estimated In-Situ Mean Effective
Stress = 39 psi

FUGRO JOB #: 0401-1686
Testing Station: RC5

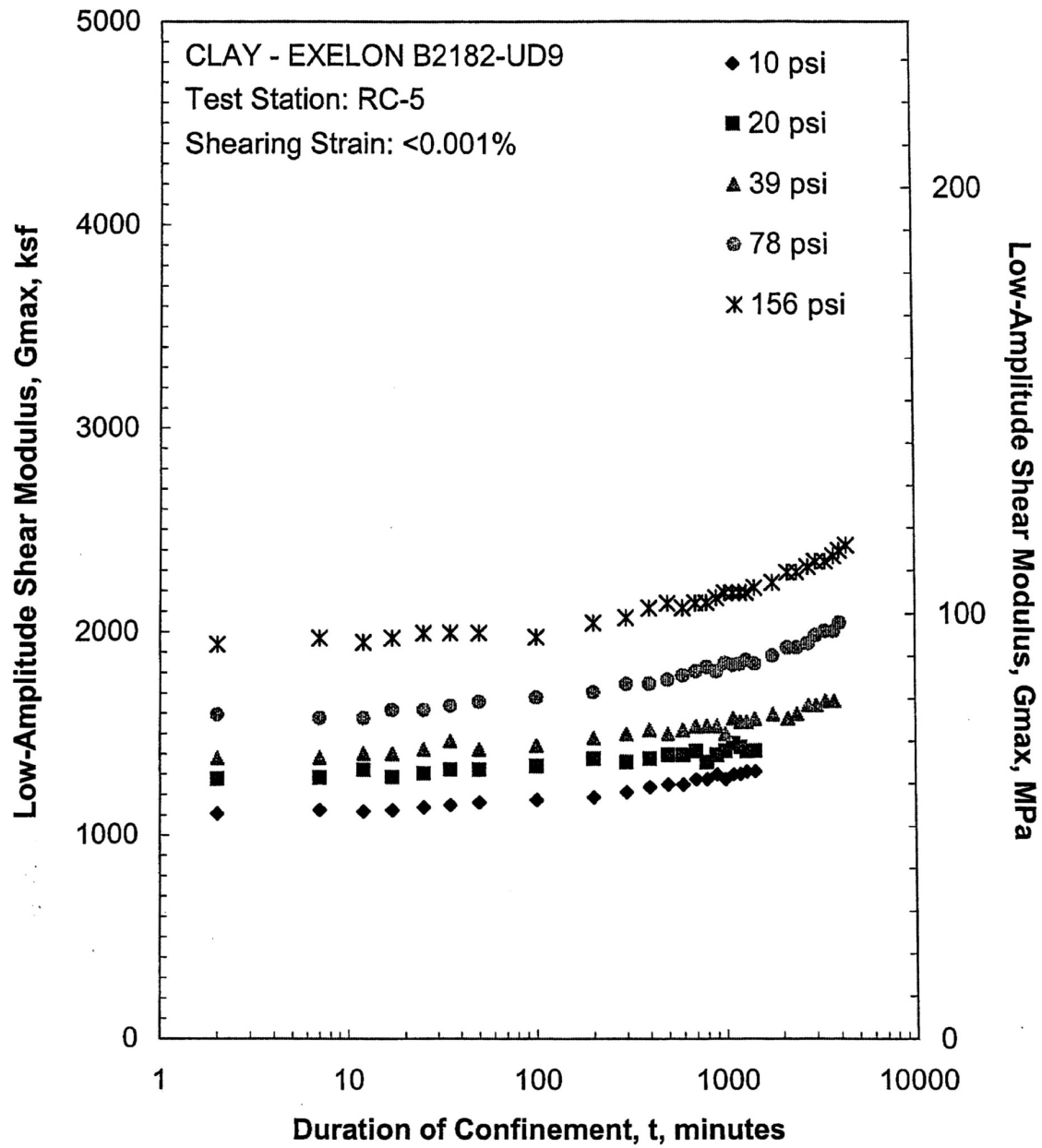


Figure E.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

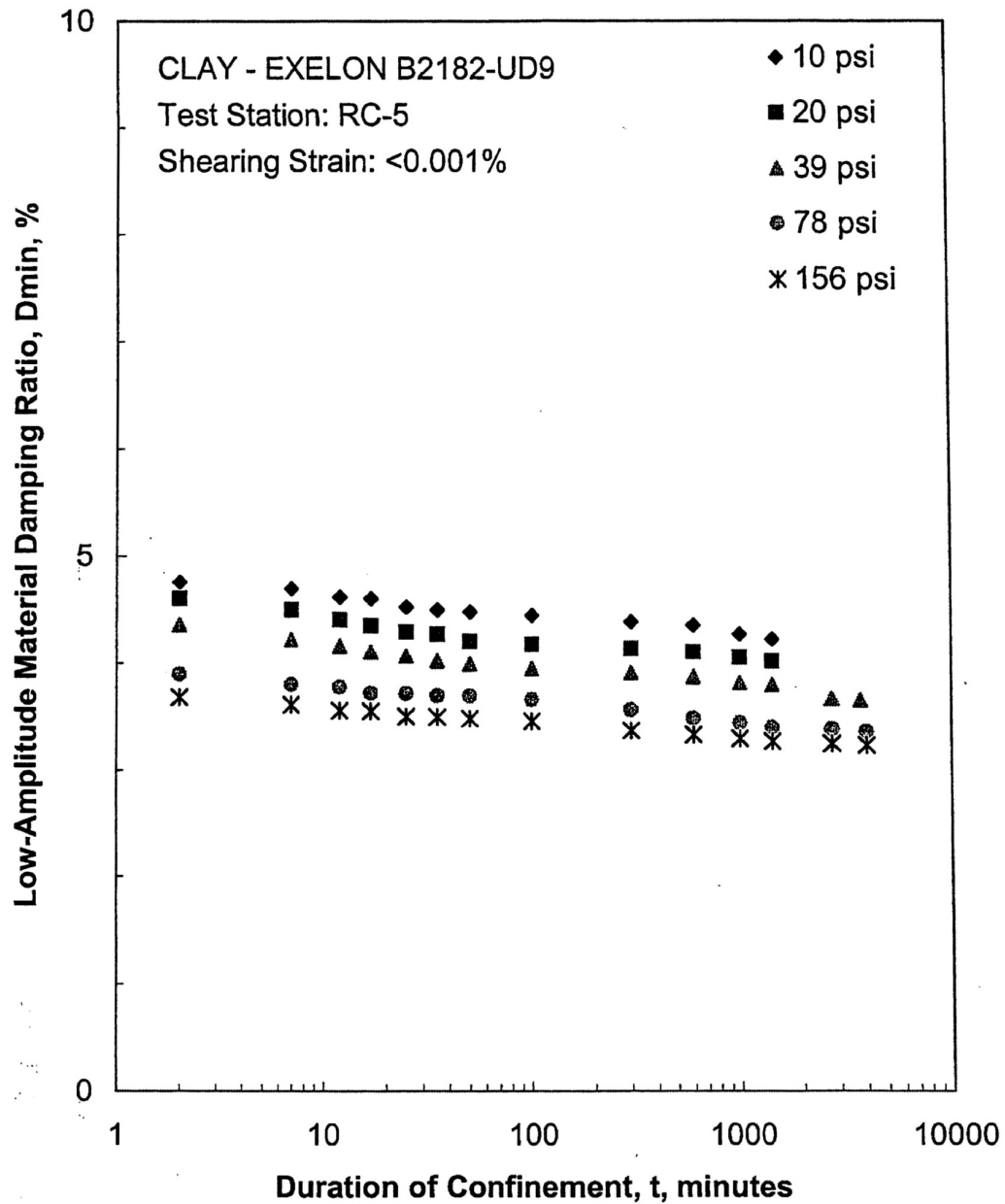


Figure E.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

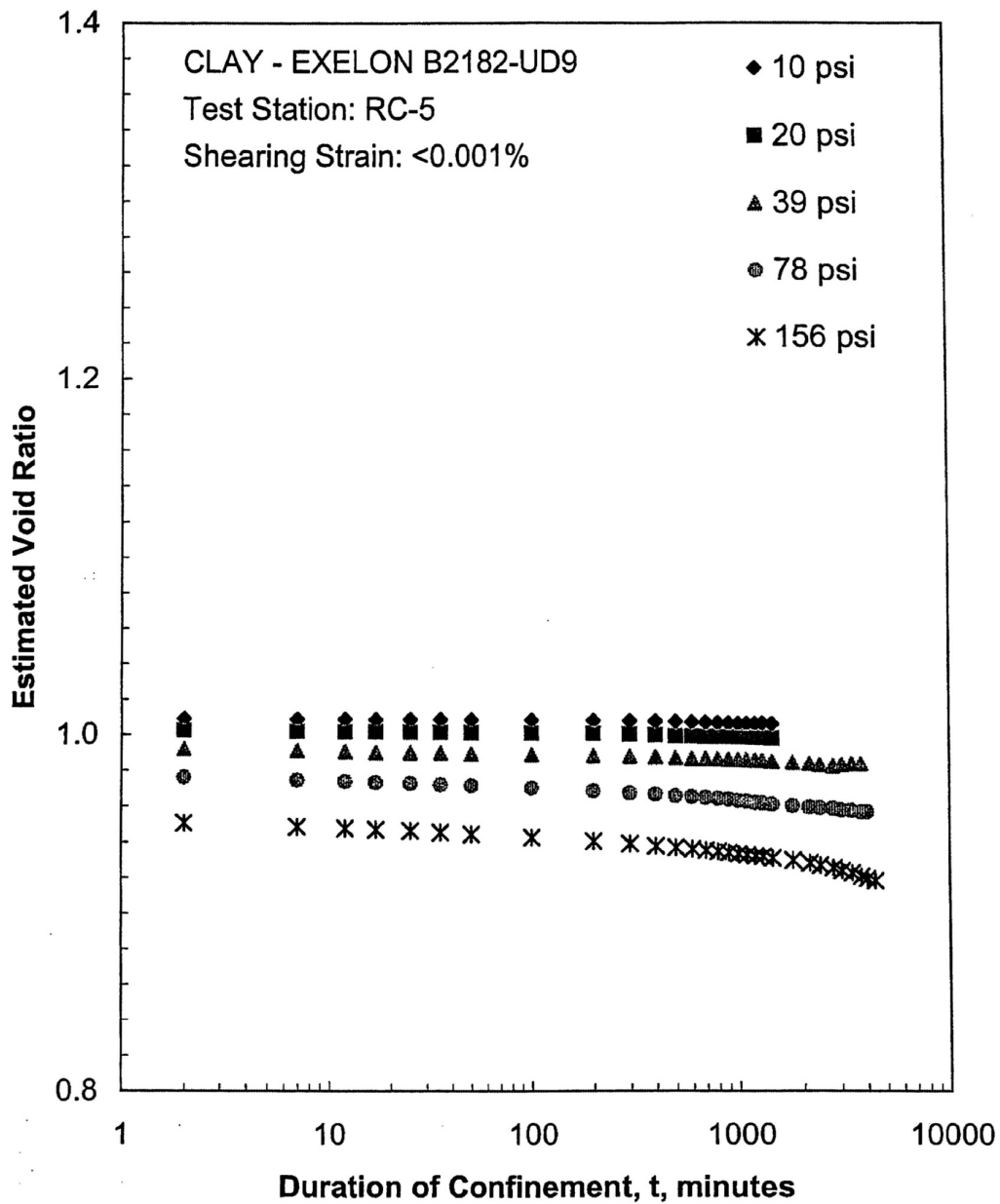


Figure E.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

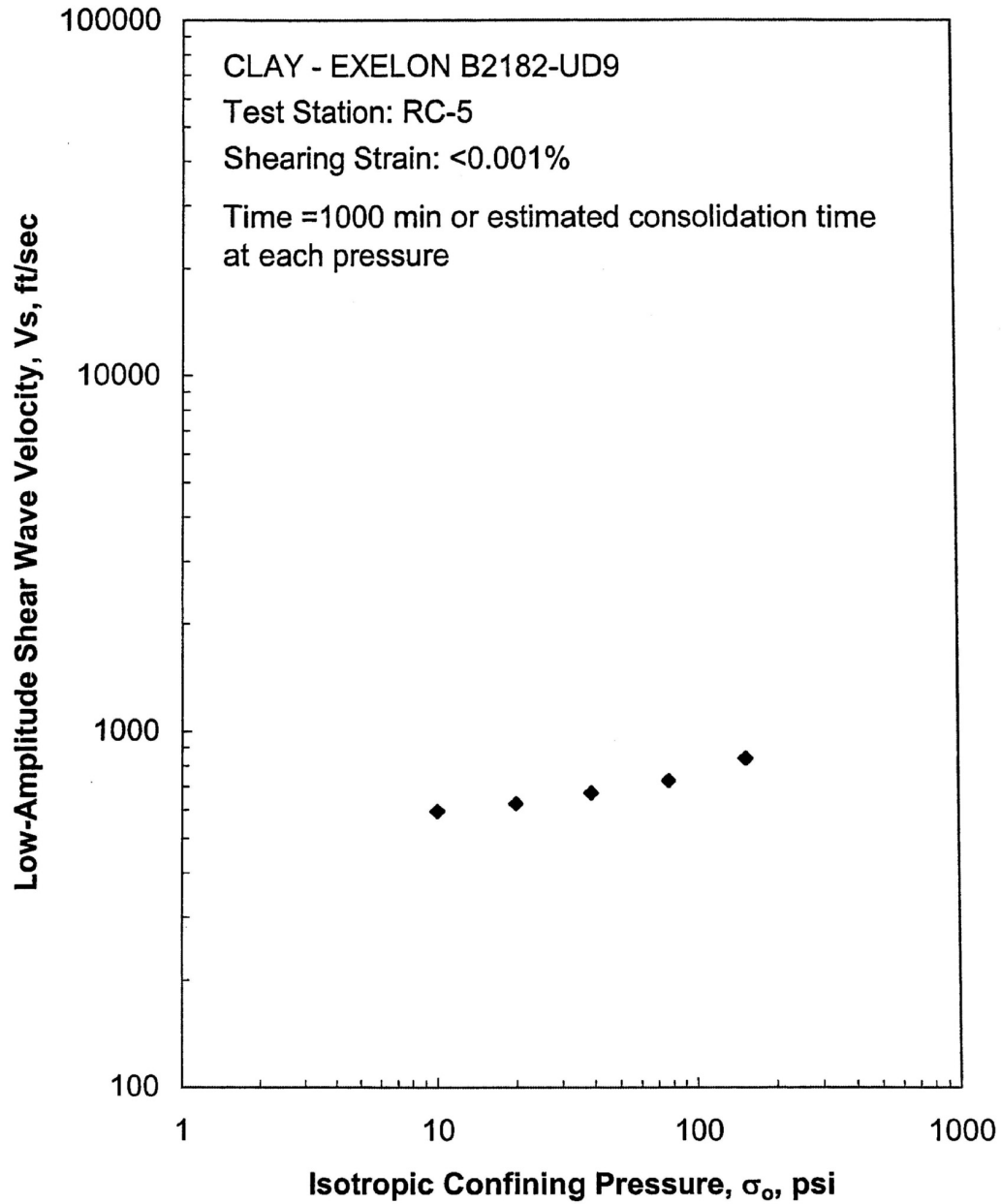


Figure E.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

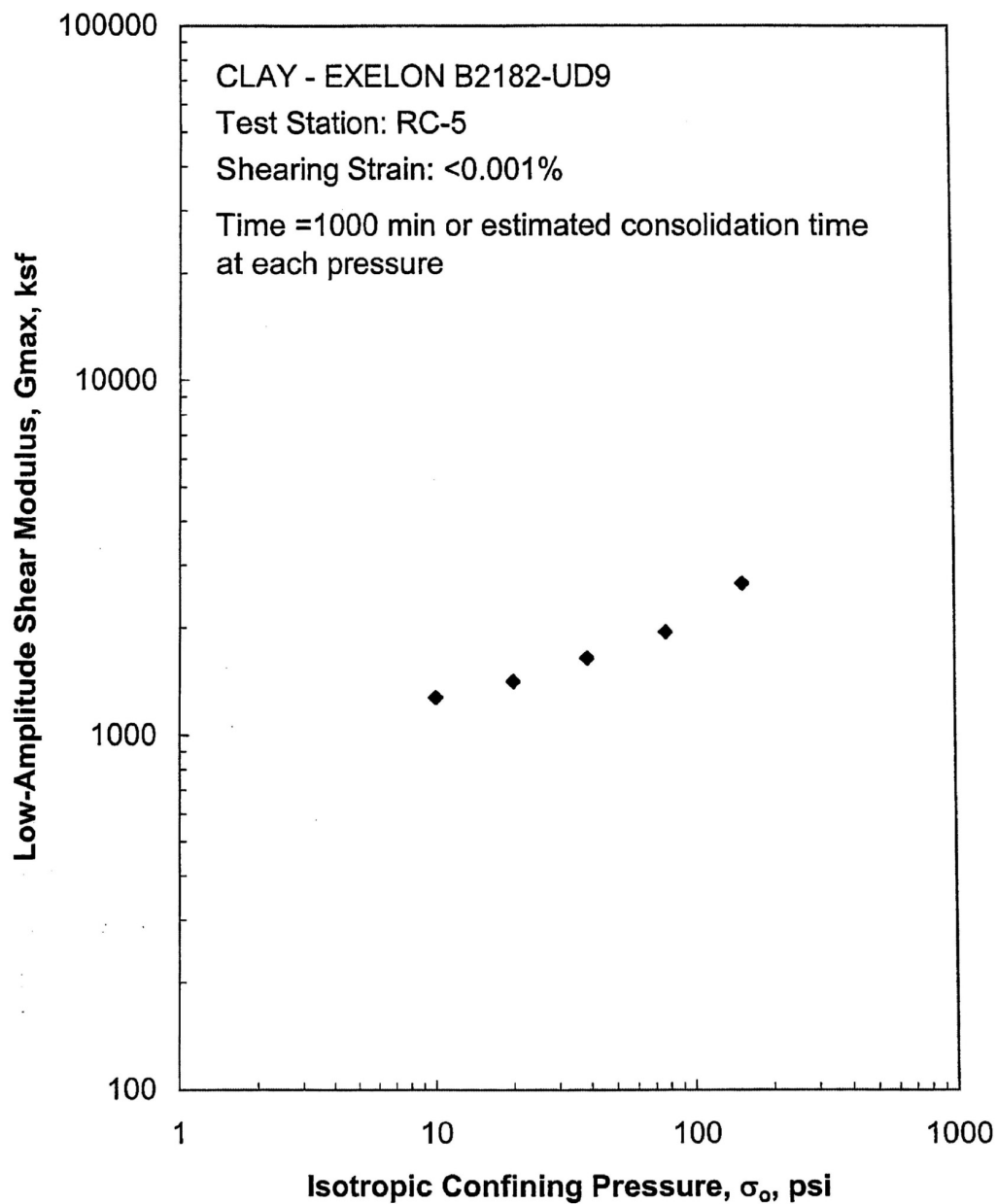


Figure E.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

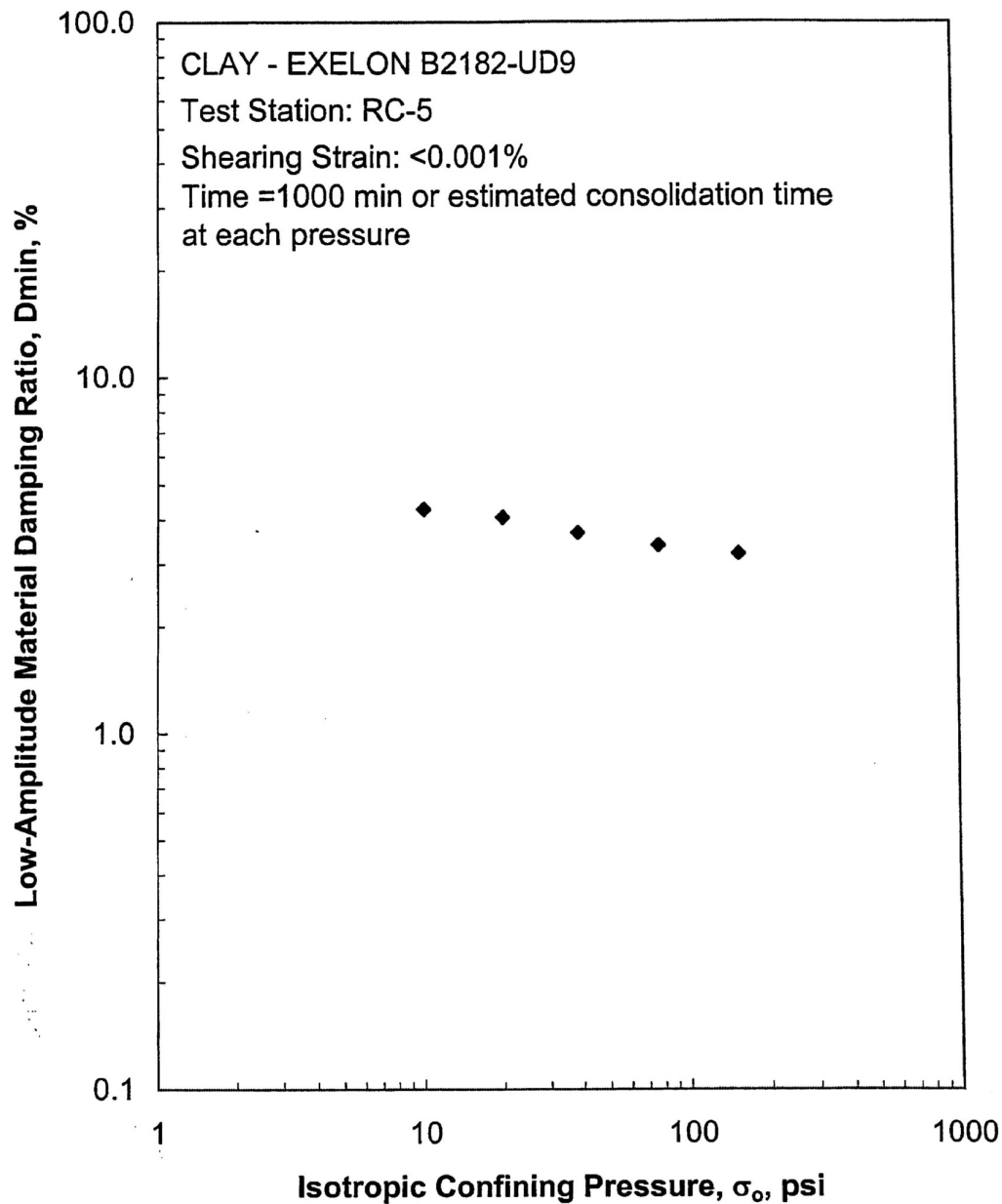


Figure E.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

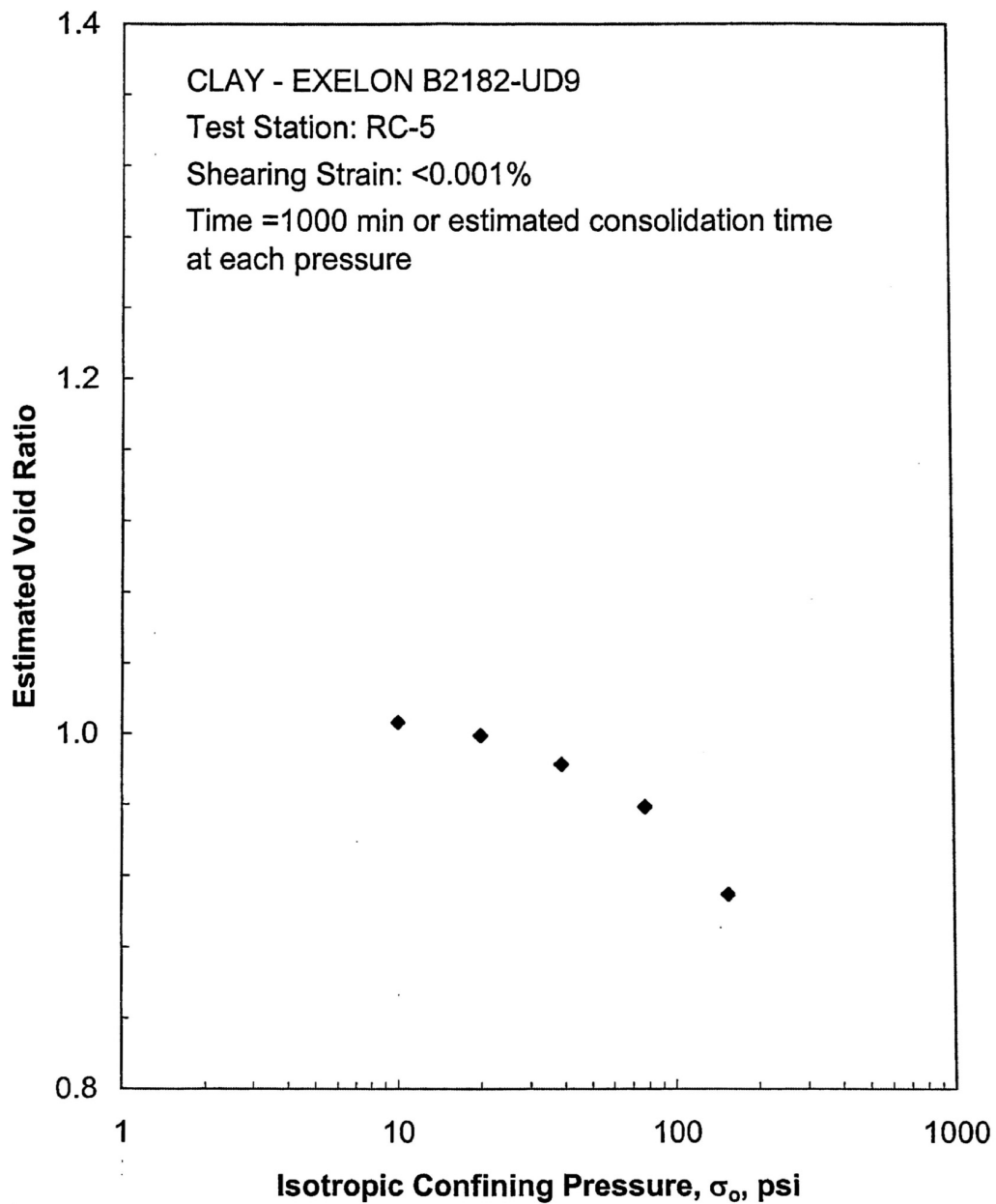


Figure E.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

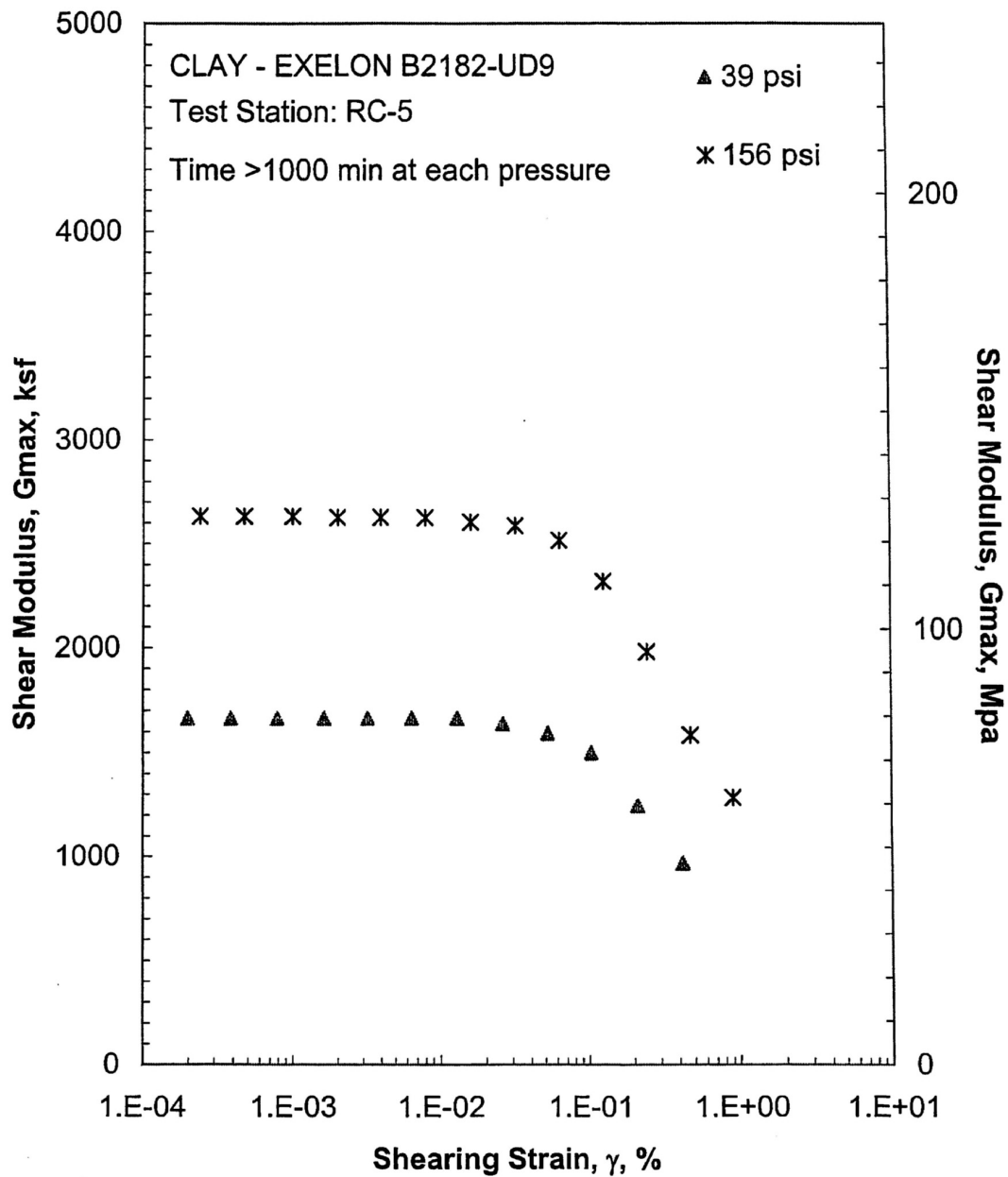


Figure E.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

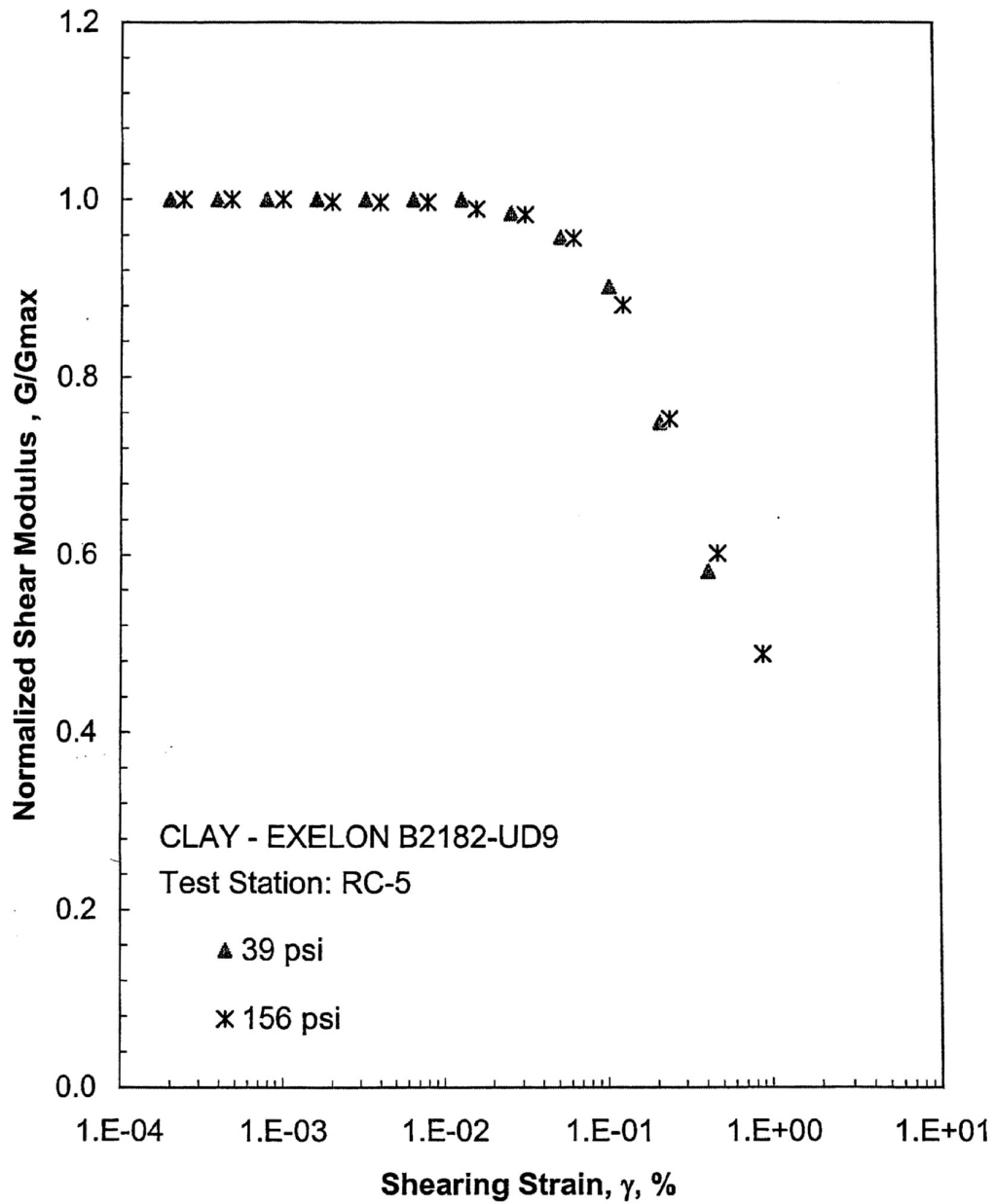


Figure E.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

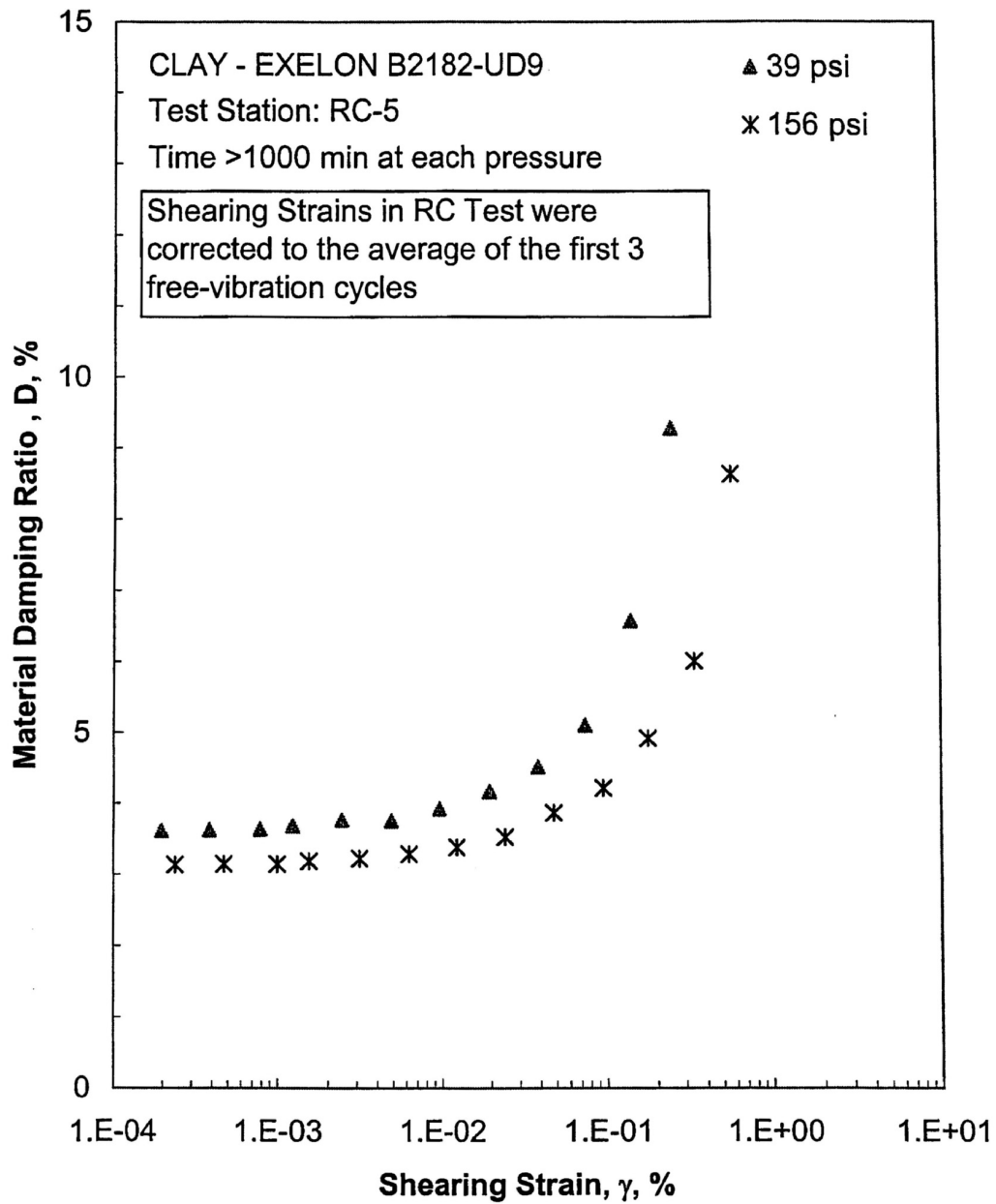


Figure E.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

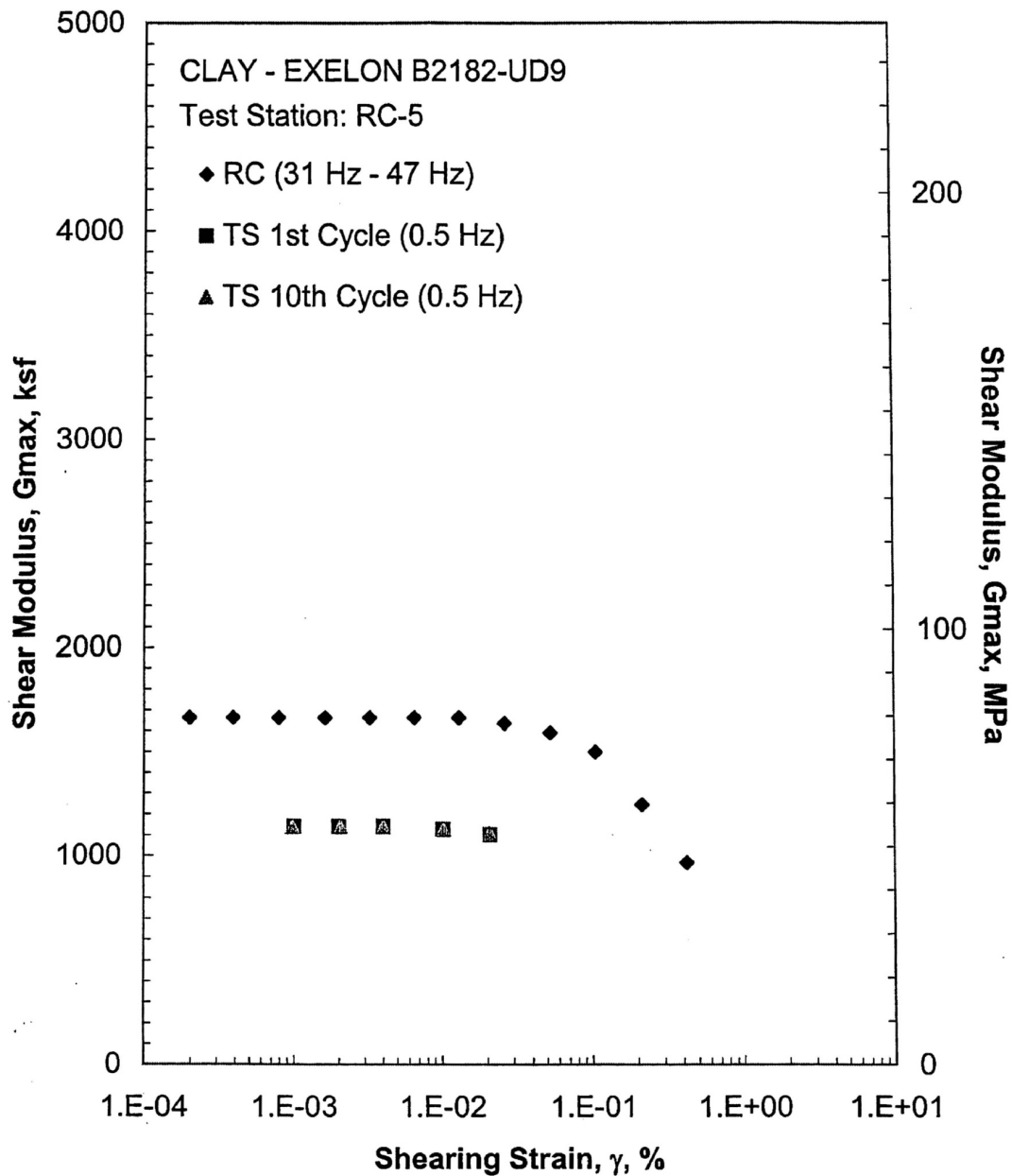


Figure E.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

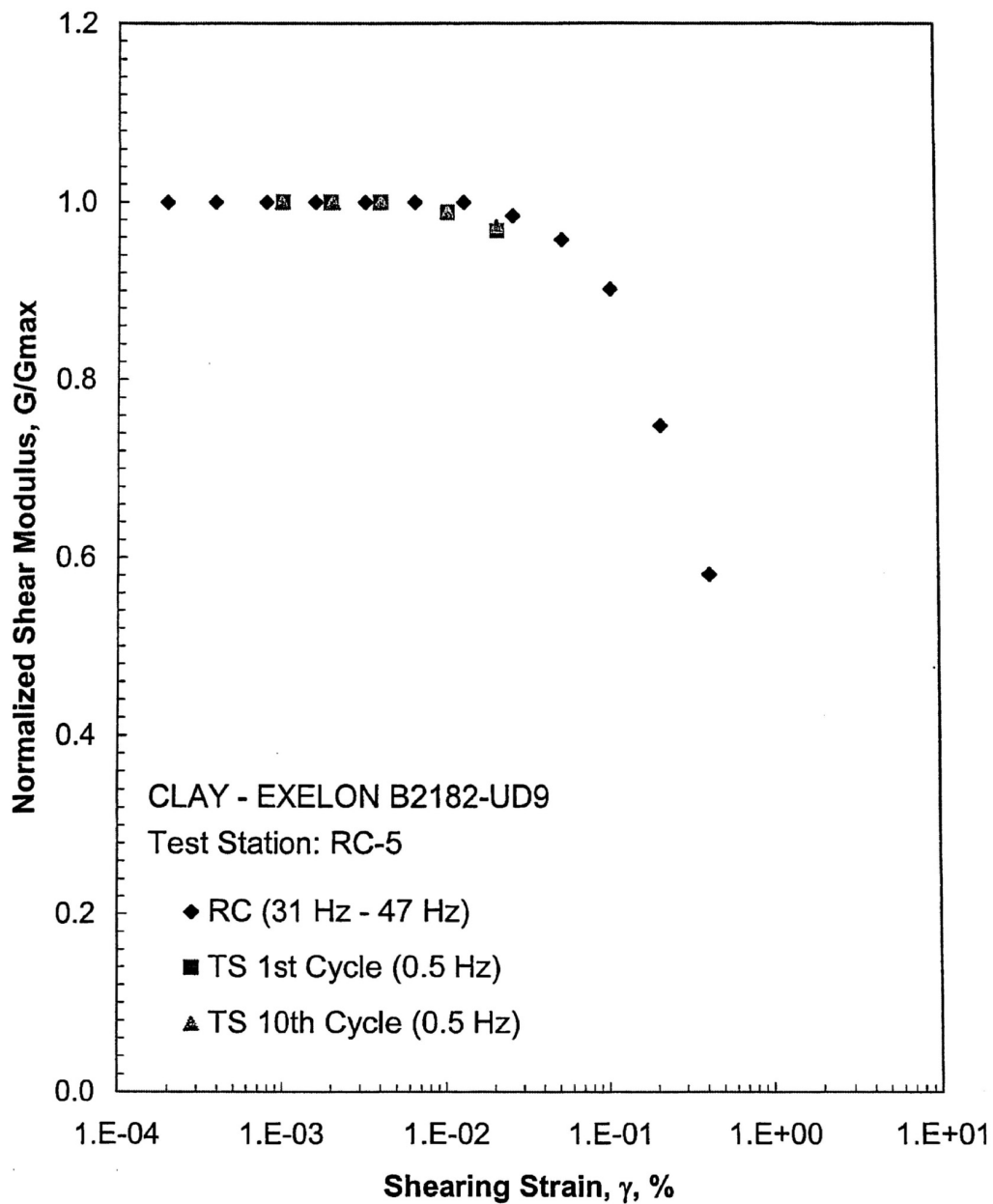


Figure E.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

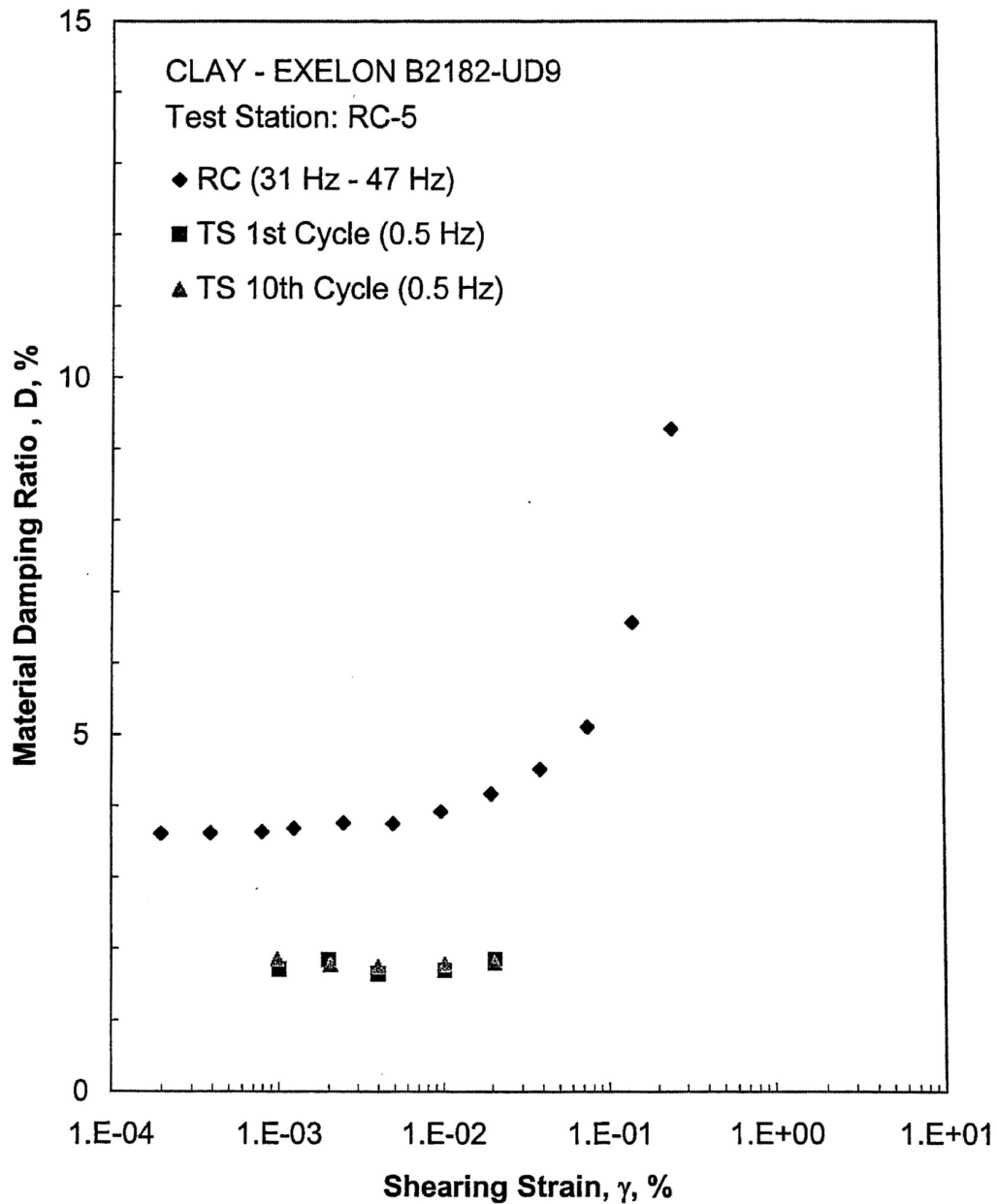


Figure E.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

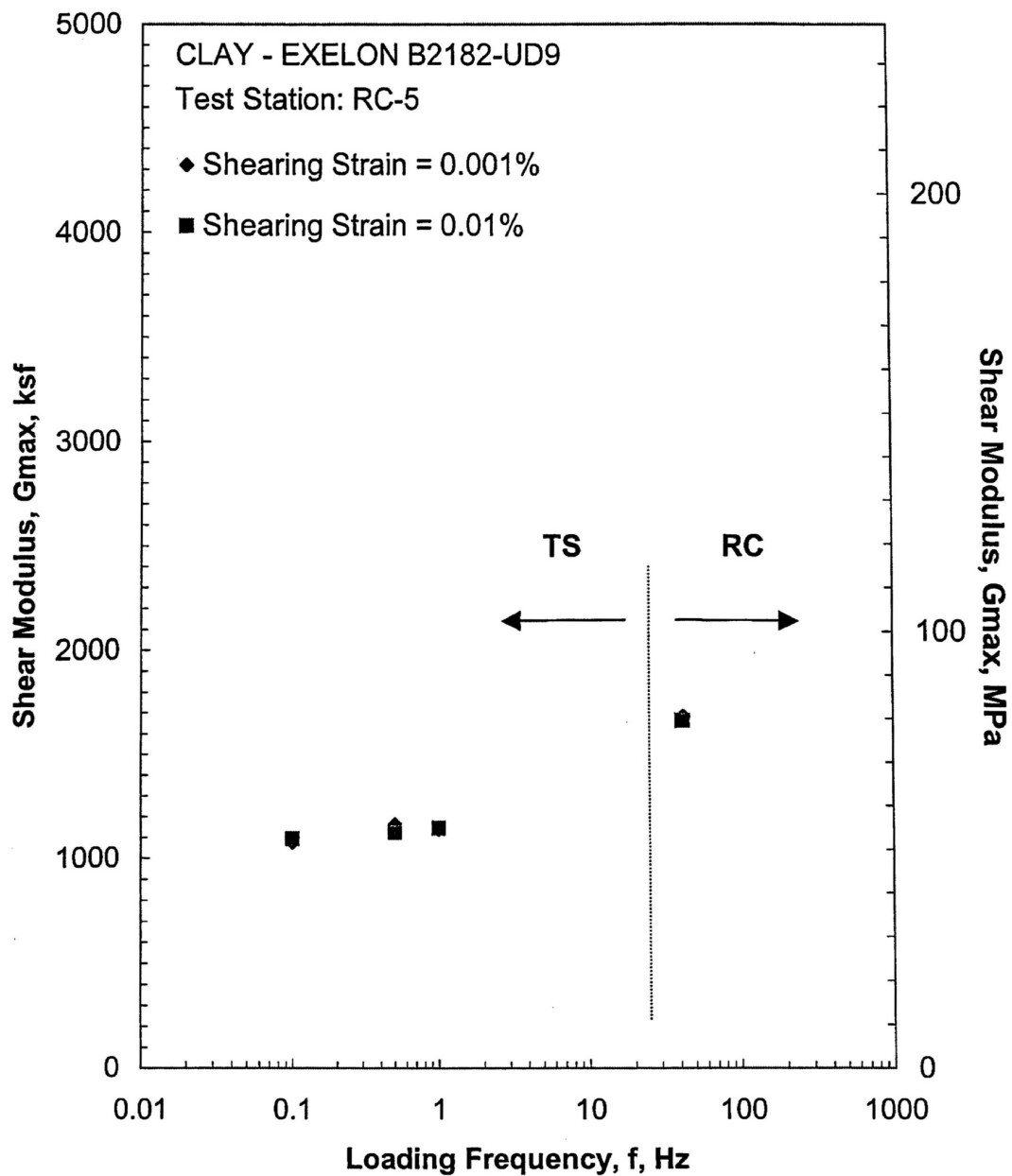


Figure E.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

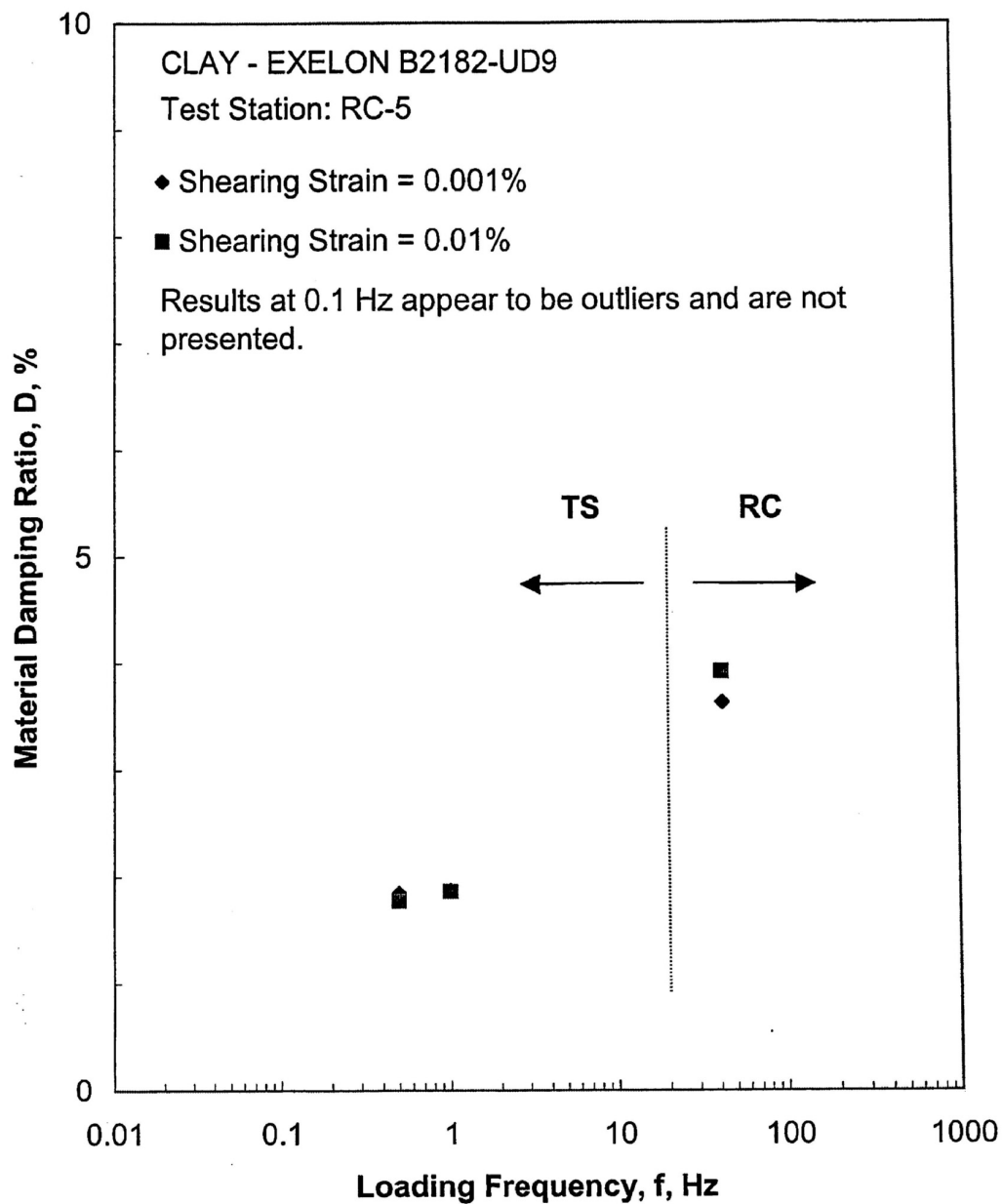


Figure E.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

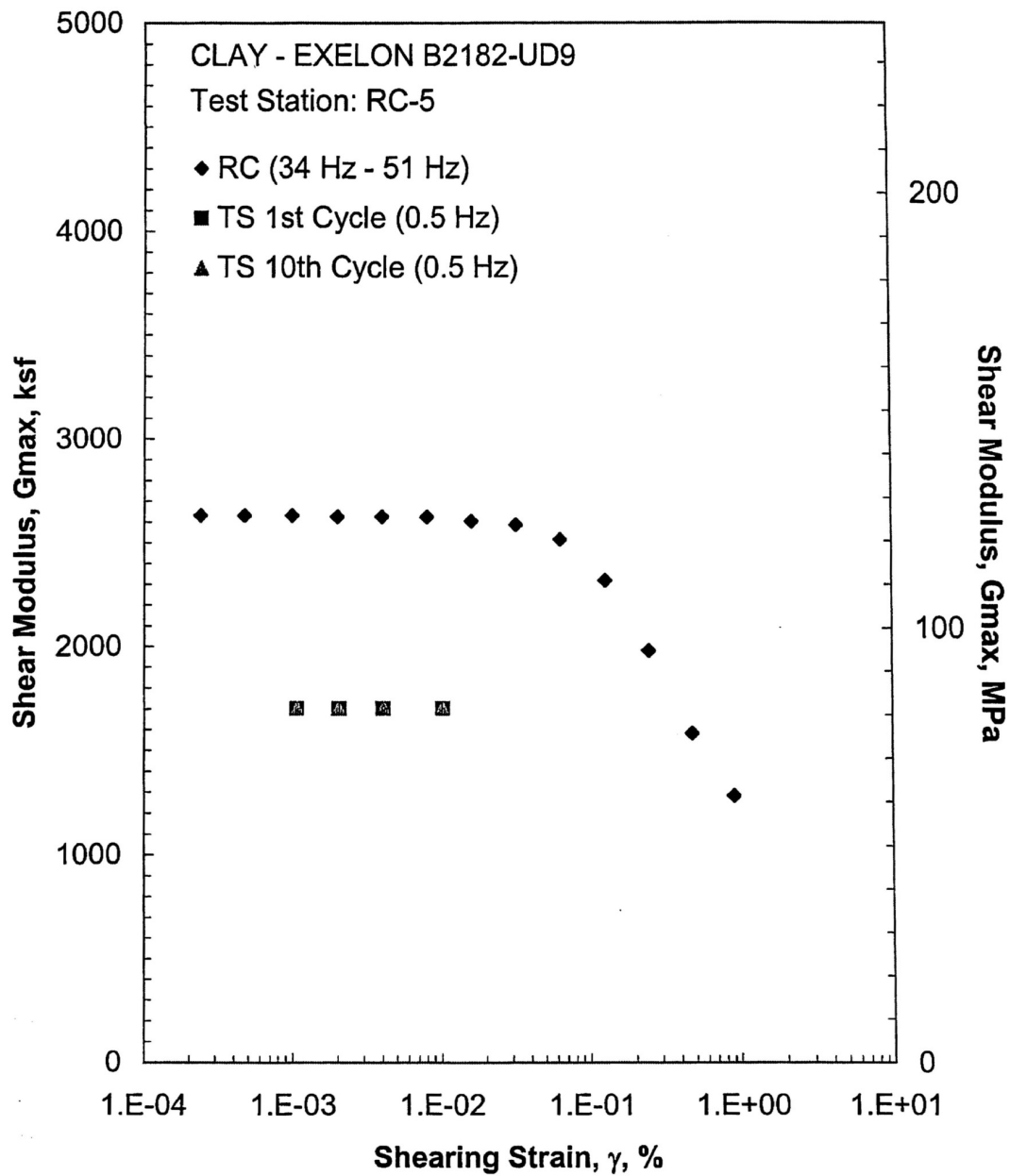


Figure E.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

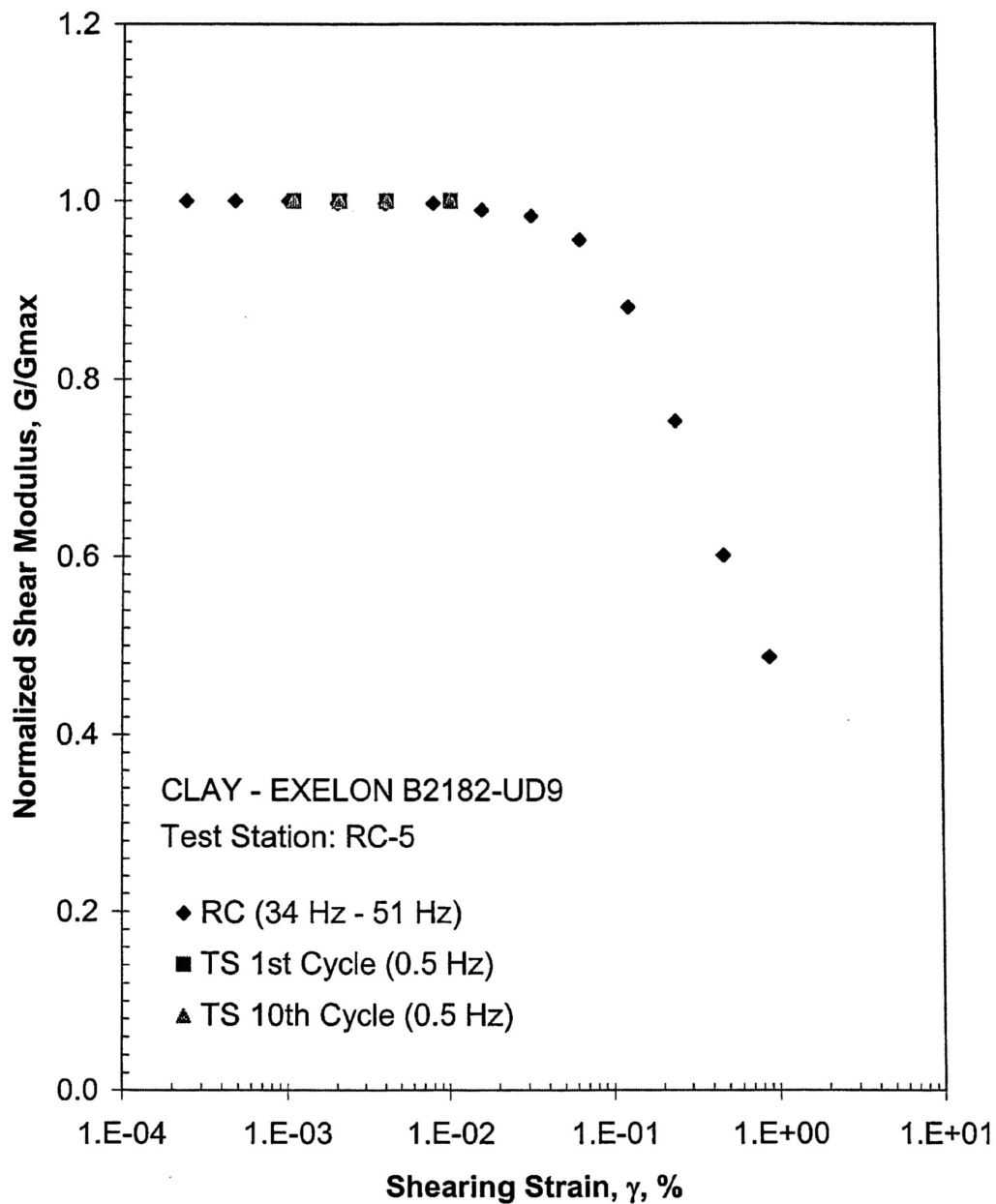


Figure E.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

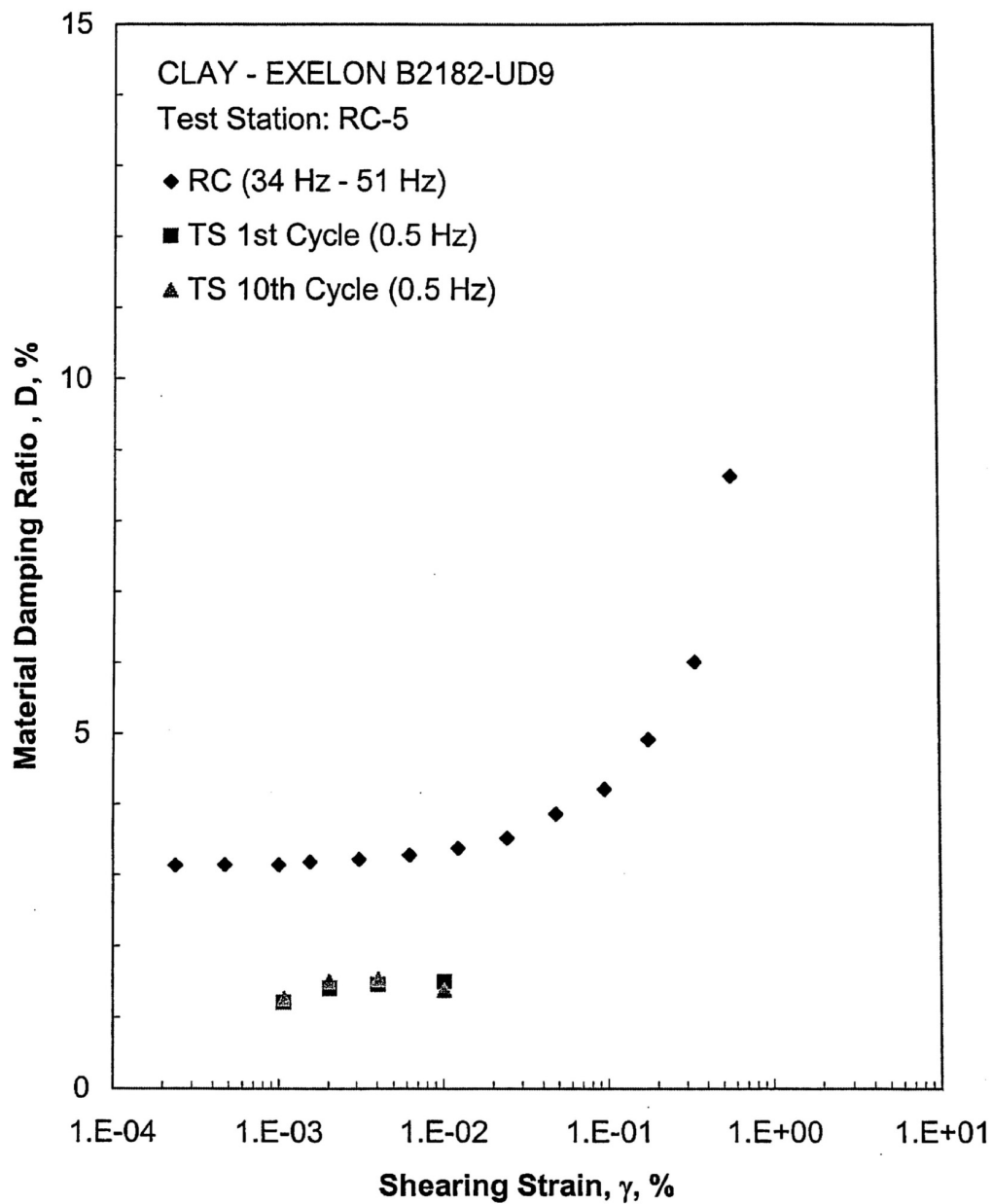


Figure E.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

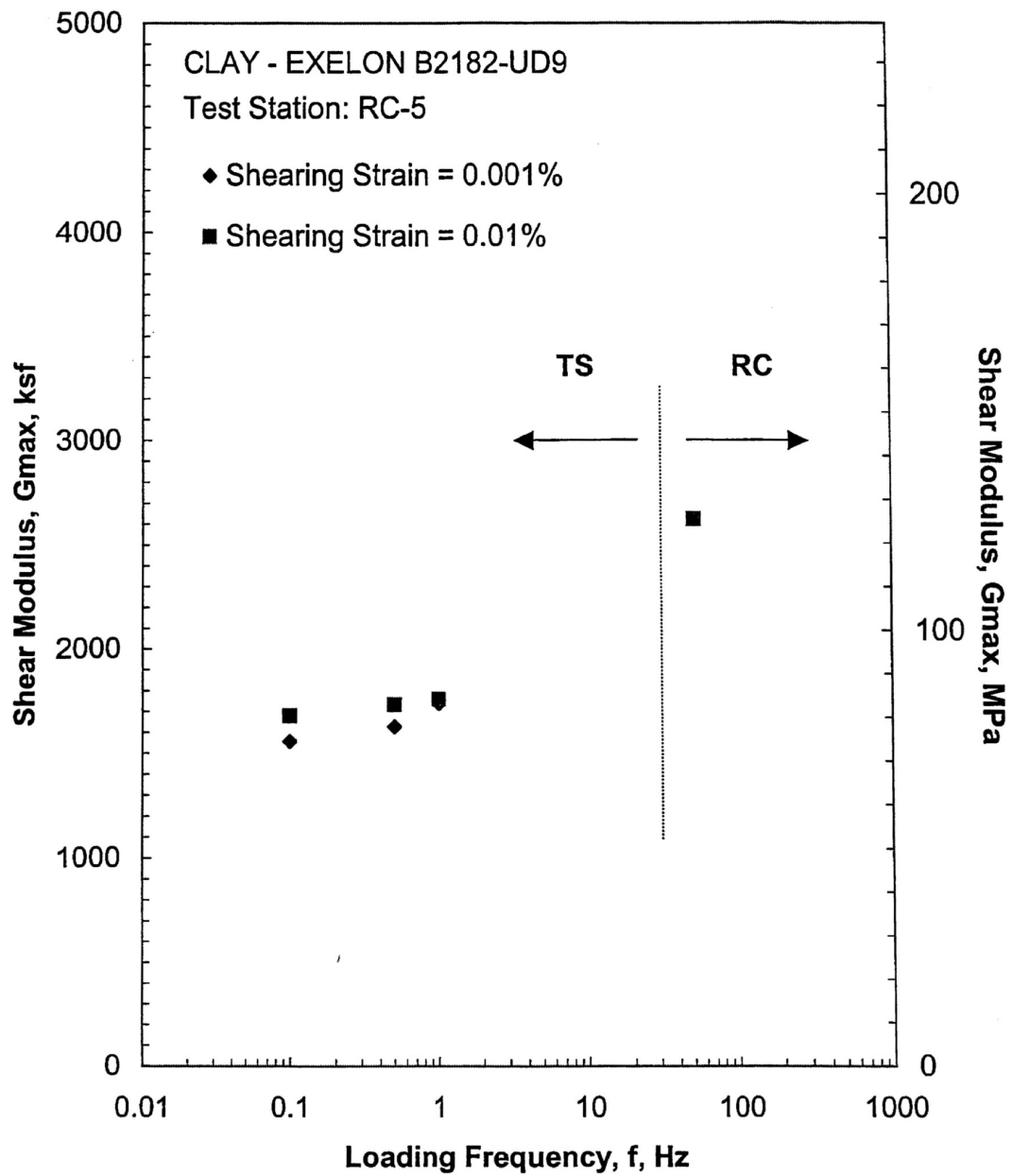


Figure E.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

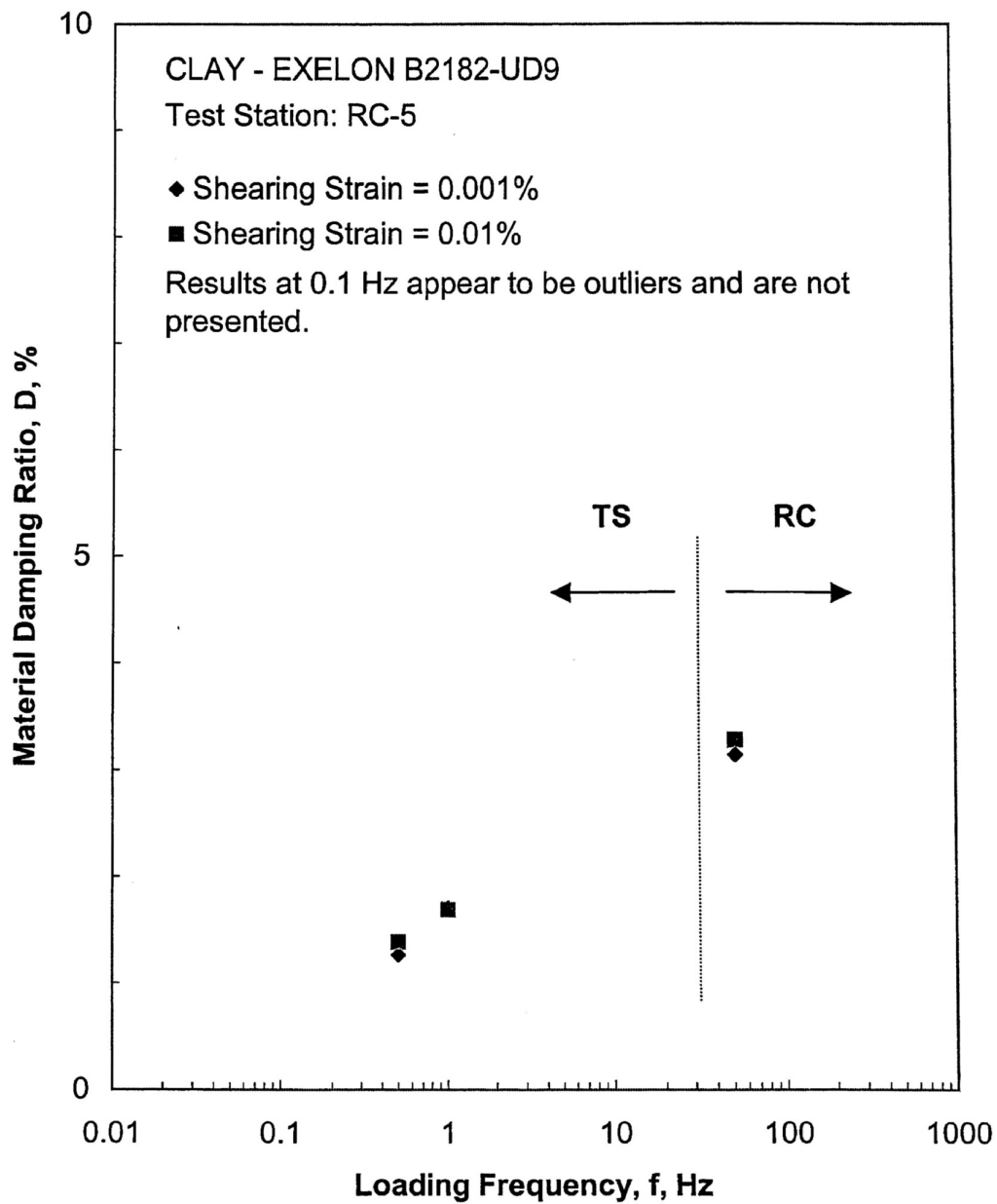


Figure E.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

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 B2182-UD9

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
10	1440	69	1276	61	596	4.27	1.01
20	2880	138	1416	68	627	4.05	1.00
39	5616	269	1642	79	672	3.67	0.98
