DATA REPORT ON DRILLED SHAFT LOAD TESTING (OSTERBERG METHOD)

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge Lexington, MO (LT-8516-2)

Prepared for: Massman Construction
8901 State Line Road
Kansas City, MO 64114

Attention: Mr.Todd Eskra

PROJECT NUMBER: LT-8516-2, May 13, 1999

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LOADTEST INC.

May 13, 1999

Massman Construction
8901 State Line Road
Kansas City, MO 64114

Attention: Mr.Todd Eskra

Fax: 816-333-2109

Data Report: Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge
Location: Lexington, MO

Dear Sirs,

LOADTEST, Inc. performed an Osterberg Cell load test for Massman Construction on dedicated Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge (LTI project LT-8516-2). The test was carried out on May 3, 1999 by LOADTEST, Inc. under the direction of Mr. M. D. Ahrens and Mr. W. G. Ryan. Representatives of Massman Construction observed the test. Preliminary test data was submitted to Massman Construction on May 5, 1999.

Massman Construction constructed the test shaft on April 21 - 27, 1999. The dedicated test shaft was drilled wet (w/ river water) with a total length of 29.89 m (98.0 ft) and an average diameter of 1170 mm (46.1 in) An auger was used for drilling and cleaning of the shaft was accomplished with an airlift. On April 22, 1999 the O-cell carrying frame assembly was inserted in the shaft, concrete was placed by pump through a 152 mm I.D. (6 in) pipe into the base of the shaft until the top of the concrete reached an elevation of +178.46 m (+585.5 ft) at which point pumping ceased because the remaining available concrete had already begun to set and could not be pumped. On April 27, 1999, the top of the cold joint was scoured for approximately three hours with water and air, after which concrete was placed until the top of the concrete reached an elevation of +184.40 m (+605.0 ft). The base of the bottom O-cell™ was located 1.52 m (5.0 ft) above the tip of shaft and the base of the mid-cell was located 4.00 m (13.1 ft) above the base of the bottom O-cell™. A summary of dimensions, elevations and piles properties used in the analyses is provided in Table A.

The sub-surface stratigraphy at the test shaft location is reported to consist of overburden soils to elevation +195 m (+640 ft) underlain by limestone, sandstone to an undetermined depth. A boring log in the vicinity of Test Shaft #2 is presented in Appendix F. Detailed geologic information can be obtained from Missouri Department of Transportation.

The key elements of the acquired data are as follows:

- Summary of Dimensions, Elevations & Pile Properties, Table A.
- Schematic Section of Test Shaft Figure A.
- Osterberg Cell Load-Movement Curves – Stage 1, Figure 1.
- Osterberg Cell Load-Movement Curves – Stages 2 & 3, Figure 2.
- Strain Gage Load Distribution Curves – Stage 1, Figure 3.
- Strain Gage Load Distribution Curves – Stages 2 & 3, Figure 4.
- Equivalent Top Load Movement Curves, Figure 5.
- Upper Side Shear Creep Limit – Stages 2 & 3, Figure 6.
- Middle Side Shear Creep Limit – Stage 2, Figure 7.
- Combined End Bearing and Bottom Side Shear Creep – Stage 1, Figure 8.
- Field Data & Data Reduction, Appendix A (12 pages).
- O-cell™ and Instrumentation Calibration Sheets, Appendix B.
- Construction of the Equivalent Top-Loaded Load-Settlement Curve, Appendix C.
- O-cell™ Method for Determining Creep Limit Loading, Appendix D.
- Hyperbolic Curve Fit, Appendix E.
- Soil Boring and Shaft Caliper Logs, Appendix F.
- Reference Beam Monitoring, Appendix G.

Standard O-cell™ instrumentation included three LVWDTs positioned between the lower and upper plates of both the bottom O-cell™ and middle O-cell™ to measure expansion (Tables 6 and 9). Compression of the shaft between the two levels of O-cells™, elevation +176.6 to 179.9 m, was measured by a pair of embedded compression telltales (ECTs) (Table 3). Compression of the shaft above the mid-cell, elevation +180.5 to 183.9 m, was also measured by a pair of ECTs (Table 4). Two LVDTs attached to a reference beam monitored the top of shaft (carrying frame) movement (Table 2).

Two levels of three sister bar vibrating wire strain gages were installed in the shaft between the O-cell™ and the mid-cell and two levels of three sister bar vibrating wire strain gages were installed in the shaft above the base of the mid-cell. Details concerning the strain gage placement appear in Table A and Figure A. The strain gages were used to assess the side shear load transfer of the shaft above and below the middle Osterberg cell. The strain gages were positioned as recommended by the LOADTEST, Inc.

American Equipment and Fabricating Corporation carried out a pressure vs. load calibration of the O-cell™ to 13.6 MN (3050 kips) prior to delivery to the test site (See Appendix B). Both a Bourdon pressure gage (0-10,000 psi) and vibrating wire pressure transducers were used to measure the pressure applied to the O-cells™ at each load interval. We used the Bourdon pressure gage for calculations and the transducer as a check. All checks were acceptable.

Note: The loads applied by the O-cell™ act in two opposing directions, resisted by upper side shear above the O-cell™ and by the combined end bearing and bottom side shear below the O-cell™. Theoretically, the O-cell™ does not impose an additional side shear and end bearing load until its expansion force exceeds the buoyant weight of the shaft above the O-cell™. Therefore, *net load*, which is defined as gross O-cell™ load minus the buoyant weight of the shaft, is used throughout this report, unless otherwise noted. For this test we calculated a buoyant weight of shaft of 0.13 MN (29 kips) above the O-cell™ and 0.07 MN (16 kips) above the mid-cell.

The Osterberg cell load test was carried out in three stages as follows:

Stage1: The 660 mm (26 in) diameter bottom O-cell™, with its base located 1.52 m (5.0 ft) above the base of shaft was pressurized to assess the combined end bearing and bottom side shear below the O-cell™ using the upper side shear above the O-cell™ as reaction. The O-cell™ was pressurized in 13 loading increments to 44.82 MPa (6500 psi) resulting in a gross O-cell™ load of 10.59 MN (1190 kips) upward and 10.59 MN (1190 kips) downward. The loading was halted after load interval 1L-13 because the combined end bearing and bottom side shear was approaching ultimate capacity. The O-cell™ was then unloaded in 5 increments and Stage 1 was concluded.

Stage 2: After unloading the bottom O-cell™, the 660 mm (26 in) mid-cell, located 4.00 m (13.1 ft) above the base of the bottom O-cell™, was pressurized to assess the shear characteristics of the shaft below the mid-cell using the upper side shear above the mid-cell as reaction. The bottom O-cell™ hydraulic system was left free to drain (no load transfer through the O-cell™ to end bearing). The mid-cell was pressurized in 13 loading increments to 44.82 MPa (6500 psi) resulting in a gross mid-cell load of 10.59 MN (1190 kips) upward and 10.59 MN (1190 kips) downward.

Stage 3: Before loading increment 2L-14, the hydraulics to the bottom O-cell™ were closed and the mid-cell continued to be pressurized to assess the shear characteristics of the shaft above mid-cell by using the end bearing and side shear below the mid-cell as reaction. The mid-cell was pressurized in 4 additional loading increments to 56.54 MPa (8200 psi) resulting in a gross mid-cell load of 13.35 MN (1500 kips) upward and 13.35 MN (1500 kips) downward. The loading was halted after load interval 2L-17 because the mid-cell reached its maximum stoke and depressurized.

The following Table summarizes the three stages of loading:

Stage	See Fig.	Load Interval	Middle O-cell™			Bottom O-cell™		
			Max Q_{gross} (MN)	O-cell™ Hydraulics System	Total Expansion (mm)	Max Q_{gross} (MN)	O-cell™ Hydraulics System	Total Expansion (mm)
1	1	1L-1 to 1L-13	0	Closed	-0.1	10.6	Pressurized	+67.6
2	2	2L-1 to 2L-13	10.6	Pressurized	+15.9	0	Draining	+60.0
3	2	2L-14 to 2L-17	13.4	Pressurized	+148.2	5.2	Closed	+56.1

DISCUSSION OF RESULTS

Combined End Bearing and Bottom Side Shear: The maximum load during stage 1 applied to the base of the shaft was 10.46 MN (2350 kips) which occurred at load interval 1L-13 (Table 7, Figure 1). At this loading, the downward movement of the bottom O-cell™ base was 60.7 mm (2.39 in) and the ultimate capacity of the shaft below the bottom O-cell™ was reached. The side shear capacity of the 1.52 m (5.0 ft) shaft section below the O-cell™ is calculated to be 3.84 MN (864 kips) assuming a unit side shear value of 725 kPa (15.1 ksf) (Figure 3, 1L-13) and a nominal shaft diameter of 1107 mm (43.6 in). The maximum applied load to end bearing is then 6.62 MN (1488 kips) and the unit end bearing at the base of the shaft is calculated to be 6874 kPa (144 ksf).

Middle Side Shear: The maximum load during stage 2 applied to the middle side shear was 10.65 MN (2394 kips) which occurred at load interval 2L-13 (Table 10, Figure 2). At this loading, the downward movement of the mid-cell base was 12.4 mm (0.49 in) and the ultimate capacity of the middle side shear was reached. The average unit side shear of the 4.00 m (13.1 ft) shaft section below the mid-cell is calculated to be 726 kPa (15.2 ksf) during the stage 2 loading.

Upper Side Shear: The maximum load during stage 3 applied to the upper side shear was 13.3 MN (2990 kips) which occurred at load interval 2L-17 (Table 8, Figure 2). At this loading, the upward movement of the mid-cell top was 7.7 mm (0.31 in) and the ultimate capacity of the upper side shear was not reached. The average unit side shear of the 4.23 m (13.9 ft) shaft section above the mid-cell is calculated to be 846 kPa (17.7 ksf). Based on the hyperbolic curve fit and extrapolation of Appendix E, we estimate the average ultimate unit side shear to be 1020 kPa (21.3 ksf) for the shaft above the mid-cell. The following section provides additional unit side shear estimates based on strain gage data.

Strain Gage Results: The strain gage data appear in Tables 11 and 12. On the day of the test, the concrete unconfined compressive strength was reported to be 33.7 MPa (4890 psi) below elevation +178.46 m and 28.1 MPa (4070 psi) above. We used the ACI formula ($E_c=57000\sqrt{f'_c}$) to calculate an elastic modulus for the concrete. This, combined with the area of reinforcing steel and average shaft diameter, was used to determine an average pile modulus (E_p) of 28.0 MPa (4060 ksi) above the mid-cell, 28.8 MPa (4170 ksi) between the mid-cell and O-cell™ and 26.9 MPa (3900 ksi) below the O-cell™. Side shear load distribution curves generated from strain gage data are shown in Figures 3 and 4. Estimated unit side shear values for the shaft based on the strain gage data, estimated shaft modulus and shaft area are as follows for 2L-17:

Load Transfer Zone	Unit Side Shear
Top of Shaft to Strain Gage Level 4	236 kPa (4.9 ksf)
Strain Gage Level 4 to Strain Gage Level 3	694 kPa (14.5 ksf)
Strain Gage Level 3 to Mid-cell	1653 kPa (34.5 ksf)
Mid-cell to Bottom O-cell™ *	570 kPa (11.9 ksf)

* By monitoring the pressure in the bottom O-cell™ during the Stage 3 loading, we were able to assess how much load was shed in the shaft between the bottom O-cell™ and mid-cell. This method was used because of the negative strain readings at levels 1 and 2 for most of the 2nd loading cycle. It should be noted that unit side shear between the two O-cells™ peaked at 2L-13 at 726 kPa (15.2 ksf).

Creep Limit: See Appendix D for our O-cell™ method for determining creep limit loading. The upper side shear creep data (Table 8) indicate that no apparent creep limit was reached at the maximum movement of 7.7 mm (0.31 in) (Figure 6). The middle side shear creep data (Table 10) indicate that a creep limit of 8.0 MN (1800 kips) was reached at a movement of 2.9 mm (0.12 in) (Figure 7). The combined end bearing and bottom side shear creep data (Table 7) indicate that a creep limit of 3.3 MN (740 kips) was reached at a movement of 1.3 mm (0.05 in) (Figure 8). A top loaded shaft will begin significant creep when all components begin creep movement. This will occur at the maximum of the movements required to reach the creep limit for each component. We believe that significant creep for this shaft will not begin until a top loading exceeds of 28.9 MN (6490 kips) by some unknown amount.

Equivalent Top Load: Figure 5 presents the equivalent top-loaded load-settlement curves. The lighter curve, described in Procedure Part I of Appendix C, was generated by using the measured upward top of mid-cell, measured downward base of mid-cell and downward bottom O-cell™ data. The curve is extended out to a settlement of 13.1 mm (0.52 in) by extrapolating the top of mid-cell data. Because it is often an important component of the settlements involved, the equivalent top load curve requires an adjustment for the additional elastic compression that would occur in a top-load test. The darker curve as described in Procedure Part II of Appendix C includes such an adjustment.

The test shaft was successfully loaded to a combined side shear and end bearing of more than 34.4 MN (7730 kips). For a top loading of 22.5 MN (5060 kips), the adjusted test data indicate this shaft would settle approximately 6.4 mm (0.25 in) of which 4.0 mm (0.16 in) is estimated elastic compression. For a top loading of 29.4 MN (6600 kips) the adjusted test data indicate this shaft would settle approximately

12.7 mm (0.50 in) of which 5.2 mm (0.21 in) is estimated elastic compression. The equivalent top load curve is shown in Figure 5.

Shaft Compression Telltales: The measured maximum shaft compression in the shaft below the mid-cell, averaged from 2 telltales, is 16.5 mm (0.65 in) at 2L-17. The relatively large compression measured is due primarily to the presence of the concrete cold joint at elevation +178.46 m.

The measured maximum shaft compression in the shaft above the mid-cell, averaged from 2 telltales, is 3.6 mm (0.14 in) at 2L-17. Using the nominal 1170 mm (46.1 in) shaft diameter, a shaft modulus of 28.0 GPa (4057 ksi), and the load distribution in Figure 2 at 2L-17, we calculated an elastic compression of 0.5 mm (0.02 in) over the length of the compression telltales. We believe the difference in the measured and calculated compressions indicates the presence variable modulus concrete above the mid-cell.

O-cell™ Tilting: The three LVWDTs measuring O-cell™ and mid-cell expansion allows us to evaluate the differential opening of the cell. Tables 6 and 9 show these measurements. For the bottom O-cell™, we calculate a maximum differential opening of 2.42 mm (0.095 in) (0.11°) at the 1L-13 maximum loading. For the mid-cell, we calculate a maximum differential opening of 3.75 mm (0.148 in) (0.16°) at the 2L-17 maximum loading. This indicates the loading plates did not tilt significantly, suggesting uniform concrete at least one shaft diameter above and below the O-cell™.

The analysis provided in this report is based on data (i.e. shaft diameter, elevations and concrete strength) provided by others. The engineer, therefore, should come to his/her own conclusions with regard to the analytical information.

We trust that this information will meet your current project needs. If you have any questions, please do not hesitate to contact us at (800) 368-1138.

Prepared for LOADTEST, Inc. by

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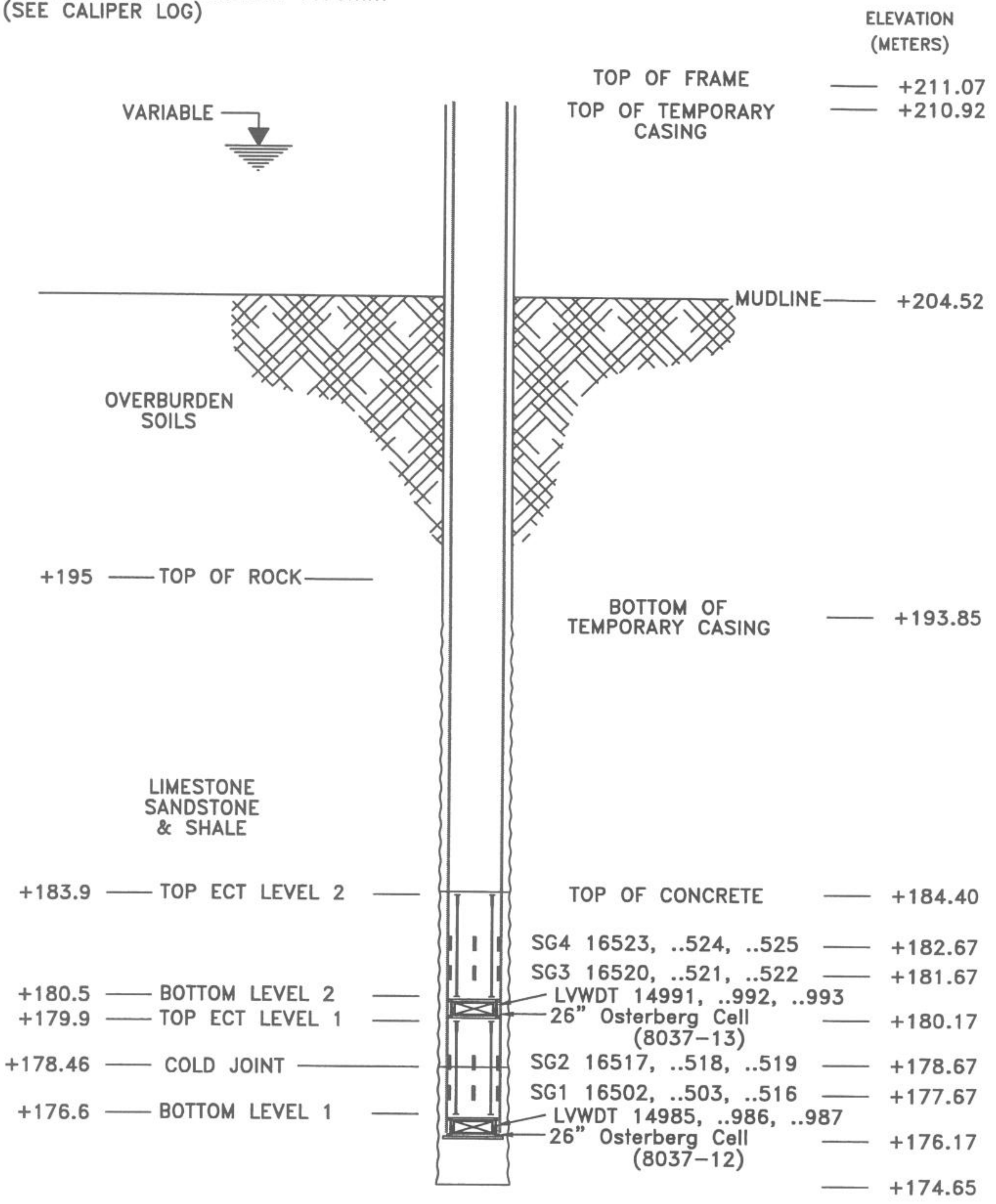
Ivan L. Guzman, M.E.

TABLE A:
SUMMARY OF DIMENSIONS, ELEVATIONS & PILE PROPERTIES

Shaft:			
Average shaft diameter (EL +184.40 m to +180.17 m)	=	1182 mm	46.5 in
Average shaft diameter (EL +180.17 m to +176.17 m)	=	1167 mm	46.0 in
Average shaft diameter (EL +176.17 m to +174.65 m)	=	1107 mm	43.6 in
Mid-cell.: 8037-13	=	660 mm	26 in
O-cell™: 8037-12	=	660 mm	26 in
Length of side shear above break at base of Mid-cell	=	4.23 m	13.9 ft
Length of side shear between O-cell™ and Mid-cell	=	4.00 m	13.1 ft
Length of side shear below break at base of O-cell™	=	1.52 m	5.0 ft
Shaft side shear area above Mid-cell base	=	15.70 m²	169.0 ft²
Shaft side shear area between O-cell™ and Mid-cell	=	14.67 m²	157.9 ft²
Shaft side shear area below O-cell™ base	=	5.30 m²	57.1 ft²
Shaft base area	=	0.96 m²	10.4 ft²
Bouyant weight of pile above base of Mid-cell	=	0.07 MN	15.6 kips
Bouyant weight of pile above base of O-cell™	=	0.13 MN	29.0 kips
Estimated shaft modulus (EL +184.40 m to +180.17 m)	=	28.0 GPa	4057 ksi
Estimated shaft modulus (EL +180.17 m to +176.17 m)	=	28.8 GPa	4173 ksi
Estimated shaft modulus (EL +176.17 m to +174.65 m)	=	26.9 GPa	3904 ksi
Elevation of Water Table	=	Variable	Variable
Elevation of mud line	=	+204.52 m	+671.0 ft
Elevation of top of shaft concrete	=	+184.40 m	+605.0 ft
Elevation of base of Mid-cell	=	+180.17 m	+591.1 ft
Elevation of base of O-cell™	=	+176.17 m	+578.0 ft
(The break between upward side shear movement and downward side shear and end bearing movement.)			
Elevation of shaft tip	=	+174.65 m	+573.0 ft
Casings:			
Elevation of top of inner temporary casing (1090 mm O.D.)	=	+210.92 m	+692.0 ft
Elevation of bottom of inner temporary casing (1090 mm O.D.)	=	+193.85 m	+636.0 ft
Compression Sections:			
Elevation of top of telltale used for level 2 shaft compression	=	+183.89 m	+603.3 ft
Elevation of bottom of telltale used for level 2 shaft compression	=	+180.54 m	+592.3 ft
Elevation of top of telltale used for level 1 shaft compression	=	+179.92 m	+590.3 ft
Elevation of bottom of telltale used for level 1 shaft compression	=	+176.57 m	+579.3 ft
Strain Gages:			
Elevation of strain gage Level 4	=	+182.67 m	+599.3 ft
Elevation of strain gage Level 3	=	+181.67 m	+596.0 ft
Elevation of strain gage Level 2	=	+178.67 m	+586.2 ft
Elevation of strain gage Level 1	=	+177.67 m	+582.9 ft
Miscellaneous:			
Top plate diameter mid-cell	=	815 mm	32.1 in
Bottom plate diameter mid-cell	=	815 mm	32.1 in
Top plate diameter O-cell™	=	815 mm	32.1 in
Bottom plate diameter O-cell™	=	915 mm	36.0 in
Carrying frame cross section (2 @ C4 x 7.25)	=	2748 mm²	4.26 in²
Unconfined compressive concrete strength (EL. +184.40 m to +178.46 m)	=	28.1 MPa	4070 psi
Unconfined compressive concrete strength (EL. +178.46 m to +174.65 m)	=	33.7 MPa	4885 psi
Mid-cell LVWDTs @ 0°, 180° and 270° with radius	=	408 mm	16.0 in
O-cell™ LVWDTs @ 0°, 180° and 270° with radius	=	458 mm	18.0 in

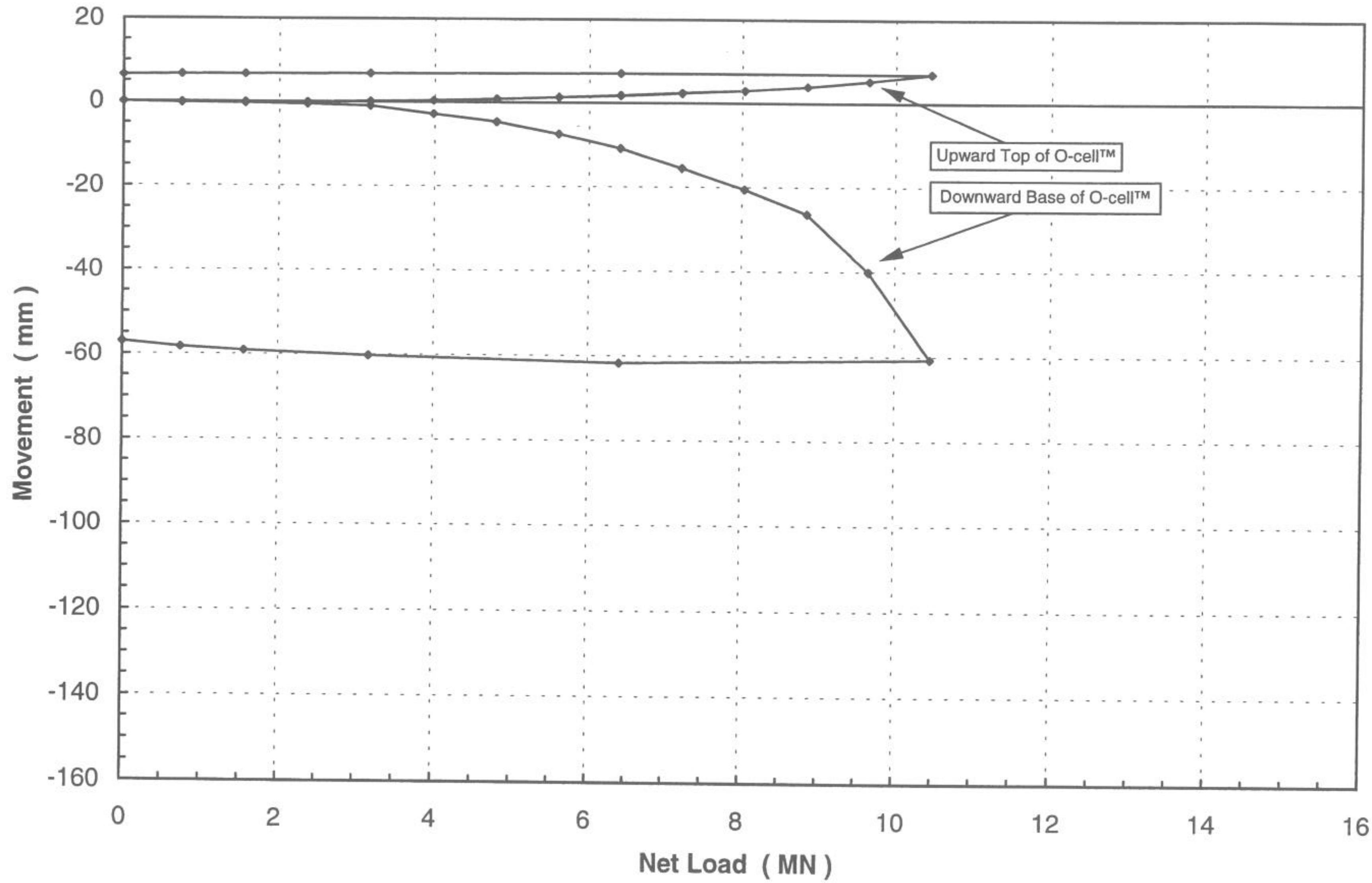
NOTE:
- AVERAGE SHAFT DIAMETER: 1170mm
(SEE CALIPER LOG)



LOADTEST	2631–D NW 41st St. Gainesville, FL 32606 Phone 800–368–1138 FAX (352) 378–3934	SCHEMATIC SECTION OF TEST SHAFT	LT–8516 Missouri River Bridge Lexington, MO FIGURE A