78	11232	537	1944	93	727	3.38	0.96
156	22464	1075	2665	128	840	3.20	0.91

Table E.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen EXELON B2182-UD9; Isotropic Confining Pressure, $\sigma_0=39$ psi (5.6 ksf = 269 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average ⁺ Shearing Strain, %	Material Damping Ratio ^x , D, %
1.97E-04	1663	1.00	1.97E-04	3.61
3.86E-04	1663	1.00	3.86E-04	3.62
7.87E-04	1663	1.00	7.87E-04	3.63
1.61E-03	1663	1.00	1.24E-03	3.68
3.22E-03	1663	1.00	2.44E-03	3.76
6.44E-03	1663	1.00	4.89E-03	3.75
1.28E-02	1663	1.00	9.63E-03	3.92
2.59E-02	1637	0.98	1.97E-02	4.17
5.25E-02	1592	0.96	3.88E-02	4.52
1.05E-01	1499	0.90	7.44E-02	5.11
2.14E-01	1245	0.75	1.41E-01	6.58
4.21E-01	966	0.58	2.49E-01	9.28

⁺ 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 B2182-UD9; Isotropic Confining Pressure, $\sigma_o = 39$ psi (5.6 ksf = 269 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	1140	1.00	1.71	9.82E-04	1139	1.00	1.85
1.99E-03	1140	1.00	1.85	2.05E-03	1139	1.00	1.77
3.99E-03	1140	1.00	1.65	3.99E-03	1139	1.00	1.75
1.02E-02	1127	0.99	1.69	1.02E-02	1126	0.99	1.78
2.07E-02	1103	0.97	1.85	2.07E-02	1108	0.97	1.80

Table E.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2182-UD9; Isotropic Confining Pressure, $\sigma_o = 156$ psi (22.5 ksf = 1075 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average* Shearing Strain, %	Material Damping Ratio ^x , D, %
2.39E-04	2632	1.00	2.39E-04	3.14
4.74E-04	2632	1.00	4.74E-04	3.14
9.98E-04	2632	1.00	9.98E-04	3.14
1.99E-03	2625	1.00	1.55E-03	3.18
3.97E-03	2625	1.00	3.13E-03	3.22
7.92E-03	2625	1.00	6.26E-03	3.28
1.59E-02	2605	0.99	1.24E-02	3.38
3.17E-02	2587	0.98	2.44E-02	3.53
6.34E-02	2516	0.96	4.82E-02	3.86
1.28E-01	2318	0.88	9.58E-02	4.22
2.47E-01	1981	0.75	1.78E-01	4.92
4.81E-01	1583	0.60	3.42E-01	6.01
9.08E-01	1283	0.49	5.72E-01	8.63

* 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 B2182-UD9; Isotropic Confining Pressure, $\sigma_o=156$ psi (22.5 ksf = 1075 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, %
1.07E-03	1702	1.00	1.21	1.08E-03	1703	1.00	1.26
2.04E-03	1702	1.00	1.40	2.03E-03	1703	1.00	1.50
4.04E-03	1702	1.00	1.46	4.06E-03	1703	1.00	1.53
1.02E-02	1702	1.00	1.50	1.01E-02	1703	1.00	1.38

APPENDIX F

Specimen B2274-UD14
(Index Properties Not Available)

Borehole B2274
Sample UD14
Depth = 267.5 ft (81.5 m)
Total Unit Weight = 130.0 lb/ft³
Water Content = 18.5 %
Estimated In-Situ K_o = 0.5
Estimated In-Situ Mean Effective
Stress = 91 psi