Osterberg Cell Load-Movement Curves - Stage 1

Multi Level Test Shaft - Missouri River Bridge - Lexington, MO



Osterberg Cell Load-Movement Curves - Stages 2 & 3

Multi Level Test Shaft - Missouri River Bridge - Lexington, MO

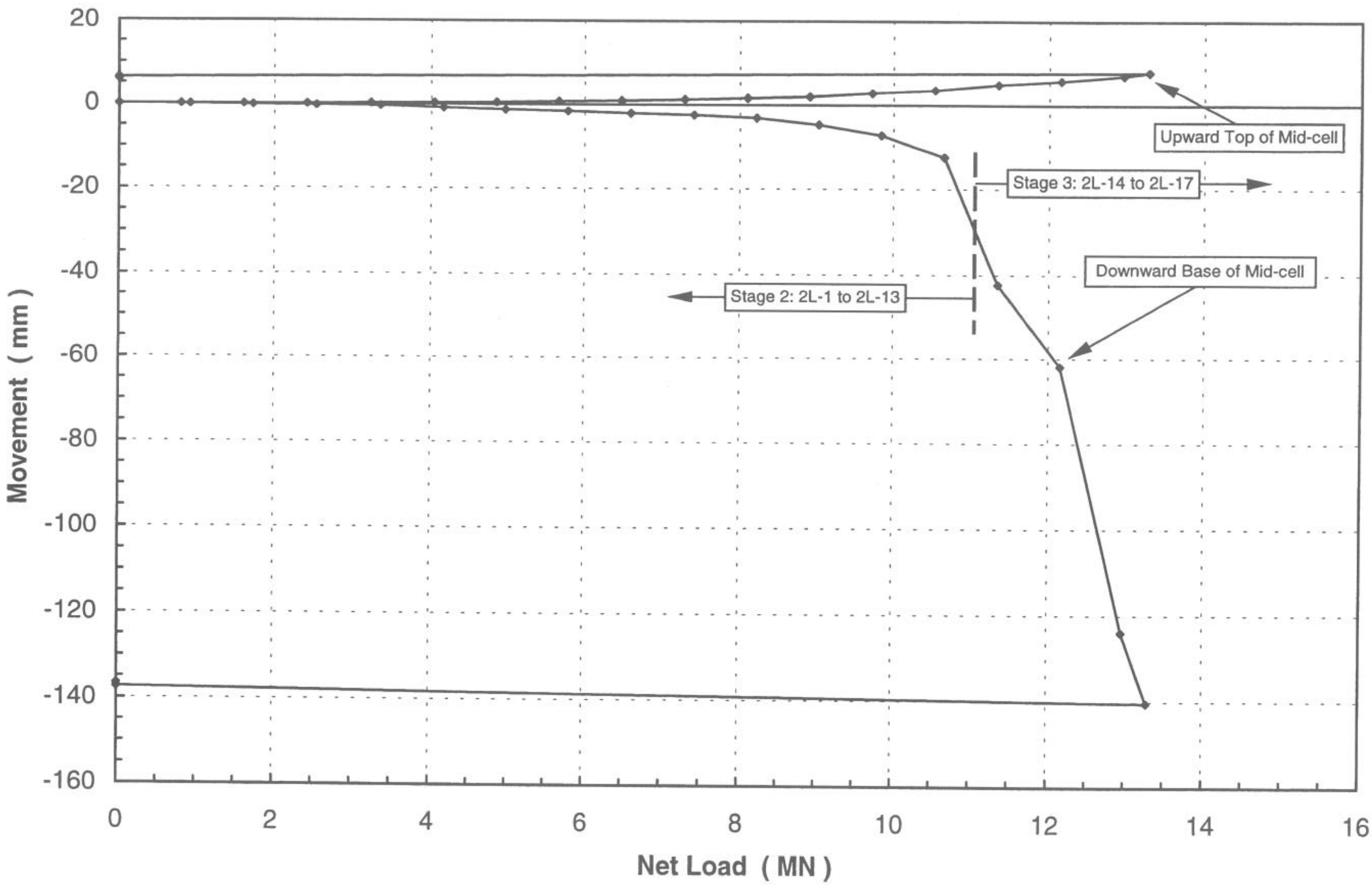


Figure 2 of 8

Strain Gage Load Distribution Curves - Stage 1

Multi Level Test Shaft - Missouri River Bridge - Lexington, MO

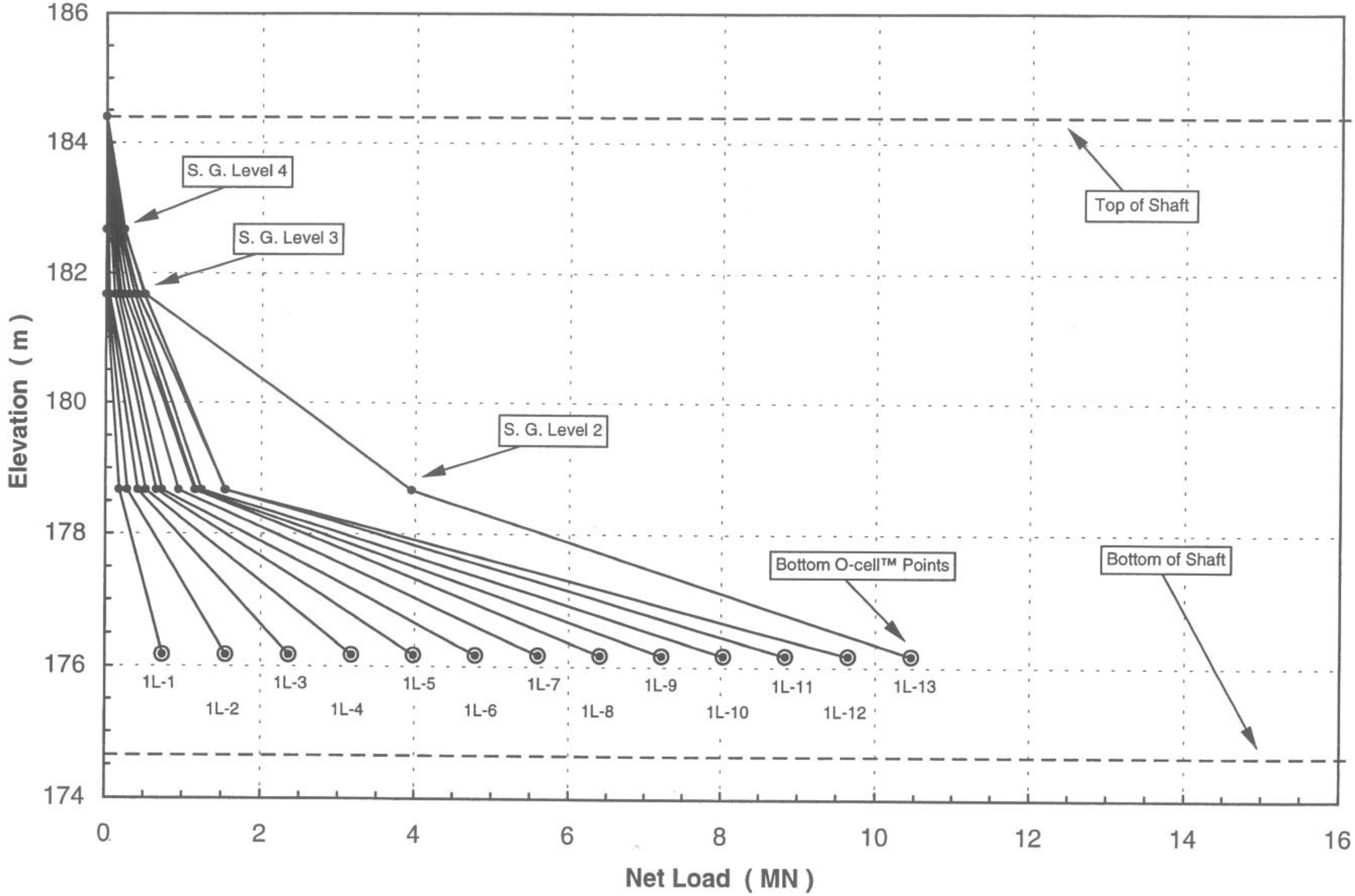


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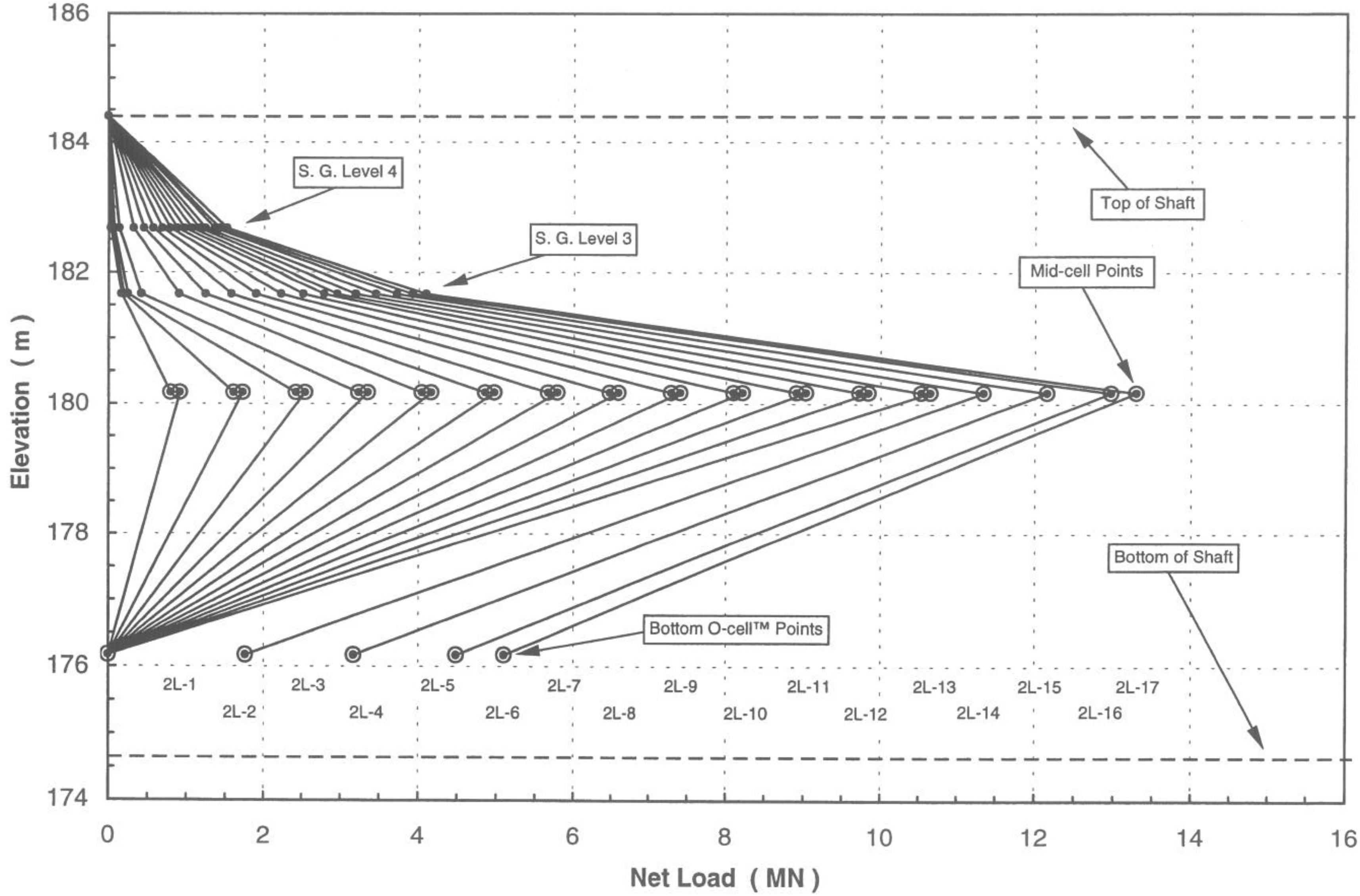
Figure 3 of 8

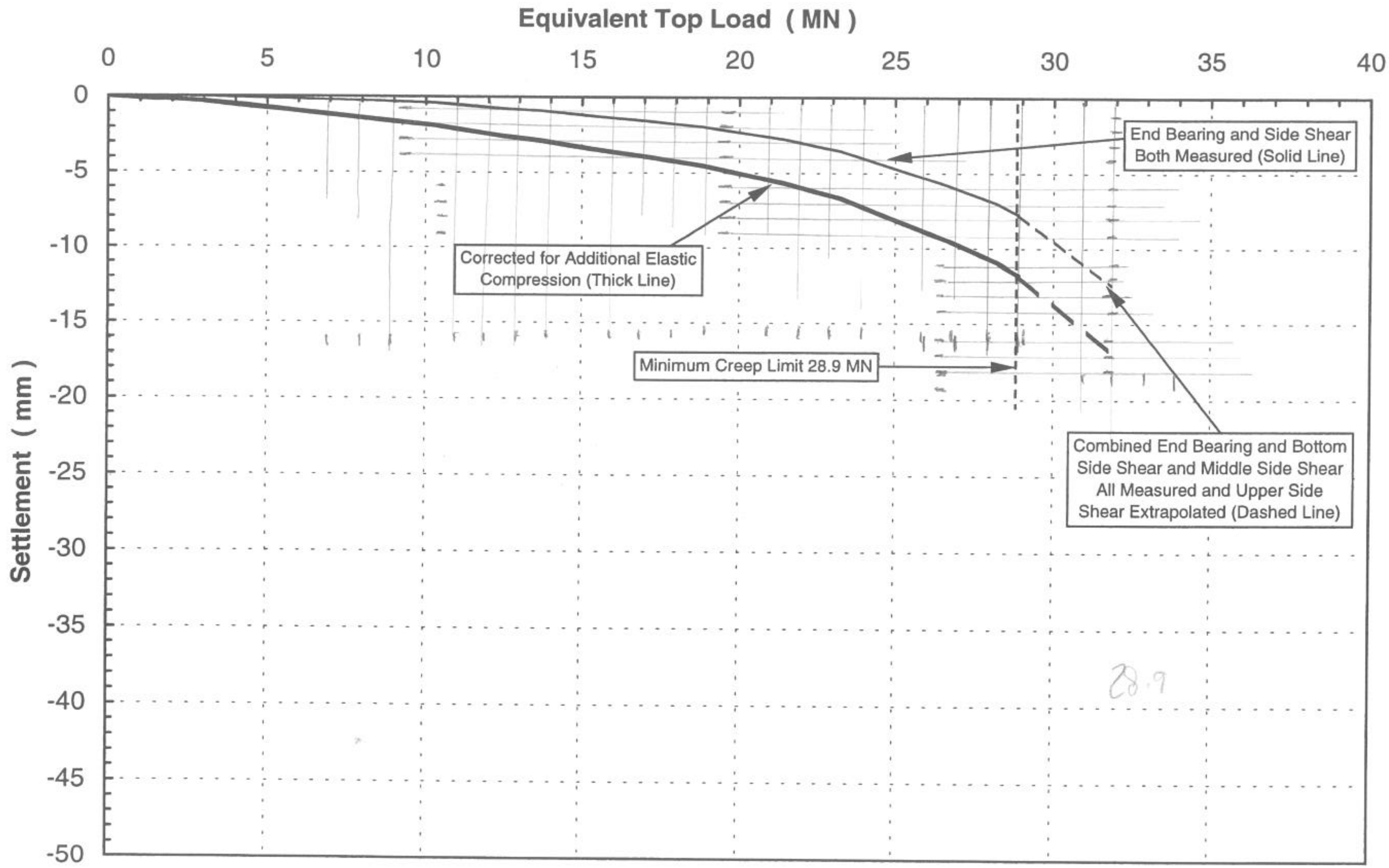
Strain Gage Load Distribution Curves - Stages 2 & 3

Multi Level Test Shaft - Missouri River Bridge - Lexington, MO



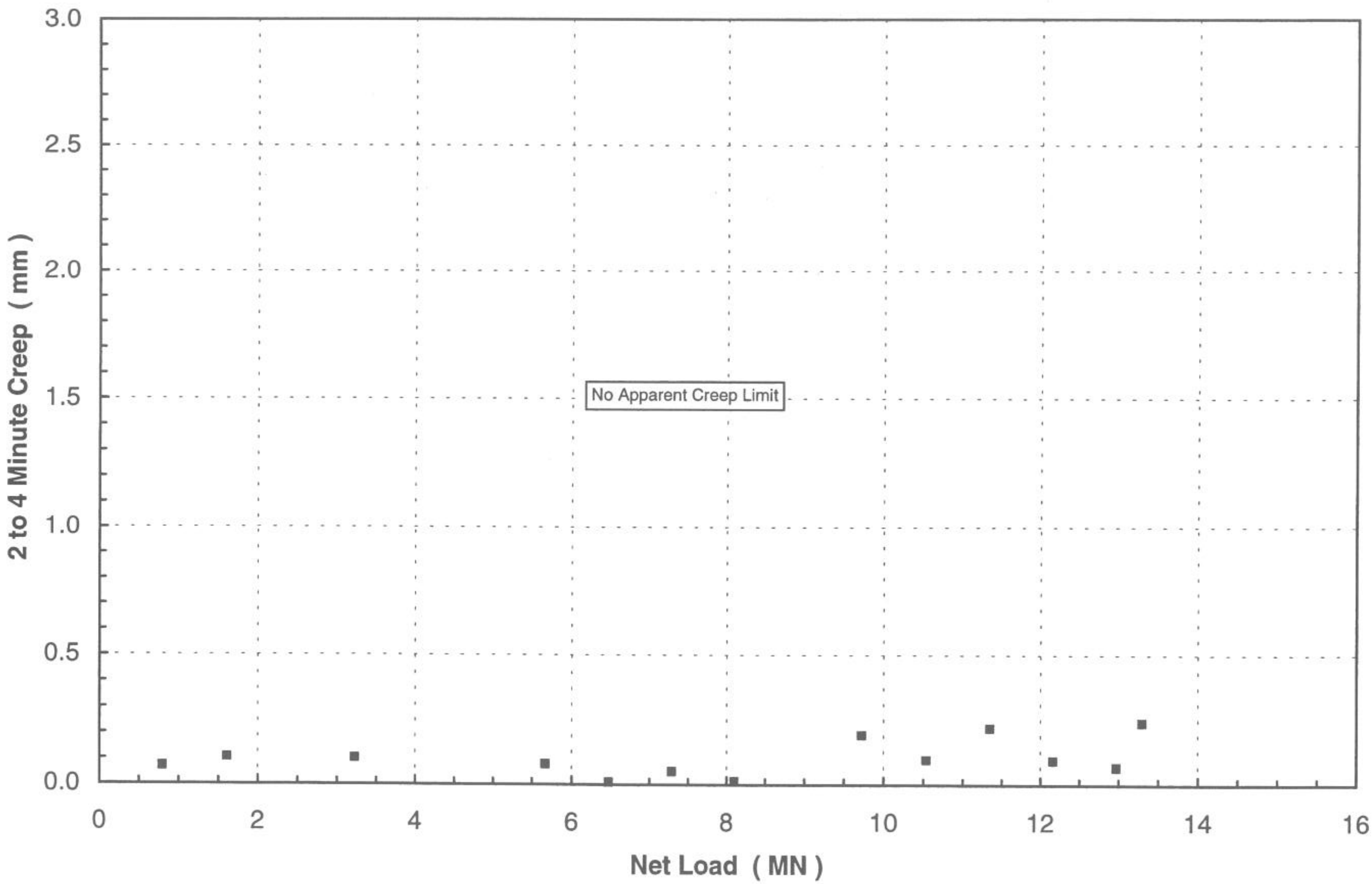
Equivalent Top Load-Movement Curves

Multi Level Test Shaft - Missouri River Bridge - Lexington, MO



Upper Side Shear Creep Limit - Stages 2 & 3

Multi Level Test Shaft - Missouri River Bridge - Lexington, MO



Middle Side Shear Creep Limit - Stage 2

Multi Level Test Shaft - Missouri River Bridge - Lexington, MO

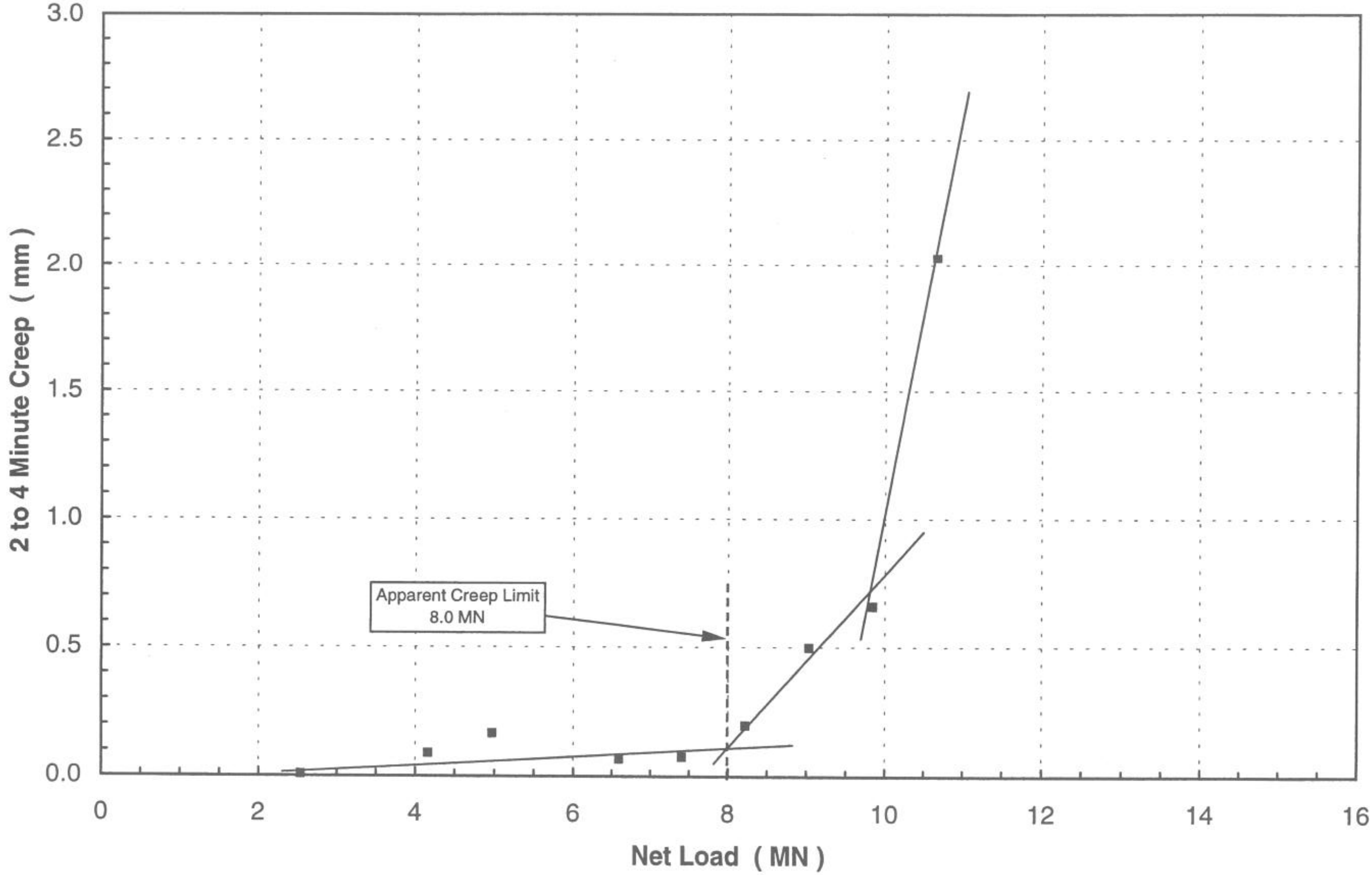


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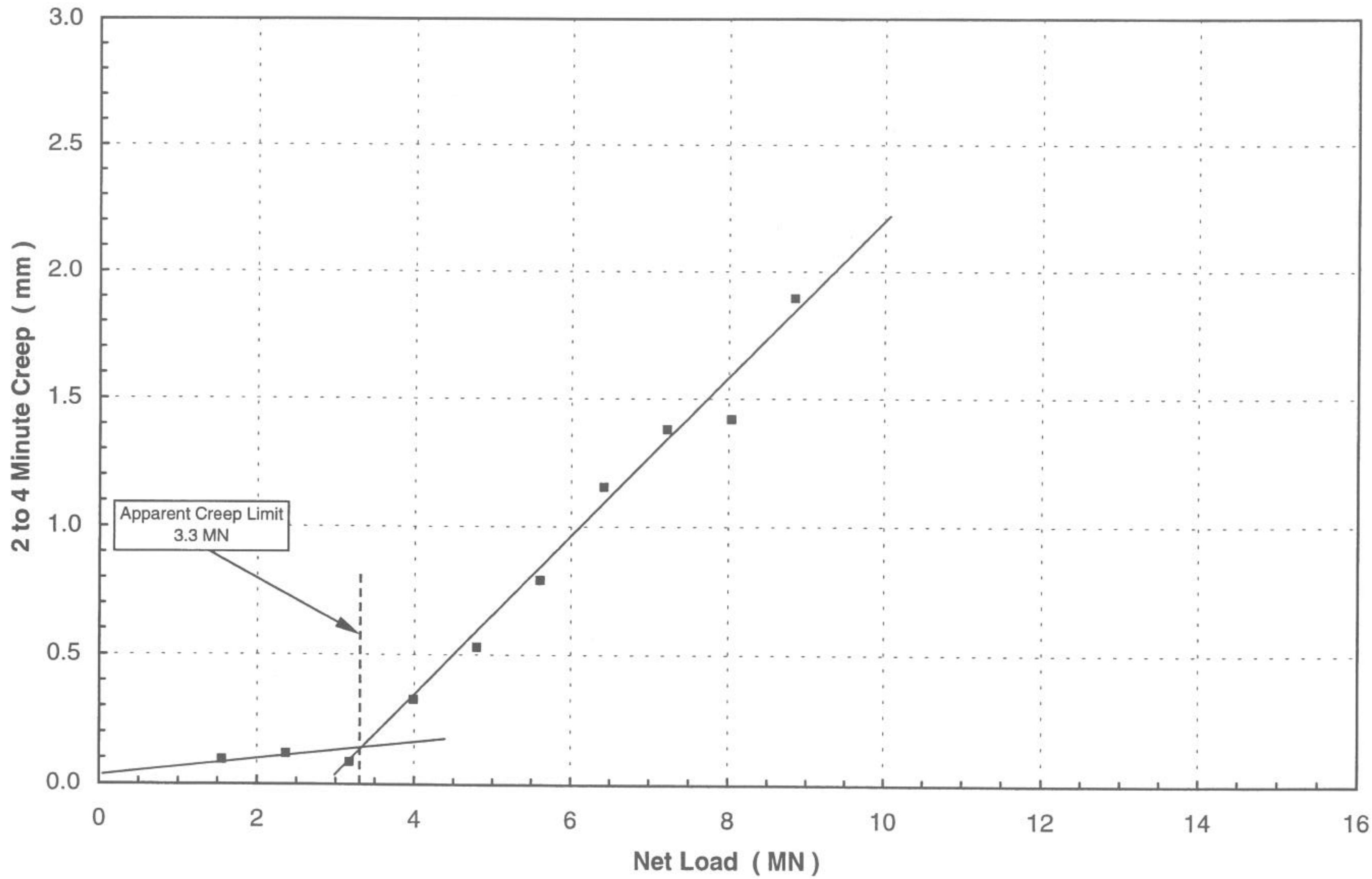
Figure 7 of 8