FUGRO JOB #: 0401-1686
Testing Station: RC5

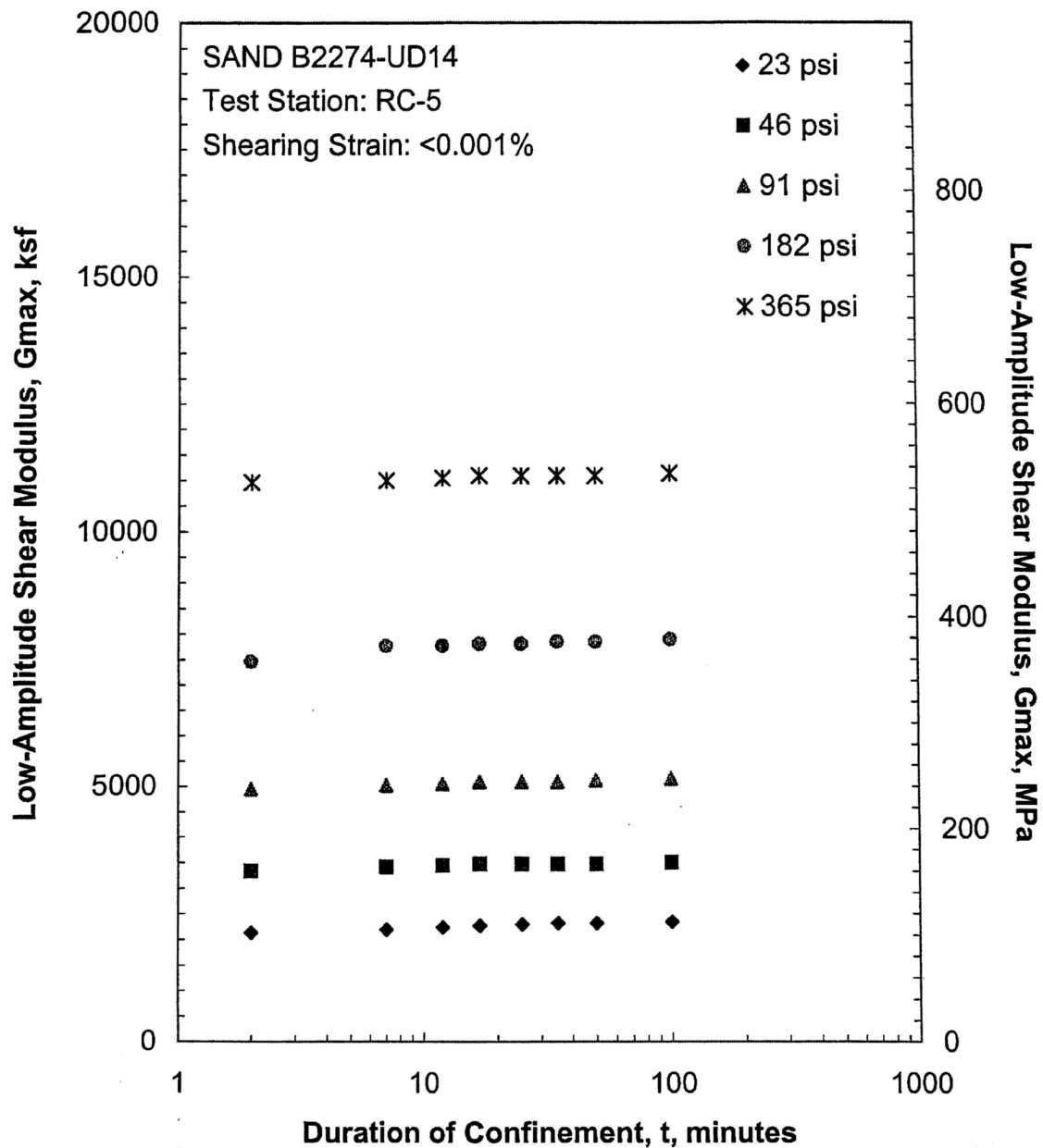


Figure F.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

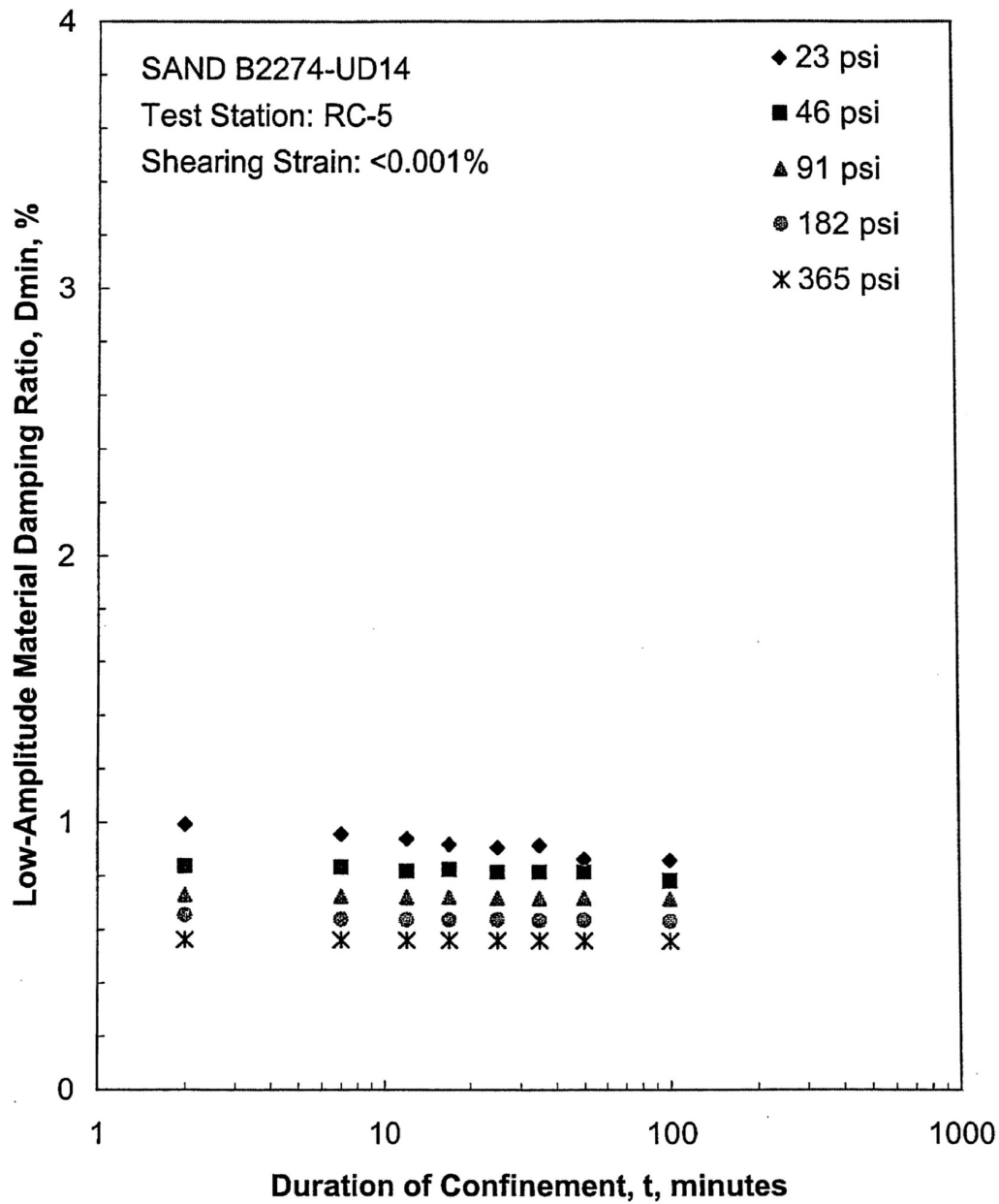


Figure F.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

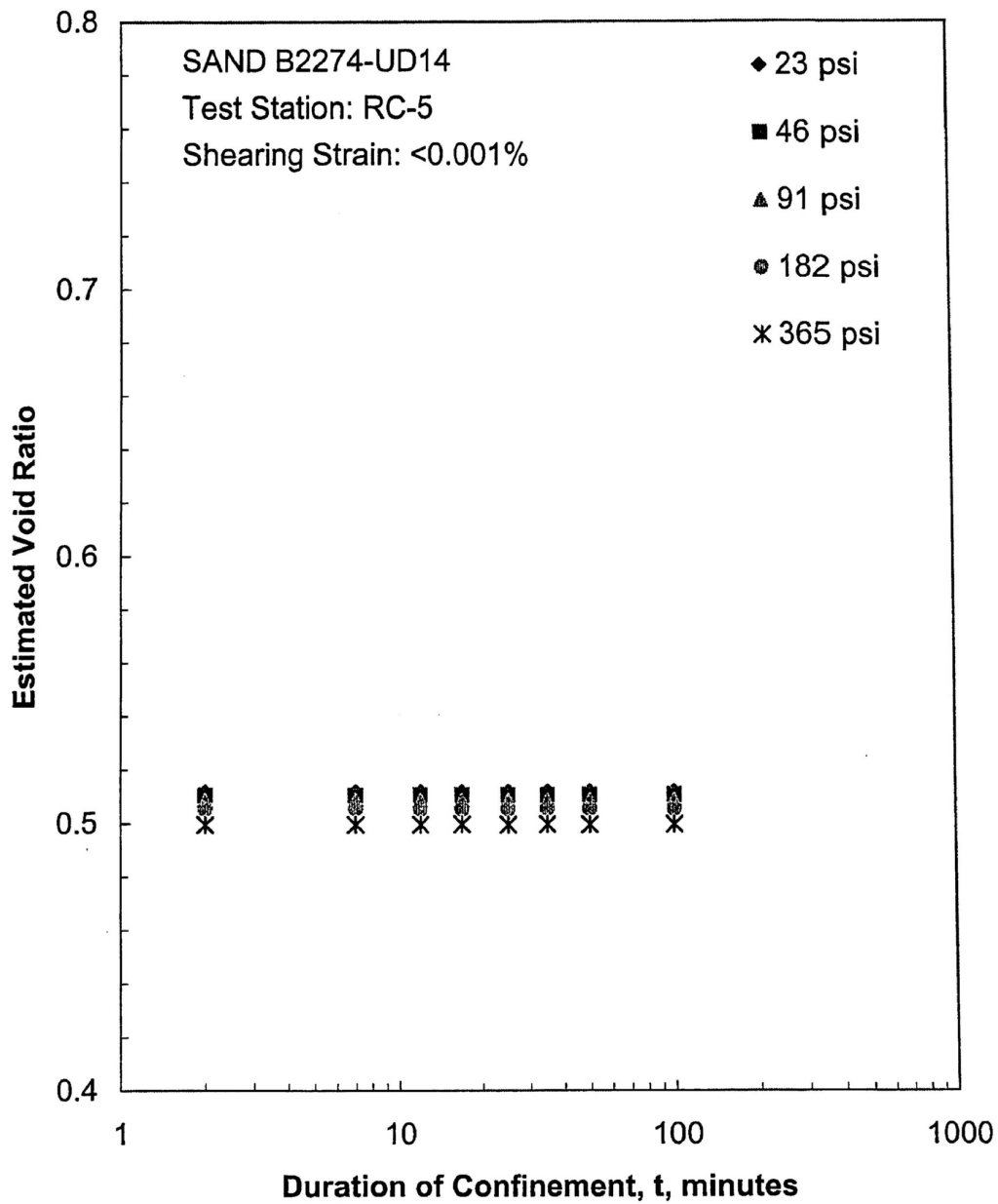


Figure F.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

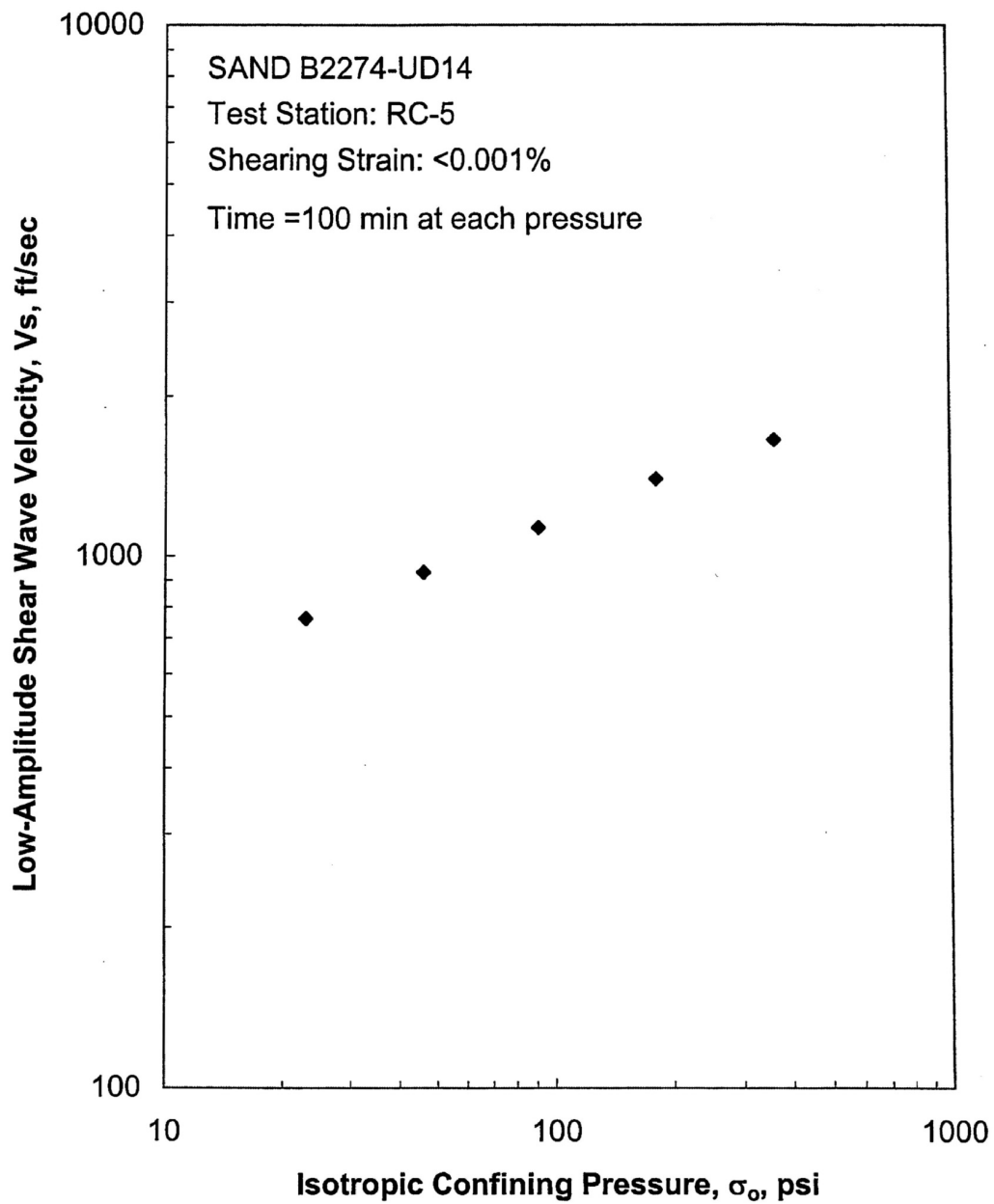


Figure F.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

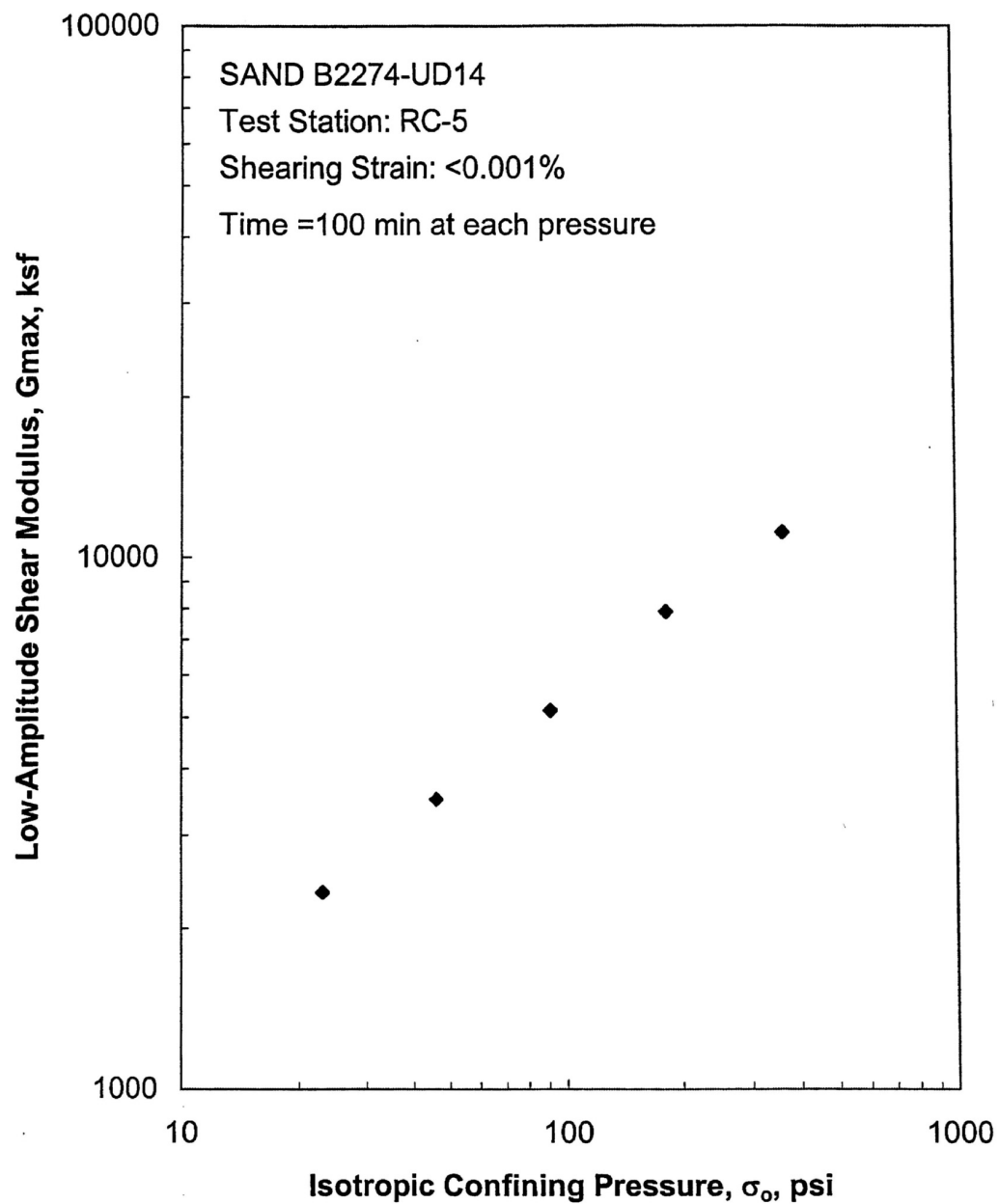


Figure F.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

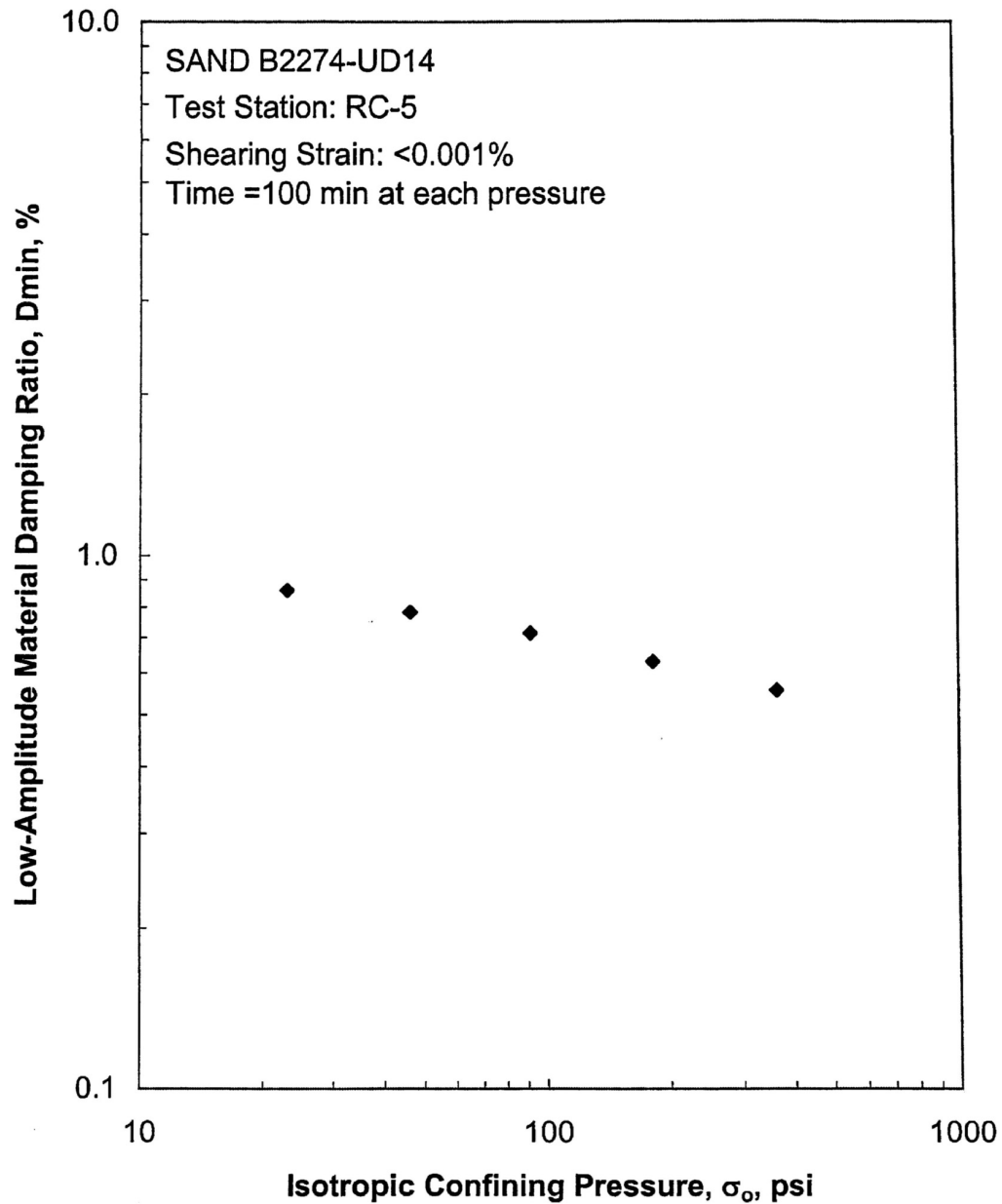


Figure F.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

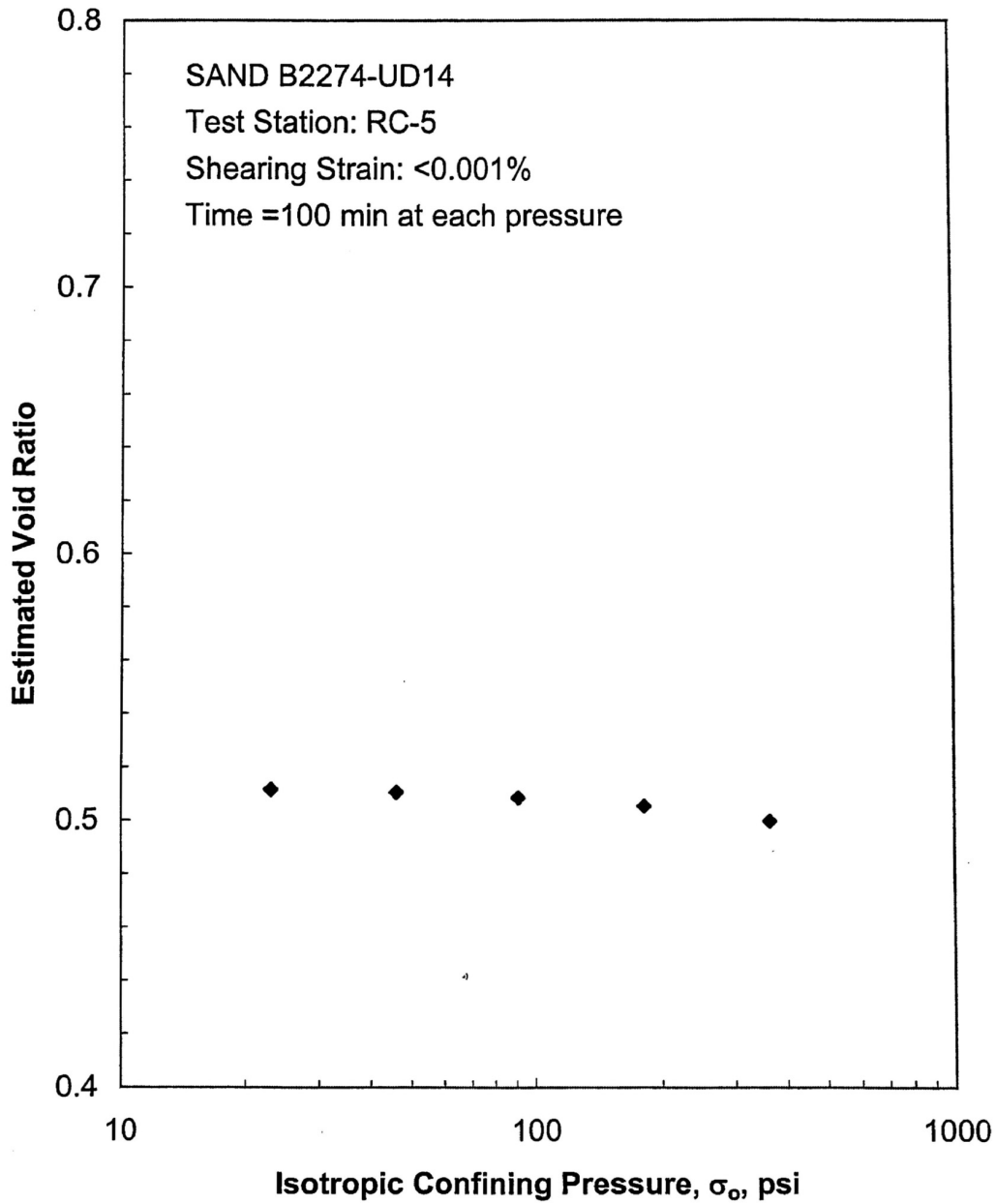


Figure F.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

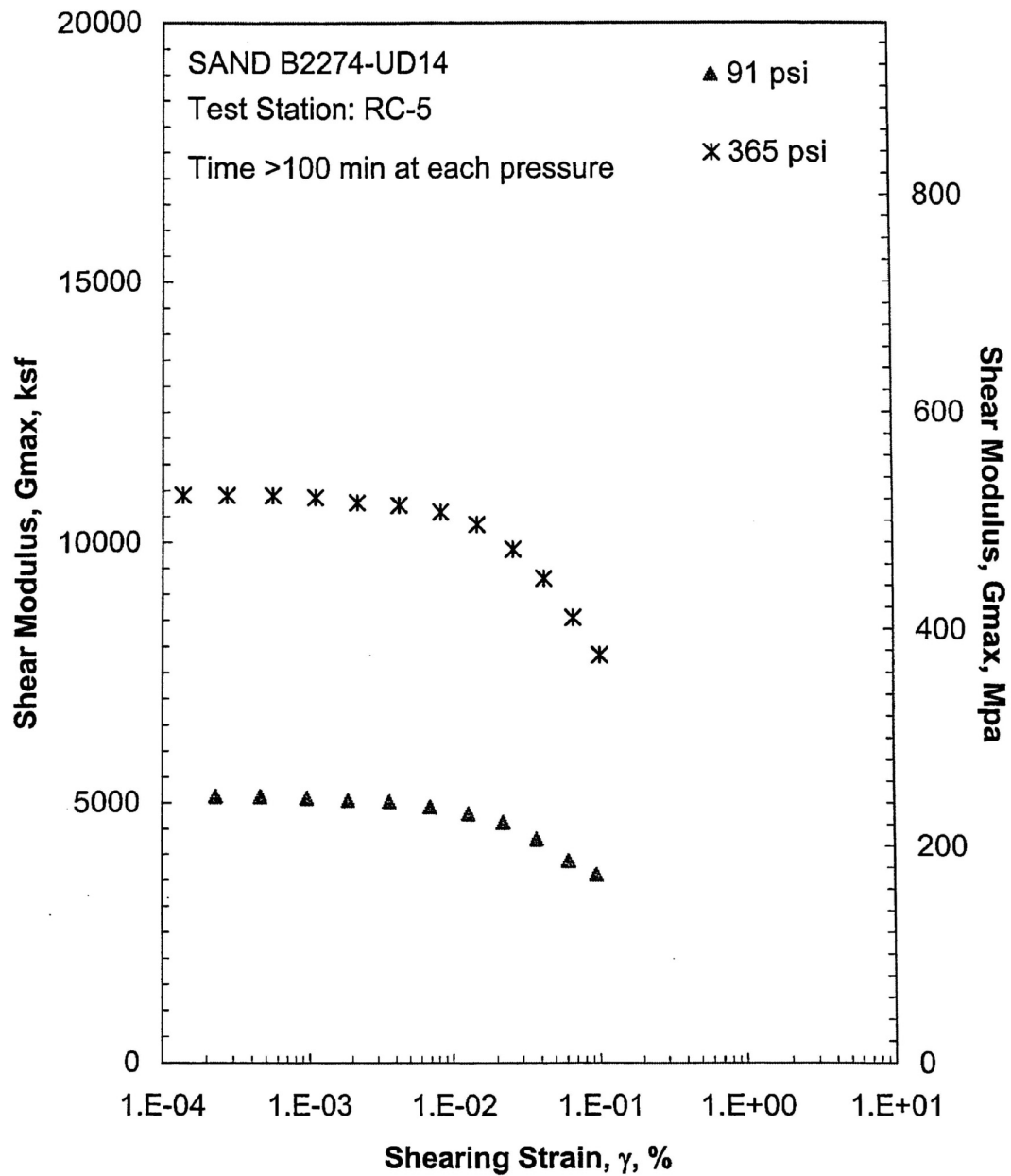


Figure F.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

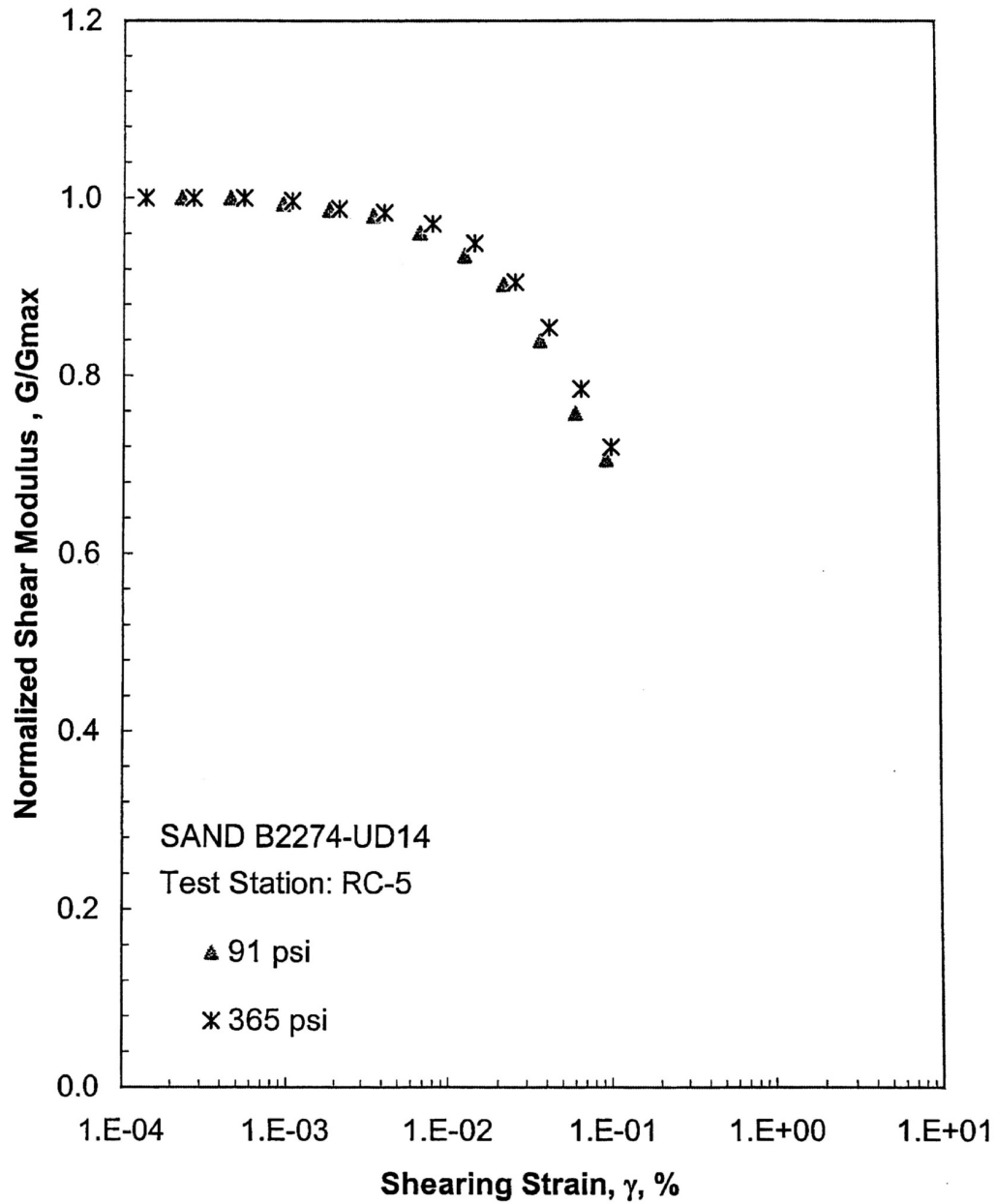


Figure F.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

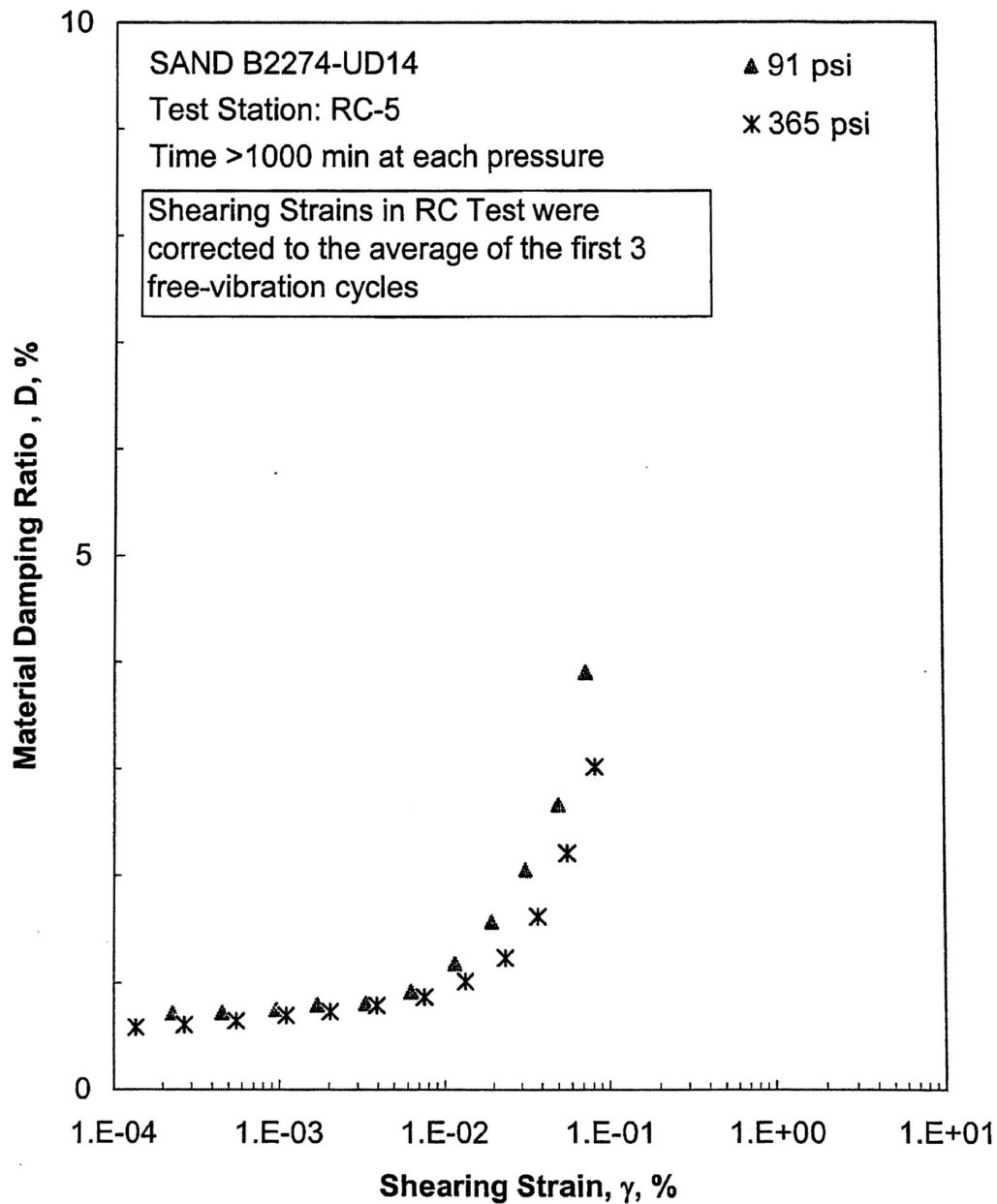


Figure F.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

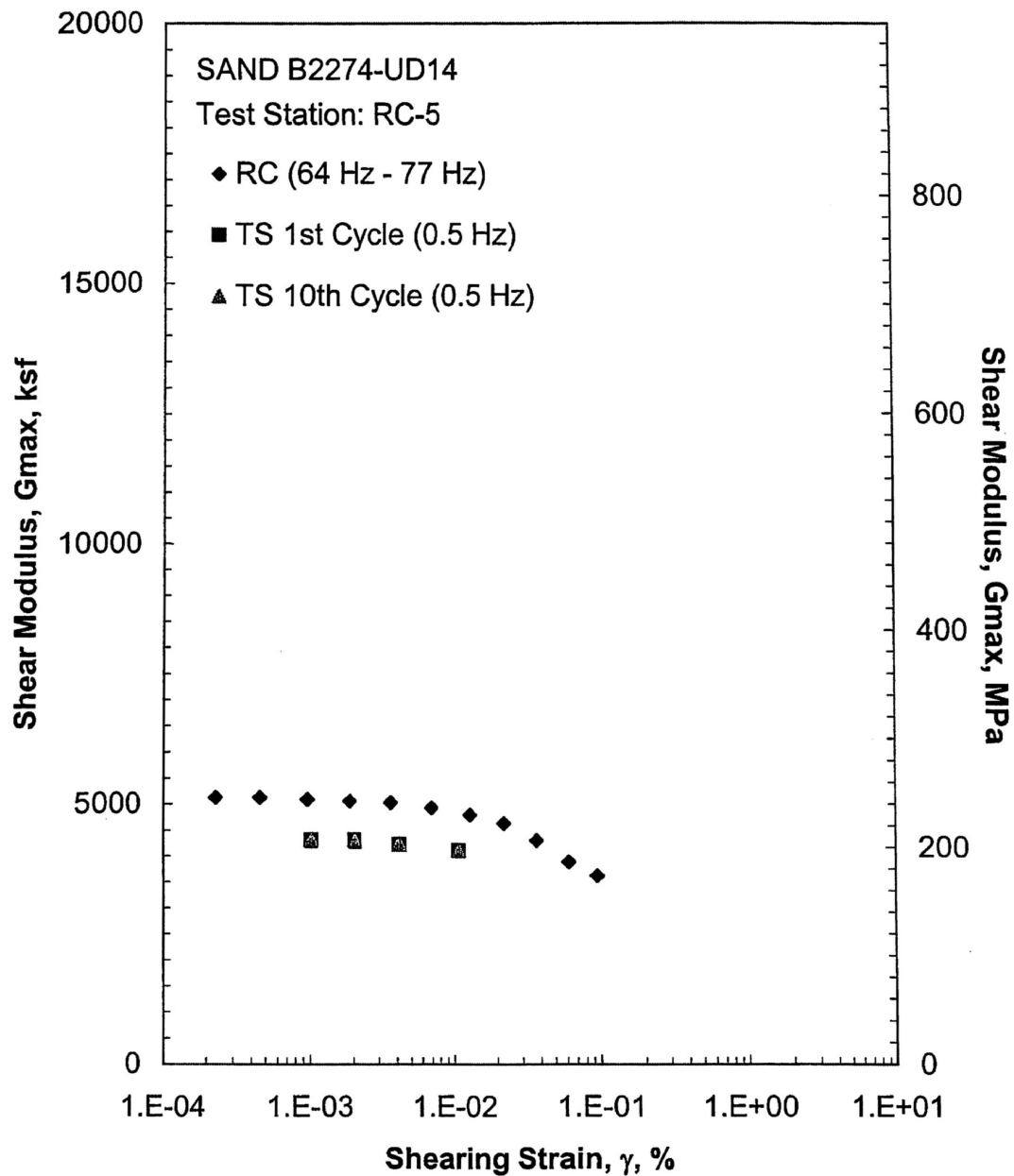


Figure F.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 91 psi from the Combined RCTS Tests

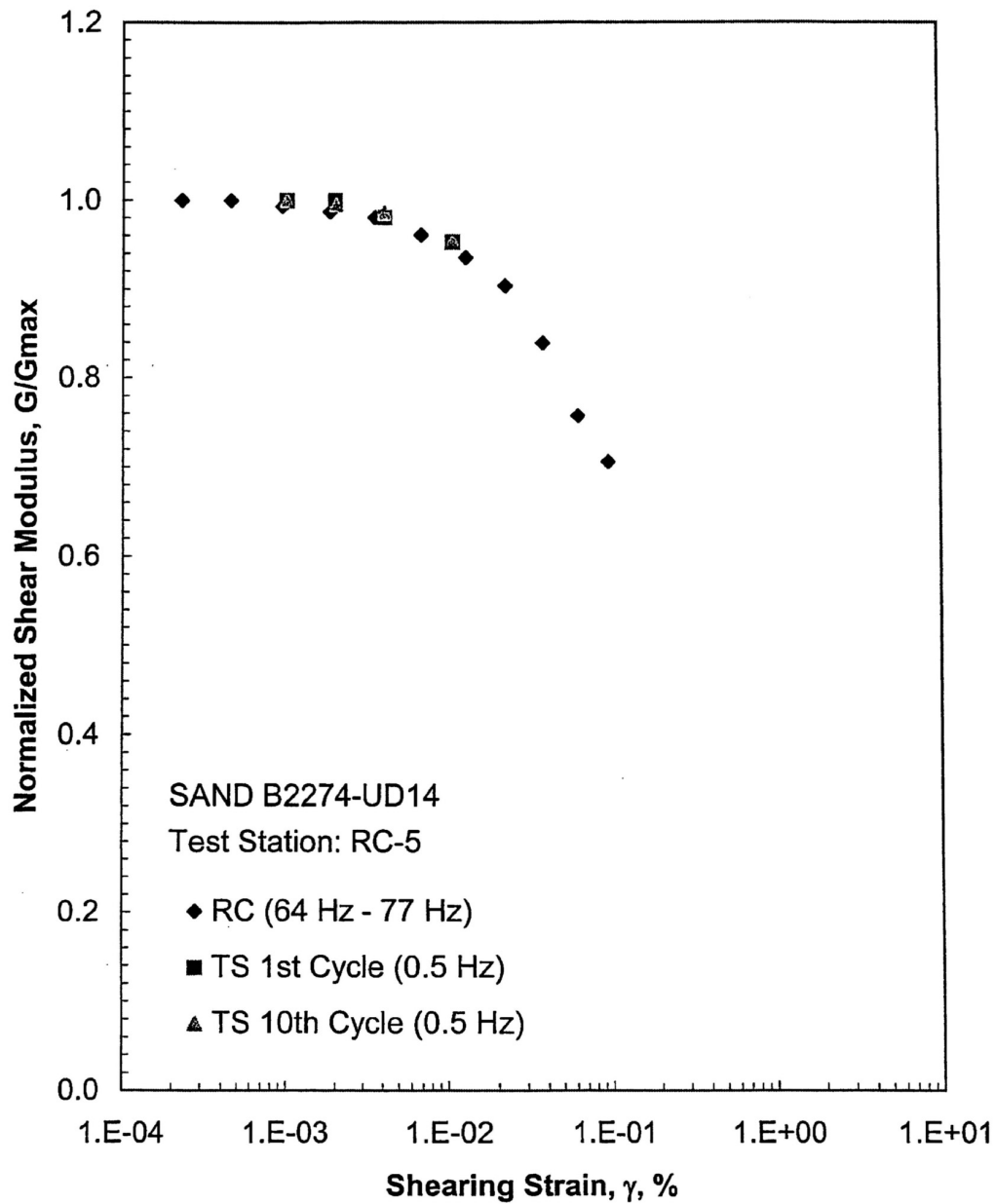


Figure F.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 91 psi from the Combined RCTS Tests

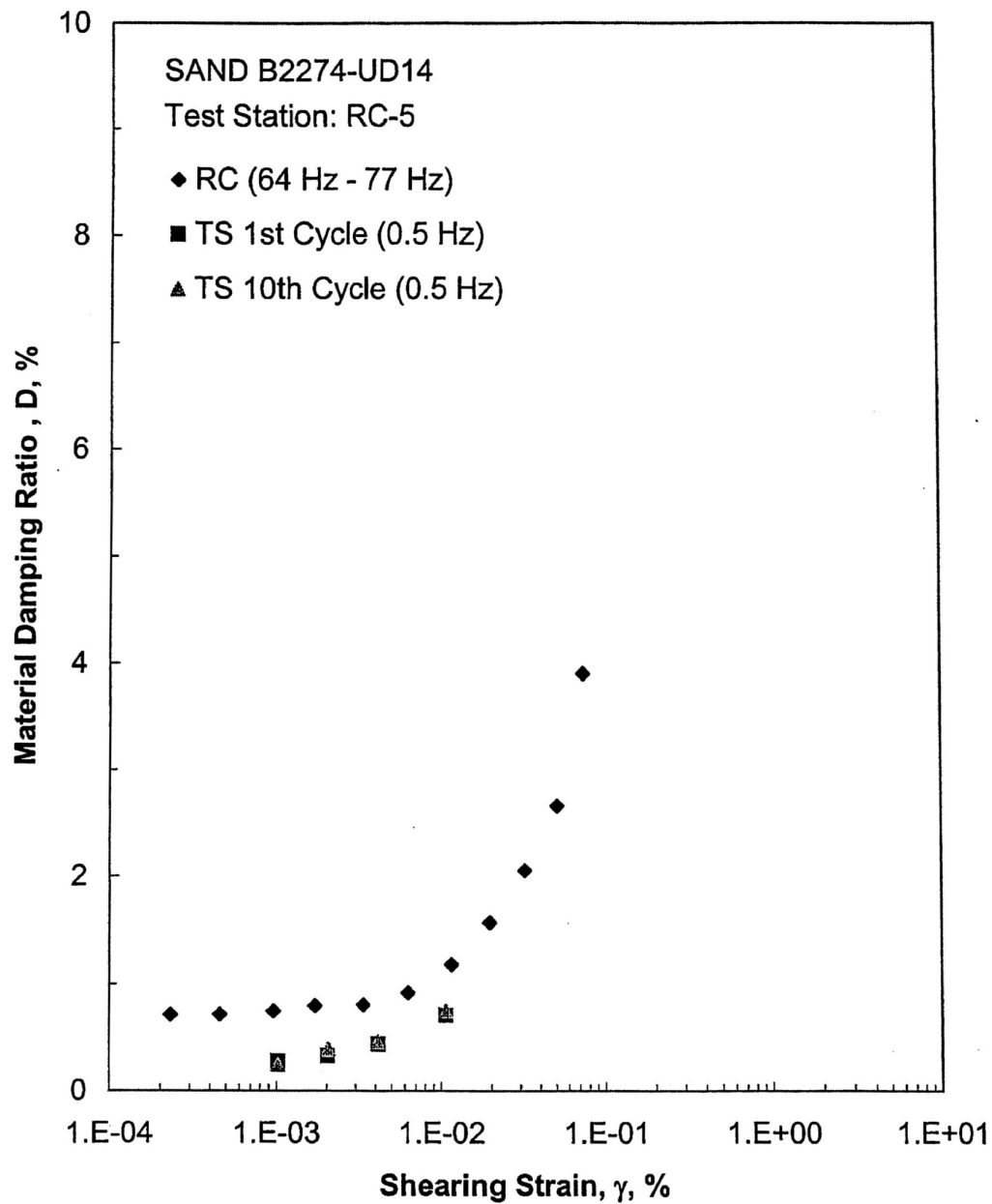


Figure F.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 91 psi from the Combined RCTS Tests

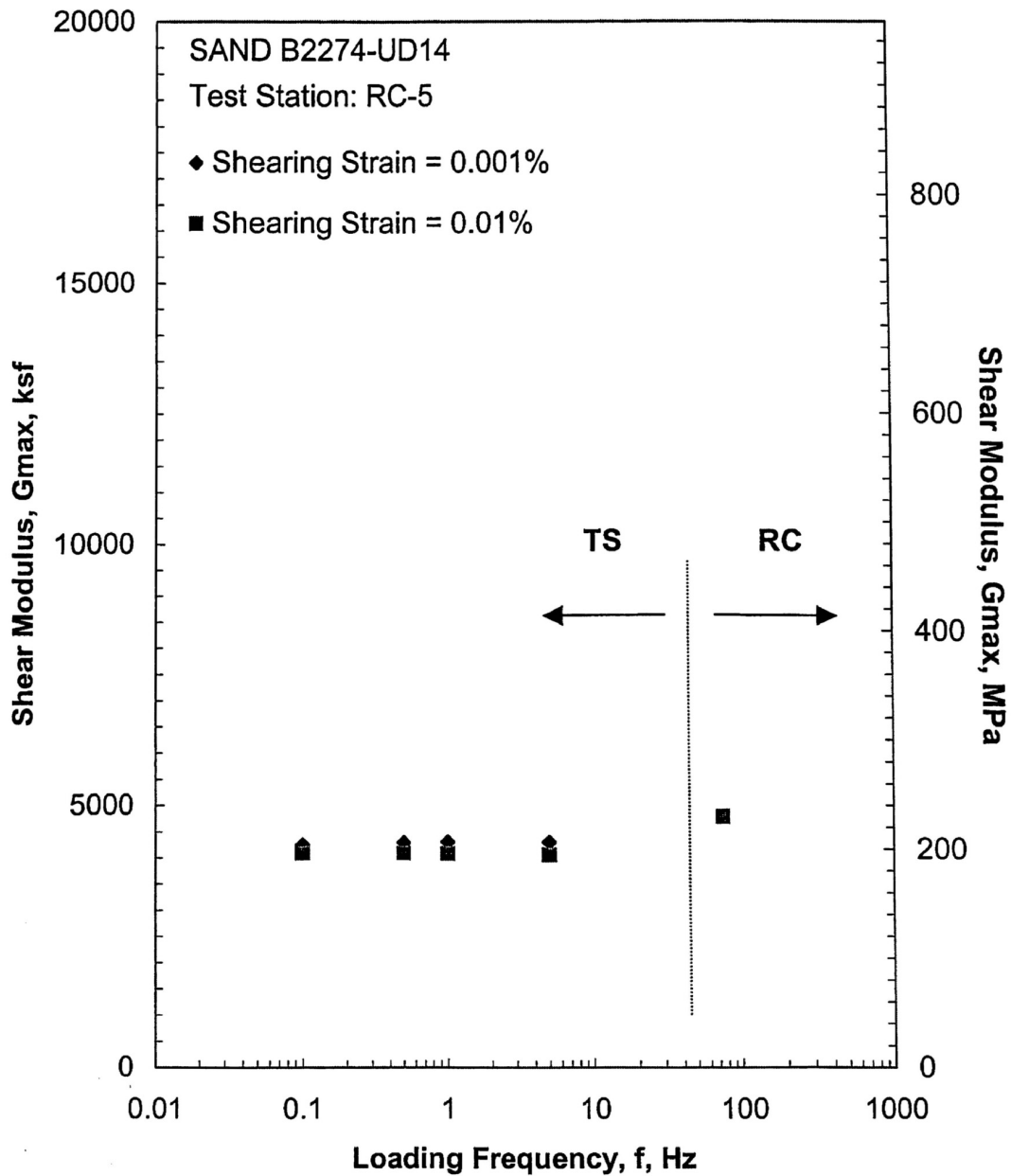


Figure F.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 91 psi from the Combined RCTS Tests

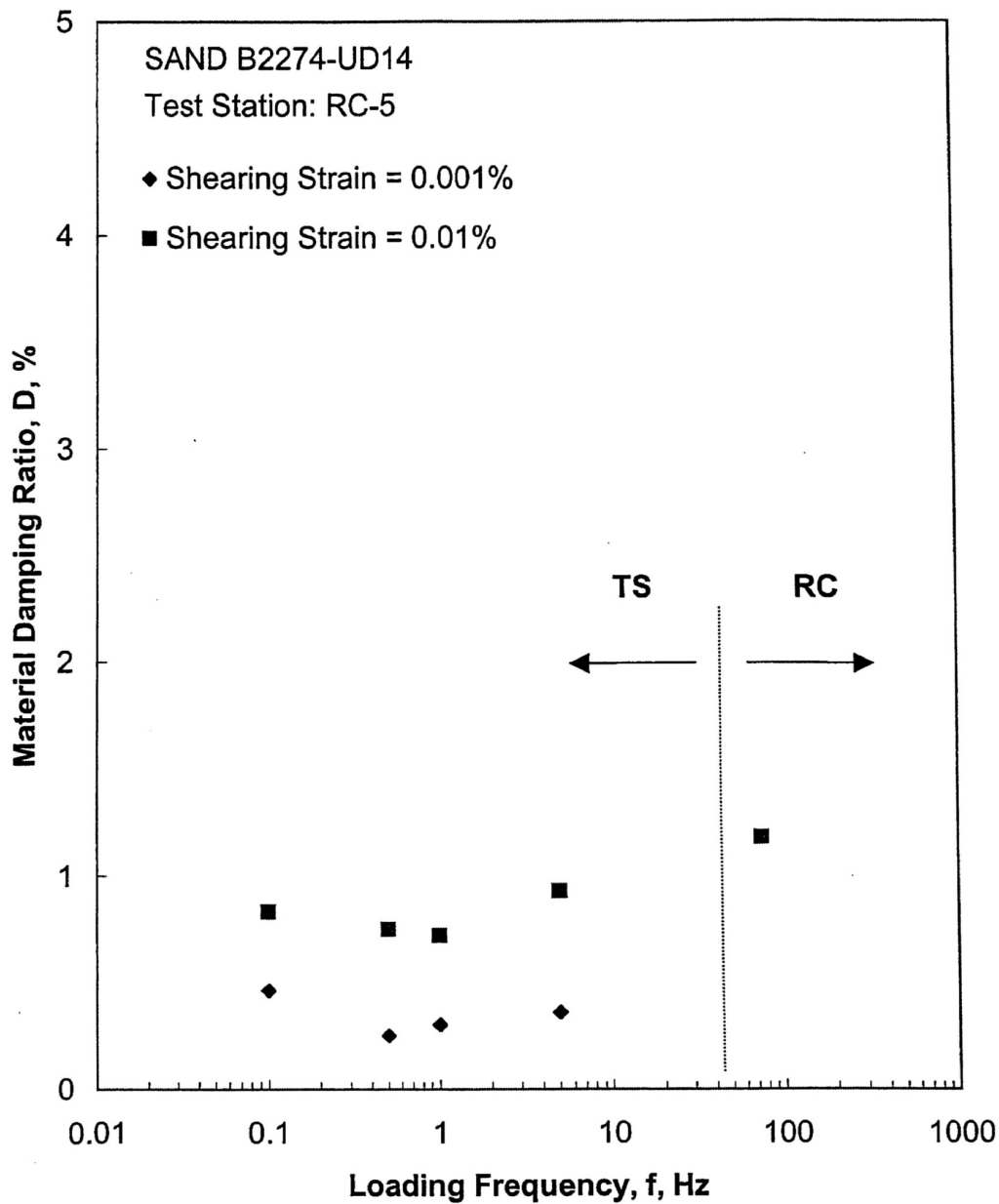


Figure F.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 91 psi from the Combined RCTS Tests