Combined End Bearing and Bottom Side Shear Creep Limit - Stage 1

Multi Level Test Shaft - Missouri River Bridge - Lexington, MO



APPENDIX A

FIELD DATA & DATA REDUCTION

LOADTEST

DEEP FOUNDATION TESTING, EQUIPMENT & SERVICES • SPECIALIZING IN OSTERBERG CELL TECHNOLOGY

0.13 MN and 0.7 MN above mid cell

Gross and Net O-cell™ Loads

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (psi)	O-cell™ Pressure (MPa)	O-cell™ Loads Gross (MN)	O-cell™ Loads Net* (MN)	Mid-cell Pressure (psi)	Mid-cell Pressure (MPa)	Mid-cell Loads Gross (MN)	Mid-cell Loads Net Up** (MN)	Mid-cell Loads Net Dn*** (MN)
1 L - 0	16:31:30	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
1 L - 1	16:36:30	500	3.45	0.87	0.74	0	0.00	0.00	0.00	0.00
1 L - 2	16:38:30	1,000	6.90	1.68	1.55	0	0.00	0.00	0.00	0.00
1 L - 3	16:43:00	1,500	10.34	2.49	2.36	0	0.00	0.00	0.00	0.00
1 L - 4	16:47:30	2,000	13.79	3.30	3.17	0	0.00	0.00	0.00	0.00
1 L - 5	16:52:30	2,500	17.24	4.11	3.98	0	0.00	0.00	0.00	0.00
1 L - 6	16:57:00	3,000	20.69	4.92	4.79	0	0.00	0.00	0.00	0.00
1 L - 7	17:01:30	3,500	24.13	5.73	5.60	0	0.00	0.00	0.00	0.00
1 L - 8	17:06:00	4,000	27.58	6.54	6.41	0	0.00	0.00	0.00	0.00
1 L - 9	17:11:00	4,500	31.03	7.35	7.22	0	0.00	0.00	0.00	0.00
1 L - 10	17:16:00	5,000	34.48	8.16	8.03	0	0.00	0.00	0.00	0.00
1 L - 11	17:21:00	5,500	37.92	8.97	8.84	0	0.00	0.00	0.00	0.00
1 L - 12	17:26:00	6,000	41.37	9.78	9.65	0	0.00	0.00	0.00	0.00
1 L - 13	17:34:00	6,500	44.82	10.59	10.46	0	0.00	0.00	0.00	0.00
1 U - 1	17:40:30	4,000	27.58	6.54	6.41	0	0.00	0.00	0.00	0.00
1 U - 2	17:45:30	2,000	13.79	3.30	3.17	0	0.00	0.00	0.00	0.00
1 U - 3	17:50:00	1,000	6.90	1.68	1.55	0	0.00	0.00	0.00	0.00
1 U - 4	17:55:00	500	3.45	0.87	0.74	0	0.00	0.00	0.00	0.00
1 U - 5	17:59:30	0	0.00	0.06	0.00	0	0.00	0.00	0.00	0.00
2 L - 0	18:06:30	0	0.00	0.06	0.00	0	0.00	0.00	0.00	0.00
2 L - 1	18:08:30	0	0.00	0.06	0.00	500	3.45	0.85	0.79	0.91
2 L - 2	18:13:00	0	0.00	0.06	0.00	1,000	6.90	1.66	1.60	1.72
2 L - 3	18:17:30	0	0.00	0.06	0.00	1,500	10.34	2.48	2.42	2.54
2 L - 4	18:22:00	0	0.00	0.06	0.00	2,000	13.79	3.29	3.23	3.35
2 L - 5	18:26:30	0	0.00	0.06	0.00	2,500	17.24	4.10	4.04	4.16
2 L - 6	18:31:00	0	0.00	0.06	0.00	3,000	20.69	4.91	4.85	4.97
2 L - 7	18:35:30	0	0.00	0.06	0.00	3,500	24.13	5.72	5.66	5.78
2 L - 8	18:40:00	0	0.00	0.06	0.00	4,000	27.58	6.53	6.47	6.59
2 L - 9	18:44:30	0	0.00	0.06	0.00	4,500	31.03	7.34	7.29	7.40
2 L - 10	18:49:00	0	0.00	0.06	0.00	5,000	34.48	8.16	8.10	8.22
2 L - 11	18:53:30	0	0.00	0.06	0.00	5,500	37.92	8.97	8.91	9.03
2 L - 12	18:58:30	0	0.00	0.06	0.00	6,000	41.37	9.78	9.72	9.84
2 L - 13	19:03:30	0	0.00	0.06	0.00	6,500	44.82	10.59	10.53	10.65
2 L - 14	19:15:30	1,130	7.79	1.89	1.76	7,000	48.27	11.40	11.34	11.34
2 L - 15	19:23:30	2,000	13.79	3.30	3.17	7,500	51.71	12.21	12.15	12.15
2 L - 16	19:43:00	2,810	19.37	4.61	4.48	8,000	55.16	13.03	12.97	12.97
2 L - 17	19:49:00	3,190	22.00	5.23	5.10	8,200	56.54	13.35	13.29	13.29
2 U - 1	19:53:30	2,140	14.76	3.53	3.40	0	0.00	0.00	0.00	0.00
2 U - 1	20:00:00	1,950	13.45	3.22	3.09	0	0.00	0.00	0.00	0.00

* Net load calculated as O-cell™ load minus weight of pile above O-cell™ = 0.13 MN

** Net load calculated as Mid-cell load minus weight of pile above mid-cell = 0.07 MN

*** Net load calculated as Mid-cell load plus weight of pile between O-cells™ = 0.06 MN (2L-1 to 2L-13)

Net load calculated as Mid-cell load minus weight of pile above mid-cell = 0.07 MN (2L-14 to 2L-17)

APPENDIX B to get equation
LOAD = Press X 0.3641 + 13.8
kips psi
BOTTOM cell

= Press X 0.3649 + 9.21
MID cell

(500 psi X 0.3641 + 13.8) X 4.448 kN/kip = 871 kN

Buoyant 0.13 MN above top cell

0.07 MN above bottom cell

26" cell = (.3425 m²)

.985

N/m² 3450

Upward Top of Shaft Movement

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (MPa)	Net * Load (MN)	TOS Indicator A Readings 1 min (mm)	TOS Indicator A Readings 2 min (mm)	TOS Indicator A Readings 4 min (mm)	TOS Indicator B Readings 1 min (mm)	TOS Indicator B Readings 2 min (mm)	TOS Indicator B Readings 4 min (mm)	Average Top of Shaft 1 min (mm)	Average Top of Shaft 2 min (mm)	Average Top of Shaft 4 min (mm)	Creep 2-4 min (mm)
1 L - 0	16:31:30	0.00	0.00	0.00			0.00			0.00			
1 L - 1	16:36:30	3.45	0.74			-0.14			-0.07			-0.10	
1 L - 2	16:38:30	6.90	1.55	-0.20	0.00	-0.14	-0.20	0.00	-0.07	-0.20	0.00	-0.10	-0.10
1 L - 3	16:43:00	10.34	2.36	-0.07	0.00	0.00	-0.07	-0.07	-0.27	-0.07	-0.03	-0.14	-0.10
1 L - 4	16:47:30	13.79	3.17	-0.14	-0.07	-0.14	-0.07	-0.07	-0.07	-0.10	-0.07	-0.10	-0.03
1 L - 5	16:52:30	17.24	3.98	-0.20	-0.07	-0.14	-0.20	-0.20	-0.34	-0.20	-0.14	-0.24	-0.10
1 L - 6	16:57:00	20.69	4.79	-0.14	-0.14	-0.07	-0.07	0.00	-0.20	-0.10	-0.07	-0.14	-0.07
1 L - 7	17:01:30	24.13	5.60	-0.14	-0.07	0.07	0.07	-0.14	-0.14	-0.03	-0.10	-0.03	0.07
1 L - 8	17:06:00	27.58	6.41	-0.14	0.00	0.07	0.00	-0.07	-0.07	-0.07	-0.03	0.00	0.03
1 L - 9	17:11:00	31.03	7.22	-0.07	0.00	0.00	-0.07	0.07	0.07	-0.07	0.03	0.03	0.00
1 L - 10	17:16:00	34.48	8.03	0.00	-0.20	-0.20	0.14	0.00	0.07	0.07	-0.10	-0.07	0.03
1 L - 11	17:21:00	37.92	8.84	-0.14	-0.20	-0.20	0.00	0.00	-0.07	-0.07	-0.10	-0.14	-0.03
1 L - 12	17:26:00	41.37	9.65	-0.34	-0.34	-0.41	-0.07	-0.34	-0.14	-0.20	-0.34	-0.27	0.07
1 L - 13	17:34:00	44.82	10.46	-0.34	-0.34	-0.55	-0.20	-0.27	-0.27	-0.27	-0.31	-0.41	-0.10
1 U - 1	17:40:30	27.58	6.41	-0.68	-0.55	-0.55	-0.48	-0.34	-0.34	-0.58	-0.44	-0.44	
1 U - 2	17:45:30	13.79	3.17	-0.61	-0.68	-0.61	-0.41	-0.48	-0.48	-0.51	-0.58	-0.55	
1 U - 3	17:50:00	6.90	1.55	-0.61	-0.68	-0.61	-0.41	-0.34	-0.34	-0.51	-0.51	-0.48	
1 U - 4	17:55:00	3.45	0.74	-0.61	-0.61	-0.55	-0.34	-0.48	-0.27	-0.48	-0.55	-0.41	
1 U - 5	17:59:30	0.00	0.00	-0.55	-0.48	-0.61	-0.34	-0.34	-0.27	-0.44	-0.41	-0.44	
2 L - 0	18:06:30	0.00	0.00	-0.61			-0.34			-0.48			
2 L - 1	18:08:30	3.45	0.79	-0.61	-0.68	-0.61	-0.48	-0.34	-0.27	-0.55	-0.51	-0.44	0.07
2 L - 2	18:13:00	6.90	1.60	-0.68	-0.68	-0.61	-0.48	-0.48	-0.34	-0.58	-0.58	-0.48	0.10
2 L - 3	18:17:30	10.34	2.42	-0.61	-0.61	-0.55	-0.34	-0.34	-0.41	-0.48	-0.48	-0.48	0.00
2 L - 4	18:22:00	13.79	3.23	-0.55	-0.55	-0.55	-0.27	-0.48	-0.27	-0.41	-0.51	-0.41	0.10
2 L - 5	18:26:30	17.24	4.04	-0.48	-0.48	-0.55	-0.27	-0.27	-0.34	-0.38	-0.38	-0.44	-0.07
2 L - 6	18:31:00	20.69	4.85	-0.48	-0.48	-0.55	-0.27	-0.27	-0.41	-0.38	-0.38	-0.48	-0.10
2 L - 7	18:35:30	24.13	5.66	-0.48	-0.48	-0.41	-0.27	-0.20	-0.14	-0.38	-0.34	-0.27	0.07
2 L - 8	18:40:00	27.58	6.47	-0.34	-0.34	-0.34	-0.14	-0.20	-0.20	-0.24	-0.27	-0.27	0.00
2 L - 9	18:44:30	31.03	7.29	-0.27	-0.27	-0.20	-0.07	0.00	0.00	-0.17	-0.14	-0.10	0.03
2 L - 10	18:49:00	34.48	8.10	-0.14	0.00	-0.07	0.14	0.20	0.27	0.00	0.10	0.10	0.00
2 L - 11	18:53:30	37.92	8.91	0.14	0.20	0.14	0.41	0.48	0.48	0.27	0.34	0.31	-0.03
2 L - 12	18:58:30	41.37	9.72	0.55	0.61	0.75	0.89	0.96	1.16	0.72	0.78	0.96	0.17
2 L - 13	19:03:30	44.82	10.53	1.16	1.23	1.30	1.50	1.57	1.64	1.33	1.40	1.47	0.07
2 L - 14	19:15:30	48.27	11.34	2.05	2.05	2.12	2.32	2.25	2.53	2.18	2.15	2.32	0.17
2 L - 15	19:23:30	51.71	12.15	2.32	2.39	2.39	2.73	2.66	2.73	2.53	2.53	2.56	0.03
2 L - 16	19:43:00	55.16	12.97	3.07	3.14	3.14	3.21	3.48	3.48	3.14	3.31	3.31	0.00
2 L - 17	19:49:00	56.54	13.29	3.34	3.48	3.55	3.62	3.82	3.89	3.48	3.65	3.72	0.07
2 U - 1	19:53:30	0.00	0.00	2.32			2.94			2.63			
2 U - 1	20:00:00	0.00	0.00	1.98			2.59			2.29			

* Net load as defined in Table 1.

DEEP FOUNDATION TESTING, EQUIPMENT & SERVICES • SPECIALIZING IN OSTERBERG CELL TECHNOLOGY

Encased Compression Telltales Level 1

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load	Time	O-cell™	Net *	LVWDT 14994			LVWDT 14995			Average Compression		
Test		Pressure	Load	1 min	2 min	4 min	1 min	2 min	4 min	1 min	2 min	4 min
Incr.	(h:m:s)	(MPa)	(MN)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
1 L - 0	16:31:30	0.00	0.00	0.00			0.00			0.00		
1 L - 1	16:36:30	3.45	0.74			0.02			0.02			0.02
1 L - 2	16:38:30	6.90	1.55	0.04	0.05	0.06	0.07	0.07	0.07	0.06	0.06	0.07
1 L - 3	16:43:00	10.34	2.36	0.09	0.11	0.11	0.12	0.12	0.12	0.11	0.11	0.12
1 L - 4	16:47:30	13.79	3.17	0.17	0.18	0.19	0.20	0.21	0.21	0.18	0.19	0.20
1 L - 5	16:52:30	17.24	3.98	0.54	0.57	0.60	0.56	0.58	0.60	0.55	0.57	0.60
1 L - 6	16:57:00	20.69	4.79	0.82	0.86	0.90	0.83	0.87	0.91	0.82	0.86	0.90
1 L - 7	17:01:30	24.13	5.60	1.14	1.18	1.26	1.14	1.19	1.27	1.14	1.19	1.26
1 L - 8	17:06:00	27.58	6.41	1.53	1.60	1.71	1.53	1.61	1.71	1.53	1.61	1.71
1 L - 9	17:11:00	31.03	7.22	2.04	2.10	2.20	2.08	2.16	2.26	2.06	2.13	2.23
1 L - 10	17:16:00	34.48	8.03	2.57	2.70	2.90	2.68	2.78	2.94	2.63	2.74	2.92
1 L - 11	17:21:00	37.92	8.84	3.43	3.59	3.91	3.55	3.75	4.05	3.49	3.67	3.98
1 L - 12	17:26:00	41.37	9.65	4.73	4.87	5.47	4.73	4.84	5.31	4.73	4.85	5.39
1 L - 13	17:34:00	44.82	10.46	6.99	7.22	7.65	6.37	6.51	6.81	6.68	6.86	7.23
1 U - 1	17:40:30	27.58	6.41	7.83	7.83	7.82	6.91	6.91	6.89	7.37	7.37	7.36
1 U - 2	17:45:30	13.79	3.17	7.74	7.73	7.73	6.82	6.82	6.81	7.28	7.28	7.27
1 U - 3	17:50:00	6.90	1.55	7.50	7.50	7.50	6.68	6.67	6.67	7.09	7.09	7.08
1 U - 4	17:55:00	3.45	0.74	7.41	7.41	7.40	6.59	6.58	6.57	7.00	6.99	6.99
1 U - 5	17:59:30	0.00	0.00	7.23	7.23	7.23	6.46	6.45	6.42	6.85	6.84	6.82
2 L - 0	18:06:30	0.00	0.00	7.22			6.41			6.82		
2 L - 1	18:08:30	3.45	0.91	7.22	7.22	7.18	6.42	6.41	6.41	6.82	6.82	6.79
2 L - 2	18:13:00	6.90	1.72	7.18	7.18	7.18	6.42	6.42	6.41	6.80	6.80	6.80
2 L - 3	18:17:30	10.34	2.54	7.19	7.19	7.19	6.42	6.42	6.42	6.80	6.80	6.80
2 L - 4	18:22:00	13.79	3.35	7.20	7.20	7.20	6.43	6.43	6.42	6.81	6.81	6.81
2 L - 5	18:26:30	17.24	4.16	7.24	7.24	7.24	6.45	6.45	6.45	6.84	6.85	6.85
2 L - 6	18:31:00	20.69	4.97	7.29	7.29	7.29	6.47	6.47	6.47	6.88	6.88	6.88
2 L - 7	18:35:30	24.13	5.78	7.34	7.35	7.35	6.51	6.51	6.51	6.93	6.93	6.93
2 L - 8	18:40:00	27.58	6.59	7.42	7.42	7.42	6.56	6.56	6.56	6.99	6.99	6.99
2 L - 9	18:44:30	31.03	7.40	7.51	7.51	7.51	6.61	6.61	6.61	7.06	7.06	7.06
2 L - 10	18:49:00	34.48	8.22	7.61	7.62	7.63	6.68	6.68	6.70	7.14	7.15	7.16
2 L - 11	18:53:30	37.92	9.03	7.77	7.80	7.84	6.83	6.86	6.90	7.30	7.33	7.37
2 L - 12	18:58:30	41.37	9.84	8.12	8.20	8.31	7.10	7.18	7.25	7.61	7.69	7.78
2 L - 13	19:03:30	44.82	10.65	8.74	8.91	9.21	7.62	7.75	8.03	8.18	8.33	8.62
2 L - 14	19;15:30	48.27	11.34	12.43	12.66	13.00	10.59	10.82	11.19	11.51	11.74	12.10
2 L - 15	19:23:30	51.71	12.15	13.85	13.93	14.06	12.55	12.76	13.17	13.20	13.35	13.61
2 L - 16	19:43:00	55.16	12.97	14.63	14.65	14.74	16.86	17.00	17.24	15.74	15.82	15.99
2 L - 17	19:49:00	56.54	13.29	14.94	15.04	15.19	17.56	17.65	17.83	16.25	16.35	16.51
2 U - 1	19:53:30	0.00	0.00	14.54			17.41			15.97		
2 U - 1	20:00:00	0.00	0.00	14.48			17.37			15.93		

* Net load as defined in Table 1.

Encased Compression Telltales Level 2

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time	O-cell™ Pressure	Net * Load	LVWDT 14997			LVWDT 14996			Average Compression		
				1 min	2 min	4 min	1 min	2 min	4 min	1 min	2 min	4 min
	(h:m:s)	(MPa)	(MN)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
1 L - 0	16:31:30	0.00	0.00	0.00			0.00			0.00		
1 L - 1	16:36:30	3.45	0.74			0.00			0.00			0.00
1 L - 2	16:38:30	6.90	1.55	-0.01	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00
1 L - 3	16:43:00	10.34	2.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 4	16:47:30	13.79	3.17	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 5	16:52:30	17.24	3.98	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01
1 L - 6	16:57:00	20.69	4.79	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1 L - 7	17:01:30	24.13	5.60	0.01	0.02	0.01	0.01	0.01	0.03	0.01	0.01	0.02
1 L - 8	17:06:00	27.58	6.41	0.02	0.02	0.03	0.01	0.01	0.02	0.02	0.02	0.02
1 L - 9	17:11:00	31.03	7.22	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.03
1 L - 10	17:16:00	34.48	8.03	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
1 L - 11	17:21:00	37.92	8.84	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.04
1 L - 12	17:26:00	41.37	9.65	0.05	0.05	0.05	0.05	0.04	0.04	0.05	0.04	0.04
1 L - 13	17:34:00	44.82	10.46	0.05	0.05	0.05	0.04	0.04	0.04	0.05	0.04	0.05
1 U - 1	17:40:30	27.58	6.41	0.04	0.04	0.04	0.02	0.03	0.03	0.03	0.03	0.03
1 U - 2	17:45:30	13.79	3.17	0.03	0.03	0.03	0.01	0.01	0.01	0.02	0.02	0.02
1 U - 3	17:50:00	6.90	1.55	0.03	0.03	0.03	0.01	0.01	0.01	0.02	0.02	0.02
1 U - 4	17:55:00	3.45	0.74	0.02	0.02	0.02	0.00	0.00	0.00	0.01	0.01	0.01
1 U - 5	17:59:30	0.00	0.00	0.02	0.01	0.02	0.00	0.00	0.00	0.01	0.01	0.01
2 L - 0	18:06:30	0.00	0.00	0.02			0.00			0.01		
2 L - 1	18:08:30	3.45	0.79	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
2 L - 2	18:13:00	6.90	1.60	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.02
2 L - 3	18:17:30	10.34	2.42	0.02	0.03	0.03	0.04	0.04	0.04	0.03	0.04	0.03
2 L - 4	18:22:00	13.79	3.23	0.04	0.04	0.04	0.17	0.17	0.18	0.10	0.11	0.11
2 L - 5	18:26:30	17.24	4.04	0.10	0.10	0.10	0.45	0.46	0.49	0.27	0.28	0.30
2 L - 6	18:31:00	20.69	4.85	0.14	0.14	0.14	0.71	0.72	0.73	0.42	0.43	0.44
2 L - 7	18:35:30	24.13	5.66	0.17	0.18	0.18	0.92	0.93	0.95	0.55	0.55	0.57
2 L - 8	18:40:00	27.58	6.47	0.21	0.22	0.22	1.14	1.16	1.18	0.68	0.69	0.70
2 L - 9	18:44:30	31.03	7.29	0.25	0.25	0.25	1.37	1.39	1.43	0.81	0.82	0.84
2 L - 10	18:49:00	34.48	8.10	0.28	0.28	0.29	1.63	1.64	1.67	0.95	0.96	0.98
2 L - 11	18:53:30	37.92	8.91	0.31	0.32	0.31	1.91	1.93	1.96	1.11	1.13	1.14
2 L - 12	18:58:30	41.37	9.72	0.33	0.33	0.34	2.24	2.28	2.31	1.28	1.30	1.33
2 L - 13	19:03:30	44.82	10.53	0.36	0.37	0.38	2.62	2.68	2.73	1.49	1.53	1.56
2 L - 14	19:15:30	48.27	11.34	0.90	0.95	1.01	3.10	3.12	3.16	2.00	2.03	2.08
2 L - 15	19:23:30	51.71	12.15	1.74	1.81	1.88	3.54	3.57	3.62	2.64	2.69	2.75
2 L - 16	19:43:00	55.16	12.97	2.35	2.41	2.50	3.86	3.89	3.94	3.10	3.15	3.22
2 L - 17	19:49:00	56.54	13.29	2.62	2.72	2.95	4.01	4.05	4.16	3.32	3.39	3.56
2 U - 1	19:53:30	0.00	0.00	2.62			3.72			3.17		
2 U - 1	20:00:00	0.00	0.00	2.59			3.69			3.14		

* Net load as defined in Table 1.

Upward Top of O-cell™ Movement (calculated)
Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (MPa)	Net * Load (MN)	Top of Shaft (tbl 2) 1 min (mm)	Top of Shaft 2 min (mm)	Top of Shaft 4 min (mm)	Shaft Comp. (tbl 3, 4 & 9) 1 min (mm)	Shaft Comp. 2 min (mm)	Shaft Comp. 4 min (mm)	Top of O-cell™ 1 min (mm)	Top of O-cell™ 2 min (mm)	Top of O-cell™ 4 min (mm)	Creep 2-4 min (mm)
1 L - 0	16:31:30	0.00	0.00	0.00			0.00	0.00	0.00	0.00			
1 L - 1	16:36:30	3.45	0.74			-0.10			0.02			-0.08	
1 L - 2	16:38:30	6.90	1.55	-0.20	0.00	-0.10	0.05	0.06	0.07	-0.15	0.06	-0.03	-0.10
1 L - 3	16:43:00	10.34	2.36	-0.07	-0.03	-0.14	0.11	0.10	0.12	0.04	0.07	-0.02	-0.09
1 L - 4	16:47:30	13.79	3.17	-0.10	-0.07	-0.10	0.20	0.20	0.21	0.09	0.14	0.11	-0.03
1 L - 5	16:52:30	17.24	3.98	-0.20	-0.14	-0.24	0.57	0.60	0.62	0.36	0.46	0.39	-0.08
1 L - 6	16:57:00	20.69	4.79	-0.10	-0.07	-0.14	0.86	0.89	0.94	0.76	0.82	0.80	-0.02
1 L - 7	17:01:30	24.13	5.60	-0.03	-0.10	-0.03	1.18	1.24	1.31	1.14	1.13	1.28	0.15
1 L - 8	17:06:00	27.58	6.41	-0.07	-0.03	0.00	1.58	1.67	1.77	1.51	1.63	1.77	0.13
1 L - 9	17:11:00	31.03	7.22	-0.07	0.03	0.03	2.13	2.21	2.31	2.06	2.24	2.34	0.10
1 L - 10	17:16:00	34.48	8.03	0.07	-0.10	-0.07	2.72	2.80	3.01	2.78	2.69	2.94	0.25
1 L - 11	17:21:00	37.92	8.84	-0.07	-0.10	-0.14	3.58	3.76	4.08	3.51	3.66	3.94	0.29
1 L - 12	17:26:00	41.37	9.65	-0.20	-0.34	-0.27	4.85	4.97	5.50	4.65	4.62	5.23	0.61
1 L - 13	17:34:00	44.82	10.46	-0.27	-0.31	-0.41	6.80	6.99	7.36	6.53	6.68	6.95	0.28
1 U - 1	17:40:30	27.58	6.41	-0.58	-0.44	-0.44	7.47	7.47	7.45	6.89	7.03	7.01	
1 U - 2	17:45:30	13.79	3.17	-0.51	-0.58	-0.55	7.36	7.36	7.33	6.85	6.78	6.78	
1 U - 3	17:50:00	6.90	1.55	-0.51	-0.51	-0.48	7.16	7.14	7.15	6.65	6.63	6.67	
1 U - 4	17:55:00	3.45	0.74	-0.48	-0.55	-0.41	7.06	7.04	7.05	6.58	6.50	6.64	
1 U - 5	17:59:30	0.00	0.00	-0.44	-0.41	-0.44	6.89	6.89	6.87	6.45	6.48	6.43	
2 L - 0	18:06:30	0.00	0.00	-0.48			6.83			6.35			
2 L - 1	18:08:30	3.45	0.79	-0.55	-0.51	-0.44	6.75	6.75	6.71	6.20	6.24	6.27	
2 L - 2	18:13:00	6.90	1.60	-0.58	-0.58	-0.48	6.64	6.64	6.64	6.06	6.06	6.16	
2 L - 3	18:17:30	10.34	2.42	-0.48	-0.48	-0.48	6.57	6.56	6.55	6.09	6.08	6.07	
2 L - 4	18:22:00	13.79	3.23	-0.41	-0.51	-0.41	6.40	6.38	6.36	5.99	5.87	5.95	
2 L - 5	18:26:30	17.24	4.04	-0.38	-0.38	-0.44	6.00	5.97	5.95	5.62	5.60	5.51	
2 L - 6	18:31:00	20.69	4.85	-0.38	-0.38	-0.48	5.67	5.62	5.56	5.29	5.25	5.08	
2 L - 7	18:35:30	24.13	5.66	-0.38	-0.34	-0.27	5.24	5.19	5.14	4.86	4.85	4.87	
2 L - 8	18:40:00	27.58	6.47	-0.24	-0.27	-0.27	4.84	4.79	4.73	4.61	4.52	4.45	
2 L - 9	18:44:30	31.03	7.29	-0.17	-0.14	-0.10	4.41	4.34	4.23	4.24	4.21	4.13	
2 L - 10	18:49:00	34.48	8.10	0.00	0.10	0.10	3.82	3.68	3.50	3.82	3.79	3.60	
2 L - 11	18:53:30	37.92	8.91	0.27	0.34	0.31	2.65	2.36	1.93	2.92	2.70	2.24	
2 L - 12	18:58:30	41.37	9.72	0.72	0.78	0.96	0.41	-0.09	-0.83	1.13	0.70	0.13	
2 L - 13	19:03:30	44.82	10.53	1.33	1.40	1.47	-3.02	-3.92	-5.73	-1.69	-2.53	-4.27	
2 L - 14	19:15:30	48.27	11.34	2.18	2.15	2.32	-27.23	-29.31	-33.03	-25.04	-27.16	-30.71	
2 L - 15	19:23:30	51.71	12.15	2.53	2.53	2.56	-45.63	-47.59	-51.35	-43.10	-45.06	-48.79	
2 L - 16	19:43:00	55.16	12.97	3.14	3.31	3.31	-102.99	-106.17	-111.72	-99.85	-102.86	-108.40	
2 L - 17	19:49:00	56.54	13.29	3.48	3.65	3.72	-119.46	-122.46	-128.08	-115.98	-118.81	-124.36	
2 U - 1	19:53:30	0.00	0.00	2.63			-124.55			-121.92			
2 U - 1	20:00:00	0.00	0.00	2.29			-123.50			-121.21			

* Net load as defined in Table 1.