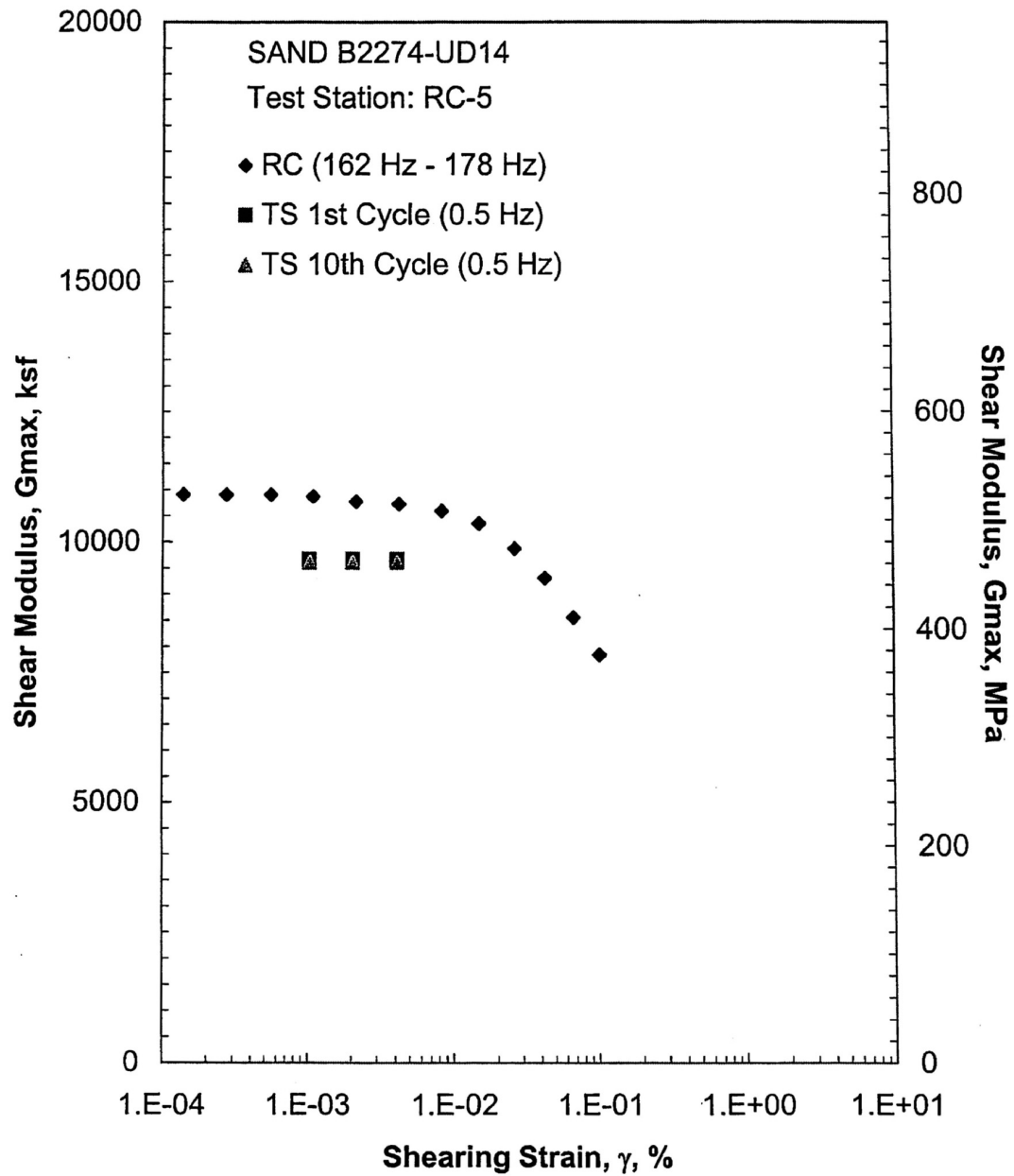


Figure F.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 365 psi from the Combined RCTS Tests

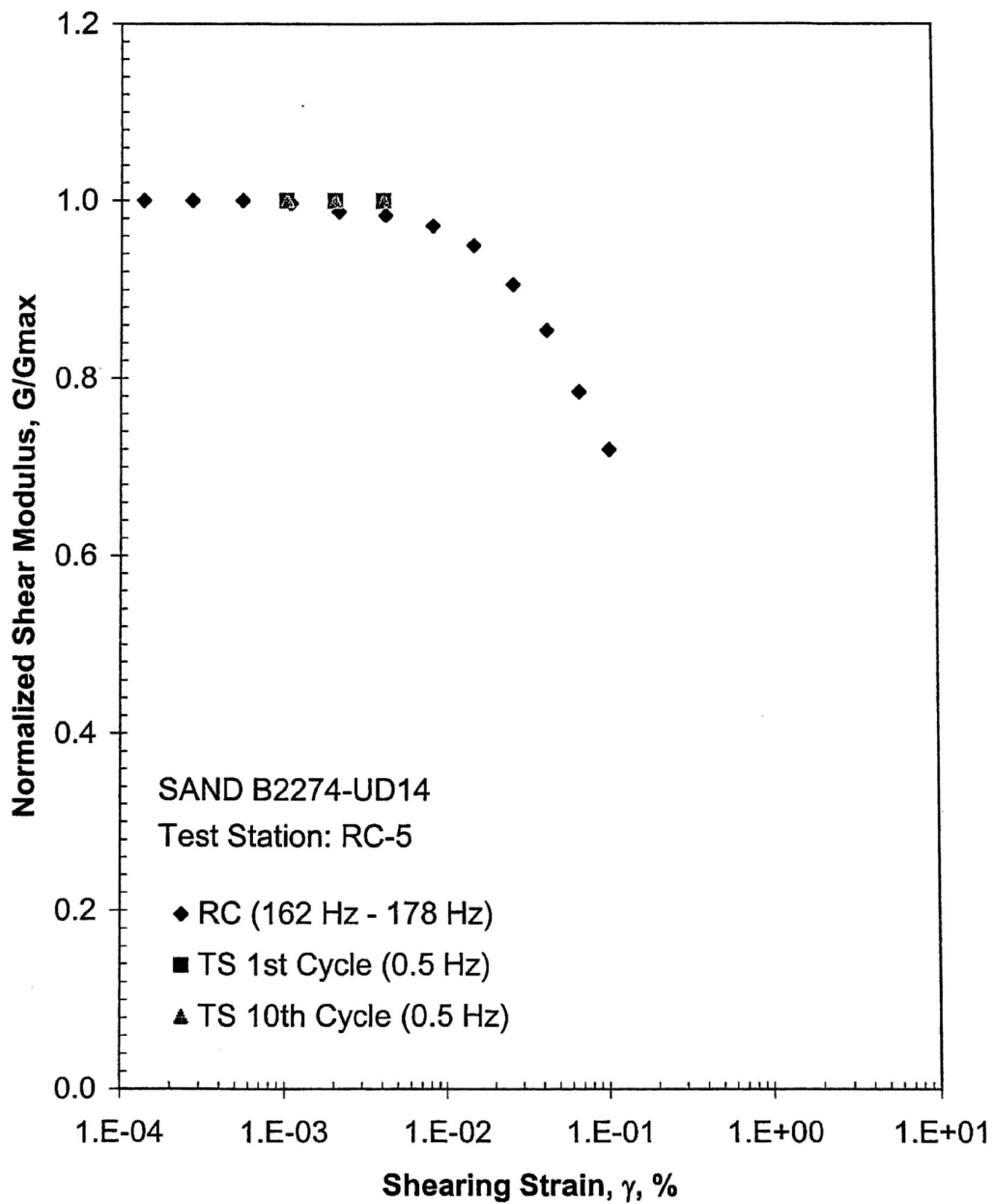


Figure F.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 365 psi from the Combined RCTS Tests

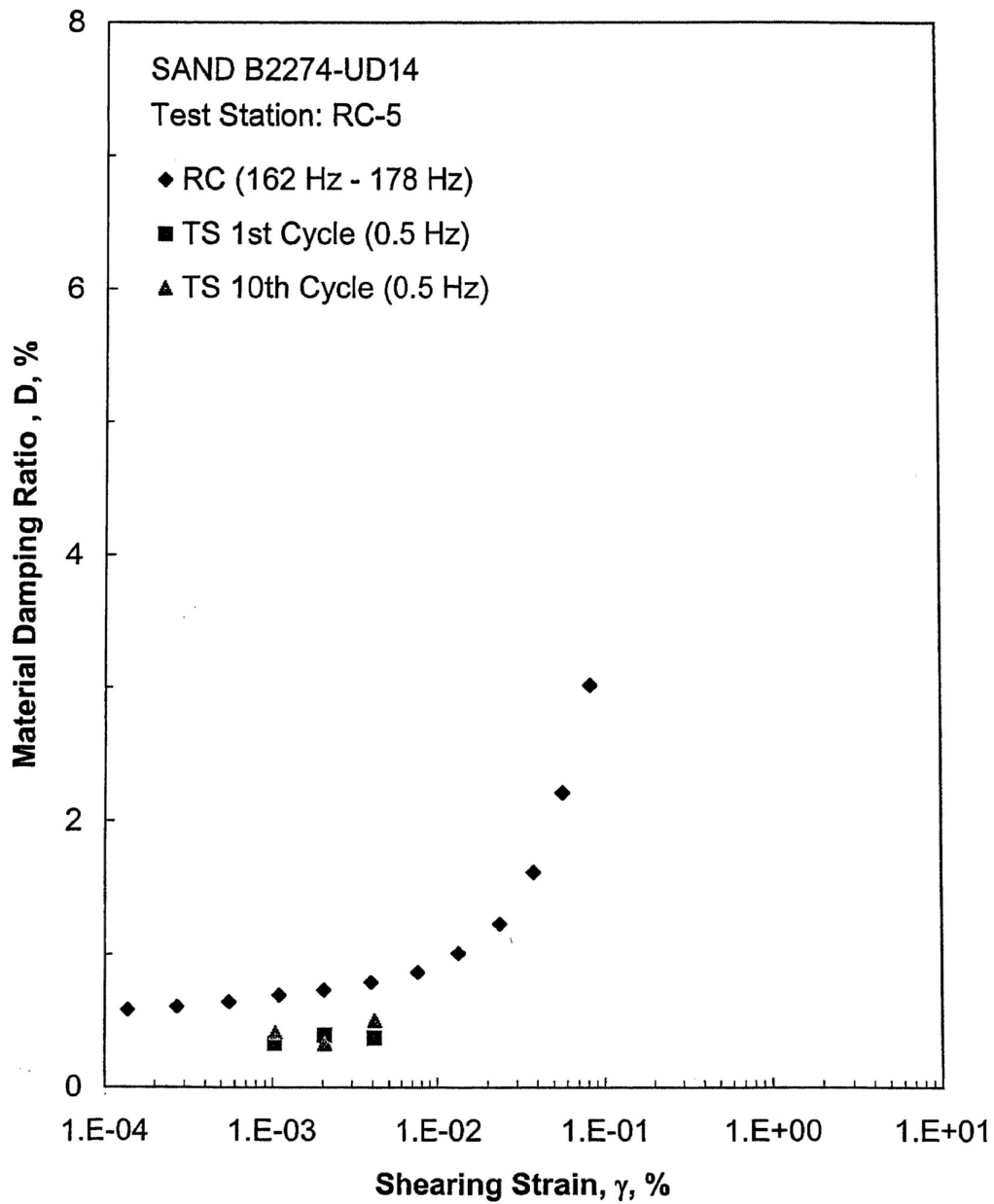


Figure F.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 365 psi from the Combined RCTS Tests

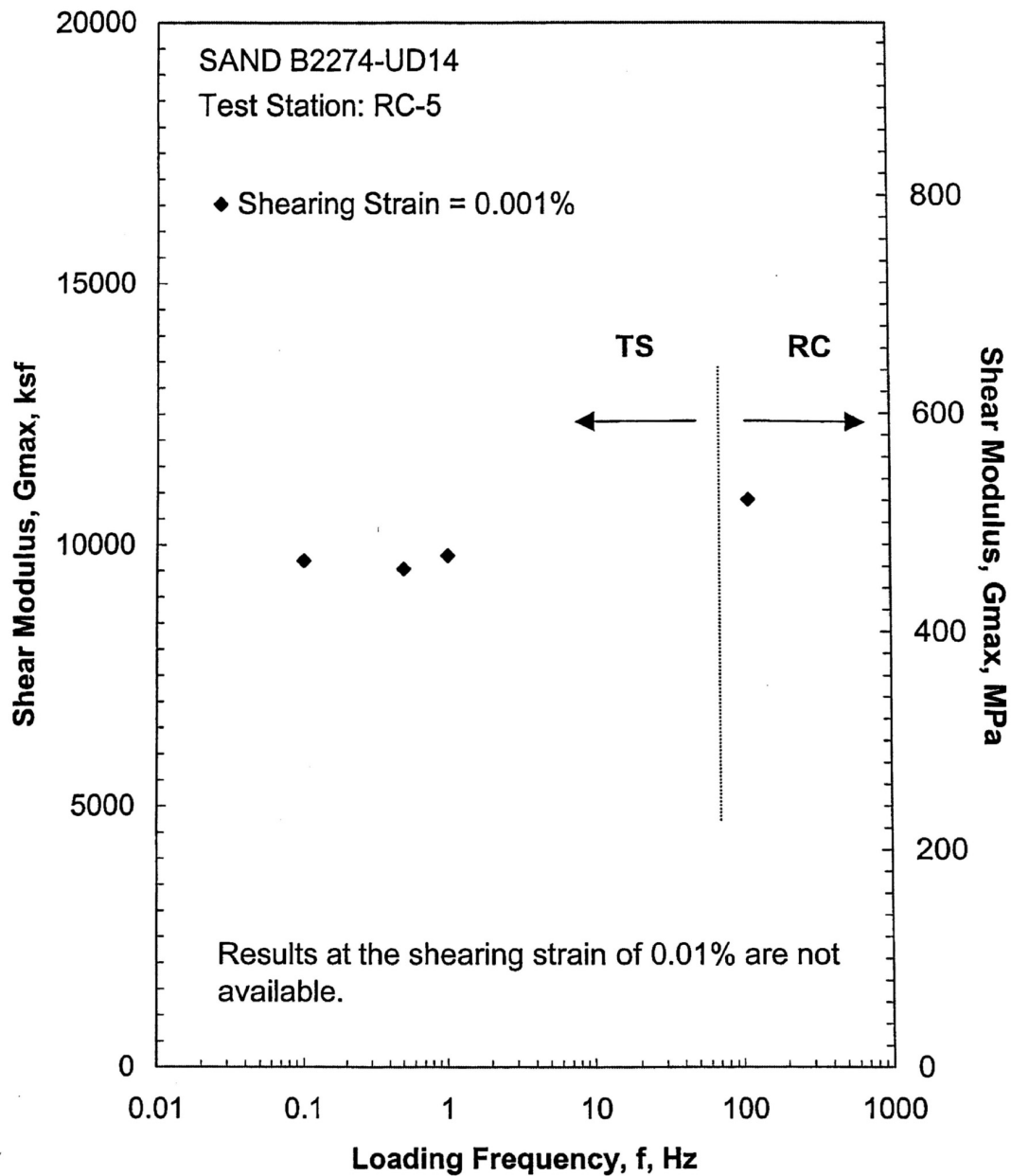


Figure F.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 365 psi from the Combined RCTS Tests

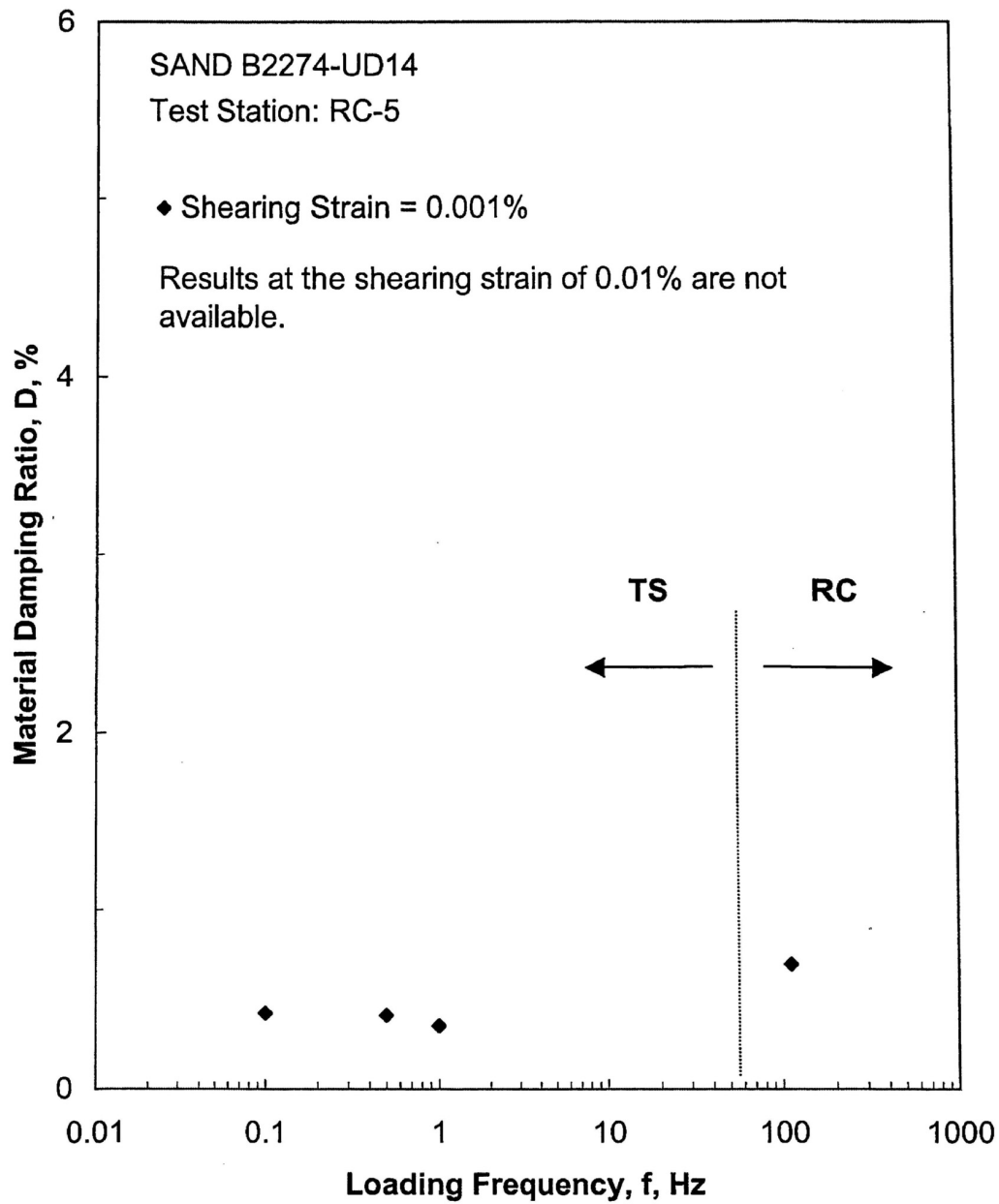


Figure F.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 365 psi from the Combined RCTS Tests

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 B2274-UD14

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
23	3312	158	2341	112	762	0.86	0.51
46	6624	317	3505	168	932	0.78	0.51
91	13104	627	5158	248	1130	0.72	0.51
182	26208	1254	7898	379	1397	0.63	0.51
365	52560	2515	11145	535	1656	0.56	0.50

Table F.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen EXELON B2274-UD14; Isotropic Confining Pressure, $\sigma_o=91$ psi (13.1 ksf = 627 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average ⁺ Shearing Strain, %	Material Damping Ratio ^x , D, %
2.30E-04	5127	1.00	2.30E-04	0.72
4.59E-04	5127	1.00	4.59E-04	0.72
9.58E-04	5093	0.99	9.58E-04	0.75
1.87E-03	5060	0.99	1.70E-03	0.80
3.61E-03	5026	0.98	3.35E-03	0.81
6.92E-03	4927	0.96	6.29E-03	0.92
1.28E-02	4795	0.94	1.16E-02	1.18
2.22E-02	4632	0.90	1.95E-02	1.57
3.75E-02	4303	0.84	3.19E-02	2.06
6.15E-02	3883	0.76	5.04E-02	2.66
9.52E-02	3619	0.71	7.33E-02	3.91

⁺ 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 B2274-UD14; Isotropic Confining Pressure, $\sigma_o = 91$ psi (13.1 ksf = 627 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, %
1.02E-03	4314	1.00	0.28	1.02E-03	4305	1.00	0.25
2.03E-03	4314	1.00	0.33	2.05E-03	4285	1.00	0.39
4.15E-03	4229	0.98	0.44	4.14E-03	4241	0.99	0.46
1.07E-02	4110	0.95	0.71	1.07E-02	4102	0.95	0.75

Table F.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2274-UD14; Isotropic Confining Pressure, $\sigma_c = 365$ psi (52.6 ksf = 2515 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average ⁺ Shearing Strain, %	Material Damping Ratio ^x , D, %
1.37E-04	10904	1.00	1.37E-04	0.58
2.71E-04	10904	1.00	2.71E-04	0.61
5.55E-04	10904	1.00	5.55E-04	0.64
1.10E-03	10871	1.00	1.10E-03	0.70
2.17E-03	10774	0.99	2.04E-03	0.73
4.22E-03	10725	0.98	3.92E-03	0.79
8.23E-03	10593	0.97	7.57E-03	0.87
1.48E-02	10351	0.95	1.35E-02	1.01
2.61E-02	9875	0.91	2.38E-02	1.23
4.26E-02	9312	0.85	3.79E-02	1.62
6.69E-02	8559	0.78	5.68E-02	2.21
1.02E-01	7844	0.72	8.28E-02	3.02

⁺ 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 B2274-UD14; Isotropic Confining Pressure, $\sigma_o=365$ psi (52.6 ksf = 2515 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, %
1.03E-03	9667	1.00	0.33	1.04E-03	9620	1.00	0.41
2.06E-03	9667	1.00	0.39	2.06E-03	9620	1.00	0.33
4.10E-03	9667	1.00	0.37	4.12E-03	9620	1.00	0.50

FUGRO CONSULTANTS, INC.



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

April 21, 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 B2274-UD23 and B2269-UD19, 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.

A handwritten signature in black ink, appearing to read "Meng", with a long, sweeping horizontal line extending to the right.

Jiewu Meng, PhD, P.E.
Project Engineer

A handwritten signature in black ink, appearing to read "Bill DeGroff", with a stylized, cursive-like script.

Bill DeGroff, P.E.
Laboratory Department Manager

Enclosures

Cc: Kathryn White, in PDF



RCTS TEST APPROVAL

PROJECT SITE/NAME	EXELON
-------------------	--------

Test ID	Sample ID	Depth B.S. (Ft)	Approved By (Initials)	Date
RCTS#G	B2274-UD23	422.5	<i>KAS</i>	12 Apr '08
RCTS#H	B2269-UD19	381.6	<i>KAS (+)</i>	12 Apr '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

Dr. Kenneth Stokoe

(+) see notes on a couple figures

APPENDIX G

Specimen B2274-UD23
(Index Properties Not Available)

Borehole B2274
Sample UD23
Depth = 422.5 (128.8 m)
Total Unit Weight = 134.4 lb/ft³
Water Content = 15.5 %
Estimated In-Situ K_o = 0.5
Estimated In-Situ Mean Effective
Stress = 136 psi

FUGRO JOB #: 0411-08-1686
Testing Station: RC7

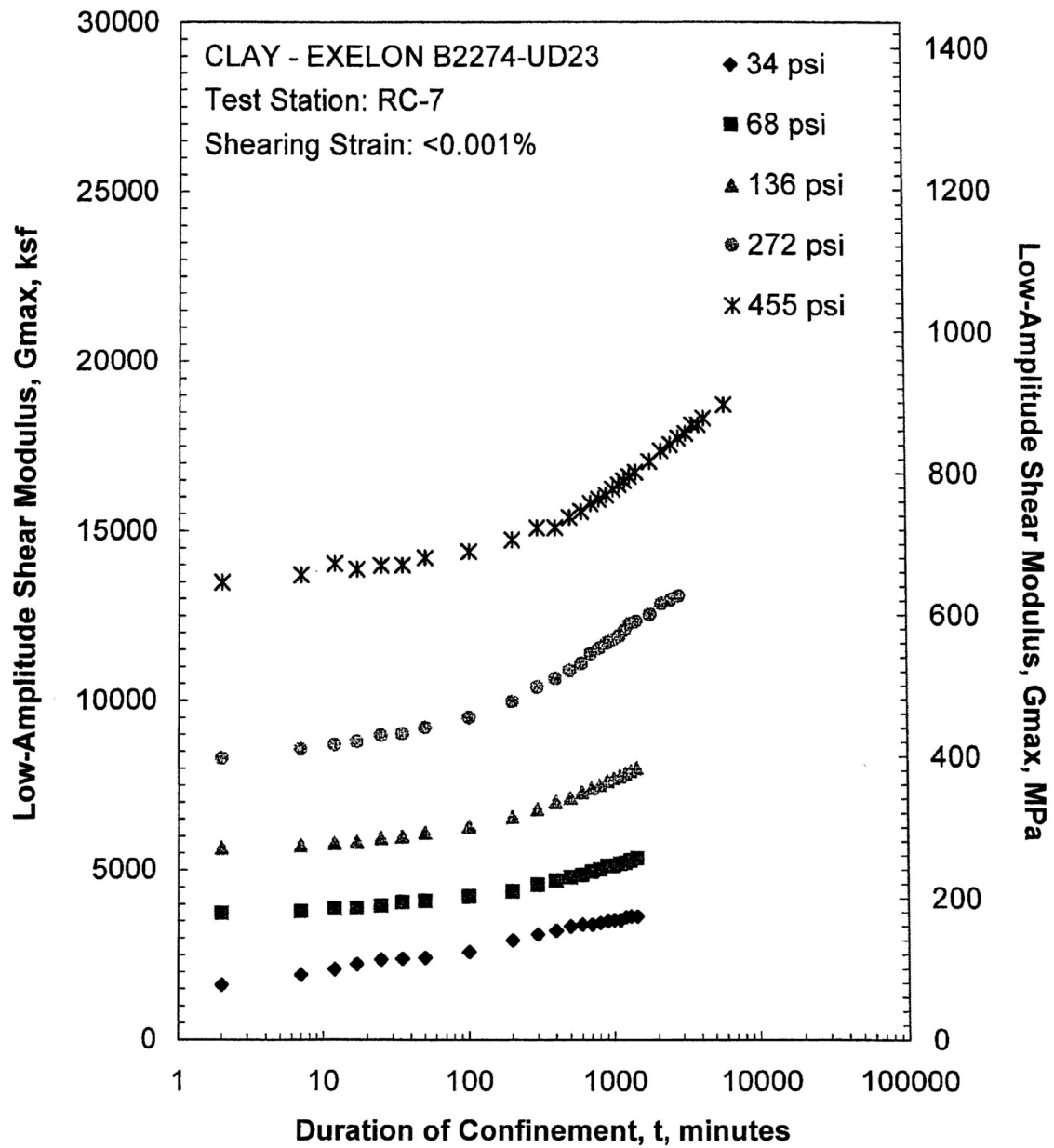


Figure G.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

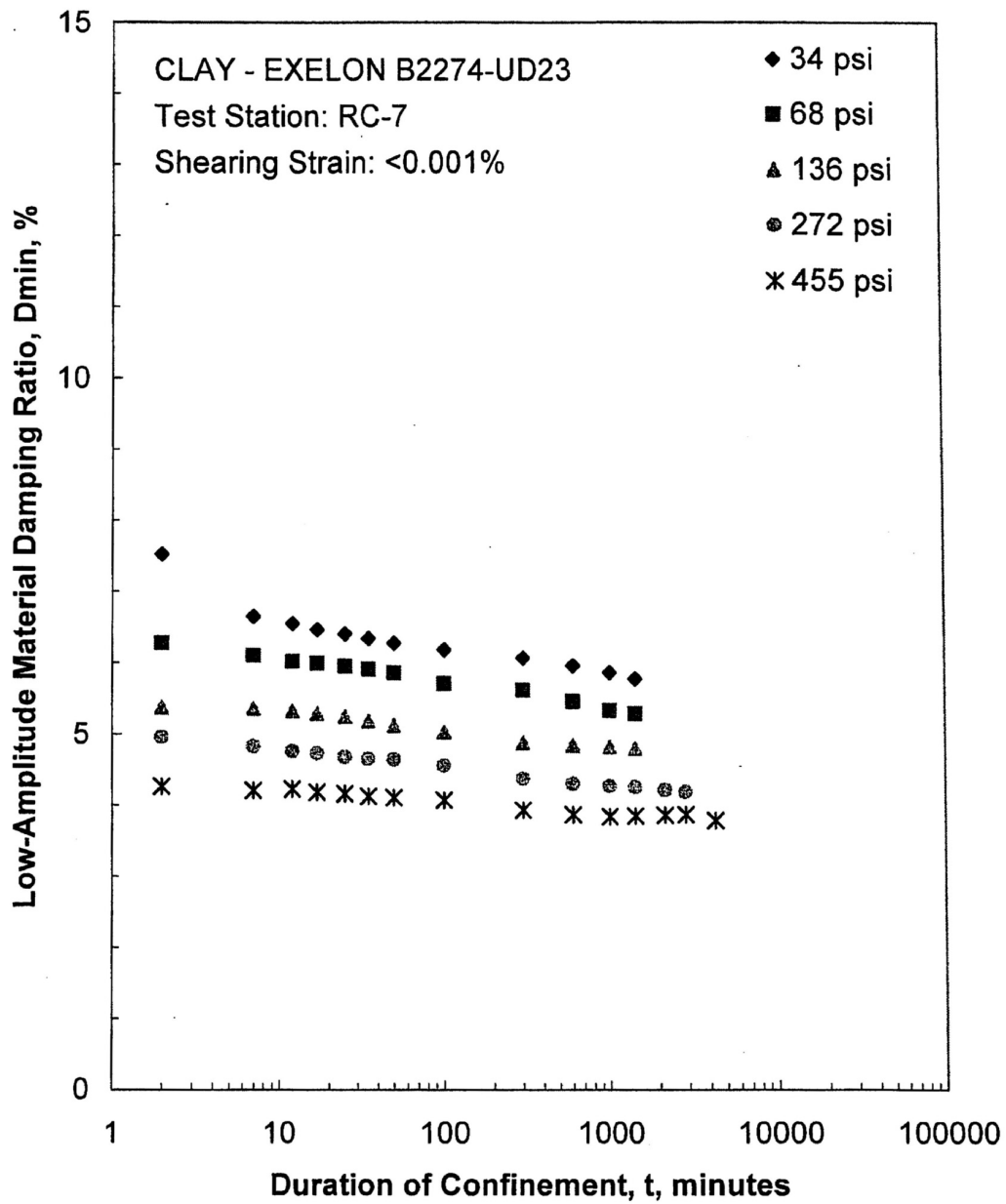


Figure G.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

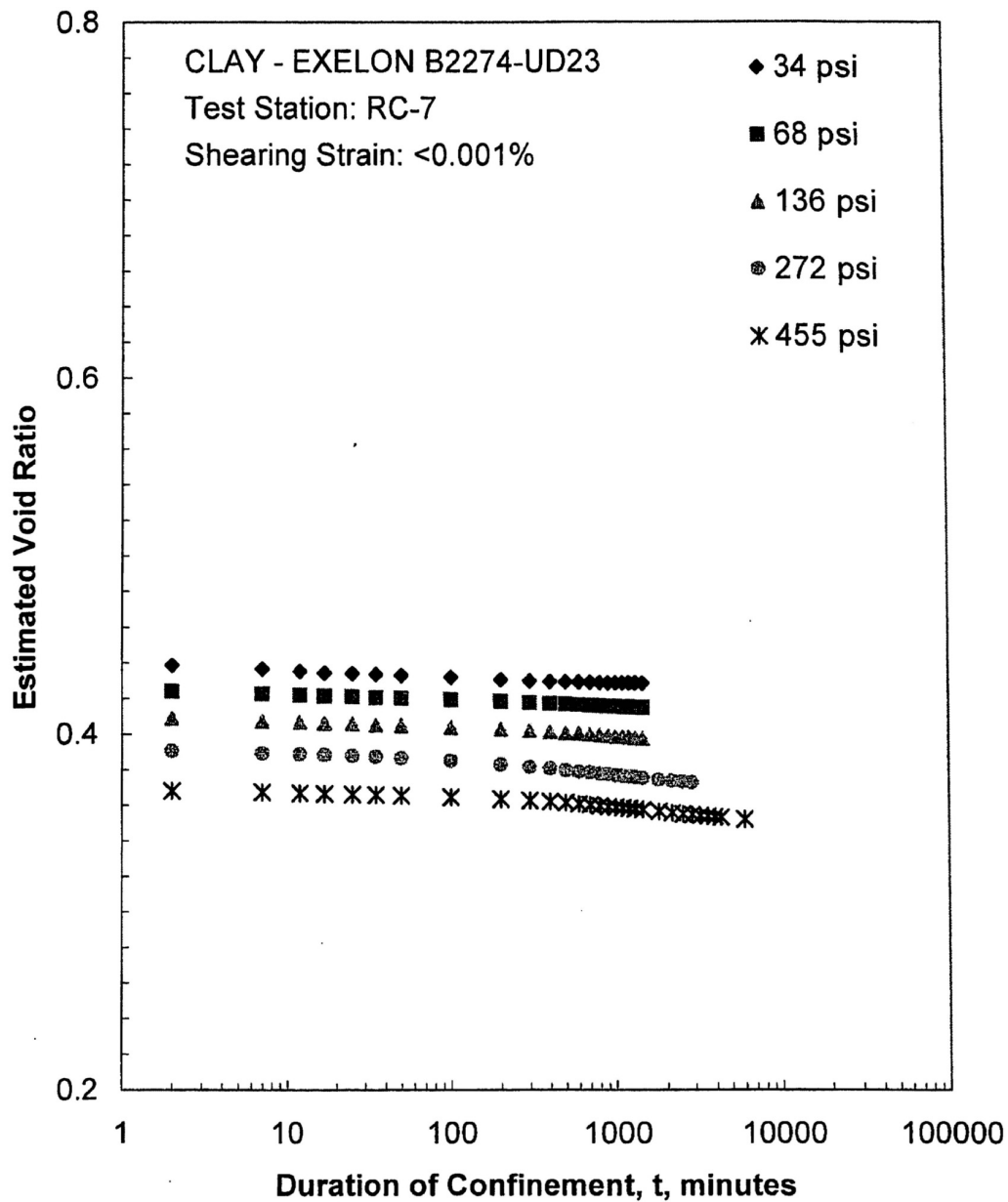


Figure G.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

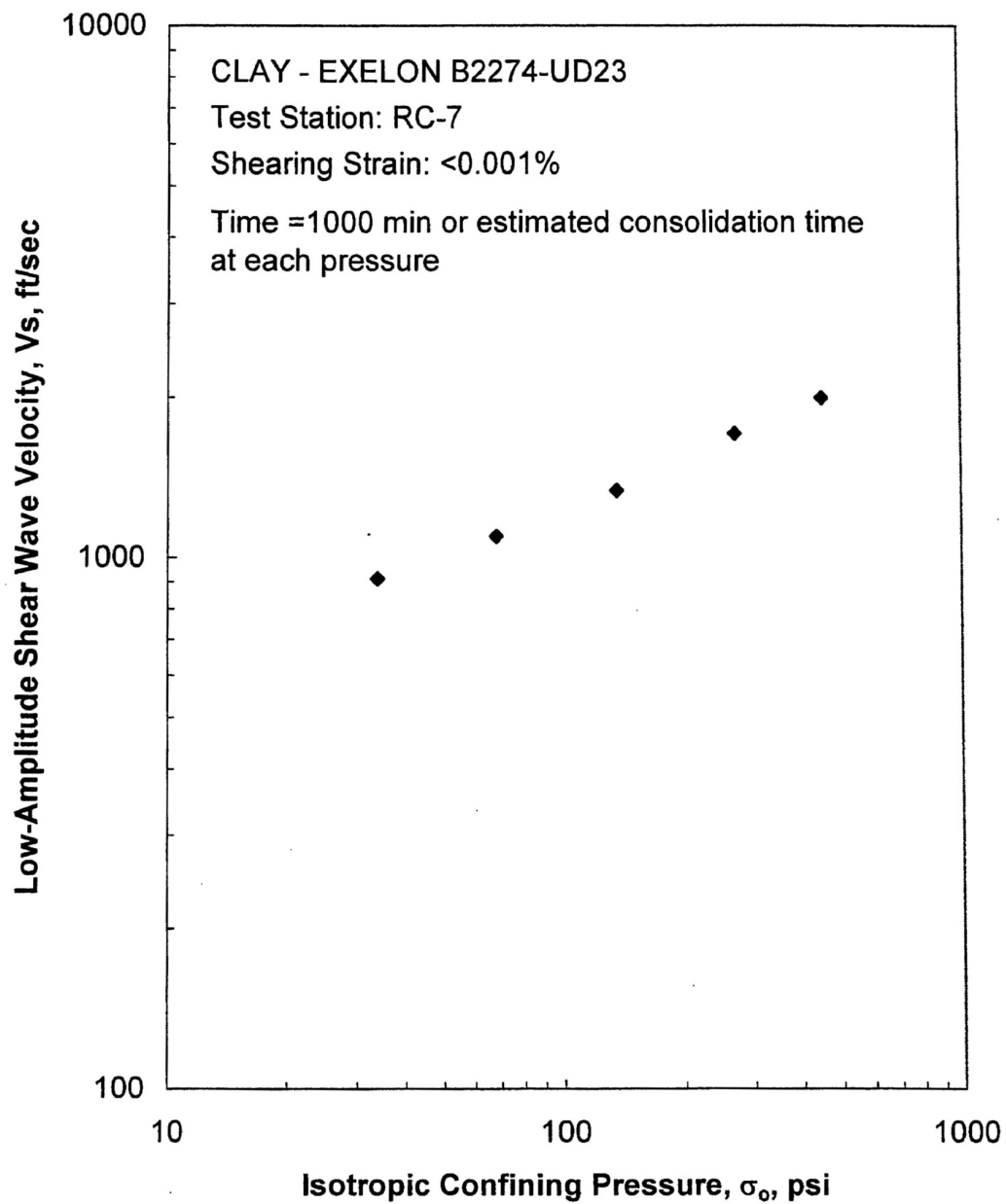


Figure G.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

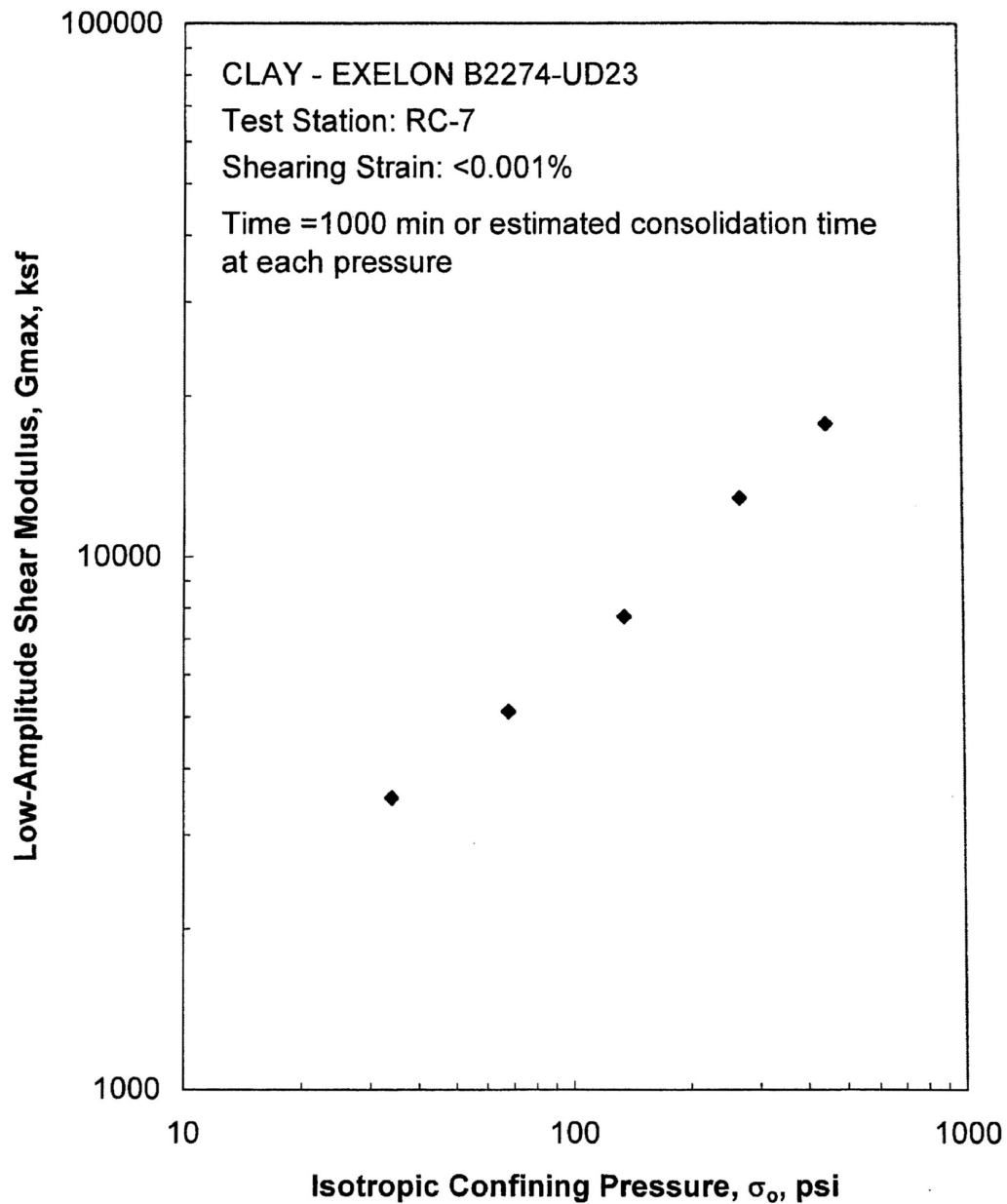


Figure G.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

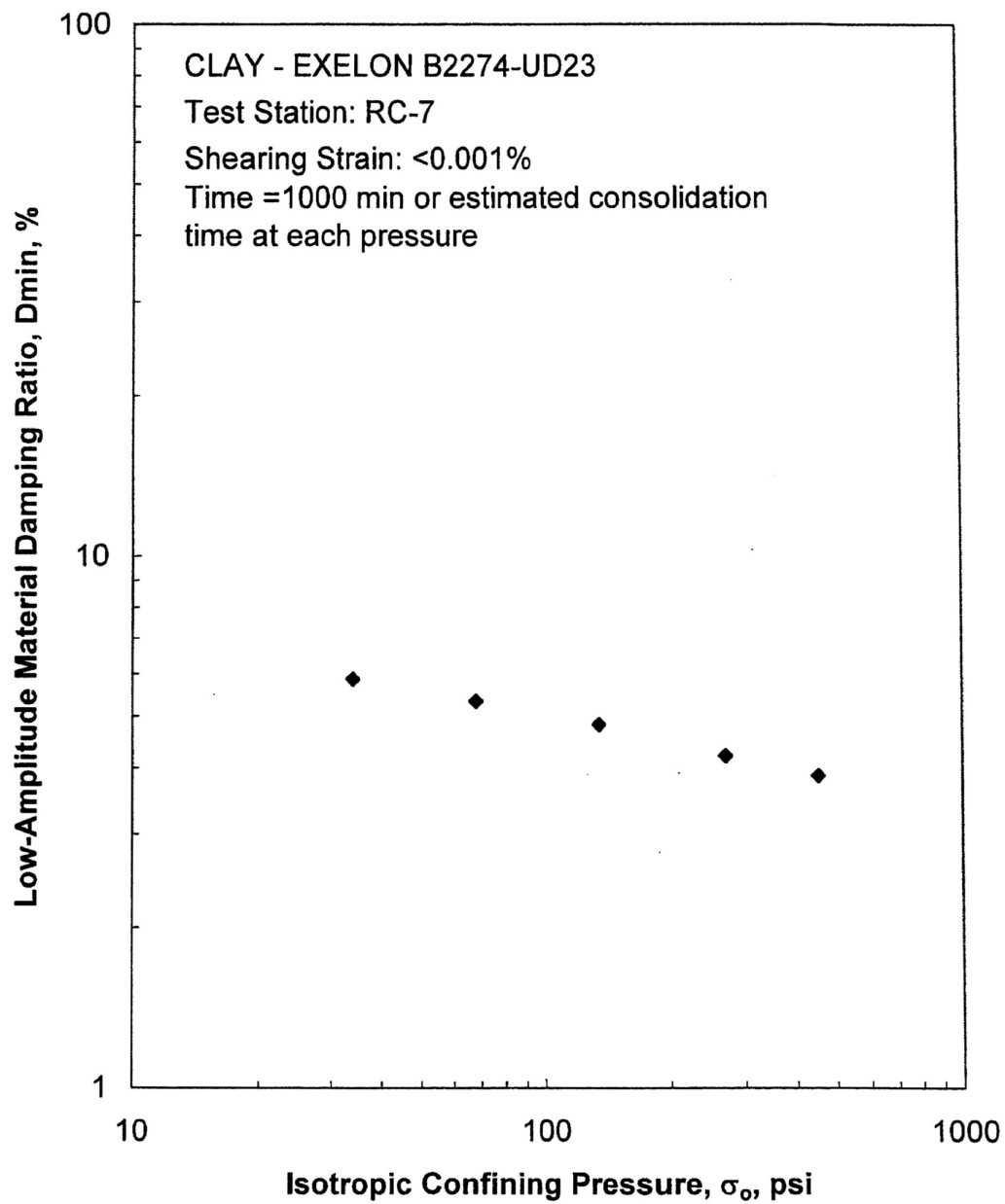


Figure G.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

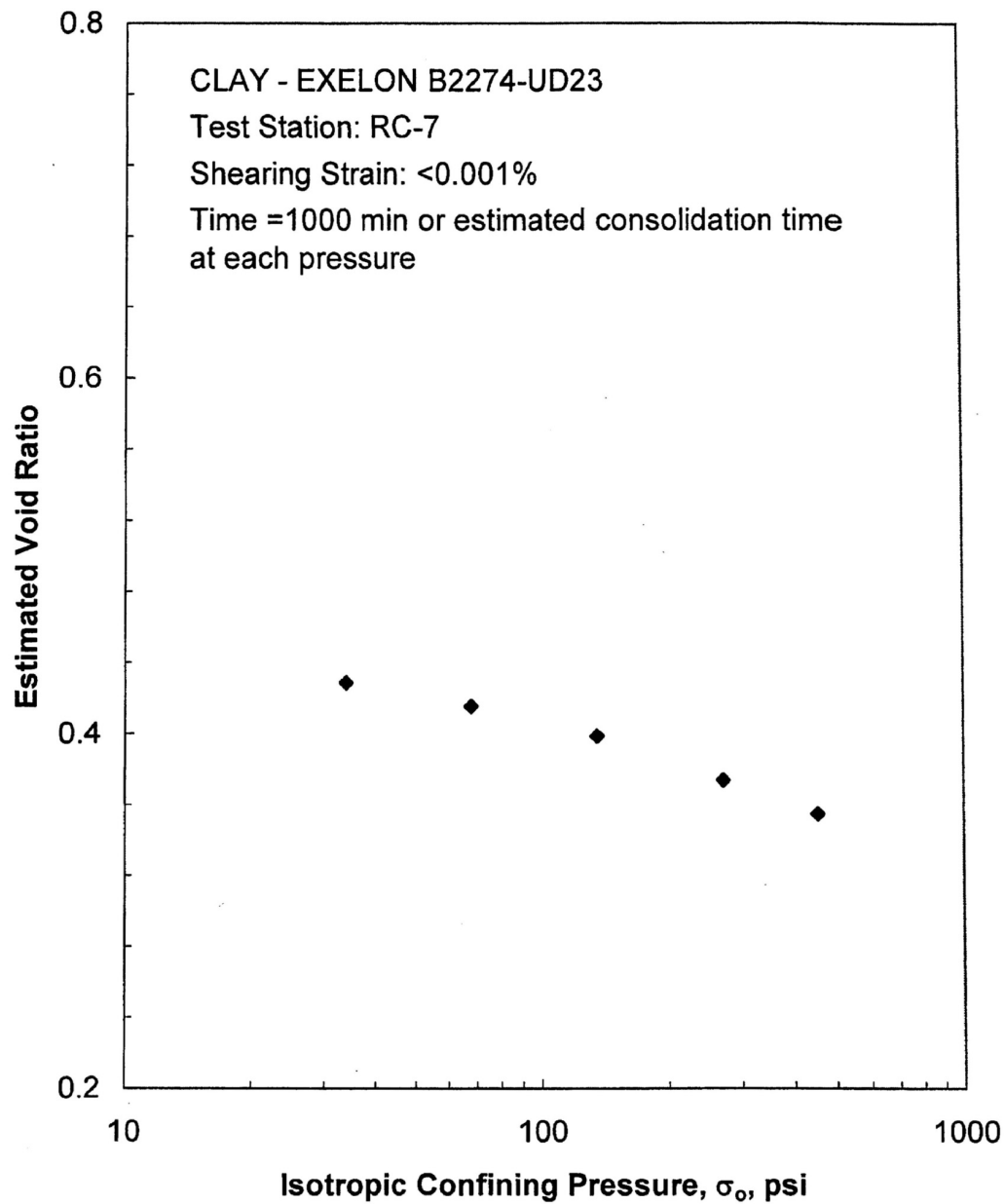


Figure G.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

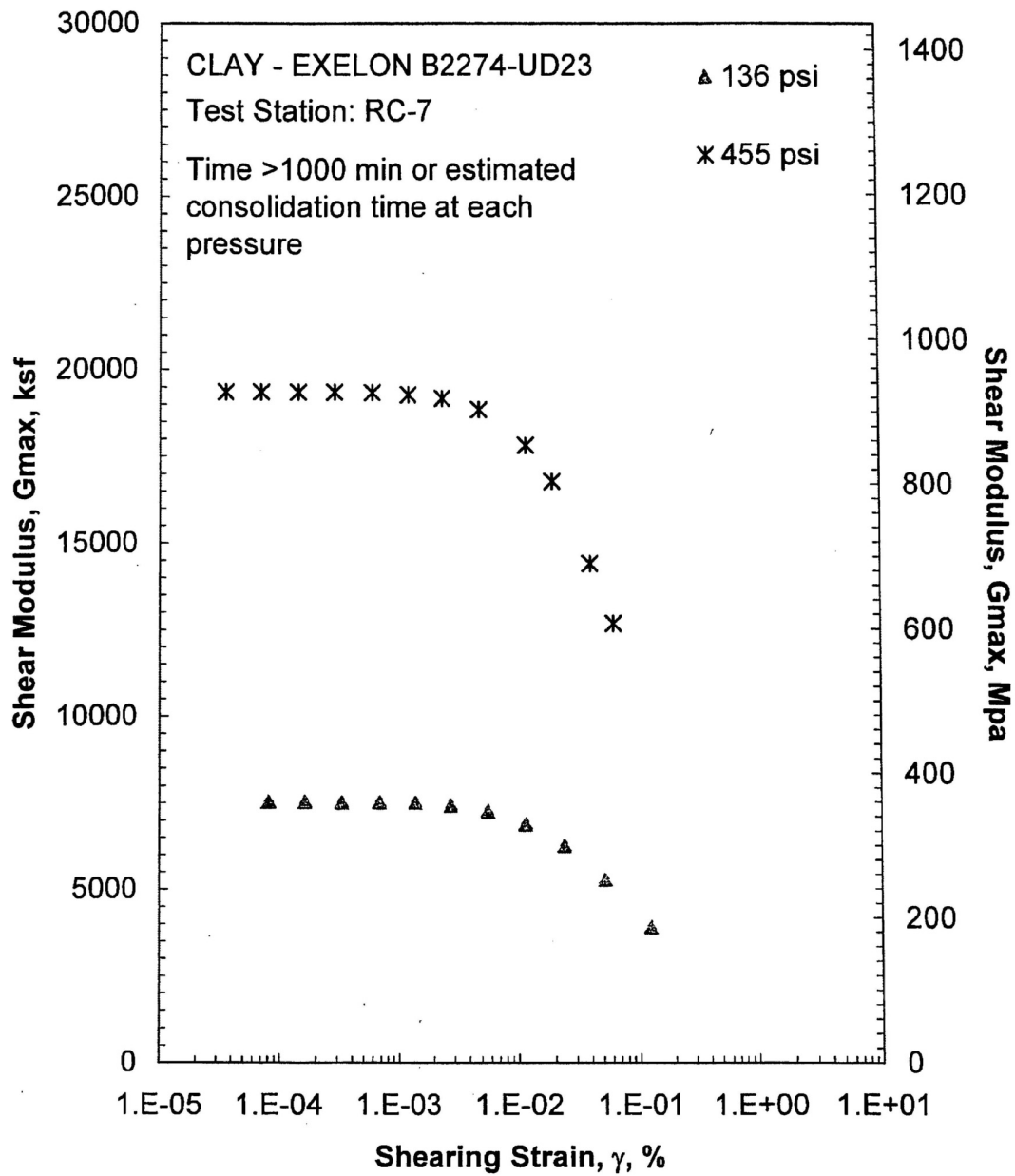


Figure G.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

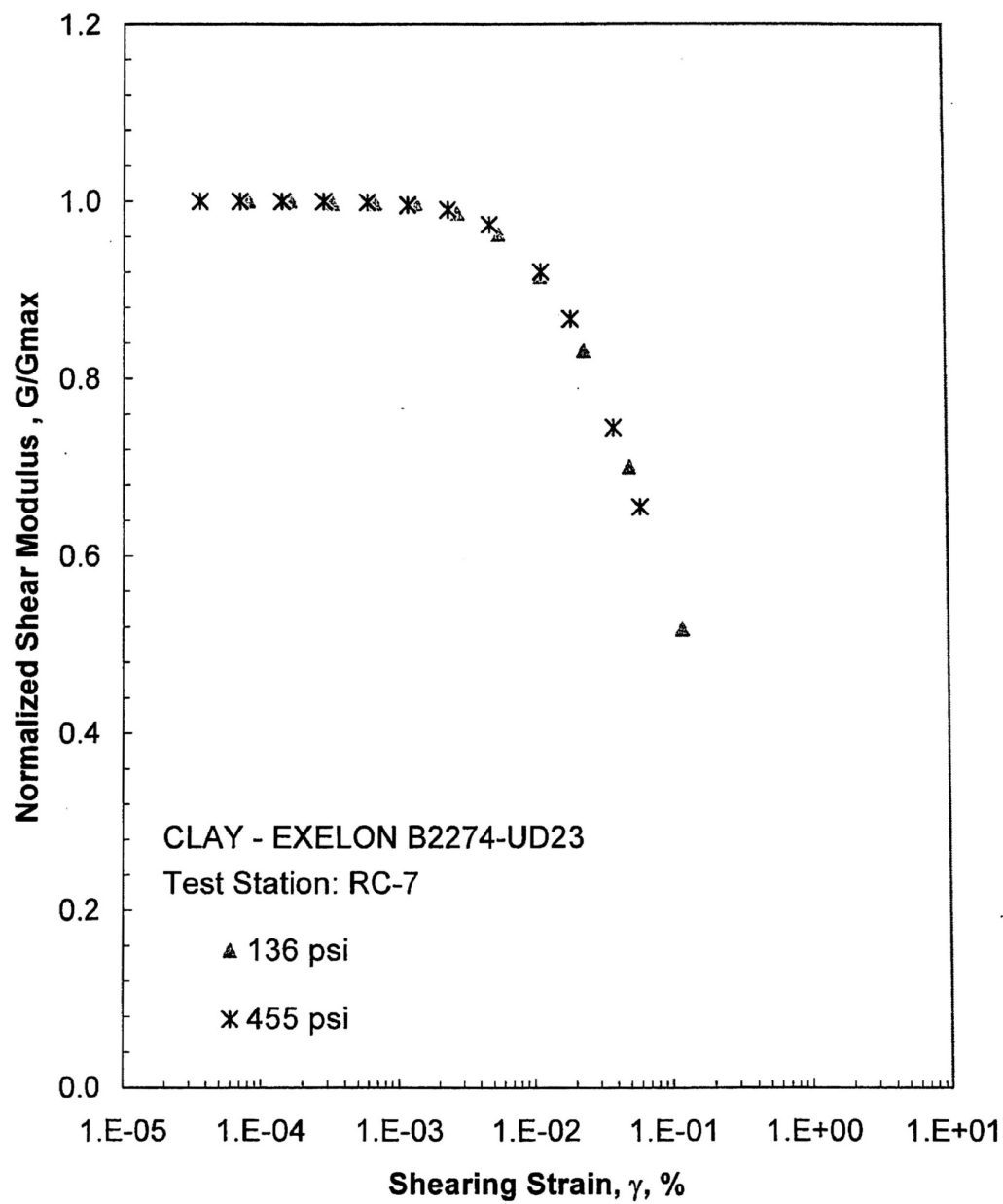


Figure G.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

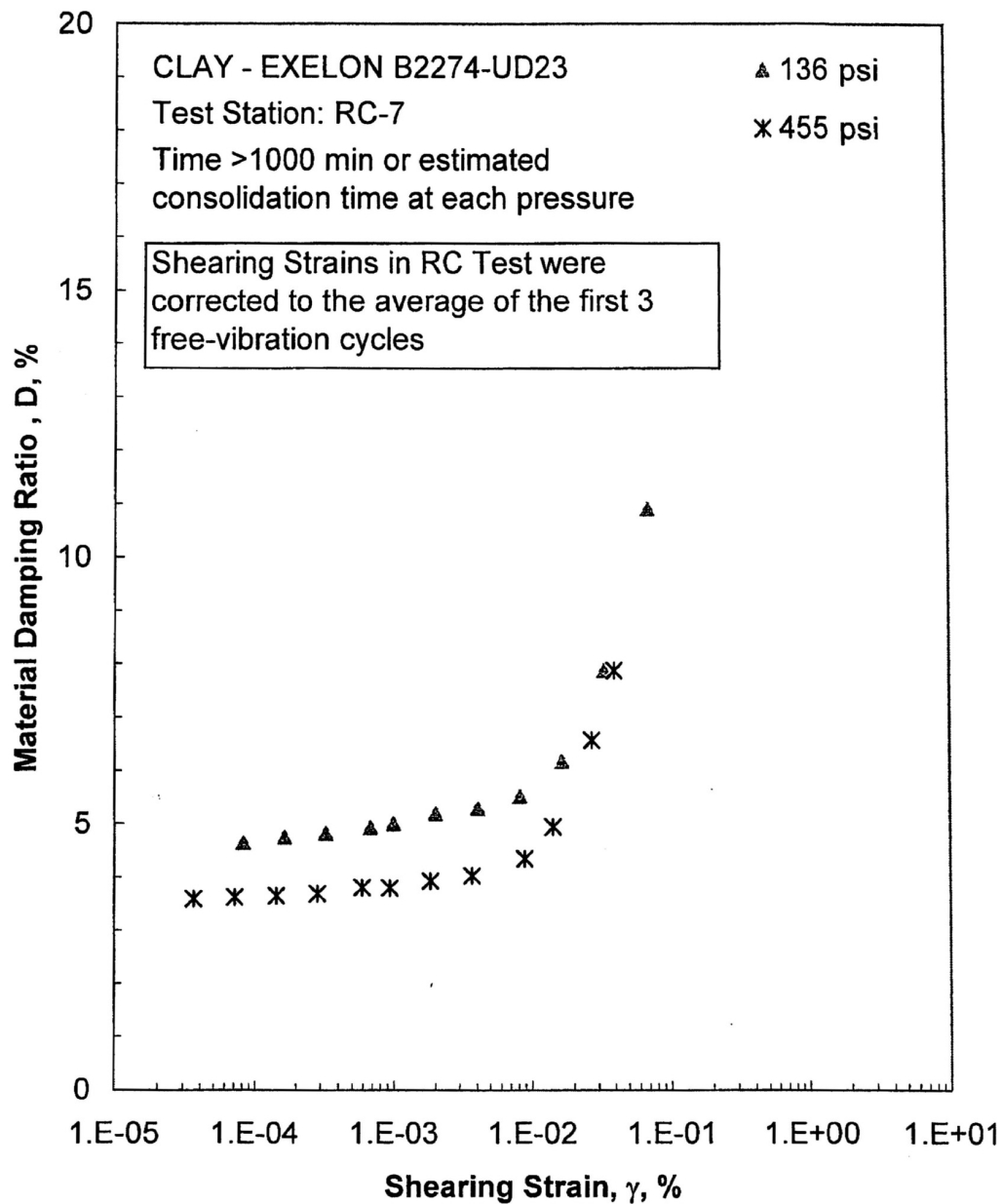


Figure G.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

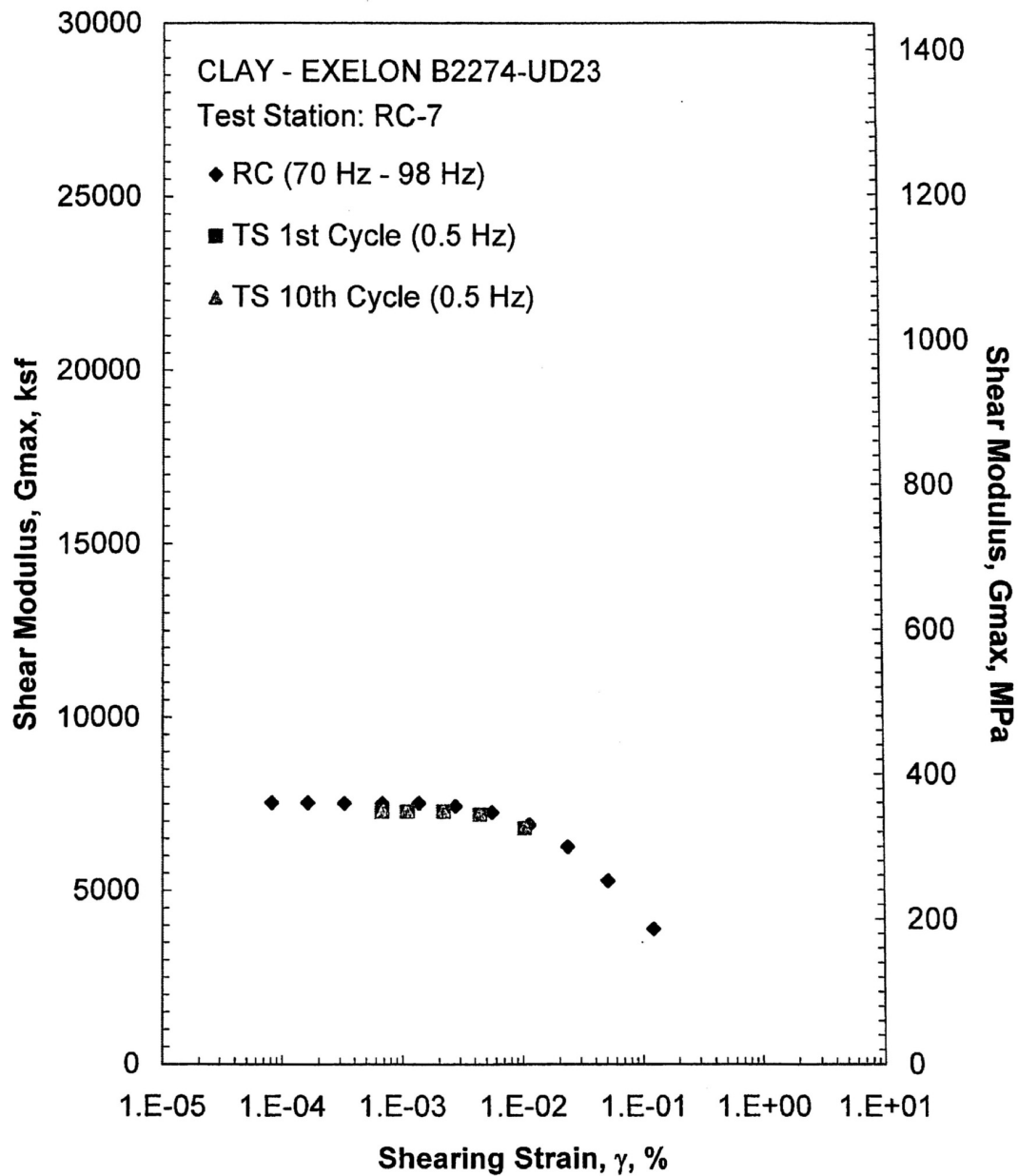


Figure G.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 136 psi from the Combined RCTS Tests

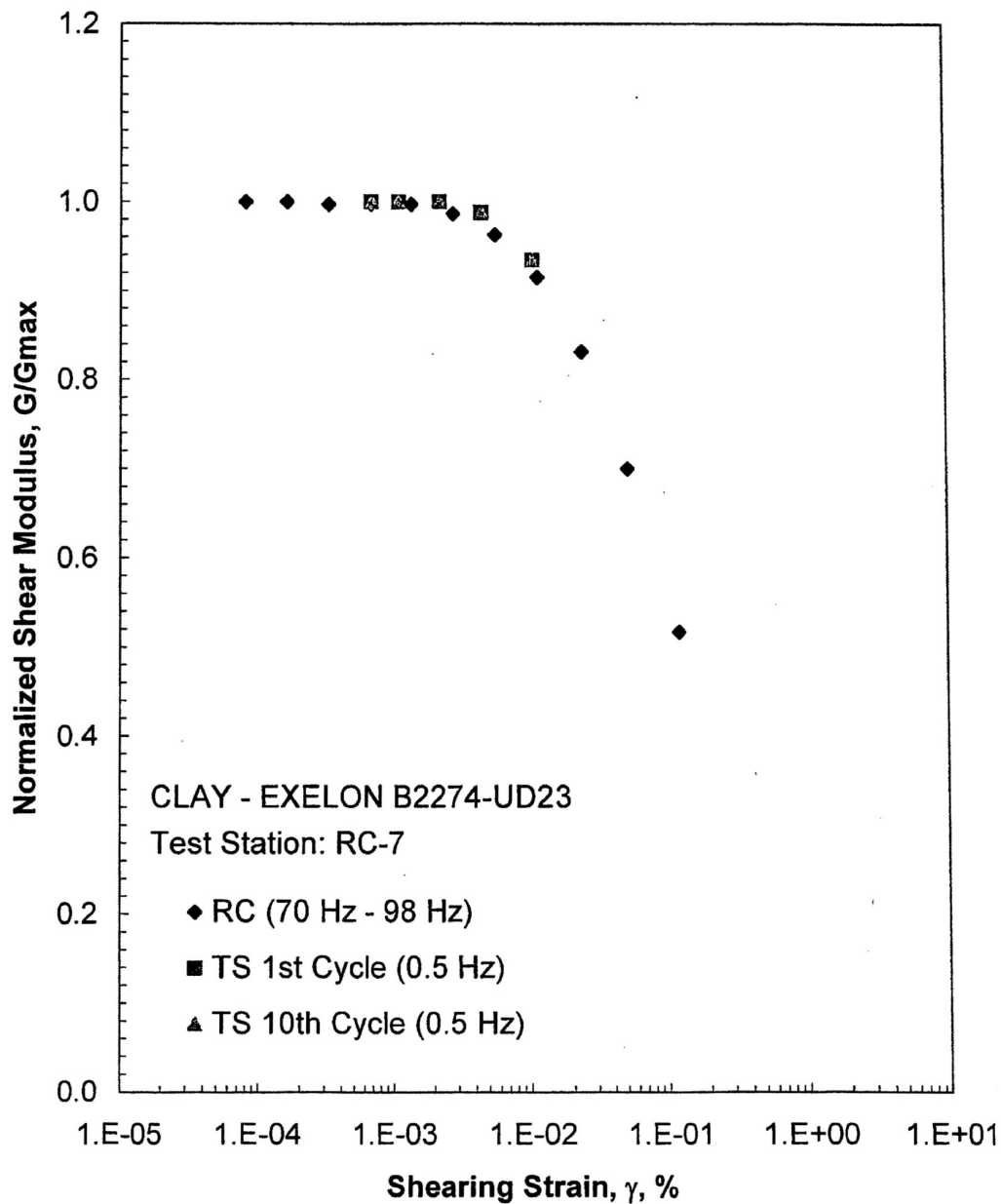


Figure G.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 136 psi from the Combined RCTS Tests