O-cell™ Expansion

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (MPa)	Net * Load (MN)	LVWDT 14985 1 min (mm)	LVWDT 14985 2 min (mm)	LVWDT 14985 4 min (mm)	LVWDT 14986 1 min (mm)	LVWDT 14986 2 min (mm)	LVWDT 14986 4 min (mm)	LVWDT 14987 1 min (mm)	LVWDT 14987 2 min (mm)	LVWDT 14987 4 min (mm)	Average Expansion ** 1 min (mm)	Average Expansion ** 2 min (mm)	Average Expansion ** 4 min (mm)
1 L - 0	16:31:30	0.00	0.00	0.00			0.00			0.00			0.00		
1 L - 1	16:36:30	3.45	0.74			0.10			0.14			0.12			0.12
1 L - 2	16:38:30	6.90	1.55	0.23	0.24	0.22	0.30	0.32	0.32	0.27	0.28	0.29	0.27	0.28	0.27
1 L - 3	16:43:00	10.34	2.36	0.39	0.42	0.44	0.55	0.54	0.57	0.50	0.53	0.55	0.47	0.48	0.51
1 L - 4	16:47:30	13.79	3.17	0.84	0.87	0.95	1.09	1.14	1.17	1.02	1.10	1.15	0.96	1.00	1.06
1 L - 5	16:52:30	17.24	3.98	2.61	2.80	3.06	2.95	3.14	3.37	2.94	3.12	3.38	2.78	2.97	3.22
1 L - 6	16:57:00	20.69	4.79	4.37	4.81	5.36	4.68	5.13	5.61	4.74	5.14	5.69	4.52	4.97	5.49
1 L - 7	17:01:30	24.13	5.60	7.02	7.69	8.64	7.30	7.92	8.85	7.35	7.97	8.95	7.16	7.80	8.74
1 L - 8	17:06:00	27.58	6.41	10.43	11.19	12.48	10.72	11.49	12.78	10.78	11.57	12.85	10.57	11.34	12.63
1 L - 9	17:11:00	31.03	7.22	15.16	16.14	17.64	15.58	16.56	18.02	15.63	16.59	18.11	15.37	16.35	17.83
1 L - 10	17:16:00	34.48	8.03	20.43	21.45	23.11	21.00	22.04	23.71	21.02	22.05	23.72	20.72	21.74	23.41
1 L - 11	17:21:00	37.92	8.84	26.39	27.61	29.75	27.19	28.39	30.61	27.17	28.32	30.54	26.79	28.00	30.18
1 L - 12	17:26:00	41.37	9.65	34.54	37.79	44.73	35.66	38.84	45.82	35.50	38.69	45.64	35.10	38.32	45.27
1 L - 13	17:34:00	44.82	10.46	61.14	63.36	66.93	62.51	64.68	68.31	62.16	64.34	67.91	61.82	64.02	67.62
1 U - 1	17:40:30	27.58	6.41	68.12	68.08	68.08	69.27	69.27	69.26	68.96	68.94	68.95	68.69	68.68	68.67
1 U - 2	17:45:30	13.79	3.17	66.67	66.61	66.54	67.61	67.53	67.48	67.33	67.27	67.21	67.14	67.07	67.01
1 U - 3	17:50:00	6.90	1.55	65.62	65.49	65.42	66.33	66.27	66.19	66.08	65.97	65.88	65.97	65.88	65.81
1 U - 4	17:55:00	3.45	0.74	64.80	64.74	64.65	65.39	65.29	65.17	65.19	65.09	65.00	65.09	65.01	64.91
1 U - 5	17:59:30	0.00	0.00	63.53	63.34	63.22	63.96	63.76	63.60	63.76	63.54	63.40	63.74	63.55	63.41
2 L - 0	18:06:30	0.00	0.00	63.07			63.43			63.23			63.25		
2 L - 1	18:08:30	3.45	0.79	63.03	62.99	62.92	63.37	63.36	63.30	63.16	63.15	63.09	63.20	63.17	63.11
2 L - 2	18:13:00	6.90	1.60	62.88	62.89	62.84	63.22	63.24	63.20	63.04	63.02	62.99	63.05	63.06	63.02
2 L - 3	18:17:30	10.34	2.42	62.83	62.80	62.78	63.16	63.14	63.12	62.95	62.94	62.88	62.99	62.97	62.95
2 L - 4	18:22:00	13.79	3.23	62.75	62.73	62.70	63.10	63.05	63.02	62.88	62.86	62.83	62.93	62.89	62.86
2 L - 5	18:26:30	17.24	4.04	62.62	62.59	62.56	62.97	62.97	62.92	62.77	62.74	62.70	62.80	62.78	62.74
2 L - 6	18:31:00	20.69	4.85	62.48	62.45	62.40	62.84	62.80	62.75	62.61	62.57	62.53	62.66	62.62	62.57
2 L - 7	18:35:30	24.13	5.66	62.30	62.26	62.21	62.64	62.61	62.53	62.42	62.39	62.34	62.47	62.43	62.37
2 L - 8	18:40:00	27.58	6.47	62.08	62.03	61.97	62.42	62.36	62.30	62.21	62.15	62.08	62.25	62.20	62.13
2 L - 9	18:44:30	31.03	7.29	61.83	61.76	61.68	62.13	62.05	61.95	61.95	61.90	61.81	61.98	61.91	61.82
2 L - 10	18:49:00	34.48	8.10	61.50	61.44	61.32	61.79	61.73	61.60	61.63	61.54	61.40	61.65	61.59	61.46
2 L - 11	18:53:30	37.92	8.91	61.12	61.03	60.89	61.35	61.29	61.16	61.24	61.13	60.99	61.24	61.16	61.03
2 L - 12	18:58:30	41.37	9.72	60.67	60.59	60.45	60.92	60.84	60.71	60.79	60.70	60.55	60.79	60.72	60.58
2 L - 13	19:03:30	44.82	10.53	60.22	60.08	59.87	60.45	60.36	60.13	60.30	60.18	59.98	60.34	60.22	60.00
2 L - 14	19:15:30	48.27	11.34	57.49	57.38	57.24	57.71	57.63	57.51	57.64	57.58	57.48	57.60	57.50	57.37
2 L - 15	19:23:30	51.71	12.15	56.59	56.56	56.45	57.14	57.11	57.05	57.16	57.11	57.07	56.87	56.84	56.75
2 L - 16	19:43:00	55.16	12.97	55.93	55.89	55.84	56.73	56.69	56.67	56.69	56.66	56.64	56.33	56.29	56.25
2 L - 17	19:49:00	56.54	13.29	55.74	55.68	55.58	56.60	56.56	56.52	56.55	56.52	56.47	56.17	56.12	56.05
2 U - 1	19:53:30	0.00	0.00	56.29			56.97			56.79			56.63		
2 U - 1	20:00:00	0.00	0.00	56.39			57.01			56.85			56.70		

* Net load as defined in Table 1.

** Average expansion calculated from gages 14985 and 14986 (180° opposed).

Downward Base of O-cell™ Movement (calculated)

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (MPa)	Net * Load (MN)	O-cell™ Expansion (tbl 6) 1 min (mm)	O-cell™ Expansion (tbl 6) 2 min (mm)	O-cell™ Expansion (tbl 6) 4 min (mm)	Upward Movement (tbl 5) 1 min (mm)	Upward Movement (tbl 5) 2 min (mm)	Upward Movement (tbl 5) 4 min (mm)	Downward Movement 1 min (mm)	Downward Movement 2 min (mm)	Downward Movement 4 min (mm)	Creep 2-4 min (mm)
1 L - 0	16:31:30	0.00	0.00	0.00			0.00			0.00			
1 L - 1	16:36:30	3.45	0.74			0.12			-0.08			0.20	
1 L - 2	16:38:30	6.90	1.55	0.27	0.28	0.27	-0.15	0.06	-0.03	0.42	0.21	0.31	0.09
1 L - 3	16:43:00	10.34	2.36	0.47	0.48	0.51	0.04	0.07	-0.02	0.43	0.41	0.52	0.12
1 L - 4	16:47:30	13.79	3.17	0.96	1.00	1.06	0.09	0.14	0.11	0.87	0.87	0.95	0.09
1 L - 5	16:52:30	17.24	3.98	2.78	2.97	3.22	0.36	0.46	0.39	2.42	2.50	2.83	0.33
1 L - 6	16:57:00	20.69	4.79	4.52	4.97	5.49	0.76	0.82	0.80	3.76	4.15	4.68	0.53
1 L - 7	17:01:30	24.13	5.60	7.16	7.80	8.74	1.14	1.13	1.28	6.02	6.67	7.46	0.79
1 L - 8	17:06:00	27.58	6.41	10.57	11.34	12.63	1.51	1.63	1.77	9.06	9.71	10.86	1.15
1 L - 9	17:11:00	31.03	7.22	15.37	16.35	17.83	2.06	2.24	2.34	13.31	14.11	15.49	1.38
1 L - 10	17:16:00	34.48	8.03	20.72	21.74	23.41	2.78	2.69	2.94	17.93	19.05	20.47	1.42
1 L - 11	17:21:00	37.92	8.84	26.79	28.00	30.18	3.51	3.66	3.94	23.28	24.34	26.24	1.90
1 L - 12	17:26:00	41.37	9.65	35.10	38.32	45.27	4.65	4.62	5.23	30.46	33.69	40.04	6.35
1 L - 13	17:34:00	44.82	10.46	61.82	64.02	67.62	6.53	6.68	6.95	55.29	57.34	60.66	3.32
1 U - 1	17:40:30	27.58	6.41	68.69	68.68	68.67	6.89	7.03	7.01	61.80	61.65	61.66	
1 U - 2	17:45:30	13.79	3.17	67.14	67.07	67.01	6.85	6.78	6.78	60.29	60.29	60.22	
1 U - 3	17:50:00	6.90	1.55	65.97	65.88	65.81	6.65	6.63	6.67	59.33	59.25	59.13	
1 U - 4	17:55:00	3.45	0.74	65.09	65.01	64.91	6.58	6.50	6.64	58.51	58.52	58.27	
1 U - 5	17:59:30	0.00	0.00	63.74	63.55	63.41	6.45	6.48	6.43	57.30	57.07	56.98	
2 L - 0	18:06:30	0.00	0.00	63.25			6.35			56.90			
2 L - 1	18:08:30	3.45	0.79	63.20	63.17	63.11	6.20	6.24	6.27	56.99	56.94	56.84	
2 L - 2	18:13:00	6.90	1.60	63.05	63.06	63.02	6.06	6.06	6.16	56.99	57.00	56.86	
2 L - 3	18:17:30	10.34	2.42	62.99	62.97	62.95	6.09	6.08	6.07	56.91	56.89	56.88	
2 L - 4	18:22:00	13.79	3.23	62.93	62.89	62.86	5.99	5.87	5.95	56.94	57.02	56.91	
2 L - 5	18:26:30	17.24	4.04	62.80	62.78	62.74	5.62	5.60	5.51	57.18	57.18	57.23	
2 L - 6	18:31:00	20.69	4.85	62.66	62.62	62.57	5.29	5.25	5.08	57.37	57.38	57.49	
2 L - 7	18:35:30	24.13	5.66	62.47	62.43	62.37	4.86	4.85	4.87	57.60	57.58	57.50	
2 L - 8	18:40:00	27.58	6.47	62.25	62.20	62.13	4.61	4.52	4.45	57.64	57.68	57.68	
2 L - 9	18:44:30	31.03	7.29	61.98	61.91	61.82	4.24	4.21	4.13	57.74	57.70	57.68	
2 L - 10	18:49:00	34.48	8.10	61.65	61.59	61.46	3.82	3.79	3.60	57.83	57.80	57.86	
2 L - 11	18:53:30	37.92	8.91	61.24	61.16	61.03	2.92	2.70	2.24	58.31	58.46	58.79	
2 L - 12	18:58:30	41.37	9.72	60.79	60.72	60.58	1.13	0.70	0.13	59.66	60.02	60.46	
2 L - 13	19:03:30	44.82	10.53	60.34	60.22	60.00	-1.69	-2.53	-4.27	62.03	62.75	64.27	
2 L - 14	19:15:30	48.27	11.34	57.60	57.50	57.37	-25.04	-27.16	-30.71	82.64	84.66	88.08	
2 L - 15	19:23:30	51.71	12.15	56.87	56.84	56.75	-43.10	-45.06	-48.79	99.97	101.90	105.54	
2 L - 16	19:43:00	55.16	12.97	56.33	56.29	56.25	-99.85	-102.86	-108.40	156.17	159.15	164.66	
2 L - 17	19:49:00	56.54	13.29	56.17	56.12	56.05	-115.98	-118.81	-124.36	172.15	174.93	180.41	
2 U - 1	19:53:30	0.00	0.00	56.63			-121.92			178.55			
2 U - 1	20:00:00	0.00	0.00	56.70			-121.21			177.91			

* Net load as defined in Table 1.

Upward Top of Mid-cell Movement (calculated)
Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (MPa)	Net * Load (MN)	Top of Shaft (tbl 2) 1 min (mm)	Top of Shaft (tbl 2) 2 min (mm)	Top of Shaft (tbl 2) 4 min (mm)	Shaft Comp. (tbl 4) 1 min (mm)	Shaft Comp. (tbl 4) 2 min (mm)	Shaft Comp. (tbl 4) 4 min (mm)	Top of Mid-cell ** 1 min (mm)	Top of Mid-cell ** 2 min (mm)	Top of Mid-cell ** 4 min (mm)	Creep 2-4 min (mm)
1 L - 0	16:31:30	0.00	0.00	0.00			0.00			0.00			
1 L - 1	16:36:30	3.45	0.74			-0.10			0.00			-0.10	
1 L - 2	16:38:30	6.90	1.55	-0.20	0.00	-0.10	-0.01	0.00	0.00	-0.21	0.00	-0.11	
1 L - 3	16:43:00	10.34	2.36	-0.07	-0.03	-0.14	0.00	0.00	0.00	-0.07	-0.04	-0.14	
1 L - 4	16:47:30	13.79	3.17	-0.10	-0.07	-0.10	0.00	0.00	0.00	-0.10	-0.07	-0.10	
1 L - 5	16:52:30	17.24	3.98	-0.20	-0.14	-0.24	0.01	0.01	0.01	-0.20	-0.13	-0.23	
1 L - 6	16:57:00	20.69	4.79	-0.10	-0.07	-0.14	0.01	0.01	0.01	-0.09	-0.06	-0.13	
1 L - 7	17:01:30	24.13	5.60	-0.03	-0.10	-0.03	0.01	0.01	0.02	-0.02	-0.09	-0.01	
1 L - 8	17:06:00	27.58	6.41	-0.07	-0.03	0.00	0.02	0.02	0.02	-0.05	-0.02	0.02	
1 L - 9	17:11:00	31.03	7.22	-0.07	0.03	0.03	0.02	0.02	0.03	-0.05	0.06	0.06	
1 L - 10	17:16:00	34.48	8.03	0.07	-0.10	-0.07	0.03	0.03	0.03	0.10	-0.07	-0.04	
1 L - 11	17:21:00	37.92	8.84	-0.07	-0.10	-0.14	0.03	0.04	0.04	-0.03	-0.07	-0.10	
1 L - 12	17:26:00	41.37	9.65	-0.20	-0.34	-0.27	0.05	0.04	0.04	-0.16	-0.30	-0.23	
1 L - 13	17:34:00	44.82	10.46	-0.27	-0.31	-0.41	0.05	0.04	0.05	-0.22	-0.26	-0.36	
1 U - 1	17:40:30	27.58	6.41	-0.58	-0.44	-0.44	0.03	0.03	0.03	-0.55	-0.41	-0.41	
1 U - 2	17:45:30	13.79	3.17	-0.51	-0.58	-0.55	0.02	0.02	0.02	-0.49	-0.56	-0.52	
1 U - 3	17:50:00	6.90	1.55	-0.51	-0.51	-0.48	0.02	0.02	0.02	-0.50	-0.49	-0.46	
1 U - 4	17:55:00	3.45	0.74	-0.48	-0.55	-0.41	0.01	0.01	0.01	-0.47	-0.53	-0.40	
1 U - 5	17:59:30	0.00	0.00	-0.44	-0.41	-0.44	0.01	0.01	0.01	-0.43	-0.40	-0.44	
2 L - 0	18:06:30	0.00	0.00	-0.48			0.01			0.00			
2 L - 1	18:08:30	3.45	0.79	-0.55	-0.51	-0.44	0.01	0.01	0.01	-0.07	-0.03	0.04	0.07
2 L - 2	18:13:00	6.90	1.60	-0.58	-0.58	-0.48	0.02	0.01	0.02	-0.10	-0.10	0.01	0.11
2 L - 3	18:17:30	10.34	2.42	-0.48	-0.48	-0.48	0.03	0.04	0.03	0.02	0.03	0.02	0.00
2 L - 4	18:22:00	13.79	3.23	-0.41	-0.51	-0.41	0.10	0.11	0.11	0.16	0.07	0.17	0.10
2 L - 5	18:26:30	17.24	4.04	-0.38	-0.38	-0.44	0.27	0.28	0.30	0.37	0.37	0.32	-0.05
2 L - 6	18:31:00	20.69	4.85	-0.38	-0.38	-0.48	0.42	0.43	0.44	0.52	0.52	0.43	-0.10
2 L - 7	18:35:30	24.13	5.66	-0.38	-0.34	-0.27	0.55	0.55	0.57	0.64	0.68	0.76	0.08
2 L - 8	18:40:00	27.58	6.47	-0.24	-0.27	-0.27	0.68	0.69	0.70	0.91	0.89	0.90	0.01
2 L - 9	18:44:30	31.03	7.29	-0.17	-0.14	-0.10	0.81	0.82	0.84	1.11	1.16	1.21	0.05
2 L - 10	18:49:00	34.48	8.10	0.00	0.10	0.10	0.95	0.96	0.98	1.42	1.53	1.55	0.01
2 L - 11	18:53:30	37.92	8.91	0.27	0.34	0.31	1.11	1.13	1.14	1.85	1.94	1.91	-0.02
2 L - 12	18:58:30	41.37	9.72	0.72	0.78	0.96	1.28	1.30	1.33	2.47	2.56	2.75	0.19
2 L - 13	19:03:30	44.82	10.53	1.33	1.40	1.47	1.49	1.53	1.56	3.29	3.40	3.49	0.10
2 L - 14	19:15:30	48.27	11.34	2.18	2.15	2.32	2.00	2.03	2.08	4.65	4.65	4.87	0.22
2 L - 15	19:23:30	51.71	12.15	2.53	2.53	2.56	2.64	2.69	2.75	5.63	5.68	5.78	0.09
2 L - 16	19:43:00	55.16	12.97	3.14	3.31	3.31	3.10	3.15	3.22	6.71	6.93	7.00	0.07
2 L - 17	19:49:00	56.54	13.29	3.48	3.65	3.72	3.32	3.39	3.56	7.27	7.51	7.75	0.24
2 U - 1	19:53:30	0.00	0.00	2.63			3.17			6.27			
2 U - 1	20:00:00	0.00	0.00	2.29			3.14			5.89			

* Net load as defined in Table 1.

** Zeroed at beginning of Load Cycle 2.

Mid-cell Expansion

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (MPa)	Net * Load (MN)	LVWDT 14991 1 min (mm)	LVWDT 14991 2 min (mm)	LVWDT 14991 4 min (mm)	LVWDT 14992 1 min (mm)	LVWDT 14992 2 min (mm)	LVWDT 14992 4 min (mm)	LVWDT 14993 1 min (mm)	LVWDT 14993 2 min (mm)	LVWDT 14993 4 min (mm)	Average Expansion ** 1 min (mm)	Average Expansion ** 2 min (mm)	Average Expansion ** 4 min (mm)
1 L - 0	16:31:30	0.00	0.00	0.00			0.00			0.00			0.00		
1 L - 1	16:36:30	3.45	0.74			-0.01			0.01			0.00			0.00
1 L - 2	16:38:30	6.90	1.55	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	-0.01	0.00	-0.01	-0.01	0.00
1 L - 3	16:43:00	10.34	2.36	-0.01	-0.01	-0.01	0.01	0.02	0.00	-0.01	0.00	0.00	0.00	0.00	-0.01
1 L - 4	16:47:30	13.79	3.17	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.00	-0.01	-0.01	-0.01
1 L - 5	16:52:30	17.24	3.98	-0.03	-0.03	-0.03	0.00	-0.02	-0.02	-0.01	-0.02	-0.02	-0.01	-0.02	-0.02
1 L - 6	16:57:00	20.69	4.79	-0.04	-0.02	-0.04	-0.02	-0.01	-0.02	-0.03	0.00	-0.02	-0.03	-0.02	-0.03
1 L - 7	17:01:30	24.13	5.60	-0.02	-0.04	-0.04	-0.03	-0.03	-0.02	-0.03	-0.03	-0.03	-0.02	-0.03	-0.03
1 L - 8	17:06:00	27.58	6.41	-0.05	-0.04	-0.04	-0.02	-0.04	-0.03	-0.03	-0.03	-0.04	-0.04	-0.04	-0.04
1 L - 9	17:11:00	31.03	7.22	-0.06	-0.06	-0.06	-0.05	-0.04	-0.04	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
1 L - 10	17:16:00	34.48	8.03	-0.06	-0.06	-0.06	-0.05	0.01	-0.05	-0.06	-0.06	-0.06	-0.06	-0.03	-0.06
1 L - 11	17:21:00	37.92	8.84	-0.07	-0.05	-0.07	-0.04	-0.05	-0.05	-0.07	-0.07	-0.07	-0.05	-0.05	-0.06
1 L - 12	17:26:00	41.37	9.65	-0.08	-0.08	-0.07	-0.06	-0.06	-0.06	-0.05	-0.08	-0.08	-0.07	-0.07	-0.07
1 L - 13	17:34:00	44.82	10.46	-0.08	-0.09	-0.09	-0.07	-0.06	-0.08	-0.10	-0.10	-0.10	-0.07	-0.08	-0.09
1 U - 1	17:40:30	27.58	6.41	-0.08	-0.08	-0.08	-0.06	-0.06	-0.04	-0.09	-0.08	-0.08	-0.07	-0.07	-0.06
1 U - 2	17:45:30	13.79	3.17	-0.07	-0.07	-0.06	-0.05	-0.05	-0.01	-0.08	-0.08	-0.08	-0.06	-0.06	-0.04
1 U - 3	17:50:00	6.90	1.55	-0.06	-0.06	-0.06	-0.04	-0.02	-0.05	-0.05	-0.07	-0.07	-0.05	-0.04	-0.05
1 U - 4	17:55:00	3.45	0.74	-0.05	-0.05	-0.07	-0.04	-0.02	-0.04	-0.07	-0.07	-0.07	-0.05	-0.04	-0.05
1 U - 5	17:59:30	0.00	0.00	-0.05	-0.05	-0.05	-0.02	-0.04	-0.03	-0.06	-0.06	-0.06	-0.03	-0.04	-0.04
2 L - 0	18:06:30	0.00	0.00	-0.05			-0.02			-0.06			0.00		
2 L - 1	18:08:30	3.45	0.79	-0.01	-0.01	-0.01	0.03	0.01	0.04	0.10	0.12	0.12	0.08	0.08	0.09
2 L - 2	18:13:00	6.90	1.60	0.06	0.06	0.06	0.09	0.08	0.09	0.25	0.23	0.26	0.17	0.17	0.17
2 L - 3	18:17:30	10.34	2.42	0.13	0.15	0.15	0.17	0.18	0.18	0.37	0.40	0.41	0.26	0.28	0.29
2 L - 4	18:22:00	13.79	3.23	0.37	0.39	0.41	0.35	0.37	0.41	0.73	0.75	0.75	0.52	0.54	0.56
2 L - 5	18:26:30	17.24	4.04	0.96	1.00	1.04	0.92	0.95	0.99	1.36	1.38	1.42	1.12	1.15	1.19
2 L - 6	18:31:00	20.69	4.85	1.50	1.54	1.60	1.43	1.46	1.53	1.86	1.94	2.01	1.64	1.69	1.76
2 L - 7	18:35:30	24.13	5.66	2.02	2.08	2.14	2.15	2.20	2.26	2.42	2.47	2.53	2.23	2.29	2.35
2 L - 8	18:40:00	27.58	6.47	2.61	2.67	2.77	2.71	2.78	2.85	3.03	3.08	3.14	2.82	2.88	2.96
2 L - 9	18:44:30	31.03	7.29	3.26	3.32	3.46	3.36	3.46	3.59	3.63	3.72	3.85	3.46	3.54	3.67
2 L - 10	18:49:00	34.48	8.10	4.05	4.18	4.41	4.20	4.38	4.57	4.45	4.61	4.82	4.27	4.43	4.64
2 L - 11	18:53:30	37.92	8.91	5.49	5.84	6.32	5.78	6.10	6.58	5.89	6.22	6.70	5.76	6.10	6.57
2 L - 12	18:58:30	41.37	9.72	8.23	8.80	9.67	8.50	9.15	9.99	8.59	9.17	10.02	8.48	9.08	9.93
2 L - 13	19:03:30	44.82	10.53	12.41	13.48	15.58	12.81	13.93	16.07	12.75	13.82	15.95	12.70	13.78	15.91
2 L - 14	19:15:30	48.27	11.34	40.35	42.72	46.79	41.15	43.48	47.67	40.58	42.93	47.04	40.74	43.08	47.21
2 L - 15	19:23:30	51.71	12.15	60.91	63.05	67.09	62.13	64.37	68.46	61.23	63.33	67.47	61.46	63.63	67.71
2 L - 16	19:43:00	55.16	12.97	121.03	124.19	129.94	122.90	126.31	132.09	121.46	124.81	130.62	121.84	125.14	130.92
2 L - 17	19:49:00	56.54	13.29	137.98	141.08	146.97	140.22	143.46	149.48	138.76	141.93	147.88	139.03	142.19	148.15
2 U - 1	19:53:30	0.00	0.00	142.86			145.03			143.08			143.70		
2 U - 1	20:00:00	0.00	0.00	141.72			143.78			142.06			142.56		

* Net load as defined in Table 1.

** Average expansion calculated from gages 14991 and 14992 (180° opposed). Zeroed at beginning of Load Cycle 2.

Downward Base of Mid-cell Movement (calculated)

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (MPa)	Net * Load (MN)	Mid-cell Expansion (tbl 11) 1 min (mm)	Mid-cell Expansion (tbl 11) 2 min (mm)	Mid-cell Expansion (tbl 11) 4 min (mm)	Upward Movement (tbl 10) 1 min (mm)	Upward Movement (tbl 10) 2 min (mm)	Upward Movement (tbl 10) 4 min (mm)	Downward Movement 1 min (mm)	Downward Movement 2 min (mm)	Downward Movement 4 min (mm)	Creep 2-4 min (mm)
1 L - 0	16:31:30	0.00	0.00	0.00			0.00			0.00			
1 L - 1	16:36:30	3.45	0.74			0.00			-0.10			0.10	
1 L - 2	16:38:30	6.90	1.55	-0.01	-0.01	0.00	-0.21	0.00	-0.11	0.21	0.00	0.10	
1 L - 3	16:43:00	10.34	2.36	0.00	0.00	-0.01	-0.07	-0.04	-0.14	0.07	0.04	0.13	
1 L - 4	16:47:30	13.79	3.17	-0.01	-0.01	-0.01	-0.10	-0.07	-0.10	0.09	0.06	0.09	
1 L - 5	16:52:30	17.24	3.98	-0.01	-0.02	-0.02	-0.20	-0.13	-0.23	0.19	0.11	0.21	
1 L - 6	16:57:00	20.69	4.79	-0.03	-0.02	-0.03	-0.09	-0.06	-0.13	0.06	0.04	0.10	
1 L - 7	17:01:30	24.13	5.60	-0.02	-0.03	-0.03	-0.02	-0.09	-0.01	0.00	0.05	-0.02	
1 L - 8	17:06:00	27.58	6.41	-0.04	-0.04	-0.04	-0.05	-0.02	0.02	0.02	-0.02	-0.06	
1 L - 9	17:11:00	31.03	7.22	-0.05	-0.05	-0.05	-0.05	0.06	0.06	-0.01	-0.11	-0.11	
1 L - 10	17:16:00	34.48	8.03	-0.06	-0.03	-0.06	0.10	-0.07	-0.04	-0.15	0.04	-0.02	
1 L - 11	17:21:00	37.92	8.84	-0.05	-0.05	-0.06	-0.03	-0.07	-0.10	-0.02	0.01	0.04	
1 L - 12	17:26:00	41.37	9.65	-0.07	-0.07	-0.07	-0.16	-0.30	-0.23	0.09	0.23	0.16	
1 L - 13	17:34:00	44.82	10.46	-0.07	-0.08	-0.09	-0.22	-0.26	-0.36	0.15	0.19	0.28	
1 U - 1	17:40:30	27.58	6.41	-0.07	-0.07	-0.06	-0.55	-0.41	-0.41	0.48	0.34	0.35	
1 U - 2	17:45:30	13.79	3.17	-0.06	-0.06	-0.04	-0.49	-0.56	-0.52	0.43	0.50	0.49	
1 U - 3	17:50:00	6.90	1.55	-0.05	-0.04	-0.05	-0.50	-0.49	-0.46	0.44	0.46	0.41	
1 U - 4	17:55:00	3.45	0.74	-0.05	-0.04	-0.05	-0.47	-0.53	-0.40	0.42	0.50	0.34	
1 U - 5	17:59:30	0.00	0.00	-0.03	-0.04	-0.04	-0.43	-0.40	-0.44	0.40	0.36	0.39	
2 L - 0	18:06:30	0.00	0.00	0.00			0.00			0.00			
2 L - 1	18:08:30	3.45	0.91	0.08	0.08	0.09	-0.07	-0.03	0.04	0.15	0.11	0.05	-0.06
2 L - 2	18:13:00	6.90	1.72	0.17	0.17	0.17	-0.10	-0.10	0.01	0.26	0.27	0.17	-0.10
2 L - 3	18:17:30	10.34	2.54	0.26	0.28	0.29	0.02	0.03	0.02	0.24	0.25	0.26	0.01
2 L - 4	18:22:00	13.79	3.35	0.52	0.54	0.56	0.16	0.07	0.17	0.36	0.48	0.40	-0.08
2 L - 5	18:26:30	17.24	4.16	1.12	1.15	1.19	0.37	0.37	0.32	0.75	0.78	0.87	0.09
2 L - 6	18:31:00	20.69	4.97	1.64	1.69	1.76	0.52	0.52	0.43	1.12	1.16	1.33	0.17
2 L - 7	18:35:30	24.13	5.78	2.23	2.29	2.35	0.64	0.68	0.76	1.59	1.61	1.59	-0.02
2 L - 8	18:40:00	27.58	6.59	2.82	2.88	2.96	0.91	0.89	0.90	1.91	2.00	2.06	0.07
2 L - 9	18:44:30	31.03	7.40	3.46	3.54	3.67	1.11	1.16	1.21	2.35	2.39	2.46	0.08
2 L - 10	18:49:00	34.48	8.22	4.27	4.43	4.64	1.42	1.53	1.55	2.85	2.90	3.09	0.20
2 L - 11	18:53:30	37.92	9.03	5.76	6.10	6.57	1.85	1.94	1.91	3.91	4.16	4.66	0.50
2 L - 12	18:58:30	41.37	9.84	8.48	9.08	9.93	2.47	2.56	2.75	6.01	6.52	7.18	0.66
2 L - 13	19:03:30	44.82	10.65	12.70	13.78	15.91	3.29	3.40	3.49	9.40	10.39	12.42	2.03
2 L - 14	19:15:30	48.27	11.34	40.74	43.08	47.21	4.65	4.65	4.87	36.08	38.43	42.34	3.91
2 L - 15	19:23:30	51.71	12.15	61.46	63.63	67.71	5.63	5.68	5.78	55.83	57.94	61.93	3.99
2 L - 16	19:43:00	55.16	12.97	121.84	125.14	130.92	6.71	6.93	7.00	115.12	118.21	123.93	5.71
2 L - 17	19:49:00	56.54	13.29	139.03	142.19	148.15	7.27	7.51	7.75	131.76	134.69	140.40	5.71
2 U - 1	19:53:30	0.00	0.00	143.70			6.27			137.43			
2 U - 1	20:00:00	0.00	0.00	142.56			5.89			136.67			

* Net load as defined in Table 1.

LOADTEST

DEEP FOUNDATION TESTING, EQUIPMENT & SERVICES • SPECIALIZING IN OSTERBERG CELL TECHNOLOGY

Strain Gage Readings and Loads at Levels 1 and 2
Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (MPa)	Net * Load (MN)	Level 1 16502 (με)	Level 1 16503 ** (με)	Level 1 16516 (με)	Level 1 Av. Load *** (MN)	Level 2 16517 (με)	Level 2 16518 ** (με)	Level 2 16519 (με)	Level 2 Av. Load (MN)
1 L - 0	16:31:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 1	16:36:30	3.45	0.74	1.48	3.21	3.14	0.08	5.62	12.26	7.56	0.18
1 L - 2	16:38:30	6.90	1.55	3.22	5.68	6.83	0.17	8.83	29.82	12.03	0.28
1 L - 3	16:43:00	10.34	2.36	5.23	7.96	10.76	0.27	13.35	54.98	17.41	0.42
1 L - 4	16:47:30	13.79	3.17	9.57	12.98	16.11	0.43	17.74	91.55	20.54	0.52
1 L - 5	16:52:30	17.24	3.98	14.71	20.53	25.03	0.67	21.59	217.55	26.81	0.66
1 L - 6	16:57:00	20.69	4.79	15.57	23.63	30.28	0.78	24.24	308.98	29.39	0.73
1 L - 7	17:01:30	24.13	5.60	16.43	27.36	36.12	0.89	30.93	397.14	38.40	0.94
1 L - 8	17:06:00	27.58	6.41	17.34	30.24	40.44	0.98	39.30	477.69	45.72	1.16
1 L - 9	17:11:00	31.03	7.22	16.24	30.60	40.58	0.96	35.05	550.29	50.78	1.17
1 L - 10	17:16:00	34.48	8.03	10.62	25.90	38.02	0.82	36.47	620.71	54.74	1.24
1 L - 11	17:21:00	37.92	8.84	1.62	15.07	29.22	0.52	45.52	528.47	68.18	1.54
1 L - 12	17:26:00	41.37	9.65	28.02	33.31	66.83	1.60	71.90	1199.60	41.23	1.54
1 L - 13	17:34:00	44.82	10.46	45.48	49.77	93.71	2.35	157.88	656.04	132.59	3.95
1 U - 1	17:40:30	27.58	6.41	21.19	17.94	50.80	1.22	27.67	569.60	44.96	0.99
1 U - 2	17:45:30	13.79	3.17	1.60	-11.60	7.40	0.15	-21.51	504.36	-2.66	-0.33
1 U - 3	17:50:00	6.90	1.55	-8.54	-27.62	-18.02	-0.45	-27.90	473.27	-10.63	-0.52
1 U - 4	17:55:00	3.45	0.74	-12.65	-35.28	-33.97	-0.79	-30.03	454.25	-12.45	-0.58
1 U - 5	17:59:30	0.00	0.00	-23.26	-99.67	-97.28	-2.04	-31.20	425.53	-14.90	-0.63
2 L - 0	18:06:30	0.00	0.00	-24.19	-111.70	-100.27	-2.11	-31.75	423.04	-14.89	-0.63
2 L - 1	18:08:30	3.45	0.91	-25.95	-117.02	-102.95	-2.18	-31.91	421.44	-14.92	-0.64
2 L - 2	18:13:00	6.90	1.72	-25.60	-119.76	-103.91	-2.19	-31.10	421.31	-14.33	-0.62
2 L - 3	18:17:30	10.34	2.54	-25.66	-120.38	-104.38	-2.20	-26.07	422.07	-12.02	-0.52
2 L - 4	18:22:00	13.79	3.35	-23.44	-119.25	-103.69	-2.15	1.63	427.18	-4.12	-0.03
2 L - 5	18:26:30	17.24	4.16	-19.33	-113.90	-99.41	-2.01	18.39	443.97	12.31	0.42
2 L - 6	18:31:00	20.69	4.97	-13.48	-105.33	-92.14	-1.79	30.72	472.74	28.93	0.81
2 L - 7	18:35:30	24.13	5.78	-9.35	-98.51	-86.57	-1.62	39.68	495.03	36.92	1.04
2 L - 8	18:40:00	27.58	6.59	-6.48	-90.82	-80.35	-1.47	45.63	522.22	45.29	1.24
2 L - 9	18:44:30	31.03	7.40	-3.17	-83.37	-73.73	-1.30	54.01	555.88	64.74	1.61
2 L - 10	18:49:00	34.48	8.22	-0.28	-74.98	-66.57	-1.13	101.71	599.25	128.60	3.13
2 L - 11	18:53:30	37.92	9.03	0.99	-67.31	-58.49	-0.97	135.58	610.83	176.39	4.24
2 L - 12	18:58:30	41.37	9.84	-0.44	-62.59	-50.84	-0.87	166.54	587.66	260.07	5.80
2 L - 13	19:03:30	44.82	10.65	-2.88	-57.82	-42.59	-0.77	156.25	553.64	231.29	5.27
2 L - 14	19:15:30	48.27	11.34	#######	12.98	#######	0.44	416.77	336.70	#######	11.33
2 L - 15	19:23:30	51.71	12.15	#######	39.14	#######	1.32	838.12	331.01	#######	22.78
2 L - 16	19:43:00	55.16	12.97	#######	112.12	#######	3.79	527.57	340.62	#######	14.34
2 L - 17	19:49:00	56.54	13.29	#######	134.82	#######	4.56	529.38	344.75	#######	14.39
2 U - 1	19:53:30	0.00	0.00	#######	12.28	#######	0.42	305.26	229.78	#######	8.30
2 U - 1	20:00:00	0.00	0.00	#######	-0.50	#######	-0.02	286.39	222.11	#######	7.78

* Net load as defined in Table 1.
** Redundent gage, not used in average uless otherwise specified.
*** Calculated from SG 16503 beyond 2L-13.
\# Gages 16502, 16516 and 16519 did not function after 2L-13.

STRAIN , MODULUS , AREA

$\left(\frac{1.48+3.14}{2}\right)\times10^{-6}\cdot 28{,}800\,\mathrm{kPa}\cdot 1.216\,\mathrm{m}^2$

$= 0.08$

BUOYANT WT ABOVE TOP O-CELL
0.13 MN

AND 0.07 MN ABOVE
BOTTOM CELL

Strain Gage Readings and Loads at Levels 3 and 4

Test Shaft @ Sta.0+146 25m Lt. - Missouri River Bridge - Lexington, MO

Load Test Incr.	Time (h:m:s)	O-cell™ Pressure (MPa)	Net * Load (MN)	Level 3 16520 (με)	Level 3 16521 ** (με)	Level 3 16522 (με)	Level 3 Av. Load (MN)	Level 4 16523 (με)	Level 4 16524 ** (με)	Level 4 16525 (με)	Level 4 Av. Load (MN)
1 L - 0	16:31:30	0.00	0.00	0.00	#######	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 1	16:36:30	3.45	0.74	0.27	#######	0.02	0.00	0.23	0.11	0.04	0.00
1 L - 2	16:38:30	6.90	1.55	0.69	#######	0.54	0.02	0.30	0.39	0.21	0.01
1 L - 3	16:43:00	10.34	2.36	1.13	#######	0.88	0.03	0.49	0.47	0.36	0.01
1 L - 4	16:47:30	13.79	3.17	1.85	#######	1.16	0.04	0.83	0.90	0.89	0.03
1 L - 5	16:52:30	17.24	3.98	4.09	#######	4.16	0.11	1.81	2.13	1.96	0.05
1 L - 6	16:57:00	20.69	4.79	5.85	#######	5.76	0.16	2.72	2.89	2.41	0.07
1 L - 7	17:01:30	24.13	5.60	7.22	#######	6.94	0.19	3.52	3.70	3.08	0.10
1 L - 8	17:06:00	27.58	6.41	9.02	#######	8.76	0.24	4.38	4.75	3.78	0.12
1 L - 9	17:11:00	31.03	7.22	11.44	#######	10.90	0.31	5.39	5.87	4.63	0.15
1 L - 10	17:16:00	34.48	8.03	13.58	#######	13.28	0.37	6.29	6.98	5.35	0.17
1 L - 11	17:21:00	37.92	8.84	15.50	#######	14.61	0.41	7.09	8.00	6.16	0.19
1 L - 12	17:26:00	41.37	9.65	18.67	#######	17.01	0.49	8.32	9.63	7.68	0.23
1 L - 13	17:34:00	44.82	10.46	19.94	#######	16.91	0.51	7.82	9.53	7.50	0.22
1 U - 1	17:40:30	27.58	6.41	16.68	#######	13.01	0.41	6.03	7.43	4.70	0.16
1 U - 2	17:45:30	13.79	3.17	12.16	#######	8.35	0.28	4.23	5.15	2.43	0.10
1 U - 3	17:50:00	6.90	1.55	9.61	#######	6.36	0.22	3.26	3.90	1.54	0.07
1 U - 4	17:55:00	3.45	0.74	8.52	#######	5.30	0.19	2.66	3.56	1.32	0.06
1 U - 5	17:59:30	0.00	0.00	7.08	#######	3.81	0.15	1.92	2.44	0.77	0.04
2 L - 0	18:06:30	0.00	0.00	6.73	#######	2.91	0.13	1.97	2.42	0.71	0.04
2 L - 1	18:08:30	3.45	0.79	7.47	#######	4.48	0.16	2.26	2.82	-0.20	0.03
2 L - 2	18:13:00	6.90	1.60	8.60	#######	5.67	0.20	2.71	3.10	0.69	0.05
2 L - 3	18:17:30	10.34	2.42	10.81	#######	6.99	0.24	3.49	3.95	1.68	0.08
2 L - 4	18:22:00	13.79	3.23	17.33	#######	13.13	0.42	5.27	6.37	4.06	0.14
2 L - 5	18:26:30	17.24	4.04	35.16	#######	30.51	0.90	11.05	13.43	10.98	0.32
2 L - 6	18:31:00	20.69	4.85	47.88	#######	42.42	1.24	14.67	18.13	16.29	0.45
2 L - 7	18:35:30	24.13	5.66	60.27	#######	54.31	1.57	18.19	22.85	20.96	0.57
2 L - 8	18:40:00	27.58	6.47	72.52	#######	65.58	1.90	21.13	26.57	26.00	0.69
2 L - 9	18:44:30	31.03	7.29	84.48	#######	77.22	2.22	23.22	31.01	30.70	0.79
2 L - 10	18:49:00	34.48	8.10	97.03	#######	85.80	2.51	24.81	34.61	35.40	0.88
2 L - 11	18:53:30	37.92	8.91	108.11	#######	94.39	2.78	26.46	38.33	39.92	0.97
2 L - 12	18:58:30	41.37	9.72	112.23	#######	102.65	2.95	31.42	40.38	41.50	1.06
2 L - 13	19:03:30	44.82	10.53	120.59	#######	111.68	3.19	35.23	44.69	44.36	1.16
2 L - 14	19:15:30	48.27	11.34	130.41	#######	120.81	3.45	38.82	49.11	46.52	1.24
2 L - 15	19:23:30	51.71	12.15	138.11	#######	132.91	3.72	42.93	53.04	50.23	1.36
2 L - 16	19:43:00	55.16	12.97	145.37	#######	140.15	3.92	45.88	56.71	51.56	1.42
2 L - 17	19:49:00	56.54	13.29	151.52	#######	146.54	4.09	49.28	60.15	54.68	1.52
2 U - 1	19:53:30	0.00	0.00	16.03	#######	7.06	0.32	2.35	2.68	-4.17	-0.03
2 U - 1	20:00:00	0.00	0.00	3.63	#######	-4.41	-0.01	0.74	-0.81	-5.87	-0.07

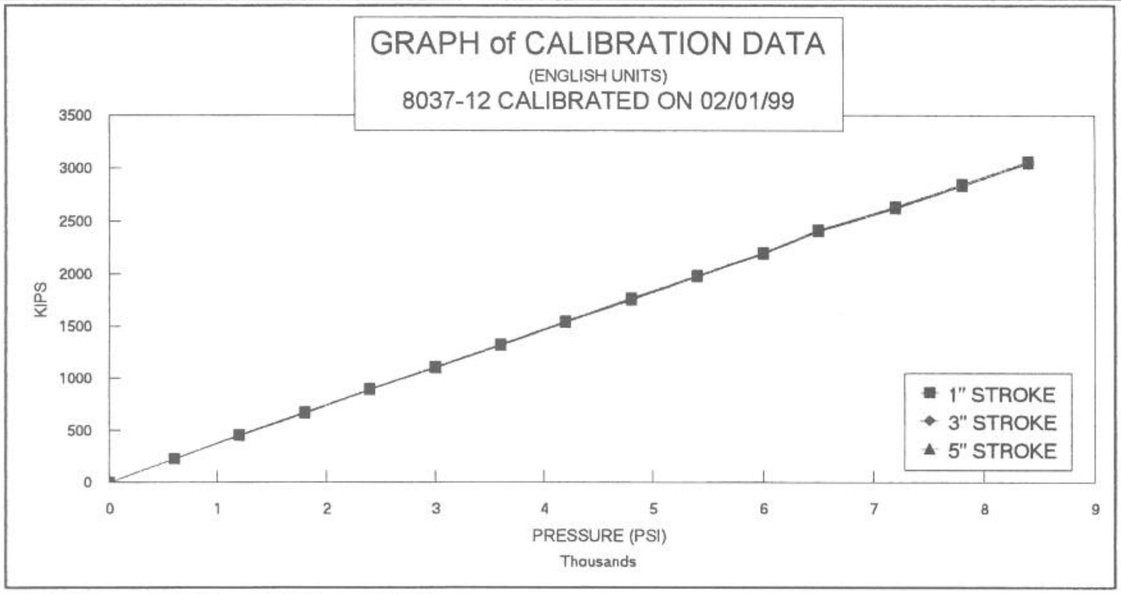
* Net load as defined in Table 1.

** Redundent gage, not used in average.

Gage 16521did not function.

APPENDIX B

O-CELL™ AND INSTRUMENTATION CALIBRATION SHEETS



STROKE:	1 INCH	3 INCH	5 INCH
PRESSURE PSI	LOAD KIPS	LOAD KIPS	LOAD KIPS
0	0	0	0
600	229	230	227
1200	457	450	447
1800	672	664	664
2400	897	889	887
3000	1111	1106	1098
3600	1330	1323	1319
4200	1545	1540	1535
4800	1768	1760	1749
5400	1987	1979	1976
6000	2200	2196	2188
6500	2421	2411	2405
7200	2640	2634	2622
7800	2853	2845	2839
8400	3072	3060	3052

26" O-CELL, SERIAL # 8037-12

LOAD CONVERSION FORMULA

LOAD = PRESSURE * 0.3641 + (13.8)
{KIPS} {PSI} +

Regression Output:

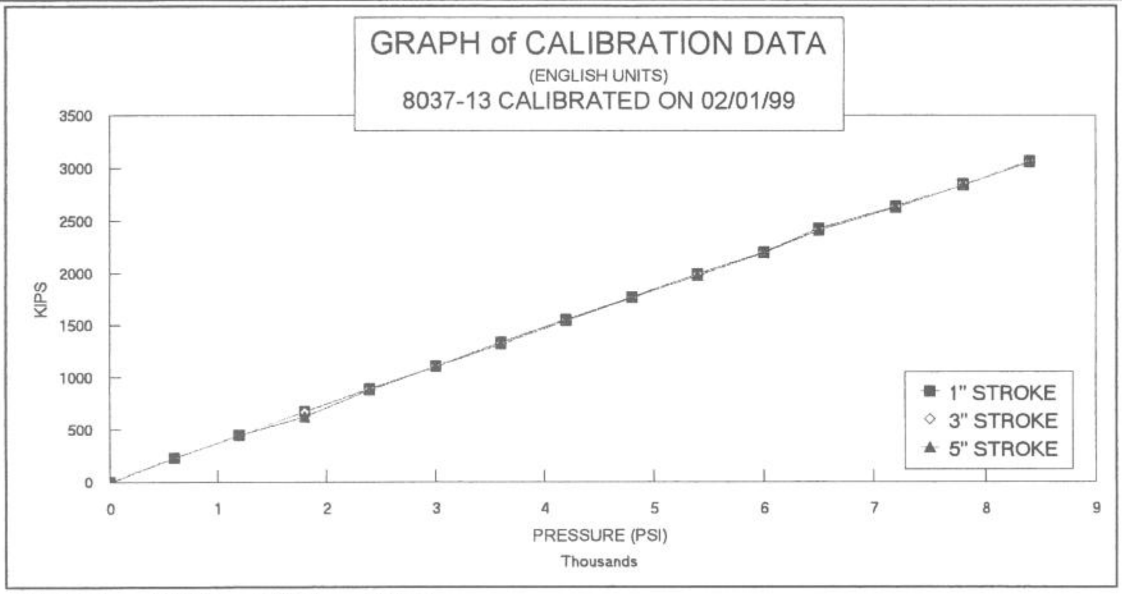
Constant	**13.8282**
X Coefficient	**0.3641**
R Squared	0.9998
No. of Observations	42
Degrees of Freedom	40
Std Err of Y Est	11.3176
Std Err of X Coef.	0.0007

CALIBRATION STANDARDS:

All data presented is derived from 6" dia. certified hydraulic pressure gauges and electronic load transducer, manufactured and calibrated by the University of Illinois at Champaign, Illinois. All calibrations and certifications are traceable through the Laboratory Master Deadweight Gauges directly to the National Institute of Standards and Technology. No Specific guidelines exist for calibration of load test jacks and equipment but procedures comply with similar guidelines for calibration of gauges, ANSI specifications B40.1.

*AE & FC CUSTOMER:LOADTEST INC. *AE & FC JOB NO.:9371 *CUSTOMER P.O.NO.:LT-8516	*CONTRACTOR:MASSMAN CONSTRUCTION *JOB LOCATION:PARKVILLE, MO *DATED:02/24/99

SERVICE ENGINEER: W. Satin DATE: 2/1/99



STROKE:	1 INCH	3 INCH	5 INCH
PRESSURE PSI	LOAD KIPS	LOAD KIPS	LOAD KIPS
0	0	0	0
600	229	227	227
1200	450	445	446
1800	673	666	627
2400	892	886	883
3000	1109	1105	1101
3600	1330	1321	1316
4200	1552	1540	1539
4800	1765	1758	1758
5400	1989	1983	1974
6000	2201	2192	2190
6500	2422	2412	2406
7200	2638	2633	2625
7800	2851	2848	2839
8400	3068	3064	3055

26" O-CELL, SERIAL # 8037-13

LOAD CONVERSION FORMULA

LOAD = PRESSURE * 0.3649 + (9.21)
{KIPS} {PSI}

Regression Output:

Constant	**9.2121**
X Coefficient	**0.3649**
R Squared	0.9998
No. of Observations	42
Degrees of Freedom	40
Std Err of Y Est	12.7300
Std Err of X Coef.	0.0008

CALIBRATION STANDARDS:

All data presented is derived from 6" dia. certified hydraulic pressure gauges and electronic load transducer, manufactured and calibrated by the University of Illinois at Champaign, Illinois. All calibrations and certifications are traceable through the Laboratory Master Deadweight Gauges directly to the National Institute of Standards and Technology. No Specific guidelines exist for calibration of load test jacks and equipment but procedures comply with similar guidelines for calibration of gauges, ANSI specifications B40.1.

*AE & FC CUSTOMER:LOADTEST INC.
*AE & FC JOB NO.:9371
*CUSTOMER P.O.NO.:LT-8516

*CONTRACTOR:MASSMAN CONSTRUCTION
*JOB LOCATION:PARKVILLE, MO
*DATED:02/24/99

SERVICE ENGINEER: [signature]

DATE: 2-1-99

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-6

Range: 6"

Serial Number: 14985

Mfg. Number: 99-250

Customer: Loadtest, Inc.

Temperature: 22.3 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 124, 406, 249

Job Number: 13196

Date: Feb. 08,1999

Technician: KB

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	2515	2510	2513		-0.21
1.200	3701	3699	3700	1188	0.08
2.400	4878	4873	4876	1176	0.17
3.600	6045	6040	6043	1167	0.11
4.800	7207	7206	7207	1164	0.00
6.000	8369	8367	8368	1162	-0.15

Calibration Factor (C): 0.001025274 (Inches/Digit)

Regression Zero: 2525

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5440

or

Position "F":* ______

Date: Feb. 26, 1999

Temperature: 22.8 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-6

Range: 6"

Serial Number: 14986

Mfg. Number: 99-276

Customer: Loadtest, Inc.

Temperature: 22.3 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 406, 124, 249

Job Number: 13196

Date: Feb. 18, 1999

Technician: KOB

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	2581	2578	2580		-0.20
1.200	3766	3764	3765	1186	0.10
2.400	4938	4933	4936	1171	0.14
3.600	6105	6099	6102	1167	0.11
4.800	7262	7263	7263	1161	-0.01
6.000	8423	8424	8424	1161	-0.13

Calibration Factor (C): 0.001027408 (Inches/Digit)

Regression Zero: 2591

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5414

or

Position "F":* ______

Date: Feb. 26, 1999

Temperature: 22.2 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-6

Range: 6"

Serial Number: 14987

Mfg. Number: 99-277

Customer: Loadtest, Inc.

Temperature: 22.3 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 406, 124, 249

Job Number: 13196

Date: Feb. 18, 1999

Technician: KCB

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	2788	2784	2786		-0.22
1.200	3990	3986	3988	1202	0.08
2.400	5178	5178	5178	1190	0.18
3.600	6360	6356	6358	1180	0.10
4.800	7537	7535	7536	1178	0.00
6.000	8712	8711	8712	1176	-0.15

Calibration Factor (C): 0.001013215 (Inches/Digit)

Regression Zero: 2799

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5495

or

Position "F":* ______

Date: Feb. 26, 1999

Temperature: 22.1 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-6

Range: 6"

Serial Number: 14991

Mfg. Number: 99-247

Customer: Loadtest, Inc.

Temperature: 22.3 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 124, 406, 249

Job Number: 13196

Date: Feb. 08,1999

Technician: KOB

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	2620	2617	2619		-0.23
1.200	3785	3783	3784	1166	0.08
2.400	4939	4934	4937	1153	0.18
3.600	6084	6082	6083	1147	0.17
4.800	7219	7218	7219	1136	-0.04
6.000	8359	8358	8359	1140	-0.16

Calibration Factor (C): 0.001046055 (Inches/Digit)

Regression Zero: 2632

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5506

or

Position "F":* ________

Date: Feb. 26, 1999

Temperature: 22.9 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-6

Range: 6"

Serial Number: 14992

Mfg. Number: 99-248

Customer: Loadtest, Inc.

Temperature: 22.3 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 124, 406, 249

Job Number: 13196

Date: Feb. 08,1999

Technician: KOB

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	2591	2587	2589		-0.23
1.200	3799	3797	3798	1209	0.07
2.400	4996	4997	4997	1199	0.19
3.600	6186	6185	6186	1189	0.15
4.800	7368	7368	7368	1183	0.00
6.000	8549	8547	8548	1180	-0.19

Calibration Factor (C): 0.001007318 (Inches/Digit)

Regression Zero: 2603

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5740

or

Position "F":*

Date: Feb. 26, 1999

Temperature: 21.8 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-6

Range: 6"

Serial Number: 14993

Mfg. Number: 99-249

Customer: Loadtest, Inc.

Temperature: 22.3 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 124, 406, 249

Job Number: 13196

Date: Feb. 08,1999

Technician: KOB

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	2563	2559	2561		-0.25
1.200	3757	3753	3755	1194	0.09
2.400	4937	4933	4935	1180	0.20
3.600	6107	6103	6105	1170	0.14
4.800	7273	7269	7271	1166	0.01
6.000	8434	8432	8433	1162	-0.19

Calibration Factor (C): 0.001022420 (Inches/Digit)

Regression Zero: 2576

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5719

or

Position "F":*

Date: Feb. 26, 1999

Temperature: 22.3 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-2

Range: 2"

Serial Number: 14994

Mfg. Number: 99-112

Customer: Loadtest, Inc.

Temperature: 23.2 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 329, 406, 249

Job Number: 13196

Date: February 04, 1999

Technician: TOB

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	3115	3116	3116		-0.20
0.400	4298	4298	4298	1183	0.08
0.800	5469	5468	5469	1171	0.15
1.200	6633	6632	6633	1164	0.12
1.600	7792	7792	7792	1160	0.01
2.000	8948	8949	8949	1157	-0.16

Calibration Factor (C): 0.000343039 (Inches/Digit)

Regression Zero: 3127

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5932

or

Position "F":* ______

Date: March 02, 1999

Temperature: 26.0 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-2

Range: 2"

Serial Number: 14995

Mfg. Number: 99-113

Customer: Loadtest, Inc.

Temperature: 23.2 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 329, 406, 249

Job Number: 13196

Date: February 04, 1999

Technician: KDB

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	3085	3087	3086		-0.27
0.400	4282	4280	4281	1195	0.10
0.800	5460	5459	5460	1179	0.20
1.200	6630	6630	6630	1171	0.16
1.600	7794	7794	7794	1164	0.01
2.000	8953	8954	8954	1160	-0.21

Calibration Factor (C): 0.000341063 (Inches/Digit)

Regression Zero: 3102

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5911

or

Position "F":* ________

Date: March 02, 1999

Temperature: 25.7 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-2

Range: 2"

Serial Number: 14996

Mfg. Number: 99-114

Customer: Loadtest, Inc.

Temperature: 23.2 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 329, 406, 249

Job Number: 13196

Date: February 04, 1999

Technician:

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	3208	3206	3207		-0.20
0.400	4389	4387	4388	1181	0.06
0.800	5559	5559	5559	1171	0.16
1.200	6723	6723	6723	1164	0.13
1.600	7882	7884	7883	1160	0.03
2.000	9036	9036	9036	1153	-0.18

Calibration Factor (C): 0.000343182 (Inches/Digit)

Regression Zero: 3219

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5951

or

Position "F":*

Date: March 02, 1999

Temperature: 26.0 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Vibrating Wire Displacement Transducer Calibration

Model Number: 4450-3-2

Range: 2"

Serial Number: 14997

Mfg. Number: 99-115

Customer: Loadtest, Inc.

Temperature: 23.2 °C

Cust. I.D. #: n/a

Cal. Std. Control Numbers: 329, 406, 249

Job Number: 13196

Date: February 04, 1999

Technician: 4508

Displacement (inches)	GK-401 Reading Position B Cycle 1	Cycle 2	Average	Change	% Linearity
0.000	2860	2858	2859		-0.25
0.400	4049	4047	4048	1189	0.09
0.800	5223	5222	5223	1175	0.19
1.200	6389	6388	6389	1166	0.14
1.600	7550	7548	7549	1161	0.00
2.000	8707	8707	8707	1158	-0.19

Calibration Factor (C): 0.000342215 (Inches/Digit)

Regression Zero: 2874

Refer to manual for temperature correction information.

Function Test at Shipment (GK-401 Reading)

Position "B":* 5614

or

Position "F":* ______

Date: March 02, 1999

Temperature: 25.3 °C

Wiring Code: Red and Black: Gage White and Green: Thermistor

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16502

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6567

Cust. I.D. #: n/a

Regression Zero: 6585

Prestress: 35,000 psi

Technician: 8L

Temperature: 23.7 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6632	6637	6635		
1,500	7255	7258	7257	622	-0.10
3,000	7930	7934	7932	676	-0.04
4,500	8606	8612	8609	677	0.07
6,000	9284	9283	9284	675	0.08
100	6638				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.3762 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16503

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6644

Cust. I.D. #: n/a

Regression Zero: 6689

Prestress: 35,000 psi

Technician: gl

Temperature: 23.5 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6735	6739	6737		
1,500	7406	7410	7408	671	-0.05
3,000	8132	8132	8132	724	0.08
4,500	8852	8853	8853	721	0.08
6,000	9567	9570	9569	716	-0.07
100	6739				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.35873 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16516

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6679

Cust. I.D. #: n/a

Regression Zero: 6701

Prestress: 35,000 psi

Technician:

Temperature: 23.6 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6748	6746	6747		
1,500	7377	7378	7378	631	-0.07
3,000	8060	8060	8060	683	0.09
4,500	8739	8737	8738	678	0.08
6,000	9414	9412	9413	675	-0.04
100	6754				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.37451 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16517

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6426

Cust. I.D. #: n/a

Regression Zero: 6448

Prestress: 35,000 psi

Technician:

Temperature: 23.8 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6494	6496	6495		
1,500	7122	7125	7124	629	-0.06
3,000	7803	7804	7804	680	0.04
4,500	8479	8480	8480	676	-0.01
6,000	9159	9157	9158	679	0.04
100	6497				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.37493 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16518

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6554

Cust. I.D. #: n/a

Regression Zero: 6565

Prestress: 35,000 psi

Technician:

Temperature: 23.8 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6608	6610	6609		
1,500	7228	7229	7229	620	-0.05
3,000	7895	7898	7897	668	0.07
4,500	8564	8564	8564	668	0.17
6,000	9220	9222	9221	657	-0.12
100	6610				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.37999 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16519

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6544

Cust. I.D. #: n/a

Regression Zero: 6563

Prestress: 35,000 psi

Technician: SG

Temperature: 23.8 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6608	6607	6608		
1,500	7226	7227	7227	619	-0.02
3,000	7892	7893	7893	666	0.05
4,500	8559	8560	8560	667	0.16
6,000	9216	9218	9217	658	-0.08
100	6608				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.3803 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

<u>Users are advised to establish their own zero conditions.</u>

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16520

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6589

Cust. I.D. #: n/a

Regression Zero: 6607

Prestress: 35,000 psi

Technician: 8

Temperature: 23.5 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6658	6658	6658		
1,500	7287	7290	7289	631	-0.16
3,000	7974	7976	7975	687	-0.14
4,500	8669	8667	8668	693	0.12
6,000	9350	9354	9352	684	0.05
100	6659				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.37149 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16521

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6639

Cust. I.D. #: n/a

Regression Zero: 6658

Prestress: 35,000 psi

Technician: 8

Temperature: 23.9 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6703	6707	6705		
1,500	7333	7337	7335	630	-0.06
3,000	8018	8016	8017	682	0.07
4,500	8693	8700	8697	680	0.11
6,000	9369	9374	9372	675	-0.02
100	6708				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.37442 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16522

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6430

Cust. I.D. #: n/a

Regression Zero: 6456

Prestress: 35,000 psi

Technician:

Temperature: 23.6 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6508	6511	6510		
1,500	7151	7153	7152	643	-0.24
3,000	7858	7860	7859	707	-0.09
4,500	8565	8569	8567	708	0.09
6,000	9268	9270	9269	702	0.06
100	6511				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.36507 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 5, 1999

Serial Number: 16523

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6380

Cust. I.D. #: n/a

Regression Zero: 6413

Prestress: 35,000 psi

Technician: gc

Temperature: 22.0 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6459	6465	6462		
1,500	7101	7103	7102	640	-0.07
3,000	7793	7794	7794	692	-0.06
4,500	8484	8490	8487	694	0.03
6,000	9177	9180	9179	692	0.05
100	6466				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.36952 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 3, 1999

Serial Number: 16524

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6504

Cust. I.D. #: n/a

Regression Zero: 6529

Prestress: 35,000 psi

Technician: 8

Temperature: 23.5 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6573	6573	6573		
1,500	7192	7190	7191	618	-0.04
3,000	7858	7857	7858	667	0.09
4,500	8523	8521	8522	665	0.15
6,000	9178	9179	9179	657	-0.10
100	6573				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.38072 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON

Sister Bar Calibration

Model Number : 4911-4

Date: March 5, 1999

Serial Number: 16525

Cal. Std. Control Numbers: 85888-1, 398

Customer: Loadtest, Inc.

Cable Length: 150'

Job Number: 13196

Factory Zero Reading: 6591

Cust. I.D. #: n/a

Regression Zero: 6633

Prestress: 35,000 psi

Technician: 8c

Temperature: 22.1 °C

Applied Load: (pounds)	Readings				Linearity % Max.Load
	Cycle #1	Cycle #2	Average	Change	
100	6684	6683	6684		
1,500	7317	7318	7318	634	-0.13
3,000	8004	8008	8006	689	-0.11
4,500	8696	8698	8697	691	-0.01
6,000	9388	9388	9388	691	0.10
100	6685				

For conversion factor, load to strain, refer to table C-2 of the Installation Manual.

Gage Factor:

0.37067 Microstrain/Digit (GK-401 Pos."B")

Calculated Strain = Gage Factor(Current Reading - Zero Reading)

Note: The above calibration uses the linear regression method.

Users are advised to establish their own zero conditions.

Linearity: ((Calculated Load-Applied Load)/ Max.Applied Load) X 100 per cent

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

APPENDIX C

CONSTRUCTION OF THE EQUIVALENT TOP-LOADED LOAD-SETTLEMENT CURVE

CONSTRUCTION OF THE EQUIVALENT TOP-LOADED LOAD-SETTLEMENT CURVE FROM THE RESULTS OF AN O-CELL™ TEST

__Introduction:__ Some engineers find it useful to see the results of an O-cell™ load test in the form of a curve showing the load versus settlement of a top-loaded driven or bored pile (drilled shaft). We believe that an O-cell™ test can provide a good estimate of this curve when using the method described herein.

__Assumptions:__ We make the following assumptions, which we consider both reasonable and usually conservative:

1. The end bearing load-movement curve in a top-loaded shaft has the same loads for a given movement as the net (subtract buoyant weight of pile above O-cell™) end bearing load-movement curve developed by the bottom of the O-cell™ when placed at or near the bottom of the shaft.

2. The side shear load-movement curve in a top-loaded shaft has the same net shear, multiplied by an adjustment factor 'F', for a given downward movement as occurred in the O-cell™ test for that same movement at the top of the cell in the upward direction. The same applies to the upward movement in a top-loaded tension test. Unless noted otherwise, we use F = 0.95 for compression and F = 0.80 for tension tests.

3. We initially assume the pile behaves as a rigid body, but include the elastic compressions that are part of the movement data obtained from an O-cell™ test (OLT). Using this assumption, we construct an equivalent top-load test (TLT) movement curve by the method described below in Procedure Part I. We then use the following Procedure Part II to correct for the effects of the additional elastic compressions in a TLT.

4. Consider the case with the O-cell™, or the bottom O-cell™ of more than one level of cells, placed some distance above the bottom of the shaft. We assume the part of the shaft below the cell, now top-loaded, has the same load-movement behavior as when top-loading the entire shaft. For this case the subsequent "end bearing movement curve" refers to the movement of the entire length of shaft below the cell

__Procedure Part I:__ Please refer to the attached Figure A showing O-cell™ test results and to Figure B, the constructed equivalent top loaded settlement curve. Note that each of the curves shown has points numbered from 1 to 12 such that the same point number on each curve has the same magnitude of movement. For example, point 4 has an upward and downward movement of 0.40 inches in Figure A and the same 0.40 inches downward in Figure B.

Using the above assumptions, construct the equivalent curve as follows: Select an arbitrary movement such as the 0.40 inches to give point 4 on the shaft side shear load movement curve in Figure A and record the 2,090 ton load in shear at that movement. Because we have a initially assumed a rigid pile, the top of moves downward the same as the bottom. Therefore, find point 4 with 0.40 inches of downward movement on the end bearing load movement curve and record the corresponding load of 1,060 tons. Adding these two loads will give the total load of 3,150 tons due to side shear plus end bearing at the same movement and thus gives point 4 on the Figure B load settlement curve for an equivalent top-loaded test.

One can use the above procedure to obtain all the points in Figure B up to the component that moved the least at the end of the test, in this case point 5 in side shear. To take advantage of the fact that the test produced end bearing movement data up to point 12, we need to make an extrapolation of the side shear curve. We usually use a convenient and suitable hyperbolic curve fitting technique for this extrapolation. Deciding on the maximum number of data points to provide a good fit (a high r^2 correlation coefficient) requires some judgment. In this case we omitted point 1 to give an $r^2 = 0.999$ (including point 1 gave $r^2 = 0.965$) with the result shown as points 6 to 12 on the dotted extension of the measured end bearing curve. Using the same movement matching procedure described earlier we can then extend the equivalent curve to points 6 to 12. The results, shown in Figure B as a dashed line, signify that this part of the equivalent curve depends partly on extrapolated data.

Sometimes, if the data warrants, we will use extrapolations of both side shear and end bearing to extend the equivalent curve to a greater movement than the maximum measured (point 12). An appendix in this report gives the details of the extrapolation(s) used with the present O-cell™ test and shows the fit with the actual data.

Procedure Part II: The elastic compression in the equivalent top load test always exceeds that in the O-cell™ test. It not only produces more top movement, but also additional side shear movement, which then generates more side shear, which produces more compression, etc........ An exact solution of this load transfer problem requires knowing the side shear vs. vertical movement (t-y) curves for a large number of pile length increments and solving the resulting set of simultaneous equations or using finite element or finite difference simulations to obtain an approximate solution for these equations. We usually do not have the data to obtain the many accurate t-y curves required. Fortunately, the approximate solution described below usually suffices.

Analysis p. 4 gives the equations for the elastic compressions that occur in the equivalent TLT for an OLT with two levels of O-cells™ and tested in three stages (as shown along the right edge). The attached analysis p.3 gives the equations for the elastic compressions that occur in the OLT. Subtracting gives the desired additional elastic compression at the top of the TLT. We then add the additional elastic compression to the 'rigid' equivalent curve obtained from Part I to obtain the final, corrected equivalent load-settlement curve for the TLT on the same pile as the actual OLT.

Note that the above pp. 3 and 4 give equations for each of three assumed patterns of developed side shear stress along the pile. As illustrated on the bottom of p. 4, adjusting the length ℓ_o with negligible or no side shear expands the usefulness of the three basic patterns approximating above the O-cells™. Experience has shown that one or more of these three patterns, with a possible ℓ_o adjustment, usually suffices as an approximation of the actual pattern in the OLT and TLT, which are assumed similar. Experience has also shown the initial solution for the additional elastic compression, as described above, gives an adequate and slightly conservative (high) estimate of the additional compression versus more sophisticated load-transfer analyses as described in the first paragraph of this Part II.

For the case of using Part II with an OLT with only a single level of cell(s), $Q_A = Q_B$, $\ell_2 = 0$, and the choice of three side shear patterns reduces to two.

The final analysis pp. 5 and 6 provide comparative examples of calculated results on hypothetical OLTs using the simplified method in Part II, with all three assumed side shear distribution patterns and in both SI (p. 5) and English (p. 6) units.

Other Tests: The example illustrated in Figure A has the maximum component movement in end bearing. The procedures remain the same if the maximum test movement occurred in side shear. Then we would have extrapolated end bearing to produce the dashed-line part of the reconstructed top-load settlement curve.

The example illustrated also assumes a pile top-loaded in compression. For a pile top-loaded in tension we would, based on assumptions 2. and 3., use the upward side shear load curve in Figure A for the equivalent top-loaded displacement curve.

Expected Accuracy: We know of only five series of tests that provide the data needed to make a direct comparison between actual, full scale, top-loaded pile movement behavior and the equivalent behavior obtained from an O-cell™ test by the method described herein. These involve three sites in Japan and one in Singapore, in a variety of soils, with three compression tests on bored piles (drilled shafts), one compression test on a driven pile and one tension test on a bored pile. The largest bored pile had a 1.2 m diameter and a 37 m length. The driven pile had a 1-m increment modular construction and a 9 m length. The largest top loading = 28 MN (3,150 tons).

The following references detail the aforementioned Japanese tests and the results therefrom:

Kishida H. et al., 1992, "Pile Loading Tests at Osaka Amenity Park Project," Paper by Mitsubishi Co., also briefly described in Schmertmann

(1993, see bibliography). Compares one drilled shaft in tension and another in compression.

Ogura, H. <u>et al</u>., 1995, "Application of Pile Toe Load Test to Cast-in-place Concrete Pile and Precast Pile," special volume 'Tsuchi-to-Kiso' on Pile Loading Test, Japanese Geotechnical Society, Vol. 3, No. 5, Ser. No. 448. Original in Japanese. Translated by M. B. Karkee, GEOTOP Corporation. Compares one drilled shaft and one driven pile, both in compression.

We compared the predicted equivalent and measured top load at three top movements in each of the above five comparisons. The top movements ranged from ¼ inch (6 mm) to 40 mm, depending on the data available. The (equiv./meas.) ratios of the top load averaged 1.03 in the 15 comparisons with a coefficient of variation of less than 10%. We believe that these available comparisons help support the practical validity of the equivalent top load method described herein.

<u>Limitations</u>: The engineer using these results should judge the conservatism of the aforementioned assumptions and extrapolation(s) before utilizing the results for design purposes. For example, brittle failure behavior may produce movement curves with abrupt changes in curvature (not hyperbolic). However, we believe the hyperbolic fit used usually produces reasonable extrapolations.

July, 1998

Example of the Construction of an Equivalent Top-Loaded Settlement Curve (Figure B) From Osterberg Cell Test Results (Figure A)

Figure A

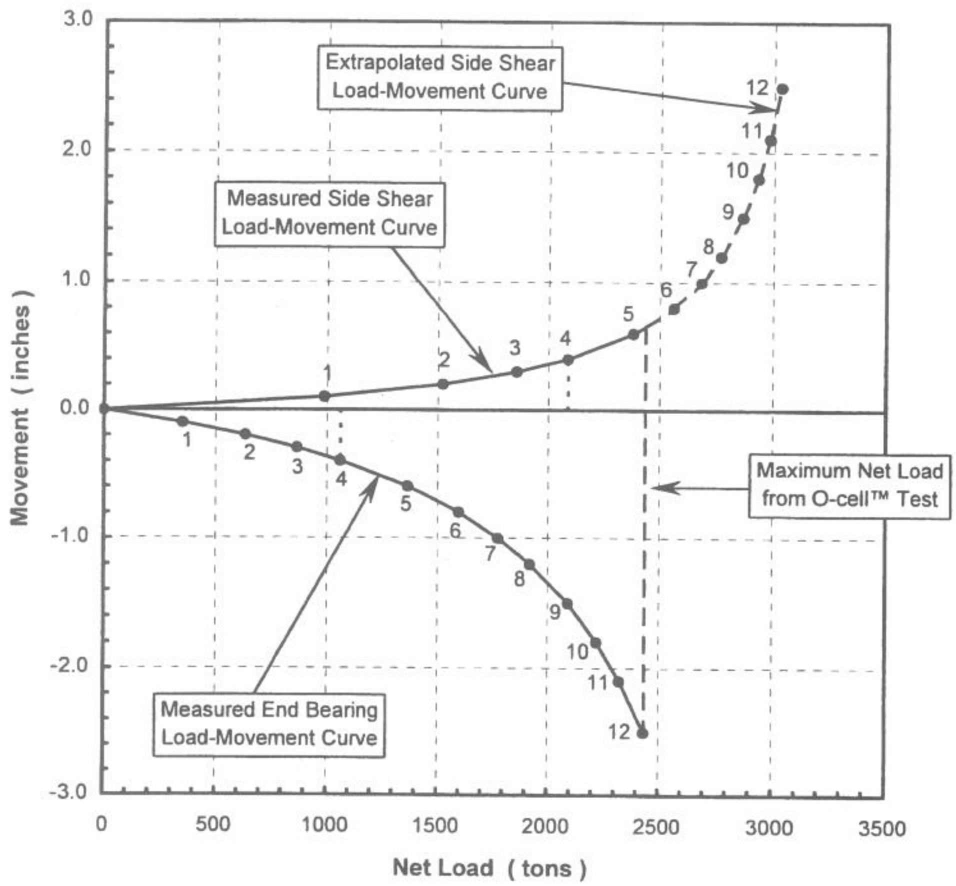
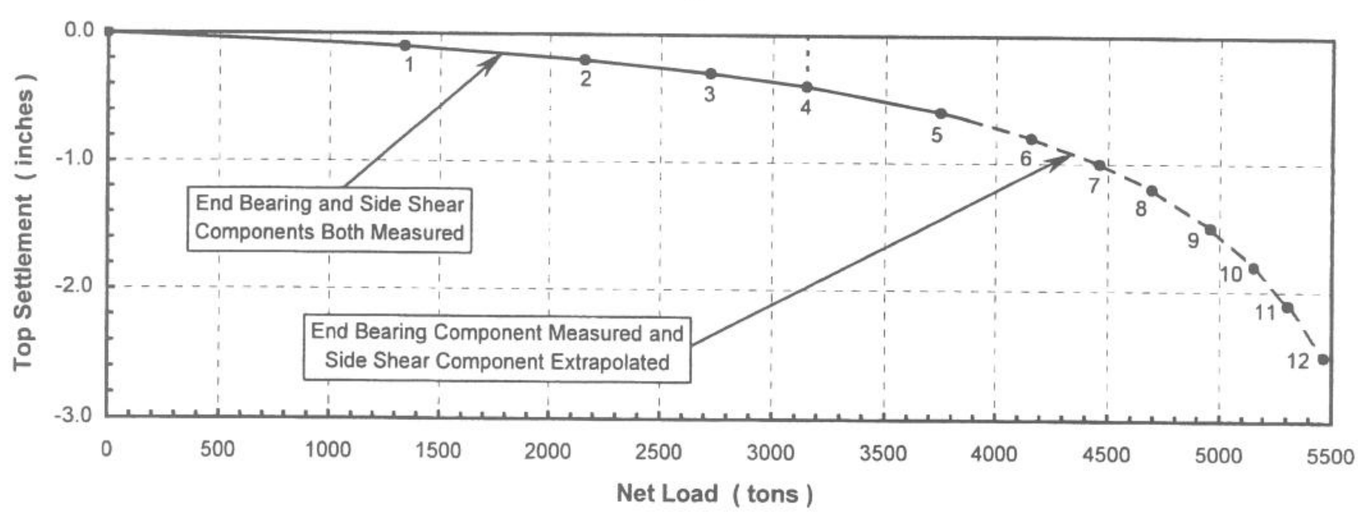


Figure B



LOADTEST, INC.
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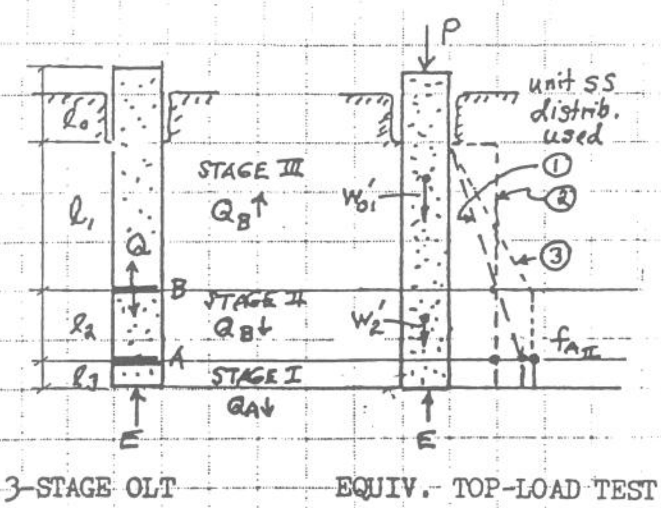
GAINESVILLE, FLORIDA 32606
(352) 378-3717
FAX (352) 378-3934

JOB APPENDIX EXAMPLE SI UNITS
SHEET NO. 5 OF
CALCULATED BY JHS DATE April 98
CHECKED BY DATE
SCALE Using HP41 JHS #185A, "Sd3"

EQUIV. 'RIGID' + SIMPLIFIED ELASTIC COMPRESSION @ TOP PILE IN TLT, FROM 1 & 3 STAGE OLTs

			1-stage test			3-stage test		
01 Avg. for pile	UNITS	Reg.	~~assume~~ ss distr. 1	2	3	1	2	3
perim. p	(m)	02	3.142			3.142		
area A	(m^2)		0.7854			0.7854		
mod. E_p	(MPa)	03	25,000			25,000		
ℓ_0	(m)	04	5			5		
ℓ_1	"	05	20			15		
ℓ_2	"	06	0			5		
02 ℓ_3	"	07	5			5		
buoy wt. W_{01}'	(MN)	09	0.3			0.25		
03 " " W_2'	"	10	0			0.06		
For Δ_i 'rigid'	(mm)		10			10		
$Q_{A_I}\downarrow$	(MN)	15	6			6		
$Q_{B_{II}}\downarrow$	"	13	0			3		
04 $Q_{B_{III}}\uparrow$	"	14	10			7		
05 side shear distrib. 1, 2, 3			1	2	3	1	2	3
elastic δ_{TLT}	(mm)		16.82	15.38	17.68	17.66	15.19	17.24
" δ_{OLT}	"	23	4.23	6.24	4.54	3.19	4.12	3.22
$\Delta\delta$ @ top	"		12.59	9.14	13.14	14.48	11.07	14.02
14 P	(MN)	21	14.92	14.92	14.92	15.16	15.16	15.16
@ $\Delta_i + \Delta\delta$	(mm)		22.6	19.1	23.1	24.5	21.1	24.0
$f_{A_{II}}$	(MPa)	12	0.309	0.154	0.154	0.223	0.195	0.195
E	(MN)	24	0.85	3.28	3.28	2.19	2.63	2.63
F = 0.95		35						



Notes:
1 & 3 stage O-cell test
(if 1, use $Q_{B_{II}}\downarrow = 0$, $\ell_2 = 0$, $W_2' = 0$)

EXAMPLES USING SI UNITS

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JOB APPENDIX EXAMPLES ENGLISH UNITS**
SHEET NO. 6 OF
CALCULATED BY JHS DATE April 98
CHECKED BY DATE
SCALE Using HP41 JHS #185A, "Sd3"

EQUIV. 'RIGID' + SIMPLIFIED ELASTIC COMPRESSION @ TOP PILE IN TLT, FROM 1 & 3 STAGE OLTs

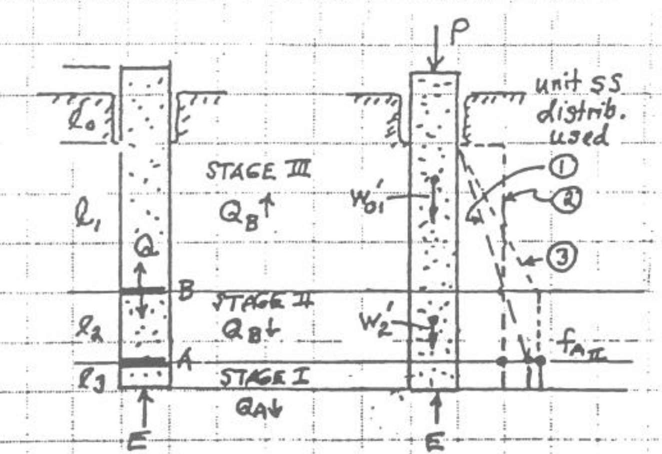
			1-stage test			3-stage test		
01 Avg. for pile	UNITS	Reg.	assume SS distr. 1	2	3	1	2	3
perim. p	(in)	02	124			124		
area A	(in^2)		1,217			1,217		
mod. E_p	(ksi)	03	25,000			25,000		
ℓ_0	(in)	04	197			197		
ℓ_1	"	05	787			591		
ℓ_2	"	06	0			197		
02 ℓ_3	"	07	197			197		
bouy wt. W_{01}'	(kips)	09	75			55		
03 " " W_2'	"	10	0			20		
For Δ_i 'rigid'	(in)		0.40			0.40		
$Q_{A_I}\downarrow$	( )	15	1,350			1,350		
$Q_{B_{II}}\downarrow$	"	13	0			680		
04 $Q_{B_{III}}\uparrow$	"	14	2,250			1,570		
05 side shear distrib. ①, ②, ③			1	2	3	1	2	3
elastic δ_{TLT}	(in)		0.660	0.603	0.694	0.697	0.598	0.679
" δ_{OLT}	"	23	0.166	0.245	0.179	0.125	0.162	0.127
14 $\Delta\delta$ @ top	"		0.494	0.358	0.515	0.571	0.436	0.553
P	(kips)	21	3,341	3,341	3,341	3,414	3,414	3,414
@ $\Delta_i + \Delta\delta$	(in)		0.894	0.758	0.915	0.971	0.836	0.953
$f_{A_{II}}$	(ksf)	12	6.42	3.21	3.21	4.72	4.13	4.13
E	(kips)	24	186	731	731	475	575	575
F = 0.95		35						

Notes:

1 & 3 stage O-cell test

(if 1, use $Q_{B_{II}}\downarrow = 0$, $\ell_2 = 0$, $W_2' = 0$)

**Approx. = to SI example, p. 5



3-STAGE OLT EQUIV.- TOP-LOAD TEST

LOADTEST, INC.
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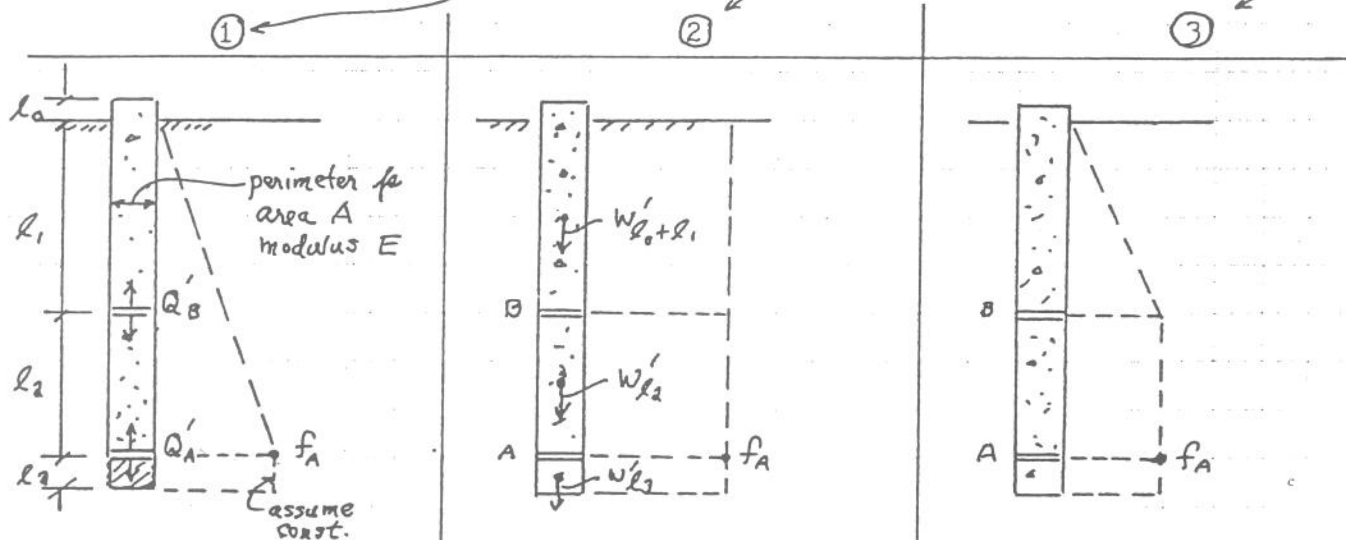
CONSIDER ELASTIC COMPRESSIONS (δ) IN 3-PHASE O-CELL TEST, AND IN EQUIVALENT TOP-LOADED TEST, FOR THREE ASSUMED PATTERNS OF DEVELOPED SIDE SHEAR STRESS



①	②	③	TEST PHASE OR STAGE
$\delta_{\downarrow \ell_3} = \frac{\ell_3}{2AE}\left(E + Q'_A\right)$ wherein $E = Q'_A - f_{A_{II}} p \ell_3$ and from Stage II $f_{A_{II}} = \frac{2(\ell_1+\ell_2)}{2\ell_1+\ell_2}\frac{Q'_{B_{II}}}{p\ell_2}$	→ " $f_{A_{II}} = \frac{Q'_{B_{II}}}{p\ell_2}$	→ " $f_{A_{II}} = \frac{Q'_{B_{II}}}{p\ell_2}$	I $Q'_A\downarrow$ to test ℓ_3 to ult. SS & EB
$\delta_{\ell_2\downarrow} = \frac{1}{3}\left(\frac{3\ell_1+2\ell_2}{2\ell_1+\ell_2}\right)\frac{Q_B\ell_2}{AE}$	$= \frac{1}{2}\left(\frac{Q_B\ell_2}{AE}\right)$	$= \frac{1}{2}\left(\frac{Q_B\ell_2}{AE}\right)$	II $Q'_B\downarrow$ to test ℓ_2 to ult SS
$\delta_{\ell_1\uparrow} = \frac{1}{3}\frac{Q_B\ell_1}{AE}$	$= \frac{1}{2}\left(\frac{Q_B\ell_1}{AE}\right)$	$= \frac{1}{3}\left(\frac{Q_B\ell_1}{AE}\right)$	III $Q'_B\uparrow$ to test ℓ_1 to ult. SS

$\Sigma\delta$ from above = total elastic compression during O-cell test

during phase (stage) I → $Q'_{A\downarrow} = (Q_A - W'_{\ell_0+\ell_1+\ell_2})$
II → $Q'_{B\downarrow} = (Q_B + W'_{\ell_2})$
III → $Q'_B\uparrow = (Q_B - W'_{\ell_0+\ell_1})$

$\left.\begin{matrix} Q_A' \\ Q_B' \end{matrix}\right\}$ = cell load ± corrections for self wt.

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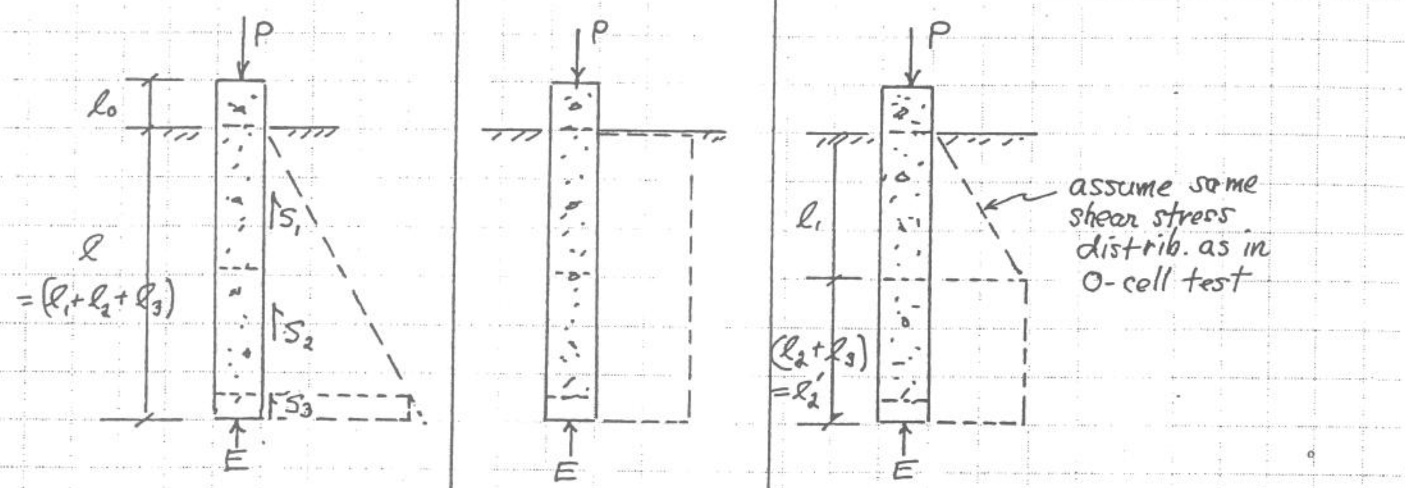
NOW CONSIDER EQUIVALENT TOP-LOADED TESTS:

① ② ③



$$\delta_{0\downarrow} = \frac{P\ell_0}{AE} \longrightarrow \text{"} \longrightarrow \text{"}$$

① $$\delta_\downarrow = \frac{(E+2P)\ell}{3AE}$$

② $$\delta_\downarrow = \frac{(E+P)\ell}{2AE}$$

③ $$\delta_\downarrow = \frac{\ell}{AE}\left[E + \left(\frac{\frac{2}{3}\ell_1^2 + \ell_1\ell_2' + \ell_2'^2}{\ell_1 + 2\ell_2'}\right)\frac{(P-E)}{\ell}\right]$$

$$\Sigma\delta_\downarrow = \delta_{0\downarrow} + \delta_\downarrow$$

note: $P = S_1 + S_2 + S_3 + E$

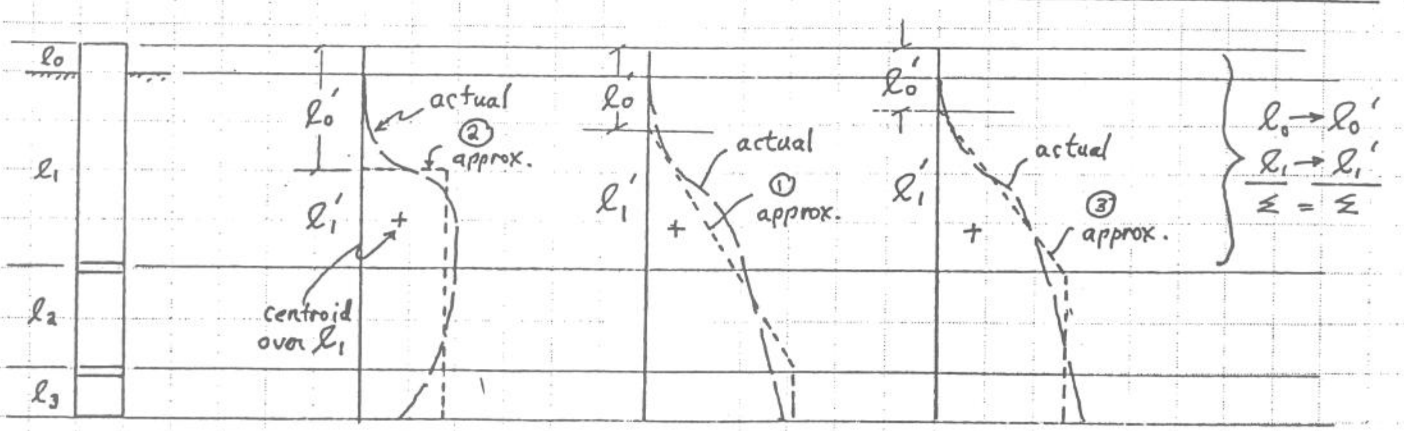
$= Q'_{A\downarrow}$ from phase I

$= Q'_{B\downarrow}$ " " II

$= (-Q_D\uparrow)$ " " III

$\simeq F\,Q'_{B\downarrow}$

EXPANDING THE USEFULNESS OF THE ABOVE 3 SIDE SHEAR PATTERNS BY ARTIFICIALLY INCREASING ℓ_0



APPENDIX D

O-CELL™ METHOD FOR DETERMINING CREEP LIMIT LOADING

O-CELL METHOD FOR DETERMINING A CREEP LIMIT LOADING ON THE EQUIVALENT TOP-LOADED SHAFT

Background: O-cell testing provides a sometimes useful method for evaluating that load beyond which a top-loaded drilled shaft might experience significant unwanted creep behavior. We refer to this load as the "creep limit," also sometimes known as the "yield limit" or "yield load".

To our knowledge, Housel (1959) first proposed the method described below for determining the creep limit. Stoll (1961), Bourges and Levillian (1988), and Fellenius (1996) provide additional references. This method also follows from long experience with the pressuremeter test (PMT). Figure 8 and section 9.4 from ASTM D4719, reproduced below, show and describe the creep curve routinely determined from the PMT. The creep curve shows how the movement or strain obtained over a fixed time interval, 30 to 60 seconds, changes versus the applied pressure. One can often detect a distinct break in the curve at the pressure P_e in Figure 8. Plastic deformations become significant beyond this break loading and progressively more severe creep can occur.

Definition: Similarly with O-cell testing using the ASTM Quick Method, one can conveniently measure the additional movement occurring over the final time interval at each constant load step, typically 2 to 4 minutes. A break in the curve of load vs. movement (as at P_e with the PMT) indicates the creep limit.

We usually indicate such a creep limit in the O-cell test for either one, or both, of the side shear and end bearing components, and herein designate the corresponding movements as M_{CL1} and M_{CL2}. We then combine the creep limit data to predict a creep limit load for the equivalent top loaded shaft.

Procedure if both M_{CL1} and M_{CL2} available: Creep cannot begin until the shaft movement exceeds the M_{CL} values. A conservative approach would assume that creep begins when movements exceed the lesser of the M_{CL} values. However, creep can occur freely only when the shaft has moved the greater of the two M_{CL} values. Although less conservative, we believe the latter to match behavior better and therefore set the creep limit as that load on the equivalent top-loaded movement curve that matches the greater M_{CL}.

Procedure if only M_{CL1} available: If we cannot determine a creep limit in the second component before it reaches its maximum movement M_x, we treat M_x as M_{CL2}. From the above method one can say that the creep limit load exceeds, by some unknown amount, that obtained when using $M_{CL2} = M_x$.

Procedure if no creep limit observed: Then, according to the above, the creep limit for the equivalent top-loaded shaft will exceed, again by some unknown amount, that load on the equivalent curve that matches the movement of the component with the maximum movement.

Limitations: The accuracy in estimating creep limits depends, in part, on the scatter of the data in the creep limit plots. The more scatter, the more difficult to define a limit. The user should make his or her own interpretation if he or she intends to make important use of the creep limit interpretations. Sometimes we obtain excessive scatter of the data and do not attempt an interpretation for a creep limit and will indicate this in the report.

Excerpts from ASTM D4719
"Standard Test Method for Pressuremeter Testing in Soils"

9.4 For Procedure A, plot the volume increase readings (V_{60}) between the 30 s and 60 s reading on a separate graph. Generally, a part of the same graph is used, see Fig. 8. For Procedure B, plot the pressure decrease reading between the 30 s and 60 s reading on a separate graph. The test curve shows an almost straight line section within the range of either low volume increase readings (V_{60}) for Procedure A or low pressure decrease for Procedure B. In this range, a constant soil deformation modulus can be measured. Past the so-called creep pressure, plastic deformations become prevalent.

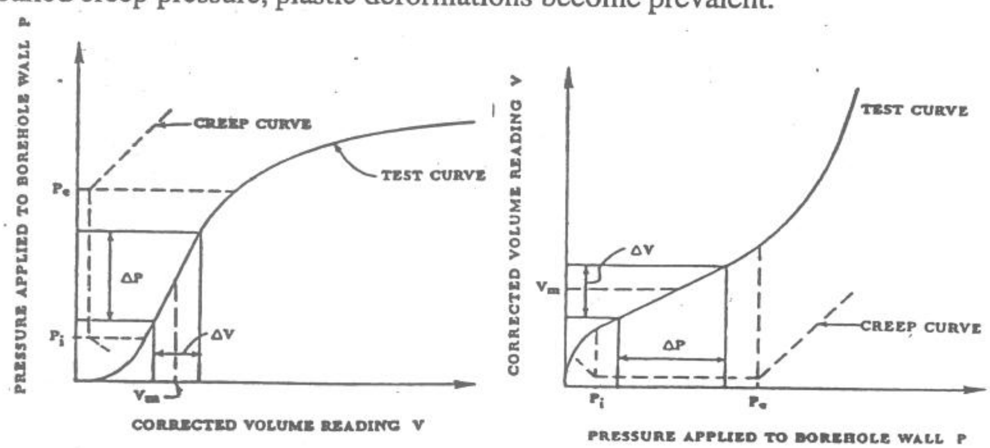


FIG. 8 Pressuremeter Test Curves for Procedure A

References

Housel, W.S. (1959), "Dynamic & Static Resistance of Coshesive Soils" 1846-1959, ASTM STP 254, pp. 22-23.

Stoll, M.U.W. (1961, Discussion, Proc. 3rd ICSMFE, Paris, Vol. III, pp. 279-281.

Bourges, F. and Levillian, J-P (1988), "force portante des rideaux plans metalliques charges verticalmement," Bull. No. 158, Nov.-Dec., des laboratoires des ponts et chaussees, p. 24.

Fellenius, Bengt H. (1966), Basics of Foundation Design, BiTech Publishers Ltd., p.79.

APPENDIX E

HYPERBOLIC CURVE FITTING

Hyperbolic Curve Fit

Multi Level Test Shaft - Missouri River Bridge - Lexington, MO

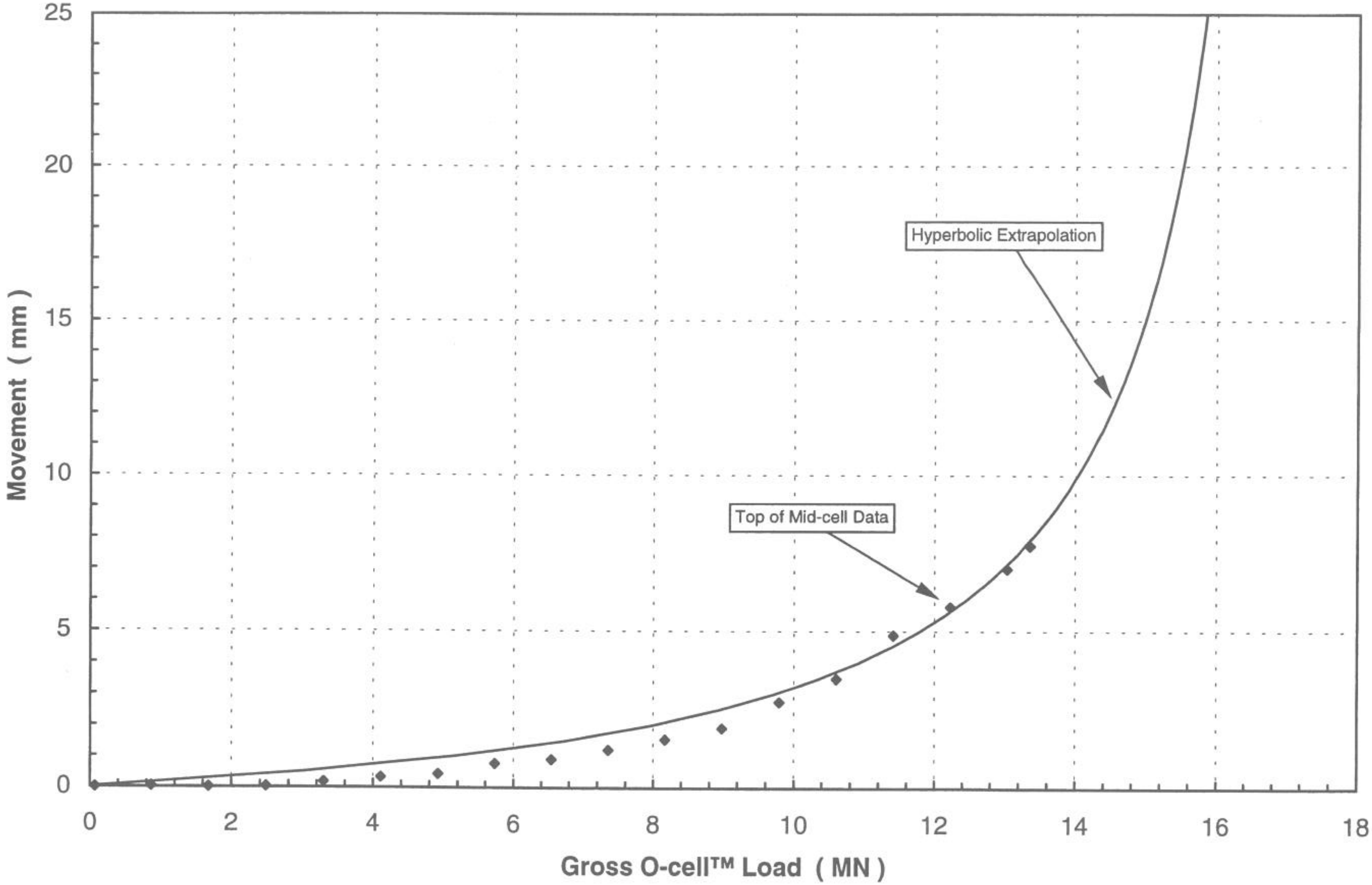
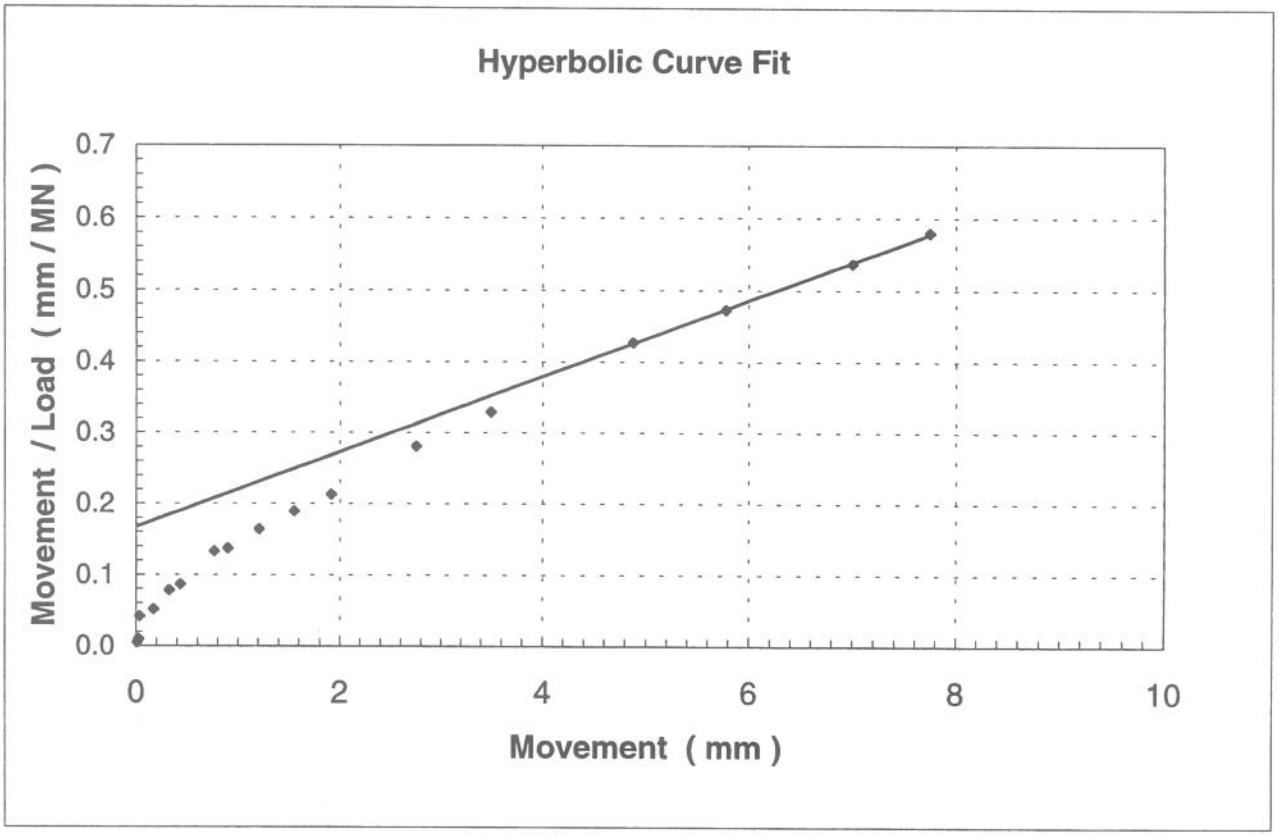


Figure E-1

Table E-1: Hyperbolic Curve Fit of Upward Top of Mid-cell Movement

Net Load (MN)	Gross Load (MN)	Up* (mm)	Y_u* (mm / MN)	$Y_{u\ calc}$ (mm / MN)	Gross $Load_{calc}$ (MN)
0.00	0.00	0.00	-	-	-
0.79	0.86	0.04	0.041	0.169	0.21
1.60	1.67	0.01	0.005	0.168	0.05
2.42	2.49	0.02	0.010	0.169	0.15
3.23	3.30	0.17	0.051	0.176	0.96
4.04	4.11	0.32	0.078	0.184	1.74
4.85	4.92	0.43	0.087	0.190	2.25
5.66	5.73	0.76	0.133	0.208	3.67
6.47	6.54	0.90	0.137	0.215	4.18
7.29	7.35	1.21	0.164	0.231	5.22
8.10	8.17	1.55	0.190	0.249	6.21
8.91	8.98	1.91	0.213	0.269	7.12
9.72	9.79	2.75	0.281	0.313	8.78
10.53	10.60	3.49	0.330	0.353	9.91
11.34	11.41	**4.87**	**0.427**	0.426	11.44
12.15	12.22	**5.78**	**0.473**	0.474	12.19
12.97	13.04	**7.00**	**0.537**	0.539	12.99
13.29	13.36	**7.75**	**0.580**	0.578	13.40

* Values in **bold** are used in the curve fit.



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.999703724
R Square	0.999407536
Adjusted R Sq	0.999111304
Standard Error	0.002018295
Observations	4

ANOVA

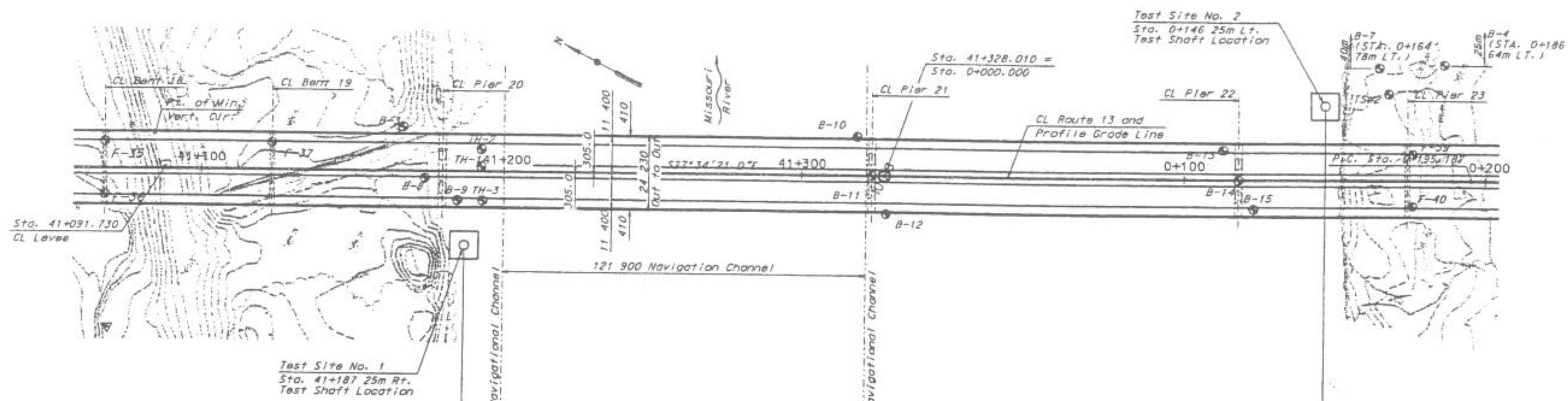
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.013742955	0.013742955	3373.733604	0.000296276
Residual	2	8.14703E-06	4.07352E-06		
Total	3	0.013751102			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.16722658	0.005886844	28.40682884	0.001236939	0.141897516	0.192555645	0.141897516	0.192555645
X Variable 1	0.053058438	0.00091348	58.08384977	0.000296276	0.049128048	0.056988828	0.049128048	0.056988828

APPENDIX F

SOIL BORING AND SHAFT CALIPER LOGS

STATE	PROJECT NO.	SHEET NO.
MO		



PLAN
NTS

Notes:

As-drilled boring location.

See Sheet 4 for Test Site Layouts.

Notice and Disclaimer Regarding Boring Log Data

The locations of all subsurface borings in the vicinity of the test sites are shown on the plans. Boring data for selected borings are shown on Sheet Nos. 5 and 6. The boring logs for the selected borings as well as any other boring logs or other factual records of subsurface data and investigations performed by the Department for Engineer are available upon written request as outlined in the Job Special Provisions. No greater significance or weight should be given to the boring log data depicted on the plan sheets than subsurface data available from the district or elsewhere.

The Commission does not represent or warrant that any such boring data accurately depicts the conditions to be encountered in constructing this project. The Contractor assumes all risks it may encounter in basing its bid prices, time or schedule of performance on the boring data depicted here or those available from the district, or any other documentation not expressly warranted, which the Contractor may obtain from the Commission.

10-8-98

TEST SITE LOCATIONS

RAY/LAFAYETTE COUNTY

A-5664

DETAILED AUG 1998
CHECKED OCT 1998

HNTB

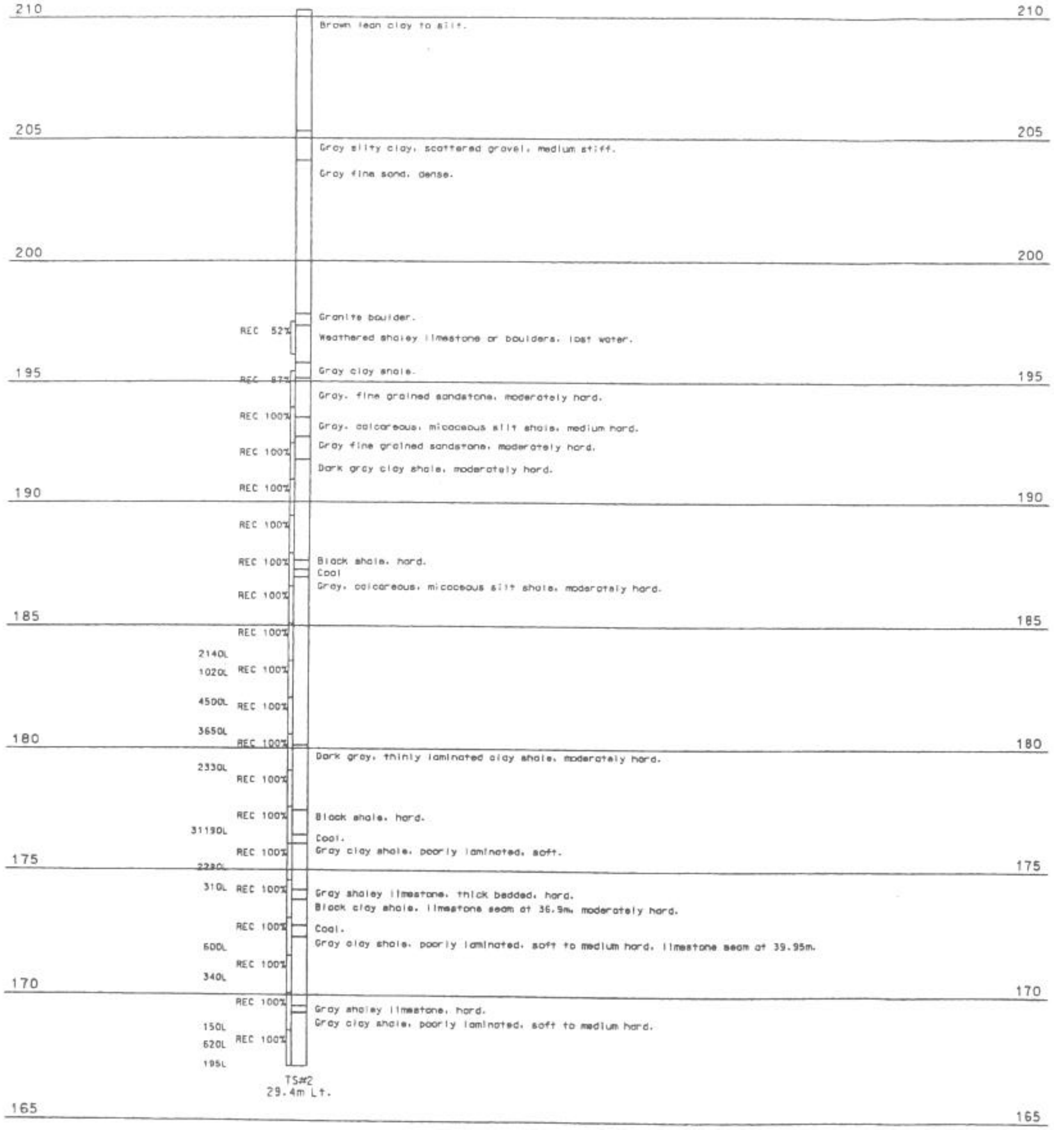
NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS.

SHEET NO. 3 OF 6.

24355

TThompson
PLOTTED: 08-OCT-1998 10:39 k:\b24355\loadtest\l4.dgn

STATE	PROJECT NO.	SHEET NO.
MO		



NOTES:

1. For Notes and Typical Boring, see sheet number 6.

NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS.

DETAILED	SEPT 1998	HNTB
CHECKED	OCT 1998	

SHEET NO. 7 OF 8.

SUBSURFACE INFORMATION (2), SITE NO. 2

RAY/LAFAYETTE COUNTY

A-5664

10-8-98

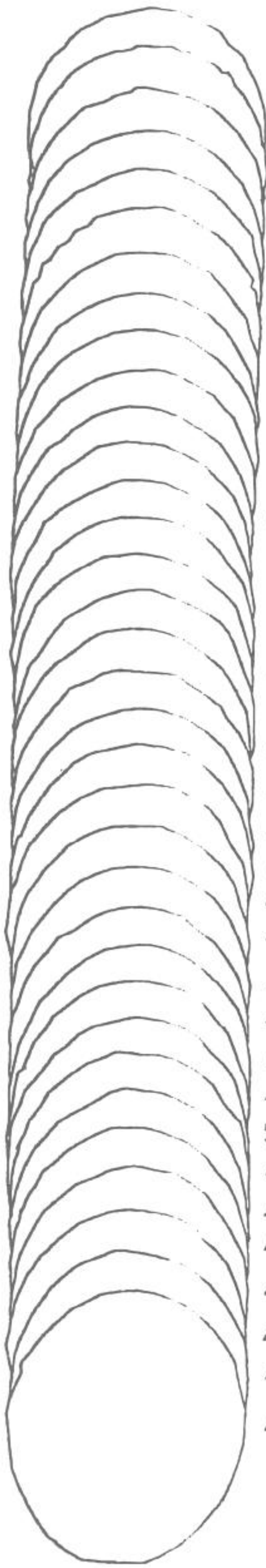
24355

Tlhompsorw PLOTTED: 08-OCT-1998 10:42 k:\b24355\loadtest\17a.dgn

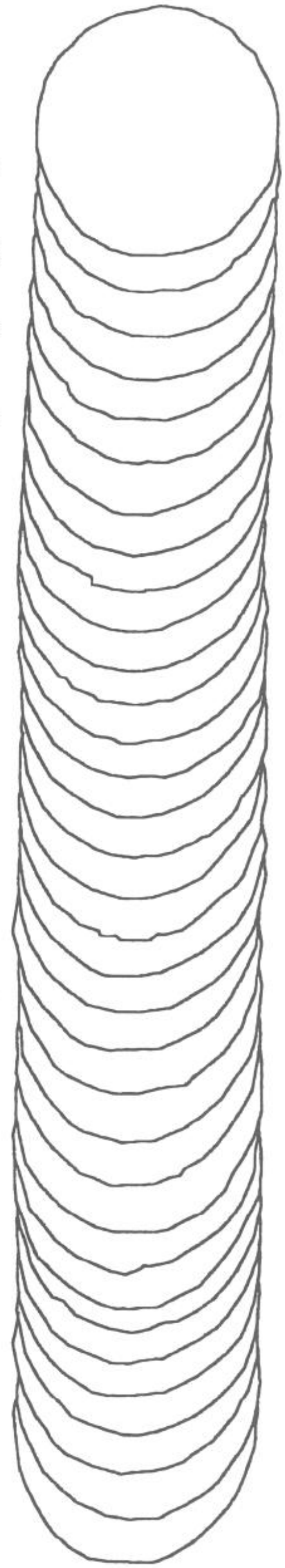
Massman Construction
Missouri River - South Bore
81 Feet to 98 Feet

April 1999

Top Casing 210.92



42.84 Diameter	-	81 Feet
43.08 Diameter	-	81.5 Feet
42.72 Diameter	-	82 Feet
43.20 Diameter	-	82.5 Feet
43.20 Diameter	-	83 Feet
42.96 Diameter	-	83.5 Feet
43.20 Diameter	-	84 Feet
43.20 Diameter	-	84.5 Feet
43.20 Diameter	-	85 Feet
43.20 Diameter	-	85.5 Feet
43.32 Diameter	-	86 Feet
43.44 Diameter	-	86.5 Feet
43.20 Diameter	-	87 Feet
43.20 Diameter	-	87.5 Feet
43.20 Diameter	-	88 Feet
43.20 Diameter	-	88.5 Feet
43.20 Diameter	-	89 Feet
43.44 Diameter	-	90 Feet
43.68 Diameter	-	90.5 Feet
43.44 Diameter	-	91 Feet
43.44 Diameter	-	91.5 Feet
47.28 Diameter	-	92 Feet
47.52 Diameter	-	92.5 Feet
47.88 Diameter	-	93 Feet
49.20 Diameter	-	93.5 Feet
49.68 Diameter	-	94 Feet
50.40 Diameter	-	94.5 Feet
48.72 Diameter	-	95 Feet
47.04 Diameter	-	95.5 Feet
46.08 Diameter	-	96 Feet
46.44 Diameter	-	96.5 Feet
45.84 Diameter	-	97 Feet
46.56 Diameter	-	97.5 Feet
46.80 Diameter	-	98 Feet



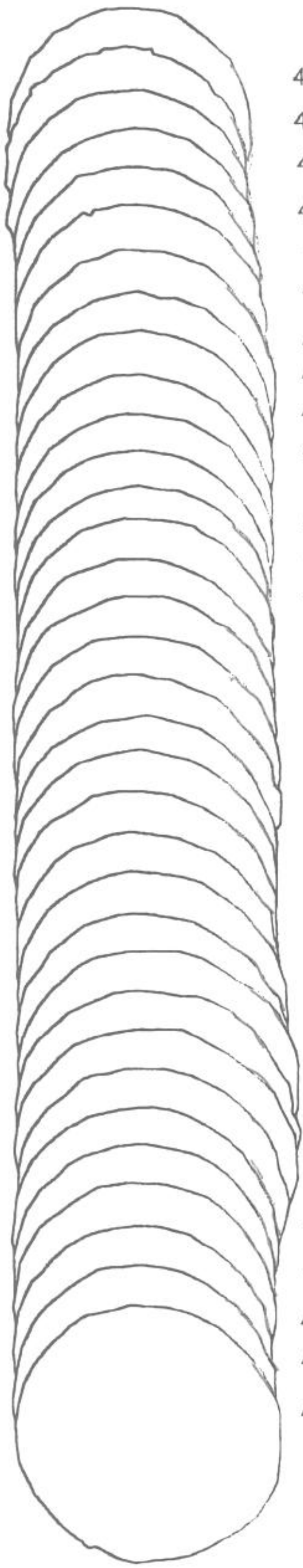
Front Vi

R&R Visual, Inc.
1828 West Olson Road
Rochester, IN 46975
(800)776-5653

Back View

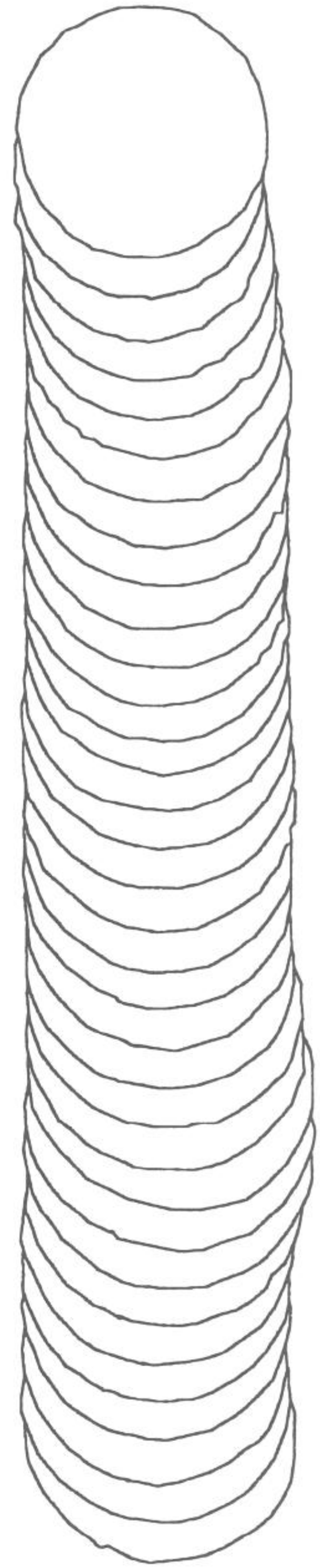
April 1999

Massman Construction
Missouri River - South Bore
81 Feet to 98 Feet



Left View

42.84 Diameter - 81 Feet
43.08 Diameter - 81.5 Feet
42.72 Diameter - 82 Feet
43.20 Diameter - 82.5 Feet
43.20 Diameter - 83 Feet
42.96 Diameter - 83.5 Feet
43.20 Diameter - 84 Feet
43.20 Diameter - 84.5 Feet
43.20 Diameter - 85 Feet
43.20 Diameter - 85.5 Feet
43.32 Diameter - 86 Feet
43.44 Diameter - 86.5 Feet
43.20 Diameter - 87 Feet
43.20 Diameter - 87.5 Feet
43.20 Diameter - 88 Feet
43.20 Diameter - 88.5 Feet
43.20 Diameter - 89 Feet
43.44 Diameter - 90 Feet
43.68 Diameter - 90.5 Feet
43.44 Diameter - 91 Feet
43.44 Diameter - 91.5 Feet
47.28 Diameter - 92 Feet
47.52 Diameter - 92.5 Feet
47.88 Diameter - 93 Feet
49.20 Diameter - 93.5 Feet
49.68 Diameter - 94 Feet
50.40 Diameter - 94.5 Feet
48.72 Diameter - 95 Feet
47.04 Diameter - 95.5 Feet
46.08 Diameter - 96 Feet
46.44 Diameter - 96.5 Feet
45.84 Diameter - 97 Feet
46.56 Diameter - 97.5 Feet
46.80 Diameter - 98 Feet



Right View

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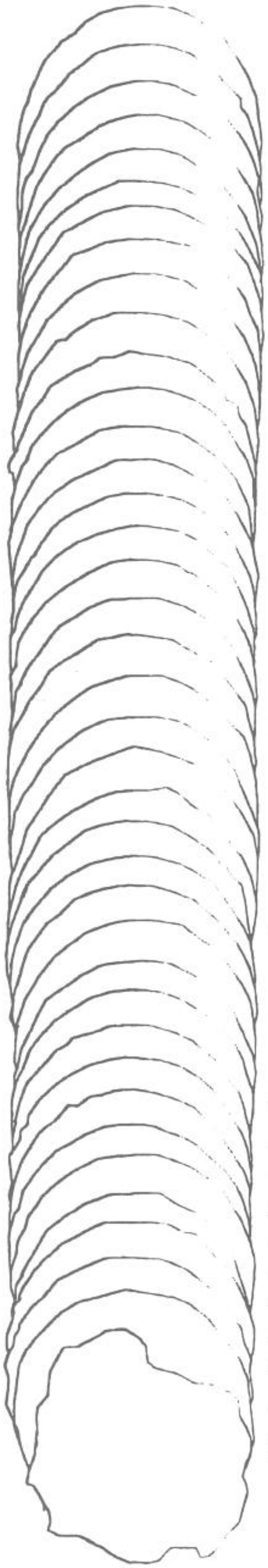
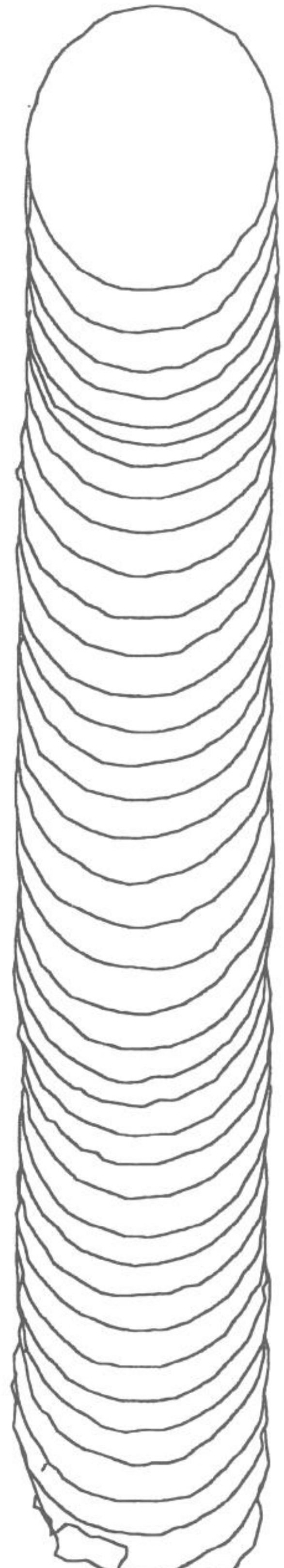
April 1999

Massman Construction
Missouri River - South Bore
98.5 Feet to 117.5 Feet (Bottom)



49.44 Diameter - 98.5 Feet
49.68 Diameter - 99 Feet
50.16 Diameter - 99.5 Feet
48.00 Diameter - 100 Feet
49.32 Diameter - 100.5 Feet
44.64 Diameter - 101 Feet
44.16 Diameter - 101.5 Feet
44.76 Diameter - 102 Feet
44.64 Diameter - 102.5 Feet
45.12 Diameter - 103 Feet
45.48 Diameter - 103.5 Feet
46.44 Diameter - 104 Feet
45.96 Diameter - 104.5 Feet
45.72 Diameter - 105 Feet
45.60 Diameter - 105.5 Feet
45.84 Diameter - 106 Feet
46.20 Diameter - 106.5 Feet
47.40 Diameter - 107 Feet
48.84 Diameter - 107.5 Feet
48.24 Diameter - 108 Feet
49.80 Diameter - 108.5 Feet
48.96 Diameter - 109 Feet
47.64 Diameter - 109.5 Feet
46.32 Diameter - 110 Feet
45.48 Diameter - 110.5 Feet
45.72 Diameter - 111 Feet
45.24 Diameter - 111.5 Feet
44.40 Diameter - 112 Feet
43.80 Diameter - 112.5 Feet
44.40 Diameter - 113 Feet
44.04 Diameter - 113.5 Feet
43.92 Diameter - 114 Feet
44.40 Diameter - 114.5 Feet
43.80 Diameter - 115 Feet
44.40 Diameter - 115.5 Feet
44.16 Diameter - 116 Feet
44.88 Diameter - 116.5 Feet
43.68 Diameter - 117 Feet
39.48 Diameter - 117.5 Feet



Front Vi

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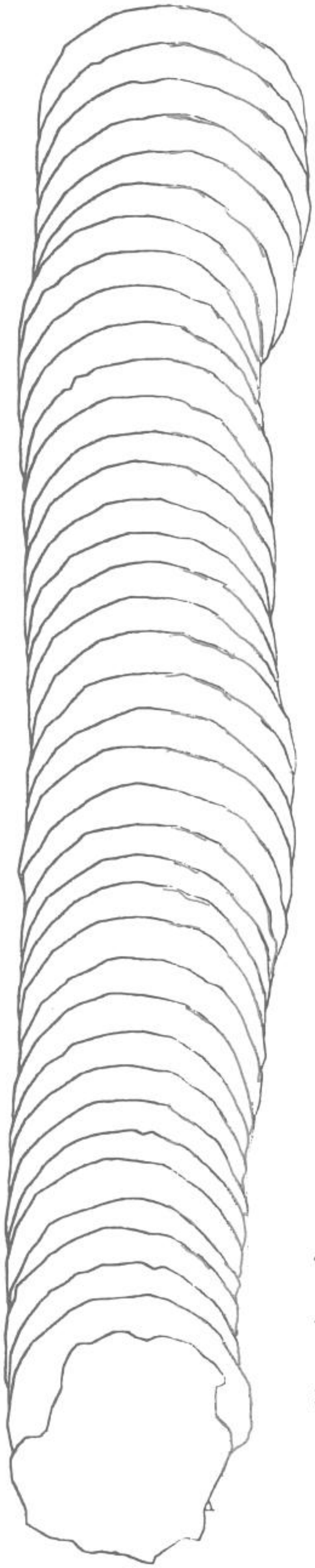
Back View

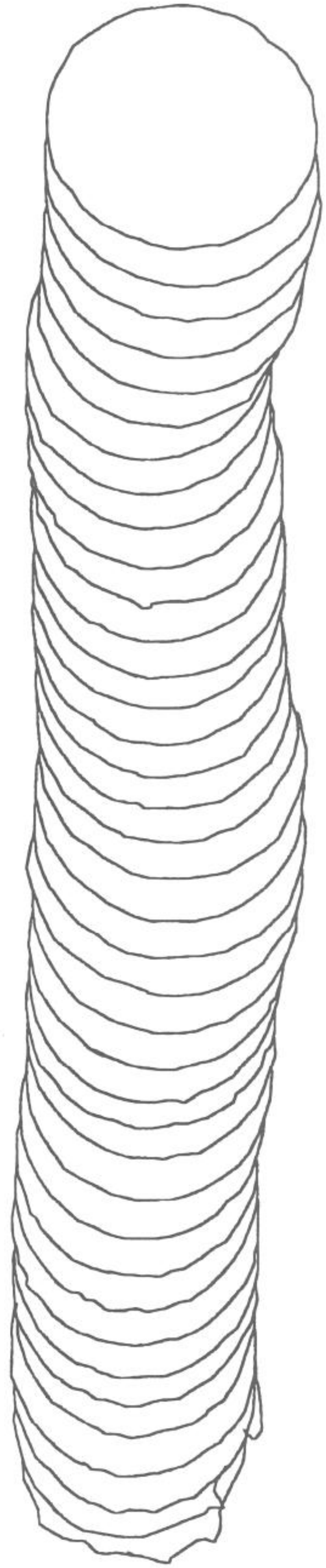
April 1999

Massman Construction
Missouri River - South Bore



Left View

49.44 Diameter - 98.5 Feet
49.68 Diameter - 99 Feet
50.16 Diameter - 99.5 Feet
48.00 Diameter - 100 Feet
49.32 Diameter - 100.5 Feet
44.64 Diameter - 101 Feet
44.16 Diameter - 101.5 Feet
44.76 Diameter - 102 Feet
44.64 Diameter - 102.5 Feet
45.12 Diameter - 103 Feet
45.48 Diameter - 103.5 Feet
46.44 Diameter - 104 Feet
45.96 Diameter - 104.5 Feet
45.72 Diameter - 105 Feet
45.60 Diameter - 105.5 Feet
45.84 Diameter - 106 Feet
46.20 Diameter - 106.5 Feet
47.40 Diameter - 107 Feet
48.84 Diameter - 107.5 Feet
48.24 Diameter - 108 Feet
49.80 Diameter - 108.5 Feet
48.96 Diameter - 109 Feet
47.64 Diameter - 109.5 Feet
46.32 Diameter - 110 Feet
45.48 Diameter - 110.5 Feet
45.72 Diameter - 111 Feet
45.24 Diameter - 111.5 Feet
44.40 Diameter - 112 Feet
43.80 Diameter - 112.5 Feet
44.40 Diameter - 113 Feet
44.04 Diameter - 113.5 Feet
43.92 Diameter - 114 Feet
44.40 Diameter - 114.5 Feet
43.80 Diameter - 115 Feet
44.40 Diameter - 115.5 Feet
44.16 Diameter - 116 Feet
44.88 Diameter - 116.5 Feet
43.68 Diameter - 117 Feet
39.48 Diameter - 117.5 Feet



Right View

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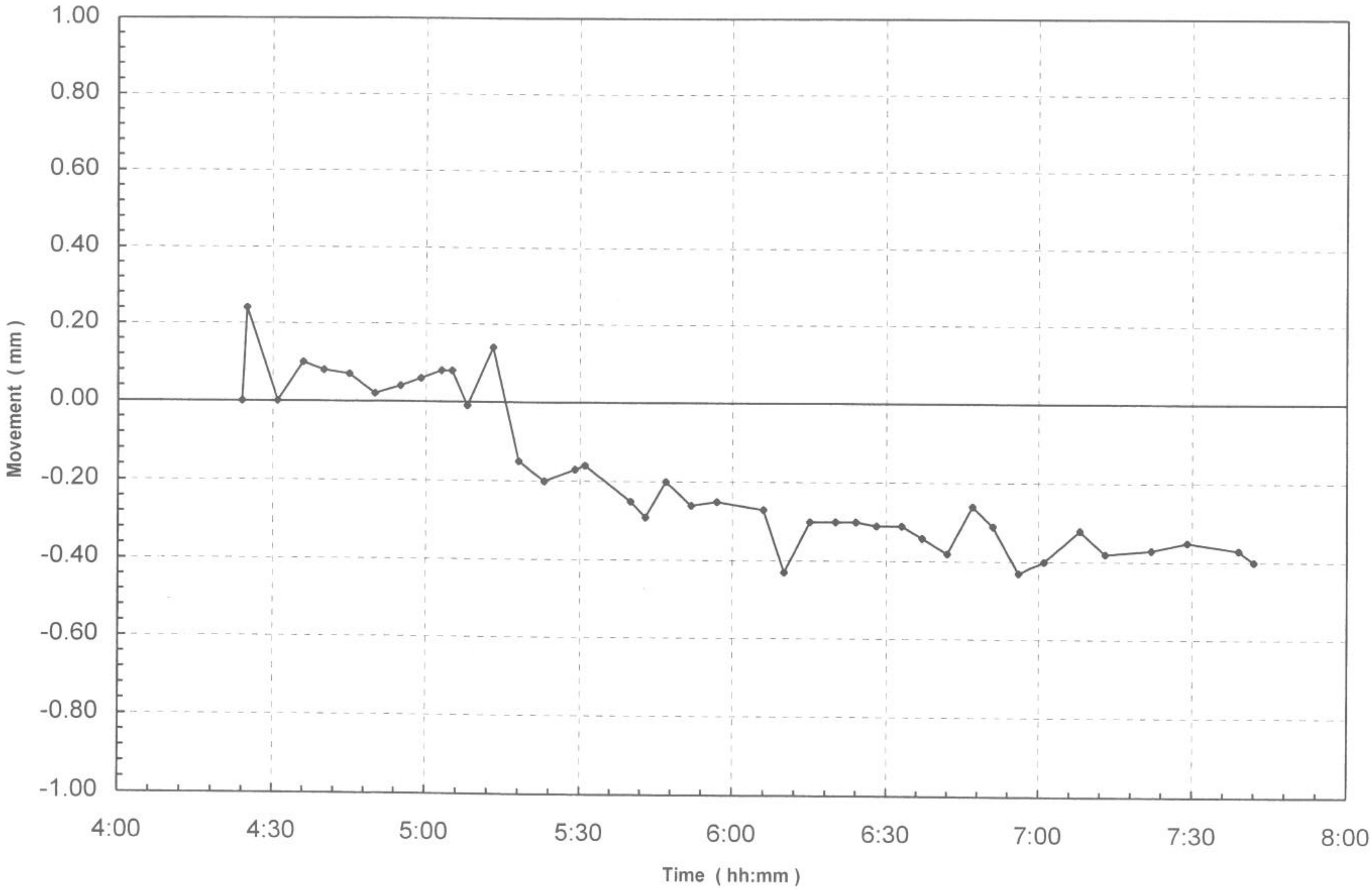
APPENDIX G

REFERENCE BEAM MONITORING

Reference Beam Monitoring

Test Shaft @ Sta. 0+146 25m Lt. - Missouri River Bridge - Lexington, MO



Reference Beam Monitoring, Test Shaft at Sta. 0+146, 25m Lt.

Time (hh:mm:ss)	Reference Beam (m)
4:24	0.10975
4:25	0.10999
4:31	0.10975
4:36	0.10985
4:40	0.10983
4:45	0.10982
4:50	0.10977
4:55	0.10979
4:59	0.10981
5:03	0.10983
5:05	0.10983
5:08	0.10974
5:13	0.10989
5:18	0.10960
5:23	0.10955
5:29	0.10958
5:31	0.10959
5:40	0.10950
5:43	0.10946
5:47	0.10955
5:52	0.10949
5:57	0.10950
6:06	0.10948
6:10	0.10932
6:15	0.10945
6:20	0.10945
6:24	0.10945
6:28	0.10944
6:33	0.10944
6:37	0.10941
6:42	0.10937
6:47	0.10949
6:51	0.10944
6:56	0.10932
7:01	0.10935
7:08	0.10943
7:13	0.10937
7:22	0.10938
7:29	0.10940
7:39	0.10938
7:42	0.10935
7:52	0.10934

Note: Increasing values indicate downward reference beam movement.
Measurements made with a Leika NA 3003 Digital Level.