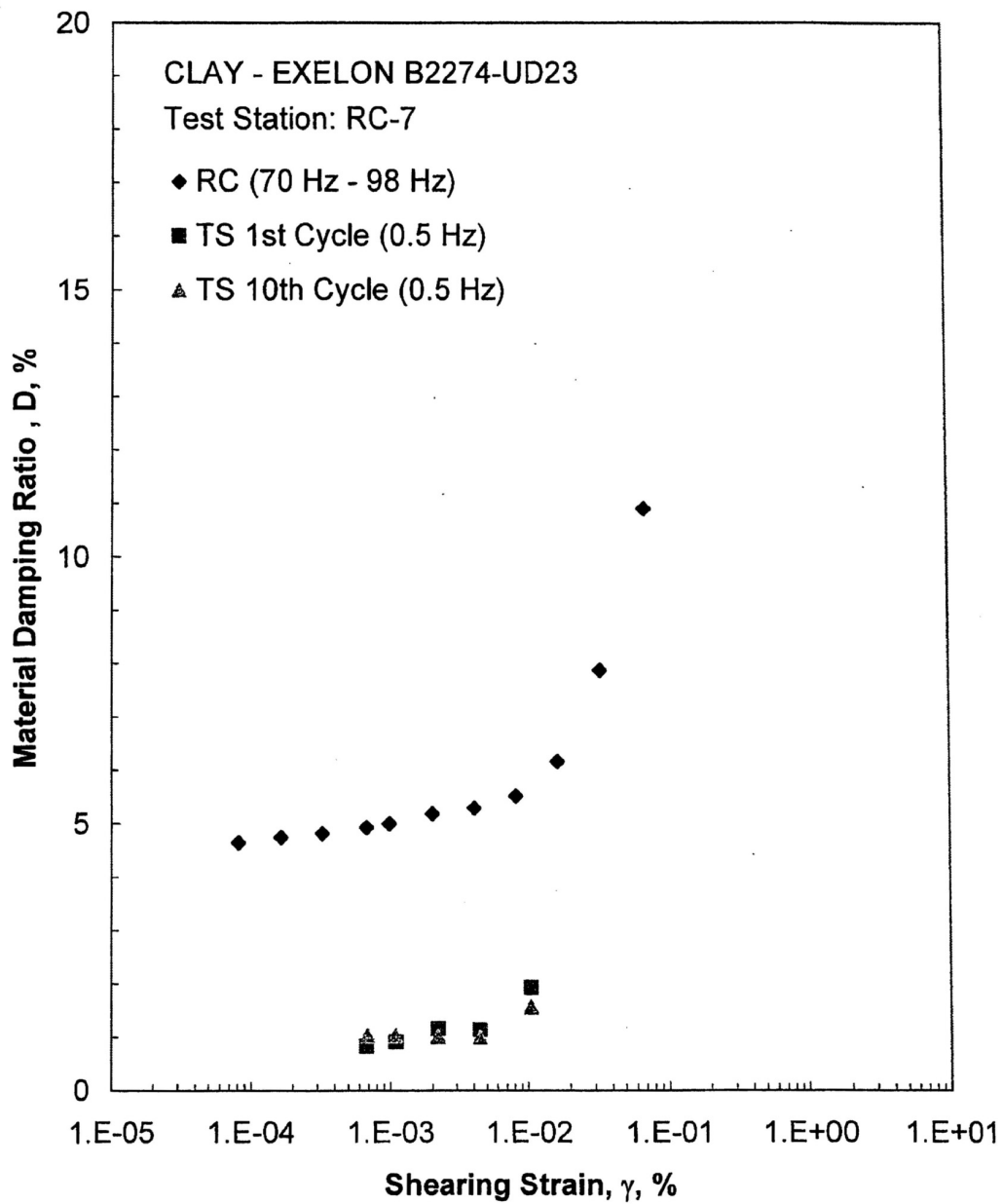


Figure G.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 136 psi from the Combined RCTS Tests

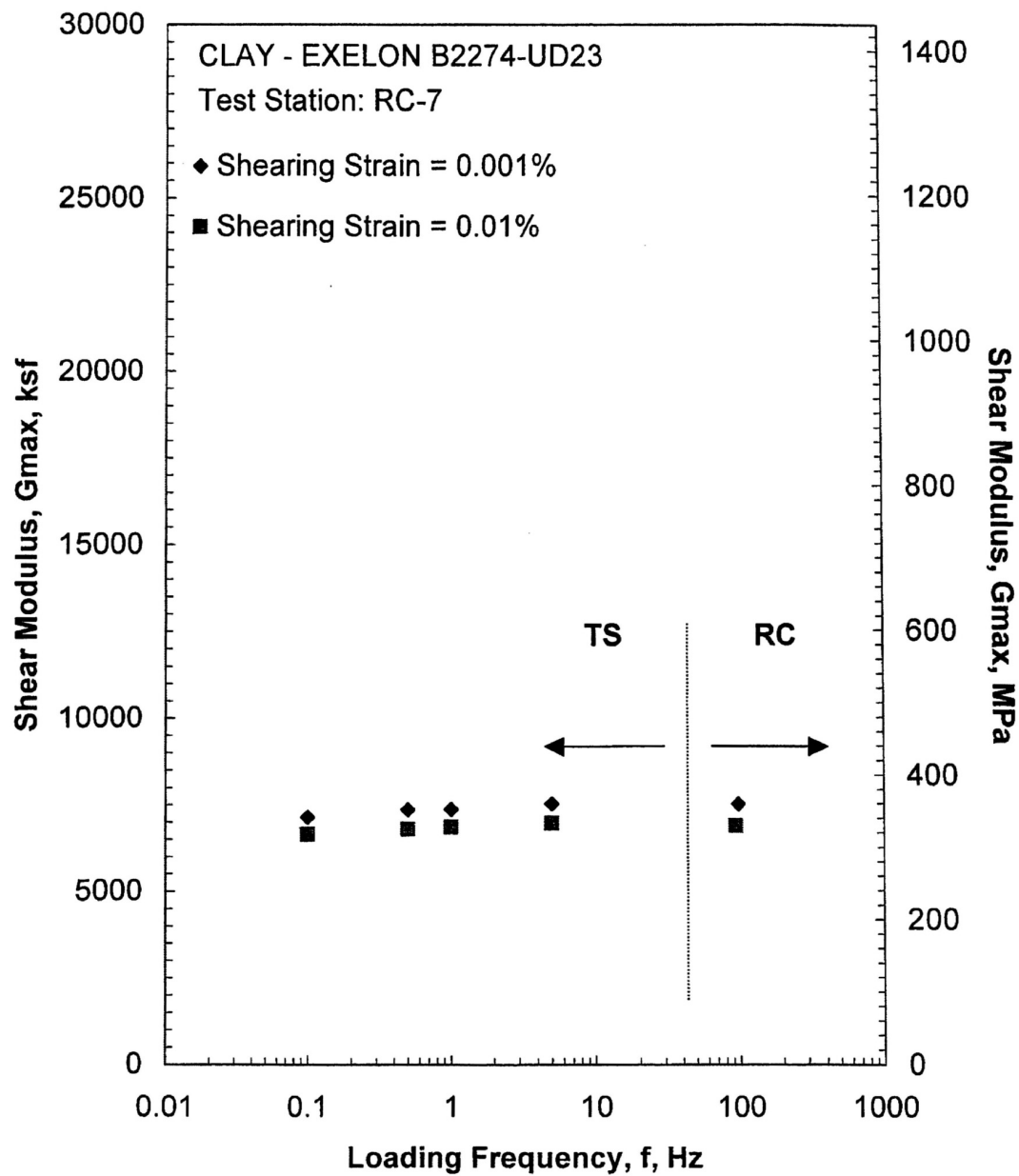


Figure G.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 136 psi from the Combined RCTS Tests

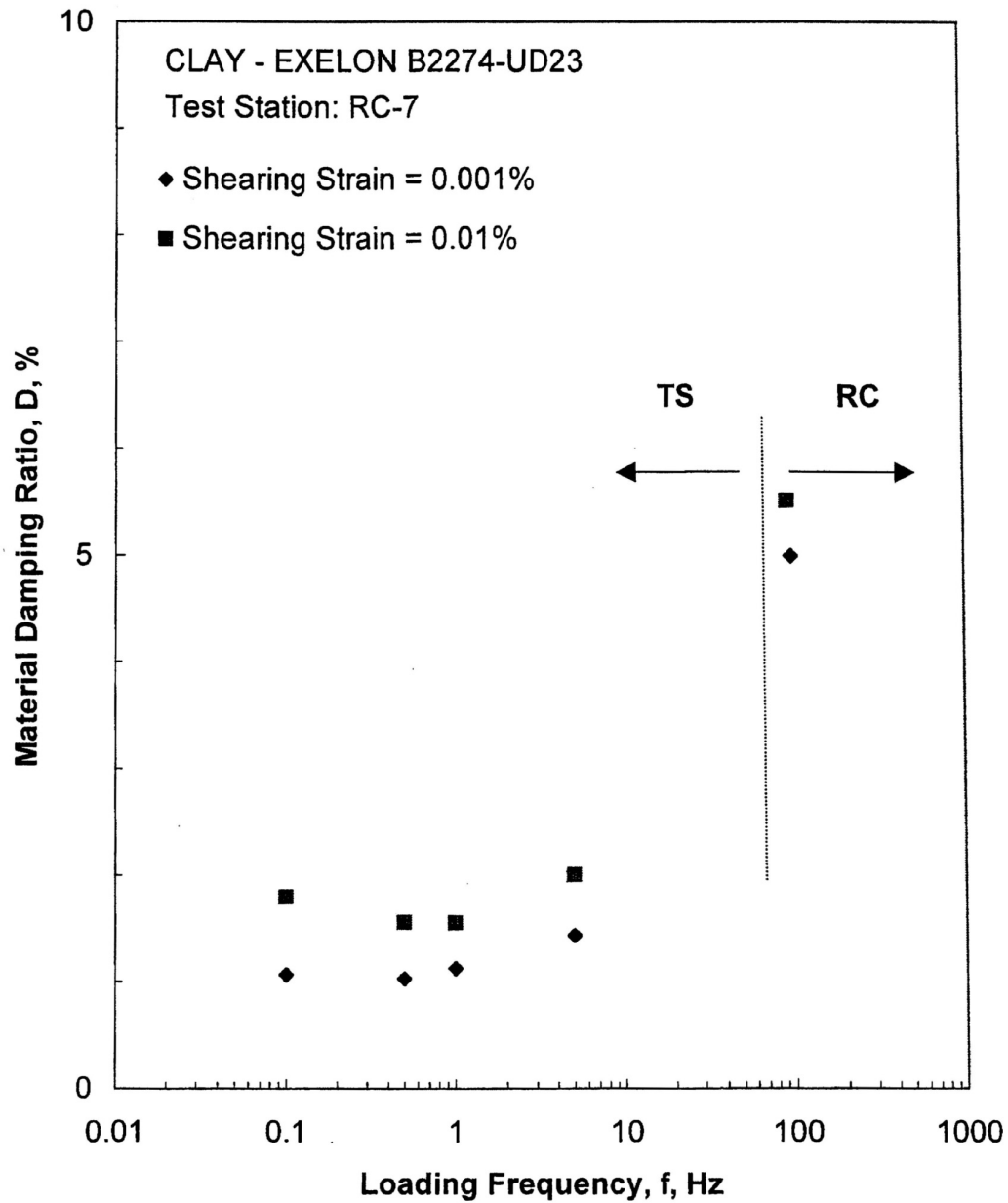


Figure G.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 136 psi from the Combined RCTS Tests

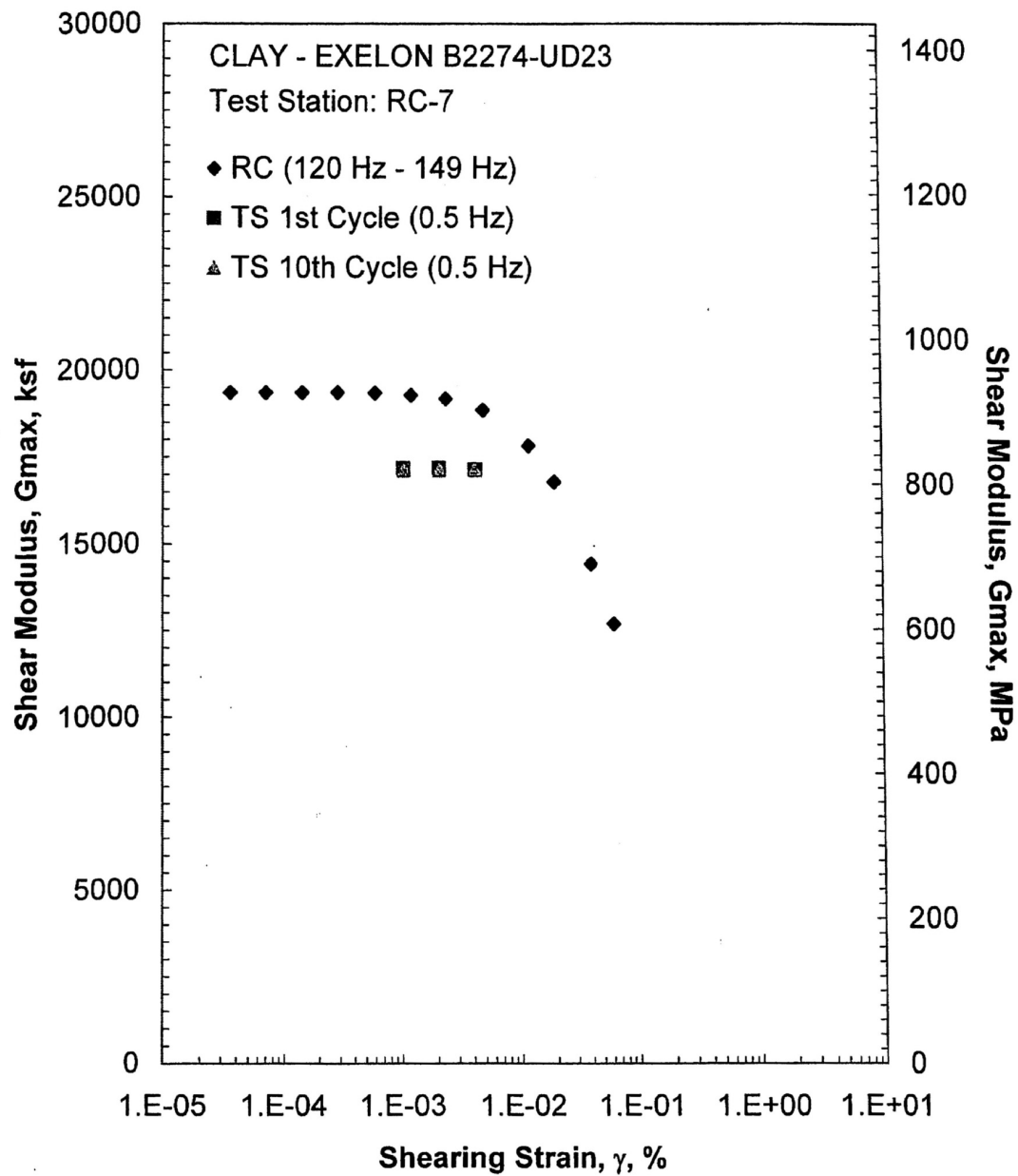


Figure G.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

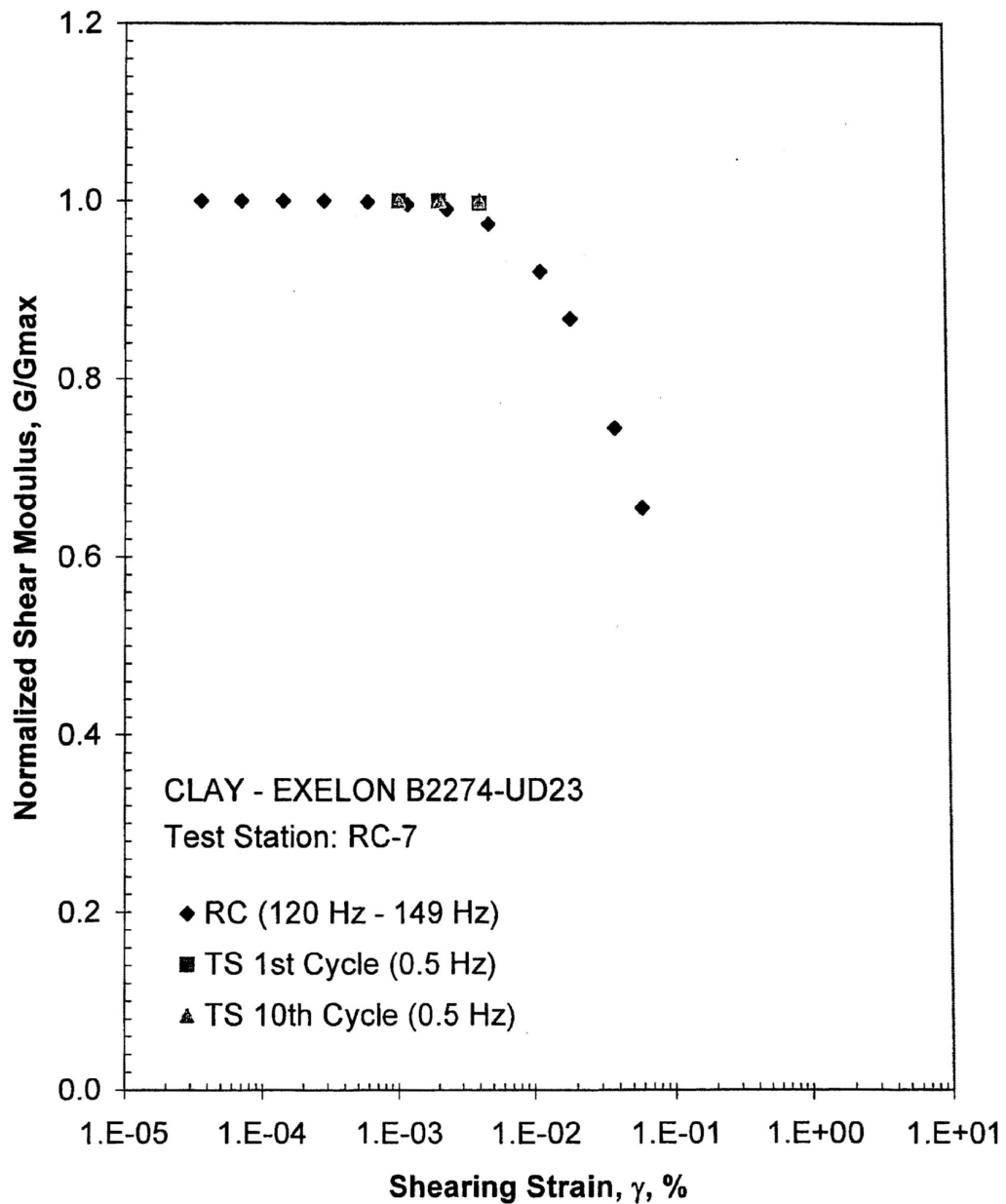


Figure G.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

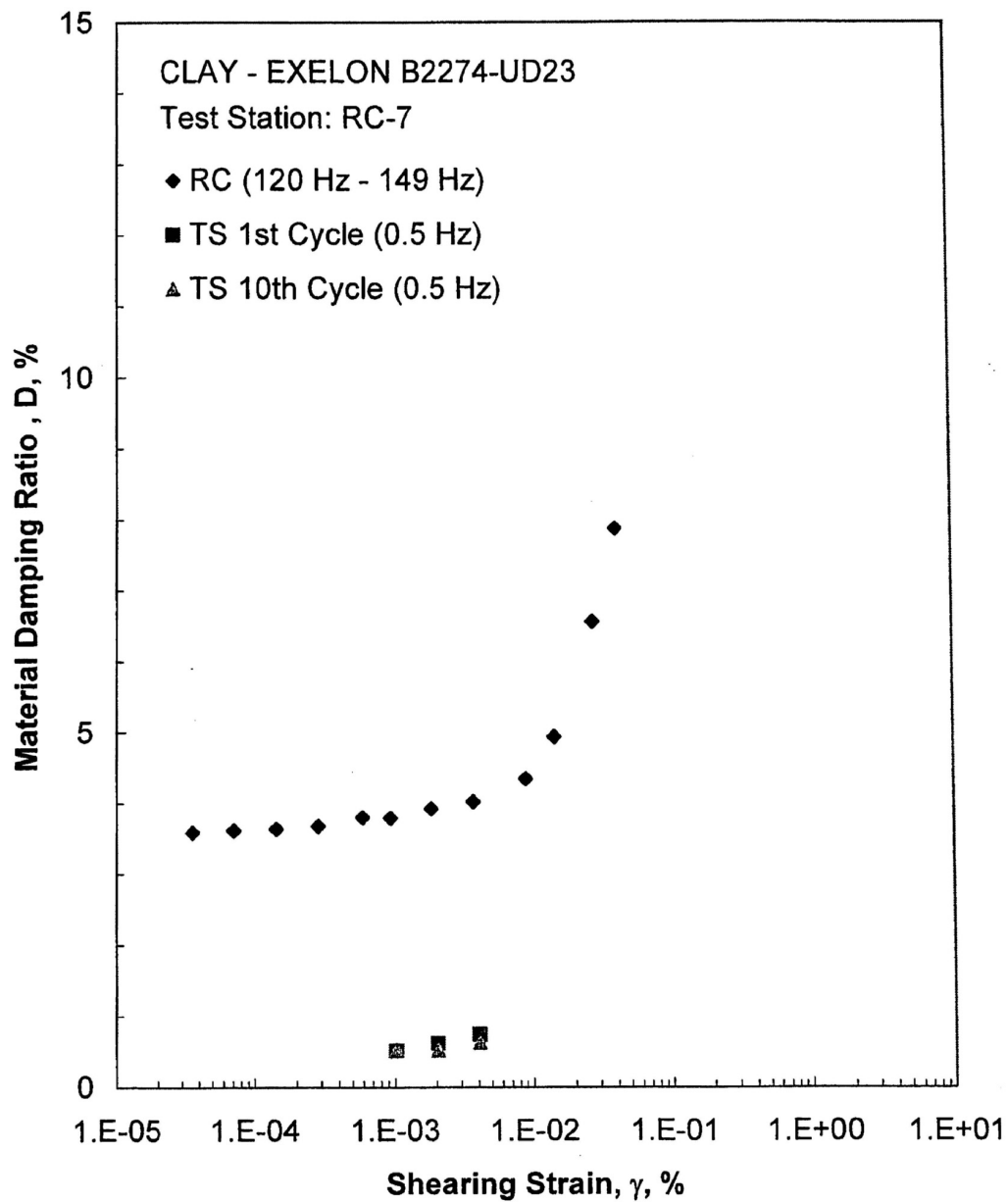


Figure G.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

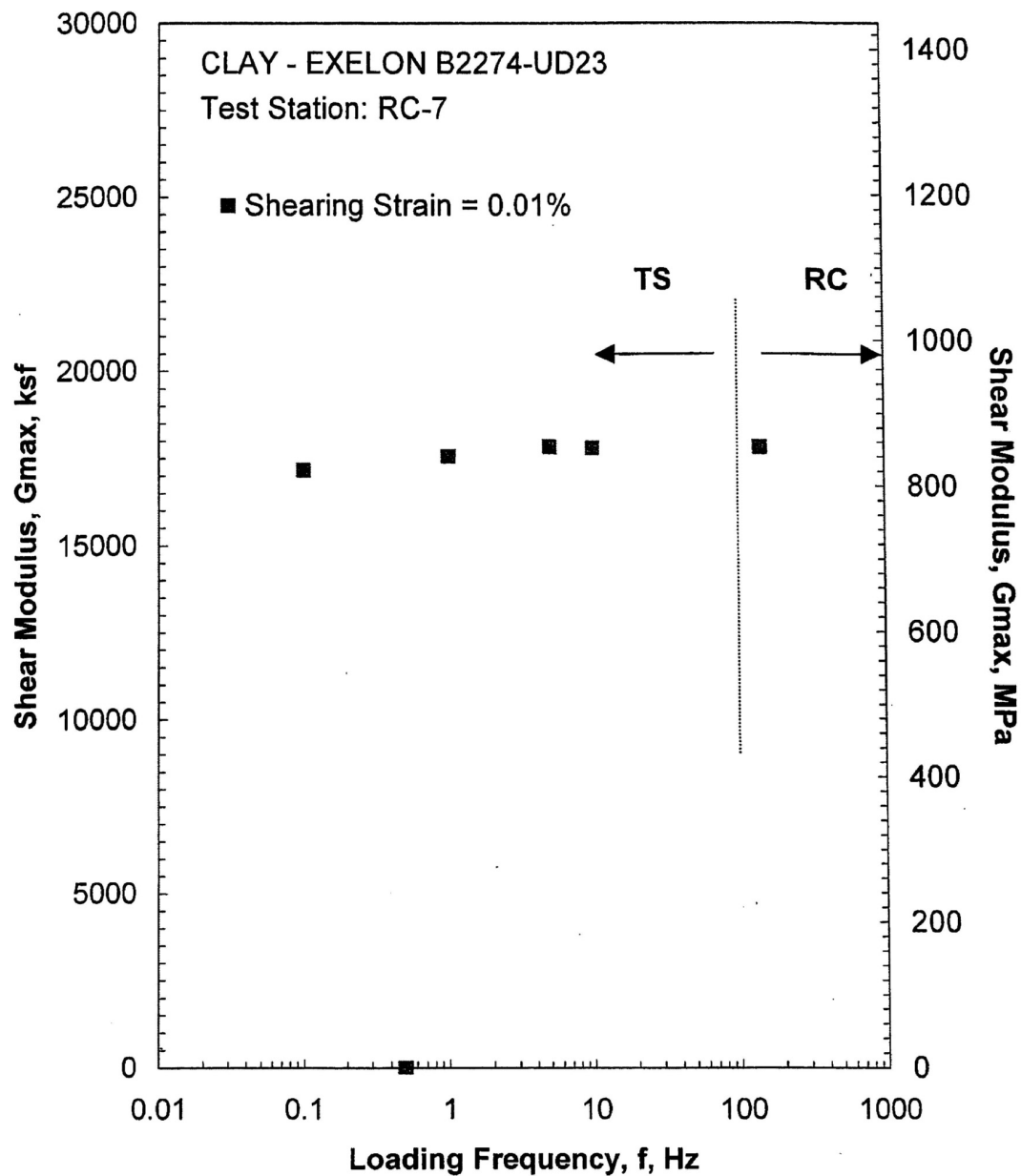


Figure G.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

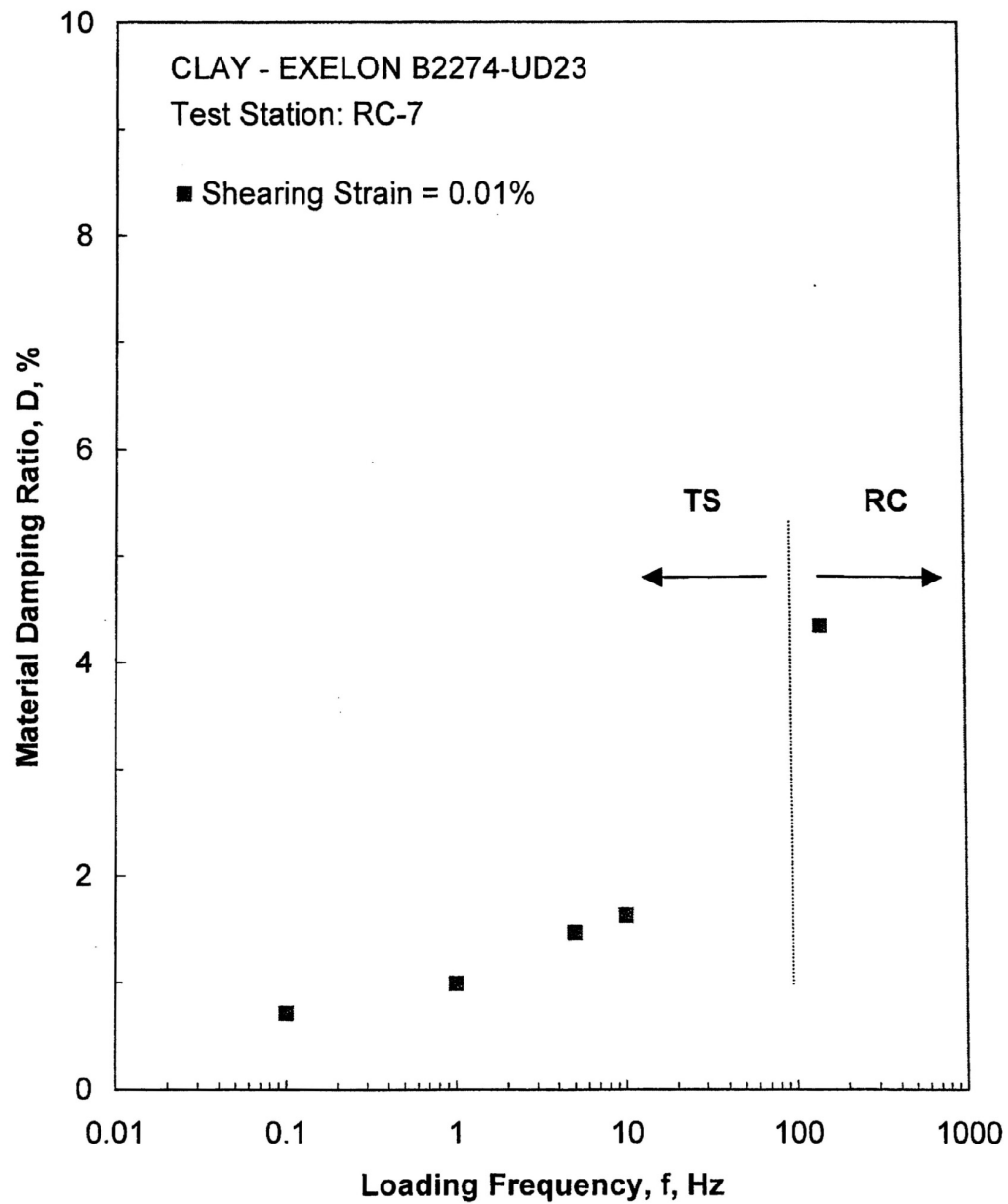


Figure G.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 455 psi from the Combined RCTS Tests

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 B2274-UD23

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
34	4896	234	3525	169	912	5.86	0.43
68	9792	469	5117	246	1094	5.33	0.42
136	19584	937	7704	370	1335	4.82	0.40
272	39168	1874	12855	617	1708	4.21	0.37
455	65520	3135	17743	852	1993	3.86	0.35

Table G.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2274-UD23; Isotropic Confining Pressure, $\sigma_o=136$ psi (19.6 ksf = 937 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average* Shearing Strain, %	Material Damping Ratio ^x , D, %
8.20E-05	7525	1.00	8.20E-05	4.64
1.64E-04	7525	1.00	1.64E-04	4.74
3.28E-04	7504	1.00	3.28E-04	4.81
6.82E-04	7504	1.00	6.82E-04	4.92
1.36E-03	7504	1.00	9.94E-04	4.99
2.76E-03	7422	0.99	2.02E-03	5.18
5.60E-03	7242	0.96	4.09E-03	5.28
1.14E-02	6885	0.91	8.22E-03	5.51
2.36E-02	6253	0.83	1.65E-02	6.16
5.14E-02	5266	0.70	3.34E-02	7.86
1.23E-01	3888	0.52	7.00E-02	10.89

* 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 B2274-UD23; Isotropic Confining Pressure, $\sigma_o = 136$ psi (19.6 ksf = 937 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, %
6.81E-04	7259	1.00	0.82	6.89E-04	7266	1.00	1.02
1.10E-03	7259	1.00	0.90	1.09E-03	7266	1.00	1.02
2.20E-03	7259	1.00	1.15	2.19E-03	7266	1.00	1.00
4.46E-03	7168	0.99	1.13	4.46E-03	7175	0.99	0.99

Table G.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2274-UD23; Isotropic Confining Pressure, $\sigma_c = 455$ 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, %
3.60E-05	19357	1.00	3.60E-05	3.59
7.10E-05	19357	1.00	7.10E-05	3.62
1.43E-04	19357	1.00	1.43E-04	3.64
2.86E-04	19357	1.00	2.86E-04	3.68
5.94E-04	19340	1.00	5.94E-04	3.80
1.19E-03	19275	1.00	9.39E-04	3.79
2.34E-03	19176	0.99	1.85E-03	3.92
4.77E-03	18850	0.97	3.72E-03	4.02
1.15E-02	17819	0.92	8.86E-03	4.34
1.90E-02	16782	0.87	1.43E-02	4.93
3.92E-02	14413	0.74	2.70E-02	6.56
6.12E-02	12678	0.65	3.98E-02	7.86

⁺ 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 B2274-UD23; Isotropic Confining Pressure, $\sigma_o=455$ 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, %
1.02E-03	17173	1.00	0.51	1.03E-03	17108	1.00	0.52
2.04E-03	17173	1.00	0.61	2.06E-03	17108	1.00	0.51
4.10E-03	17124	1.00	0.74	4.09E-03	17108	1.00	0.62

APPENDIX H

Specimen B2269-UD19
(Index Properties Not Available)

Borehole B2269
Sample UD19
Depth = 381.6 (116.3 m)
Total Unit Weight = 114.6 lb/ft³
Water Content = 33.0%
Estimated In-Situ K_o = 0.5
Estimated In-Situ Mean Effective
Stress = 125 psi

FUGRO JOB #: 0411-08-1686
Testing Station: RC8

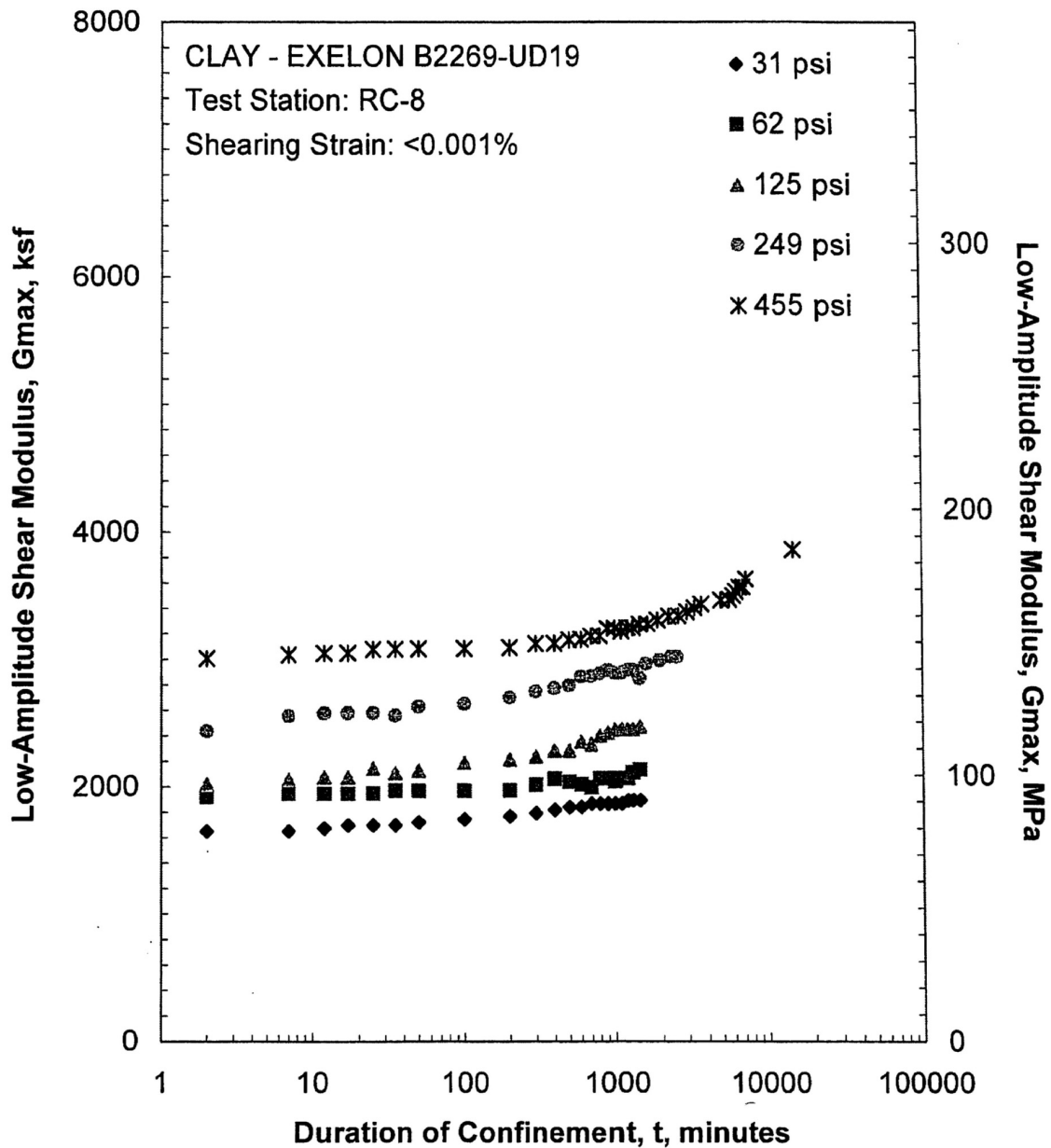


Figure H.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

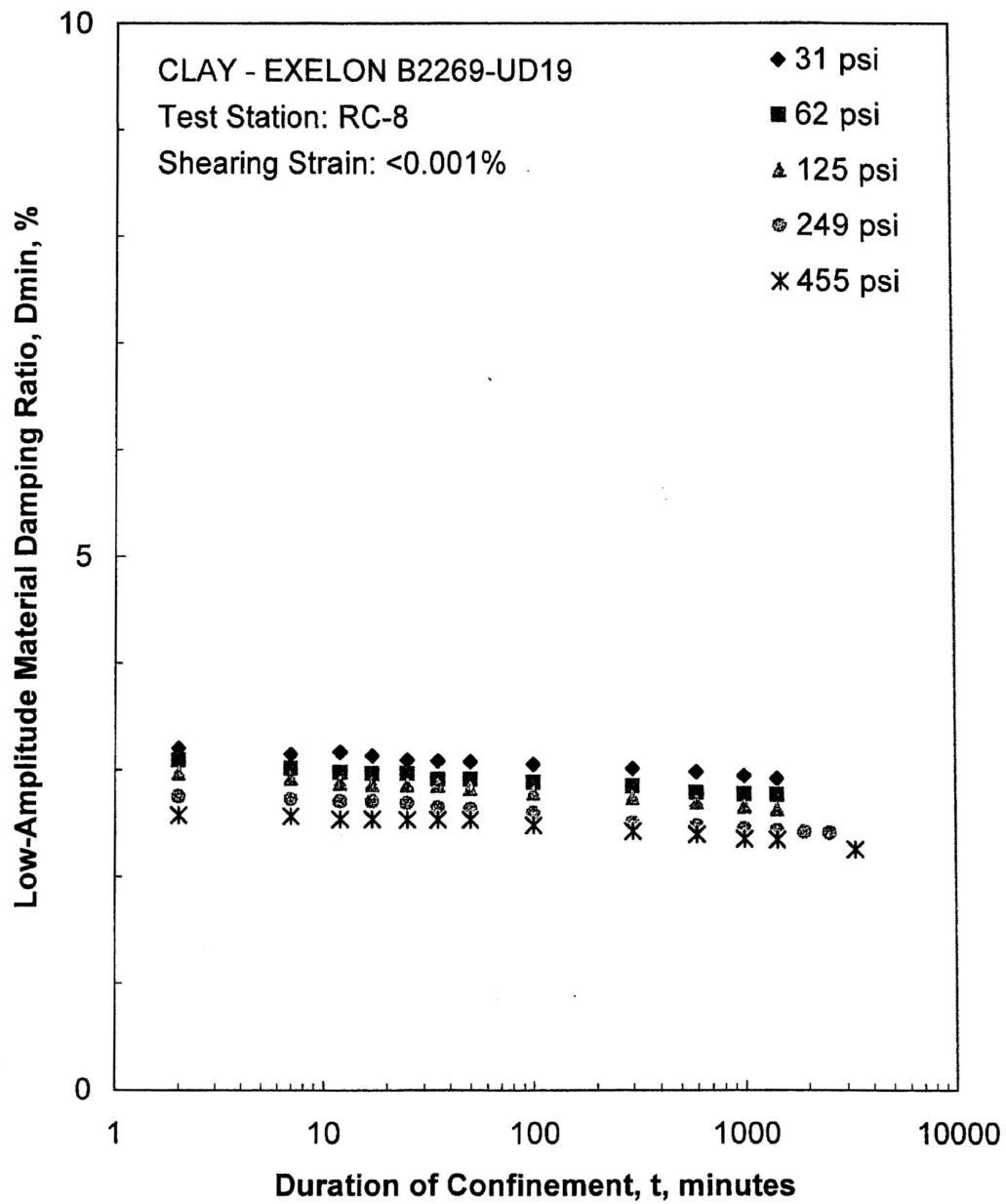


Figure H.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

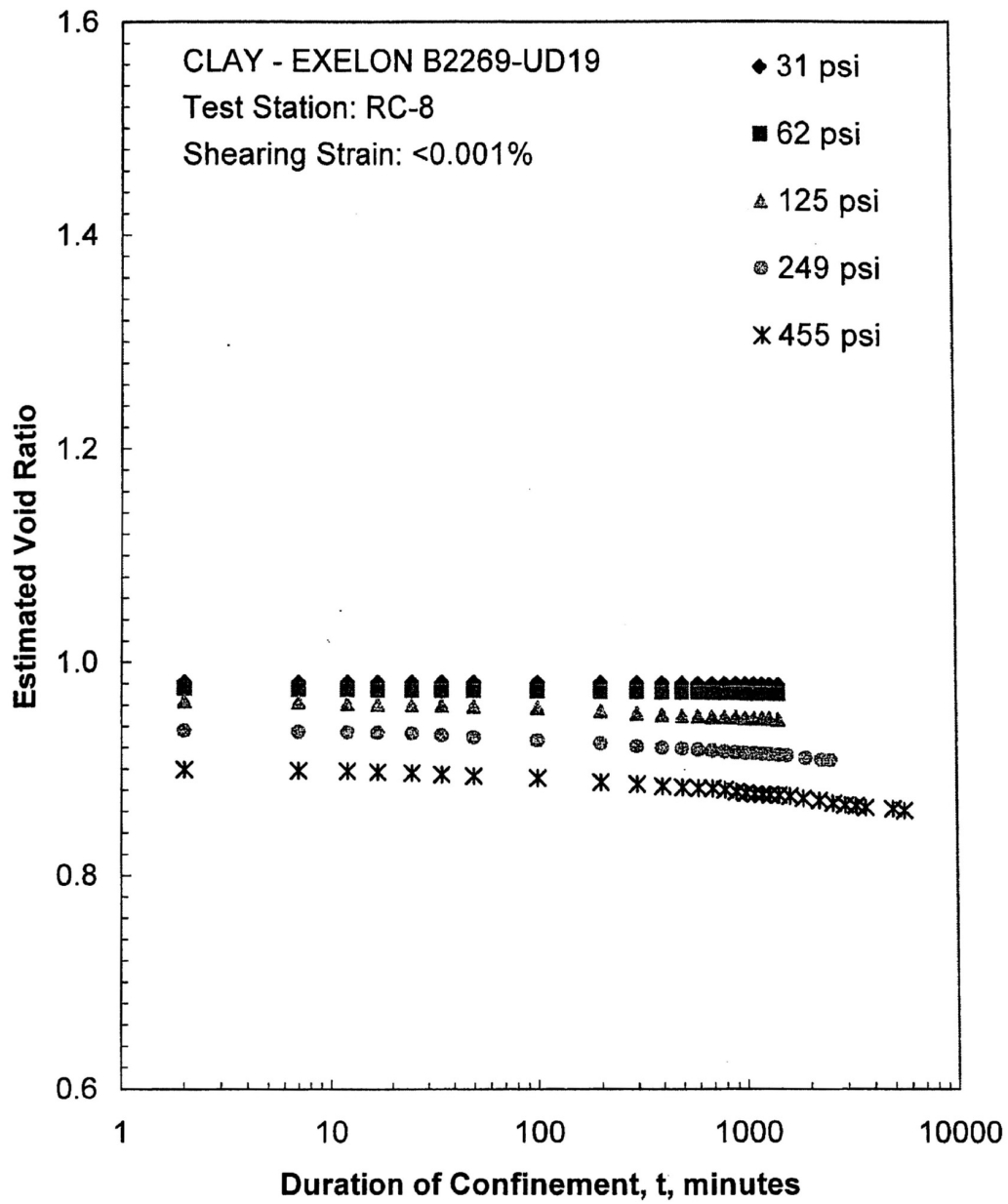


Figure H.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

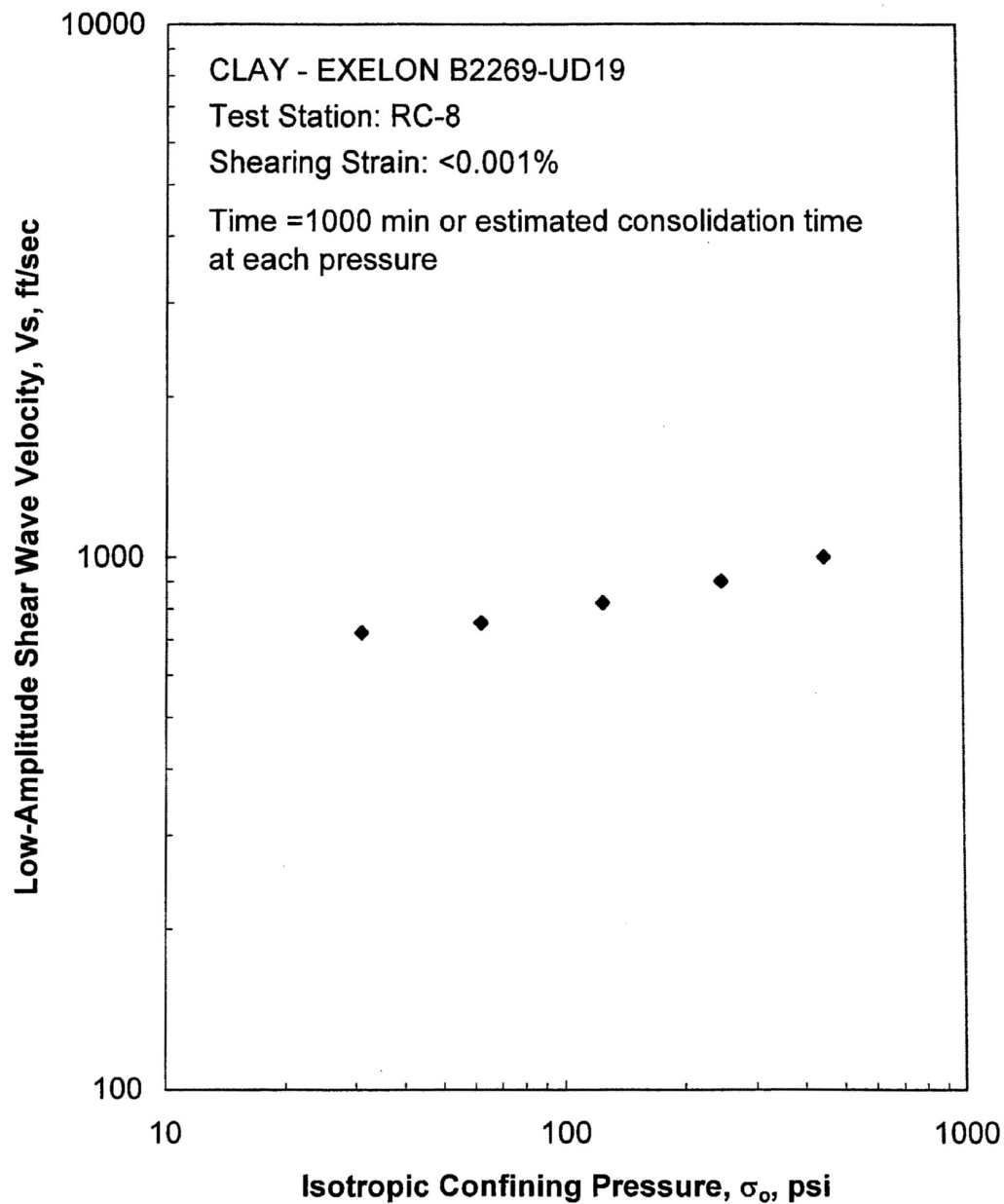


Figure H.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

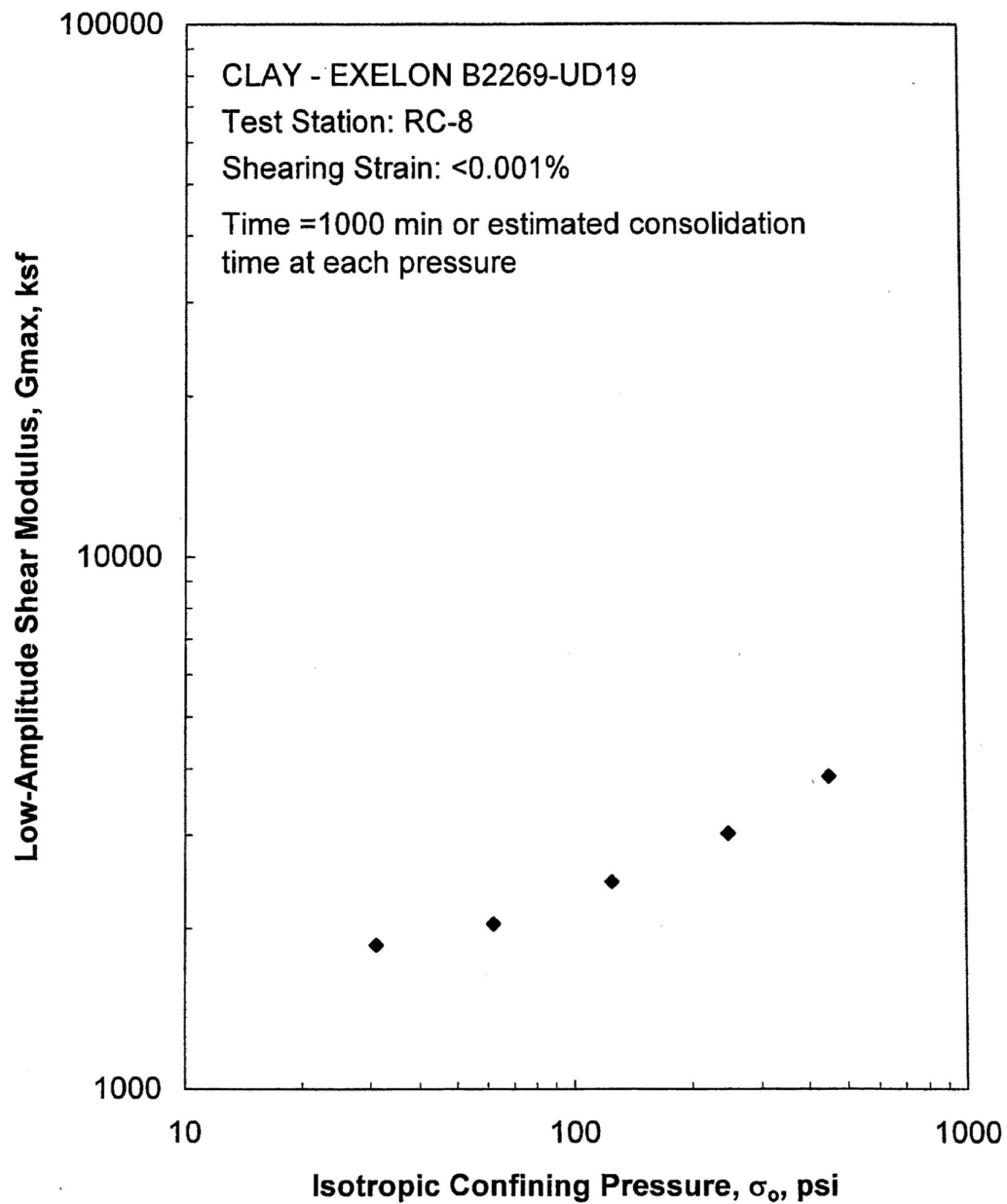


Figure H.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

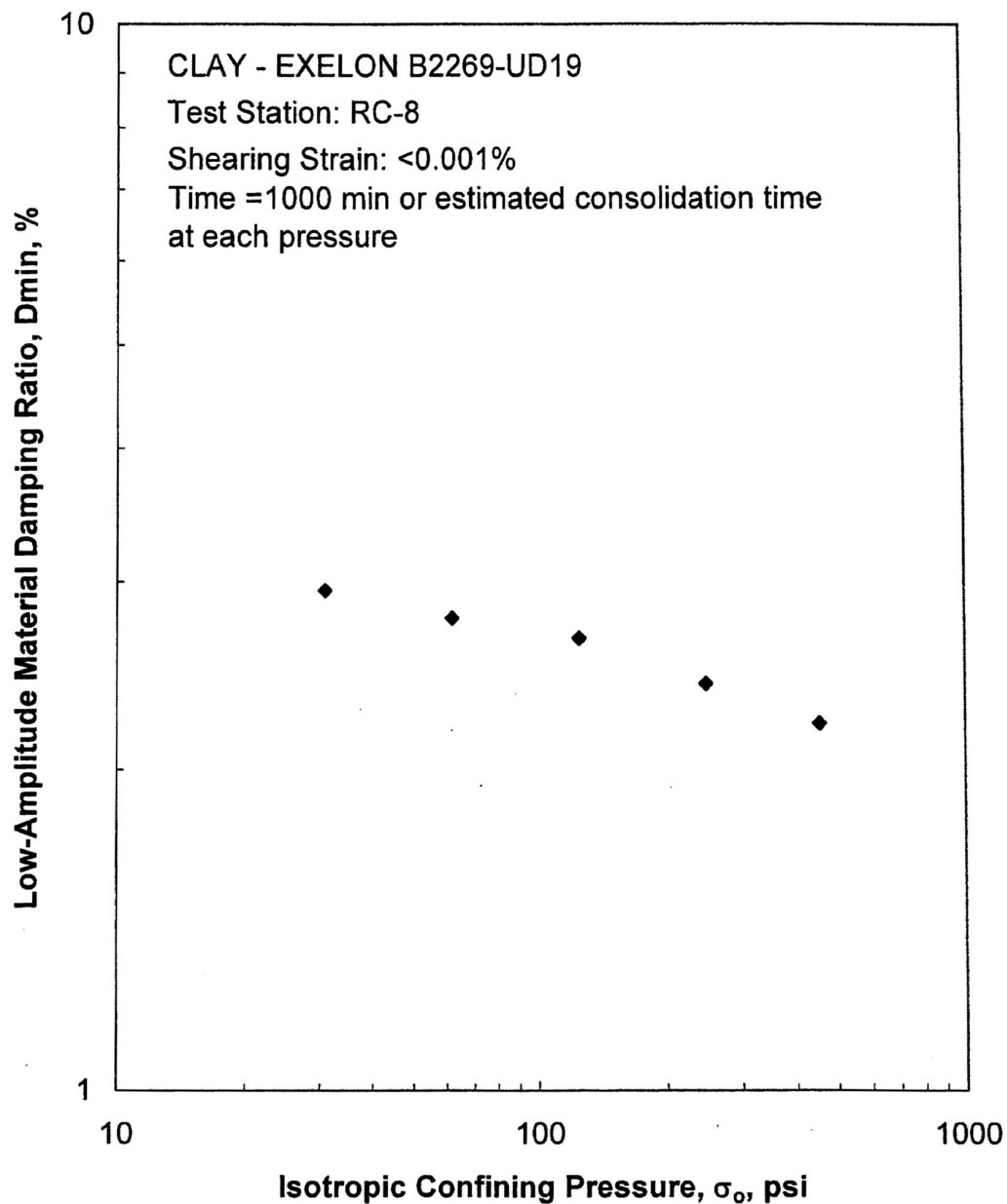


Figure H.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

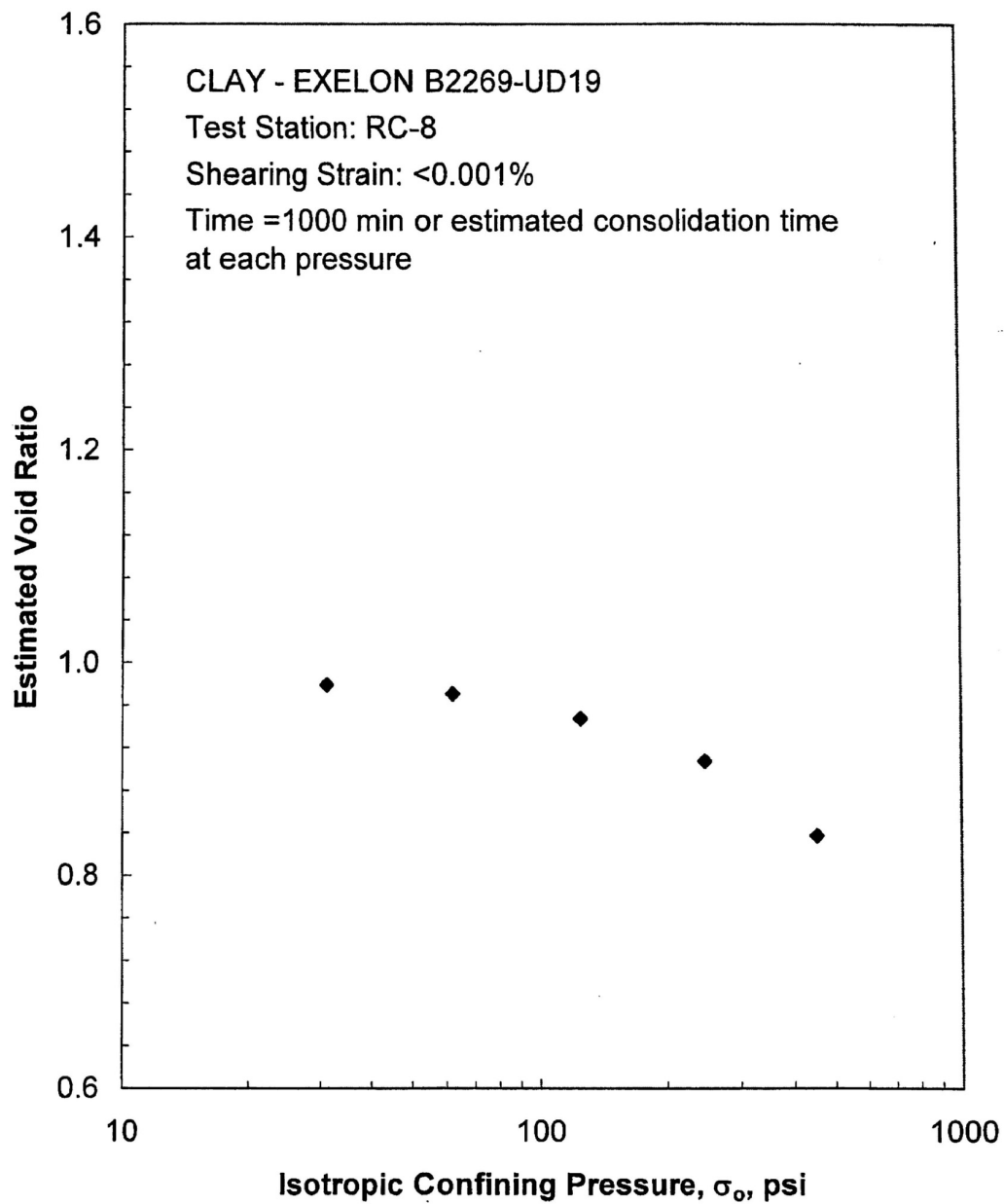


Figure H.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

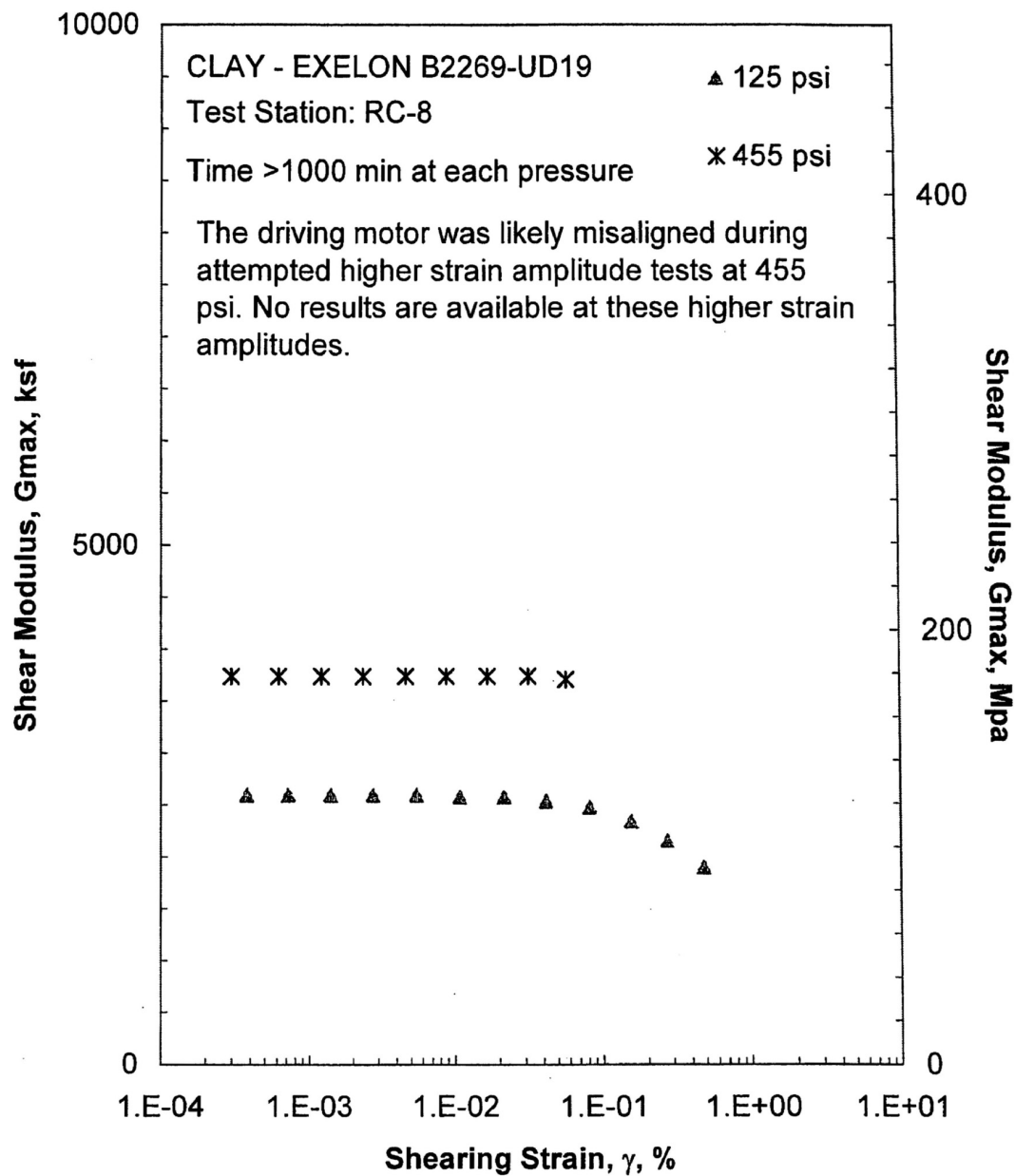


Figure H.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

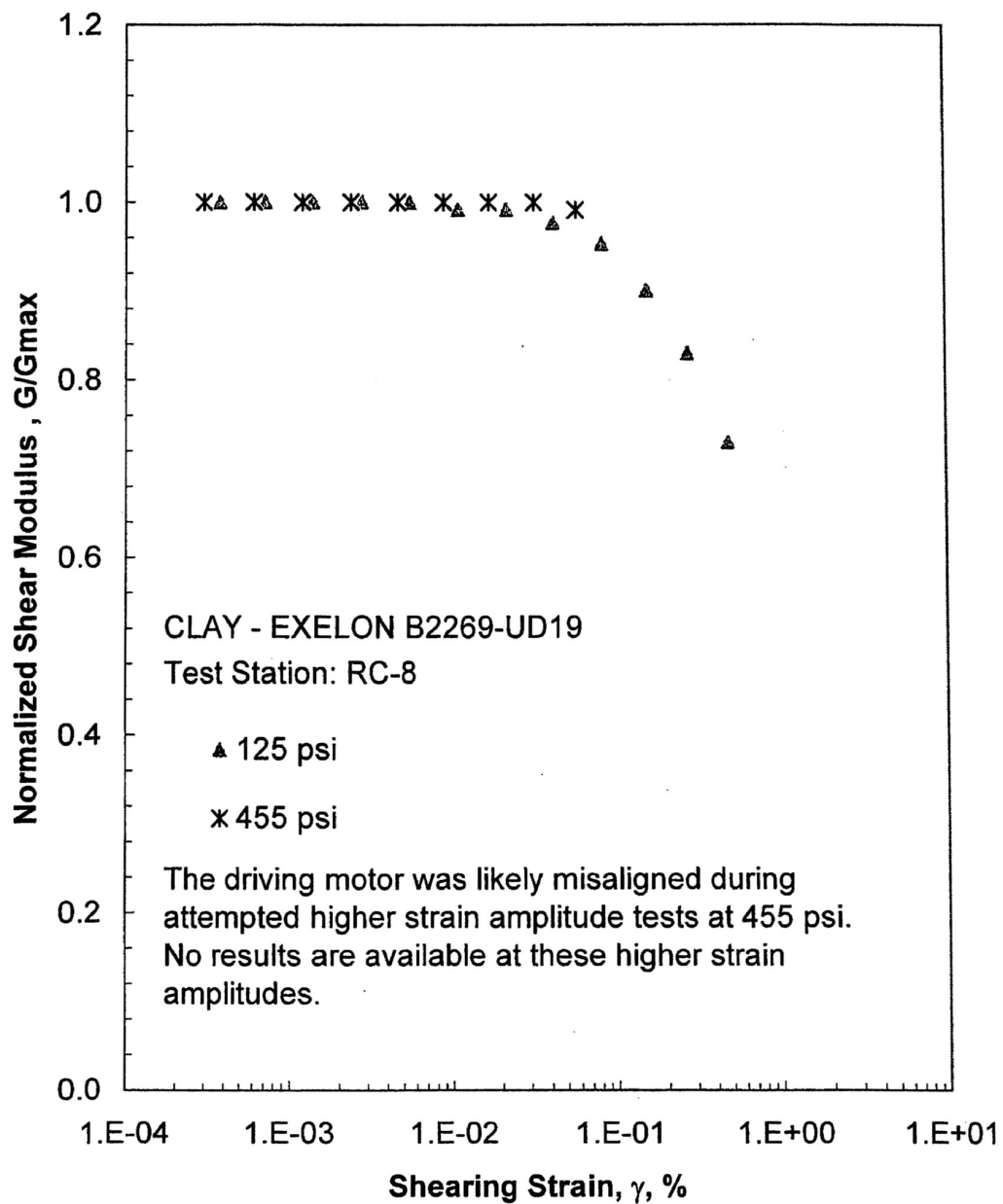


Figure H.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests