MONITORING OF SOIL NAILED WALLS AT THE HIGHWAY 217 AND HIGHWAY 26 INTERCHANGE FINAL REPORT

STATE PLANNING AND RESEARCH PROJECT 370

by

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16. Abstract

Soil nailing is an innovative and cost effective technique that has received increased attention in recent years. Engineers faced with the challenge of retrofitting and maximizing the use of existing structures, minimizing new construction cost, and increasing usable space within existing rights-of-way have found that soil nail walls provide a flexible and cost-effective solution in many cases. However, the geotechnical engineering community's understanding of the behavior of soil nail walls, especially under unique loading conditions, is still somewhat limited. As additional field data becomes available, engineers will achieve a better understanding of soil nail wall performance under a variety of loading conditions and configurations. This report summarizes the results of a soil nail wall research project completed by the Oregon Department of Transportation (ODOT).

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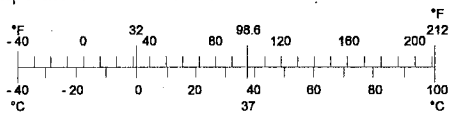
SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	Millimeters	Mm
ft	feet	0.305	Meters	M
yd	yards	0.914	Meters	M
mi	miles	1.61	Kilometers	Km
		AREA		
in^2	square inches	645.2	Millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	Hectares	Ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	Milliliters	ML
gal	gallons	3.785	Liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
oz	ounces	28.35	Grams	G
lb	pounds	0.454	Kilograms	Kg
T	short tons (2000 lb)	0.907	Megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
Mm	millimeters	0.039	inches	in
M	meters	3.28	feet	ft
M	meters	1.09	yards	yd
Km	kilometers	0.621	miles	mi
		AREA		
Mm^2	millimeters squared	0.0016	square inches	in^2
M^2	meters squared	10.764	square feet	ft^2
Ha	hectares	2.47	acres	ac
Km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
ML	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
M^3	meters cubed	35.315	cubic feet	ft^3
M^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
G	grams	0.035	ounces	oz
Kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8 + 32	Fahrenheit	°F



* SI is the symbol for the International System of Measurement

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MONITORING OF SOIL NAILED WALLS AT THE HIGHWAY 217 AND HIGHWAY 26 INTERCHANGE
FINAL REPORT

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1.0 INTRODUCTION

Soil nailing is an innovative and cost effective technique that has received increased attention in recent years. Engineers faced with the challenge of retrofitting and maximizing the use of existing structures, minimizing new construction cost, and increasing usable space within existing rights-of-way have found that soil nail walls provide a flexible and cost-effective solution in many cases. However, the geotechnical engineering community's understanding of the behavior of soil nail walls, especially under unique loading conditions, is still somewhat limited. As additional field data becomes available, engineers will achieve a better understanding of soil nail wall performance under a variety of loading conditions and configurations. This report summarizes the results of a soil nail wall research project completed by the Oregon Department of Transportation (ODOT).

The walls were constructed as part of interchange improvements and construction of a light rail corridor for the Cedar Hills Blvd Interchange-SW 76th Ave. Section of Contract C11394, (Bridge No. 17402). The two walls selected for study are located at the interchange of Highway 26 with Highway 217 in Beaverton, Oregon, west of Portland, as shown on the Vicinity Map, Figure 1.1. Both walls support heavy surcharge loads. One wall (Segment A of Wall 13) is located beneath an overcrossing bridge abutment, a common application for soil nail walls where additional usable width is required under a crossing. The second wall selected for study (Segment C of Wall 14) supports a fill constructed with a mechanically stabilized earth (MSE) wall used to widen an existing embankment.

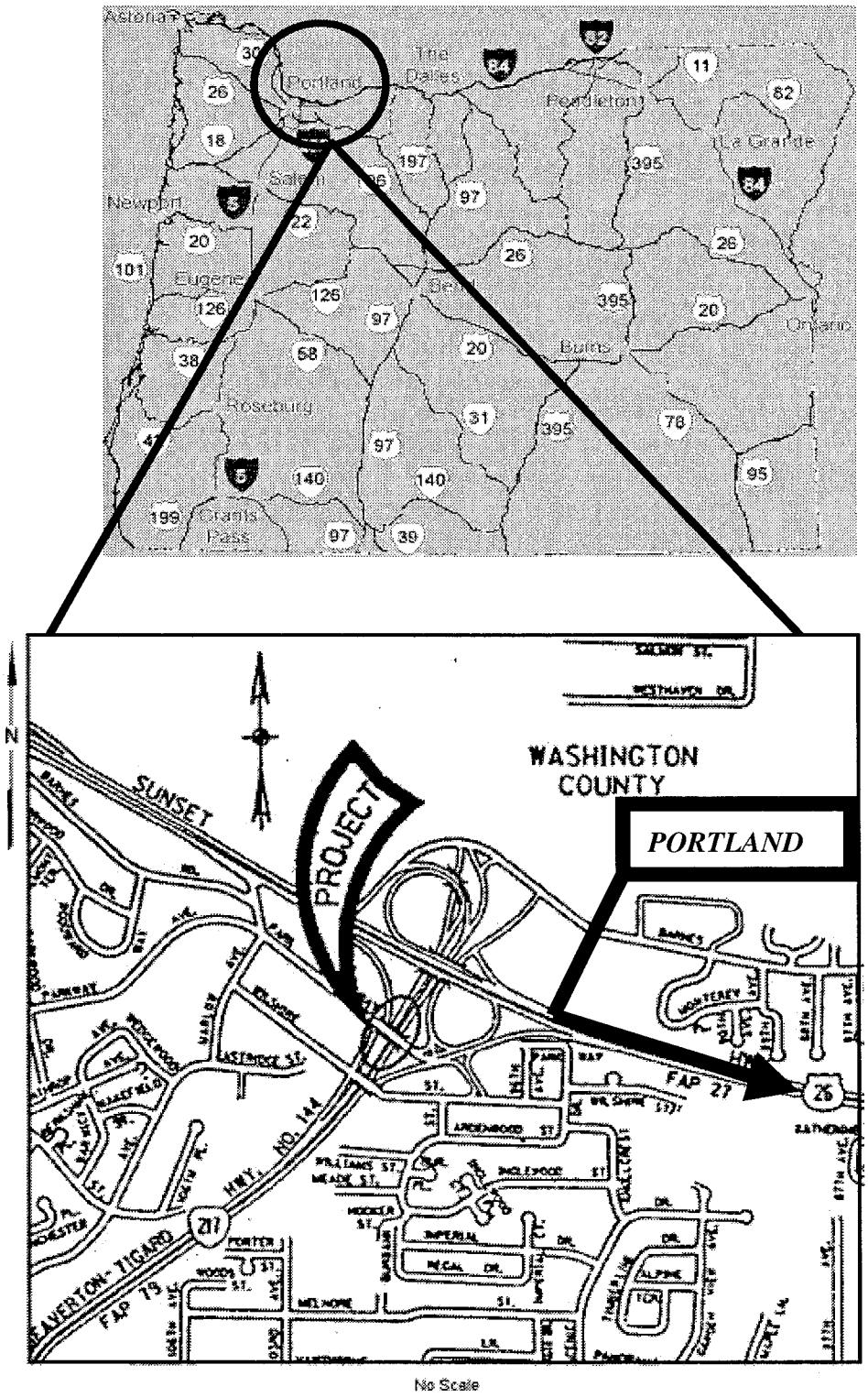


Figure 1.1: Vicinity Map

2.0 RESEARCH STUDY DESCRIPTION

This study was initiated in July 1994 in order to investigate the development of soil nail loading and the lateral movement of the wall and retained earth, both during and after construction of two heavily surcharged soil nail walls. Specifically, the original objectives of the research project were to:

- Determine the influence and effects of a large, bridge spread footing, which is located immediately behind the top of the wall, on the forces in the soil nails and the resulting loads and displacement at the wall face.

- Better the understanding of the effect of prestressing the top row of soil nails on limiting wall displacement, and the compatibility of this procedure with the limit equilibrium design method commonly used for designing soil nail walls.

- Evaluate the influence of an MSE wall surcharge, constructed on top of a soil nail wall, on the forces in the soil nails and the resulting loads and displacement at the wall face.

- Determine the magnitude of stress transfer between the soil-grout interface and the soil nail, and attempt to identify a stress transfer mechanism.

- Verify design assumptions made during the design process to optimize future designs.

A detailed instrumentation plan was formulated in order to accomplish the above objectives. However, due to difficulties during installation (including instrument deletion, instrument failure, and/or instrument disturbance), wall construction, monitoring, and documentation, not all of the original project objectives can be fulfilled. Study objectives were re-evaluated and revised prior to preparation of this report. This report presents and describes the study, summarizes analyses and interpretation of collected data, evaluates the original design assumptions, discusses the overall performance of the soil nail walls, and makes recommendations for the design of future surcharged soil nail walls.

3.0 GEOLOGIC AND SOIL CONDITIONS

Subsurface soil and groundwater conditions were explored within the study area as part of the geotechnical investigation for the interchange/light rail project. Exploration logs, laboratory test results, subsurface profiles, and a comprehensive lithographic description are contained in a geology report produced by ODOT (*D'Agnese 1992*) for the interchange project and are not duplicated in this report. Five test holes; WC1-D112, WC1-IN3, WC1-D102, WC1-D103, and WC1-D104; are located in the vicinity of the study area. Their approximate locations are shown on the Site Plans, Figures 3.1 and 3.2, and the exploration logs for these test holes are included in Appendix A.

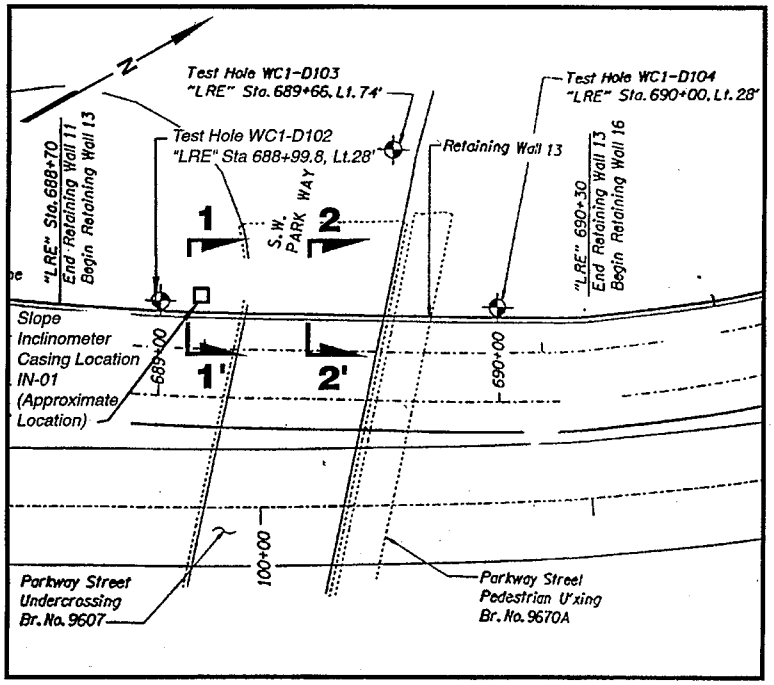


Figure 3.1: Site plan for Wall 13

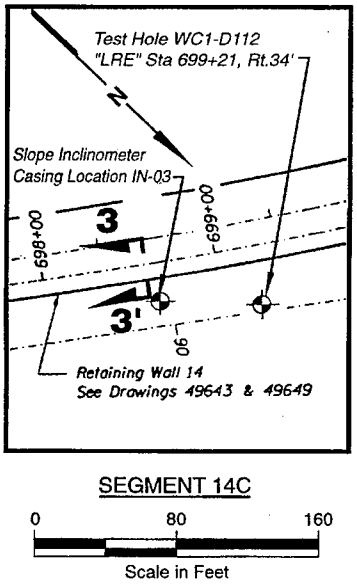


Figure 3.2: Site plan for Wall 14

The exploration logs and laboratory testing results were used to define soil profiles along the wall alignments and to determine appropriate soil parameters for design. The local lithology is summarized below.

Four soil and rock units are present in the study area: 1) Fill; 2) Portland Hills Silt (PHS); 3) Boring Lava Rubble (BLR); and 4) Boring Lava Basalt. Fill, where present, is associated with approach embankments for the Parkway Street bridge, the eastbound Highway 26 to southbound Highway 217 ramp adjacent to the rail corridor, and subgrade for the rail line. Reliable geotechnical engineering data on the fill are limited due to its variable nature. It appears that none of the soil nails were installed in fill zones. Except for the fill density (surcharge loading), the geotechnical parameters of the fill material are not especially relevant.

Except where fill is present, the PHS is the uppermost lithologic layer in the area. Geologic mapping of the PHS indicates that it is probably a deposit of loess (windblown silt) derived from the Columbia basin east of the Cascade Range (*Baldwin 1981; Yeats, Graven, et al. 1991*). This material is medium stiff, becoming softer with elevated moisture contents and landslide prone when saturated (*Madin 1990*). The PHS is most often classified as silt (ML) or borderline silt-clay (ML-CL) of low plasticity in the Unified Soil Classification System (USCS). Based on available laboratory testing results, the PHS has an average moist unit weight of 115 pounds per cubic ft (pcf) and an average moisture content of 28 percent. The average liquid limit and plasticity index values are 33 and 12, respectively, which actually classifies as a clay of low plasticity (CL) in the USCS. Typical strength parameters are a friction angle of 35 degrees, cohesion of 100 pounds per square ft (psf), and undrained shear strength of 800 to 1200 psf. The PHS is typically overconsolidated with an overconsolidation ratio of up to 4 or 5. Standard Penetration Test blow counts range from about 6 to 15. Where clay-like material underlies the PHS, groundwater tends to perch on top of the clay and rise into the PHS during the wet season. The regional groundwater table is well below the bottom of the walls.

Rock encountered in the explorations consists of gray basalt and basalt andesite flows, locally termed the Boring Lava geologic unit. The Boring Lava flows typically display blocky to columnar jointing (*Madin 1990; Yeats, Graven, et al. 1991*). Joint spaces ranging from 4 inches to over 3 ft were noted during drilling. The BLR is a layer of weathered Boring Lava Basalt ranging from about 3 to 5.5 ft thick and the contact between the BLR and the overlying PHS is very irregular. It consists of cobbles to large boulders in a clay-like silt matrix that becomes sandier with depth. Large voids are present in some areas. Slopes excavated in the Boring Lava and BLR typically have a rough, irregular appearance as overexcavated pockets are formed due to the rock jointing or where boulders are pulled out. Reportedly, it is difficult to distinguish between the BLR and the underlying basalt during exploration drilling because of the bouldery nature of the BLR layer. Laboratory test data for the BLR essentially consists of moisture content results, since the nature of this unit does not lend itself to standard geotechnical index testing. The assumed engineering properties for the BLR are a unit weight of 120 pcf, a friction angle of 38 degrees, and a cohesion value of 150 psf. Actual average strength values are probably higher, but conservative values were assumed due to the variable quality of the BLR and the inherent uncertainties of the contact between the BLR and the PHS. Soil nails could be undersized if the contact is lower than assumed.

The soil properties used in design are summarized in Table 3.1.

Table 3.1: Design Soil Values

PARAMETER	Fill[a]	Portland Hills Silt (PHS)	Boring Lava Rubble (BLR)
Unit Weight	Segment 13A: 115 pcf Segment 14C: 110 pcf	115 pcf	120 pcf
Cohesion	10 psf	100 psf	150 psf
Friction Angle	30 degrees	35 degrees	38 degrees
Ultimate Adhesion	Segment 13A: 3770 lb/lf Segment 14C: 6283 lb/lf	3140 lb/lf	7000 lb/lf
Grout hole diameter	12 inches	12 inches	6 inches
Ultimate Bond Stress[b]	Segment 13A: 8.33 psi Segment 14C: 13.9 psi	6.94 psi	30.95 psi

(a) No nails were installed in the fill; therefore, the ultimate adhesion, grout hole diameter, and ultimate bond stress values were not used for designing the soil nails.

(b) Ultimate bond stress equals the ultimate adhesion divided by the soil nail surface area per unit length; surface area based on the listed grout hole diameter.

4.0 PROJECT CONFIGURATION

Monitoring instruments were installed at three soil nail wall sections for this study. Wall Section 1 and Wall Section 2 are located along Segment 13A at project stationing 689+10 and 689+45, respectively. Wall Section 3 is located along Segment 14C at project stationing 698+60. The locations of the project sections are shown by the numbered arrows on the Site Plans, Figures 3.1 and 3.2, on page 5. Elevation and section views are shown on Figures 4.1, 4.2, 4.3, 4.4, and 4.5.

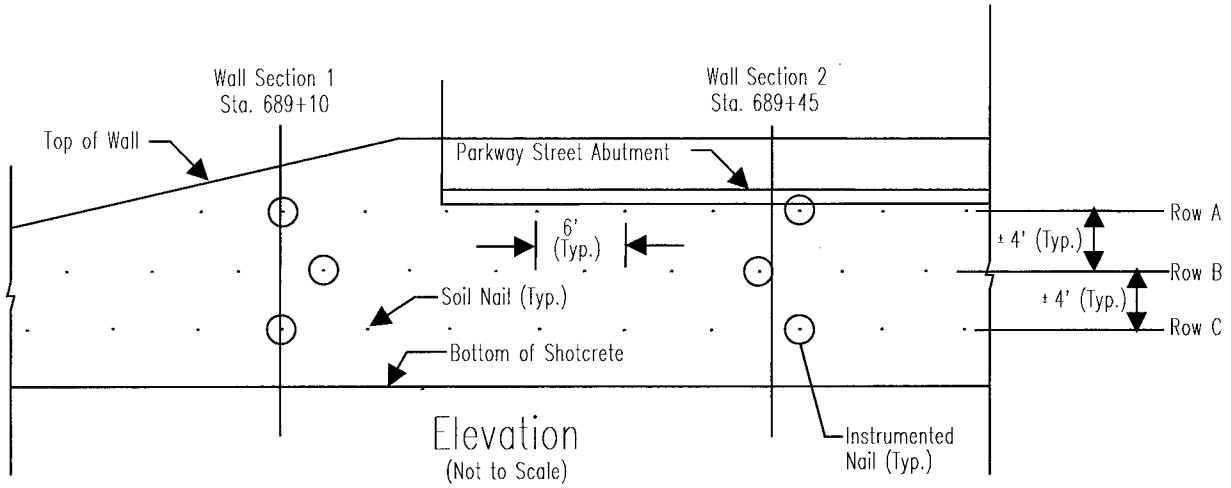
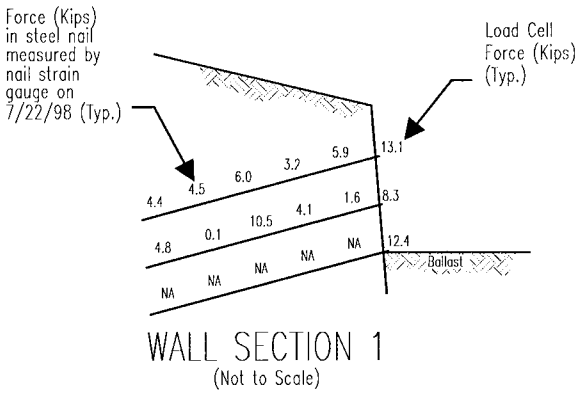
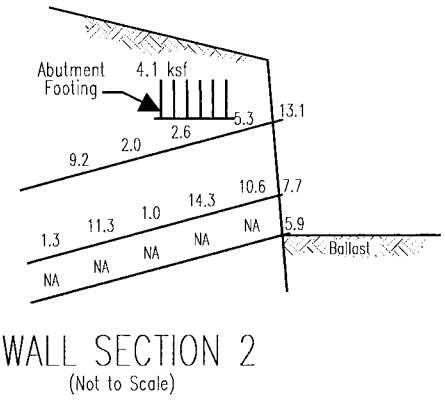


Figure 4.1: Wall 13A elevation



NA = Not Available; zero readings were not collected so true nail forces cannot be determined.

Figure 4.2: Wall 13A Section 1



NA = Not Available; zero readings were not collected so true nail forces cannot be determined.

Figure 4.3: Wall 13A Section 2

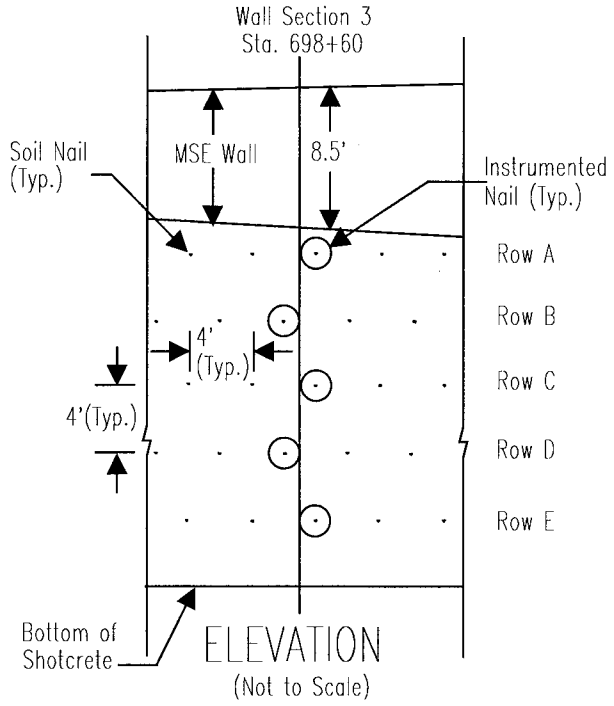


Figure 4.4: Wall 14C Elevation

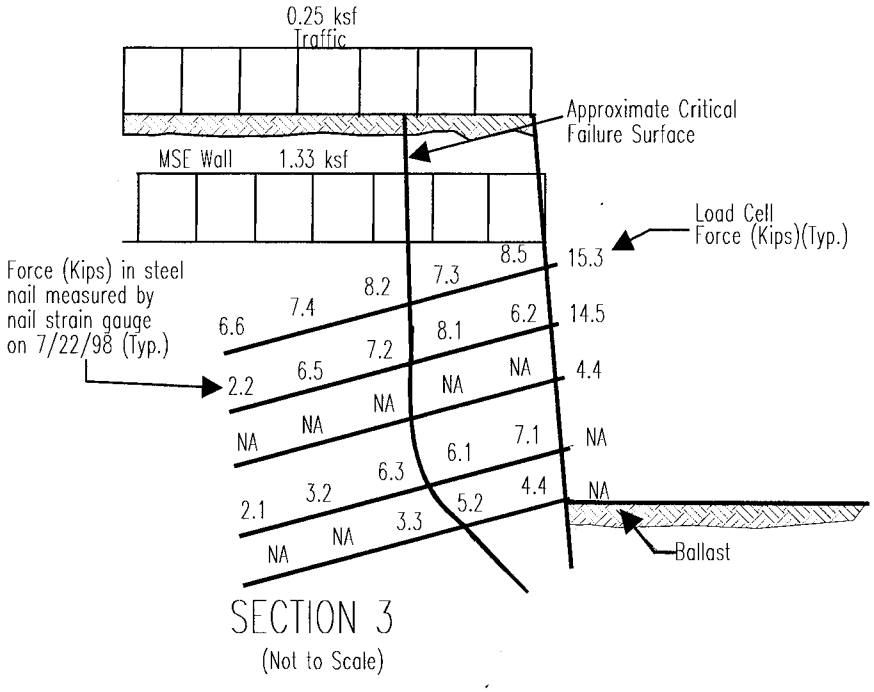


Figure 4.5: Wall 14C Section

Both wall segments are located along the light rail corridor. The rail corridor was over-excavated at a depth of about 3 ft below subgrade to facilitate soil nail wall construction and to provide depth to construct the rail bed. The rail corridor grade is at approximately the same elevation as the lowest row of soil nails in the walls.

4.1 SOIL NAIL WALL SEGMENT 13A (BRIDGE ABUTMENT BEHIND SOIL NAIL WALL)

Wall Section 1 is about 16.0 ft in height (measured from the bottom of the shotcrete face) and located approximately 15 ft from the southeast corner of bent 5 of the Parkway Street Bridge (Bridge No. 9607). Wall Section 2 is about 17.7 ft in height (measured from the bottom of the shotcrete face) and approximately centered beneath the middle of the Parkway Street Bridge alignment. Bent 5 of the Parkway Street Bridge is a spread footing located approximately 3 ft behind the top of the soil nail wall. According to record documents, the footing is about 3 ft deep, 6 ft wide, 44 ft long, and exerts a nominal bearing pressure of 4.1 kips per square ft (ksf). The ground slope behind the soil nail wall is inclined at about 26 degrees from horizontal. Wall segment 13A is shown on Figure 4.6.

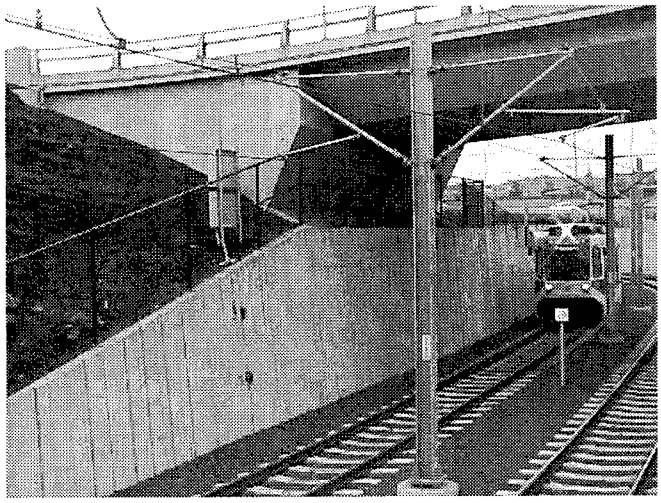


Figure 4.6: Wall 13A

Segment 13A contains 3 rows of soil nails spaced 6 ft horizontally, and declined at about 15 degrees from horizontal. The vertical nail spacing between the top row (Row A) and the middle row (Row B) is generally about 4 ft. Vertical spacing between the middle and bottom rows (Row C) is variable, but was designed to be 4.5 ft. Construction records indicate there is only about 1 to 2 ft of vertical separation between the top row of soil nails (Row A) at Wall Section 2 and the bottom of bent 5 footing. Note that the nails are arranged in a staggered pattern; that is, every other row is offset horizontally one-half of the horizontal spacing.

Soil nails in Segment 13A are constructed entirely within the BLR unit. The PHS-BLR contact at project Wall Sections 1 and 2 is located about 3 ft above the top row of soil nails. The BLR-Boring Lava Basalt contact is located about 4 to 5 ft below the toe of the wall. Soil nails located

in the BLR were constructed with a nominal diameter of 6 inches and were designed with an ultimate load transfer of 7 kips per ft. Segment 13A configuration is summarized in Table 4.1.

Table 4.1: Segment 13A Wall Configuration

PARAMETER	WALL SECTION 1 (STA 689+10)	WALL SECTION 2 (STA 689+45)
Wall height	16.0 ft (end-of-construction)	17.7 ft (end-of-construction)
Distance from top of wall to 1st row of soil nails	3.5 ft	5.5 ft
Vertical nail spacing	4 ft	Rows A to B: 4.5 ft Rows B to C: 4 ft
Horizontal nail spacing	6 ft	6 ft
Nail declination	15 degrees	15 degrees
Bar length, size	Row A: 20 ft, #8 Row B: 20 ft, #9 Row C: 18 ft, #9	Row A: 20 ft, #8 Row B: 20 ft, #9 Row C: 18 ft, #9
Nail grade	60 ksi	60 ksi
Nail hole diameter	6 inches	6 inches
Surcharge loading	Embankment slope	Embankment slope plus bent 5 footing (4,100 psf)*

* A footing load of 3,400 psf was used in the original design.

An atypical aspect of the soil nail wall design at Wall 13 called for prestressing the top row of nails (Row A) located below the abutment to 23 kips during construction. The intent of prestressing these nails was to limit soil nail wall displacement. Although the construction drawings show a design prestressing magnitude for the Row A nails at Wall Section 2, it is the recollection of ODOT personnel involved in the project that prestressing was not performed at the instrumented sections. The reasons for deleting the prestressing were not determined for this study.

4.2 SOIL NAIL WALL SEGMENT 14C (MSE WALL ABOVE SOIL NAIL WALL)

The soil nail portion of Segment 14C at Wall Section 3 is approximately 22.5 ft in height. Embankment fill placed for the new ramp overlies the soil nail portion of Segment 14C and was placed using MSE techniques to lower lateral earth pressures on the concrete facing of the wall. Wall Segment 14C is shown in Figure 4.7.

Figure 4.7: Wall segment 14C

Wall Section 3 contains five rows of soil nails spaced 4 ft horizontally and declined at 15 degrees from horizontal. Vertical spacing at the test section ranges from 2.5 to 5.5 ft between rows and averages 4 ft. Note that the nails are arranged in a staggered pattern; that is, every other row is offset horizontally one-half the horizontal spacing. Wall configuration is summarized in Table 4.2.

Table 4.2: Segment 14C Wall Configuration

PARAMETER	**WALL SECTION 3 (STA 698+60)**
Wall height	MSE portion 8.5 ft Soil nail portion 22.5 ft Total height 31 ft (end-of-construction)
Distance from top of wall to 1st row of soil nails	2.0 ft
Vertical nail spacing	±4 ft
Horizontal nail spacing	4 ft
Nail declination	15 degrees
Bar length, size	Rows A and B: 23 ft, #10 Rows C and D: 23 ft, #11 Row E: 21 ft, #10
Nail grade	60
Nail hole diameter	Rows A and B: 12 inches Rows C through E: 6 inches
Surcharge loading	MSE wall (1330 psf) plus traffic (250 psf)

PHS and BLR are both present at Segment 14C. The contact between the PHS and the BLR is approximately 11 ft above the toe of the wall, and the BLR-Boring Lava contact is at least 8 ft below the wall toe. Nails located within the PHS were constructed with a nominal 12-inch

diameter hole and an ultimate load transfer rate of 3.140 kips per ft. Nails located entirely within the BLR were constructed with 6-inch diameter holes and a load transfer rate of 7 kips per ft.

The MSE wall constructed above the soil nail wall is approximately 8.5 ft in height and extends back about 6.5 ft from the face of the wall where it abuts the fill for the ramp embankment. Construction of the MSE portion of Wall 14C began as construction of the underlying soil nail portion of the wall was being completed to the shotcrete finish stage. The ground slope behind the wall is approximately horizontal. Vertical surcharge loading imposed by the MSE wall and fill is estimated to be approximately 1.33 ksf.

5.0 SOIL NAIL WALL CONSTRUCTION SEQUENCING

Available documentation tracking the progress of soil nail wall construction, surrounding earthwork, and monitoring instrumentation installation is not as comprehensive as would be needed to meet all of the original research project objectives. The individuals involved in this project moved on to other positions, causing the lack of continuity in the available documentation. Documents referring to the sequence of construction consists of several ODOT quarterly project memos and notes related to instrument sensor installation, and four dated sketches illustrating the construction progress for Segment 14C.

The project memos reviewed for this study cover the year from July 1994 through June 1995, the period from October 1 through December 31, 1995, and the period from April 1 through June 30, 1997. The memos provide general information for the entire construction project, including the progress of major work items, outline work planned for the following quarter, and mention some abnormalities with construction such as damaged and deleted instrumentation sensors. Details regarding construction sequencing, such as specific dates individual tasks were accomplished, are not included in the quarterly memos.

Initial instrumentation readings were recorded for most of the strain gauges and load cells installed at the instrumented sections. Some information regarding the status of the excavation progress, soil nail installation and grouting, and placement of the load cells may be inferred from the dates of these readings and accompanying notations by the field inspector. Similarly, the four sketches during construction of Segment 14C also provide information related to excavation sequencing, excavation elevation, nail spacing, and other information related to the progress of construction.

Lack of comprehensive field documentation, such as daily or weekly field progress reports, does not allow for a detailed discussion of the construction progress or extensive analyses of instrumentation data during the construction period. Information gleaned from the sources discussed above is summarized in the construction timeline presented on Figure 5.1. Pictures from construction are presented on Figures 5.2 through 5.5.

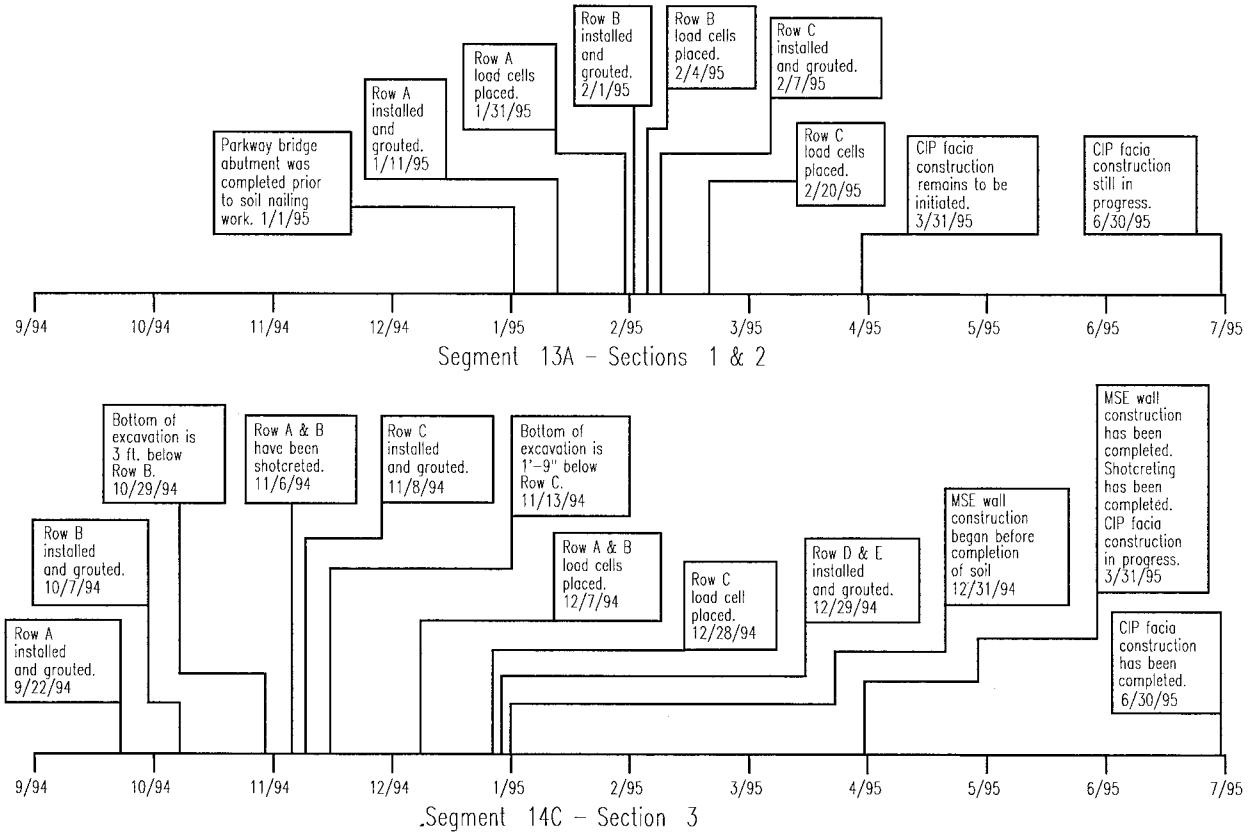


Figure 5.1: Construction timeline

Figure 5.2: Construction site

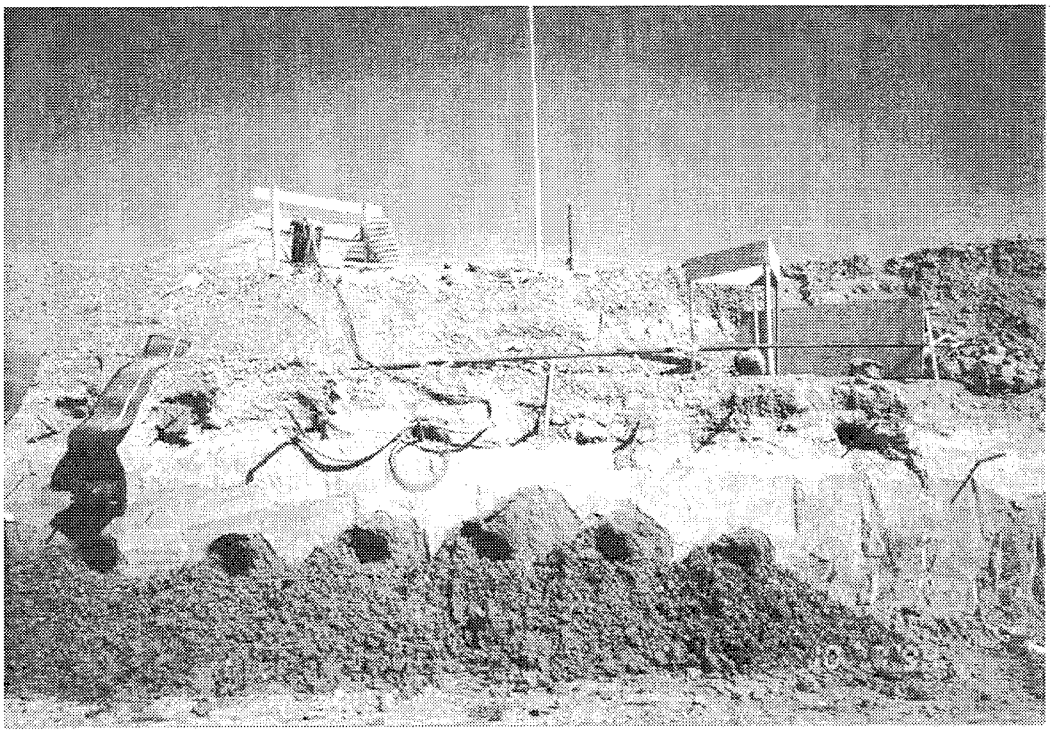


Figure 5.3: Drilled nail holes

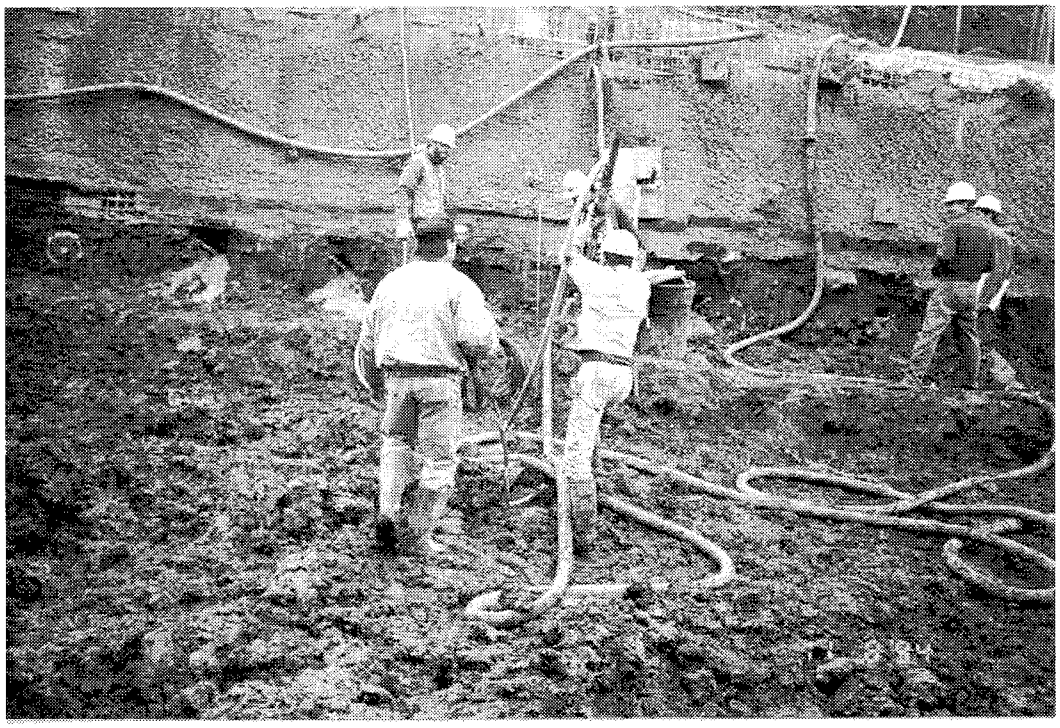


Figure 5.4: Instrumented soil nail installation

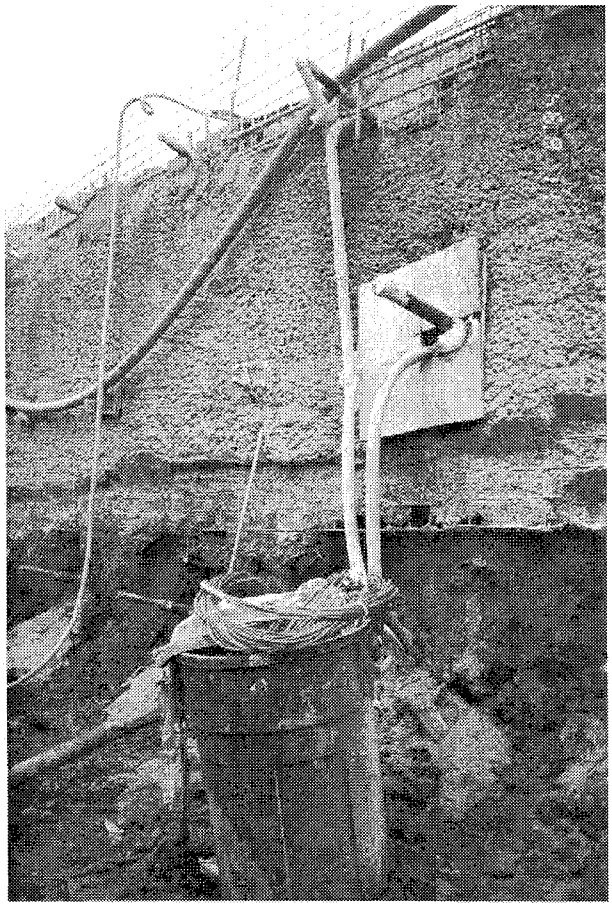


Figure 5.5: Installed soil nail

6.0 WALL INSTRUMENTATION

The original instrumentation plan specified the number and locations of the various types of instruments. Load cells were to be placed on the head of each soil nail at the three project sections for a total of 11 load cells. Five pairs of nail strain gauges were to be welded onto each of the 11 soil nails at equal spacing along the nail length. The pair closest to the wall face was installed at 3 ft from the end of the bar and the last pair was installed 1 ft from the far end. The three intermediate pairs were installed at a 4-ft spacing on the 20-ft long bars and at a 4.5-ft spacing on the 22-ft long bars. Each pair was to consist of one gauge on the top of the soil nail and one on the bottom. Grout strain gauges were to be installed in pairs along the nail length at Wall Section 3, Rows A and B (12-inch diameter holes in PHS). A slope inclinometer casing was to be installed behind the wall face at each of the project sections to measure wall deflection. Two extensometers were to be installed between the Parkway Bridge abutment and the soil nail wall face on Segment 13A to measure bridge abutment deflection.

Unfortunately, some instruments were deleted, damaged, or disturbed during construction activities and other instruments later failed during the study period, reducing the amount and usefulness of the data collected. The following sections describe the location and performance of each installed instrument.

6.1 LOAD CELLS

To eliminate any load transfer between the nail and the cast-in-place (CIP) concrete wall facing, instrumented soil nails were constructed without a structural connection to the retaining wall facing. The instrumented nails were isolated from the wall by installing a PVC pipe sleeve around each nail prior to placing the wall shotcrete and topping off of the soil nail grout. Each sleeve was sized to the diameter of the soil nail and extended from the face of the excavation to about 6 inches beyond the face of the shotcrete wall. The sleeves were filled with shotcrete to about the face of the shotcrete wall. The excess sleeve was trimmed during load cell installation and the load cells were placed between a plate bearing on the shotcrete within the sleeve and the nail nut. A 12-inch square block-out was also constructed in the permanent CIP wall around each of the instrumented nails. With the nail able to move independently of the wall face, the load cell measures the full magnitude of soil nail loading at the face.

Load cells were successfully installed on all three rows of soil nails at Wall Sections 1 and 2. At Wall Section 3, load cells were successfully installed on the top three rows of nails (Rows A through C). To facilitate wall construction, the contractor erroneously removed and then replaced the load cell at Row C subsequent to the initial installation. Load cells were not installed on the soil nails at Rows D and E because of a lag between excavation and nail installation. These two rows were excavated concurrently and the excavation was left open several weeks before the nails were installed. Construction of the overlying MSE portion of the wall also occurred during this time period so the opportunity to record changes in the nail load during construction was lost. Because it was probable that much of the soil's strength had been

mobilized, load cell data would be of little value and the load cells were installed on another project.

6.2 NAIL STRAIN GAUGES

Five pairs of vibrating-wire strain gauges were welded to each of the soil nails prior to installation. Each pair consisted of one gauge on the top of the soil nail and one on the bottom. The spacing of strain gauges along the length of the nails (as recorded in the installation notes) varied with the length of each nail. The gauges were placed at 4-ft spacing on the nails in Wall Sections 1 and 2 with the first gauge placed 3 ft from the face on Row A and 2.0 to 2.2 ft from the face on Rows B and C. At Wall Section 3, gauge spacing was 5 ft on Rows A through D and 4.5 ft on Row E. The first gauge was located 2 ft from the face on all 5 rows. Nail strain gauges were successfully installed on every soil nail at each of the three wall sections.

The locations of the nail strain gauges along the soil nails are shown on Figures 4.2, 4.3, and 4.5, starting on page 9. The five strain gauge pair locations are designated 'a' through 'e', with 'a' closest to the wall face and 'e' the furthest from the wall face. The following nail strain gauge pairs failed during or after installation:

- Wall Section 2, Row A, gauge 'e'
- Wall Section 3, Row C, gauge 'e'
- Wall Section 3, Row E, gauge 'd'

6.3 GROUT STRAIN GAUGES

Five pairs of vibrating-wire strain gauges were installed in the grout column of Rows A and B at Wall Section 3. The grout strain gauges were installed at the same location along the nail (and carry the same 'a' through 'e' designations) as the corresponding nail strain gauges. The grout strain gauges were positioned within the nail hole by attaching them to centralizers mounted on the steel bar that placed the strain gauges about 4 inches from the steel bar and 2 inches from the grout/soil interface (nominal 12-inch diameter holes). At Row B, grout strain gauge pairs 'c' and 'e' failed or were damaged during or shortly after installation.

6.4 SLOPE INCLINOMETER CASINGS

Standard 2-inch diameter slope inclinometer casings were installed behind the wall face near Wall Section 1 on Segment 13A and Wall Section 3 on Segment 14C to provide a means for measuring the lateral displacement of the retained soil. The casings were installed in holes drilled behind the wall face, which were then grouted to the surface. An inclinometer casing was not installed near Wall Section 2 due to inaccessibility.

The approximate location of inclinometer casing IN-01 along Segment 13A is shown on the Site Plan for Wall 13, Figure 3.1 on page 5. Its exact location and surface elevation are unknown, as the log and survey data for test hole WC1-IN1 were not reviewed for this study. Comparing the

length of the casing to the subsurface profile developed from nearby explorations, it is believed the bottom of the casing penetrates into the Boring Lava.

Slope inclinometer casing IN-03 was installed in test hole WC1-IN3 at station 698+49 about 11 ft east-southeast from Wall Section 3. The exploration log for this test hole provides soil data and installation details for this casing and is included in Appendix A. The casing was installed prior to construction of the MSE wall with the intent that it would be extended upward as MSE wall construction progressed. The casing was not extended through the MSE portion of the wall as planned and according to the field inspector's notes, the inclinometer casing was damaged in late December 1994. The casing was damaged during installation of a Row C soil nail when the contractor drilled through the casing. Data collection from this casing was discontinued following this event.

6.5 EXTENSOMETERS

An extensometer consists of a stainless steel rod in a casing. The casing is anchored to the structure, while the rod is anchored to the soil. The device measures the relative displacement between the structure and the surrounding soil.

Installation of one extensometer was deleted from the scope of work and the other extensometer was from the bikeway portion of the Parkway Bridge abutment and the wall located about 25 ft east of Section 2. The contractor accidentally covered over the installed extensometer with shotcrete during wall construction. The extensometers were not replaced and no extensometer data were collected.

7.0 INSTRUMENTATION DATA

ODOT staff collected instrumentation data. The vibrating wire load cells and strain gauges were wired to aboveground control panels. The Wall 13 control panel is presented on Figure 7.1 and the Wall 14 control panel is presented on Figure 7.2. Sensor readings were obtained by connecting the control panels to a portable electronic readout device. Load cell data and nail strain gauge data are presented in Appendix B.

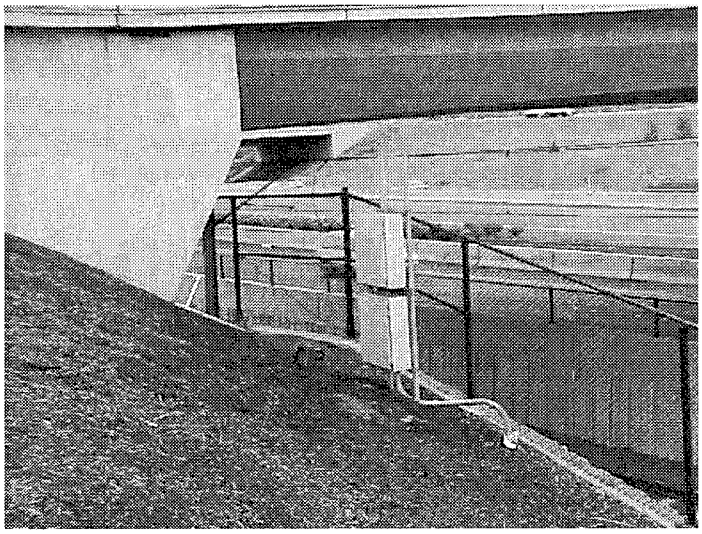


Figure 7.1: Wall 13 control panel

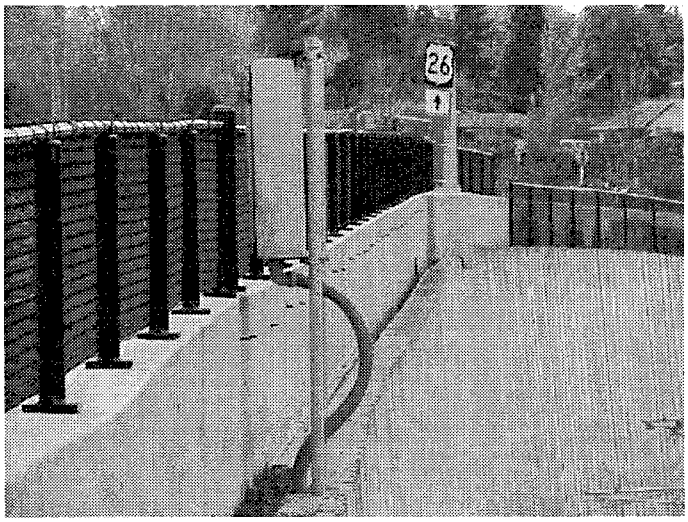


Figure 7.2: Wall 14 control panel

Slope inclinometer readings were accomplished by lowering an inclinometer probe into the inclinometer casing and collecting data at regular depth intervals. Slope inclinometer plots showing any movement at Wall Sections 1 and 3 are included in Appendix C. Data points greater than the 21-ft depth are false readings and should be ignored.

7.1 LOAD CELL DATA

7.1.1 Gauge Calibration

Geokon Model 4900-100-3.0 load cells, with a maximum rated capacity of 100 kips, were used for this project. Geokon provided the original factory calibration sheets. Load cell calibration was accomplished by loading the cell to 100 kips in 20-kip increments and noting the sum of the three vibrating wire outputs. The "gauge factor" was then determined by dividing 100 kips by the change in the load cell output.

Geokon used linear regression to calculate the original gauge factor although the calibration data were not linear. The gauge factor shown on the calibration sheets represents an approximation for the entire 100-kip range of the load cell capacity. The working load for the load cells in this application is generally less than 20 kips. The gauge factor was therefore recalculated based on the zero and 20-kip load readings. The difference between the original full-range gauge factor and the 20-kip range gauge factor is significant. For load cell Serial No. 3765, the full-range gauge factor is 42.36 lb/digit compared to 38.46 lb/digit for the 20-kip range. Using the factory calibrations would have resulted in an overestimation of the actual load at the wall face by about 10 percent.

The factory calibration data also shows that the "zero reading" changes with each complete load cycle. Apparently, as the number of loading cycles increases to about 5, the zero reading becomes more stable. The initial zero readings taken during sensor installation were significantly different from the factory readings. The field-measured zero readings were therefore used for data interpretation.

7.1.2 Data Collection and Temperature Correlations

Following installation, load cell data were collected at regular intervals until April 9, 1996 when data collection was suspended. Two more sets of readings were taken in July and November 1998. The load cell data for Wall Sections 1, 2, and 3 are presented on Figures 7.3, 7.4, and 7.5, respectively.

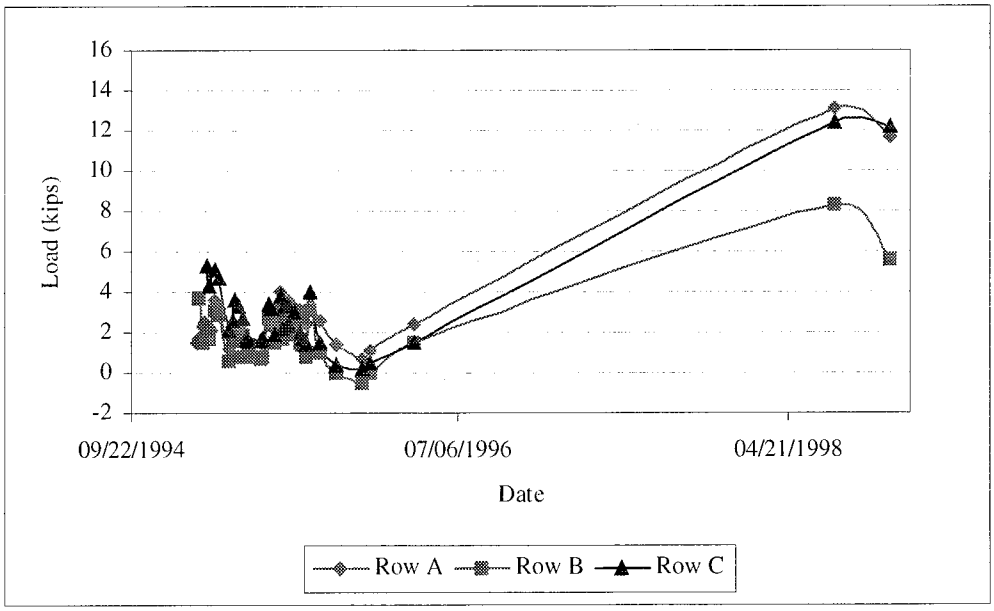


Figure 7.3: Wall Section 1 Load Cell Readings

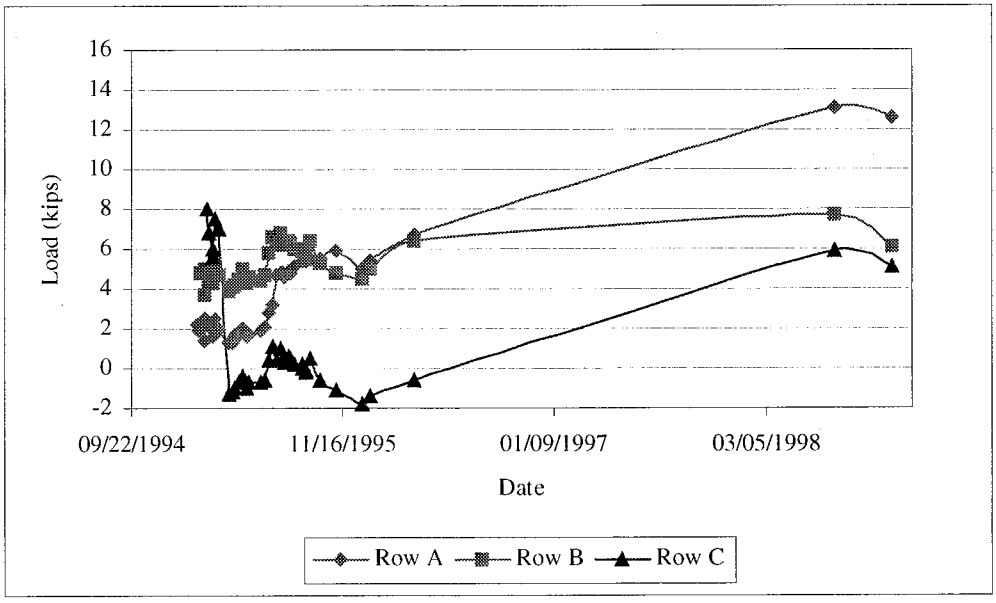


Figure 7.4: Wall Section 2 Load Cell Readings

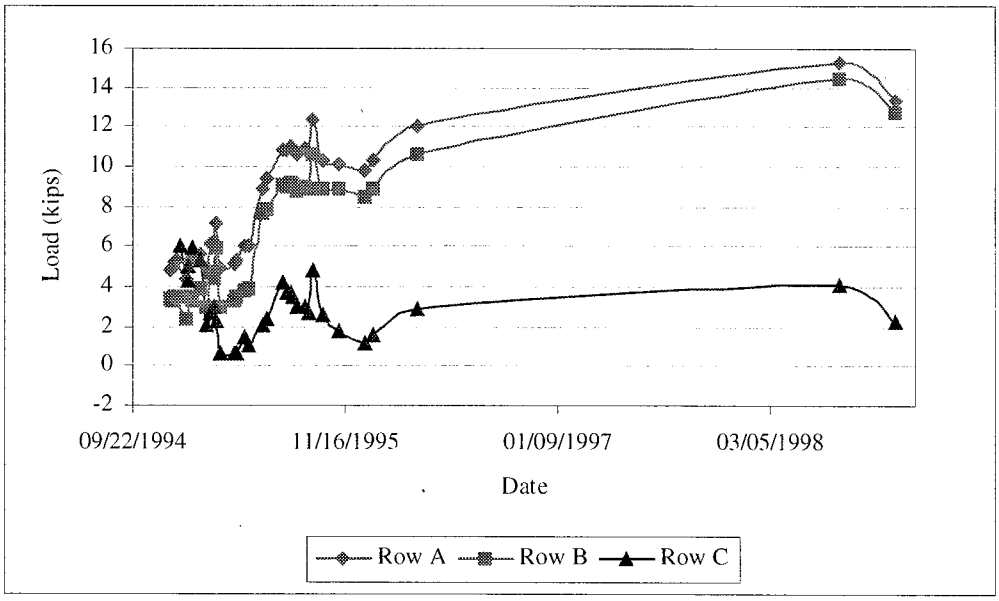


Figure 7.5: Wall Section 3 Load Cell Readings

In all cases, nail head loads fluctuate, but show a general upward trend over time. Initial readings indicate relatively high loads and temperatures. The reason for the high temperatures are unknown, but may be attributed to heat of hydration of the surrounding concrete. Loads generally drop off after this initial period and show erratic fluctuations before starting an upward trend. Load readings were compared to temperature readings to determine if there was any correlation. The correlation was weak using all of the data, but if the 1998 readings and the initial 5 readings collected after nail installation are ignored, a strong correlation was found for more than half of the nails. The correlation coefficient, R^2, ranged from 0.82 to 0.99 for the three nails at Wall Section 1 and the Row C nail at Sections 2 and 3. This means that at least 82 percent of the changes in the measured loads can be related to the temperature of the load cell for these nails. The R^2 for Rows A and B at Wall Section 2 was 0.05 and 0.72 respectively and for Rows A and B at Wall Section 3, the R^2 was 0.43 and 0.38, respectively. It is noted that there are large increases in the measured loads for these four nails during late 1994 and early 1995 that may represent actual load independent of temperature fluctuations.

7.1.3 Nail Loads

At each of the wall sections, the Row A (top row) soil nails measured the highest load. The initial "lock-off" loading applied to the soil nails at the wall face during load cell installation varied from about 1.5 kips to about 8.0 kips. The initial loading was not measured on the Row B load cells at Wall Sections 1 and 2.

Load readings at the Segment 13A wall face fluctuated from about 0 to 4 kips prior to April 9, 1996. The last two sets of readings show a marked increase in loading at Segment 13A over time. The Row A and Row C load cells at Wall Section 1 increased from about 2 to about 12.5 kips between April 9, 1996 and November 13, 1998. A smaller increase in loading (from about 6

to about 13 kips at Row A and 0 to 6 kips at Row C) occurred during this time period at Wall Section 2.

The maximum nail head loading at Wall Section 3 also occurred on July 22, 1998; however, the increase in nail head loading over time was less for Wall Section 3 than for the other two wall sections. Rows A and B at Wall Section 3 exhibited the highest nail head loading of all instrumented nails at 15.3 and 14.5 kips, respectively as measured on July 22, 1998. The maximum measured nail head load of 4.1 kips for Row C, which also occurred on this date, is meaningless because the load cell had been disturbed by the contractor.

Although all nails exhibited a decrease in loading after the first five readings, the decrease in the load in Row C at Wall Section 2 (Figure 7.4) was dramatic. The data shown on Figure 7.4 indicate a drop in load from 7.0 kips to −1.3 kips occurring between March 16 and April 5, 1995. The negative loading indicates that the zero reading may have shifted due to complete unloading of the load cell. The reasons for this decrease are unknown but speculation is that the nail may have been disturbed in a way so as to relieve the load at the head. A similar trend present in the data for the Row C nail at Section 3 is attributed to the contractor removing and then reinstalling the load cell. It was also noted that the temperature of the load cell on March 16 was measured at 70 °F, but strain gauge temperatures were in the low to mid-50's and climatological data indicate that the maximum daily temperature was in the mid- to high 60's during this period. This discrepancy could indicate that the validity of the reading is questionable.

7.2 NAIL AND GROUT STRAIN GAUGE DATA

7.2.1 Nail Gauges

Geokon Model VK-4100 vibrating wire strain gauges were welded to the soil nails in pairs. These gauges convert the vibration frequency of the wire to a micro strain and measure the strain gauge temperature. The manufacturer's literature states that the coefficient of thermal expansion for the vibrating wire steel used in these sensors is the same as the coefficient of thermal expansion of the steel soil nails. Therefore, a temperature correction to the raw data should not be applied. The raw data therefore represents the strain in the soil nail due to applied load only, rather than strain due to loading plus strain due to thermal expansion or contraction of the steel soil nails.

Except for those nails in Row C, initial strain gauge readings were recorded in the field prior to installing the nails or immediately following installation while the grout was still fluid. No initial readings were recorded for the Row C strain gauges at each of the three wall sections. The first set of readings for the Row C nail strain gauges were recorded some days after the grout was placed and, therefore, do not represent a zero reading.

The microstrain (με/ε) at each nail strain gauge pair was averaged to account for the effects of nail bending during and after soil nail installation. The average microstrain at each strain gauge pair was converted into an average stress within the soil nail using the equation:

$$\sigma = E \times \varepsilon \qquad \textbf{(7-1)}$$

σ is the stress in ksi, E is the modulus of elasticity of steel (29 ksi), and ε is the strain (measured microstrain divided by 1,000). The average stress was converted into a load carried by the soil nail at each location using the equation:

$$\mathbf{P = \sigma \times A_s} \qquad \textbf{(7-2)}$$

P is the nail load in kips and A_s is the area of the steel nail tendon in square inches (varies with bar diameter). The loads in the soil nails calculated from nail strain gauge data on July 22, 1998 are shown on Figures 4.2, 4.3 and 4.5, starting on page 9. The calculated loads in the soil nails at each strain gauge pair location over time are presented on Figures 7.6 through 7.13. Since true zero readings were not recorded for the Row C nails, the calculated nail forces for these nails are not shown on the figures.

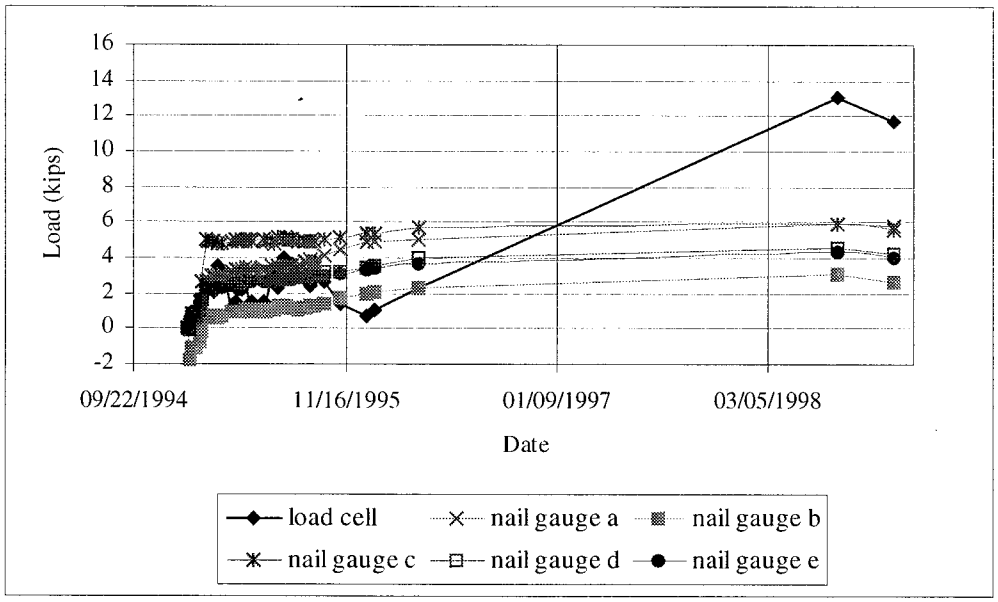


Figure 7.6: Wall Section 1 Row A Strain Gauge Readings

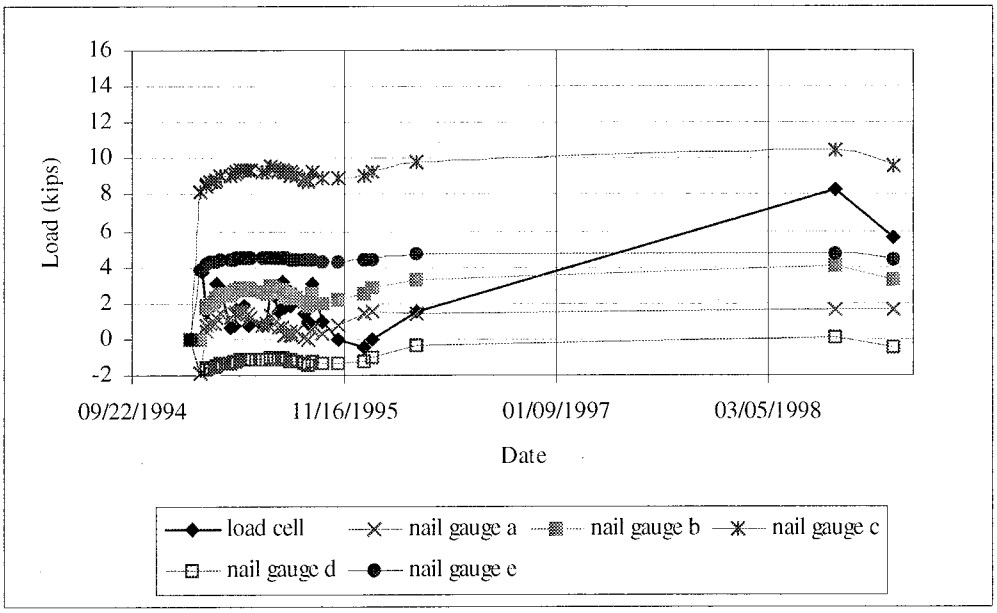


Figure 7.7: Wall Section 1 Row B Strain Gauge Readings

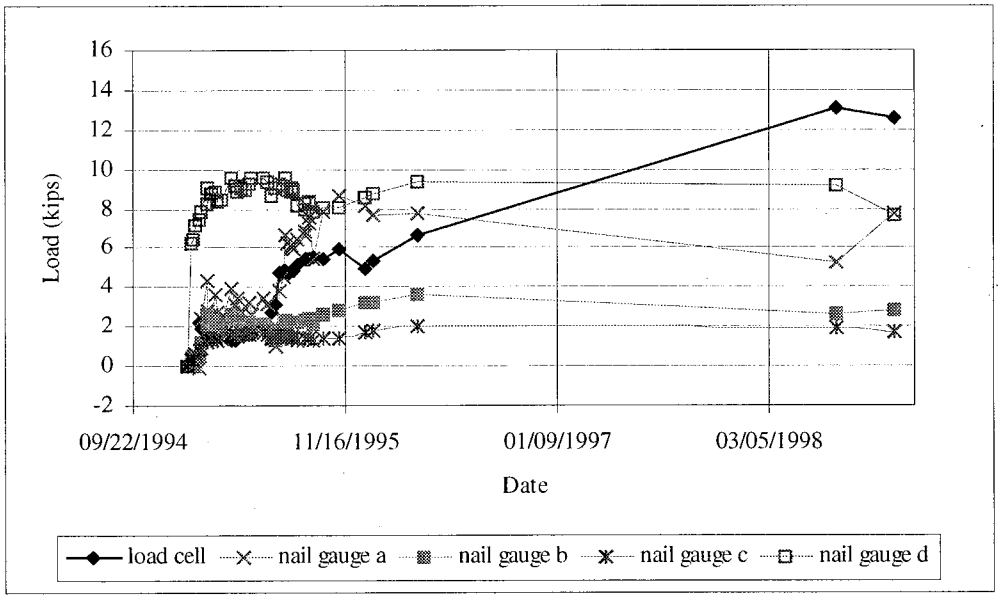


Figure 7.8: Wall Section 2 Row A Strain Gauge Readings

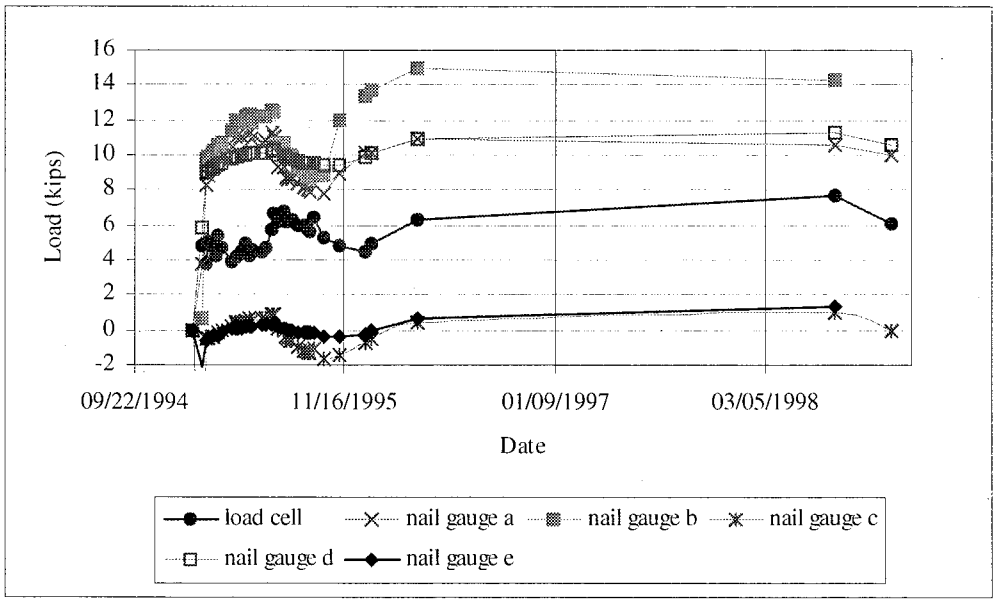


Figure 7.9: Wall Section 2 Row B Strain Gauge Readings

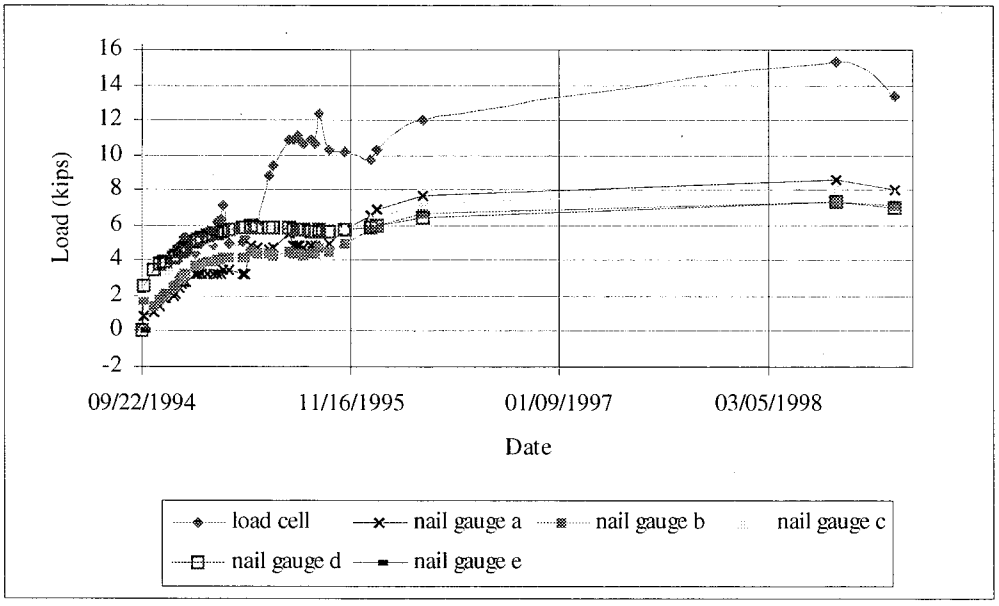


Figure 7.10: Wall Section 3 Row A Strain Gauge Readings

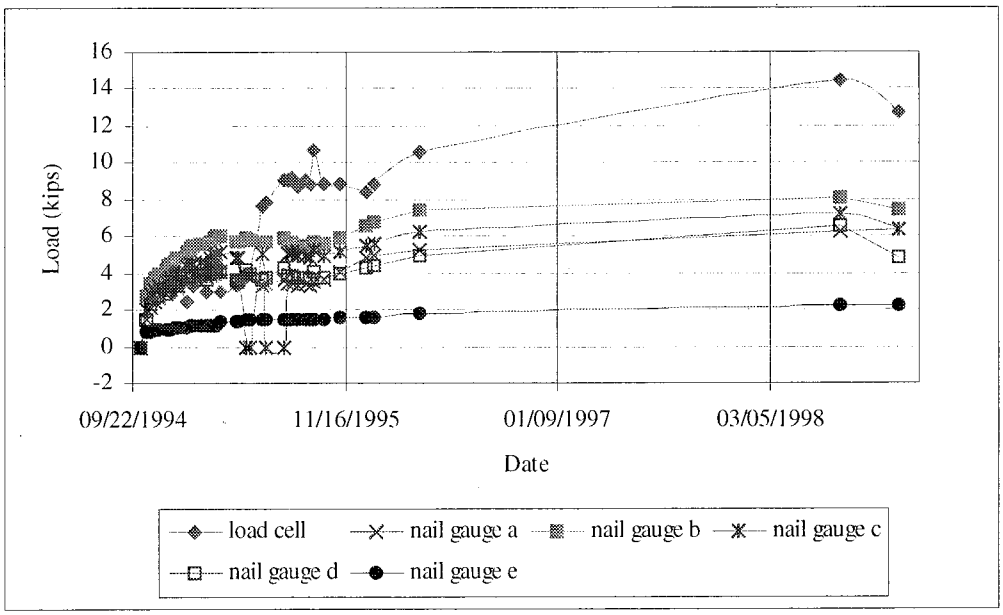


Figure 7.11: Wall Section 3 Row B Strain Gauge Readings

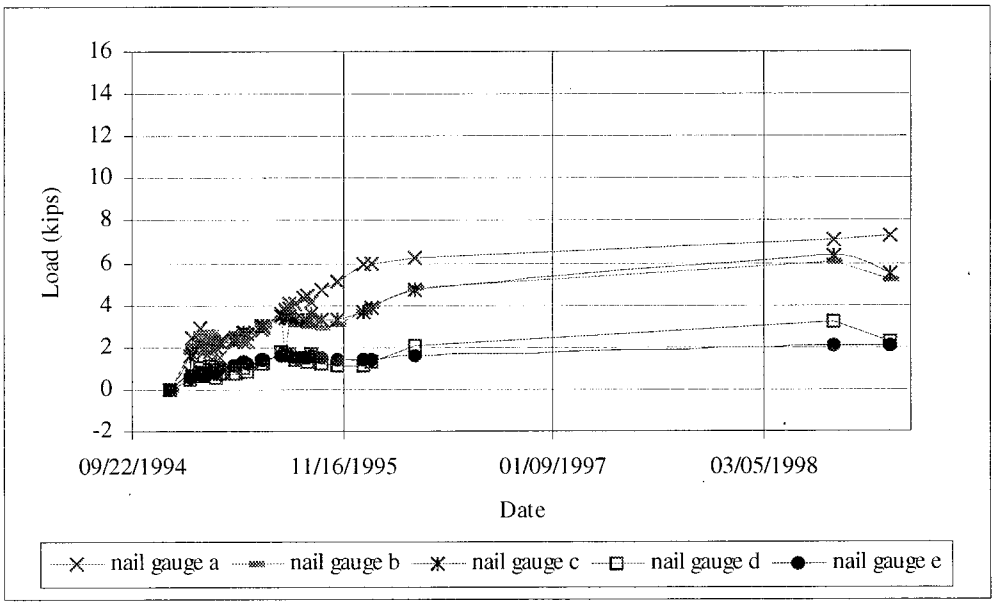


Figure 7.12: Wall Section 3 Row D Strain Gauge Readings

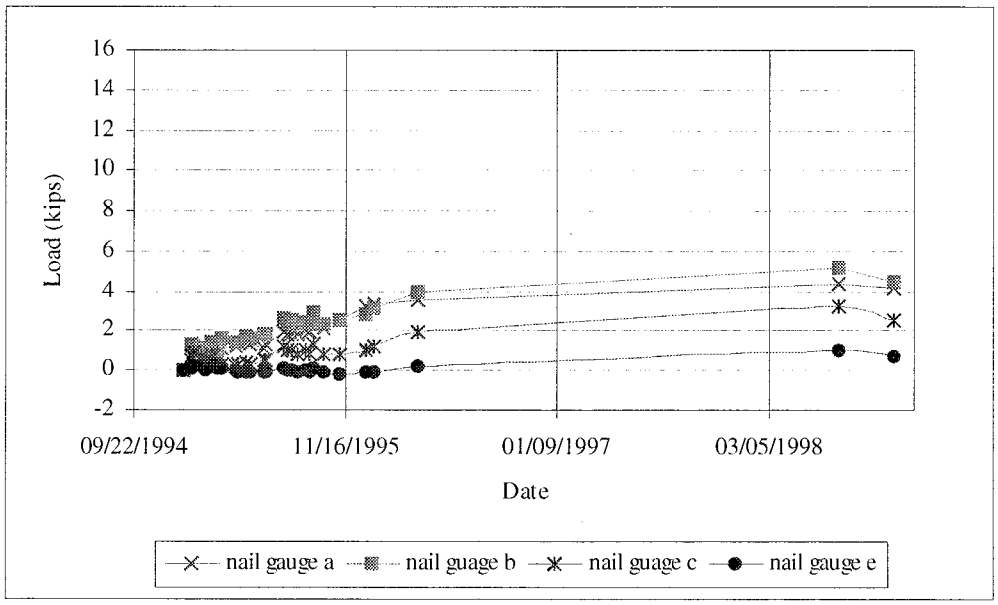


Figure 7.13: Wall Section 3 Row E Strain Gauge Readings

7.2.2 Grout Gauges

Geokon Model VCE-4200 vibrating wire strain gauges were installed within the Row A and B grout columns at Wall Section 3. The force carried by the grout column at the grout strain gauge location was calculated using a method similar to the one described above for the nail strain gauges. A correction was applied to the strain readings to account for the different thermal expansion coefficients of the concrete grout and the strain gauge in accordance with the manufacturer's recommendations. A thermal expansion coefficient of 10.8 με/°C was assumed for the grout.

The elastic modulus of the concrete grout continues to increase over time as the cement continues to hydrate and cure. Using laboratory data from grout test cylinders and cubes collected during construction, equations for the grout mixes used at the wall sections were developed to estimate the modulii. Two grout mixes, a "9-sack" mix and a "10-sack" mix, were used for the nail grout at the three sections. The "9-sack" equation is:

$$\mathbf{E = 318{,}649 \times Ln\ (time\ in\ days) + 2x10^6} \qquad \textbf{(7-3)}$$

The "10-sack" equation is:

$$\mathbf{E = 667{,}156 \times Ln\ (time\ in\ days) + 2x10^6} \qquad \textbf{(7-4)}$$

The stress in the grout column at the sensor locations could then be calculated using the measured strain (adjusted for temperature effects) and the grout modulus.

As stated in section 6.2, the five strain gauge pair locations are designated 'a' through 'e', with 'a' closest to the wall face and 'e' the furthest from the wall face. For the Row A nail, calculated

grout stresses vary along the nail, with a minimum value at gauge 'a', increasing to a maximum in the vicinity of gauges 'b' and 'c' and then showing slight to moderate drops at gauges 'd' and 'e'. The same general pattern exists on the Row B nail; minimum stress at gauge 'a', a maximum at gauge 'b', and a lower value at gauge 'd' (gauges 'c' and 'e' are not functional). The maximum tensile stress measured in the grout columns to date occurred at the Row A nail at gauge 'b' on July 22, 1998. The tensile stress at this location was about 800 psi. An estimate of the tensile load carried by the grout column may be calculated assuming the calculated stress is a representative average and assuming the stress is carried by the full cross-sectional area of the grout. Under these assumptions, the maximum calculated load carried by the grout is about 21.6 kips.

7.3 SLOPE INCLINOMETER DATA

Selected slope inclinometer data for IN-01 at Wall Section 1 are presented in Appendix C. The initial, baseline reference readings were taken on August 15, 1994 and all plots are measured against these readings. Readings were taken at regular intervals until March 7, 1995 and one additional reading was performed on August 26, 1998.

The positive "A" axis of the inclinometer casing is orientated perpendicular to and in the direction of the wall face. The positive "B" axis is orientated 90 degrees clockwise from the positive "A" axis. Displacements were summed to provide a cumulative displacement profile for the casing.

The difference in elevation between the top of the inclinometer casing and the top of the wall is unknown. For the following discussion, it has been approximated at 4 ft to account for the embankment slope and a slightly higher wall at the inclinometer location relative to Wall Section 1. The maximum positive movement perpendicular to the wall (outward) is approximately 0.16 inch and occurs at the top of the inclinometer casing. The magnitude of the outward movement decreases with increasing depth to the approximate location of the Row A nail at a depth of 11 ft. Outward movement then increases again, reaching a second peak of about 0.10 inch between Rows B and C. With a further increase in depth, relative displacement drops to zero near Row C and then turns negative (inward). The greatest negative movement perpendicular to the wall is about 0.20 inch and occurs at approximately midway between Row C and the bottom of the wall.

Except for an area centered at a depth of about 19.5 ft, movement parallel to the wall is within ±0.05 inch of the reference reading which is within the manufacturer's stated expected system accuracy of ±0.09 inch. Readings through January 1995 showed a maximum displacement in the positive direction, away from the bridge abutment, of about 0.38 inch at a depth of about 19.5 ft. The reading in August 1998 showed a cumulative movement of about 0.70 inch at this location and it also showed movement of about 0.16 inch between the Row A and B nails.

Selected slope inclinometer data for IN-03 at Wall Section 3 are also presented in Appendix C. The extreme deflections shown above a depth of about 23 ft are dummy readings and should be ignored. These readings were collected before the MSE wall was constructed with the intent that the inclinometer casing would be extended and measurements within the MSE portion of the wall would be collected. The data show virtually no movement at this location.

8.0 SOIL NAIL WALL DESIGN AND ANALYSIS

An outside consultant for ODOT performed the original soil nail wall design for Segments 13A and 14C. Available project data related to the original design consists of stability analyses, results from pullout load tests performed along the project wall segments, sketches, and miscellaneous design notes. The computer program Goldnail, developed by Golder Associates (*Golder 1996*), was used for the stability analyses. Goldnail is a limit-equilibrium, stability analysis and design program developed exclusively for soil nail walls. The design parameters used for the original stability analyses at stations near Wall Sections 2 and 3 were presented in Section 4. Select Goldnail stability analyses are contained in Appendix D.

Goldnail has three analysis modes: design, factor-of-safety, and nail load. In design mode, the designer inputs ultimate soil parameters, a trial design, and strength factors (for the service load design method) and the program determines if tendon lengths and strengths and nail head strengths are adequate. Soil parameters consist of unit weight, cohesion, friction angle, and pullout resistance. Pullout resistance is input as a force per unit length that is based on an adhesion stress and the diameter of the grout column. Design parameters for the nails include number, horizontal and vertical spacing, inclination angle, length, strength, and head strength. Nail strength is input as a force, calculated based on the yield stress of the steel and the selected bar diameter. The designer makes adjustments to the design if needed and reruns the analysis until a satisfactory design is achieved.

In factor of safety mode, the partial factors of safety on the soil cohesion and friction angle (normally at 1.35 for design) are set to 1.0 and the program is run to determine a global safety factor on the design. The nail service load mode provides an estimate of the actual loads in the nails that is consistent with the assumption that the full strength of the soil is mobilized.

Stability was reevaluated based on available project information including the approximate geometric configuration; loading conditions; nail size, location, and declination; grouted hole diameters, and conditions at each section. The primary difference between the original assumed design configuration and the as-built condition was an increase in the surcharge loading exerted by the Parkway Street bridge abutment from 3.4 ksf to 4.1 ksf. Except for a slightly reduced global factor of safety at Wall Section 2 (due to increased surcharge load), the latest analyses were consistent with previous results.

The computer program SNAIL Version 2.11, developed by the California Department of Transportation (*Caltrans 1996*), was also used to investigate wall stability in this study. SNAIL, like Goldnail, is a limit-equilibrium, stability analysis program developed specifically for soil nail wall analyses. SNAIL performs "working stress" analyses using ultimate soil adhesion parameters. The resulting output includes an estimate of the actual, maximum reinforcement force that occurs at the location of the critical failure surface. The critical surface is approximated as a two-part, bi-linear plane.

Results from these analyses were consistent with the Goldnail results, with one exception. In evaluating overall stability at Wall Section 2, SNAIL predicts that stresses in the steel tendons approach the yield stress and the wall is only marginally stable. However, the maximum reinforcement working force for the same analysis shows the average force (and factor of safety) consistent with Goldnail.

Goldnail was used in the nail load mode to compare estimated working loads with actual measured loads. The "working stress" method was used in this study to more closely approximate actual field conditions and wall performance. The working stress method does not apply factors of safety to the soil strength. A summary of measured and calculated nail loads is presented in Table 8.1.

Table 8.1: Nail Load Comparison

NAIL	MAXIMUM MEASURED LOAD (KIPS)	WORKING LOAD PREDICTED BY GOLDNAIL (KIPS)
Section 1, Row A	6.0	4.0
Section 1, Row B	10.5	5.0
Section 1, Row C	NA	4.1
Section 2, Row A	9.2	14.0
Section 2, Row B	14.3	17.7
Section 2, Row C	NA	15.5
Section 3, Row A	8.5	11.3
Section 3, Row B	8.1	12.3
Section 3, Row C	NA	11.7
Section 3, Row D	7.1	13.0
Section 3, Row E	5.2	10.9

NA = Not available due to known or suspected gauge failure.

The difference between predicted load and actual measured load is variable. The smallest differences are found at Row B, Wall Section 1; Row A, Wall Section 2; and Rows A and B, Wall Section 3. The biggest differences that cannot be attributed to load cell disturbance are found at Rows A and C, Wall Section 1 and Row B, Wall Section 2. As expected, due to the presence of the abutment load, the predicted loads in the nails at Wall Section 2 are substantially greater than at Wall Section 1. The reasons that the measured loads at Wall Section 1 are greater than anticipated are unknown, but it is thought that the nearby Parkway Street Bridge abutment surcharge may be responsible for the high nail stresses at Wall Section 1.

Fill for the rail line, in the form of structural fill and ballast, was placed at the toe of the walls up to about the bottom row of soil nails, following wall construction. The fill increases the stability at each section due to a buttressing effect and should reduce the load in those nails located below the fill level. The Goldnail program generates failure planes passing through or above the toe of the wall only and, therefore, cannot model this buttressing effect.

At most locations along the two nails instrumented with grout gauges (Section 3, Rows A and B), the measured ratio between the grout stress and nail stress agreed well with calculated values. The ratio between the grout stress and the nail stress at nail gauge 'a' was about half of the ratio at other locations along the nail. The low ratio at gauge 'a' is attributed to incomplete development of stress in the grout near the face of the wall due to lower confining pressures. At

other locations, the ratio decreased as a limiting strain was reached. Figures 8.1 and 8.2 present comparisons between the nail and grout strain at two locations where the divergence between measured strains is clearest. Both figures show that the lower-bound limiting strain for tension cracks in grout appears to be approximately 100 micro strain. Since the data show that the strain in the steel nails exceeded the lower bound for the initiation of grout cracking, the quality of the grout strain gauge data obtained in this study is variable and uncertain.

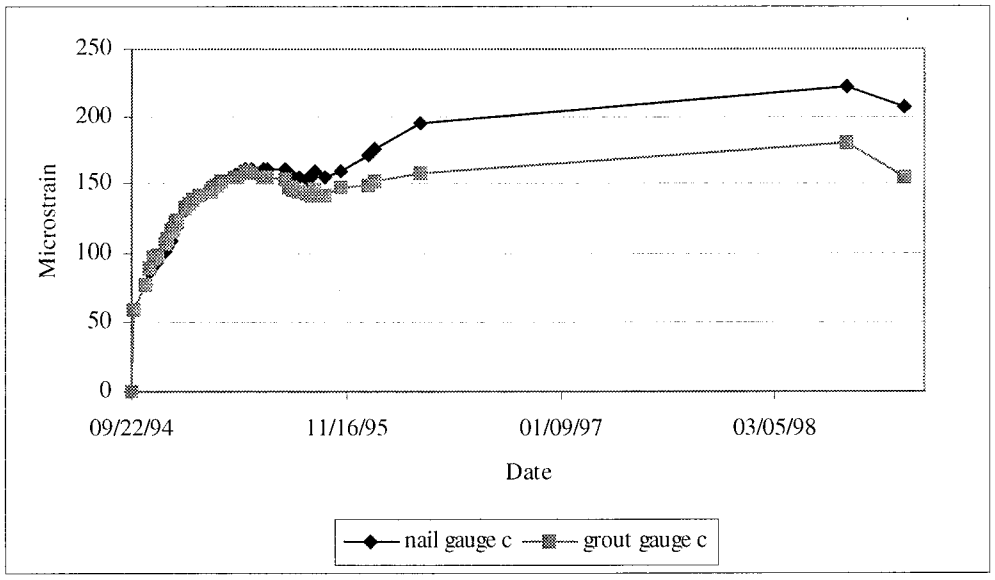


Figure 8.1: Wall Section 3 Row A Nail and Grout Strain Comparison

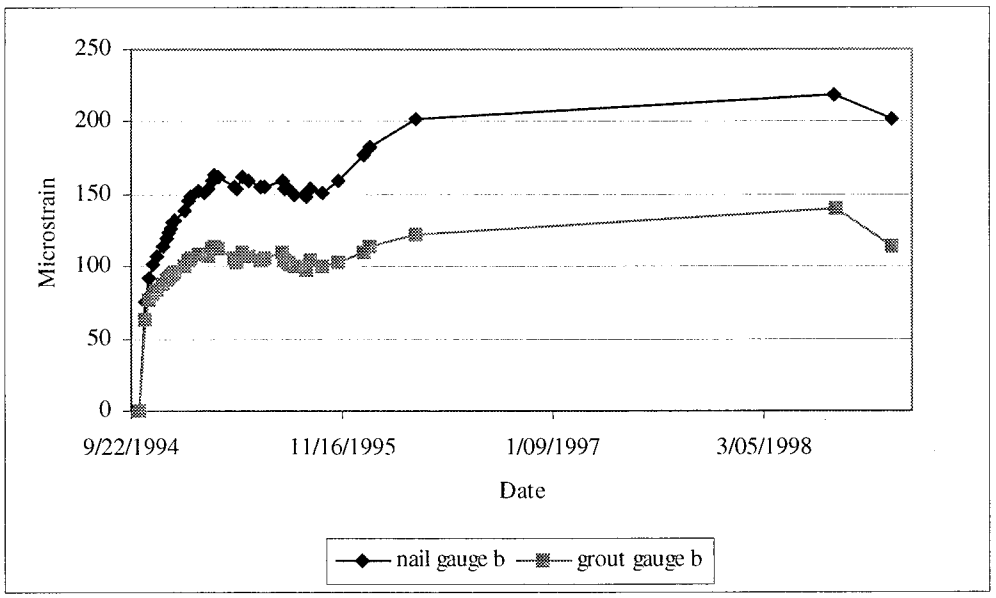


Figure 8.2: Wall Section 3 Row B Nail and Grout Strain Comparison

In all cases, the load measured in the load cells at the wall face are significantly less than the theoretical maximum forces in the nails interpreted from the strain gauges, as expected. The load cell readings at the Row A soil nails quantify the "lock off load" obtained while securing the nails to the wall face. Nail loads at the wall face of production nails are likely higher, since they are supporting the wall facing in addition to retaining the soil mass. Also, because the test nails were installed without a structural connection to the wall face, there is less confinement on the soil surrounding the head end of the test nail. The soil could be deforming without transferring additional load to the nail head.

The slope inclinometer data suggests that significant wall deflection has not occurred at Wall Section 1, adjacent to the Parkway Street bridge abutment. The data show that approximately 0.16 inch of deflection has occurred in the retained soil near the top of the wall. Although the data are limited, lateral movements of soil nail walls generally correspond to the same magnitude expected for well braced systems and tieback walls (*FHWA 1996*); that is, within a range of H/1000 to 3H/1000, where H is the height of the wall. For Wall Section 1 with a wall height of 16.0 ft, a lateral movement in the range of 0.2 to 0.6 inch would be expected. It is believed that a larger movement has not been observed because the BLR is much stiffer than modeled. Without a second set of data from Wall Section 2, it is impossible to determine what affect the additional surcharge due to the bent 5 footing had on wall deflections. Because movement is near the lower end of the expected range under the as-built condition, it is doubtful that prestressing the top row of nails would have had any significant effect in reducing wall deflections in this case.

The data also show movement between Rows B and C. The displacement is approximately 0.25 inch negative movement perpendicular to the wall and about 0.7 inch positive movement (away from the abutment) parallel to the wall. About half of this parallel movement occurred between March 7, 1995 and August 26, 1998, but it appears that no additional wall movement occurred in the perpendicular direction during this period. The parallel movement (i.e. creep due to abutment loading) conflicts with what would be expected in the perpendicular direction.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

Data collected during this study are insufficient to fulfill the original project objectives. Difficulties encountered during implementation of this research project reduced the amount of data collected from the anticipated amount and also have limited the usefulness of the data collected. These shortcomings were identified during the course of the study, but it was realized that the data collected could and should be added to the body of knowledge regarding soil nail walls. Lessons learned during this study may be applied to future studies.

Data collected to date is of variable quality due to difficulties during installation and uncertainties during the collection of data. The measured nail head loads start at reasonable levels shortly after installation and then show a decrease before increasing again. Some of this behavior may be due to continued changes in the wall configuration, but the latest increases in the loads occur after construction was completed. Also, the increases in the loads measured with the load cells are not reflected in the strain gauge data.

The amount of agreement between the soil nail forces predicted by the Goldnail limit equilibrium computer program and the soil nail forces interpreted from the field sensors was investigated by performing a working stress analysis. The purpose of this analysis was to determine the ability of the limit equilibrium type of stability analysis to predict stresses in the soil nails.

Limit-equilibrium methods appear to approximate actual stresses in the steel nails when the working stress approach is used. The limit-equilibrium method does not have the capability to directly predict the amount of wall deflection or the possible benefits of nail prestressing. It appears that limit-equilibrium analyses can reasonably predict the factor of safety for heavily surcharged soil nail walls. In this study, the actual stresses in the nails are uncertain and the comparison between the interpreted maximum nail loads and the maximum nail loads predicted by computer analyses is approximate.

A theoretical grout-nail stress relationship developed for interpretation of the strain gauge data can be considered as an upper-bound value because it does not account for the effects of grout cracking. The extent and location of the grout cracking, with respect to the nail strain gauge locations, cannot be determined without direct observation and laboratory testing of the grouted nails. The relationship also assumes that the measured stress is representative of the average stress in the grout at that location. However, stress differences between gauge pairs show that the stress does vary. Therefore, the value of placing strain gauges within the grout column appears to have questionable value.

9.2 RECOMMENDATIONS

For nontraditional applications of soil nail technology, establish a commitment from management to have a small group of individuals oversee the nail installation, monitoring, reporting, etc. This small group should have authority to coordinate with the project manager and contractor, to ensure a quality installation of monitoring equipment.

A different method should be used to obtain accurate measurements of the stresses in steel soil nails. One possible method would include isolating thin cross-sections of the soil nails from the grout column. Strain gauges welded to the steel nails at the isolated locations would measure stress carried entirely by the steel at that location. Another possibility includes preventing the development of grout cracking. Admixtures, such as fiberglass, could be used to obtain a high tensile strength grout.

The apparent movement detected at Wall Section 2 and the measured stresses in the nails at Wall Sections 1 and 2 are not consistent with expectations. Further monitoring of Wall 13, including periodic inclinometer, load cell, and strain gauge measurements may generate additional useful data.

In general, instrumentation and data collection/reporting is critical to better understand the soil nailed wall dynamics. It is highly encouraged for others to instrument and document their results for nontraditional applications.

10.0 REFERENCES

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APPENDIX A

TEST HOLE LOGS

SOILS AND GEOLOGICAL EXPLORATION LOG

Highway Division, Region 1

Project Information		Crew/Equipment		Hole Information	
Section Name:	Westside Corridor	Equipment:	PC Explorations Mobile B-53	Hole Number:	WCI-DII2
Highway:	Sunset Highway No. 47	Driller:	Dave Johnson	X Coordinate:	699+20 SPC E (1415632)
County:	Washington	Recorder:	Dan Raker	Y Coordinate:	Rt. 33 SPC N (680141)
Bridge Name:		Geologist:	Bob VanVickle	Elevation:	415.4
Bridge Number:	Cut Wall #14	Date Started:	1/27/92	Boring Depth:	38
EA Number:	C0341405-010-926	Date Completed:	1/27/92	Tube Stick Up:	0

DRILL TESTS	DRILL METHOD	LEGEND
Number of SPT: 3 Core Type: HX	Type: HX Wireline Total Depth: 38'	SPT
Number of Shelby: 3 Number of Cores: 7	Type: Total Depth:	Shelby
Other Tests:		Core

Depth	Elevation	Material Description	Graphic Log	Water Level	Driving Resistance	Sample Range	Test Number	Recovery (ft)	Recovery (%)	Moisture (%)	Hardness	R.Q.D.
	414	**FILL (0'-4')**										
5	409	**PORTLAND HILLS SILT (4'-18.5')** **U-1** (5'-7') Clayey SILT, ML. Brown, Slightly Mottled, Medium Plasticity, Damp, Stiff.			2-6-7		U-1	2.0	100	33		
		N-1 (7'-8.5') Same as **U-1**. L.L.=32.8, P.I.=8.0.					N-1	1.5	100	33		
10	404	**U-2** (10'-12') Same as **U-1**.					U-2	2.0	100	29		
		N-2 (12'-13.5') Same as **U-1**.			4-5-5		N-2	1.5	100	28		
15	399	**U-3** (15'-17') Same as **U-1**.		11/28/92			U-3	2.0	100			
		N-3 (17'-18.5') Silty CLAY, CL. Brown, Mottled, Medium Plasticity, Damp, Stiff. L.L.=30.4, P.I.=11.5.			3-4-9		N-3	1.0	67	28		
20	394	**BORING LAVA RUBBLE (18.5'-38')** **C-1** (18.5'-20') BASALT Fragments, 1"-4". Red-Gray, Predominantly Decomposed to Slightly Weathered, Vesicular With 25% Silty Clay Matrix.					C-1	1.5	100			
							C-2	2.0	67			
		C-2 (20'-23') Same as **C-1**.					C-3	2.0	100			
25	389	**C-3** (23'-25') Same as **C-1**. With 15% Silty Sandy Matrix.					C-4	4.5	100			
		C-4 (25'-29') Same as **C-3**.					C-5	2.0	67			

SOILS AND GEOLOGICAL EXPLORATION LOG

Highway Division, Region 1

Section Name: Westside Corridor

Test Hole Number: WCI-DH2

Depth	Elevation	Material Description	Graphic Log	Water Level	Driving Resistance	Sample Range	Test Number	Recovery (ft)	Recovery (%)	Moisture (%)	Hardness	R.Q.D.
	384	**C-5** (29'-32.5') Same as **C-3**.										
		C-6 (32.5'-35') Same as **C-3**. In a 30% Silty, Sandy, Clayey Matrix.					C-6	1.5	60			
35		**C-7** (35'-37') Same as **C-6**.					C-7	1.2	40			
	379											
		Bottom of hole at 38'										
40		Piezometer Installed at 38', Slotted 38-28', Sealed 0-3'.										
	374	Dry Hole.										
45												
	369											
50												
	364											
55												
	359											
60												
	354											
65												
	349											

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SOILS AND GEOLOGICAL EXPLORATION LOG

Highway Division, Region 1

Project Information		Crew/Equipment		Hole Information	
Section Name:	Westside Corridor Unit 1	Equipment:	CME 850	Hole Number:	WCI-IN3
Highway:	Sunset Highway No. 47	Driller:	John Lee	X Coordinate:	'LRE' 698+49
County:	Washington	Recorder:	Curran Mohney	Y Coordinate:	Rt. 12
Bridge Name:	Wall 14	Geologist:	Amy Pfeiffer	Elevation:	408
Bridge Number:	17402	Date Started:	7/30/94	Boring Depth:	32
EA Number:	CON00050 000 900	Date Completed:	7/30/94	Tube Stick Up:	3'

DRILL TESTS		DRILL METHOD		LEGEND
Number of SPT:	Core Type: HQ3	Type: HQ3 Wireline	Total Depth: 32'	I SPT
Number of Shelby:	Number of Cores: 7	Type:	Total Depth:	Shelby
Other Tests:				I Core

Depth	Elevation	Material Description	Graphic Log	Water Level	Driving Resistance	Sample Range	Test Number	Recovery (ft)	Recovery (%)	Moisture (%)	Hardness	R.Q.D.
	407	**PORTLAND HILLS SILT (0'-9.5')**					C-1	5.0	100			
		C-1 (0'-5') Clayey SILT, ML. Brown, Medium Plasticity, Damp, Stiff to Very Stiff, Homogenous, Scattered 0.5mm Root Holes. Micaceous.										
5		**C-2** (5'-9.5') Same as **C-1** Root Holes Absent.					C-2	2.9	58			
	402											
10		**BORING LAVA RUBBLE (9.5'-32')**					C-3	2.6	52			
	397	**C-2** (9.5'-10') BASALT Fragments, 1"-5". Gray, Slightly Weathered to Predominantly Decomposed, Vesicular, with a 50% Silty CLAY Matrix.										
		C-3 (10'-15') BASALT Fragments, 1"-4', Gray, Slightly Weathered to Predominantly Decomposed, Vesicular, with a 25% Silty SAND Matrix.										
15	392	Lost Water Return at 14'.					C-4	4.3	86			
		C-4 (15'-20') Same as **C-3**. Red-Gray, with 75-90° Joints in larger boulders.										
		Water Return at 17.5'.										
20		Lost Water Return at 18.5'.					C-5	4.0	80			
	387	**C-5** (20'-25') Same as **C-4**.										
25		**C-6** (25'-30') Same as **C-4**. With a 20% Silty SAND Matrix.					C-6	4.2	84			
	382											

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SOILS AND GEOLOGICAL EXPLORATION LOG

Highway Division, Region 1

Section Name: Westside Corridor Unit 1

Test Hole Number: WC1-IN3

Depth	Elevation	Material Description	Graphic Log	Water Level	Driving Resistance	Sample Range	Test Number	Recovery (ft)	Recovery (%)	Moisture (%)	Hardness	R.Q.D.
	377	C-7 (30'-32') Same as C-4. With a 10% Silty SAND Matrix.	+ + + +				C-7	1.8	90			
		Bottom of Hole at 32'. Installed 2" diameter SINCO™ Inclinometer tube to 32'. Grouted Hole (32'-0'), with 3' of tube above the surface for further extension.										
35	372											
40	367											
45	362											
50	357											
55	352											
60	347											
65	342											

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SOILS AND GEOLOGICAL EXPLORATION LOG

Highway Division, Region 1

South side of Abutment 2

Project Information	Crew/Equipment	Hole Information
Section Name: Westside Corridor	Equipment: PC Explorations Mobile B-53	Hole Number: WCI-DI02
Highway: Highway 217	Driller: Ken Bennet	X Coordinate: 688+98 SPC E (1415970)
County: Washington	Recorder: Jim Huss	Y Coordinate: Lt. 28 SPC N (679330)
Bridge Name:	Geologist: Bob VanVickle	Elevation: 403.19
Bridge Number: Cut Wall #13	Date Started: 2/7/92	Boring Depth: 33
EA Number: C0341405-010-926	Date Completed: 2/7/92	Tube Stick Up: 0

DRILL TESTS	DRILL METHOD	LEGEND
Number of SPT: 0 Core Type: HX	Type: HX Wireline Total Depth: 33'	I SPT
Number of Shelby: 0 Number of Cores: 7	Type: Total Depth:	▯ Shelby
Other Tests:		I Core

Depth	Elevation	Material Description	Graphic Log	Water Level	Driving Resistance	Sample Range	Test Number	Recovery (ft)	Recovery (%)	Moisture (%)	Hardness	R.Q.D.
	402	**FILL (0'-2')**					C-1	3.8	76			
		C-1 (0'-2'): Silty GRAVEL.										
		BORING LAVA RUBBLE (2'-19')										
5	397	C-1 (2'-5'): BASALT Fragments, 1"-4", Red-Gray, Predominantly Decomposed to Slightly Weathered. Vesicular, with 25% Silty Sandy Matrix.					C-2	1.5	50			
		C-2 (5'-8') Same as C-1.					C-3	4.3	86			
10		C-3 (8'-13') Same as C-1.										
	392											
		C-4 (13'-18') Same as C-1.					C-4	1.5	30			
15												
	387											
		C-5 (18'-19') Same as C-1.					C-5	4.3	86			
		BORING LAVA (19'-33')										
20	382	C-5 (19'-23') BASALT. Gray, Slightly Weathered, Medium Hard, Close Jointed, Some Vesicles.										
		C-6 (23'-28') Same as C-5.					C-6	4.1	82		R-3	60
25												
	377											
		C-7 (28'-33') Same as C-5. Hard.					C-7	5.0	100		R-4	60

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SOILS AND GEOLOGICAL EXPLORATION LOG

Highway Division, Region 1

Section Name: Westside Corridor

Test Hole Number: WCI-DI02

Depth	Elevation	Material Description	Graphic Log	Water Level	Driving Resistance	Sample Range	Test Number	Recovery (ft)	Recovery (%)	Moisture (%)	Hardness	R.Q.D.
	372											
35	367	Bottom of Hole at 33' Two Piezometers installed. Piezometer installed to 33', Slotted to 23', Sealed 20'-17', and 3'-0'. Piezometer installed to 17', Slotted to 7', Sealed 3'-0'. Both Piezometers have been Dry since drilling.										
40	362											
45	357											
50	352											
55	347											
60	342											
65	337											

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SOILS AND GEOLOGICAL EXPLORATION LOG

Highway Division, Region 1

Behind the Abutment

Project Information	Crew/Equipment	Hole Information
Section Name: Westside Corridor	Equipment: PC Explorations Mobile B-53	Hole Number: WCI-DI03
Highway: Highway 217	Driller: Dave Johnson	X Coordinate: 689+66 SPC E (1415957)
County: Washington	Recorder: Dan Raker	Y Coordinate: Lt. 74 SPC N (679409)
Bridge Name:	Geologist: Bob VanVickle	Elevation: 418.59
Bridge Number: Cut Wall #13	Date Started: 1/23/92	Boring Depth: 33
EA Number: C0341405-010-926	Date Completed: 1/23/92	Tube Stick Up: 0

DRILL TESTS	DRILL METHOD	LEGEND
Number of SPT: 4 Core Type: HX	Type: 4" Hollow Stem Auger Total Depth: 16'	SPT
Number of Shelby: 2 Number of Cores: 4	Type: HX Wire Line Total Depth: 17'	Shelby
Other Tests:		Core

Depth	Elevation	Material Description	Graphic Log	Water Level	Driving Resistance	Sample Range	Test Number	Recovery (ft)	Recovery (%)	Moisture (%)	Hardness	R.Q.D.
	417	**FILL (0-7')**										
		U-1 (1.5'-2') No Recovery.			15-19-17		U-1	0.0	0			
		N-1 (2'-3.5') Silty GRAVEL, GM. Angular, Brown-Black, Damp, Very Dense.					N-1	0.3	20	10		
5												
	412	**PORTLAND HILLS SILT (7'-12')**					U-2	1.4	93			
		U-2 (7'-9') Silty CLAY, CL. Brown, Medium Plasticity, Damp, Medium Stiff to Stiff. Torvane=0.45 tsf.			4-5-3		N-2	0.3	20	25		
10												
	407	**N-2** (9'-10.5') Drill Cuttings. (Hole not cleaned out properly; rock in drive shoe). SAND, SW. Gray, Moist, Loose.			3-3-7		N-3	1.4	93	27		
		BORING LAVA RUBBLE (12'-33')			15-18-10		N-4	1.0	67	34		
15		**N-3** (12'-13.5') BASALT Fragments 1"-4". Red-Gray, Predominantly Decomposed to Slightly Weathered, Vesicular, With 70% Silty Clay Matrix. L.L.=33.1, P.I.=13.3.					C-1	3.0	100			
	402	**N-4** (14.5'-16') Same as **N-3**. L.L.=32.0, P.I.=10.2.					C-2	3.0	60			
20		**C-1** (16'-19') BASALT Fragments 1"-4". Red-Gray, Predominantly Decomposed to Slightly Weathered, Vesicular, With 40% Silty Sandy Matrix.					C-3	3.4	85			
	397	**C-2** (19'-24') Same as **C-1**.										
25		**C-3** (24'-28') Same as **C-1** With 20% Silty Sandy Matrix.										
	392	**C-4** (28'-33') Same as **C-1**.					C-4	3.0	60			

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SOILS AND GEOLOGICAL EXPLORATION LOG

Highway Division, Region 1

Section Name: Westside Corridor

Test Hole Number: WCI-DI03

Depth	Elevation	Material Description	Graphic Log	Water Level	Driving Resistance	Sample Range	Test Number	Recovery (ft)	Recovery (%)	Moisture (%)	Hardness	R.Q.D.
	387											
		Bottom of Hole at 33'.										
35	382											
40	377											
45	372											
50	367											
55	362											
60	357											
65	352											

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SOILS AND GEOLOGICAL EXPLORATION LOG

Highway Division, Region 1

North side of Abutment

Project Information		Crew/Equipment		Hole Information	
Section Name:	Westside Corridor	Equipment:	PC Explorations Mobile B-53	Hole Number:	WCI-D104
Highway:	Highway 217	Driller:	Ken Bennet	X Coordinate:	689+99 SPC E (1416012)
County:	Washington	Recorder:	Jim Huss	Y Coordinate:	Lt. 28 SPC N (679419)
Bridge Name:		Geologist:	Bob VanVickle	Elevation:	404.03
Bridge Number:	Cut Wall #15 ? #13	Date Started:	2/7/92	Boring Depth:	26
EA Number:	C0341405-010-926	Date Completed:	2/7/92	Tube Stick Up:	0

DRILL TESTS		DRILL METHOD		LEGEND
Number of SPT: 0	Core Type: HX	Type: 4" Hollow Stem Auger	Total Depth: 4'	SPT
Number of Shelby: 1	Number of Cores: 6	Type: HX Wireline	Total Depth: 22'	Shelby
Other Tests:				Core

Depth	Elevation	Material Description	Graphic Log	Water Level	Driving Resistance	Sample Range	Test Number	Recovery (ft)	Recovery (%)	Moisture (%)	Hardness	R.Q.D.
	403	**BORING LAVA RUBBLE (0'-21')**										
		U-1 (2'-4') BASALT Fragments, 1"-4". Red-Gray, Predominantly Decomposed to Slightly Weathered, Vesicular, in a Silty Sandy Matrix.					U-1	0.8	40			
5							C-1	2.8	93			
	398	C-1 (4'-7') Same as U-1 With 40% matrix.										
		C-2 (7'-11') Same as C-1					C-2	3.2	80			
10												
	393	C-3 (11'-15') Same as C-2.					C-3	3.2	80			
15												
	388	C-4 (15'-19') Same as C-2.					C-4	2.3	58			
		C-5 (19'-21') Same as C-2.					C-5	2.0	100			
20												
	383	**BORING LAVA (21'-26')**					C-6	5.0	100		R-3	58
		C-6 (21'-26') BASALT. Dark Gray, Fresh to Slightly Weathered, Medium Hard, Some Vesicles.										
25												
	378	Bottom of Hole at 26'										
		Piezometer installed to 26', slotted to 16', sealed 3'-0".										
		Dry Hole.										

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APPENDIX B

LOAD CELL AND NAIL STRAIN GAUGE DATA

Cedar Hills Interchange - S.W. 76th, Wall 13 (Soil Nail Wall)

Load Cell Data

Section #1 Row A ID LC-1A # 3763 G.F. (lbs/dig) 39.22 Zero Read.= 19808 20100 Temperature (C)

Date	Gauge #1(m')	Gauge #2(m')	Gauge #3(m')	Sum	Δɔ	Kip Load (lab zero)	Kip Load (field zero)	Gauge #1
1/31/95	6713	6661	6750	20124	-24	-0.94	-	
1/31/95	6682	6653	6750	20085	15	0.59	1.53	
2/3/95	6677	6651	6752	20080	20	0.78	1.73	15.1
2/14/95	6666	6648	6752	20066	34	1.33	2.27	------
2/17/95	6664	6646	6750	20060	40	1.57	2.51	------
2/23/95	6667	6647	6751	20065	35	1.37	2.31	------
3/2/95	6670	6649	6752	20071	29	1.14	2.08	------
3/7/95	6658	6636	6739	20033	67	2.63	3.57	------
3/16/95	6662	6639	6741	20042	58	2.27	3.22	------
4/5/95	6680	6655	6758	20093	7	0.27	1.22	9.2
4/14/95	6677	6653	6755	20085	15	0.59	1.53	10.9
4/18/95	6676	6645	6747	20068	32	1.26	2.20	10.9
4/25/95	6672	6647	6748	20067	33	1.29	2.24	19.1
5/3/95	6669	6644	6746	20059	41	1.61	2.55	20.1
5/12/95	6679	6653	6755	20087	13	0.51	1.45	12.4
5/16/95	6680	6652	6753	20085	15	0.59	1.53	14
6/6/95	6680	6652	6754	20086	14	0.55	1.49	12.1
6/13/95	6681	6652	6754	20087	13	0.51	1.45	12.9
6/23/95	6664	6638	6740	20042	58	2.27	3.22	26.2
6/29/95	6667	6640	6740	20047	53	2.08	3.02	27.3
7/7/95	6673	6646	6747	20066	34	1.33	2.27	21.3
7/18/95	6657	6632	6732	20021	79	3.10	4.04	32.8
7/21/95	6661	6639	6739	20039	61	2.39	3.33	26.2
7/25/95	6661	6637	6737	20035	65	2.55	3.49	27.4
7/31/95	6663	6640	6740	20043	57	2.24	3.18	25.7
8/1/95	6660	6636	6736	20032	68	2.67	3.61	28.9
8/4/95	6661	6639	6739	20039	61	2.39	3.33	26.8
8/14/95	6664	6639	6740	20043	57	2.24	3.18	25.2
8/28/95	6663	6641	6742	20046	54	2.12	3.06	24
8/31/95	6663	6642	6742	20047	53	2.08	3.02	24.3

9/5/95	6668	6646	6745	20059	41	1.61	2.55	19.3
9/7/95	6669	6647	6747	20063	37	1.45	2.39	18
9/14/95	6658	6635	6734	20027	73	2.86	3.80	29.6
10/5/95	6666	6645	6746	20057	43	1.69	2.63	19.8
11/6/95	6677	6654	6757	20088	12	0.47	1.41	9.2
12/28/95	6683	6659	6763	20105	-5	-0.20	0.75	3.6
1/11/96	6680	6656	6760	20096	4	0.16	1.10	7
4/9/96	6670	6646	6748	20064	36	1.41	2.35	17.2
7/21/98	6547	6580	6664	19791	309	12.12	13.06	24.4
11/13/98	6551	6595	6680	19826	274	10.75	11.69	9.7

Section #1 Row B ID LC-1B # 3767 G.F. (lbs/dig) 38.17 Zero Read.= 19808 19838 Temperature (C)

Date	Gauge #1(m')	Gauge #2(m')	Gauge #3(m')	Sum	Δ	Kip Load (lab zero)	Kip Load (field zero)	Gauge #1
2/4/95	6652	6597	6612	19861	-23	-0.88	-	14.7
2/6/95	6610	6573	6580	19763	75	2.86	3.74	15.1
2/14/95	6634	6589	6599	19822	16	0.61	1.49	------
2/17/95	6632	6586	6599	19817	21	0.80	1.68	------
2/23/95	6632	6586	6598	19816	22	0.84	1.72	------
3/7/95	6620	6575	6585	19780	58	2.21	3.09	------
3/16/95	6622	6577	6587	19786	52	1.98	2.86	27.6
4/5/95	6643	6594	6608	19845	-7	-0.27	0.61	9.3
4/14/95	6643	6594	6604	19841	-3	-0.11	0.76	11.1
4/18/95	6635	6586	6596	19817	21	0.80	1.68	11.1
4/25/95	6635	6587	6596	19818	20	0.76	1.64	21.5
5/3/95	6634	6585	6593	19812	26	0.99	1.87	21.5
5/12/95	6643	6594	6603	19840	-2	-0.08	0.80	13
5/16/95	6641	6592	6601	19834	4	0.15	1.03	14.7
6/6/95	6644	6594	6604	19842	-4	-0.15	0.73	12.2
6/13/95	6643	6593	6603	19839	-1	-0.04	0.84	12.9
6/23/95	6626	6579	6586	19791	47	1.79	2.67	29.4
6/29/95	6629	6581	6588	19798	40	1.53	2.40	28.3
7/7/95	6637	6588	6597	19822	16	0.61	1.49	22.4
7/18/95	6621	6574	6581	19776	62	2.37	3.24	35.8

7/21/95	6635	6586	6595	19816	22	0.84	1.72	24.7
7/25/95	6628	6579	6588	19795	43	1.64	2.52	31.3
7/31/95	6634	6584	6593	19811	27	1.03	1.91	28.6
8/1/95	6627	6578	6586	19791	47	1.79	2.67	32.7
8/4/95	6633	6583	6592	19808	30	1.15	2.02	28.5
8/14/95	6630	6581	6590	19801	37	1.41	2.29	29.6
8/28/95	6637	6588	6598	19823	15	0.57	1.45	24.4
8/31/95	6638	6588	6599	19825	13	0.50	1.37	24.9
9/5/95	6642	6591	6603	19836	2	0.08	0.95	18.1
9/7/95	6643	6592	6604	19839	-1	-0.04	0.84	17.1
9/14/95	6623	6575	6583	19781	57	2.18	3.05	34.2
10/5/95	6641	6591	6602	19834	4	0.15	1.03	21.4
11/6/95	6650	6599	6612	19861	-23	-0.88	0.00	9.3
12/28/95	6654	6603	6616	19873	-35	-1.34	-0.46	4
1/11/96	6650	6599	6612	19861	-23	-0.88	0.00	7.5
4/9/96	6637	6585	6599	19821	17	0.65	1.53	17.3
7/21/98	6578	6525	6540	19643	195	7.44	8.32	26.8
11/13/98	6605	6544	6565	19714	124	4.73	5.61	10

Section #1 Row C ID LC-1C G.F. (lbs/dig) 42.83 Temperature (C)
3759 Zero Read.= 19808 19927

Date	Gauge #1(m')	Gauge #2(m')	Gauge #3(m')	Sum	Δɘ	Kip Load (lab zero)	Kip Load (field zero)	Gauge #1
2/20/95	6640	6638	6656	19934	-7	-0.30	-	19.9
2/20/95	6614	6578	6619	19811	116	4.97	5.27	20
2/23/95	6618	6588	6628	19834	93	3.98	4.28	------
3/7/95	6611	6581	6622	19814	113	4.84	5.14	------
3/16/95	6615	6584	6625	19824	103	4.41	4.71	24
4/5/95	6630	6609	6645	19884	43	1.84	2.14	9.1
4/14/95	6627	6605	6642	19874	53	2.27	2.57	10.7
4/18/95	6621	6595	6634	19850	77	3.30	3.60	10.7
4/25/95	6623	6597	6636	19856	71	3.04	3.34	19.1
5/3/95	6625	6606	6641	19872	55	2.36	2.66	19.8
5/12/95	6632	6616	6649	19897	30	1.28	1.58	12.8
5/16/95	6630	6614	6647	19891	36	1.54	1.84	14.5

6/6/95	6631	6617	6649	19897	30	1.28	1.58	12.3
6/13/95	6631	6616	6648	19895	32	1.37	1.67	13
6/23/95	6621	6599	6635	19855	72	3.08	3.38	27.6
6/29/95	6621	6602	6636	19859	68	2.91	3.21	26.3
7/7/95	6628	6616	6646	19890	37	1.58	1.88	22.3
7/18/95	6616	6601	6629	19846	81	3.47	3.77	36.6
7/21/95	6626	6614	6642	19882	45	1.93	2.23	23.5
7/25/95	6619	6605	6633	19857	70	3.00	3.30	32.9
7/31/95	6626	6613	6642	19881	46	1.97	2.27	26.5
8/1/95	6620	6604	6633	19857	70	3.00	3.30	31.2
8/4/95	6625	6612	6641	19878	49	2.10	2.40	26.8
8/14/95	6622	6608	6635	19865	62	2.66	2.96	30.6
8/28/95	6627	6616	6645	19888	39	1.67	1.97	23.3
8/31/95	6629	6618	6647	19894	33	1.41	1.71	21.5
9/5/95	6630	6621	6648	19899	28	1.20	1.50	17.9
9/7/95	6631	6622	6648	19901	26	1.11	1.41	16.8
9/14/95	6615	6598	6628	19841	86	3.68	3.98	37.3
10/5/95	6630	6622	6648	19900	27	1.16	1.46	20.6
11/6/95	6637	6631	6656	19924	3	0.13	0.43	9.3
12/28/95	6639	6632	6659	19930	-3	-0.13	0.17	6.1
1/11/96	6637	6629	6656	19922	5	0.21	0.51	8.9
4/9/96	6632	6619	6648	19899	28	1.20	1.50	14.6
7/21/98	6531	6515	6599	19645	282	12.08	12.38	19.7
11/13/98	6528	6514	6607	19649	278	11.91	12.21	10.9

Cedar Hills Interchange - S.W. 76th, Wall 13 (Soil Nail Wall)

Load Cell Data

Section #2 Row A ID LC-2A G.F. (lbs/dig) 40.65 Temperature (C)
3761 Zero Read.= 19808 20173

Date	Gauge #1(m')	Gauge #2(m')	Gauge #3(m')	Sum	Δɔ	Kip Load (lab zero)	Kip Load (field zero)	Gauge #1
1/31/95	6699	6757	6742	20198	-25	-1.02	-	
1/31/95	6695	6742	6707	20144	29	1.18	2.20	
2/3/95	6698	6744	6709	20151	22	0.89	1.91	15.1
2/14/95	6706	6749	6709	20164	9	0.37	1.38	------
2/17/95	6695	6740	6701	20136	37	1.50	2.52	------
2/23/95	6698	6742	6707	20147	26	1.06	2.07	------
3/5/95	6702	6709	6747	20158	15	0.61	1.63	9.2
3/7/95	6695	6702	6740	20137	36	1.46	2.48	------
3/16/95	6698	6708	6744	20150	23	0.93	1.95	15.2
4/5/95	6704	6712	6749	20165	8	0.33	1.34	8.5
4/14/95	6704	6712	6749	20165	8	0.33	1.34	9
4/18/95	6701	6709	6746	20156	17	0.69	1.71	11.1
4/25/95	6700	6711	6746	20157	16	0.65	1.67	13.3
5/3/95	6697	6708	6743	20148	25	1.02	2.03	15.9
5/12/95	6701	6711	6747	20159	14	0.57	1.59	11.1
5/16/95	6699	6713	6745	20157	16	0.65	1.67	13.8
6/6/95	6695	6711	6745	20151	22	0.89	1.91	12.8
6/13/95	6692	6711	6744	20147	26	1.06	2.07	13.9
6/23/95	6684	6707	6739	20130	43	1.75	2.76	22
6/29/95	6678	6707	6735	20120	53	2.15	3.17	26.1
7/7/95	6668	6689	6725	20082	91	3.70	4.72	29.6
7/18/95	6669	6684	6726	20079	94	3.82	4.84	26.7
7/21/95	6671	6683	6726	20080	93	3.78	4.80	24.1
7/25/95	6672	6684	6728	20084	89	3.62	4.63	22.9
7/31/95	6672	6681	6727	20080	93	3.78	4.80	22.4
8/1/95	6671	6681	6726	20078	95	3.86	4.88	23
8/4/95	6671	6681	6727	20079	94	3.82	4.84	22.8
8/14/95	6672	6675	6725	20072	101	4.11	5.12	20.1
8/28/95	6671	6671	6723	20065	108	4.39	5.41	19.6

8/31/95	6670	6671	6723	20064	109	4.43	5.45	20
9/5/95	6671	6670	6723	20064	109	4.43	5.45	19.1
9/7/95	6671	6670	6723	20064	109	4.43	5.45	18.5
9/14/95	6669	6671	6722	20062	111	4.51	5.53	22.4
10/5/95	6672	6667	6724	20063	110	4.47	5.49	15.4
11/6/95	6673	6658	6722	20053	120	4.88	5.89	10.3
12/28/95	6680	6667	6729	20076	97	3.94	4.96	5.6
1/11/96	6676	6664	6726	20066	107	4.35	5.37	8.3
4/9/96	6665	6651	6718	20034	139	5.65	6.67	14.5
7/21/98	6641	6585	6649	19875	298	12.11	13.13	21.4
11/13/98	6649	6586	6653	19888	285	11.59	12.60	10.7

Section #2 Row B ID LC-2B # 3762 G.F. (lbs/dig) 39.29 Zero Read.= 19808 20141 Temperature (C)

Date	Gauge #1(m')	Gauge #2(m')	Gauge #3(m')	Sum	Δɘ	Kip Load (lab zero)	Kip Load (field zero)	Gauge #1
2/4/95	6746	6723	6704	20173	-32	-1.26	-	14.3
2/6/95	6666	6682	6703	20051	90	3.54	4.79	13.8
2/14/95	6675	6692	6711	20078	63	2.48	3.73	------
2/17/95	6663	6680	6702	20045	96	3.77	5.03	------
2/23/95	6666	6683	6703	20052	89	3.50	4.75	------
3/5/95	6670	6707	6687	20064	77	3.03	4.28	9.6
3/7/95	6660	6700	6677	20037	104	4.09	5.34	------
3/16/95	6667	6704	6683	20054	87	3.42	4.68	15.9
4/5/95	6673	6710	6690	20073	68	2.67	3.93	8.5
4/14/95	6671	6709	6688	20068	73	2.87	4.13	9.2
4/18/95	6670	6708	6687	20065	76	2.99	4.24	10.9
4/25/95	6668	6705	6685	20058	83	3.26	4.52	13.4
5/3/95	6664	6702	6681	20047	94	3.69	4.95	16.1
5/12/95	6670	6707	6687	20064	77	3.03	4.28	11.2
5/16/95	6668	6704	6684	20056	85	3.34	4.60	13.8
6/6/95	6672	6702	6686	20060	81	3.18	4.44	12.6
6/13/95	6670	6699	6684	20053	88	3.46	4.71	13.9
6/23/95	6661	6689	6676	20026	115	4.52	5.78	22.1

6/29/95	6655	6680	6670	20005	136	5.34	6.60	26.6
7/7/95	6665	6674	6675	20014	127	4.99	6.25	24.2
7/18/95	6662	6665	6673	20000	141	5.54	6.80	27.8
7/21/95	6669	6668	6679	20016	125	4.91	6.17	23
7/25/95	6669	6667	6679	20015	126	4.95	6.21	22.7
7/31/95	6668	6666	6679	20013	128	5.03	6.29	23.4
8/1/95	6667	6665	6679	20011	130	5.11	6.36	23.8
8/4/95	6668	6666	6679	20013	128	5.03	6.29	23.4
8/14/95	6671	6667	6683	20021	120	4.71	5.97	20.4
8/28/95	6672	6666	6684	20022	119	4.68	5.93	19.8
8/31/95	6671	6666	6684	20021	120	4.71	5.97	20.4
9/5/95	6674	6667	6686	20027	114	4.48	5.74	18.7
9/7/95	6675	6668	6687	20030	111	4.36	5.62	17.6
9/14/95	6667	6662	6680	20009	132	5.19	6.44	23
10/5/95	6678	6669	6691	20038	103	4.05	5.30	14.7
11/6/95	6682	6673	6696	20051	90	3.54	4.79	9.5
12/28/95	6682	6676	6700	20058	83	3.26	4.52	4.2
1/11/96	6678	6673	6696	20047	94	3.69	4.95	7.2
4/9/96	6663	6661	6687	20011	130	5.11	6.36	15.5
7/21/98	6659	6638	6680	19977	164	6.44	7.70	23.3
11/13/98	6676	6650	6693	20019	122	4.79	6.05	10.5

Section #2 Row C ID LC-3C # 3758 G.F. (lbs/dig) 39.84 Zero Read.= 19808 19962 Temperature (C)

Date	Gauge #1(m')	Gauge #2(m')	Gauge #3(m')	Sum	Δɔ	Kip Load (lab zero)	Kip Load (field zero)	Gauge #1
2/20/95	6664	6661	6649	19974	-12	-0.48	-	19.6
2/20/95	6613	6562	6597	19772	190	7.57	8.05	19.8
2/23/95	6622	6577	6605	19804	158	6.29	6.77	------
3/2/95	6627	6587	6610	19824	138	5.50	5.98	------
3/5/95	6630	6614	6590	19834	128	5.10	5.58	9.4
3/7/95	6615	6598	6572	19785	177	7.05	7.53	------
3/16/95	6620	6603	6576	19799	163	6.49	6.97	21.3

4/5/95	6674	6660	6673	20007	-45	-1.79	-1.31	8.5
4/14/95	6674	6659	6671	20004	-42	-1.67	-1.20	9.2
4/18/95	6672	6657	6669	19998	-36	-1.43	-0.96	11.5
4/25/95	6670	6655	6667	19992	-30	-1.20	-0.72	13.3
5/3/95	6668	6652	6664	19984	-22	-0.88	-0.40	16.3
5/12/95	6672	6658	6670	20000	-38	-1.51	-1.04	11.4
5/16/95	6670	6655	6667	19992	-30	-1.20	-0.72	13.8
6/6/95	6670	6655	6667	19992	-30	-1.20	-0.72	12.8
6/13/95	6669	6654	6666	19989	-27	-1.08	-0.60	13.7
6/23/95	6662	6646	6657	19965	-3	-0.12	0.36	22.3
6/29/95	6656	6640	6650	19946	16	0.64	1.12	27.3
7/7/95	6661	6646	6656	19963	-1	-0.04	0.44	22.6
7/18/95	6656	6641	6651	19948	14	0.56	1.04	27.3
7/21/95	6661	6646	6657	19964	-2	-0.08	0.40	22.3
7/25/95	6661	6646	6660	19967	-5	-0.20	0.28	22.1
7/31/95	6659	6645	6656	19960	2	0.08	0.56	22.9
8/1/95	6659	6645	6656	19960	2	0.08	0.56	23.2
8/4/95	6660	6645	6656	19961	1	0.04	0.52	23.2
8/14/95	6663	6648	6659	19970	-8	-0.32	0.16	19.8
8/28/95	6664	6649	6660	19973	-11	-0.44	0.04	19.1
8/31/95	6663	6648	6659	19970	-8	-0.32	0.16	19.8
9/5/95	6665	6650	6661	19976	-14	-0.56	-0.08	18.3
9/7/95	6666	6651	6662	19979	-17	-0.68	-0.20	17.2
9/14/95	6660	6645	6656	19961	1	0.04	0.52	23.2
10/5/95	6669	6654	6666	19989	-27	-1.08	-0.60	14.2
11/6/95	6673	6658	6671	20002	-40	-1.59	-1.12	9.6
12/28/95	6678	6664	6677	20019	-57	-2.27	-1.79	4.5
1/11/96	6675	6661	6674	20010	-48	-1.91	-1.43	7.3
4/9/96	6669	6654	6666	19989	-27	-1.08	-0.60	13.2
7/21/98	6616	6599	6610	19825	137	5.46	5.94	19.2
11/13/98	6622	6605	6618	19845	117	4.66	5.14	10.7

Cedar Hills Interchange - S.W. 76th, Wall 14 (Soil Nail Wall)

Load Cell Data

Section #3 Row A ID LC3A G.F. (lbs/dig) 41.07 Temperature (C)
3747 Zero Read.= 19808 19664

Date	Gauge #1(m')	Gauge #2(m')	Gauge #3(m')	Sum	Δ	Kip Load (lab zero)	Kip Load (field zero)	Gauge #1
12/7/94	6589	6660	6476	19725	-61	-2.51	-	
12/7/94	6552	6629	6427	19608	56	2.30	4.81	4.9
12/12/94	6552	6626	6427	19605	59	2.42	4.93	7
12/16/94	6550	6623	6424	19597	67	2.75	5.26	10.1
12/20/94	6549	6623	6424	19596	68	2.79	5.30	10.8
1/7/95	6555	6630	6433	19618	46	1.89	4.39	3.7
1/13/95	6549	6623	6426	19598	66	2.71	5.22	10.6
1/20/95	6548	6621	6425	19594	70	2.87	5.38	10.3
2/3/95	6547	6618	6422	19587	77	3.16	5.67	13.8
2/14/95	6553	6626	6427	19606	58	2.38	4.89	-----
2/23/95	6538	6626	6411	19575	89	3.66	6.16	-----
3/2/95	6542	6614	6416	19572	92	3.78	6.28	-----
3/7/95	6536	6607	6409	19552	112	4.60	7.11	-----
3/16/95	6552	6625	6428	19605	59	2.42	4.93	10.2
4/14/95	6550	6625	6426	19601	63	2.59	5.09	12.2
4/18/95	6550	6620	6425	19595	69	2.83	5.34	12.8
5/3/95	6546	6612	6421	19579	85	3.49	6.00	14.8
5/12/95	6548	6608	6422	19578	86	3.53	6.04	14.1
6/6/95	6520	6586	6403	19509	155	6.37	8.87	19.6
6/13/95	6518	6585	6394	19497	167	6.86	9.36	19.6
7/18/95	6505	6574	6382	19461	203	8.34	10.84	25.8
7/25/95	6504	6574	6383	19461	203	8.34	10.84	25.4
8/1/95	6503	6572	6381	19456	208	8.54	11.05	26.5
8/4/95	6503	6573	6383	19459	205	8.42	10.92	24.7
8/14/95	6505	6576	6386	19467	197	8.09	10.60	20.5
8/31/95	6502	6574	6384	19460	204	8.38	10.88	21.6
9/7/95	6504	6576	6386	19466	198	8.13	10.64	18.9
9/14/95	6492	6561	6371	19424	240	9.86	12.36	33.9
10/5/95	6505	6579	6389	19473	191	7.84	10.35	14.6
11/6/95	6506	6581	6391	19478	186	7.64	10.14	10.6

12/28/95	6508	6585	6394	19487	177	7.27	9.77	5.5
1/11/96	6504	6581	6390	19475	189	7.76	10.27	8.2
4/9/96	6491	6565	6377	19433	231	9.49	11.99	17
7/22/98	6464	6535	6354	19353	311	12.77	15.28	24.9
11/13/98	6478	6551	6370	19399	265	10.88	13.39	10.8

Section #3 Row B ID LC3B # 3760 G.F. (lbs/dig) 39.68 Zero Read.= 19808 20011 Temperature (C)

Date	Gauge #1(m')	Gauge #2(m')	Gauge #3(m')	Sum	Δə	Kip Load (lab zero)	Kip Load (field zero)	Gauge #1
12/7/94	6735	6644	6700	20079	-68	-2.70	-	
12/7/94	6701	6605	6687	19993	18	0.71	3.41	4.1
12/12/94	6702	6607	6688	19997	14	0.56	3.25	6.6
12/16/94	6700	6605	6687	19992	19	0.75	3.45	9.7
12/20/94	6699	6605	6686	19990	21	0.83	3.53	10.8
1/7/95	6708	6614	6696	20018	-7	-0.28	2.42	3.9
1/13/95	6700	6605	6687	19992	19	0.75	3.45	10.8
1/20/95	6701	6607	6688	19996	15	0.60	3.29	9.5
2/3/95	6696	6602	6682	19980	31	1.23	3.93	15.2
2/14/95	6705	6610	6690	20005	6	0.24	2.94	-----
2/23/95	6690	6596	6675	19961	50	1.98	4.68	-----
3/2/95	6692	6598	6677	19967	44	1.75	4.44	-----
3/7/95	6680	6585	6665	19930	81	3.21	5.91	-----
3/16/95	6704	6610	6691	20005	6	0.24	2.94	9.8
4/14/95	6701	6607	6687	19995	16	0.63	3.33	12.2
4/18/95	6700	6606	6686	19992	19	0.75	3.45	12.7
5/3/95	6698	6601	6684	19983	28	1.11	3.81	14.9
5/12/95	6698	6597	6685	19980	31	1.23	3.93	14.1
6/6/95	6666	6563	6657	19886	125	4.96	7.66	18.9
6/13/95	6665	6562	6655	19882	129	5.12	7.82	19.3
7/18/95	6655	6551	6644	19850	161	6.39	9.09	26.7
7/25/95	6654	6553	6645	19852	159	6.31	9.01	24.7
8/1/95	6653	6552	6642	19847	164	6.51	9.21	25.8
8/4/95	6653	6553	6643	19849	162	6.43	9.13	24.5

8/14/95	6657	6556	6646	19859	152	6.03	8.73	20.9
8/31/95	6654	6554	6644	19852	159	6.31	9.01	21.6
9/7/95	6655	6555	6645	19855	156	6.19	8.89	19.1
9/14/95	6640	6541	6630	19811	200	7.94	10.63	33.1
10/5/95	6656	6555	6645	19856	155	6.15	8.85	15.3
11/6/95	6659	6551	6646	19856	155	6.15	8.85	11.1
12/28/95	6661	6557	6648	19866	145	5.75	8.45	5.4
1/11/96	6657	6553	6645	19855	156	6.19	8.89	8
4/9/96	6646	6537	6629	19812	199	7.90	10.59	17.4
7/22/98	6614	6502	6598	19714	297	11.78	14.48	25
11/13/98	6627	6518	6613	19758	253	10.04	12.74	11.1

Section #3 Row C ID LC3C # 3765 G.F. (lbs/dig) 38.46 Zero Read.= 19808 19934 Temperature (C)

Date	Gauge #1(m')	Gauge #2(m')	Gauge #3(m')	Sum	Δɜ	Kip Load (lab zero)	Kip Load (field zero)	Gauge #1
12/28/94	6623	6680	6663	19966	-32	-1.23	-	13
12/28/94	6562	6625	6623	19810	124	4.77	6.00	9.5
1/12/95	6583	6637	6633	19853	81	3.12	4.35	6.1
1/13/95	6577	6631	6628	19836	98	3.77	5.00	11.1
1/20/95	6548	6634	6630	19812	122	4.69	5.92	9.3
2/3/95	6575	6628	6625	19828	106	4.08	5.31	16
2/14/95	6607	6669	6635	19911	23	0.88	2.12	-----
2/23/95	6604	6660	6632	19896	38	1.46	2.69	-----
3/2/95	6600	6658	6631	19889	45	1.73	2.96	-----
3/7/95	6606	6663	6638	19907	27	1.04	2.27	-----
3/16/95	6620	6678	6651	19949	-15	-0.58	0.65	11.9
4/14/95	6621	6678	6651	19950	-16	-0.62	0.62	10.9
4/18/95	6620	6678	6651	19949	-15	-0.58	0.65	11.2
5/3/95	6614	6671	6644	19929	5	0.19	1.42	16.6
5/12/95	6618	6675	6646	19939	-5	-0.19	1.04	13.1
6/6/95	6613	6672	6627	19912	22	0.85	2.08	16
6/13/95	6610	6670	6624	19904	30	1.15	2.38	17.7
7/18/95	6592	6657	6607	19856	78	3.00	4.23	30.4
7/25/95	6598	6662	6611	19871	63	2.42	3.65	26.5

8/1/95	6597	6662	6611	19870	64	2.46	3.69	27.5
8/4/95	6599	6664	6613	19876	58	2.23	3.46	25
8/14/95	6603	6668	6618	19889	45	1.73	2.96	20.8
8/31/95	6603	6668	6617	19888	46	1.77	3.00	21.6
9/7/95	6606	6670	6620	19896	38	1.46	2.69	18.6
9/14/95	6587	6652	6602	19841	93	3.58	4.81	36.6
10/5/95	6601	6675	6624	19900	34	1.31	2.54	14.8
11/6/95	6614	6679	6627	19920	14	0.54	1.77	10.4
12/28/95	6620	6685	6632	19937	-3	-0.12	1.12	4.8
1/11/96	6616	6682	6628	19926	8	0.31	1.54	7.9
4/9/96	6604	6670	6618	19892	42	1.62	2.85	17.9
7/22/98	6594	6658	6608	19860	74	2.85	4.08	25.4
11/13/98	6610	6675	6623	19908	26	1.00	2.23	10.9

Cedar Hills Interchange to S.W. 76th AVE. Wall 13, Instrumented Section 1
Section 1 - Strain Gauge Data
Revised 4/11/96 zero readings
Last:

Row - A

	Nail Strain Gage										Temperature									
Date	1A1	1A2	1A3	1A4	1A5	1A6	1A7	1A8	1A9	1A10	1A1	1A2	1A3	1A4	1A5	1A6	1A7	1A8	1A9	1A10
1/9/95	1488	1385	1327	1387	1422	1492	1566	1691	1270	1243	11.7	11.5	11.4	11.5	11.5	11.5	11.1	11	10.9	11.1
1/12/95	1681	1205	1282	1281	1445	1460	1483	1766	1238	1314	14.1	13.9	15.8	15.8	17.1	16.9	18.8	18.8	16.9	17.1
1/17/95	1712	1229	1314	1302	1470	1490	1512	1802	1257	1331										
1/20/95	1716	1231	1316	1304	1474	1498	1514	1806	1261	1333										
1/24/95	1716	1203	1316	1307	1478	1506	1513	1810	1264	1336										
1/31/95	1729	1203	1325	1319	1504	1541	1524	1828	1275	1349	11.8	11.7	12.6	12.6	13.7	13.7	14.2	14.1	14.6	14.8
2/3/95	1766	1231	1357	1336	1524	1621	1544	1851	1290	1362	12.0	12.0	12.6	12.5	13.6	13.6	14.1	14.0	14.5	14.7
2/14/95	1814	1291	1403	1370	1620	1729	1571	1894	1315	1385										
2/17/95	1817	1294	1402	1369	1617	1726	1570	1896	1316	1387	11.6	11.5	13.0	12.9	13.6	13.6	14.0	13.9	14.4	14.6
2/23/95	1819	1312	1402	1370	1615	1724	1573	1901	1318	1388	13.7	13.7	13.9	13.9	13.4	13.0	13.1	13.1	13.5	13.3
3/2/95	1820	1315	1406	1373	1616	1724	1575	1905	1319	1390	11.9	11.8	12.4	12.4	13.3	13.3	13.8	13.7	14.2	14.5
3/7/95	1816	1318	1399	1367	1609	1719	1574	1905	1320	1391	11.4	11.4	12.5	12.5	13.3	13.3	13.7	13.6	14.2	14.2
3/16/95	1814	1326	1402	1370	1610	1719	1575	1910	1323	1395	11.3	11.2	12.3	12.3	13.2	13.2	13.6	13.5	14.0	14.2
4/5/95	1821	1334	1416	1383	1618	1726	1586	1920	1327	1400	13.0	12.9	12.2	12.2	12.9	12.9	13.3	13.2	13.7	13.9
4/14/95	1824	1342	1416	1382	1620	1728	1590	1931	1330	1403	12.3	12.2	12.5	12.5	12.9	12.9	13.2	13.1	13.6	13.8
4/18/95	1822	1342	1413	1380	1618	1727	1590	1932	1331	1404	12.3	12.2	12.5	12.5	12.9	12.9	13.2	13.1	13.5	13.8
4/25/95	1823	1344	1414	1381	1617	1727	1591	1933	1332	1405	12.3	12.3	12.4	12.4	12.9	12.9	13.1	13.0	13.5	13.7
5/3/95	1823	1347	1418	1384	1620	1729	1593	1936	1334	1407	13.2	13.2	12.5	12.5	12.8	12.9	13.0	12.9	13.4	13.6
5/12/95	1825	1348	1421	1386	1622	1731	1594	1938	1335	1408	13.5	13.5	12.8	12.8	12.9	12.9	13.0	12.9	13.3	13.6
5/16/95	1822	1344	1417	1383	1617	1727	1592	1937	1335	1408	14.0	13.9	12.9	12.9	12.9	12.9	13.0	12.9	13.3	13.5
6/6/95	1815	1340	1421	1386	1621	1731	1593	1940	1336	1410	19.2	19.1	15.0	15.0	13.5	13.5	13.0	12.9	13.2	13.4
6/13/95	1817	1342	1418	1383	1618	1728	1592	1940	1335	1410	18.6	18.5	15.8	15.7	13.9	13.9	13.1	13.0	13.1	13.4
6/23/95	1825	1355	1421	1386	1618	1729	1593	1942	1337	1412	16.9	16.8	16.0	16.0	14.4	14.4	13.4	13.3	13.2	13.4
6/29/95	1821	1351	1420	1386	1613	1724	1590	1939	1336	1411	18.5	18.5	16.0	16.0	14.6	14.6	13.5	13.4	13.2	13.5
7/7/95	1825	1353	1432	1397	1626	1736	1597	1946	1339	1416	20.7	20.6	16.6	16.5	14.8	14.8	13.7	13.6	13.3	13.6
7/18/95	1820	1353	1423	1389	1621	1730	1594	1945	1339	1415	21.7	21.6	17.6	17.5	15.4	15.4	14.0	13.9	13.5	13.7
7/21/95	1827	1359	1431	1396	1626	1735	1596	1947	1340	1416	22.7	22.6	17.9	17.8	15.5	15.5	14.1	14.0	13.5	13.7
7/25/95	1821	1353	1426	1392	1623	1733	1595	1946	1340	1415	23.4	23.3	18.4	18.3	15.8	15.8	14.3	14.2	13.6	13.8
7/31/95	1825	1355	1425	1390	1621	1730	1593	1945	1339	1415	22.9	22.8	19.1	19.0	16.2	16.2	14.5	14.4	13.7	13.9
8/1/95	1825	1355	1424	1390	1621	1730	1593	1945	1340	1415	22.8	22.7	19.1	19.0	16.2	16.2	14.5	14.4	13.7	13.9
8/4/95	1827	1357	1425	1391	1620	1729	1593	1945	1340	1415	22.7	22.6	19.3	19.2	16.4	14.6	14.5	14.5	13.7	14.0
8/14/95	1827	1356	1422	1388	1617	1726	1590	1944	1345	1414	22.1	22.0	19.7	19.6	17.0	17.0	15.1	15.0	14.0	14.3
8/28/95	1837	1367	1427	1393	1616	1724	1588	1943	1349	1413	21.4	21.3	19.5	19.4	17.5	17.5	15.6	15.5	14.4	14.7
8/31/95	1837	1366	1427	1393	1615	1723	1587	1943	1349	1412	21.5	21.4	19.5	19.4	17.6	17.6	15.7	15.6	14.5	14.7
9/5/95	1840	1368	1430	1395	1616	1724	1587	1944	1349	1412	21.7	21.6	19.5	19.5	17.7	17.7	15.9	15.8	14.6	14.9
9/7/95	1840	1368	1430	1395	1616	1724	1587	1944	1349	1411	21.6	21.5	19.6	19.5	17.7	17.7	15.9	15.8	14.7	14.9
9/14/95	1838	1367	1429	1395	1615	1723	1588	1945	1354	1415	21.3	21.2	19.6	19.5	17.8	17.8	16.1	16.0	14.9	15.1
10/5/95	1852	1377	1438	1402	1620	1728	1588	1947	1364	1414	19.9	19.8	19.6	19.5	18.1	18.1	16.5	16.4	15.3	15.6
11/6/95	1870	1393	1451	1414	1626	1733	1590	1951	1371	1417	14.9	14.9	17.0	16.9	17.3	17.3	16.5	16.5	15.7	16.0
12/28/95	1889	1410	1463	1427	1638	1744	1598	1963	1377	1426	9.6	9.5	12.8	12.8	14.7	14.7	15.3	15.2	15.4	15.7
1/11/96	1888	1411	1465	1428	1640	1746	1600	1966	1380	1429	9.7	9.7	12.0	11.9	14.0	14.0	14.8	14.7	15.2	15.4
4/9/96	1890	1418	1477	1441	1652	1759	1615	1995	1393	1444	11.6	11.5	10.6	10.5	11.3	11.3	12.1	12.0	13.0	13.2
7/21/98	1926	1462	1507	1482	1665	1771	1629	2023	1435	1457	19.2	19.2	15.7	15.6	14.1	14.1	13.3	13.1	12.9	13.2
11/13/98	1925	1457	1484	1461	1647	1752	1619	2010	1421	1441	14.0	14.0	16.5	16.0	17.0	17.0	16.0	16.0	15.0	16.0

Row - B

	Nail Strain Gage										Temperature									
Date	1B1	1B2	1B3	1B4	1B5	1B6	1B7	1B8	1B9	1B10	1B1	1B2	1B3	1B4	1B5	1B6	1B7	1B8	1B9	1B10
1/16/95	1442	1490	1618	1324	905	1268	1676	1595	1263	1213	8.9	9.3	9.0	9.1	8.2	8.5	8.1	8.3	7.6	7.8
02/03/95	1284	1514	1511	1431	1406	1333	1675	1451	1318	1421	14.8	14.8	16.6	16.6	17.6	17.8	17.5	17.4	16.1	16.3
2/14/95	1362	1601	1571	1492	1419	1342	1692	1467	1335	1427										
2/17/95	1371	1611	1576	1496	1423	1345	1695	1468	1338	1427	13.5	13.0	14.2	14.1	14.6	14.7	15.5	15.4	15.5	15.9
2/23/95	1374	1616	1581	1501	1426	1348	1698	1469	1342	1428	13.9	13.3	13.8	13.3	13.1	13.8	13.1	13.4	12.8	13.4
3/2/95	1374	1617	1582	1502	1425	1346	1699	1468	1344	1429	12.9	12.8	13.7	13.6	14.2	14.3	14.8	14.7	14.7	14.9
3/7/95	1383	1628	1591	1511	1431	1352	1703	1467	1345	1429	11.9	11.7	13.6	13.4	14.1	14.2	14.6	14.6	14.6	14.7
3/16/95	1389	1638	1599	1518	1437	1358	1710	1466	1347	1431	12.0	11.8	13.2	13.0	13.9	14.0	14.4	14.4	14.3	14.5
4/5/95	1381	1636	1596	1516	1436	1357	1712	1463	1347	1431	13.8	13.7	12.9	12.7	13.5	13.6	14.1	14.1	14.1	14.3
4/14/95	1388	1645	1605	1522	1443	1364	1717	1469	1350	1433	12.4	12.3	13.0	12.8	13.4	13.5	14.0	13.9	14.0	14.2
4/18/95	1390	1647	1609	1526	1447	1368	1719	1471	1356	1433	12.6	12.5	13.0	12.8	13.3	13.4	13.9	13.9	13.9	14.1
4/25/95	1388	1646	1610	1526	1449	1370	1720	1472	1351	1434	12.9	12.8	12.9	12.7	13.3	13.4	13.8	13.8	13.8	14.0
5/3/95	1387	1647	1613	1529	1451	1372	1722	1474	1352	1434	13.5	13.3	12.9	12.8	13.2	13.3	13.7	13.7	13.7	13.9
5/12/95	1384	1643	1610	1527	1449	1369	1721	1473	1352	1434	13.6	13.5	13.0	12.9	13.2	13.3	13.6	13.6	13.7	13.8
5/16/95	1378	1637	1607	1524	1449	1368	1720	1473	1352	1434	14.4	14.3	13.1	12.9	13.1	13.3	13.6	13.6	13.6	13.8
6/6/95	1363	1623	1601	1520	1447	1367	1720	1473	1353	1434	18.3	18.2	14.4	14.2	13.3	13.4	13.5	13.5	13.5	13.7
6/13/95	1365	1624	1599	1518	1447	1366	1720	1473	1354	1434	17.7	17.6	14.9	14.7	13.5	13.6	13.5	13.5	13.4	13.6
6/23/95	1381	1639	1614	1532	1456	1375	1724	1477	1355	1434	16.2	16.1	15.2	15.0	13.9	14.0	13.6	13.6	13.6	13.4
6/29/95	1368	1627	1610	1528	1452	1372	1721	1475	1354	1433	18.6	18.4	15.2	15.0	14.0	14.1	13.7	13.6	13.4	13.6
7/7/95	1360	1618	1604	1523	1450	1370	1722	1475	1354	1433	19.8	19.7	15.7	15.5	14.2	14.3	13.8	13.8	13.4	13.6
7/18/95	1359	1617	1607	1528	1453	1370	1722	1476	1354	1432	20.8	20.7	16.3	16.1	14.5	14.6	14.0	13.9	13.5	13.7
7/21/95	1344	1603	1594	1516	1446	1369	1719	1474	1354	1431	21.7	21.6	16.4	16.2	14.6	14.7	14.0	14.0	13.5	13.7
7/25/95	1350	1606	1597	1520	1447	1364	1719	1474	1354	1431	21.8	21.7	16.7	16.5	14.7	14.8	14.1	14.0	13.6	13.7
7/31/95	1345	1601	1587	1511	1442	1358	1716	1471	1353	1430	21.3	21.2	17.1	17.0	14.9	15.1	14.2	14.1	13.6	13.8
8/1/95	1351	1607	1595	1518	1446	1363	1718	1473	1353	1430	21.3	21.2	17.2	17.0	15.0	15.1	14.2	14.4	13.6	13.8
8/4/95	1345	1601	1588	1511	1442	1359	1716	1471	1353	1430	21.3	21.2	17.3	17.2	15.0	15.2	14.2	14.2	13.6	13.8
8/14/95	1352	1607	1589	1515	1440	1357	1715	1470	1353	1429	20.6	20.5	17.7	17.5	15.5	15.6	14.5	14.4	13.8	13.9
8/28/95	1344	1598	1578	1507	1435	1352	1711	1467	1353	1427	20.5	20.4	17.7	17.6	15.9	16.0	14.8	14.8	13.9	14.1
8/31/95	1343	1597	1578	1506	1434	1351	1711	1467	1353	1427	20.5	20.4	17.8	17.6	15.9	16.0	14.9	14.8	14.0	14.2
9/5/95	1339	1592	1572	1501	1431	1349	1709	1465	1353	1426	20.7	20.6	17.8	17.7	16.0	16.1	15.0	14.9	14.1	14.3
9/7/95	1339	1592	1571	1500	1430	1347	1709	1465	1353	1426	20.4	20.3	17.9	17.7	16.1	16.2	15.1	15.0	14.1	14.3
9/14/95	1358	1611	1594	1522	1447	1364	1716	1473	1354	1426	20.5	20.4	17.9	17.7	16.2	16.3	15.2	15.1	14.2	14.4
10/5/95	1350	1602	1574	1505	1435	1354	1710	1467	1352	1423	19.2	19.0	18.1	18.0	16.5	16.6	15.5	15.5	14.5	14.7
11/6/95	1368	1619	1580	1510	1434	1355	1709	1469	1351	1421	14.8	14.7	16.6	16.4	16.4	16.5	15.8	15.8	14.9	15.1
12/28/95	1389	1640	1595	1521	1441	1357	1714	1476	1354	1422	9.7	9.6	13.1	12.9	14.6	14.8	15.2	15.2	14.9	15.1
1/11/96	1392	1644	1605	1531	1449	1363	1718	1480	1355	1423	9.9	9.8	12.2	12.0	14.0	14.1	14.9	14.8	14.8	15.0
4/9/96	1388	1642	1623	1546	1473	1378	1735	1509	1368	1433	11.7	11.6	10.4	10.2	11.2	11.3	12.4	12.3	13.1	13.3
7/21/98	1394	1651	1646	1576	1500	1395	1738	1540	1373	1433	18.3	18.2	14.3	14.2	13.2	13.3	13.0	12.9	12.8	13.0
11/13/98	1652	1393	1552	1616	1359	1472	1519	1720	1422	1361	13.0	13.5	16.0	16.0	16.0	16.0	15.0	15.0	14.5	14.0

Row - C

	Nail Strain Gage										Temperature									
Date	1C1	1C2	1C3	1C4	1C5	1C6	1C7	1C8	1C9	1C10	1C1	1C2	1C3	1C4	1C5	1C6	1C7	1C8	1C9	1C10
initial?																				
2/14/95	1559	1358	1498	1381	1561	1645	1836	1348	1963	1497										
2/17/95	1572	1374	1503	1385	1564	1647	1839	1351	1967	1500	14.5	13.6	15.6	15.7	15.7	15.6	15.5	14.9	14.8	15.1
2/23/95	1578	1377	1508	1387	1566	1646	1838	1349	1967	1498	13.5	13.6	13.6	13.6	13.4	13.2	13.6	13.5	13.7	13.1
3/2/95	1556	1338	1508	1380	1567	1644	1834	1344	1965	1493	12.8	12.8	13.9	14.2	14.6	14.3	14.5	14.4	14.3	14.4
3/7/95	1596	1403	1516	1387	1569	1645	1835	1344	1967	1494	11.9	11.7	13.7	13.9	14.4	14.2	14.4	14.3	14.2	14.3
3/16/95	1609	1419	1522	1388	1572	1645	1836	1345	1968	1493	12.0	12.0	13.3	13.5	14.2	13.3	14.2	14.2	14.1	14.2
4/5/95	1560	1334	1518	1370	1573	1642	1831	1337	1958	1481	13.5	13.4	13.0	13.3	13.8	13.5	13.9	13.9	14.0	14.1
4/14/95	1606	1398	1524	1375	1577	1645	1840	1346	1971	1490	12.1	12.1	13.1	13.3	13.7	13.4	13.8	13.8	13.9	14.0
4/18/95	1625	1425	1528	1378	1577	1645	1841	1347	1974	1492	12.2	12.2	13.0	13.2	13.7	13.4	13.8	13.7	13.8	14.0
4/25/95	1616	1409	1527	1375	1578	1644	1841	1346	1975	1490	12.6	12.6	12.8	13.0	13.6	13.3	13.7	13.7	13.8	13.9
5/3/95	1597	1370	1524	1367	1578	1644	1839	1344	1977	1490	13.0	13.0	12.9	13.2	13.5	13.2	13.6	13.6	13.7	13.8
5/12/95	1596	1367	1525	1364	1578	1642	1838	1341	1980	1487	13.0	13.0	13.0	13.3	13.5	13.2	13.5	13.5	13.6	13.7
5/16/95	1597	1367	1523	1361	1578	1641	1837	1340	1982	1486	13.9	13.9	13.0	13.3	13.5	13.2	13.5	13.5	13.6	13.7
6/6/95	1601	1373	1519	1346	1576	1636	1831	1333	1987	1486	17.1	17.2	14.4	14.7	13.7	13.4	13.5	13.4	13.5	13.6
6/13/95	1601	1372	1518	1341	1575	1634	1830	1332	1990	1479	16.8	16.6	14.7	14.9	13.9	13.6	13.5	13.4	13.4	13.6
6/23/95	1605	1377	1526	1339	1574	1632	1830	1331	2002	1480	15.2	15.2	14.6	14.8	14.1	13.8	13.6	13.5	13.4	13.6
6/29/95	1597	1365	1516	1331	1572	1629	1828	1328	2009	1478	17.7	17.7	14.7	14.9	14.1	13.9	13.6	13.6	13.4	13.6
7/7/95	1614	1387	1518	1329	1572	1628	1826	1326	2018	1476	18.6	18.6	15.3	15.5	14.3	14.0	13.7	13.6	13.4	13.6
7/18/95	1616	1388	1518	1325	1570	1625	1823	1322	2026	1474	19.2	19.2	15.6	15.8	14.5	14.3	13.8	13.7	13.5	13.6
7/21/95	1595	1355	1517	1319	1570	1624	1822	1319	2026	1471	20.2	20.2	15.8	16.0	14.6	14.4	13.9	13.8	13.5	13.7
7/25/95	1591	1351	1517	1316	1569	1622	1820	1317	2028	1469	19.9	19.9	16.1	16.3	14.7	14.5	13.9	13.9	13.6	13.7
7/31/95	1577	1329	1516	1310	1568	1620	1818	1314	2032	1467	19.3	19.3	16.4	16.6	14.9	14.6	14.0	13.9	13.6	13.7
8/1/95	1585	1341	1518	1311	1568	1620	1818	1314	2033	1467	19.3	19.2	16.4	16.6	14.9	14.6	14.0	13.9	13.5	13.7
8/4/95	1582	1335	1518	1309	1567	1619	1817	1313	2035	1466	19.3	19.3	16.4	16.6	15.0	14.7	14.0	14.0	13.6	13.7
8/14/95	1585	1341	1521	1306	1566	1617	1815	1309	2044	1463	18.6	18.6	16.5	16.7	15.2	14.9	14.2	14.1	13.7	13.8
8/28/95	1578	1327	1523	1302	1565	1614	1813	1305	2056	1460	18.7	18.7	16.5	16.7	15.4	15.2	14.4	14.3	13.8	13.9
8/31/95	1576	1324	1523	1301	1565	1613	1812	1305	2059	1460	18.7	18.7	16.5	16.8	15.5	15.2	14.4	14.4	13.8	13.9
9/5/95	1573	1320	1524	1299	1564	1612	1811	1303	2062	1455	18.7	18.7	16.6	16.8	15.5	15.3	14.5	14.5	13.9	14.0
9/7/95	1572	1317	1524	1298	1564	1612	1811	1302	2062	1453	18.5	18.5	16.6	16.8	15.6	15.3	14.5	14.5	13.9	14.0
9/14/95	1598	1355	1529	1301	1564	1612	1812	1303	2068	1454	18.7	18.7	16.6	16.0	15.6	15.4	14.6	14.6	13.9	14.1
10/5/95	1570	1313	1530	1291	1562	1608	1806	1295	2071	1445	17.4	17.4	16.7	16.9	15.8	15.6	14.8	14.8	14.2	14.3
11/6/95	1571	1312	1544	1295	1565	1607	1806	1292	2109	1442	14.0	14.1	15.7	15.9	15.8	15.5	15.1	15.0	14.4	14.6
12/28/95	1572	1311	1563	1306	1570	1614	1814	1297	2193	1447	10.2	10.2	13.1	13.4	14.5	14.2	14.7	14.6	14.5	14.6
1/11/96	1579	1318	1569	1312	1574	1618	1821	1302	2212	1452	10.1	10.2	12.4	12.6	13.9	13.7	14.4	14.3	14.4	14.5
4/9/96	1600	1340	1587	1324	1594	1636	1846	1326	2285	1476	10.1	10.2	10.3	10.6	11.4	11.2	12.1	12.1	12.8	12.9
7/21/98	1763	1452	1672	1283	1643	1613	1926	1306	2470	1471	15.2	15.5	13.5	13.7	13.1	12.8	12.7	12.7	12.6	12.8
11/13/98	1736	1390	1680	1266	1632	1598	1911	1282	2457	1446	13.0	14.0	15.0	15.0	15.0	15.0	14.0	14.0	14.0	14.0

Cedar Hills Interchange to S.W. 76th AVE. Wall 13 Instrumented Section 2
Section 2 - Strain Gauge Data
Revised 4/11/96 zero readings
Last:

Row - A

	Nail Strain Gage										Temperature									
Date	2A1	2A2	2A3	2A4	2A5	2A6	2A7	2A8	2A9	2A10	2A1	2A2	2A3	2A4	2A5	2A6	2A7	2A8	2A9	2A10
1/9/95	1591	1329	1032	1619	1296	1601	1927	1910	1747	1362	10.8	10.6	11.0	11.1	10.8	10.5	10.5	10.5	10.4	10.7
1/17/95	1783	1176	1216	1444	1288	1634	2138	2243	0	1473										
1/20/95	1791	1173	1208	1444	1291	1635	2164	2239	0	1470										
1/24/95	1798	1147	1204	1448	1303	1645	2217	2240	0	1471										
1/31/95	2000	909	1215	1485	1314	1655	2252	2239	0	1470	12.2	12.2	10.3	10.3	11.1	10.8	11.3	11.4		14.9
2/3/95	2091	1043	1243	1514	1319	1660	2280	2239	0	1464	11.8	11.6	10.3	10.3	11.2	10.9	12.1	12.1		13.1
2/14/95	2181	1117	1299	1583	1347	1671	2386	2245	0	1460										
2/17/95	2100	1069	1267	1548	1340	1660	2321	2238	0	1456	5.9	5.6	10.9	11.2	11.7	11.4	12.4	12.3		15.9
2/23/95	2093	1059	1268	1550	1348	1666	2358	2241	0	1455										
3/2/95	2143	1091	1284	1570	1352	1670	2363	2245	0	1454	8.5	8.3	10.3	10.3	11.3	11.0	12.0	12.1		13.1
3/7/95	2102	1058	1270	1561	1349	1665	2331	2240	0	1449	7.6	7.4	10.3	10.3	11.2	11.0	12.2	12.2		13.2
3/16/95	2075	1041	1265	1554	1352	1667	2335	2242	0	1474	9.8	9.6	10.1	10.2	11.2	11.0	12.3	12.3		15.1
4/5/95	2157	1110	1292	1589	1367	1678	2417	2251	0	1547	11.6	11.4	10.7	10.7	11.3	11.1	12.3	12.3		14.9
4/14/95	2122	1073	1283	1576	1364	1674	2386	2249	0	1562	9.9	9.7	10.9	11.0	11.4	11.2	12.3	12.3		15.1
4/18/95	2134	1083	1282	1575	1362	1671	2363	2248	0	1562	10.0	9.8	10.9	10.9	11.5	11.2	12.3	12.3		15.0
4/25/95	2099	1058	1277	1567	1365	1673	2381	2250	0	1566	12.6	12.4	10.8	10.9	11.5	11.3	12.4	12.4		15.1
5/3/95	2078	1043	1272	1561	1363	1672	2374	2249	0	1565	12.2	12.0	11.3	11.4	11.6	11.3	12.3	12.3		14.8
5/12/95	2126	1080	1281	1568	1367	1675	2395	2250	0	1566	12.1	11.9	11.7	11.7	11.7	11.5	12.3	12.4		14.9
5/16/95	2090	1058	1275	1561	1370	1676	2417	2252	0	1570	15.1	15.0	11.9	11.9	11.8	11.6	12.4	12.4		14.6
6/6/95	2122	1095	1277	1559	1370	1678	2422	2252	0	1566	16.7	16.5	14.7	14.7	12.7	12.4	12.5	12.5		14.8
6/13/95	2106	1085	1270	1550	1367	1674	2406	2251	0	1565	16.7	16.5	15.0	15.0	13.2	12.9	12.5	12.6		13.0
6/23/95	2031	1019	1248	1527	1359	1665	2346	2246	0	1563	15.8	15.6	14.9	14.9	13.7	15.4	12.7	12.8		14.5
6/29/95	2005	1004	1246	1523	1364	1668	2383	2249	0	1566	20.8	20.6	15.2	15.2	13.8	13.5	12.9	12.9		14.7
7/7/95	2102	1152	1269	1544	1366	1671	2396	2250	0	1566	25.9	26.7	16.6	16.6	14.1	13.9	13.1	13.1		14.5
7/18/95	2175	1143	1273	1548	1364	1668	2389	2249	0	1565	23.3	23.2	19.0	19.0	15.3	15.0	13.5	13.5		14.4
7/21/95	2256	1246	1288	1563	1368	1671	2418	2252	0	1568	23.5	23.3	19.2	19.2	15.7	15.4	13.7	13.7		14.6
7/25/95	2246	1216	1285	1560	1361	1666	2374	2248	0	1564	22.7	22.6	19.4	19.4	16.1	15.8	13.9	13.9		14.6
7/31/95	2247	1209	1286	1560	1361	1666	2377	2248	0	1565	21.4	21.2	19.5	19.5	16.6	16.3	14.3	14.3		14.8
8/1/95	2243	1204	1284	1557	1360	1664	2361	2247	0	1564	21.3	21.1	19.5	19.5	16.6	16.3	14.3	14.3		14.9
8/4/95	2237	1202	1285	1558	1361	1664	2370	2247	0	1565	21.2	21.1	19.4	19.4	16.8	16.5	14.5	14.5		15.0
8/14/95	2268	1215	1287	1559	1355	1660	2309	2243	0	1562	20.0	19.8	19.3	19.3	17.2	16.9	14.9	14.9		15.2
8/28/95	2277	1241	1291	1562	1359	1661	2313	2244	0	1563	19.0	18.8	18.7	18.7	17.3	17.0	15.4	15.3		15.5
8/31/95	2271	1231	1291	1562	1359	1661	2287	2243	0	1563	18.9	18.7	18.6	18.6	17.3	17.0	15.4	15.4		15.7
9/5/95	2293	1260	1296	1567	1360	1662	2312	2244	0	1563	19.3	19.1	18.5	18.5	17.3	17.0	15.6	15.6		15.8
9/7/95	2307	1271	1298	1569	1360	1662	2327	2243	0	1563	19.1	18.9	18.5	18.5	17.3	17.0	15.6	15.6		15.8
9/14/95	2219	1173	1282	1553	1356	1658	2286	2241	0	1561	19.2	19.0	18.5	18.5	17.3	17.0	15.7	15.7		16.1
10/5/95	2326	1281	1303	1574	1359	1660	2300	2241	0	1561	17.3	17.1	18.3	18.3	17.4	17.1	16.1	16.1		16.3
11/6/95	2374	1302	1315	1586	1365	1660	2299	2239	0	1561	12.8	12.6	15.9	16.0	16.5	16.2	16.0	16.0		16.8
12/28/95	2356	1272	1329	1601	1380	1668	2342	2242	0	1561	8.4	8.2	11.7	11.8	13.3	13.0	14.3	14.4		15.8
1/11/96	2332	1259	1330	1601	1384	1670	2354	2244	0	1562	9.2	9.0	11.2	11.3	13.0	12.7	14.2	14.2		15.7
4/9/96	2316	1280	1349	1616	1398	1676	2408	2250	0	1555	10.7	10.5	10.2	10.2	11.2	10.9	12.4	12.4		13.9
7/21/98	2158	1219	1318	1561	1398	1670	2407	2233	0	1515	17.9	18.2	15.2	15.2	13.7	13.5	12.9	13.0		12.9
11/13/98	2275	1322	1329	1571	1384	1664	2283	2222	0	1512	12.0	12.0	16.0	16.0	16.0	16.0	16.0	16.0		15.0

Row - B

	Nail Strain Gage										Temperature									
Date	2B1	2B2	2B3	2B4	2B5	2B6	2B7	2B8	2B9	2B10	2B1	2B2	2B3	2B4	2B5	2B6	2B7	2B8	2B9	2B10
1/16/95	1426	1321	1469	1511	1374	1337	1500	1435	1321	1322	9.2	9.4	8.6	8.9	8.3	8.3	8.1	8.2	7.7	7.7
2/3/95	1584	1420	1891	1137	1339	927	1691	1646	1290	1208	11.0	11.2	11.0	10.9	12.5	12.7	15.0	15.2	16.7	16.7
2/14/95	1769	1547	2240	1414	1524	1153	1808	1745	1348	1256										
2/17/95	1790	1570	2242	1420	1525	1154	1810	1748	1351	1257	9.0	9.0	11.5	12.0	12.0	12.0	13.2	13.9	13.7	13.9
2/23/95	1801	1576	2249	1431	1529	1157	1817	1754	1357	1263										
3/2/95	1810	1580	2249	1437	1528	1159	1822	1757	1358	1264	9.5	9.7	10.6	10.5	11.2	11.5	12.2	12.3	12.9	
3/7/95	1827	1596	2262	1451	1534	1165	1825	1758	1358	1262	8.7	8.9	10.6	10.5	11.3	11.5	12.1	12.3	12.8	
3/16/95	1838	1604	2264	1456	1537	1169	1832	1763	1363	1268	9.4	9.6	10.4	10.3	11.2	11.4	12.0	12.1	12.6	
4/5/95	1853	1616	2283	1479	1546	1176	1840	1770	1371	1276	11.0	11.2	10.7	10.6	11.2	11.4	11.9	12.0	12.4	
4/14/95	1873	1635	2305	1502	1556	1186	1845	1773	1372	1276	10.1	10.3	10.9	10.8	11.2	11.4	11.8	12.0	12.3	
4/18/95	1875	1638	2303	1505	1556	1186	1845	1772	1370	1275	10.2	10.4	11.0	10.8	11.2	11.4	11.8	11.9	12.3	
4/25/95	1871	1634	2295	1502	1557	1185	1847	1774	1373	1278	10.8	11.0	11.0	10.9	11.3	11.5	11.8	11.9	12.2	
5/3/95	1881	1642	2308	1516	1562	1190	1850	1777	1374	1279	11.4	11.6	11.1	11.0	11.3	11.5	11.8	11.9	12.2	
5/12/95	1882	1642	2309	1519	1563	1190	1851	1778	1376	1281	11.8	12.1	11.4	11.3	11.3	11.6	11.8	11.9	12.1	
5/16/95	1868	1630	2290	1505	1560	1186	1852	1779	1376	1283	12.7	12.8	11.5	11.4	11.4	11.6	11.8	11.9	12.1	
6/6/95	1857	1626	2299	1522	1565	1189	1853	1780	1379	1286	15.7	15.9	12.5	12.4	11.7	11.9	11.9	12.1	12.1	
6/13/95	1859	1629	2299	1524	1566	1189	1855	1780	1379	1286	15.6	15.7	12.9	12.8	11.9	12.1	12.0	12.1	12.1	
6/23/95	1876	1646	2309	1536	1573	1196	1858	1783	1379	1285	14.5	14.7	13.2	13.1	12.2	12.4	12.1	12.2	12.1	
6/29/95	1869	1641	2302	1532	1574	1196	1861	1786	1382	1289	16.7	16.9	13.3	13.2	12.3	12.5	12.2	12.3	12.1	
7/7/95	1807	1585	2239	1479	1549	1166	1849	1776	1375	1282	18.5	18.6	13.7	13.6	12.5	12.7	12.3	12.4	12.2	
7/18/95	1804	1588	2240	1478	1547	1159	1847	1774	1372	1279	19.6	19.8	14.6	14.5	12.8	13.0	12.4	12.5	12.2	
7/21/95	1779	1566	2214	1459	1538	1148	1844	1772	1371	1280	20.0	20.1	14.8	14.7	12.9	13.1	12.5	12.6	12.3	
7/25/95	1778	1565	2208	1456	1533	1141	1843	1768	1368	1276	19.9	20.1	15.0	14.9	13.1	13.3	12.6	12.7	12.3	
7/31/95	1781	1568	2210	1459	1533	1139	1842	1767	1368	1276	19.4	19.6	15.3	15.2	13.3	13.5	12.7	12.8	12.4	
8/1/95	1780	1568	2208	1457	1533	1138	1842	1767	1368	1275	19.3	19.5	15.3	15.2	13.3	13.5	12.7	12.8	12.4	
8/4/95	1777	1566	2202	1453	1531	1135	1841	1767	1368	1276	19.3	19.4	15.4	15.3	13.4	13.6	12.8	12.9	12.4	
8/14/95	1767	1557	2182	1440	1521	1122	1836	1761	1363	1271	18.7	18.9	15.7	15.7	13.8	14.0	13.0	13.1	12.5	
8/28/95	1759	1553	2171	1433	1516	1114	1834	1759	1363	1271	18.1	18.3	16.0	15.9	14.2	14.4	13.4	13.5	12.8	
8/31/95	1763	1556	2173	1435	1517	1114	1834	1759	1363	1272	18.1	18.3	16.0	15.9	14.3	14.5	13.4	13.6	12.8	
9/5/95	1752	1547	2161	1428	1513	1108	1833	1758	1362	1271	18.3	18.5	16.1	16.0	14.4	14.6	13.6	13.7	12.9	
9/7/95	1750	1545	2159	1427	1511	1106	1832	1757	1361	1270	18.2	18.4	16.1	16.0	14.4	14.7	13.6	13.7	12.9	
9/14/95	1767	1561	2170	1437	1518	1115	1835	1759	1361	1270	18.1	18.3	16.2	16.1	13.6	14.8	13.8	13.9	13.1	
10/5/95	1744	1540	2155	1432	1503	1090	1829	1752	1355	1265	17.5	17.8	16.5	16.4	15.0	15.2	14.2	14.3	13.4	
11/6/95	1783	1579	2206	1599	1518	1093	1832	1756	1353	1263	13.6	13.9	15.6	15.5	15.2	15.4	14.6	14.7	13.8	
12/28/95	1823	1618	2257	1647	1543	1118	1846	1768	1356	1271	9.3	9.6	12.1	12.1	13.4	13.6	14.1	14.2	14.0	
1/11/96	1823	1624	2268	1659	1547	1130	1854	1776	1362	1277	9.6	9.9	11.6	11.5	12.8	13.1	13.7	13.8	13.8	
4/9/96	1851	1647	2308	1700	1591	1148	1885	1807	1383	1303	10.0	10.2	10.0	9.9	10.4	10.6	11.2	11.3	12.0	
7/21/98	1841	1636	2443	1521	1654	1126	1898	1817	1402	1333	16.4	16.5	13.4	13.3	12.4	12.6	12.2	12.3	12.1	
11/13/98	1821	1616	2374		1623	1082	1873	1789	1383	1312	13.0	13.0	15.0	15.0	15.0	15.0	14.0	14.0	14.0	

Row - C

	Nail Strain Gage										Temperature									
Date initial?	2C1	2C2	2C3	2C4	2C5	2C6	2C7	2C8	2C9	2C10	2C1	2C2	2C3	2C4	2C5	2C6	2C7	2C8	2C9	2C10
2/14/95	1892	1193	1594	1442	1370	1582	1479	1606	990	1474										
2/17/95	1897	1195	1597	1447	1374	1585	1482	1610	994	1477	12.4	12.3	13.9	13.7	14.3	14.4	14.6	14.7	14.6	15.4
2/23/95	1922	1226	1609	1463	1383	1593	1485	1614	1001	1484										
3/2/95	1931	1239	1621	1478	1395	1603	1489	1618	1008	1490	11.4	11.2	12.3	12.3	12.9	13.0	13.3	13.3	13.5	13.7
3/7/95	1930	1236	1622	1480	1397	1603	1487	1617	1009	1490	10.6	10.4	12.2	12.2	12.8	12.8	13.2	13.2	13.3	13.6
3/16/95	1931	1236	1625	1482	1400	1606	1488	1618	1013	1494	10.6	10.4	11.6	11.6	12.5	12.5	12.9	12.9	13.1	13.4
4/5/95	1930	1233	1639	1495	1413	1615	1489	1618	983	1496	11.3	11.1	11.4	11.4	12.1	12.1	12.5	12.6	12.8	13.1
4/14/95	1924	1223	1638	1495	1415	1615	1491	1616	978	1491	10.8	10.6	11.5	11.5	12.0	12.0	12.4	12.4	12.7	13.0
4/18/95	1923	1221	1639	1495	1416	1616	1491	1614	977	1490	10.8	10.6	11.5	11.5	11.9	12.0	12.3	12.4	12.7	12.9
4/25/95	1926	1223	1640	1496	1416	1617	1492	1612	975	1491	10.9	10.7	11.4	11.4	11.8	11.9	12.3	12.3	12.6	12.8
5/3/95	1916	1211	1640	1496	1418	1618	1493	1608	973	1489	11.7	11.5	11.5	11.5	11.8	11.9	12.2	12.2	12.5	12.8
5/12/95	1919	1216	1643	1500	1419	1620	1493	1604	1109	1485	12.0	11.8	11.7	11.6	11.8	11.8	12.1	12.2	12.5	12.7
5/16/95	1921	1216	1642	1498	1418	1619	1494	1603	1127	1483	12.4	12.2	11.7	11.7	11.8	11.9	12.1	12.1	12.4	12.7
6/6/95	1917	1210	1648	1505	1422	1619	1493	1593	1136	1475	15.1	14.9	12.7	12.6	12.0	12.0	12.1	12.1	12.4	12.6
6/13/95	1918	1209	1649	1505	1423	1617	1492	1590	1140	1476	14.9	14.7	12.9	12.9	12.1	12.1	12.1	12.1	12.3	12.6
6/23/95	1910	1196	1644	1499	1421	1612	1491	1587	1139	1474	14.2	13.9	15.2	13.2	12.3	12.3	12.1	12.2	12.3	12.5
6/29/95	1909	1195	1644	1498	1420	1610	1492	1586	1139	1475	15.5	15.3	13.2	13.2	12.4	12.4	12.2	12.2	12.3	12.5
7/7/95	1879	1154	1632	1488	1412	1598	1484	1578	1137	1472	16.8	16.6	13.6	13.6	12.5	12.5	12.3	12.3	12.3	12.6
7/18/95	1850	1122	1608	1463	1396	1579	1479	1570	1135	1468	17.8	17.5	14.4	14.4	12.7	12.8	12.4	12.4	12.4	12.6
7/21/95	1825	1099	1596	1452	1388	1570	1476	1566	1134	1467	18.1	17.8	14.5	14.5	12.8	12.9	12.4	12.4	12.4	12.6
7/25/95	1822	1096	1592	1448	1385	1565	1473	1563	1133	1465	18.2	17.9	14.7	14.7	12.9	13.0	12.4	12.5	12.4	12.6
7/31/95	1821	1095	1590	1445	1382	1560	1471	1561	1134	1460	17.9	17.6	14.9	14.9	13.1	13.1	12.5	12.6	12.5	12.7
8/1/95	1819	1093	1589	1444	1382	1559	1471	1561	1134	1460	17.8	17.6	15.0	14.9	13.1	13.2	12.5	12.6	12.5	12.7
8/4/95	1819	1093	1588	1443	1380	1557	1472	1560	1134	1458	17.8	17.6	15.0	15.0	13.2	13.3	12.6	12.6	12.5	12.7
8/14/95	1807	1081	1579	1435	1374	1545	1470	1554	1133	1454	17.5	17.2	15.3	15.2	13.5	13.5	12.8	12.8	12.6	12.8
8/28/95	1801	1076	1574	1431	1370	1537	1469	1549	1134	1451	17.0	16.8	15.3	15.3	13.7	13.8	13.0	13.0	12.7	12.9
8/31/95	1802	1076	1574	1430	1369	1535	1469	1549	1135	1450	17.0	16.8	15.3	15.3	13.8	13.8	13.0	13.1	12.7	12.9
9/5/95	1794	1069	1570	1427	1367	1531	1468	1547	1135	1450	17.1	16.9	15.4	15.4	13.9	13.9	13.1	13.2	12.8	13.0
9/7/95	1793	1068	1570	1426	1366	1529	1468	1546	1135	1449	17.1	16.9	15.4	15.4	13.9	13.9	13.2	13.2	12.8	13.0
9/14/95	1810	1083	1576	1432	1371	1532	1473	1548	1136	1451	17.1	16.9	15.4	15.4	14.0	14.0	13.3	13.3	12.9	13.1
10/5/95	1786	1062	1562	1419	1364	1514	1467	1542	1135	1453	16.8	16.6	15.7	15.7	14.3	14.3	13.5	13.6	13.1	13.3
11/6/95	1801	1078	1569	1427	1371	1510	1472	1545	1136	1461	14.3	14.1	15.1	15.1	14.5	14.5	13.9	13.9	13.5	13.7
12/28/95	1819	1095	1581	1440	1386	1511	1489	1557	1138	1475	10.5	10.3	12.9	12.9	13.7	13.8	13.9	13.9	13.8	14.0
1/11/96	1824	1097	1586	1446	1394	1516	1497	1564	1139	1481	10.3	10.1	12.1	12.1	13.2	13.3	13.6	13.7	13.7	13.9
4/9/96	1836	1106	1600	1469	1432	1532	1529	1594	1156	1515	9.6	9.4	10.0	10.0	10.7	10.8	11.5	11.5	12.1	12.4
7/21/98	1844	1141	1676	1519	1467	1502	1511	1572	1165	1539	14.5	14.2	12.8	12.8	12.0	12.1	11.9	11.9	11.8	12.2
11/13/98	1813	1113	1656	1503	1449	1481	1491	1556	1164	1528	14.0	14.0	14.5	14.5	14.0	14.0	13.0	13.0	13.0	13.0

Cedar Hills Interchange to S.W. 76th AVE. Wall 14 Instrumented Section
Section 3 - Strain Gauge Data
Revised 4/11/96 zero readings
Last:

Row A grouted 9-22-94

	Nail Strain Gage										Temperature									
Date	3A1	3A2	3A3	3A4	3A5	3A6	3A7	3A8	3A9	3A10	3A1	3A2	3A3	3A4	3A5	3A6	3A7	3A8	3A9	3A10
9/22/94	2044	1604	1664	1599	1300	1796	1579	1868	1404	2104	29.0	29.0	29.1	29.1	28.5	28.5	28.7	28.7	28.1	28.1
9/26/94	2066	1630	1722	1634	1367	1847	1650	1934	1474	2201	21.9	21.9	23.0	23.0	21.7	21.7	20.6	20.6	19.2	19.2
10/18/94	2070	1637	1714	1628	1392	1859	1679	1958	1495	2230	16.1	16.1	20.8	20.8	20.5	20.5	19.3	19.3	18.2	18.2
10/29/94	2080	1648	1720	1638	1404	1864	1687	1965	1501	2235	14.6	14.6	19.2	19.2	20.1	20.1	19.4	19.4	18.4	18.4
11/4/94	2091	1658	1725	1644	1411	1866	1692	1966	1503	2237	11.5	11.5	17.5	17.5	19.4	19.4	19.1	19.1	18.5	18.5
11/11/94	2092	1659	1728	1647	1415	1868	1694	1966	1505	2238	11.1	11.1	16.8	16.8	18.9	18.9	19.0	19.0	18.4	18.4
11/26/94	2096	1661	1738	1656	1425	1873	1703	1972	1510	2244	9.1	9.1	14.2	14.2	17.6	17.6	18.3	18.3	17.8	17.8
12/1/94	2098	1663	1743	1661	1429	1876	1705	1973	1510	2246	8.9	8.9	13.4	13.4	16.8	16.8	17.8	17.8	17.9	17.9
12/7/94	2109	1674	1751	1668	1436	1877	1710	1978	1514	2249	7.0	7.0	12.4	12.4	16.0	16.0	17.3	17.3	17.7	17.7
12/12/94	2113	1677	1756	1673	1440	1883	1713	1980	1516	2250	6.8	6.8	11.7	11.7	15.5	15.5	17.0	17.0	17.5	17.5
12/16/94	2116	1682	1760	1676	1444	1886	1713	1983	1518	2252	6.8	6.8	11.2	11.2	14.9	14.9	16.7	16.7	17.3	17.3
12/20/94	2116	1681	1762	1679	1446	1888	1718	1987	1518	2253	7.7	7.7	10.9	10.9	14.5	14.5	16.3	16.3	17.1	17.1
1/7/95	2126	1695	1771	1690	1459	1898	1729	1995	1522	2260	6.9	6.9	10.7	10.7	13.3	13.3	15.0	15.0	16.3	16.3
1/13/95	2125	1696	1774	1692	1463	1900	1731	1998	1524	2262	7.4	7.4	10.4	10.4	13.0	13.0	14.7	14.7	16.0	16.0
1/20/95	2127	1698	1777	1695	1466	1903	1734	2001	1525	2264	7.8	7.8	10.2	10.2	12.6	12.6	14.2	14.2	15.7	15.7
2/3/95	2124	1697	1779	1698	1471	1908	1738	2004	1528	2267	8.6	8.6	10.0	10.0	12.1	12.1	13.7	13.7	15.0	15.0
2/14/95	2128	1698	1779	1700	1473	1909	1738	2008	1529	2268										
2/23/95	2125	1697	1779	1701	1476	1911	1739	2010	1531	2270	9.0	9.0	10.0	10.0	12.0	12.0	13.0	13.0	14.0	14.0
3/2/95	2126	1699	1781	1704	1479	1914	1740	2012	1531	2270	10.3	10.3	10.2	10.2	11.6	11.6	12.9	12.9	14.2	14.2
3/7/95	2131	1704	1782	1705	1480	1915	1741	2013	1532	2272	9.9	9.9	10.3	10.3	11.5	11.5	12.8	12.8	14.2	14.2
3/16/95	2132	1702	1783	1708	1483	1918	1743	2016	1536	2275	10.1	10.1	10.4	10.4	11.4	11.4	12.6	12.6	13.9	13.9
4/14/95	2126	1697	1781	1708	1487	1922	1745	2022	1539	2280	12.7	12.7	11.7	11.7	11.7	11.7	12.4	12.4	13.5	13.5
4/18/95	2127	1697	1780	1707	1487	1922	1745	2022	1539	2281	12.4	12.4	11.7	11.7	11.6	11.6	12.3	12.3	13.4	13.4
5/3/95	2170	1743	1788	1718	1491	1927	1745	2024	1541	2285	13.0	13.0	11.9	11.9	11.8	11.8	12.3	12.3	13.3	13.3
5/12/95	2165	1738	1786	1717	1490	1927	1744	2024	1542	2286	13.3	13.3	12.1	12.1	12.0	12.0	12.4	12.4	13.2	13.2
6/6/95	2162	1738	1783	1716	1490	1927	1743	2024	1543	2288	17.4	17.4	13.5	13.5	12.6	12.6	12.7	12.7	13.3	13.2
6/13/95	2163	1739	1781	1715	1490	1926	1742	2024	1543	2288	17.5	17.5	14.1	14.1	12.9	12.9	12.8	12.8	13.3	13.3
7/18/95	2188	1759	1784	1723	1490	1927	1741	2024	1543	2288	20.0	20.0	16.6	16.6	14.7	14.7	14.0	14.0	14.0	14.0
7/25/95	2171	1740	1780	1719	1487	1924	1739	2022	1542	2287	21.3	21.3	17.2	17.2	15.1	15.1	14.3	14.3	14.2	14.2
8/1/95	2172	1739	1780	1719	1486	1923	1738	2022	1542	2286	21.6	21.6	17.8	17.8	15.5	15.5	14.5	14.5	14.4	14.4
8/4/95	2171	1738	1779	1719	1485	1922	1738	2021	1541	2286	21.8	21.8	18.0	18.0	15.7	15.7	14.7	14.7	14.5	14.5
8/14/95	2170	1735	1779	1718	1485	1921	1737	2021	1541	2285	21.9	21.9	18.7	18.7	16.4	16.4	15.1	15.1	14.8	14.8
8/31/95	2174	1737	1780	1720	1484	1920	1736	2019	1540	2284	21.7	21.7	19.3	19.3	17.1	17.1	15.8	15.8	15.3	15.3
9/7/95	2173	1737	1781	1721	1485	1920	1736	2019	1539	2284	21.8	21.8	19.5	19.5	17.4	17.4	16.1	16.1	15.6	15.6
9/14/95	2194	1759	1789	1730	1489	1924	1738	2022	1539	2285	21.7	21.7	19.6	19.6	17.7	17.7	16.4	16.4	15.8	15.8
10/5/95	2178	1741	1785	1723	1485	1920	1736	2019	1538	2283	21.1	21.1	20.0	20.0	18.3	18.3	17.0	17.0	16.4	16.4
11/6/95	2199	1761	1797	1735	1490	1924	1737	2021	1538	2284	17.4	17.4	18.9	18.9	18.5	18.5	17.6	17.6	17.0	17.0
12/28/95	2220	1783	1819	1754	1501	1936	1741	2027	1546	2287	11.8	11.8	15.3	15.3	16.6	16.6	16.9	16.9	16.9	16.9
1/11/96	2228	1793	1826	1762	1506	1941	1743	2030	1541	2287	11.4	11.4	14.2	14.2	15.8	15.8	16.5	16.5	16.6	16.6
4/9/96	2246	1820	1843	1781	1526	1961	1753	2045	1551	2296	12.0	12.0	11.5	11.5	12.3	12.3	13.4	13.4	14.3	14.3
7/22/98	2268	1844	1859	1802	1553	1986	1779	2069	1563	2304	19.3	19.3	15.6	15.6	14.2	14.2	14.0	14.0	14.1	14.1
11/13/98	2259	1827	1849	1798	1541	1970	1770	2058	1555	2295	16.0		18.3		17.8		17.4		16.7	

Row A

Date	Grout Strain Gage										Temperature									
	3A1G	3A2G	3A3G	3A4G	3A5G	3A6G	3A7G	3A8G	3A9G	3A10G	3A1G	3A2G	3A3G	3A4G	3A5G	3A6G	3A7G	3A8G	3A9G	3A10G
9/22/94	2639	2506	2163	2642	2501	2260	2178	2465	2591	2542	27.5	27.5	29.3	29.3	25.0	25.0	27.0	27.0	26.4	26.4
9/26/94	2573	2534	2299	2666	2602	2289	2255	2498	2669	2594	21.9	21.9	23.2	23.2	21.6	21.6	20.8	20.8	18.9	18.9
10/18/94	2586	2565	2321	2681	2623	2309	2273	2520	2689	2629	16.4	16.4	20.9	20.9	20.6	20.6	19.5	19.5	17.9	17.9
10/29/94	2608	2575	2331	2703	2634	2324	2284	2530	2696	2643	14.8	14.8	19.3	19.3	20.2	20.2	19.6	19.6	18.9	18.9
11/4/94	2636	2586	2341	2709	2644	2330	2292	2536	2700	2650	11.5	11.5	17.5	17.5	19.5	19.5	19.3	19.3	18.2	18.2
11/11/94	2640	2592	2347	2711	2648	2332	2296	2539	2704	2653	11.2	11.2	16.7	16.7	19.1	19.1	19.1	19.1	18.1	18.1
11/26/94	2668	2596	2364	2711	2660	2343	2305	2549	2711	2659	9.7	9.7	14.2	14.2	17.6	17.6	18.3	18.3	17.8	17.8
12/1/94	2671	2601	2369	2715	2665	2346	2309	2552	2714	2661	8.8	8.8	13.2	13.2	17.0	17.0	18.1	18.1	17.6	17.6
12/7/94	2688	2606	2378	2719	2673	2352	2314	2557	2717	2664	6.9	6.9	12.2	12.2	16.2	16.2	17.4	17.4	17.4	17.4
12/12/94	2691	2613	2382	2723	2679	2353	2318	2559	2719	2664	6.7	6.7	11.5	11.5	15.4	15.4	17.1	17.1	17.2	17.2
12/16/94	2694	2613	2387	2726	2684	2357	2323	2561	2721	2664	6.8	6.8	11.1	11.1	14.8	14.8	16.8	16.8	17.0	17.0
12/20/94	2691	2613	2389	2729	2686	2359	2326	2562	2723	2665	7.7	7.7	10.7	10.7	14.5	14.5	16.4	16.4	16.8	16.8
1/7/95	2691	2628	2395	2744	2700	2368	2338	2571	2731	2666	7.2	7.2	10.6	10.6	13.5	13.5	15.2	15.2	16.0	16.0
1/13/95	2687	2638	2398	2745	2707	2368	2341	2574	2734	2665	7.4	7.4	10.4	10.4	13.3	13.3	14.8	14.8	15.7	15.7
1/20/95	2687	2641	2401	2749	2710	2371	2346	2574	2738	2664	7.8	7.8	10.1	10.1	12.9	12.9	14.3	14.3	15.3	15.3
2/3/95	2685	2640	2403	2753	2714	2376	2351	2579	2742	2665	8.5	8.5	9.9	9.9	12.3	12.3	13.8	13.8	14.8	14.8
2/14/95	2686	2633	2404	2750	2716	2377	2352	2580	2744	2665										
2/23/95	2681	2641	2404	2750	2718	2380	2355	2585	2746	2667	9.3	9.3	10.3	10.3	12.0	12.0	13.2	13.2	14.2	14.2
3/2/95	2681	2640	2406	2753	2720	2383	2358	2587	2748	2668	10.3	10.3	10.2	10.2	11.8	11.8	13.1	13.1	14.0	14.0
3/7/95	2683	2643	2408	2754	2722	2383	2361	2588	2750	2667	10.0	10.0	10.3	10.3	11.8	11.8	13.0	13.0	13.9	13.9
3/16/95	2687	2642	2411	2754	2725	2386	2365	2591	2754	2669	10.1	10.1	10.4	10.4	11.7	11.7	12.8	12.8	13.7	13.7
4/14/95	2681	2634	2411	2748	2731	2387	2371	2596	2760	2669	12.7	12.7	11.7	11.7	11.8	11.8	12.6	12.6	13.2	13.2
4/18/95	2682	2634	2411	2748	2731	2387	2371	2596	2760	2669	12.4	12.4	11.7	11.7	11.9	11.9	12.5	12.5	13.2	13.2
5/3/95	2686	2648	2415	2765	2733	2392	2375	2597	2763	2670	12.9	12.9	11.8	11.8	12.0	12.0	12.5	12.5	13.3	13.3
5/12/95	2685	2644	2414	2761	2731	2391	2376	2597	2764	2671	13.2	13.2	12.1	12.1	12.2	12.2	12.5	12.5	13.5	13.5
6/6/95	2666	2629	2408	2759	2725	2390	2375	2597	2766	2671	17.2	17.2	13.5	13.5	12.7	12.7	12.8	12.8	14.0	14.0
6/13/95	2665	2628	2406	2758	2723	2390	2375	2597	2766	2670	17.4	17.4	14.2	14.2	13.0	13.0	13.0	13.0	16.1	16.1
7/18/95	2654	2630	2402	2764	2710	2393	2374	2599	2766	2671	20.0	20.0	16.7	16.7	14.8	14.8	14.2	14.2	11.1	11.1
7/25/95	2644	2617	2398	2755	2704	2388	2372	2597	2766	2670	21.2	21.2	17.3	17.3	15.2	15.2	14.5	14.5	19.6	19.6
8/1/95	2640	2615	2397	2753	2701	2387	2371	2596	2766	2669	21.5	21.5	17.9	17.9	15.6	15.6	14.8	14.8	17.0	17.0
8/4/95	2637	2613	2395	2750	2698	2387	2370	2595	2766	2669	21.7	21.7	18.1	18.1	15.8	15.8	14.9	14.9	20.1	20.1
8/14/95	2635	2608	2395	2743	2696	2384	2370	2595	2766	2668	22.0	22.0	18.8	18.8	16.4	16.4	15.3	15.3	17.0	17.0
8/31/95	2630	2608	2395	2738	2691	2383	2368	2594	2765	2667	21.7	21.7	19.3	19.3	17.3	17.3	16.1	16.1	14.0	14.0
9/7/95	2630	2606	2397	2735	2689	2382	2369	2594	2766	2666	21.7	21.7	19.6	19.6	17.6	17.6	16.4	16.4	12.4	12.4
9/14/95	2634	2621	2401	2748	2692	2388	2371	2597	2766	2667	21.7	21.7	19.7	19.7	17.8	17.8	16.6	16.6	13.7	13.7
10/5/95	2630	2605	2398	2726	2687	2381	2369	2593	2765	2663	22.0	22.0	20.2	20.2	18.4	18.4	17.3	17.3	11.4	11.4
11/6/95	2648	2616	2410	2724	2693	2385	2374	2594	2766	2661	17.7	17.7	19.0	19.0	18.7	18.7	17.8	17.8	17.0	17.0
12/28/95	2674	2633	2429	2727	2706	2382	2384	2600	2772	2660			15.4	15.4	16.9	16.9	17.1	17.1		
1/11/96	2678	2641	2434	2735	2711	2386	2387	2603	2773	2660	11.2	11.2	14.3	14.3	16.2	16.2	16.6	16.6	17.0	17.0
4/9/96	2679	2656	2448	2754	2728	2392	2402	2619	2771	2661			11.6	11.6	12.7	12.7	13.5	13.5		
7/22/98	2681	2671	2454	2773	2741	2418	2407	2630	2736	2660	19.1	19.1	15.9	15.9	14.6	14.6	14.2	14.2	14.0	14.0
11/13/98	2681	2662	2446	2750	2729	2399	2382	2618	2730	2653	16.3		18.6		18.4		17.6			

Row B grouted 10/7/94

	Nail Strain Gage										Temperature									
Date	3B1	3B2	3B3	3B4	3B5	3B6	3B7	3B8	3B9	3B10	3B1	3B2	3B3	3B4	3B5	3B6	3B7	3B8	3B9	3B10
10/7/94	1857	1666	1801	1860	1853	1678	1896	1863	1696	1904	25.5	25.5	25.7	25.7	25.3	25.3	22.9	22.9	25.3	25.3
10/18/94	1893	1708	1880	1932	1766	1875	1940	1896	1740	1903	14.6	14.6	20.6	20.6	19.4	19.4	18.2	18.2	17.1	17.1
10/29/94	1911	1726	1895	1951	1791	1894	1961	1926	1741	1905	13.4	13.4	19.2	19.2	19.1	19.1	18.5	18.5	17.3	17.3
11/4/94	1921	1736	1904	1960	1801	1901	1964	1938	1742	1906	12.5	12.5	18.3	18.3	18.9	18.9	18.5	18.5	17.5	17.5
11/11/94	1926	1741	1910	1965	1804	1904	1967	1942	1743	1907	12.0	12.0	17.9	17.9	18.8	18.8	18.5	18.5	17.6	17.6
11/26/94	1936	1744	1919	1971	1814	1908	1967	1950	1743	1908	9.6	9.6	16.4	16.4	18.0	18.0	18.3	18.3	17.7	17.7
12/1/94	1939	1749	1924	1976	1817	1913	1971	1956	1744	1908	9.6	9.6	15.8	15.8	17.6	17.6	18.1	18.1	17.6	17.6
12/7/94	1941	1753	1929	1979	1820	1914	1970	1967	1743	1909	7.6	7.6	15.0	15.0	17.0	17.0	17.7	17.7	17.5	17.5
12/12/94	1946	1755	1931	1982	1823	1916	1973	1967	1746	1909	7.5	7.5	14.6	14.6	16.7	16.7	17.5	17.5	17.5	17.5
12/16/94	1947	1758	1935	1986	1828	1919	1979	1972	1746	1909	7.4	7.4	14.1	14.1	16.3	16.3	17.2	17.2	17.3	17.3
12/20/94	1946	1759	1938	1988	1830	1922	1979	1973	1745	1909	8.6	8.6	13.7	13.7	16.0	16.0	16.9	16.9	17.3	17.3
1/7/95	1953	1765	1944	1995	1841	1928	1982	1980	1749	1910	6.6	6.6	12.8	12.8	14.8	14.8	15.8	15.8	16.7	16.7
1/13/95	1957	1773	1950	2001	1840	1933	1984	1984	1750	1910	7.7	7.7	12.4	12.4	14.4	14.4	15.5	15.5	16.5	16.5
1/20/95	1957	1774	1953	2004	1841	1935	1985	1986	1748	1912	7.9	7.9	12.0	12.0	14.1	14.1	15.2	15.2	16.3	16.3
2/3/95	1958	1775	1957	2010	1844	1939	1986	1988	1750	1913	9.2	9.2	11.6	11.6	13.4	13.4	14.5	14.5	15.8	15.8
2/14/95	1955	1769	1955	2007	1839	1936	1978	1980	1749	1911										
2/23/95	1957	1774	1958	2012	1848	1944	1984	1989	1750	1912	9.9	9.9	11.4	11.4			13.9	13.9	15.9	15.9
3/2/95	1961	1779	1963	2018	1853	1949	1987	1993	1751	1912	11.1	11.1	11.4	11.4			13.7	13.7	15.0	15.0
3/7/95	1966	1783	1966	2021	1854	1953	1989	1996	1752	1913	11.0	11.0	11.5	11.5	12.6	12.6	13.3	13.3	15.1	15.1
3/16/95	1964	1780	1966	2020	1855	1954	1987	1994	1755	1916	10.8	10.8	11.6	11.6			13.4	13.4	14.7	14.7
4/14/95	1952	1768	1960	2011	1848	1948	1975	1980	1757	1917	12.8	12.8	12.3	12.3	12.3	12.3	13.0	13.0	14.1	14.1
4/18/95	1952	1767	1959	2010	1846	1946	1973	1978	1757	1917	12.6	12.6	12.3	12.3	12.1	12.1	13.0	13.0	14.0	14.0
5/3/95	1960	1772	1966	2019	N/A	1958	1987	1999	1759	1918	13.3	13.3	12.4	12.4			13.0	13.0	13.8	13.8
5/12/95	1957	1769	1963	2016	N/A	1954	1982	1992	1759	1918	13.4	13.4	12.8	12.8	12.4	12.4	13.0	13.0	13.7	13.7
6/6/95	1945	1760	1959	2013	1852	1951	1974	1984	1760	1919	17.9	17.9	13.7	13.7			13.1	13.1	13.6	13.6
6/13/95	1947	1762	1959	2013	N/A	1952	1975	1986	1761	1919	17.6	17.6	14.2	14.2			13.1	13.1	13.5	13.5
7/18/95	1952	1768	1961	2019	N/A	1961	1988	2002	1762	1920	19.8	19.8	16.1	16.1			13.7	13.7	13.7	13.7
7/25/95	1943	1763	1956	2013	1853	1955	1979	1990	1761	1919	21.2	21.2	16.5	16.5	14.4	14.4	13.8	13.8	13.8	13.8
8/1/95	1943	1764	1956	2012	1854	1955	1980	1991	1761	1920	21.2	21.2	17.0	17.0	14.7	14.7	14.0	14.0	13.8	13.8
8/4/95	1943	1764	1955	2011	1853	1955	1979	1990	1761	1920	21.5	21.5	17.2	17.2	14.8	14.8	14.1	14.1	13.9	13.9
8/14/95	1941	1763	1953	2008	1849	1952	1975	1986	1760	1920	21.4	21.4	17.9	17.9	15.3	15.3	14.4	14.4	14.1	14.1
8/31/95	1943	1765	1953	2008	1850	1952	1977	1987	1761	1920	21.3	21.3	18.6	18.6	16.1	16.1	14.9	14.9	14.4	14.4
9/7/95	1941	1764	1952	2006	1846	1949	1973	1982	1760	1920	21.3	21.3	18.8	18.8	16.4	16.4	15.1	15.1	14.6	14.6
9/14/95	1947	1769	1956	2014	1857	1958	1986	1997	1761	1920	21.6	21.6	19.0	19.0	16.7	16.7	15.4	15.4	14.7	14.7
10/5/95	1949	1771	1954	2009	1849	1951	1977	1986	1761	1920	20.2	20.2	19.6	19.6	17.4	17.4	16.0	16.0	15.2	15.2
11/6/95	1966	1781	1963	2017	1855	1955	1983	1992	1763	1920	16.4	16.4	18.7	18.7	17.9	17.9	16.8	16.8	15.9	15.9
12/28/95	1990	1798	1980	2035	1864	1964	1991	1999	1763	1922	10.7	10.7	15.7	15.7	16.8	16.8	16.9	16.9	16.4	16.4
1/11/96	1993	1801	1985	2042	1868	1966	1995	2004	1763	1922	10.9	10.9	14.9	14.9	16.2	16.2	16.6	16.6	16.3	16.3
4/9/96	1998	1810	2000	2064	1884	1985	2012	2016	1767	1928	12.6	12.6	12.3	12.3	13.1	13.1	13.9	13.9	14.8	14.8
7/21/98	2022	1840	2016	2083	1917	2005	2040	2073	1789	1932	19.5	19.5	15.5	15.5	14.1	14.1	14.0	14.0	13.8	13.8
11/13/98	2022	1846	2004	2062	1889	1987	2019	2001	1790	1932	14.7		18.3		17.6		16.6		15.6	

Row B grouted 10/7/94

	Grout Strain Gage										Temperature									
Date	3B1G	3B2G	3B3G	3B4G	3B5G	3B6G	3B7G	3B8G	3B9G	3B10G	3B1G	3B2G	3B3G	3B4G	3B5G	3B6G	3B7G	3B8G	3B9G	3B10G
10/7/94	2590	2620	2673	2638	2658	2545	2432	2384	3250	2441	25.5	25.5	25.8	25.8	21.4	21.4	20.4	20.4	24.6	24.6
10/18/94	2554	2661	2777	2679	N/A	2603	2421	2406		2490	14.9	14.9	20.7	20.7	19.5	19.5	18.2	18.2	17.2	17.2
10/29/94	2574	2674	2787	2700	N/A	2633	2430	2432		2502	13.7	13.7	19.4	19.4	19.2	19.2	18.5	18.5	17.4	17.4
11/4/94	2588	2687	2790	2709	N/A	2642	2439	2437	3385	2507	13.0	13.0	18.5	18.5	19.0	19.0	18.5	18.5	17.6	17.6
11/11/94	2594	2694	2795	2711	N/A	2646	2442	2437	3386	2511	12.5	12.5	18.0	18.0	18.8	18.8	18.5	18.5	17.7	17.7
11/26/94	2618	2689	2808	2712	N/A	2651	2443	2440		2515	10.1	10.1	16.6	16.6	18.0	18.0	18.2	18.2	17.8	17.8
12/1/94	2626	2689	2812	2715	N/A	2656	2443	2444	3389	2518	9.8	9.8	16.0	16.0	17.6	17.6	18.0	18.0	17.8	17.8
12/7/94	2628	2692	2820	2712	N/A	2657	2443	2446	3391	2521	8.1	8.1	15.3	15.3	17.0	17.0	17.5	17.5	17.7	17.7
12/12/94	2633	2693	2824	2712	N/A	2660	2443	2449	3392	2523	7.9	7.9	14.9	14.9	16.7	16.7	17.3	17.3	17.6	17.6
12/16/94	2630	2699	2829	2713	N/A	2667	2442	2453	3391	2524	7.7	7.7	14.4	14.4	16.3	16.3	17.0	17.0	17.5	17.5
12/20/94	2628	2699	2832	2714	N/A	2669	2442	2453	3391	2526	8.7	8.7	14.0	14.0	16.0	16.0	16.7	16.7	17.4	17.4
1/7/95	2634	2707	2836	2723	N/A	2680	2443	2457		2532	7.1	7.1	12.9	12.9	14.6	14.6	15.6	15.6	16.9	16.9
1/13/95	2632	2722	2841	2727	N/A	2690	2442	2457	3393	2534	7.9	7.9	12.7	12.7	14.4	14.4	15.3	15.3	16.7	16.7
1/20/95	2632	2724	2843	2728	N/A	2693	2442	2458	3391	2537	8.1	8.1	12.3	12.3	14.0	14.0	14.9	14.9	16.5	16.5
2/3/95	2629	2725	2848	2731	N/A	2699	2441	2459	3394	2541	9.3	9.3	11.8	11.8	13.4	13.4	14.3	14.3	16.0	16.0
2/14/95	2627	2714	2847	2723	N/A	2689	2440	2449	3393	2527										
2/23/95	2628	2723	2848	2728	N/A	2700	2440	2455		2544	10.0	10.0	11.7	11.7	12.9	12.9	13.7	13.7	15.5	15.5
3/2/95	2634	2728	2850	2736	N/A	2707	2440	2458		2544	11.2	11.2	11.6	11.6	12.7	12.7	13.5	13.5	15.3	15.3
3/7/95	2642	2728	2854	2737	N/A	2709	2440	2458		2544	11.2	11.2	11.7	11.7	12.6	12.6	13.4	13.4	15.2	15.2
3/16/95	2639	2726	2856	2732	N/A	2705	2440	2453	3395	2546	10.9	10.9	11.7	11.7	12.4	12.4	13.2	13.2	14.9	14.9
4/14/95	2610	2718	2857	2713	N/A	2685	2441	2432	3398	2540	13.0	13.0	12.3	12.3	12.4	12.4	12.9	12.9	14.3	14.3
4/18/95	2609	2718	2855	2711	N/A	2684	2441	2428	3398	2539	12.9	12.9	12.4	12.4	12.4	12.4	12.8	12.8	14.2	14.2
5/3/95	2626	2715	2856	2724	N/A	2702	2442	2444	3394	2537	13.5	13.5	12.4	12.4	12.5	12.5	12.8	12.8	14.0	14.0
5/12/95	2617	2712	2855	2718	N/A	2692	2442	2436	3393	2536	13.6	13.6	12.8	12.8	12.5	12.5	12.8	12.8	13.9	13.9
6/6/95	2595	2697	2852	2713	N/A	2681	2441	2420	3394	2534	18.0	18.0	13.6	13.6	12.8	12.8	12.9	12.9	13.7	13.7
6/13/95	2595	2698	2851	2713	N/A	2682	2442	2421	3395	2532	17.8	17.8	14.1	14.1	12.9	12.9	13.0	13.0	13.7	13.7
7/18/95	2605	2684	2845	2722	N/A	2693	2444	2433	3396	2521	20.0	20.0	16.1	16.1	14.1	14.1	13.6	13.6	13.8	13.8
7/25/95	2585	2681	2843	2710	N/A	2678	2446	2419	3396	2517	21.3	21.3	16.5	16.5	14.4	14.4	13.7	13.7	13.9	13.9
8/1/95	2583	2681	2841	2708	N/A	2678	2447	2419	3396	2515	21.4	21.4	17.0	17.0	14.7	14.7	14.0	14.0	13.8	13.8
8/4/95	2581	2681	2840	2706	N/A	2676	2448	2416	3395	2513	21.6	21.6	17.2	17.2	14.9	14.9	14.0	14.0	14.0	14.0
8/14/95	2572	2679	2841	2698	N/A	2668	2450	2411	3396	2510	21.6	21.6	17.9	17.9	15.4	15.4	14.3	14.3	14.2	14.2
8/31/95	2570	2679	2841	2696	N/A	2668	2454	2409	3397	2506	21.5	21.5	18.6	18.6	16.1	16.1	14.8	14.8	14.5	14.5
9/7/95	2563	2677	2841	2690	N/A	2662	2456	2403	3397	2505	21.6	21.6	18.8	18.8	16.4	16.4	15.1	15.1	14.7	14.7
9/14/95	2581	2674	2841	2704	N/A	2678	2457	2418	3397	2506	21.7	21.7	19.0	19.0	16.7	16.7	15.3	15.3	14.8	14.8
10/5/95	2563	2680	2846	2688	N/A	2665	2462	2405	3397	2504	20.6	20.6	19.6	19.6	17.4	17.4	16.0	16.0	15.3	15.3
11/6/95	2579	2687	2852	2691	N/A	2671	2465	2406	3397	2500	16.9	16.9	18.8	18.8	17.9	17.9	16.7	16.7	16.0	16.0
12/28/95	2601	2704	2868	2699	N/A	2681	2468	2410	3401	2491	11.2	11.2	15.9	15.9	16.8	16.8	16.8	16.8	16.4	16.4
1/11/96	2606	2701	2872	2706	N/A	2687	2467	2414	3400	2489	11.2	11.2	15.0	15.0	16.2	16.2	16.5	16.5	16.3	16.3
4/9/96	2616	2696	2881	2724	N/A	2705	2453	2423	3401	2482	12.7	12.7	12.4	12.4	13.1	13.1	13.7	13.7	14.9	14.9
7/22/98	2632	2711	2877	2752	N/A	2715	2479	2430	1561437	2508	19.7	19.7	15.5	15.5	14.1	14.1	13.7	13.7	14.0	14.0
11/13/98	2613	2738	2874	2724	N/A	2684	2498	2401	11432526	2504	15.4		18.4		17.7		16.5		15.8	

Row C grouted 11/8/94

	Nail Strain Gage										Temperature									
Date	3C1	3C2	3C3	3C4	3C5	3C6	3C7	3C8	3C9	3C10	3C1	3C2	3C3	3C4	3C5	3C6	3C7	3C8	3C9	3C10
initial?																				
11/11/94	1834	1709	1779	1769	1829	1739	1873	1759	N/A	1877	13.9	13.9	19.5	19.1	20.3	20.3	20.5	20.5	18.8	19.4
11/26/94	1858	1716	1801	1785	1853	1753	1895	1778	N/A	1877	9.8	9.8	16.8	16.5	18.2	18.4	18.6	18.5	16.9	17.5
12/1/94	1858	1712	1803	1787	1856	1755	1859	1780	N/A	1873	10.3	10.3	16.3	16	17.9	18.2	18.4	18.4	16.8	17.4
12/7/94	1868	1717	1825	1808	1881	1777	1917	1799	N/A	1869	7.9	7.9	15.7	15.4	17.6	17.9	18.2	18.1	16.7	17.4
12/12/94	1870	1714	1830	1813	1886	1781	1920	1802	N/A	1866	8	8	15.3	15	17.4	17.4	18	18	18	18
12/16/94	1872	1698	1846	1828	1913	1807	1945	1829	N/A	1866	9	9	14.9	14.6	17.1	17.4	17.9	17.9	16.6	17.3
12/20/94	1872	1697	1854	1836	1923	1816	1954	1837	N/A	1861	10	10.1	14.5	14.2	16.9	17.2	17.8	17.8	16.6	17.2
1/7/95	1905	1735	1897	1874	1984	1874	2006	1891	N/A	1855	7.1	7.1	13.7	13.4	15.9	16.2	17.2	17.1	16.3	17
1/13/95	1917	1751	1923	1899	2003	1891	2019	1906	N/A	1854	8.5	8.5	13.3	12.9	15.7	16	17	16.9	16.3	16.9
1/20/95	1918	1751	1930	1905	2012	1900	2027	1914	N/A	1853	8.6	8.6	12.9	12.6	15.4	15.7	16.8	16.7	16.2	16.8
2/3/95	1924	1757	1941	1905	2024	1911	2036	1922	N/A	1846	10.1	10.2	12.4	12.1	14.7	15	16.2	16.2	15.8	16.5
2/14/95	1915	1741	1934	1896	2023	1908	2036	1919	N/A	1838										
2/23/95	1914	1746	1941	1904	2033	1918	2045	1929	N/A	1838	10.7	10.8	12.2	11.9	14.0	14.2	15.6	15.5	15.4	16.0
3/2/95	1901	1732	1934	1897	2032	1917	2047	1930	N/A	1836	12.2	12.2	12.1	11.8	13.8	14.1	15.3	15.3	15.2	15.9
3/7/95	1887	1711	1927	1890	2029	1913	2043	1927	N/A	1834	13.9	13.9	12.2	11.9	13.6	13.9	15.2	15.1	15.1	15.8
3/16/95	1892	1714	1932	1896	2037	1920	2051	1933	N/A	1831	12.4	12.4	12.5	12.2	13.4	13.7	14.9	14.9	14.9	15.5
4/14/95	1894	1706	1932	1897	2043	1926	2058	1939	67	1821	12.9	12.9	12.9	12.6	13.1	13.4	14.3	14.3	14.3	15.0
4/18/95	1893	1705	1930	1896	2043	1925	2057	1938	N/A	1820	12.9	12.9	12.9	12.7	13.1	13.4	14.2	14.2	14.3	14.9
5/3/95	1896	1710	1936	1903	2050	1931	2065	1946	N/A	1820	13.9	13.9	13.0	12.7	13.0	13.3	14.1	14.0	14.0	14.7
5/12/95	1893	1704	1932	1901	2049	1930	2064	1945	59	1818	13.9	13.9	13.2	12.9	13.0	13.3	14.0	13.9	13.9	14.6
6/6/95	1894	1707	1935	1910	2055	1934	2068	1949	N/A	1817	18.6	18.7	14.1	13.9	13.2	13.4	13.8	13.8	13.7	14.3
6/13/95	1897	1711	1935	1911	2056	1935	2068	1949	107	1817	18.3	18.4	14.6	14.4	13.2	13.5	13.8	13.8	13.6	14.3
7/18/95	1898	1730	1940	1924	2060	1942	2075	1958	N/A	1816	20.7	20.8	16.9	16.0	14.1	14.4	14.0	14.0	13.5	14.1
7/25/95	1894	1724	1937	1922	2056	1939	2072	1954	N/A	1815	21.9	22.0	16.7	16.4	14.3	14.6	14.1	14.0	13.5	14.1
8/1/95	1896	1729	1937	1924	2057	1939	2072	1955	N/A	1815	21.8	21.9	17:2	16.9	14.6	14.8	14.2	14.1	13.5	14.2
8/4/95	1897	1731	1936	1924	2056	1938	2071	1954	N/A	1814	22.2	22.3	17.3	17.1	14.7	14.9	14.2	14.2	13.5	14.2
8/14/95	1896	1727	1932	1922	2054	1935	2069	1952	N/A	1814	21.7	21.7	17.9	17.7	15.0	15.3	14.4	14.4	13.6	14.2
8/31/95	1899	1733	1933	1926	2054	1936	2069	1952	N/A	1814	21.5	21.5	18.5	18.2	15.7	16.0	14.8	14.7	13.7	14.4
9/7/95	1896	1728	1929	1924	2052	1934	2067	1950	N/A	1813	21.4	21.5	18.7	18.4	16.0	16.3	15.0	14.9	13.8	14.5
9/14/95	1897	1738	1935	1931	2059	1940	2073	1957	N/A	1815	22.0	22.0	18.9	18.6	16.2	16.5	15.2	15.1	13.9	15.6
10/5/95	1902	1745	1930	1927	2052	1933	2065	1949	N/A	1805	20.1	20.1	19.4	19.1	16.9	17.1	15.7	15.7	14.3	14.9
11/6/95	1912	1759	1933	1932	2053	1934	2064	1948	N/A	1801	15.7	15.7	18.5	18.5	17.4	17.7	16.5	16.4	14.8	15.4
12/28/95	1936	1790	1947	1945	2062	1942	2066	1951	N/A	1799	10.2	10.1	15.6	15.3	16.7	17.0	16.8	16.8	15.4	16.1
1/11/96	1938	1795	1952	1950	2066	1947	2069	1955	N/A	1800	10.9	10.8	14.8	14.5	16.3	16.6	16.7	16.7	15.5	16.1
4/9/96	1947	1811	1958	1971	2090	1970	2085	1978	N/A	1803	13.6	13.7	12.7	12.4	13.6	13.9	14.9	14.9	14.7	15.3
7/22/98	1978	1846	1983	2004	2117	1987	2110	1994	N/A	1812	20.5	20.6	15.6	15.3	14.0	14.2	14.0	13.9	13.4	14.1
11/13/98	1976	1826	1964	1983	2095	1970	2092	1975	N/A	1804	14.4	14.3	17.9	17.6	17.0	17.3	16.1	16.1	14.5	15.1

Row D grouted 12/29/94 wires re-spliced 11/14/95 initial readings taken before installation

	Nail Strain Gage										Temperature									
Date	3D1	3D2	3D3	3D4	3D5	3D6	3D7	3D8	3D9	3D10	3D1	3D2	3D3	3D4	3D5	3D6	3D7	3D8	3D9	3D10
12/8/94	1830	1531	1762	1804	1741	1722	1799	1885	1825	1787	3.4	3	2.6	2.3	1.6	1.5	1.8	1.4	1.7	1.6
1/14/95	1809	1591	1870	1777	1715	1820	1879	1827	1824	1814	11.1	11.1	14.5	14.2	16.5	16.5	N/A	16.7	16.5	16.5
1/20/95	1834	1636	1875	1782	1715	1824	1882	1830	1826	1815	10.4	10.2	14.2	14.0	16.3	16.3	N/A	16.5	16.3	16.4
2/3/95	1845	1647	1887	1795	1726	1835	1890	1839	1829	1820	10.9	10.7	13.7	13.5	15.6	15.7	N/A	16.1	16.1	16.1
2/14/95	1822	1619	1880	1788	1720	1831	1884	1830	1827	1814										
2/23/95	1824	1618	1889	1798	1728	1840	1893	1841	1831	1823	11.4	10.6	13.8	13.3	15.3	15.1	N/A	15.9	16.1	16.1
3/2/95	1816	1608	1885	1793	1726	1839	1890	1837	1831	1823	12.8	12.4	13.2	12.8	15.1	15.1	N/A	15.8	15.9	15.9
3/7/95	1801	1595	1875	1782	1718	1832	1881	1827	1829	1821	14.3	14.0	13.1	12.8	14.7	14.7	N/A	15.4	15.9	15.7
3/16/95	1817	1611	1882	1790	1724	1838	1886	1833	1833	1825	14.2	13.1	18.8	13.9	14.8	14.5	N/A	15.2	15.6	16.1
4/14/95	1832	1627	1886	1794	1726	1843	1885	1832	1835	1828	13.0	12.8	13.4	12.9	14.0	14.1	N/A	14.7	15.2	15.2
4/18/95	1833	1629	1886	1795	1727	1843	1885	1832	1835	1828	13.2	12.8	13.4	12.9	13.9	14.0	N/A	14.6	15.1	15.1
5/3/95	1832	1629	1891	1800	1732	1850	1890	1839	1838	1831	14.1	14.0	13.2	12.8	13.8	14.1	N/A	14.4	14.9	14.9
5/12/95	1832	1631	1888	1797	1731	1848	1887	1836	1837	1831	14.2	14.1	13.4	12.9	13.8	14.6	N/A	14.3	14.8	14.9
6/6/95	1837	1649	1896	1806	1738	1858	1893	1845	1840	1833	19.6	19.2	15.3	14.3	14.1	14.4	N/A	14.1	14.9	14.7
6/13/95	1840	1652	1895	1806	1739	1859	1893	1846	1840	1834	18.8	18.7	18.6	21.0	13.9	14.3	N/A	14.0	14.7	14.6
7/18/95	1845	1676	1903	1815	1748	1871	1903	1862	1845	1837	21.2	21.1	16.7	16.7	14.6	14.5	N/A	13.9	14.5	14.4
7/25/95	1845	1683	1820	1812	1745	1869	1899	1858	1844	1837	22.4	22.2	21.0	16.7	14.7	14.6	N/A	13.9	14.4	14.4
8/1/95	1847	1685	1900	1812	1746	1870	1899	1859	1844	1837	22.2	22.1	18.3	17.2	18.3	14.7	N/A	13.9	14.5	14.3
8/4/95	1850	1690	1900	1812	1745	1870	1899	1858	1844	1837	22.6	22.5	17.4	17.4	14.9	14.8	N/A	14.0	14.4	14.3
8/14/95	1850	1691	1895	1807	1742	1867	1894	1854	1843	1836	22.2	21.8	18.7	18.0	15.1	15.1	N/A	14.1	14.4	14.3
8/31/95	1856	1698	1897	1809	1742	1869	1894	1856	1844	1836	21.7	21.6	19.9	18.3	15.6	15.6	N/A	14.3	14.3	14.3
9/7/95	1856	1700	1894	1806	1740	1868	1891	1852	1843	1836	21.5	21.4	18.4	18.4	15.8	15.8	N/A	14.4	14.6	14.3
9/14/95	1854	1691	1901	1813	1746	1875	1899	1862	1845	1838	22.0	21.9	18.5	19.3	16.0	16.1	N/A	14.5	14.5	14.4
10/5/95	1861	1707	1893	1804	1739	1869	1887	1849	1842	1835	20.0	19.8	19.2	19.4	16.4	16.5	N/A	14.9	14.7	14.5
11/6/95	1875	1712	1896	1808	1738	1871	1885	1847	1842	1834	15.7	15.2	20.6	16.9	20.0	16.9	N/A	15.4	15.0	14.8
12/28/95	1896	1729	1909	1821	1745	1881	1885	1850	1841	1833	10.3	10.1	18.1	14.6	18.9	16.3	N/A	15.7	15.2	15.2
1/11/96	1896	1729	1915	1827	1750	1886	1889	1854	1842	1834	10.9	10.7	15.2	13.9	18.8	16.1	N/A	15.6	15.3	15.4
4/9/96	1900	1737	1933	1846	1767	1904	1902	1872	1846	1837	13.9	13.8	13.0	12.0	14.2	14.3	N/A	14.7	15.0	15.2
7/22/98	1931	1744	1965	1870	1798	1943	1921	1906	1863	1840	20.4	20.3	15.4	14.8	13.7	13.1	N/A	13.5	8.2	14.4
11/13/98	1939	1742	1947	1848	1778	1927	1901	1883	1858	1844	13.8	13.7	16.7	16.4	16.0		N/A	14.7	7.5	14.3

Row E grouted 12/29/94 wires re-spliced 1/14/95 initial readings taken "on bench"

	Nail Strain Gage										Temperature									
Date	3E1	3E2	3E3	3E4	3E5	3E6	3E7	3E8	3E9	3E10	3E1	3E2	3E3	3E4	3E5	3E6	3E7	3E8	3E9	3E10
12/29/94	1754	1838	1655	1905	1685	1891	1753	1902	1753	1619	8.5	8.2	7.7	7.4	7	7.1	6.9	6.8	6.9	6.8
1/14/95	1870	1751	1765	1870	1760	1856	1980	1666	1746	1635	11.4	11.4	13.9	13.7	15.7	15.9	15.9	15.9	15.9	15.8
1/20/95	1878	1760	1751	1874	1762	1862	1981	1666	1747	1639	10.3	10.3	14.0	13.7	15.6	15.7	15.9	15.9	15.8	15.8
2/3/95	1877	1757	1753	1870	1754	1864	1970	1658	1744	1641	11.0	11.0	13.5	13.2	15.0	15.2	15.6	15.6	15.6	15.5
2/14/95	1880	1769	1748	1859	1741	1857	1954	1643	1737	1638										
2/23/95	1883	1779	1765	1873	1745	1875	1956	1653	1740	1644	10.8	10.8	13.2	12.8	14.6	14.9	15.7	15.5	15.4	15.6
3/2/95	1867	1771	1765	1870	1739	1874	1949	1648	1739	1645	14.2	13.8	14.8	13.3	14.6	15.5	15.6	15.8	15.3	16.8
3/7/95	1868	1765	1755	1859	1728	1862	1936	1629	1734	1642	14.5	14.2	13.1	12.7	14.3	14.6	15.4	15.0	15.3	15.3
3/16/95	1879	1775	1763	1886	1728	1866	1936	N/A	1734	1644	13.3	14.6	13.6	17.6	14.1	14.9	15.4	15.0	15.1	15.1
4/14/95	1874	1785	1773	1865	1725	1864	1922	N/A	1727	1647	12.8	13.2	13.6	12.5	13.9	14.2	14.5	14.6	14.9	14.6
4/18/95	1877	1787	1774	1866	1726	1865	1921	N/A	1727	1642	13.1	14.3	13.6	12.8	13.8	14.2	14.5	14.6	14.8	14.6
5/3/95	1878	1790	1783	1872	1731	1870	1919	N/A	1726	1644	14.5	14.6	13.4	12.8	13.2	14.2	14.3	14.4	14.7	14.5
5/12/95	1876	1789	1781	1868	1728	1866	1916	N/A	1724	1643	14.4	14.5	13.5	13.0	13.7	14.0	14.3	14.3	14.6	14.6
6/6/95	1868	1787	1787	1872	1733	1872	1916	N/A	1721	1644	19.6	21.4	14.7	17.4	13.8	14.2	14.1	14.2	14.7	14.5
6/13/95	1871	1791	1788	1872	1734	1873	1916	N/A	1721	1644	18.9	20.7	15.1	17.9	13.8	14.2	14.1	14.2	14.5	14.5
7/18/95	1888	1809	1814	1890	1751	1891	1924	N/A	1731	1647	22.1	23.8	16.4	18.2	14.4	14.6	15.2	14.2	14.2	14.2
7/25/95	1884	1806	1809	1885	1747	1885	1918	N/A	1729	1644	22.1	23.8	16.4	18.2	14.4	14.6	15.2	14.2	14.2	14.2
8/1/95	1885	1808	1810	1886	1748	1886	1916	N/A	1729	1645	22.4	22.6	17.1	17.8	14.7	14.2	16.6	14.2	14.1	14.1
8/4/95	1885	1808	1810	1885	1747	1885	1915	N/A	1729	1644	22.9	23.3	17.2	17.9	14.7	14.9	16.1	14.4	14.3	14.5
8/14/95	1885	1808	1805	1880	1743	1879	1907	N/A	1727	1643	21.5	21.8	17.6	18.8	15.0	15.1	16.0	14.3	14.2	14.1
8/31/95	1891	1813	1811	1884	1748	1882	1903	N/A	1728	1643	21.3	21.9	17.8	17.7	15.4	15.4	15.3	14.5	14.2	14.0
9/7/95	1890	1810	1807	1880	1745	1877	1896	N/A	1726	1642	20.7	21.6	17.9	17.8	15.5	15.5	14.6	14.7	14.3	14.0
9/14/95	1902	1820	1824	1896	1757	1892	1906	N/A	1730	1646	21.8	22.4	18.0	17.8	15.6	15.6	14.9	14.7	14.4	14.7
10/5/95	1894	1813	1808	1880	1745	1875	1884	N/A	1724	1641	18.9	19.2	18.2	18.1	15.9	15.8	15.1	14.9	14.4	14.1
11/6/95	1909	1822	1812	1884	1746	1875	1872	N/A	1724	1639	17.0	14.2	17.0	19.1	16.2	15.7	15.4	15.3	14.7	14.8
12/28/95	1930	1839	1822	1894	1751	1881	1872	N/A	1725	1640	10.9	11.0	14.6	15.3	15.6	14.3	15.7	15.4	14.9	14.5
1/11/96	1931	1841	1831	1902	1757	1888	1874	N/A	1727	1642	10.6	12.6	14.0	14.7	15.3	13.7	15.4	15.3	14.9	14.5
4/9/96	1938	1850	1853	1921	1774	1908	1870	N/A	1736	1646	13.4	13.5	12.7	12.5	13.6	11.1	14.5	14.4	14.5	13.9
7/22/98	1959	1871	1892	1952	1817	1938	1875	N/A	1760	1666	17.8	17.8	14.9	14.5	13.8	11.2	13.8	13.4	12.5	9.8
11/13/98	1955	1866	1871	1932	1800	1916	1857	N/A	1755	1659	9.0		16.0	15.5	15.5		15.8	14.4	12.7	5.3

APPENDIX C

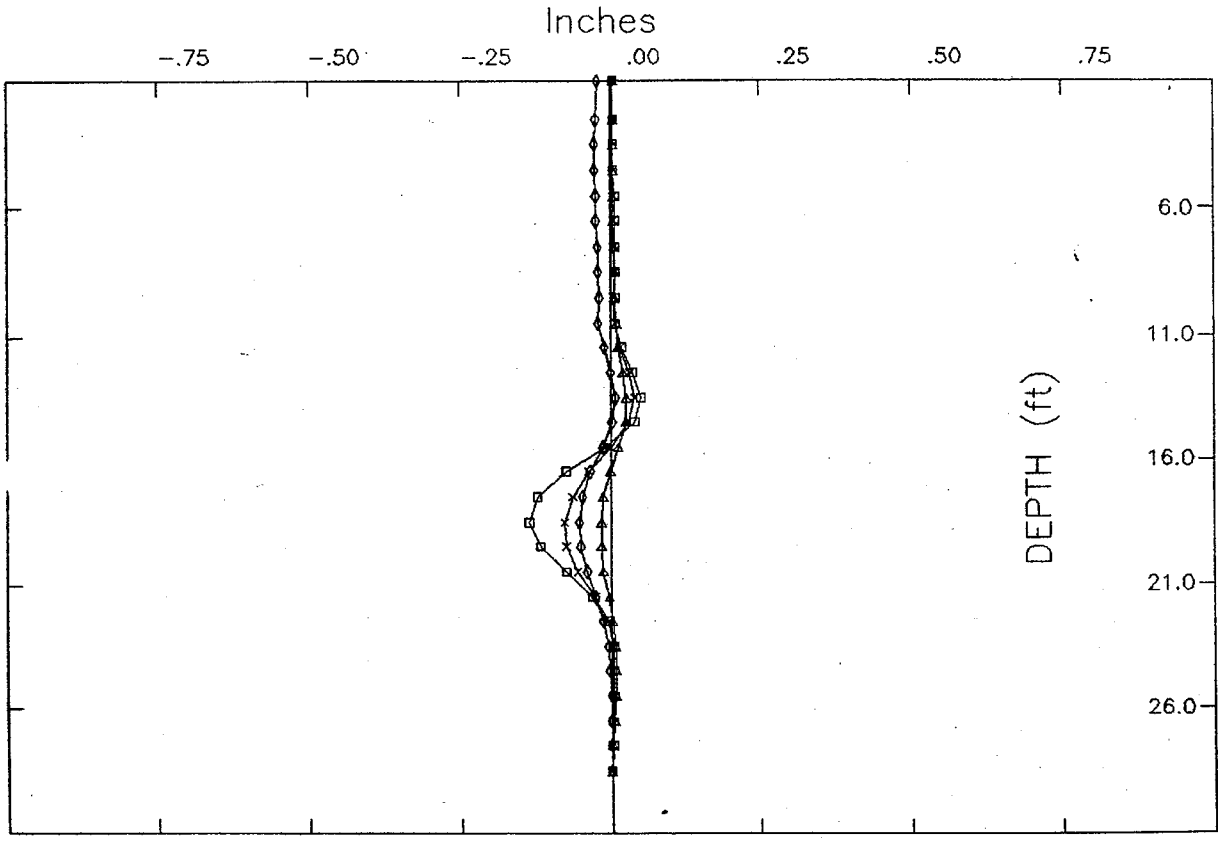
SLOPE INCLINOMETER PLOTS

(NOTE: DATA POINTS GREATER THAN THE 21-FT DEPTH ARE FALSE READINGS AND SHOULD BE IGNORED.)

A – A DEFLECTIONS

HOLE NUMBER: IN-01

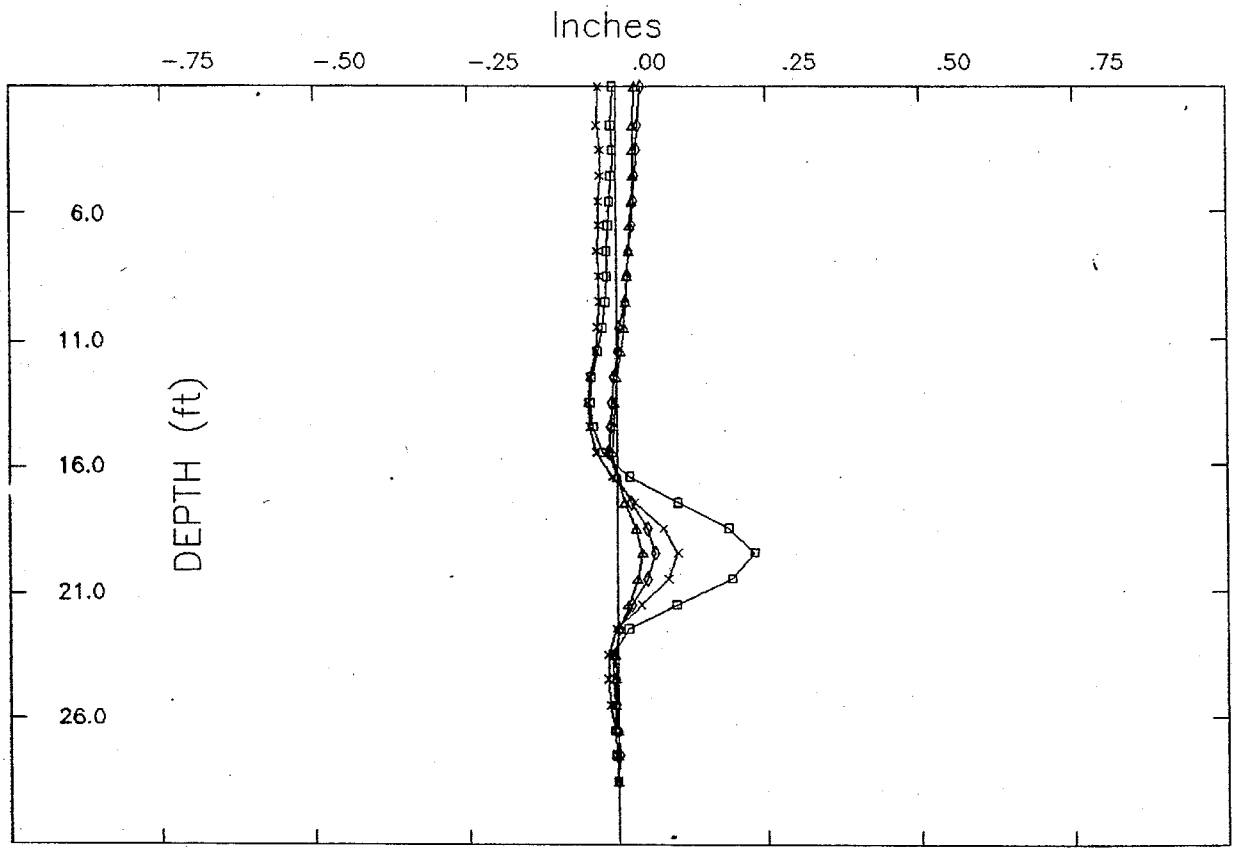
PAST FILE NAME: in01s1.sn	PAST DATE: 08/15/94	
FILE NAME: IN01S5.OUT	DATE: 12/15/94	□
FILE NAME: IN01S4.OUT	DATE: 10/14/94	×
FILE NAME: IN01S3.OUT	DATE: 09/06/94	◇
FILE NAME: IN01S2.OUT	DATE: 08/29/94	△



B – B DEFLECTIONS

HOLE NUMBER: IN-01
PAST FILE NAME: in01s1.sn
FILE NAME: IN01S5.OUT
FILE NAME: IN01S4.OUT
FILE NAME: IN01S3.OUT
FILE NAME: IN01S2.OUT

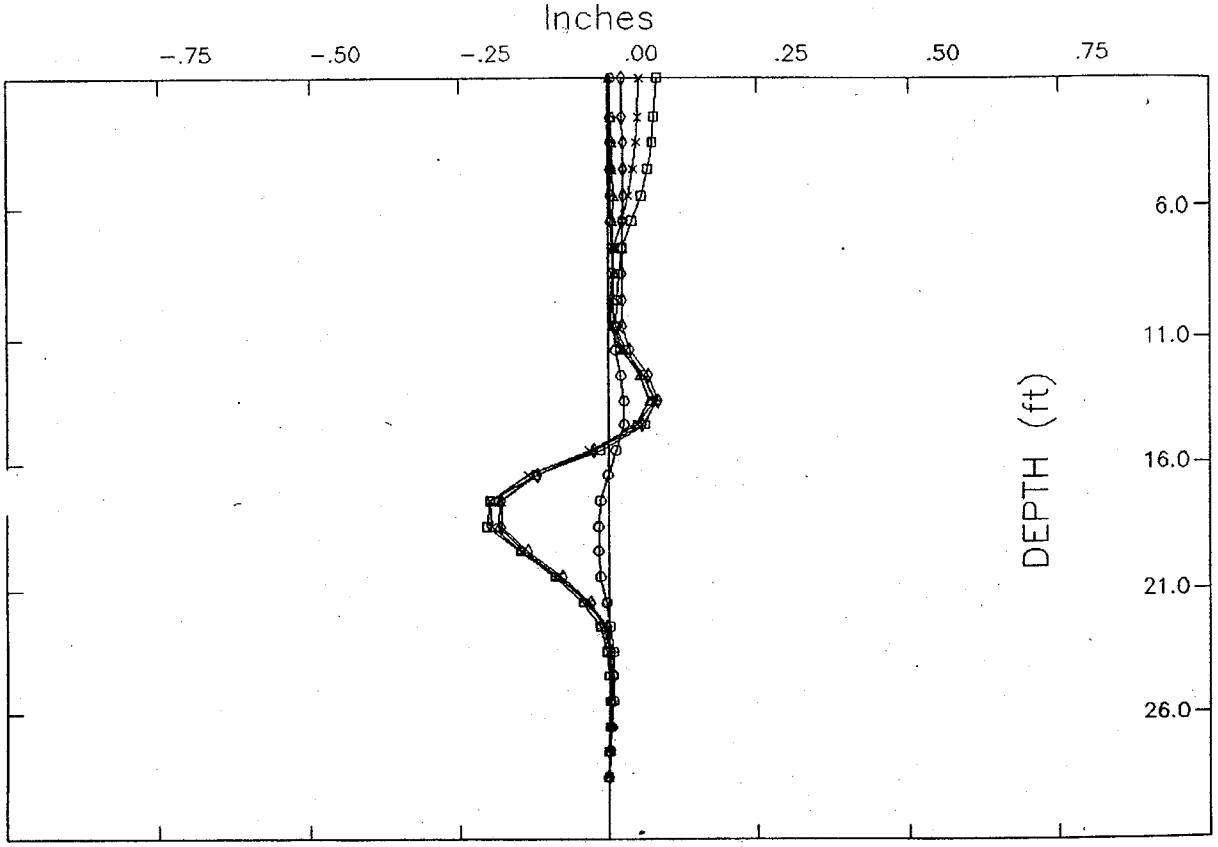
PAST DATE: 08/15/94
DATE: 12/15/94
DATE: 10/14/94
DATE: 09/06/94
DATE: 08/29/94



A – A DEFLECTIONS

HOLE NUMBER: IN-01

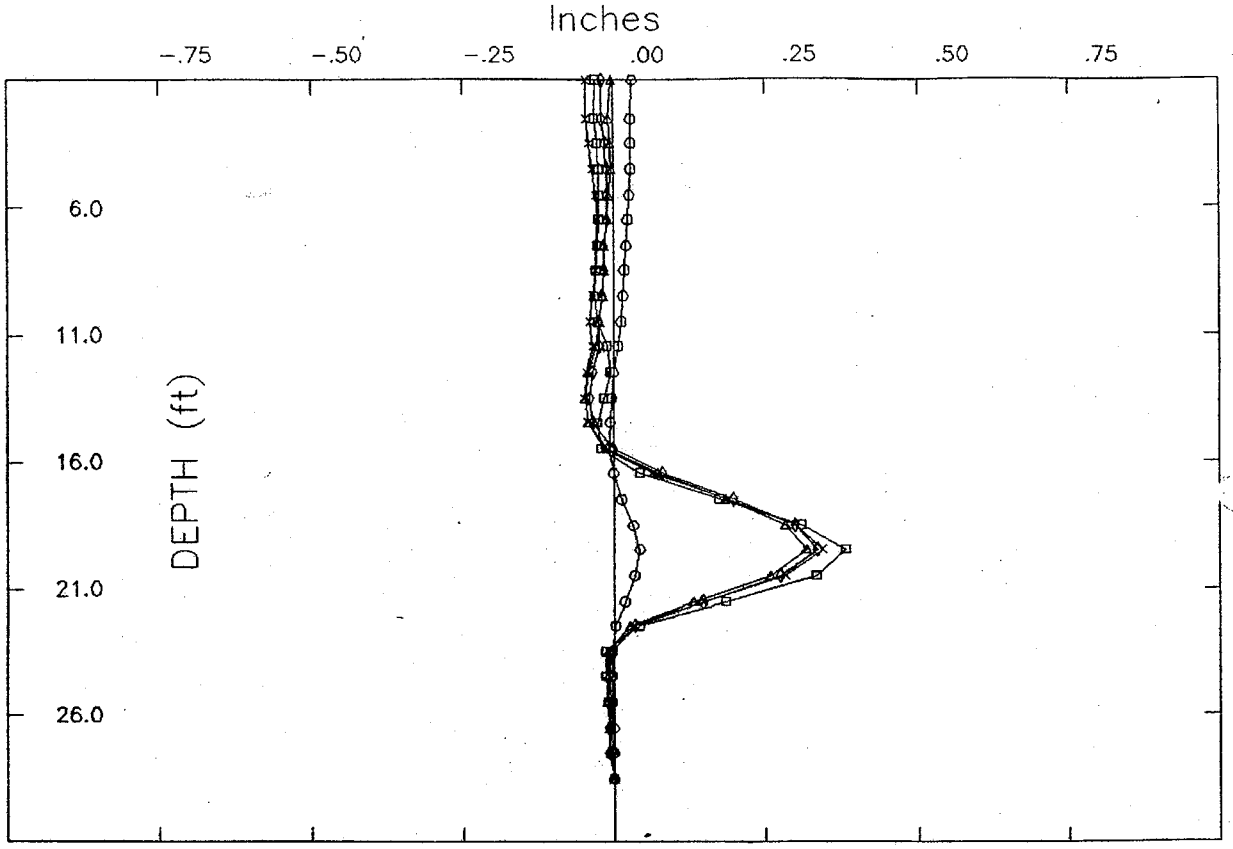
PAST FILE NAME: in01s1.sn	PAST DATE: 08/15/94
FILE NAME: IN01S14.OUT	DATE: 02/14/95
FILE NAME: IN01S13.OUT	DATE: 02/08/95
FILE NAME: IN01S12.OUT	DATE: 02/01/95
FILE NAME: IN01S11.OUT	DATE: 01/27/95
FILE NAME: IN01S2.OUT	DATE: 08/29/94



B – B DEFLECTIONS

HOLE NUMBER: IN-01

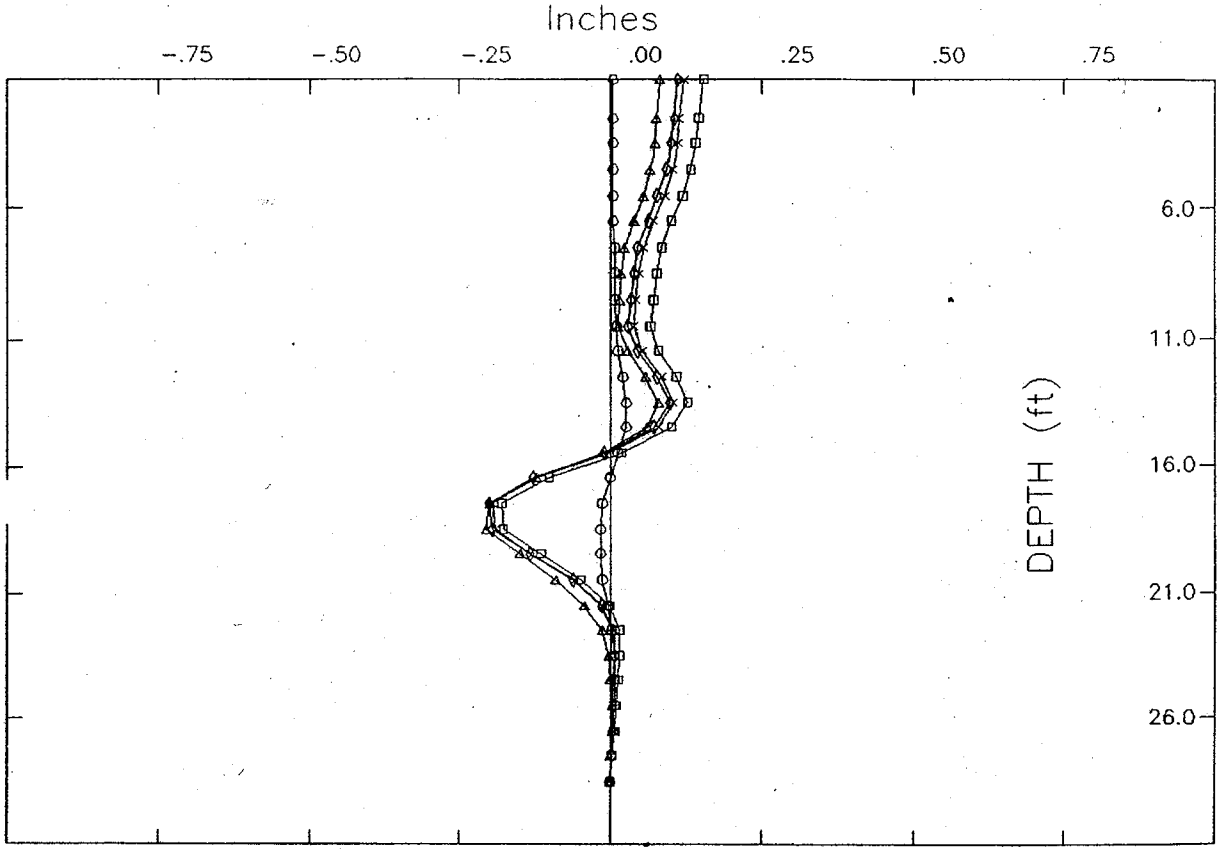
PAST FILE NAME: in01s1.sn	PAST DATE: 08/15/94	
FILE NAME: IN01S14.OUT	DATE: 02/14/95	□
FILE NAME: IN01S13.OUT	DATE: 02/08/95	×
FILE NAME: IN01S12.OUT	DATE: 02/01/95	◊
FILE NAME: IN01S11.OUT	DATE: 01/27/95	△
FILE NAME: IN01S2.OUT	DATE: 08/29/94	○



A – A DEFLECTIONS

HOLE NUMBER: IN-01

PAST FILE NAME: in01s1.sn	PAST DATE: 08/15/94
FILE NAME: IN01S17.OUT	DATE: 03/07/95
FILE NAME: IN01S16.OUT	DATE: 03/02/95
FILE NAME: IN01S15.OUT	DATE: 02/28/95
FILE NAME: IN01S14.OUT	DATE: 02/14/95
FILE NAME: IN01S2.OUT	DATE: 08/29/94



B – B DEFLECTIONS

HOLE NUMBER: IN-01

PAST FILE NAME: in01s1.sn — PAST DATE: 08/15/94

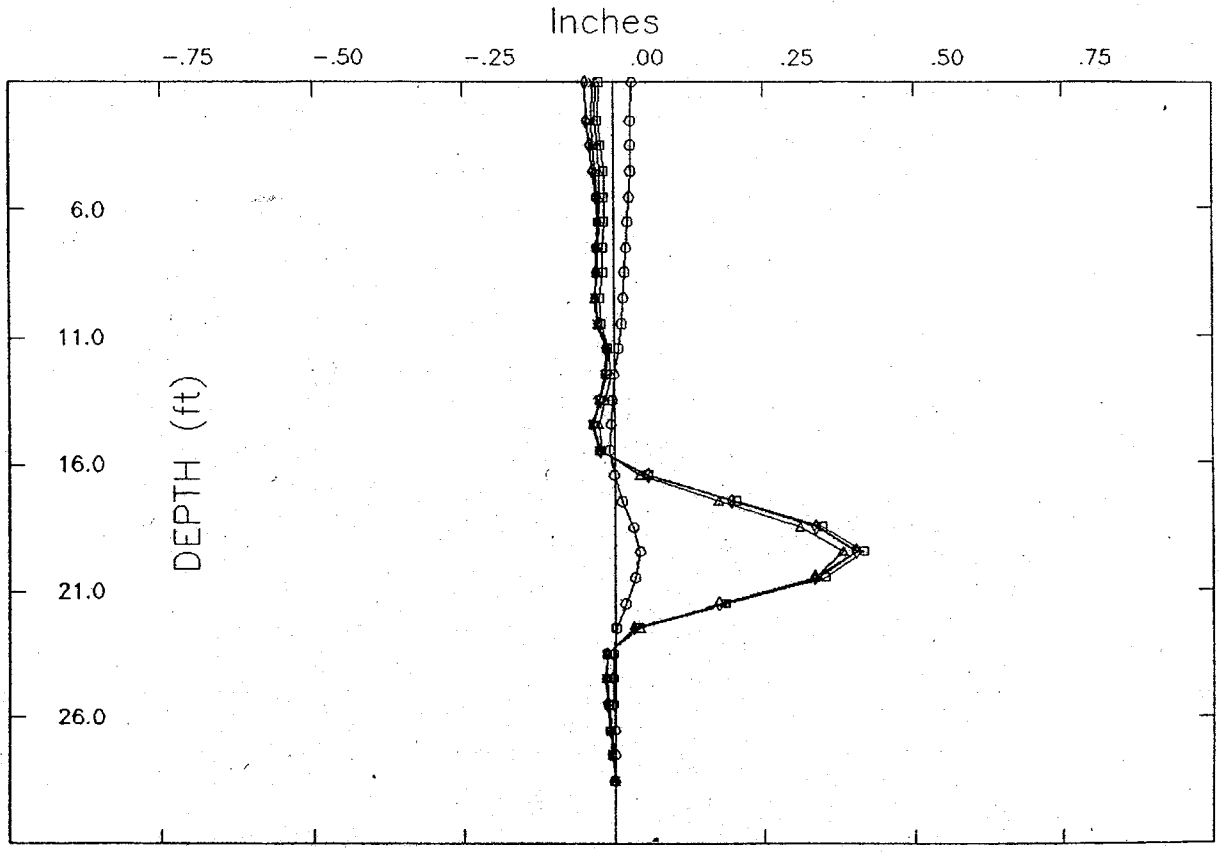
FILE NAME: IN01S17.OUT — DATE: 03/07/95 □

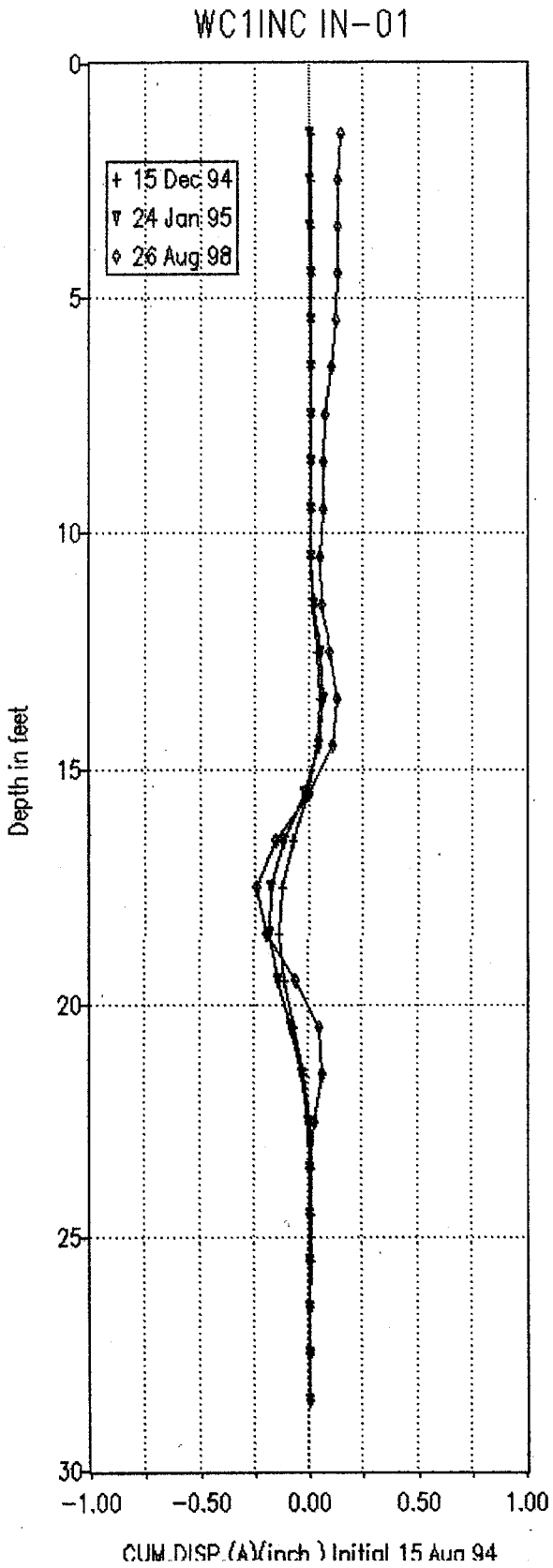
FILE NAME: IN01S16.OUT — DATE: 03/02/95 ×

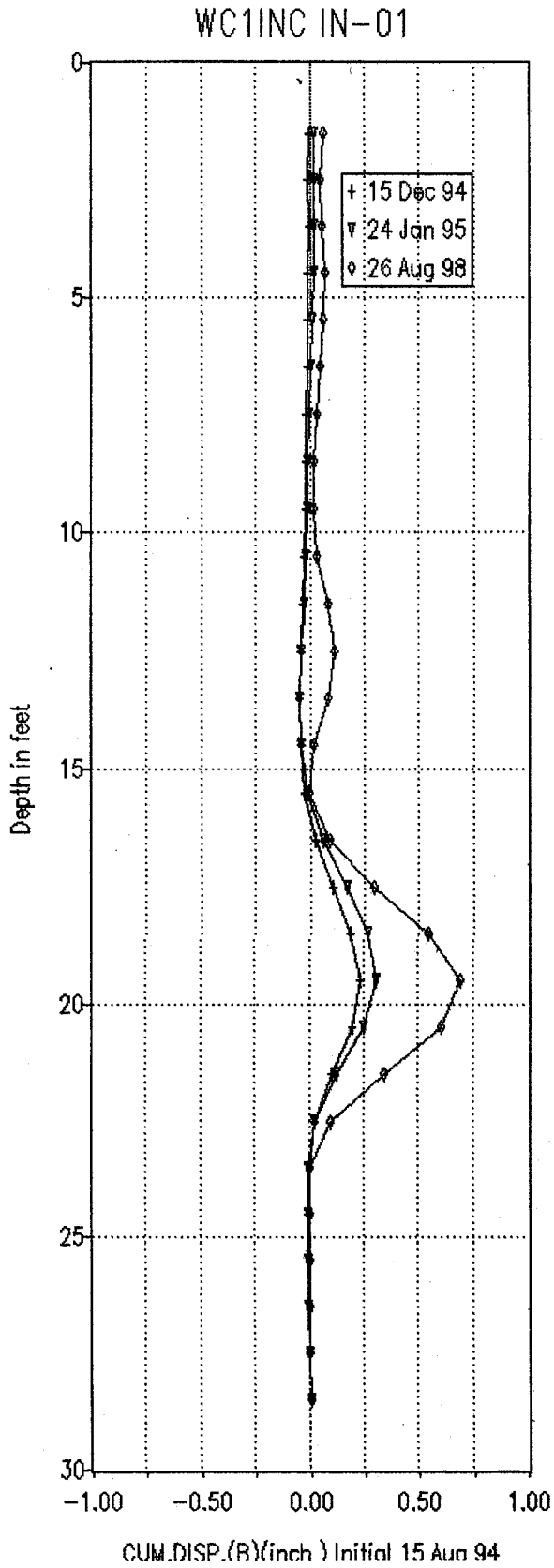
FILE NAME: IN01S15.OUT — DATE: 02/28/95 ◇

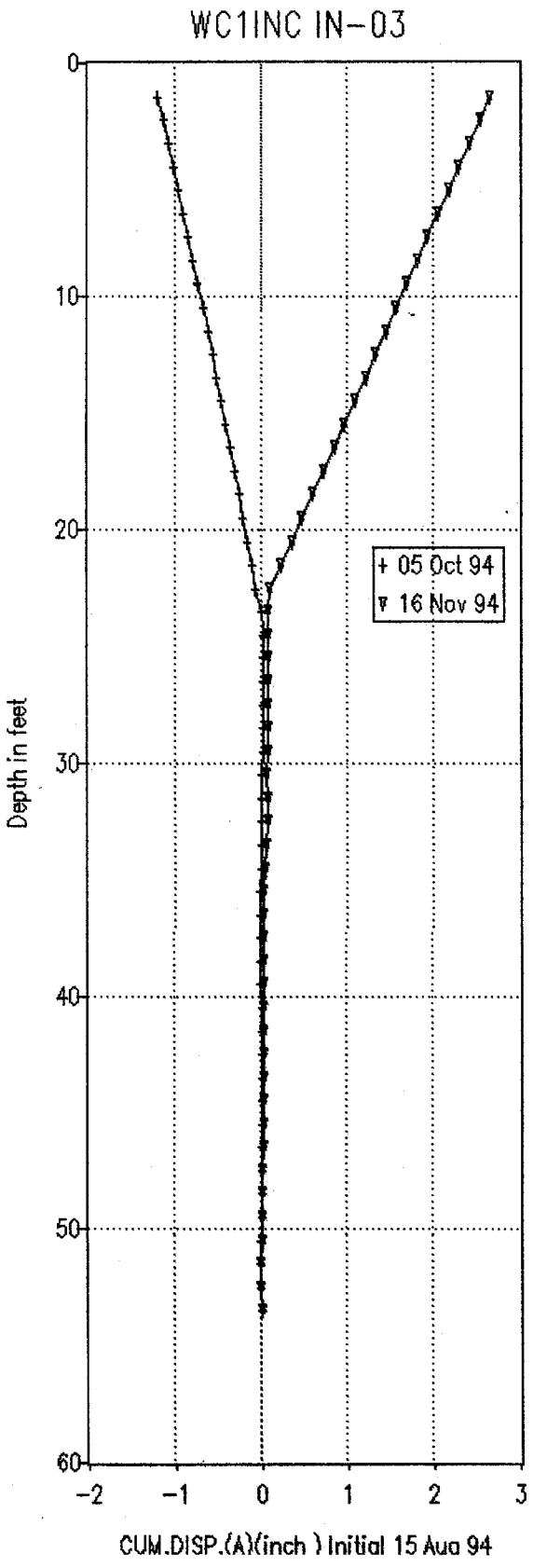
FILE NAME: IN01S14.OUT — DATE: 02/14/95 △

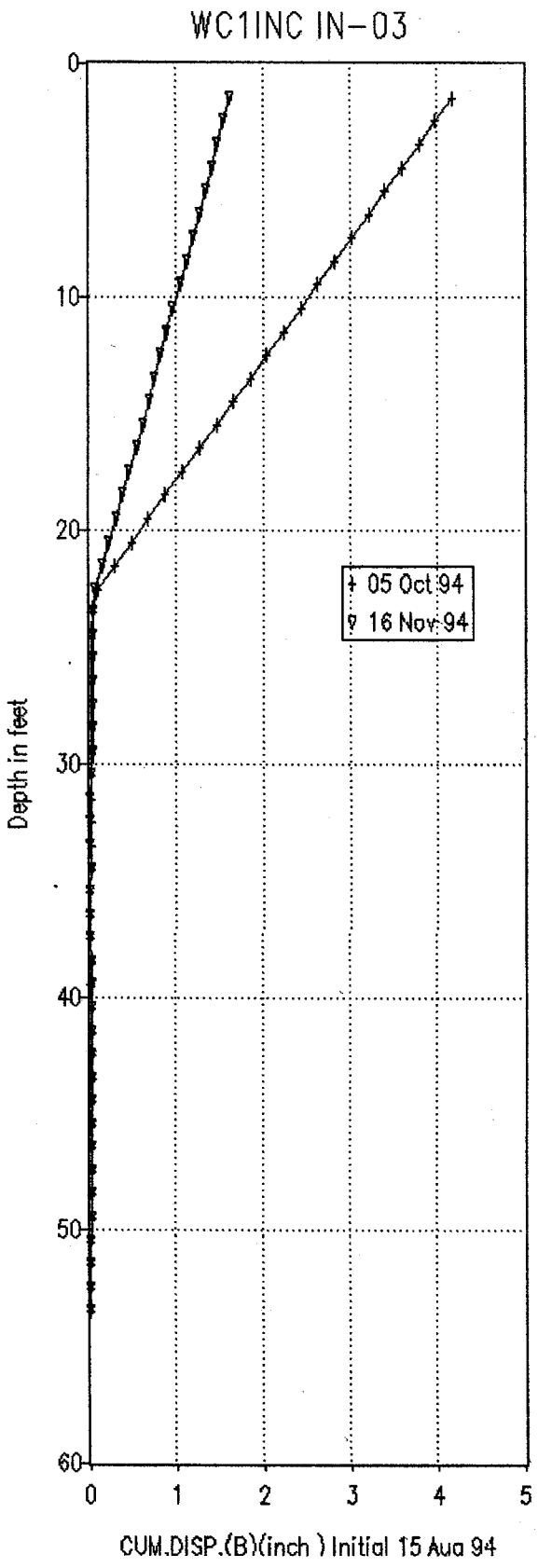
FILE NAME: IN01S2.OUT — DATE: 08/29/94 ○




WC1INC IN-01
+ 15 Dec 94
▽ 24 Jan 95
◇ 26 Aug 98
Depth in feet
0
5
10
15
20
25
30
-1.00
-0.50
0.00
0.50
1.00
CUM.DISP.(A)(inch) Initial 15 Aug 94


WC1INC IN-01
+ 15 Dec 94
▽ 24 Jan 95
◇ 26 Aug 98
Depth in feet
0
5
10
15
20
25
30
-1.00
-0.50
0.00
0.50
1.00
CUM.DISP.(B)(inch) Initial 15 Aug 94


WC1INC IN-03
Depth in feet
0
10
20
30
40
50
60
-2
-1
0
1
2
3
+ 05 Oct 94
▽ 16 Nov 94
CUM.DISP.(A)(inch) Initial 15 Aug 94


WC1INC IN-03
Depth in feet
0
10
20
30
40
50
60
0
1
2
3
4
5
+ 05 Oct 94
▽ 16 Nov 94
CUM.DISP.(B)(inch) Initial 15 Aug 94

APPENDIX D

RESULTS OF STABILITY ANALYSES

Input File Version = 311
Wall 13, Sta 689+50 Backslope Nail Loads

General Data	
File Identifier	13XFTGNL.GNI
Unit weight of water	62.4
Base depth for analysis	0.0
Seismic Coefficient	0.0
Minimum Base Exit Angle	-10.0
X Search limit (left)	0.1
X Search limit (right)	25.0
Number of slip circles	250
No. of slip circle exits	20

LRFD and Safety Factor Data	
Analysis Mode: (L)RFD or (S)LD (specify L or S)	S
= SLD Safety and Strength Factors (mode S only) =	
FS for Soil Cohesion	1
FS for Soil Friction	1
Strength Factor for Head Strength	0.67
Strength Factor for Nail Tendon Strength	0.55
Strength Factor for Nail Pullout Resistance	0.5
= LRFD Load Factors (mode L only) =	
LF for Unit Weight of Water	1
LF for Unit Weight of Soil	1.35
LF for Surcharge Loads	1.75
LF for Seismic Loads	1
= LRFD Resistance Factors (mode L only) =	
RF for Soil Cohesion	1
RF for Soil Friction Angle	0.75
RF for Head Strength	0.9
RF for Nail Pullout Resistance	0.7
RF for Nail Tendon Strength	0.9

PIEZOMETRIC DATA	X-Value	Piez. Level
Point 1		
Point 2		
Point 3		
Point 4		
Point 5		
Point 6		
Point 7		
Point 8		
Point 9		
Point 10		

Nodal Data

Node No	X-Value	Y-Value	Node No	X-Value	Y-Value	Node No	X-Value	Y-Value
1	-1.45	17.5	16			31		
2	0	0	17			32		
3	2	-1	18			33		
4	3	-1.5	19			34		
5	3.1	-1.55	20			35		
6	9.1	-4.55	21			36		
7	9.2	-4.6	22			37		
8	9.3	-4.65	23			38		
9	12	-5.35	24			39		
10	25	-12.5	25			40		
11	50	-12.5	26			41		
12	50	-5.35	27			42		
13	50	-1.5	28			43		
14			29			44		
15			30			45		

Wall Segment Data

Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID	Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID
1	1	2	3	3	11				
2					12				
3					13				
4					14				
5					15				
6					16				
7					17				
8					18				
9					19				
10					20				

Surface Segment Data

Seg. No.	Node 1	Node 2	Soil ID	Seg. No.	Node 1	Node 2	Soil ID
1	2	3	3	11			
2	3	4	3	12			
3	4	5	2	13			
4	5	6	2	14			
5	6	7	2	15			
6	7	8	2	16			
7	8	9	2	17			
8	9	10	1	18			
9	10	11	1	19			
10				20			

Internal Segment Data									
Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID	Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID
1	9	12	2	2	11				
2	4	13	3	3	12				
3					13				
4					14				
5					15				
6					16				
7					17				
8					18				
9					19				
10					20				

Soil Strength & Pullout Resist. Data				
Material ID No.	c	φ	Unit Weight	Pullout Res.
1	10	30	110	3770
2	100	35	115	3140
3	150	38	120	7000
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Surcharge Pressure Data			
Load No	X-value	Vert.	Horiz.
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Nail Data	Nail Depth	Nail Length	Tendon Strength	Head Strength	Fixed Nail?
Nail Row 1	5.5	20	47400	30000	
Nail Row 2	10	20	60000	30000	
Nail Row 3	14	18	60000	30000	
Nail Row 4					
Nail Row 5					
Nail Row 6					
Nail Row 7					
Nail Row 8					
Nail Row 9					
Nail Row 10					
Nail Row 11					
Nail Row 12					
Nail Row 13					
Nail Row 14					
Nail Row 15					
Horiz. Spacing	6				
Nail Declination	15				

Facing Data	
Maximum Facing Pressure	0.0
Facing Pressure angle	15.0
Press. Distribution type	3
Press. Distribution type	Triangular

Analysis Options	
Analysis Mode	FOS
Soil Model	Linear
Analysis with nails?	Yes

Output Data

Wall Height = 17.50
Wall Slope = 85.26

Circle Number	Circle X-Intercept	Circle Base Angle	Circle X-Center	Circle Y-Center	Moment Ratio	Force Req'd/ Unit Wall Length
1	2.40	67.97	-50.42	-2.32	1.004	128.89
2	2.99	69.90	-77.04	-10.17	1.001	173.01
3	2.99	68.17	-61.41	-6.52	1.002	361.28
4	2.99	66.45	-50.93	-4.07	1.003	535.81
5	2.99	64.72	-43.40	-2.31	1.004	696.19
6	3.63	73.48	-309.22	-73.80	1.000	8.89
7	3.63	71.75	-156.45	-33.61	1.000	218.36
8	3.63	70.03	-104.35	-19.90	1.001	414.57
9	3.63	68.30	-78.04	-12.98	1.001	597.09
10	3.63	66.58	-62.14	-8.79	1.002	766.26
11	3.63	64.85	-51.48	-5.99	1.003	917.55
12	3.63	63.13	-43.83	-3.97	1.004	1059.28
13	3.63	61.40	-38.05	-2.46	1.005	1189.51
14	4.35	73.53	-9834.92	-2890.08	1.000	239.56
15	4.35	71.80	-314.60	-85.44	1.000	445.38
16	4.35	70.08	-159.01	-39.61	1.000	636.57
17	4.35	68.35	-105.94	-23.97	1.001	814.00
18	4.35	66.63	-79.14	-16.08	1.001	978.23
19	4.35	64.90	-62.95	-11.31	1.001	1127.58
20	4.35	63.18	-52.10	-8.11	1.002	1259.30
21	4.35	61.45	-44.30	-5.81	1.003	1378.31
22	4.35	59.73	-38.42	-4.08	1.004	1482.72
23	4.35	58.00	-33.82	-2.72	1.005	1568.94
24	5.14	71.77	-10032.67	-3286.57	1.000	650.79
25	5.14	70.04	-320.57	-98.37	1.000	839.60
26	5.14	68.32	-161.84	-46.27	1.000	1011.76
27	5.14	66.59	-107.71	-28.50	1.000	1169.04
28	5.14	64.87	-80.37	-19.52	1.001	1309.95
29	5.14	63.14	-63.85	-14.10	1.001	1434.93
30	5.14	61.42	-52.78	-10.47	1.002	1543.85
31	5.14	59.69	-44.82	-7.85	1.002	1637.07
32	5.14	57.97	-38.82	-5.88	1.003	1714.84
33	5.14	56.24	-34.13	-4.34	1.004	1777.21
34	5.14	54.52	-30.35	-3.10	1.005	1824.91
35	6.02	69.92	-10253.70	-3729.73	1.000	1017.23
36	6.02	68.20	-327.24	-112.83	1.000	1187.14
37	6.02	66.47	-165.01	-53.71	1.000	1340.13
38	6.02	64.75	-109.68	-33.55	1.000	1475.95
39	6.02	63.02	-81.74	-23.37	1.001	1594.34
40	6.02	61.30	-64.86	-17.22	1.001	1696.13
41	6.02	59.57	-53.54	-13.10	1.001	1780.38
42	6.02	57.84	-45.41	-10.14	1.002	1848.18
43	6.02	56.12	-39.28	-7.90	1.003	1898.96
44	6.02	54.39	-34.48	-6.15	1.003	1932.87
45	6.02	52.67	-30.62	-4.75	1.004	1950.25
46	6.02	50.94	-27.44	-3.59	1.006	1951.30
47	7.02	67.98	-10502.60	-4228.78	1.000	1334.61
48	7.02	66.26	-334.75	-129.10	1.000	1485.34
49	7.02	64.53	-168.58	-62.10	1.000	1618.72
50	7.02	62.81	-111.91	-39.25	1.000	1733.78
51	7.02	61.08	-83.29	-27.71	1.000	1830.45
52	7.02	59.36	-65.99	-20.74	1.001	1908.51
53	7.02	57.63	-54.40	-16.06	1.001	1967.86

54	7.02	55.91	-46.07	-12.70	1.002	2008.48
55	7.02	54.18	-39.79	-10.17	1.002	2030.56
56	7.02	52.46	-34.88	-8.19	1.003	2035.95
57	7.02	50.73	-30.92	-6.60	1.003	2023.15
58	7.02	49.00	-27.66	-5.28	1.004	1992.17
59	7.02	47.28	-24.93	-4.18	1.005	1944.59
60	8.15	65.95	-10785.33	-4795.67	1.000	1597.21
61	8.15	64.22	-343.29	-147.59	1.000	1728.19
62	8.15	62.50	-172.64	-71.63	1.000	1840.31
63	8.15	60.77	-114.43	-45.72	1.000	1933.34
64	8.15	59.05	-85.04	-32.63	1.000	2007.12
65	8.15	57.32	-67.28	-24.73	1.001	2061.58
66	8.15	55.60	-55.38	-19.43	1.001	2097.11
67	8.15	53.87	-46.82	-15.62	1.001	2114.26
68	8.15	52.14	-40.37	-12.75	1.002	2112.51
69	8.15	50.42	-35.33	-10.51	1.002	2091.74
70	8.15	48.69	-31.26	-8.70	1.003	2052.02
71	8.15	46.97	-27.92	-7.21	1.003	1993.47
72	8.15	45.24	-25.11	-5.96	1.004	1916.25
73	8.15	43.52	-22.71	-4.89	1.005	1820.55
74	9.43	63.81	-11088.39	-5435.66	1.000	1802.01
75	9.43	62.08	-352.41	-168.45	1.000	1910.31
76	9.43	60.36	-176.95	-82.36	1.000	1998.95
77	9.43	58.63	-117.11	-53.01	1.000	2067.78
78	9.43	56.91	-86.89	-38.18	1.000	2116.86
79	9.43	55.18	-68.63	-29.22	1.000	2147.01
80	9.43	53.46	-56.39	-23.22	1.001	2157.20
81	9.43	51.73	-47.60	-18.90	1.001	2147.59
82	9.43	50.01	-40.96	-15.65	1.001	2118.16
83	9.43	48.28	-35.77	-13.10	1.002	2068.92
84	9.43	46.56	-31.60	-11.05	1.002	1999.91
85	9.43	44.83	-28.16	-9.36	1.002	1911.16
86	9.43	43.11	-25.27	-7.95	1.003	1800.15
87	9.43	41.38	-22.80	-6.74	1.004	1670.58
88	9.43	39.65	-20.68	-5.69	1.005	1523.87
89	9.43	37.93	-18.81	-4.78	1.006	1358.61
90	10.71	61.56	-11253.58	-6075.43	1.000	1959.51
91	10.71	59.84	-357.10	-189.16	1.000	2042.34
92	10.71	58.11	-179.02	-92.96	1.000	2104.76
93	10.71	56.39	-118.28	-60.16	1.000	2147.17
94	10.71	54.66	-87.61	-43.59	1.000	2169.12
95	10.71	52.94	-69.08	-33.58	1.000	2170.87
96	10.71	51.21	-56.65	-26.86	1.000	2152.44
97	10.71	49.49	-47.73	-22.04	1.001	2113.60
98	10.71	47.76	-41.00	-18.41	1.001	2054.28
99	10.71	46.04	-35.73	-15.56	1.001	1974.42
100	10.71	44.31	-31.49	-13.27	1.001	1871.97
101	10.71	42.59	-28.00	-11.38	1.002	1749.48
102	10.71	40.86	-25.07	-9.80	1.002	1606.03
103	10.71	39.13	-22.57	-8.45	1.003	1441.53
104	10.71	37.41	-20.40	-7.28	1.003	1249.61
105	10.71	35.68	-18.51	-6.26	1.004	1038.65
106	10.71	33.96	-16.85	-5.36	1.005	823.66
107	12.20	59.21	-11475.25	-6820.12	1.000	2011.41
108	12.20	57.48	-363.50	-213.31	1.000	2067.37
109	12.20	55.76	-181.90	-105.33	1.000	2102.47
110	12.20	54.03	-119.96	-68.51	1.000	2116.60
111	12.20	52.31	-88.69	-49.91	1.000	2109.64
112	12.20	50.58	-69.79	-38.67	1.000	2081.48
113	12.20	48.86	-57.12	-31.14	1.000	2032.01
114	12.20	47.13	-48.02	-25.73	1.000	1961.92
115	12.20	45.40	-41.15	-21.65	1.001	1870.08
116	12.20	43.68	-35.78	-18.45	1.001	1751.82

117	12.20	41.95	-31.46	-15.88	1.001	1612.32
118	12.20	40.23	-27.90	-13.76	1.001	1463.71
119	12.20	38.50	-24.91	-11.99	1.001	1292.88
120	12.20	36.78	-22.36	-10.47	1.002	1097.05
121	12.20	35.05	-20.15	-9.16	1.002	873.81
122	12.20	33.33	-18.23	-8.01	1.002	622.80
123	12.20	31.60	-16.53	-7.00	1.003	349.25
124	12.20	29.88	-15.01	-6.10	1.003	51.83
125	14.36	56.73	-12066.60	-7897.86	1.000	1997.42
126	14.36	55.01	-381.46	-248.51	1.000	2020.92
127	14.36	53.28	-190.49	-123.49	1.000	2022.74
128	14.36	51.56	-125.36	-80.86	1.000	2002.38
129	14.36	49.83	-92.46	-59.33	1.000	1957.78
130	14.36	48.11	-72.59	-46.32	1.000	1890.23
131	14.36	46.38	-59.27	-37.59	1.000	1805.37
132	14.36	44.66	-49.70	-31.33	1.000	1701.74
133	14.36	42.93	-42.48	-26.60	1.000	1575.08
134	14.36	41.20	-36.83	-22.91	1.000	1424.56
135	14.36	39.48	-32.28	-19.93	1.000	1245.88
136	14.36	37.75	-28.54	-17.48	1.000	1043.20
137	14.36	36.03	-25.39	-15.42	1.000	816.57
138	14.36	34.30	-22.71	-13.67	1.000	565.86
139	14.36	32.58	-20.39	-12.15	1.000	290.72
140	17.03	54.13	-12800.80	-9235.94	1.000	1891.74
141	17.03	52.41	-403.75	-292.21	1.000	1875.41
142	17.03	50.68	-201.15	-146.04	1.000	1838.02
143	17.03	48.96	-132.05	-96.19	1.000	1779.11
144	17.03	47.23	-97.15	-71.02	1.000	1698.06
145	17.03	45.51	-76.07	-55.81	1.000	1593.44
146	17.03	43.78	-61.93	-45.61	1.000	1462.23
147	17.03	42.06	-51.78	-38.28	1.000	1307.15
148	17.03	40.33	-44.12	-32.76	1.000	1127.58
149	17.03	38.61	-38.13	-28.44	1.000	923.32
150	17.03	36.88	-33.31	-24.96	0.999	693.78
151	17.03	35.16	-29.33	-22.09	0.999	439.84
152	17.03	33.43	-26.00	-19.68	0.999	162.10
153	20.45	51.41	-13739.85	-10947.34	1.000	1670.03
154	20.45	49.68	-432.27	-348.11	1.000	1608.87
155	20.45	47.96	-214.78	-174.89	1.000	1523.24
156	20.45	46.23	-140.61	-115.81	1.000	1411.65
157	20.45	44.50	-103.15	-85.97	1.000	1276.29
158	20.45	42.78	-80.52	-67.95	1.000	1115.83
159	20.45	41.05	-65.34	-55.86	1.000	929.48
160	20.45	39.33	-54.44	-47.18	1.000	716.81
161	20.45	37.60	-46.22	-40.63	0.999	478.64
162	20.45	35.88	-39.79	-35.51	0.999	215.29
163	25.00	48.54	-14988.22	-13222.50	1.000	1297.10
164	25.00	46.82	-470.18	-422.42	1.000	1175.31
165	25.00	45.09	-232.91	-213.23	1.000	1027.22
166	25.00	43.37	-151.99	-141.89	1.000	852.41
167	25.00	41.64	-111.12	-105.85	1.000	650.20
168	25.00	39.91	-86.43	-84.09	1.000	420.93
169	25.00	38.19	-69.88	-69.49	1.000	164.90

Nail Forces

Nail No.	Circle No.	Nail Force
1	94	3963.44
2	94	5017.01
3	96	4076.45

Input File Version = 311
Wall 13, Sta 689+50 Design Mode

General Data	
File Identifier	WALL13DS.GNI
Unit weight of water	62.4
Base depth for analysis	0.0
Seismic Coefficient	0.0
Minimum Base Exit Angle	-10.0
X Search limit (left)	0.1
X Search limit (right)	25.0
Number of slip circles	250
No. of slip circle exits	20

LRFD and Safety Factor Data	
Analysis Mode: (L)RFD or (S)LD (specify L or S)	S
SLD Safety and Strength Factors (mode S only)	
FS for Soil Cohesion	1.35
FS for Soil Friction	1.35
Strength Factor for Head Strength	0.67
Strength Factor for Nail Tendon Strength	0.55
Strength Factor for Nail Pullout Resistance	0.5
LRFD Load Factors (mode L only)	
LF for Unit Weight of Water	1
LF for Unit Weight of Soil	1.35
LF for Surcharge Loads	1.75
LF for Seismic Loads	1
LRFD Resistance Factors (mode L only)	
RF for Soil Cohesion	1
RF for Soil Friction Angle	0.75
RF for Head Strength	0.9
RF for Nail Pullout Resistance	0.7
RF for Nail Tendon Strength	0.9

PIEZOMETRIC DATA	X-Value	Piez. Level
Point 1		
Point 2		
Point 3		
Point 4		
Point 5		
Point 6		
Point 7		
Point 8		
Point 9		
Point 10		

Nodal Data

Node No	X-Value	Y-Value	Node No	X-Value	Y-Value	Node No	X-Value	Y-Value
1	-1.45	17.5	16			31		
2	0	0	17			32		
3	2	-1	18			33		
4	3	-1	19			34		
5	3.1	4.5	20			35		
6	9.1	4.5	21			36		
7	9.2	-1.5	22			37		
8	9.3	-4	23			38		
9	12	-5.35	24			39		
10	25	-12.5	25			40		
11	50	-12.5	26			41		
12	50	-5.35	27			42		
13	50	-1.5	28			43		
14			29			44		
15			30			45		

Wall Segment Data

Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID	Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID
1	1	2	3	3	11				
2					12				
3					13				
4					14				
5					15				
6					16				
7					17				
8					18				
9					19				
10					20				

Surface Segment Data

Seg. No.	Node 1	Node 2	Soil ID	Seg. No.	Node 1	Node 2	Soil ID
1	2	3	3	11			
2	3	4	3	12			
3	4	5	3	13			
4	5	6	3	14			
5	6	7	3	15			
6	7	8	2	16			
7	8	9	2	17			
8	9	10	1	18			
9	10	11	1	19			
10				20			

Internal Segment Data									
Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID	Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID
1	9	12	2	2	11				
2	7	13	3	3	12				
3					13				
4					14				
5					15				
6					16				
7					17				
8					18				
9					19				
10					20				

Soil Strength & Pullout Resist. Data				
Material ID No.	c	φ	Unit Weight	Pullout Res.
1	10	30	110	3770
2	100	35	115	3140
3	150	38	120	7000
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Surcharge Pressure Data			
Load No	X-value	Vert.	Horiz.
1	3.1	0	0
2	9.1	4100	0
3	25	0	0
4			
5			
6			
7			
8			
9			
10			

Nail Data	Nail Depth	Nail Length	Tendon Strength	Head Strength	Fixed Nail?
Nail Row 1	5.5	20	47400	30000	
Nail Row 2	10	20	60000	30000	
Nail Row 3	14	18	60000	30000	
Nail Row 4					
Nail Row 5					
Nail Row 6					
Nail Row 7					
Nail Row 8					
Nail Row 9					
Nail Row 10					
Nail Row 11					
Nail Row 12					
Nail Row 13					
Nail Row 14					
Nail Row 15					

Horiz. Spacing	6
Nail Declination	15

Facing Data	
Maximum Facing Pressure	0.0
Facing Pressure angle	15.0
Press. Distribution type	3
Press. Distribution type	Triangular

Analysis Options	
Analysis Mode	Design
Soil Model	Linear
Analysis with nails?	Yes

Output Data

Wall Height = 17.50
Wall Slope = 85.26

Circle Number	Circle X-Intercept	Circle Base Angle	Circle X-Center	Circle Y-Center	Moment Ratio	Force Req'd/ Unit Wall Length
1	1.36	72.52	-59.56	-0.81	1.003	133.40
2	1.86	74.59	-100.40	-9.78	1.001	223.10
3	1.86	72.86	-75.29	-5.27	1.001	556.37
4	1.86	71.14	-60.13	-2.55	1.002	873.45
5	2.36	76.59	-296.75	-52.89	1.000	316.50
6	2.36	74.87	-150.44	-22.79	1.000	647.94
7	2.36	73.14	-100.53	-12.53	1.001	965.00
8	2.36	71.42	-75.33	-7.34	1.001	1270.75
9	2.36	69.69	-60.11	-4.21	1.002	1559.22
10	2.36	67.97	-49.90	-2.11	1.002	1828.72
11	2.87	76.80	-9249.29	-2151.84	1.000	739.44
12	2.87	75.07	-296.49	-61.15	1.000	1053.06
13	2.87	73.35	-150.18	-26.99	1.000	1352.69
14	2.87	71.62	-100.28	-15.33	1.000	1637.01
15	2.87	69.90	-75.08	-9.45	1.001	1910.87
16	2.87	68.17	-59.85	-5.89	1.001	2163.70
17	2.87	66.45	-49.64	-3.51	1.002	2400.84
18	2.87	64.72	-42.31	-1.80	1.002	2622.42
19	3.03	75.20	-8507.79	-2229.49	1.000	1670.52
20	3.03	73.48	-272.59	-62.93	1.000	1917.60
21	3.03	71.75	-138.01	-27.52	1.000	2154.52
22	3.03	70.03	-92.10	-15.45	1.000	2380.38
23	3.03	68.30	-68.92	-9.35	1.000	2592.83
24	3.03	66.58	-54.92	-5.66	1.001	2792.15
25	3.03	64.85	-45.53	-3.19	1.001	2977.96
26	3.03	63.13	-38.78	-1.42	1.002	3145.01
27	3.03	61.40	-33.70	-0.08	1.002	3292.48
28	3.06	73.53	-7650.60	-2244.22	1.000	2398.87
29	3.06	71.80	-245.04	-62.57	1.000	2598.92
30	3.06	70.08	-124.01	-26.92	1.000	2789.27
31	3.06	68.35	-82.73	-14.76	1.000	2969.07
32	3.06	66.63	-61.88	-8.62	1.000	3139.54
33	3.06	64.90	-49.29	-4.91	1.001	3296.31
34	3.06	63.18	-40.85	-2.42	1.001	3438.77
35	3.06	61.45	-34.78	-0.63	1.001	3568.39
36	3.06	59.73	-30.21	0.71	1.002	3685.86
37	3.06	58.00	-26.63	1.77	1.002	3792.43
38	3.09	71.77	-6906.86	-2256.99	1.000	2885.14
39	3.09	70.04	-221.13	-62.27	1.000	3052.25
40	3.09	68.32	-111.86	-26.40	1.000	3209.61
41	3.09	66.59	-74.60	-14.16	1.000	3357.96
42	3.09	64.87	-55.78	-7.99	1.000	3495.85
43	3.09	63.14	-44.41	-4.25	1.000	3622.65
44	3.09	61.42	-36.78	-1.75	1.001	3737.98
45	3.09	59.69	-31.31	0.05	1.001	3841.69
46	3.09	57.97	-27.18	1.40	1.001	3933.71
47	3.09	56.24	-23.95	2.46	1.002	4011.78
48	3.09	54.52	-21.35	3.32	1.002	4067.21
49	3.29	69.92	-6499.08	-2357.41	1.000	3958.99
50	3.29	68.20	-207.93	-65.10	0.999	4117.90
51	3.29	66.47	-105.11	-27.63	0.999	4266.47
52	3.29	64.75	-70.05	-14.86	0.998	4403.65
53	3.29	63.02	-52.34	-8.40	0.998	4526.57

54	3.29	61.30	-41.64	-4.51	0.997	4634.99
55	3.29	59.57	-34.46	-1.89	0.996	4728.08
56	3.29	57.84	-29.31	-0.01	0.996	4805.33
57	3.29	56.12	-25.43	1.40	0.995	4870.87
58	3.29	54.39	-22.38	2.51	0.995	4921.71
59	3.29	52.67	-19.94	3.40	0.994	4956.43
60	3.29	50.94	-17.92	4.14	0.994	4975.88
61	3.79	67.98	-6498.83	-2609.80	1.000	6023.49
62	3.79	66.26	-207.67	-73.21	0.998	6195.81
63	3.79	64.53	-104.86	-31.75	0.997	6351.74
64	3.79	62.81	-69.79	-17.61	0.995	6490.08
65	3.79	61.08	-52.08	-10.47	0.993	6609.78
66	3.79	59.36	-41.39	-6.16	0.991	6711.06
67	3.79	57.63	-34.21	-3.27	0.993	6858.59
68	3.79	55.91	-29.06	-1.19	0.992	6939.16
69	3.79	54.18	-25.17	0.38	0.990	6999.38
70	3.79	52.46	-22.13	1.60	0.994	7135.68
71	3.79	50.73	-19.68	2.59	0.994	7172.16
72	3.79	49.00	-17.67	3.40	0.990	7077.61
73	3.79	47.28	-15.98	4.09	0.992	7099.58
74	4.34	65.95	-6498.55	-2882.35	1.000	7838.11
75	4.34	64.22	-207.40	-81.96	0.997	8008.32
76	4.34	62.50	-104.59	-36.20	0.994	8156.31
77	4.34	60.77	-69.52	-20.59	0.991	8280.74
78	4.34	59.05	-51.81	-12.71	0.991	8430.33
79	4.34	57.32	-41.11	-7.94	0.991	8575.94
80	4.34	55.60	-33.94	-4.75	0.996	8775.30
81	4.34	53.87	-28.79	-2.46	0.995	8856.92
82	4.34	52.14	-24.90	-0.73	0.992	8878.96
83	4.34	50.42	-21.86	0.63	0.990	8901.24
84	4.34	48.69	-19.41	1.72	0.999	9117.03
85	4.34	46.97	-17.40	2.61	0.998	9118.73
86	4.34	45.24	-15.70	3.37	0.993	8982.03
87	4.34	43.52	-14.26	4.01	0.993	8907.85
88	4.93	63.81	-6498.26	-3177.98	1.000	9400.89
89	4.93	62.08	-207.11	-91.46	0.997	9569.15
90	4.93	60.36	-104.29	-41.02	0.993	9710.94
91	4.93	58.63	-69.23	-23.82	0.992	9874.81
92	4.93	56.91	-51.52	-15.13	0.992	10042.35
93	4.93	55.18	-40.82	-9.88	0.996	10276.04
94	4.93	53.46	-33.64	-6.36	0.995	10371.38
95	4.93	51.73	-28.49	-3.83	0.993	10438.57
96	4.93	50.01	-24.60	-1.92	0.992	10478.03
97	4.93	48.28	-21.56	-0.43	0.996	10634.06
98	4.93	46.56	-19.12	0.77	0.995	10627.94
99	4.93	44.83	-17.10	1.76	0.994	10594.88
100	4.93	43.11	-15.41	2.59	0.993	10542.19
101	4.93	41.38	-13.96	3.30	0.994	10512.97
102	4.93	39.65	-12.72	3.91	0.991	10298.21
103	4.93	37.93	-11.62	4.44	1.009	10673.02
104	5.57	61.56	-6497.94	-3500.29	1.000	10705.30
105	5.57	59.84	-206.78	-101.82	0.996	10868.71
106	5.57	58.11	-103.97	-46.28	0.992	10998.09
107	5.57	56.39	-68.90	-27.33	0.991	11157.09
108	5.57	54.66	-51.19	-17.77	0.991	11344.26
109	5.57	52.94	-40.50	-11.99	0.994	11579.19
110	5.57	51.21	-33.32	-8.11	0.993	11659.20
111	5.57	49.49	-28.17	-5.33	0.991	11706.33
112	5.57	47.76	-24.28	-3.23	1.000	12004.17
113	5.57	46.04	-21.24	-1.59	0.998	12012.08
114	5.57	44.31	-18.79	-0.27	0.998	12010.19
115	5.57	42.59	-16.78	0.82	1.004	12169.90
116	5.57	40.86	-15.08	1.74	1.004	12120.13

117	5.57	39.13	-13.64	2.52	1.003	12042.56
118	5.57	37.41	-12.39	3.19	1.001	11877.54
119	5.57	35.68	-11.30	3.78	1.006	11810.27
120	5.57	33.96	-10.34	4.30	1.005	11593.77
121	6.28	59.21	-6497.58	-3853.76	1.000	11739.96
122	6.28	57.48	-206.43	-113.18	0.996	11903.28
123	6.28	55.76	-103.62	-52.04	0.992	12024.60
124	6.28	54.03	-68.55	-31.19	0.991	12179.99
125	6.28	52.31	-50.84	-20.66	0.994	12458.94
126	6.28	50.58	-40.14	-14.30	0.992	12552.40
127	6.28	48.86	-32.97	-10.04	0.997	12820.59
128	6.28	47.13	-27.82	-6.97	0.996	12885.69
129	6.28	45.40	-23.93	-4.66	0.995	12916.64
130	6.28	43.68	-20.89	-2.86	0.999	13050.51
131	6.28	41.95	-18.44	-1.40	0.997	13002.89
132	6.28	40.23	-16.42	-0.20	0.996	12941.83
133	6.28	38.50	-14.73	0.81	0.995	12847.74
134	6.28	36.78	-13.29	1.66	1.002	12965.28
135	6.28	35.05	-12.04	2.41	1.001	12819.34
136	6.28	33.33	-10.95	3.05	1.001	12650.01
137	6.28	31.60	-9.99	3.63	0.996	12292.83
138	6.28	29.88	-9.13	4.14	1.001	12125.43
139	7.06	56.73	-6497.19	-4244.04	1.000	12486.50
140	7.06	55.01	-206.04	-125.71	0.997	12654.60
141	7.06	53.28	-103.22	-58.41	0.993	12788.74
142	7.06	51.56	-68.16	-35.45	0.992	12944.61
143	7.06	49.83	-50.45	-23.86	0.990	13081.05
144	7.06	48.11	-39.75	-16.86	0.993	13308.49
145	7.06	46.38	-32.58	-12.16	0.991	13365.65
146	7.06	44.66	-27.42	-8.79	0.997	13633.74
147	7.06	42.93	-23.54	-6.25	0.996	13650.86
148	7.06	41.20	-20.50	-4.25	0.995	13630.07
149	7.06	39.48	-18.05	-2.65	0.998	13726.80
150	7.06	37.75	-16.03	-1.33	0.996	13588.88
151	7.06	36.03	-14.34	-0.22	0.995	13469.29
152	7.06	34.30	-12.90	0.72	0.993	13316.06
153	7.06	32.58	-11.65	1.54	0.992	13126.67
154	7.06	30.85	-10.56	2.25	1.000	13198.79
155	7.06	29.13	-9.59	2.88	1.003	13096.49
156	7.06	27.40	-8.74	3.45	0.998	12612.63
157	7.06	25.68	-7.96	3.95	0.994	12186.91
158	7.06	23.95	-7.27	4.41	0.997	11868.56
159	7.93	54.13	-6496.76	-4678.36	1.000	12917.32
160	7.93	52.41	-205.61	-139.67	0.997	13075.19
161	7.93	50.68	-102.79	-65.49	0.993	13195.87
162	7.93	48.96	-67.73	-40.20	0.992	13332.88
163	7.93	47.23	-50.02	-27.42	0.990	13452.87
164	7.93	45.51	-39.32	-19.70	0.990	13605.09
165	7.93	43.78	-32.14	-14.53	0.994	13837.06
166	7.93	42.06	-26.99	-10.81	0.991	13816.50
167	7.93	40.33	-23.10	-8.01	0.998	14106.18
168	7.93	38.61	-20.06	-5.81	0.996	14030.80
169	7.93	36.88	-17.62	-4.05	0.995	13959.19
170	7.93	35.16	-15.60	-2.59	0.993	13840.32
171	7.93	33.43	-13.91	-1.37	0.998	13895.37
172	7.93	31.70	-12.46	-0.33	0.997	13715.53
173	7.93	29.98	-11.22	0.57	0.993	13406.14
174	7.93	28.25	-10.12	1.36	0.992	13140.50
175	7.93	26.53	-9.16	2.05	0.990	12836.50
176	7.93	24.80	-8.30	2.67	0.999	12859.48
177	7.93	23.08	-7.53	3.23	0.998	12494.44
178	7.93	21.35	-6.83	3.73	1.010	12482.18
179	7.93	19.63	-6.20	4.19	0.993	11331.54

180	8.90	51.41	-6496.27	-5166.12	1.000	12994.93
181	8.90	49.68	-205.12	-155.34	0.997	13130.05
182	8.90	47.96	-102.30	-73.45	0.994	13236.17
183	8.90	46.23	-67.24	-45.52	0.992	13369.22
184	8.90	44.50	-49.53	-31.42	0.993	13529.09
185	8.90	42.78	-38.83	-22.90	0.997	13796.60
186	8.90	41.05	-31.66	-17.18	0.997	13900.10
187	8.90	39.33	-26.50	-13.08	0.996	13906.64
188	8.90	37.60	-22.62	-9.98	0.995	13879.75
189	8.90	35.88	-19.58	-7.56	0.993	13762.44
190	8.90	34.15	-17.13	-5.61	1.004	14166.49
191	8.90	32.43	-15.11	-4.00	1.004	14068.47
192	8.90	30.70	-13.42	-2.66	1.002	13855.10
193	8.90	28.98	-11.98	-1.51	0.999	13596.13
194	8.90	27.25	-10.73	-0.51	1.002	13516.59
195	8.90	25.53	-9.64	0.36	1.008	13567.70
196	8.90	23.80	-8.67	1.12	1.009	13357.26
197	8.90	22.07	-7.81	1.81	1.007	13022.76
198	8.90	20.35	-7.04	2.42	1.007	12646.31
199	8.90	18.62	-6.34	2.98	1.005	12079.55
200	8.90	16.90	-5.71	3.49	1.004	11584.67
201	8.90	15.17	-5.12	3.95	1.004	10853.68
202	8.90	13.45	-4.59	4.38	1.000	10003.93
203	25.00	48.54	-14988.22	-13222.50	1.000	13227.64
204	25.00	46.82	-470.18	-422.42	0.998	12726.18
205	25.00	45.09	-232.91	-213.23	0.997	12189.59
206	25.00	43.37	-151.99	-141.89	0.995	11615.00
207	25.00	41.64	-111.12	-105.85	0.993	11003.76
208	25.00	39.91	-86.43	-84.09	0.991	10373.79
209	25.00	38.19	-69.88	-69.49	0.992	9874.09
210	25.00	36.46	-57.99	-59.01	0.990	9221.46
211	25.00	34.74	-49.02	-51.10	0.993	8723.68
212	25.00	33.01	-42.00	-44.91	0.991	8010.64
213	25.00	31.29	-36.35	-39.93	0.995	7487.45
214	25.00	29.56	-31.70	-35.83	0.994	6705.36
215	25.00	27.84	-27.79	-32.39	0.990	5780.43
216	25.00	26.11	-24.46	-29.45	0.995	5202.27
217	25.00	24.39	-21.58	-26.91	0.994	4325.27
218	25.00	22.66	-19.06	-24.69	0.993	3443.12
219	25.00	20.94	-16.84	-22.73	0.996	2694.43
220	25.00	19.21	-14.86	-20.98	0.995	1709.69
221	25.00	17.48	-13.08	-19.41	0.993	682.08

Design Data

Nail Head Factor = 1.00 for circle no 221
Nail Length Factor = 0.74 for circle no 190

Nail No.	Circle No	Required Nail Tendon Strength
1	167	45235.34
2	186	57384.81
3	195	58428.20

Nail No.	Circle No	Required Nail Length
1		14.86
2		14.86
3		13.37

Output Data

Wall Height = 17.50
Wall Slope = 85.26

Circle Number	Circle X-Intercept	Circle Base Angle	Circle X-Center	Circle Y-Center	Moment Ratio	Factor of Safety
1	0.12	84.84	-8780.29	-775.54	1.000	21.23
2	0.12	83.11	-282.76	-16.48	1.000	8.62
3	0.12	81.39	-143.88	-4.07	1.000	5.44
4	0.49	83.71	-8872.85	-961.12	1.000	5.48
5	0.49	81.98	-285.55	-22.53	1.000	4.79
6	0.49	80.25	-145.21	-7.19	1.000	4.47
7	0.49	78.53	-97.35	-1.96	1.000	4.20
8	0.91	82.46	-8977.73	-1171.40	1.000	4.80
9	0.91	80.73	-288.72	-29.39	1.000	4.49
10	0.91	79.00	-146.71	-10.72	1.000	4.23
11	0.91	77.28	-98.28	-4.36	1.000	4.01
12	0.91	75.55	-73.82	-1.14	1.001	3.82
13	1.36	81.14	-9091.24	-1398.99	1.000	4.50
14	1.36	79.42	-292.14	-36.81	1.000	4.25
15	1.36	77.69	-148.34	-14.55	1.000	4.04
16	1.36	75.97	-99.30	-6.96	1.000	3.85
17	1.36	74.24	-74.53	-3.12	1.000	3.70
18	1.36	72.52	-59.56	-0.81	1.001	3.56
19	1.86	79.76	-9214.46	-1646.06	1.000	4.25
20	1.86	78.04	-295.86	-44.87	1.000	4.05
21	1.86	76.31	-150.11	-18.70	1.000	3.87
22	1.86	74.59	-100.40	-9.78	1.000	3.73
23	1.86	72.86	-75.29	-5.27	1.000	3.60
24	1.86	71.14	-60.13	-2.55	1.001	3.48
25	2.36	78.32	-9249.54	-1894.72	1.000	4.04
26	2.36	76.59	-296.75	-52.89	1.000	3.87
27	2.36	74.87	-150.44	-22.79	1.000	3.74
28	2.36	73.14	-100.53	-12.53	1.000	3.61
29	2.36	71.42	-75.33	-7.34	1.000	3.49
30	2.36	69.69	-60.11	-4.21	1.000	3.38
31	2.36	67.97	-49.90	-2.11	1.001	3.30
32	2.87	76.80	-9249.29	-2151.84	1.000	3.87
33	2.87	75.07	-296.49	-61.15	1.000	3.72
34	2.87	73.35	-150.18	-26.99	1.000	3.59
35	2.87	71.62	-100.28	-15.33	1.000	3.48
36	2.87	69.90	-75.08	-9.45	1.000	3.39
37	2.87	68.17	-59.85	-5.89	1.000	3.31
38	2.87	66.45	-49.64	-3.51	1.000	3.24
39	2.87	64.72	-42.31	-1.80	1.000	3.17
40	3.03	75.20	-8507.79	-2229.49	1.000	3.68
41	3.03	73.48	-272.59	-62.93	1.000	3.56
42	3.03	71.75	-138.01	-27.52	1.000	3.45
43	3.03	70.03	-92.10	-15.45	1.000	3.36
44	3.03	68.30	-68.92	-9.35	1.000	3.28
45	3.03	66.58	-54.92	-5.66	1.000	3.20
46	3.03	64.85	-45.53	-3.19	1.000	3.14
47	3.03	63.13	-38.78	-1.42	1.000	3.09
48	3.03	61.40	-33.70	-0.08	1.000	3.05
49	3.06	73.53	-7650.60	-2244.22	1.000	3.62
50	3.06	71.80	-245.04	-62.57	1.000	3.50
51	3.06	70.08	-124.01	-26.92	1.000	3.40
52	3.06	68.35	-82.73	-14.76	1.000	3.31
53	3.06	66.63	-61.88	-8.62	1.000	3.23
54	3.06	64.90	-49.29	-4.91	1.000	3.16

55	3.06	63.18	-40.85	-2.42	1.000	3.10
56	3.06	61.45	-34.78	-0.63	1.000	3.05
57	3.06	59.73	-30.21	0.71	1.000	3.01
58	3.06	58.00	-26.63	1.77	1.000	2.97
59	3.09	71.77	-6906.86	-2256.99	1.000	3.67
60	3.09	70.04	-221.13	-62.27	1.000	3.56
61	3.09	68.32	-111.86	-26.40	1.000	3.45
62	3.09	66.59	-74.60	-14.16	1.000	3.36
63	3.09	64.87	-55.78	-7.99	1.000	3.28
64	3.09	63.14	-44.41	-4.25	1.000	3.21
65	3.09	61.42	-36.78	-1.75	1.000	3.15
66	3.09	59.69	-31.31	0.05	1.000	3.10
67	3.09	57.97	-27.18	1.40	1.000	3.05
68	3.09	56.24	-23.95	2.46	0.999	3.01
69	3.09	54.52	-21.35	3.32	0.999	2.99
70	3.29	69.92	-6499.08	-2357.41	1.000	3.24
71	3.29	68.20	-207.93	-65.10	0.999	3.16
72	3.29	66.47	-105.11	-27.63	0.999	3.08
73	3.29	64.75	-70.05	-14.86	0.998	3.02
74	3.29	63.02	-52.34	-8.40	0.998	2.96
75	3.29	61.30	-41.64	-4.51	0.997	2.91
76	3.29	59.57	-34.46	-1.89	0.996	2.87
77	3.29	57.84	-29.31	-0.01	0.995	2.84
78	3.29	56.12	-25.43	1.40	0.994	2.81
79	3.29	54.39	-22.38	2.51	0.993	2.78
80	3.29	52.67	-19.94	3.40	0.992	2.76
81	3.29	50.94	-17.92	4.14	0.990	2.75
82	3.79	67.98	-6498.83	-2609.80	1.000	2.45
83	3.79	66.26	-207.67	-73.21	0.998	2.41
84	3.79	64.53	-104.86	-31.75	0.997	2.37
85	3.79	62.81	-69.79	-17.61	0.995	2.34
86	3.79	61.08	-52.08	-10.47	0.993	2.32
87	3.79	59.36	-41.39	-6.16	0.991	2.30
88	3.79	57.63	-34.21	-3.27	0.995	2.26
89	3.79	55.91	-29.06	-1.19	0.994	2.24
90	3.79	54.18	-25.17	0.38	0.993	2.23
91	3.79	52.46	-22.13	1.60	0.991	2.22
92	3.79	50.73	-19.68	2.59	0.999	2.18
93	3.79	49.00	-17.67	3.40	0.996	2.21
94	3.79	47.28	-15.98	4.09	0.998	2.20
95	4.34	65.95	-6498.55	-2882.35	1.000	2.03
96	4.34	64.22	-207.40	-81.96	0.997	2.01
97	4.34	62.50	-104.59	-36.20	0.994	1.99
98	4.34	60.77	-69.52	-20.59	0.991	1.97
99	4.34	59.05	-51.81	-12.71	0.992	1.96
100	4.34	57.32	-41.11	-7.94	0.994	1.94
101	4.34	55.60	-33.94	-4.75	0.992	1.93
102	4.34	53.87	-28.79	-2.46	0.990	1.92
103	4.34	52.14	-24.90	-0.73	0.995	1.91
104	4.34	50.42	-21.86	0.63	0.993	1.91
105	4.34	48.69	-19.41	1.72	0.992	1.91
106	4.34	46.97	-17.40	2.61	0.990	1.91
107	4.34	45.24	-15.70	3.37	1.000	1.89
108	4.34	43.52	-14.26	4.01	1.001	1.89
109	4.93	63.81	-6498.26	-3177.98	1.000	1.78
110	4.93	62.08	-207.11	-91.46	0.997	1.77
111	4.93	60.36	-104.29	-41.02	0.993	1.76
112	4.93	58.63	-69.23	-23.82	0.993	1.74
113	4.93	56.91	-51.52	-15.13	0.993	1.73
114	4.93	55.18	-40.82	-9.88	0.991	1.73
115	4.93	53.46	-33.64	-6.36	0.997	1.70
116	4.93	51.73	-28.49	-3.83	0.996	1.70
117	4.93	50.01	-24.60	-1.92	0.995	1.70

118	4.93	48.28	-21.56	-0.43	1.000	1.69
119	4.93	46.56	-19.12	0.77	0.999	1.69
120	4.93	44.83	-17.10	1.76	0.999	1.69
121	4.93	43.11	-15.41	2.59	0.998	1.69
122	4.93	41.38	-13.96	3.30	0.999	1.69
123	4.93	39.65	-12.72	3.91	0.997	1.71
124	4.93	37.93	-11.62	4.44	0.995	1.73
125	5.57	61.56	-6497.94	-3500.29	1.000	1.63
126	5.57	59.84	-206.78	-101.82	0.996	1.62
127	5.57	58.11	-103.97	-46.28	0.992	1.61
128	5.57	56.39	-68.90	-27.33	0.991	1.61
129	5.57	54.66	-51.19	-17.77	0.992	1.59
130	5.57	52.94	-40.50	-11.99	0.996	1.58
131	5.57	51.21	-33.32	-8.11	0.995	1.57
132	5.57	49.49	-28.17	-5.33	0.993	1.57
133	5.57	47.76	-24.28	-3.23	0.992	1.57
134	5.57	46.04	-21.24	-1.59	1.002	1.54
135	5.57	44.31	-18.79	-0.27	1.001	1.54
136	5.57	42.59	-16.78	0.82	0.992	1.57
137	5.57	40.86	-15.08	1.74	0.991	1.58
138	5.57	39.13	-13.64	2.52	1.008	1.54
139	5.57	37.41	-12.39	3.19	1.006	1.56
140	5.57	35.68	-11.30	3.78	1.003	1.59
141	5.57	33.96	-10.34	4.30	1.003	1.60
142	6.28	59.21	-6497.58	-3853.76	1.000	1.53
143	6.28	57.48	-206.43	-113.18	0.996	1.53
144	6.28	55.76	-103.62	-52.04	0.992	1.53
145	6.28	54.03	-68.55	-31.19	0.991	1.52
146	6.28	52.31	-50.84	-20.66	0.995	1.49
147	6.28	50.58	-40.14	-14.30	0.993	1.49
148	6.28	48.86	-32.97	-10.04	0.990	1.49
149	6.28	47.13	-27.82	-6.97	0.998	1.47
150	6.28	45.40	-23.93	-4.66	0.997	1.47
151	6.28	43.68	-20.89	-2.86	1.000	1.46
152	6.28	41.95	-18.44	-1.40	0.999	1.46
153	6.28	40.23	-16.42	-0.20	0.998	1.47
154	6.28	38.50	-14.73	0.81	0.998	1.48
155	6.28	36.78	-13.29	1.66	1.005	1.47
156	6.28	35.05	-12.04	2.41	1.005	1.48
157	6.28	33.33	-10.95	3.05	1.005	1.50
158	6.28	31.60	-9.99	3.63	1.001	1.52
159	6.28	29.88	-9.13	4.14	1.006	1.54
160	7.06	56.73	-6497.19	-4244.04	1.000	1.48
161	7.06	55.01	-206.04	-125.71	0.997	1.47
162	7.06	53.28	-103.22	-58.41	0.993	1.46
163	7.06	51.56	-68.16	-35.45	0.992	1.45
164	7.06	49.83	-50.45	-23.86	0.991	1.45
165	7.06	48.11	-39.75	-16.86	0.993	1.43
166	7.06	46.38	-32.58	-12.16	0.992	1.43
167	7.06	44.66	-27.42	-8.79	0.997	1.41
168	7.06	42.93	-23.54	-6.25	0.996	1.42
169	7.06	41.20	-20.50	-4.25	0.996	1.42
170	7.06	39.48	-18.05	-2.65	0.999	1.42
171	7.06	37.75	-16.03	-1.33	0.997	1.43
172	7.06	36.03	-14.34	-0.22	0.996	1.44
173	7.06	34.30	-12.90	0.72	0.996	1.45
174	7.06	32.58	-11.65	1.54	0.995	1.46
175	7.06	30.85	-10.56	2.25	1.003	1.46
176	7.06	29.13	-9.59	2.88	1.007	1.47
177	7.06	27.40	-8.74	3.45	1.002	1.50
178	7.06	25.68	-7.96	3.95	1.000	1.53
179	7.06	23.95	-7.27	4.41	1.004	1.55
180	7.93	54.13	-6496.76	-4678.36	1.000	1.45

181	7.93	52.41	-205.61	-139.67	0.997	1.44
182	7.93	50.68	-102.79	-65.49	0.993	1.43
183	7.93	48.96	-67.73	-40.20	0.992	1.43
184	7.93	47.23	-50.02	-27.42	0.990	1.42
185	7.93	45.51	-39.32	-19.70	0.991	1.41
186	7.93	43.78	-32.14	-14.53	0.994	1.40
187	7.93	42.06	-26.99	-10.81	0.992	1.41
188	7.93	40.33	-23.10	-8.01	0.998	1.39
189	7.93	38.61	-20.06	-5.81	0.996	1.40
190	7.93	36.88	-17.62	-4.05	0.995	1.41
191	7.93	35.16	-15.60	-2.59	0.994	1.42
192	7.93	33.43	-13.91	-1.37	0.999	1.42
193	7.93	31.70	-12.46	-0.33	0.998	1.43
194	7.93	29.98	-11.22	0.57	0.996	1.45
195	7.93	28.25	-10.12	1.36	0.995	1.47
196	7.93	26.53	-9.16	2.05	0.994	1.48
197	7.93	24.80	-8.30	2.67	1.003	1.48
198	7.93	23.08	-7.53	3.23	1.003	1.50
199	7.93	21.35	-6.83	3.73	0.996	1.55
200	7.93	19.63	-6.20	4.19	1.000	1.56
201	8.90	51.41	-6496.27	-5166.12	1.000	1.44
202	8.90	49.68	-205.12	-155.34	0.997	1.43
203	8.90	47.96	-102.30	-73.45	0.994	1.43
204	8.90	46.23	-67.24	-45.52	0.992	1.43
205	8.90	44.50	-49.53	-31.42	0.993	1.42
206	8.90	42.78	-38.83	-22.90	0.990	1.42
207	8.90	41.05	-31.66	-17.18	0.997	1.40
208	8.90	39.33	-26.50	-13.08	0.997	1.41
209	8.90	37.60	-22.62	-9.98	0.996	1.41
210	8.90	35.88	-19.58	-7.56	0.993	1.42
211	8.90	34.15	-17.13	-5.61	0.990	1.43
212	8.90	32.43	-15.11	-4.00	1.005	1.41
213	8.90	30.70	-13.42	-2.66	1.003	1.42
214	8.90	28.98	-11.98	-1.51	1.001	1.44
215	8.90	27.25	-10.73	-0.51	1.004	1.44
216	8.90	25.53	-9.64	0.36	1.003	1.46
217	8.90	23.80	-8.67	1.12	1.003	1.47
218	8.90	22.07	-7.81	1.81	1.003	1.48
219	8.90	20.35	-7.04	2.42	1.003	1.50
220	8.90	18.62	-6.34	2.98	0.992	1.55
221	8.90	16.90	-5.71	3.49	1.004	1.54
222	8.90	15.17	-5.12	3.95	1.004	1.59
223	8.90	13.45	-4.59	4.38	1.003	1.63
224	25.00	48.54	-14988.22	-13222.50	1.000	1.42
225	25.00	46.82	-470.18	-422.42	0.998	1.45
226	25.00	45.09	-232.91	-213.23	0.997	1.48
227	25.00	43.37	-151.99	-141.89	0.995	1.52
228	25.00	41.64	-111.12	-105.85	0.993	1.55
229	25.00	39.91	-86.43	-84.09	0.991	1.60
230	25.00	38.19	-69.88	-69.49	0.992	1.63
231	25.00	36.46	-57.99	-59.01	0.994	1.66
232	25.00	34.74	-49.02	-51.10	0.992	1.71
233	25.00	33.01	-42.00	-44.91	0.991	1.76
234	25.00	31.29	-36.35	-39.93	0.994	1.80
235	25.00	29.56	-31.70	-35.83	0.993	1.85
236	25.00	27.84	-27.79	-32.39	0.995	1.89
237	25.00	26.11	-24.46	-29.45	0.994	1.95
238	25.00	24.39	-21.58	-26.91	0.992	2.02
239	25.00	22.66	-19.06	-24.69	0.991	2.06
240	25.00	20.94	-16.84	-22.73	0.993	2.10
241	25.00	19.21	-14.86	-20.98	0.991	2.16
242	25.00	17.48	-13.08	-19.41	1.000	2.18
243	25.00	15.76	-11.47	-17.99	0.999	2.23

244	25.00	14.03	-10.00	-16.70	0.998	2.30
245	25.00	12.31	-8.65	-15.51	0.996	2.35
246	25.00	10.58	-7.41	-14.42	0.995	2.41
247	25.00	8.86	-6.27	-13.41	0.994	2.47

Global Stability
Minimum global safety factor = 1.391 for circle no. 188

Output Data

Wall Height = 17.50
Wall Slope = 85.26

Circle Number	Circle X-Intercept	Circle Base Angle	Circle X-Center	Circle Y-Center	Moment Ratio	Force Req'd/ Unit Wall Length
1	2.36	67.97	-49.90	-2.11	1.004	137.26
2	2.87	71.62	-100.28	-15.33	1.001	6.60
3	2.87	69.90	-75.08	-9.45	1.001	200.77
4	2.87	68.17	-59.85	-5.89	1.002	379.53
5	2.87	66.45	-49.64	-3.51	1.003	545.11
6	2.87	64.72	-42.31	-1.80	1.004	696.99
7	3.03	75.20	-8507.79	-2229.49	1.000	118.16
8	3.03	73.48	-272.59	-62.93	1.000	291.79
9	3.03	71.75	-138.01	-27.52	1.000	456.14
10	3.03	70.03	-92.10	-15.45	1.000	610.68
11	3.03	68.30	-68.92	-9.35	1.001	754.44
12	3.03	66.58	-54.92	-5.66	1.001	886.98
13	3.03	64.85	-45.53	-3.19	1.002	1007.71
14	3.03	63.13	-38.78	-1.42	1.003	1115.24
15	3.03	61.40	-33.70	-0.08	1.004	1210.25
16	3.06	73.53	-7650.60	-2244.22	1.000	738.47
17	3.06	71.80	-245.04	-62.57	1.000	873.44
18	3.06	70.08	-124.01	-26.92	1.000	999.74
19	3.06	68.35	-82.73	-14.76	1.000	1116.69
20	3.06	66.63	-61.88	-8.62	1.001	1224.39
21	3.06	64.90	-49.29	-4.91	1.001	1321.06
22	3.06	63.18	-40.85	-2.42	1.001	1406.20
23	3.06	61.45	-34.78	-0.63	1.002	1480.21
24	3.06	59.73	-30.21	0.71	1.003	1543.53
25	3.06	58.00	-26.63	1.77	1.004	1597.58
26	3.09	71.77	-6906.86	-2256.99	1.000	1171.42
27	3.09	70.04	-221.13	-62.27	1.000	1280.86
28	3.09	68.32	-111.86	-26.40	1.000	1381.44
29	3.09	66.59	-74.60	-14.16	1.000	1473.10
30	3.09	64.87	-55.78	-7.99	1.000	1555.02
31	3.09	63.14	-44.41	-4.25	1.001	1626.71
32	3.09	61.42	-36.78	-1.75	1.001	1687.85
33	3.09	59.69	-31.31	0.05	1.002	1738.27
34	3.09	57.97	-27.18	1.40	1.002	1777.90
35	3.09	56.24	-23.95	2.46	1.003	1806.17
36	3.09	54.52	-21.35	3.32	1.004	1820.37
37	3.29	69.92	-6499.08	-2357.41	1.000	1964.65
38	3.29	68.20	-207.93	-65.10	0.999	2068.86
39	3.29	66.47	-105.11	-27.63	0.999	2162.55
40	3.29	64.75	-70.05	-14.86	0.998	2244.91
41	3.29	63.02	-52.34	-8.40	0.998	2314.29
42	3.29	61.30	-41.64	-4.51	0.997	2370.34
43	3.29	59.57	-34.46	-1.89	0.997	2412.51
44	3.29	57.84	-29.31	-0.01	0.996	2440.47
45	3.29	56.12	-25.43	1.40	0.996	2456.13
46	3.29	54.39	-22.38	2.51	0.996	2458.09
47	3.29	52.67	-19.94	3.40	0.996	2446.58
48	3.29	50.94	-17.92	4.14	0.996	2419.24
49	3.79	67.98	-6498.83	-2609.80	1.000	3382.10
50	3.79	66.26	-207.67	-73.21	0.998	3497.97
51	3.79	64.53	-104.86	-31.75	0.997	3597.73
52	3.79	62.81	-69.79	-17.61	0.995	3680.37
53	3.79	61.08	-52.08	-10.47	0.993	3745.03

54	3.79	59.36	-41.39	-6.16	0.991	3791.53
55	3.79	57.63	-34.21	-3.27	0.992	3865.45
56	3.79	55.91	-29.06	-1.19	0.991	3884.39
57	3.79	54.18	-25.17	0.38	0.993	3941.77
58	3.79	52.46	-22.13	1.60	0.992	3931.90
59	3.79	50.73	-19.68	2.59	0.991	3903.13
60	3.79	49.00	-17.67	3.40	0.996	3927.42
61	3.79	47.28	-15.98	4.09	0.998	3901.58
62	4.34	65.95	-6498.55	-2882.35	1.000	4598.44
63	4.34	64.22	-207.40	-81.96	0.997	4712.67
64	4.34	62.50	-104.59	-36.20	0.994	4805.41
65	4.34	60.77	-69.52	-20.59	0.991	4875.53
66	4.34	59.05	-51.81	-12.71	0.990	4957.76
67	4.34	57.32	-41.11	-7.94	0.990	5031.44
68	4.34	55.60	-33.94	-4.75	0.993	5138.61
69	4.34	53.87	-28.79	-2.46	0.991	5152.83
70	4.34	52.14	-24.90	-0.73	0.996	5266.77
71	4.34	50.42	-21.86	0.63	0.995	5243.17
72	4.34	48.69	-19.41	1.72	0.994	5195.14
73	4.34	46.97	-17.40	2.61	0.992	5123.03
74	4.34	45.24	-15.70	3.37	0.998	5161.94
75	4.34	43.52	-14.26	4.01	0.999	5051.03
76	4.93	63.81	-6498.26	-3177.98	1.000	5600.19
77	4.93	62.08	-207.11	-91.46	0.997	5714.09
78	4.93	60.36	-104.29	-41.02	0.993	5801.84
79	4.93	58.63	-69.23	-23.82	0.992	5899.75
80	4.93	56.91	-51.52	-15.13	0.991	5993.61
81	4.93	55.18	-40.82	-9.88	0.993	6131.29
82	4.93	53.46	-33.64	-6.36	0.991	6157.56
83	4.93	51.73	-28.49	-3.83	0.997	6326.11
84	4.93	50.01	-24.60	-1.92	0.996	6324.02
85	4.93	48.28	-21.56	-0.43	0.992	6203.41
86	4.93	46.56	-19.12	0.77	0.990	6123.70
87	4.93	44.83	-17.10	1.76	1.000	6306.78
88	4.93	43.11	-15.41	2.59	0.999	6205.71
89	4.93	41.38	-13.96	3.30	1.001	6131.95
90	4.93	39.65	-12.72	3.91	1.000	5910.05
91	4.93	37.93	-11.62	4.44	0.998	5692.38
92	5.57	61.56	-6497.94	-3500.29	1.000	6369.20
93	5.57	59.84	-206.78	-101.82	0.996	6480.60
94	5.57	58.11	-103.97	-46.28	0.992	6557.36
95	5.57	56.39	-68.90	-27.33	0.990	6649.94
96	5.57	54.66	-51.19	-17.77	0.990	6763.00
97	5.57	52.94	-40.50	-11.99	0.992	6902.48
98	5.57	51.21	-33.32	-8.11	0.990	6913.87
99	5.57	49.49	-28.17	-5.33	0.995	7084.75
100	5.57	47.76	-24.28	-3.23	0.994	7060.30
101	5.57	46.04	-21.24	-1.59	0.992	6986.96
102	5.57	44.31	-18.79	-0.27	0.991	6899.61
103	5.57	42.59	-16.78	0.82	0.996	6964.57
104	5.57	40.86	-15.08	1.74	0.995	6819.48
105	5.57	39.13	-13.64	2.52	0.993	6639.93
106	5.57	37.41	-12.39	3.19	0.990	6392.10
107	5.57	35.68	-11.30	3.78	0.995	6259.91
108	5.57	33.96	-10.34	4.30	0.993	5944.57
109	6.28	59.21	-6497.58	-3853.76	1.000	6882.10
110	6.28	57.48	-206.43	-113.18	0.996	6995.60
111	6.28	55.76	-103.62	-52.04	0.992	7066.40
112	6.28	54.03	-68.55	-31.19	0.990	7157.19
113	6.28	52.31	-50.84	-20.66	0.992	7336.55
114	6.28	50.58	-40.14	-14.30	0.995	7514.62
115	6.28	48.86	-32.97	-10.04	0.993	7517.09
116	6.28	47.13	-27.82	-6.97	0.991	7502.67

117	6.28	45.40	-23.93	-4.66	0.997	7661.16
118	6.28	43.68	-20.89	-2.86	0.993	7500.92
119	6.28	41.95	-18.44	-1.40	0.990	7365.33
120	6.28	40.23	-16.42	-0.20	0.998	7515.34
121	6.28	38.50	-14.73	0.81	0.997	7358.05
122	6.28	36.78	-13.29	1.66	0.993	7026.74
123	6.28	35.05	-12.04	2.41	0.991	6775.72
124	6.28	33.33	-10.95	3.05	1.003	6935.64
125	6.28	31.60	-9.99	3.63	0.999	6513.79
126	6.28	29.88	-9.13	4.14	1.003	6265.45
127	7.06	56.73	-6497.19	-4244.04	1.000	7107.70
128	7.06	55.01	-206.04	-125.71	0.997	7230.04
129	7.06	53.28	-103.22	-58.41	0.993	7316.19
130	7.06	51.56	-68.16	-35.45	0.991	7409.15
131	7.06	49.83	-50.45	-23.86	0.993	7593.04
132	7.06	48.11	-39.75	-16.86	0.991	7604.92
133	7.06	46.38	-32.58	-12.16	0.995	7791.94
134	7.06	44.66	-27.42	-8.79	0.992	7734.54
135	7.06	42.93	-23.54	-6.25	0.991	7668.19
136	7.06	41.20	-20.50	-4.25	0.996	7817.23
137	7.06	39.48	-18.05	-2.65	0.992	7567.41
138	7.06	37.75	-16.03	-1.33	0.998	7654.97
139	7.06	36.03	-14.34	-0.22	0.997	7464.81
140	7.06	34.30	-12.90	0.72	0.995	7232.44
141	7.06	32.58	-11.65	1.54	0.994	6954.87
142	7.06	30.85	-10.56	2.25	1.002	6953.85
143	7.06	29.13	-9.59	2.88	0.991	6207.37
144	7.06	27.40	-8.74	3.45	0.999	6159.65
145	7.06	25.68	-7.96	3.95	0.994	5596.86
146	7.06	23.95	-7.27	4.41	0.996	5153.33
147	7.93	54.13	-6496.76	-4678.36	1.000	7003.94
148	7.93	52.41	-205.61	-139.67	0.997	7121.62
149	7.93	50.68	-102.79	-65.49	0.993	7199.13
150	7.93	48.96	-67.73	-40.20	0.991	7277.73
151	7.93	47.23	-50.02	-27.42	0.992	7419.04
152	7.93	45.51	-39.32	-19.70	0.994	7582.65
153	7.93	43.78	-32.14	-14.53	0.992	7547.54
154	7.93	42.06	-26.99	-10.81	0.995	7703.87
155	7.93	40.33	-23.10	-8.01	0.993	7599.07
156	7.93	38.61	-20.06	-5.81	0.990	7427.69
157	7.93	36.88	-17.62	-4.05	0.997	7573.15
158	7.93	35.16	-15.60	-2.59	0.996	7384.78
159	7.93	33.43	-13.91	-1.37	1.000	7367.62
160	7.93	31.70	-12.46	-0.33	0.999	7103.48
161	7.93	29.98	-11.22	0.57	0.995	6692.13
162	7.93	28.25	-10.12	1.36	0.994	6328.73
163	7.93	26.53	-9.16	2.05	0.991	5897.18
164	7.93	24.80	-8.30	2.67	1.000	5767.48
165	7.93	23.08	-7.53	3.23	0.997	5207.85
166	7.93	21.35	-6.83	3.73	0.998	4736.30
167	7.93	19.63	-6.20	4.19	1.000	4289.61
168	8.90	51.41	-6496.27	-5166.12	1.000	6516.46
169	8.90	49.68	-205.12	-155.34	0.997	6620.62
170	8.90	47.96	-102.30	-73.45	0.994	6692.67
171	8.90	46.23	-67.24	-45.52	0.992	6774.98
172	8.90	44.50	-49.53	-31.42	0.992	6873.85
173	8.90	42.78	-38.83	-22.90	0.995	7053.73
174	8.90	41.05	-31.66	-17.18	0.995	7093.63
175	8.90	39.33	-26.50	-13.08	0.994	7027.82
176	8.90	37.60	-22.62	-9.98	0.992	6921.06
177	8.90	35.88	-19.58	-7.56	1.001	7187.62
178	8.90	34.15	-17.13	-5.61	0.998	6950.10
179	8.90	32.43	-15.11	-4.00	0.997	6739.37

180	8.90	30.70	-13.42	-2.66	0.994	6393.67
181	8.90	28.98	-11.98	-1.51	1.004	6609.08
182	8.90	27.25	-10.73	-0.51	0.991	5756.33
183	8.90	25.53	-9.64	0.36	0.997	5637.08
184	8.90	23.80	-8.67	1.12	0.995	5176.51
185	8.90	22.07	-7.81	1.81	0.991	4570.12
186	8.90	20.35	-7.04	2.42	1.008	4887.79
187	25.00	48.54	-14988.22	-13222.50	1.000	5149.19
188	25.00	46.82	-470.18	-422.42	0.998	4632.65
189	25.00	45.09	-232.91	-213.23	0.997	4079.45
190	25.00	43.37	-151.99	-141.89	0.995	3488.92
191	25.00	41.64	-111.12	-105.85	0.993	2861.85
192	25.00	39.91	-86.43	-84.09	0.991	2216.48
193	25.00	38.19	-69.88	-69.49	0.992	1663.42
194	25.00	36.46	-57.99	-59.01	0.991	951.22
195	25.00	34.74	-49.02	-51.10	0.993	383.57

Nail Forces

Nail No.	Circle No.	Nail Force
1	133	13965.41
2	133	17677.73
3	136	15526.35

Input File Version = 311
Wall 14, Sta 698+60 Design Mode

General Data	
File Identifier	WALL14DS.GNI
Unit weight of water	62.4
Base depth for analysis	0.0
Seismic Coefficient	0.0
Minimum Base Exit Angle	-10.0
X Search limit (left)	0.1
X Search limit (right)	25.0
Number of slip circles	250
No. of slip circle exits	20

LRFD and Safety Factor Data	
Analysis Mode: (L)RFD or (S)LD (specify L or S)	S
SLD Safety and Strength Factors (mode S only)	
FS for Soil Cohesion	1.35
FS for Soil Friction	1.35
Strength Factor for Head Strength	0.67
Strength Factor for Nail Tendon Strength	0.55
Strength Factor for Nail Pullout Resistance	0.5
LRFD Load Factors (mode L only)	
LF for Unit Weight of Water	1
LF for Unit Weight of Soil	1.35
LF for Surcharge Loads	1.75
LF for Seismic Loads	1
LRFD Resistance Factors (mode L only)	
RF for Soil Cohesion	1
RF for Soil Friction Angle	0.75
RF for Head Strength	0.9
RF for Nail Pullout Resistance	0.7
RF for Nail Tendon Strength	0.9

PIEZOMETRIC DATA	X-Value	Piez. Level
Point 1		
Point 2		
Point 3		
Point 4		
Point 5		
Point 6		
Point 7		
Point 8		
Point 9		
Point 10		

Nodal Data

Node No	X-Value	Y-Value	Node No	X-Value	Y-Value	Node No	X-Value	Y-Value
1	-1.92	23	16			31		
2	-1	12	17			32		
3	0	0	18			33		
4	6.5	0	19			34		
5	7.21	-8.5	20			35		
6	50	-8.5	21			36		
7	50	0	22			37		
8	50	12	23			38		
9			24			39		
10			25			40		
11			26			41		
12			27			42		
13			28			43		
14			29			44		
15			30			45		

Wall Segment Data

Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID	Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID
1	1	2	3	3	11				
2	2	3	2	2	12				
3					13				
4					14				
5					15				
6					16				
7					17				
8					18				
9					19				
10					20				

Surface Segment Data

Seg. No.	Node 1	Node 2	Soil ID	Seg. No.	Node 1	Node 2	Soil ID
1	3	4	2	11			
2	4	5	1	12			
3	5	6	1	13			
4				14			
5				15			
6				16			
7				17			
8				18			
9				19			
10				20			

Internal Segment Data									
Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID	Seg. No.	Node 1	Node 2	Soil ID	Pullout Res. ID
1	4	7	2	2	11				
2	2	8	3	3	12				
3					13				
4					14				
5					15				
6					16				
7					17				
8					18				
9					19				
10					20				

Soil Strength & Pullout Resist. Data				
Material ID No.	c	φ	Unit Weight	Pullout Res.
1	10	30	110	6283
2	100	35	115	3140
3	150	38	120	7000
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Surcharge Pressure Data			
Load No	X-value	Vert.	Horiz.
1	0	0	0
2	6.5	1580	0
3	25	250	0
4			
5			
6			
7			
8			
9			
10			

Nail Data	Nail Depth	Nail Length	Tendon Strength	Head Strength	Fixed Nail?
Nail Row 1	2.6	23	76200	30000	
Nail Row 2	8.1	23	76200	30000	
Nail Row 3	10.6	23	93600	30000	
Nail Row 4	15.1	23	93600	30000	
Nail Row 5	18.6	21	76200	30000	
Nail Row 6					
Nail Row 7					
Nail Row 8					
Nail Row 9					
Nail Row 10					
Nail Row 11					
Nail Row 12					
Nail Row 13					
Nail Row 14					
Nail Row 15					

Horiz. Spacing	4
Nail Declination	15

Facing Data	
Maximum Facing Pressure	0.0
Facing Pressure angle	15.0
Press. Distribution type	3
Press. Distribution type	Triangular

Analysis Options	
Analysis Mode	Design
Soil Model	Linear
Analysis with nails?	Yes

Output Data

Wall Height = 23.00
Wall Slope = 85.23

Circle Number	Circle X-Intercept	Circle Base Angle	Circle X-Center	Circle Y-Center	Moment Ratio	Force Req'd/ Unit Wall Length
1	0.57	80.37	-191.57	-9.18	0.999	6.88
2	0.57	78.68	-128.46	-2.34	0.999	702.13
3	1.07	82.54	-11500.42	-1482.51	1.000	1845.29
4	1.07	80.85	-376.32	-37.33	1.000	2526.29
5	1.07	79.15	-191.32	-13.30	0.999	3199.41
6	1.07	77.46	-128.21	-5.10	0.999	3874.71
7	1.07	75.76	-96.33	-0.96	0.998	4509.71
8	1.59	81.26	-11500.16	-1744.88	1.000	4824.17
9	1.59	79.56	-376.05	-45.91	1.000	5458.18
10	1.59	77.87	-191.06	-17.66	0.999	6082.30
11	1.59	76.17	-127.95	-8.02	0.999	6715.36
12	1.59	74.48	-96.07	-3.15	0.999	7342.14
13	1.59	72.78	-76.81	-0.21	0.998	7879.29
14	2.15	79.91	-11499.88	-2022.31	1.000	7523.44
15	2.15	78.22	-375.78	-54.98	1.000	8116.28
16	2.15	76.52	-190.78	-22.26	0.999	8685.28
17	2.15	74.83	-127.67	-11.10	0.999	9247.87
18	2.15	73.13	-95.79	-5.46	0.999	9818.88
19	2.15	71.44	-76.54	-2.06	0.998	10368.04
20	2.74	78.50	-11499.59	-2316.10	1.000	9958.67
21	2.74	76.81	-375.48	-64.58	1.000	10513.09
22	2.74	75.11	-190.49	-27.14	0.999	11029.73
23	2.74	73.42	-127.38	-14.36	0.999	11527.22
24	2.74	71.72	-95.50	-7.91	0.998	12038.55
25	2.74	70.03	-76.24	-4.01	0.998	12576.23
26	2.74	68.33	-63.33	-1.40	0.998	13004.29
27	3.36	77.02	-11499.28	-2627.77	1.000	12141.63
28	3.36	75.32	-375.17	-74.77	1.000	12644.65
29	3.36	73.63	-190.18	-32.31	0.999	13120.88
30	3.36	71.93	-127.07	-17.83	0.999	13585.97
31	3.36	70.24	-95.19	-10.51	0.998	14023.45
32	3.36	68.54	-75.93	-6.09	0.998	14458.24
33	3.36	66.85	-63.02	-3.13	0.998	14910.17
34	3.36	65.15	-53.75	-1.00	0.997	15189.72
35	4.02	75.46	-11498.95	-2959.03	1.000	14079.56
36	4.02	73.76	-374.84	-85.60	0.999	14528.38
37	4.02	72.07	-189.85	-37.81	0.999	14964.23
38	4.02	70.37	-126.73	-21.51	0.999	15362.97
39	4.02	68.68	-94.86	-13.27	0.998	15753.58
40	4.02	66.98	-75.60	-8.30	0.998	16132.07
41	4.02	65.29	-62.69	-4.96	0.997	16490.45
42	4.02	63.59	-53.41	-2.57	0.997	16846.73
43	4.02	61.90	-46.42	-0.76	0.996	17029.86
44	4.73	73.82	-11498.59	-3311.92	1.000	15795.14
45	4.73	72.13	-374.49	-97.13	0.999	16187.58
46	4.73	70.43	-189.49	-43.67	0.999	16536.85
47	4.73	68.74	-126.38	-25.43	0.999	16886.57
48	4.73	67.04	-94.50	-16.22	0.998	17186.95
49	4.73	65.35	-75.25	-10.65	0.998	17515.80
50	4.73	63.65	-62.33	-6.92	0.998	17840.96
51	4.73	61.96	-53.06	-4.24	0.997	18161.06
52	4.73	60.26	-46.07	-2.22	0.997	18393.92
53	4.73	58.57	-40.60	-0.64	0.996	18465.60

54	5.48	72.11	-11498.22	-3688.79	1.000	17279.20
55	5.48	70.41	-374.11	-109.45	0.999	17609.30
56	5.48	68.72	-189.12	-49.92	0.999	17907.41
57	5.48	67.02	-126.00	-29.62	0.998	18168.36
58	5.48	65.33	-94.13	-19.36	0.998	18442.21
59	5.48	63.63	-74.87	-13.16	0.997	18652.96
60	5.48	61.94	-61.96	-9.01	0.997	18889.26
61	5.48	60.24	-52.68	-6.02	0.996	19083.89
62	5.48	58.55	-45.69	-3.77	0.996	19330.02
63	5.48	56.85	-40.22	-2.01	0.997	19458.63
64	5.48	55.16	-35.82	-0.60	0.996	19417.20
65	6.29	70.30	-11497.81	-4092.41	1.000	18553.79
66	6.29	68.61	-373.71	-122.64	0.999	18832.71
67	6.29	66.91	-188.71	-56.62	0.999	19083.33
68	6.29	65.22	-125.60	-34.10	0.998	19278.25
69	6.29	63.52	-93.72	-22.73	0.997	19431.12
70	6.29	61.83	-74.47	-15.85	0.997	19611.32
71	6.29	60.13	-61.55	-11.25	0.996	19664.64
72	6.29	58.44	-52.28	-7.94	0.997	19828.21
73	6.29	56.74	-45.29	-5.44	0.996	19934.12
74	6.29	55.05	-39.82	-3.49	0.995	20083.66
75	6.29	53.35	-35.41	-1.92	0.994	20025.22
76	6.29	51.66	-31.79	-0.62	0.995	19876.41
77	10.51	68.41	-15745.70	-6207.31	1.000	21649.98
78	10.51	66.71	-510.51	-195.88	0.999	21784.90
79	10.51	65.02	-257.15	-95.91	0.999	21868.75
80	10.51	63.32	-170.72	-61.80	0.998	21796.81
81	10.51	61.63	-127.06	-44.58	0.998	21721.20
82	10.51	59.93	-100.68	-34.17	0.998	21654.02
83	10.51	58.24	-83.00	-27.19	0.997	21451.46
84	10.51	56.54	-70.30	-22.18	0.997	21221.79
85	10.51	54.85	-60.72	-18.40	0.997	21067.29
86	10.51	53.15	-53.23	-15.45	0.995	20790.37
87	10.51	51.46	-47.20	-13.07	0.999	20813.71
88	10.51	49.76	-42.23	-11.11	0.998	20598.75
89	10.51	48.07	-38.06	-9.46	0.998	20205.21
90	11.79	66.42	-15745.06	-6847.92	1.000	22215.57
91	11.79	64.73	-509.87	-216.82	0.999	22233.05
92	11.79	63.03	-256.51	-106.54	0.999	22216.23
93	11.79	61.34	-170.07	-68.92	0.998	22101.46
94	11.79	59.64	-126.42	-49.92	0.998	21938.98
95	11.79	57.95	-100.04	-38.44	0.997	21849.82
96	11.79	56.25	-82.36	-30.74	0.997	21678.39
97	11.79	54.56	-69.66	-25.22	0.997	21552.44
98	11.79	52.86	-60.08	-21.05	0.998	21452.04
99	11.79	51.17	-52.59	-17.79	0.998	21179.80
100	11.79	49.47	-46.56	-15.16	0.996	20435.60
101	11.79	47.78	-41.59	-13.00	0.996	20009.73
102	11.79	46.08	-37.42	-11.18	0.997	19562.75
103	11.79	44.39	-33.87	-9.64	0.997	19132.65
104	13.18	64.33	-15744.37	-7541.76	1.000	22551.64
105	13.18	62.64	-509.18	-239.50	1.000	22488.10
106	13.18	60.94	-255.82	-118.06	0.999	22413.24
107	13.18	59.25	-169.38	-76.63	0.999	22323.31
108	13.18	57.55	-125.72	-55.71	0.999	22232.24
109	13.18	55.86	-99.35	-43.07	0.998	22080.65
110	13.18	54.16	-81.66	-34.59	0.997	21858.71
111	13.18	52.47	-68.96	-28.50	0.998	21374.98
112	13.18	50.77	-59.39	-23.91	0.997	21019.88
113	13.18	49.08	-51.89	-20.32	0.997	20550.73
114	13.18	47.38	-45.86	-17.43	0.996	20046.42
115	13.18	45.69	-40.89	-15.05	0.997	19657.86
116	13.18	43.99	-36.73	-13.05	0.997	19196.55

117	13.18	42.30	-33.17	-11.35	0.996	18564.16
118	13.18	40.60	-30.10	-9.88	0.997	18032.43
119	13.18	38.91	-27.42	-8.59	0.997	17457.85
120	14.69	62.14	-15743.61	-8296.91	1.000	22701.89
121	14.69	60.45	-508.42	-264.18	0.999	22627.95
122	14.69	58.75	-255.06	-130.60	0.999	22552.26
123	14.69	57.06	-168.63	-85.02	0.999	22405.41
124	14.69	55.36	-124.97	-62.00	0.998	22006.99
125	14.69	53.67	-98.59	-48.10	0.999	21771.97
126	14.69	51.97	-80.91	-38.78	0.998	21400.12
127	14.69	50.28	-68.21	-32.08	0.997	20990.03
128	14.69	48.58	-58.63	-27.03	0.997	20582.20
129	14.69	46.89	-51.14	-23.08	0.996	20060.02
130	14.69	45.19	-45.11	-19.90	0.998	19737.29
131	14.69	43.50	-40.14	-17.28	0.997	19127.78
132	14.69	41.80	-35.97	-15.08	0.997	18576.37
133	14.69	40.11	-32.42	-13.21	0.996	17908.77
134	14.69	38.41	-29.35	-11.59	0.996	17297.04
135	14.69	36.72	-26.66	-10.17	0.997	16654.14
136	14.69	35.02	-24.29	-8.92	0.996	15996.58
137	16.34	59.84	-15742.78	-9123.37	1.000	22710.76
138	16.34	58.15	-507.60	-291.20	1.000	22474.65
139	16.34	56.45	-254.24	-144.32	0.999	22248.72
140	16.34	54.76	-167.80	-94.21	0.999	22025.92
141	16.34	53.06	-124.14	-68.90	0.999	21690.80
142	16.34	51.37	-97.77	-53.61	0.998	21298.02
143	16.34	49.67	-80.08	-43.36	0.998	20871.06
144	16.34	47.98	-67.38	-35.99	0.997	20499.62
145	16.34	46.28	-57.80	-30.44	0.997	20052.86
146	16.34	44.59	-50.31	-26.10	0.997	19545.18
147	16.34	42.89	-44.28	-22.60	0.997	18969.45
148	16.34	41.20	-39.31	-19.72	0.997	18385.48
149	16.34	39.50	-35.14	-17.30	0.995	17639.80
150	16.34	37.81	-31.59	-15.24	0.995	16989.02
151	16.34	36.11	-28.52	-13.46	0.997	16470.27
152	16.34	34.41	-25.83	-11.91	0.997	15773.79
153	16.34	32.72	-23.46	-10.53	0.994	14829.65
154	16.34	31.02	-21.35	-9.31	0.995	14064.70
155	18.16	57.42	-15741.87	-10033.69	1.000	22335.72
156	18.16	55.73	-506.69	-320.95	1.000	22131.36
157	18.16	54.03	-253.33	-159.43	1.000	21836.01
158	18.16	52.34	-166.89	-104.32	0.999	21484.07
159	18.16	50.64	-123.23	-76.49	0.999	21087.06
160	18.16	48.95	-96.86	-59.67	0.999	20708.58
161	18.16	47.25	-79.17	-48.40	0.999	20297.56
162	18.16	45.56	-66.47	-40.30	0.999	19808.65
163	18.16	43.86	-56.89	-34.20	0.997	19169.23
164	18.16	42.17	-49.40	-29.42	0.996	18602.89
165	18.16	40.47	-43.37	-25.58	0.996	17999.83
166	18.16	38.78	-38.40	-22.41	0.994	17209.61
167	18.16	37.08	-34.23	-19.75	0.993	16527.52
168	18.16	35.39	-30.68	-17.49	0.993	15805.33
169	18.16	33.69	-27.61	-15.53	0.992	15050.46
170	18.16	32.00	-24.92	-13.82	0.992	14255.35
171	18.16	30.30	-22.55	-12.31	0.994	13505.85
172	18.16	28.61	-20.44	-10.96	0.995	12680.65
173	18.16	26.91	-18.54	-9.75	0.996	11828.56
174	18.16	25.22	-16.83	-8.66	0.994	10768.09
175	20.18	54.89	-15740.86	-11043.84	1.000	21767.28
176	20.18	53.19	-505.68	-353.97	1.000	21455.84
177	20.18	51.50	-252.32	-176.20	1.000	21125.02
178	20.18	49.80	-165.88	-115.55	1.000	20787.36
179	20.18	48.11	-122.22	-84.91	0.999	20295.98

180	20.18	46.41	-95.85	-66.41	0.999	19825.23
181	20.18	44.72	-78.16	-54.00	0.998	19318.17
182	20.18	43.02	-65.46	-45.09	0.997	18692.31
183	20.18	41.33	-55.88	-38.37	0.997	18100.38
184	20.18	39.63	-48.39	-33.11	0.996	17467.57
185	20.18	37.94	-42.36	-28.88	0.995	16766.92
186	20.18	36.24	-37.39	-25.39	0.994	16012.68
187	20.18	34.55	-33.22	-22.47	0.994	15268.80
188	20.18	32.85	-29.67	-19.97	0.994	14492.30
189	20.18	31.16	-26.60	-17.82	0.995	13731.91
190	20.18	29.46	-23.91	-15.94	0.993	12770.18
191	20.18	27.77	-21.54	-14.27	0.993	11894.55
192	20.18	26.07	-19.43	-12.79	0.994	10991.64
193	20.18	24.38	-17.53	-11.46	0.995	10069.04
194	20.18	22.68	-15.82	-10.26	0.996	9106.77
195	20.18	20.99	-14.26	-9.16	0.993	7892.11
196	22.44	52.22	-15739.73	-12174.46	1.000	20893.07
197	22.44	50.53	-504.55	-390.92	1.000	20536.15
198	22.44	48.83	-251.19	-194.96	1.000	20127.90
199	22.44	47.14	-164.75	-128.11	0.999	19657.95
200	22.44	45.44	-121.09	-94.34	0.999	19167.27
201	22.44	43.75	-94.72	-73.94	0.999	18639.67
202	22.44	42.05	-77.03	-60.27	0.998	18065.37
203	22.44	40.36	-64.33	-50.44	0.997	17380.04
204	22.44	38.66	-54.75	-43.03	0.997	16728.23
205	22.44	36.97	-47.26	-37.24	0.996	16041.95
206	22.44	35.27	-41.23	-32.57	0.996	15318.58
207	22.44	33.58	-36.26	-28.73	0.997	14579.39
208	22.44	31.88	-32.09	-25.51	0.995	13618.02
209	22.44	30.19	-28.54	-22.76	0.994	12768.97
210	22.44	28.49	-25.47	-20.39	0.995	11910.89
211	22.44	26.80	-22.78	-18.31	0.995	11008.45
212	22.44	25.10	-20.41	-16.48	0.995	10072.15
213	22.44	23.41	-18.30	-14.84	0.992	8940.15
214	22.44	21.71	-16.40	-13.37	0.990	7773.12
215	22.44	20.02	-14.69	-12.05	0.991	6706.24
216	22.44	18.32	-13.13	-10.84	0.991	5612.37
217	22.44	16.63	-11.69	-9.73	0.999	4869.92
218	22.44	14.93	-10.38	-8.71	1.000	3708.01
219	25.00	49.43	-15738.46	-13452.75	1.000	19647.02
220	25.00	47.73	-503.27	-432.71	1.000	19217.80
221	25.00	46.04	-249.91	-216.18	1.000	18732.01
222	25.00	44.34	-163.47	-142.31	1.000	18225.20
223	25.00	42.65	-119.81	-105.00	0.999	17622.79
224	25.00	40.95	-93.44	-82.46	0.999	17050.43
225	25.00	39.26	-75.75	-67.35	1.000	16469.53
226	25.00	37.56	-63.05	-56.50	0.997	15655.67
227	25.00	35.86	-53.47	-48.31	0.996	14915.75
228	25.00	34.17	-45.98	-41.91	0.995	14143.22
229	25.00	32.47	-39.95	-36.75	0.996	13405.23
230	25.00	30.78	-34.98	-32.51	0.997	12593.50
231	25.00	29.08	-30.81	-28.95	0.996	11679.27
232	25.00	27.39	-27.26	-25.91	0.996	10784.57
233	25.00	25.69	-24.19	-23.28	0.997	9852.34
234	25.00	24.00	-21.51	-20.99	0.994	8726.92
235	25.00	22.30	-19.13	-18.96	0.998	7896.05
236	25.00	20.61	-17.02	-17.16	0.999	6882.46
237	25.00	18.91	-15.13	-15.54	0.999	5801.35
238	25.00	17.22	-13.41	-14.07	1.000	4682.02
239	25.00	15.52	-11.85	-12.74	1.001	3533.32
240	25.00	13.83	-10.42	-11.51	0.990	1707.94
241	25.00	12.13	-9.10	-10.39	0.991	449.13

Design Data

Nail Head Factor = 1.00 for circle no 241
Nail Length Factor = 0.58 for circle no 204

Nail No.	Circle No	Required Nail Tendon Strength
1	77	17388.22
2	77	21193.37
3	120	44014.61
4	155	53310.62
5	200	54416.21

Nail No.	Circle No	Required Nail Length
1		13.27
2		13.27
3		13.27
4		13.27
5		12.12

Output Data

Wall Height = 23.00
Wall Slope = 85.23

Circle Number	Circle X-Intercept	Circle Base Angle	Circle X-Center	Circle Y-Center	Moment Ratio	Factor of Safety
1	0.12	84.87	-11500.89	-1010.09	1.000	7.83
2	0.12	83.17	-376.79	-21.89	1.000	4.32
3	0.12	81.48	-191.80	-5.46	1.000	3.97
4	0.57	83.76	-11500.67	-1234.06	1.000	3.88
5	0.57	82.07	-376.57	-29.21	1.000	3.68
6	0.57	80.37	-191.57	-9.18	0.999	3.49
7	0.57	78.68	-128.46	-2.34	0.999	3.31
8	1.07	82.54	-11500.42	-1482.51	1.000	3.41
9	1.07	80.85	-376.32	-37.33	1.000	3.27
10	1.07	79.15	-191.32	-13.30	0.999	3.15
11	1.07	77.46	-128.21	-5.10	0.999	3.01
12	1.07	75.76	-96.33	-0.96	0.998	2.91
13	1.59	81.26	-11500.16	-1744.88	1.000	3.07
14	1.59	79.56	-376.05	-45.91	1.000	2.97
15	1.59	77.87	-191.06	-17.66	0.999	2.88
16	1.59	76.17	-127.95	-8.02	0.999	2.79
17	1.59	74.48	-96.07	-3.15	0.999	2.69
18	1.59	72.78	-76.81	-0.21	0.998	2.63
19	2.15	79.91	-11499.88	-2022.31	1.000	2.81
20	2.15	78.22	-375.78	-54.98	1.000	2.74
21	2.15	76.52	-190.78	-22.26	0.999	2.67
22	2.15	74.83	-127.67	-11.10	0.999	2.61
23	2.15	73.13	-95.79	-5.46	0.999	2.54
24	2.15	71.44	-76.54	-2.06	0.998	2.48
25	2.74	78.50	-11499.59	-2316.10	1.000	2.62
26	2.74	76.81	-375.48	-64.58	1.000	2.56
27	2.74	75.11	-190.49	-27.14	0.999	2.51
28	2.74	73.42	-127.38	-14.36	0.999	2.47
29	2.74	71.72	-95.50	-7.91	0.998	2.42
30	2.74	70.03	-76.24	-4.01	0.998	2.36
31	2.74	68.33	-63.33	-1.40	0.998	2.33
32	3.36	77.02	-11499.28	-2627.77	1.000	2.47
33	3.36	75.32	-375.17	-74.77	1.000	2.42
34	3.36	73.63	-190.18	-32.31	0.999	2.39
35	3.36	71.93	-127.07	-17.83	0.999	2.35
36	3.36	70.24	-95.19	-10.51	0.998	2.32
37	3.36	68.54	-75.93	-6.09	0.998	2.29
38	3.36	66.85	-63.02	-3.13	0.997	2.25
39	3.36	65.15	-53.75	-1.00	0.996	2.24
40	4.02	75.46	-11498.95	-2959.03	1.000	2.35
41	4.02	73.76	-374.84	-85.60	0.999	2.32
42	4.02	72.07	-189.85	-37.81	0.999	2.30
43	4.02	70.37	-126.73	-21.51	0.999	2.27
44	4.02	68.68	-94.86	-13.27	0.998	2.25
45	4.02	66.98	-75.60	-8.30	0.998	2.23
46	4.02	65.29	-62.69	-4.96	0.997	2.20
47	4.02	63.59	-53.41	-2.57	0.997	2.18
48	4.02	61.90	-46.42	-0.76	0.996	2.18
49	4.73	73.82	-11498.59	-3311.92	1.000	2.27
50	4.73	72.13	-374.49	-97.13	0.999	2.25
51	4.73	70.43	-189.49	-43.67	0.999	2.23
52	4.73	68.74	-126.38	-25.43	0.999	2.22
53	4.73	67.04	-94.50	-16.22	0.998	2.21
54	4.73	65.35	-75.25	-10.65	0.998	2.19

55	4.73	63.65	-62.33	-6.92	0.997	2.17
56	4.73	61.96	-53.06	-4.24	0.997	2.15
57	4.73	60.26	-46.07	-2.22	0.996	2.15
58	4.73	58.57	-40.60	-0.64	0.995	2.15
59	5.48	72.11	-11498.22	-3688.79	1.000	2.21
60	5.48	70.41	-374.11	-109.45	0.999	2.20
61	5.48	68.72	-189.12	-49.92	0.999	2.19
62	5.48	67.02	-126.00	-29.62	0.998	2.19
63	5.48	65.33	-94.13	-19.36	0.998	2.18
64	5.48	63.63	-74.87	-13.16	0.997	2.18
65	5.48	61.94	-61.96	-9.01	0.997	2.17
66	5.48	60.24	-52.68	-6.02	0.996	2.16
67	5.48	58.55	-45.69	-3.77	0.996	2.14
68	5.48	56.85	-40.22	-2.01	0.996	2.14
69	5.48	55.16	-35.82	-0.60	0.995	2.15
70	6.29	70.30	-11497.81	-4092.41	1.000	2.16
71	6.29	68.61	-373.71	-122.64	0.999	2.16
72	6.29	66.91	-188.71	-56.62	0.999	2.15
73	6.29	65.22	-125.60	-34.10	0.998	2.15
74	6.29	63.52	-93.72	-22.73	0.997	2.15
75	6.29	61.83	-74.47	-15.85	0.997	2.15
76	6.29	60.13	-61.55	-11.25	0.995	2.15
77	6.29	58.44	-52.28	-7.94	0.996	2.15
78	6.29	56.74	-45.29	-5.44	0.995	2.15
79	6.29	55.05	-39.82	-3.49	0.995	2.14
80	6.29	53.35	-35.41	-1.92	0.993	2.15
81	6.29	51.66	-31.79	-0.62	0.993	2.18
82	10.51	68.41	-15745.70	-6207.31	1.000	1.94
83	10.51	66.71	-510.51	-195.88	0.999	1.95
84	10.51	65.02	-257.15	-95.91	0.999	1.96
85	10.51	63.32	-170.72	-61.80	0.998	1.99
86	10.51	61.63	-127.06	-44.58	0.998	2.02
87	10.51	59.93	-100.68	-34.17	0.997	2.05
88	10.51	58.24	-83.00	-27.19	0.997	2.09
89	10.51	56.54	-70.30	-22.18	0.996	2.13
90	10.51	54.85	-60.72	-18.40	0.997	2.17
91	10.51	53.15	-53.23	-15.45	0.995	2.22
92	10.51	51.46	-47.20	-13.07	0.998	2.24
93	10.51	49.76	-42.23	-11.11	0.998	2.28
94	10.51	48.07	-38.06	-9.46	0.997	2.35
95	11.79	66.42	-15745.06	-6847.92	1.000	1.93
96	11.79	64.73	-509.87	-216.82	0.999	1.95
97	11.79	63.03	-256.51	-106.54	0.999	1.97
98	11.79	61.34	-170.07	-68.92	0.998	2.00
99	11.79	59.64	-126.42	-49.92	0.998	2.04
100	11.79	57.95	-100.04	-38.44	0.997	2.07
101	11.79	56.25	-82.36	-30.74	0.997	2.11
102	11.79	54.56	-69.66	-25.22	0.997	2.14
103	11.79	52.86	-60.08	-21.05	0.998	2.18
104	11.79	51.17	-52.59	-17.79	0.997	2.23
105	11.79	49.47	-46.56	-15.16	0.996	2.34
106	11.79	47.78	-41.59	-13.00	0.996	2.42
107	11.79	46.08	-37.42	-11.18	0.996	2.50
108	11.79	44.39	-33.87	-9.64	0.996	2.58
109	13.18	64.33	-15744.37	-7541.76	1.000	1.94
110	13.18	62.64	-509.18	-239.50	1.000	1.97
111	13.18	60.94	-255.82	-118.06	0.999	1.99
112	13.18	59.25	-169.38	-76.63	0.999	2.02
113	13.18	57.55	-125.72	-55.71	0.998	2.05
114	13.18	55.86	-99.35	-43.07	0.998	2.09
115	13.18	54.16	-81.66	-34.59	0.997	2.13
116	13.18	52.47	-68.96	-28.50	0.998	2.22
117	13.18	50.77	-59.39	-23.91	0.997	2.28

118	13.18	49.08	-51.89	-20.32	0.996	2.36
119	13.18	47.38	-45.86	-17.43	0.995	2.44
120	13.18	45.69	-40.89	-15.05	0.996	2.52
121	13.18	43.99	-36.73	-13.05	0.996	2.60
122	13.18	42.30	-33.17	-11.35	0.995	2.72
123	13.18	40.60	-30.10	-9.88	0.996	2.82
124	13.18	38.91	-27.42	-8.59	0.996	2.94
125	14.69	62.14	-15743.61	-8296.91	1.000	1.96
126	14.69	60.45	-508.42	-264.18	0.999	1.99
127	14.69	58.75	-255.06	-130.60	0.999	2.02
128	14.69	57.06	-168.63	-85.02	0.999	2.06
129	14.69	55.36	-124.97	-62.00	0.998	2.12
130	14.69	53.67	-98.59	-48.10	0.999	2.17
131	14.69	51.97	-80.91	-38.78	0.998	2.24
132	14.69	50.28	-68.21	-32.08	0.997	2.31
133	14.69	48.58	-58.63	-27.03	0.997	2.38
134	14.69	46.89	-51.14	-23.08	0.995	2.47
135	14.69	45.19	-45.11	-19.90	0.997	2.54
136	14.69	43.50	-40.14	-17.28	0.996	2.65
137	14.69	41.80	-35.97	-15.08	0.996	2.76
138	14.69	40.11	-32.42	-13.21	0.995	2.88
139	14.69	38.41	-29.35	-11.59	0.995	3.00
140	14.69	36.72	-26.66	-10.17	0.995	3.13
141	14.69	35.02	-24.29	-8.92	0.995	3.24
142	16.34	59.84	-15742.78	-9123.37	1.000	1.99
143	16.34	58.15	-507.60	-291.20	1.000	2.04
144	16.34	56.45	-254.24	-144.32	0.999	2.09
145	16.34	54.76	-167.80	-94.21	0.999	2.14
146	16.34	53.06	-124.14	-68.90	0.999	2.20
147	16.34	51.37	-97.77	-53.61	0.998	2.27
148	16.34	49.67	-80.08	-43.36	0.997	2.35
149	16.34	47.98	-67.38	-35.99	0.997	2.42
150	16.34	46.28	-57.80	-30.44	0.997	2.50
151	16.34	44.59	-50.31	-26.10	0.997	2.59
152	16.34	42.89	-44.28	-22.60	0.997	2.70
153	16.34	41.20	-39.31	-19.72	0.996	2.81
154	16.34	39.50	-35.14	-17.30	0.994	2.95
155	16.34	37.81	-31.59	-15.24	0.994	3.07
156	16.34	36.11	-28.52	-13.46	0.995	3.15
157	16.34	34.41	-25.83	-11.91	0.996	3.28
158	16.34	32.72	-23.46	-10.53	0.992	3.46
159	16.34	31.02	-21.35	-9.31	0.993	3.62
160	18.16	57.42	-15741.87	-10033.69	1.000	2.07
161	18.16	55.73	-506.69	-320.95	1.000	2.12
162	18.16	54.03	-253.33	-159.43	1.000	2.18
163	18.16	52.34	-166.89	-104.32	0.999	2.24
164	18.16	50.64	-123.23	-76.49	0.999	2.31
165	18.16	48.95	-96.86	-59.67	0.998	2.38
166	18.16	47.25	-79.17	-48.40	0.998	2.46
167	18.16	45.56	-66.47	-40.30	0.998	2.55
168	18.16	43.86	-56.89	-34.20	0.996	2.66
169	18.16	42.17	-49.40	-29.42	0.995	2.77
170	18.16	40.47	-43.37	-25.58	0.995	2.87
171	18.16	38.78	-38.40	-22.41	0.993	3.00
172	18.16	37.08	-34.23	-19.75	0.992	3.11
173	18.16	35.39	-30.68	-17.49	0.991	3.25
174	18.16	33.69	-27.61	-15.53	0.990	3.39
175	18.16	32.00	-24.92	-13.82	0.990	3.53
176	18.16	30.30	-22.55	-12.31	0.992	3.62
177	18.16	28.61	-20.44	-10.96	0.992	3.72
178	18.16	26.91	-18.54	-9.75	0.993	3.84
179	18.16	25.22	-16.83	-8.66	0.991	4.00
180	20.18	54.89	-15740.86	-11043.84	1.000	2.16

181	20.18	53.19	-505.68	-353.97	1.000	2.22
182	20.18	51.50	-252.32	-176.20	1.000	2.29
183	20.18	49.80	-165.88	-115.55	1.000	2.36
184	20.18	48.11	-122.22	-84.91	0.999	2.44
185	20.18	46.41	-95.85	-66.41	0.998	2.53
186	20.18	44.72	-78.16	-54.00	0.998	2.62
187	20.18	43.02	-65.46	-45.09	0.996	2.72
188	20.18	41.33	-55.88	-38.37	0.996	2.82
189	20.18	39.63	-48.39	-33.11	0.995	2.92
190	20.18	37.94	-42.36	-28.88	0.994	3.04
191	20.18	36.24	-37.39	-25.39	0.993	3.17
192	20.18	34.55	-33.22	-22.47	0.992	3.31
193	20.18	32.85	-29.67	-19.97	0.992	3.40
194	20.18	31.16	-26.60	-17.82	0.993	3.49
195	20.18	29.46	-23.91	-15.94	0.991	3.61
196	20.18	27.77	-21.54	-14.27	0.991	3.73
197	20.18	26.07	-19.43	-12.79	0.991	3.85
198	20.18	24.38	-17.53	-11.46	0.991	3.98
199	20.18	22.68	-15.82	-10.26	0.992	4.05
200	20.18	20.99	-14.26	-9.16	1.003	4.01
201	22.44	52.22	-15739.73	-12174.46	1.000	2.28
202	22.44	50.53	-504.55	-390.92	1.000	2.35
203	22.44	48.83	-251.19	-194.96	1.000	2.43
204	22.44	47.14	-164.75	-128.11	0.999	2.51
205	22.44	45.44	-121.09	-94.34	0.999	2.60
206	22.44	43.75	-94.72	-73.94	0.998	2.68
207	22.44	42.05	-77.03	-60.27	0.998	2.77
208	22.44	40.36	-64.33	-50.44	0.996	2.87
209	22.44	38.66	-54.75	-43.03	0.996	2.98
210	22.44	36.97	-47.26	-37.24	0.995	3.10
211	22.44	35.27	-41.23	-32.57	0.995	3.20
212	22.44	33.58	-36.26	-28.73	0.995	3.27
213	22.44	31.88	-32.09	-25.51	0.992	3.39
214	22.44	30.19	-28.54	-22.76	0.992	3.49
215	22.44	28.49	-25.47	-20.39	0.992	3.59
216	22.44	26.80	-22.78	-18.31	0.991	3.70
217	22.44	25.10	-20.41	-16.48	0.991	3.82
218	22.44	23.41	-18.30	-14.84	0.999	3.79
219	22.44	21.71	-16.40	-13.37	0.998	3.86
220	22.44	20.02	-14.69	-12.05	0.999	3.91
221	22.44	18.32	-13.13	-10.84	1.000	3.94
222	22.44	16.63	-11.69	-9.73	0.997	3.96
223	22.44	14.93	-10.38	-8.71	0.998	3.94
224	25.00	49.43	-15738.46	-13452.75	1.000	2.44
225	25.00	47.73	-503.27	-432.71	1.000	2.52
226	25.00	46.04	-249.91	-216.18	1.000	2.59
227	25.00	44.34	-163.47	-142.31	0.999	2.67
228	25.00	42.65	-119.81	-105.00	0.999	2.76
229	25.00	40.95	-93.44	-82.46	0.999	2.85
230	25.00	39.26	-75.75	-67.35	0.999	2.95
231	25.00	37.56	-63.05	-56.50	0.996	3.06
232	25.00	35.86	-53.47	-48.31	0.995	3.13
233	25.00	34.17	-45.98	-41.91	0.994	3.20
234	25.00	32.47	-39.95	-36.75	0.994	3.27
235	25.00	30.78	-34.98	-32.51	0.994	3.36
236	25.00	29.08	-30.81	-28.95	0.993	3.46
237	25.00	27.39	-27.26	-25.91	0.993	3.57
238	25.00	25.69	-24.19	-23.28	0.993	3.65
239	25.00	24.00	-21.51	-20.99	0.999	3.63
240	25.00	22.30	-19.13	-18.96	0.995	3.71
241	25.00	20.61	-17.02	-17.16	0.995	3.72
242	25.00	18.91	-15.13	-15.54	0.996	3.74
243	25.00	17.22	-13.41	-14.07	0.996	3.73

244	25.00	15.52	-11.85	-12.74	0.996	3.71
245	25.00	13.83	-10.42	-11.51	0.997	3.70
246	25.00	12.13	-9.10	-10.39	0.999	3.67
247	25.00	10.44	-7.88	-9.35	1.000	3.65

Global Stability
Minimum global safety factor = 1.931 for circle no. 95

Output Data

Wall Height = 23.00
Wall Slope = 85.23

Circle Number	Circle X-Intercept	Circle Base Angle	Circle X-Center	Circle Y-Center	Moment Ratio	Force Req'd/ Unit Wall Length
1	1.07	80.85	-376.32	-37.33	1.000	334.36
2	1.07	79.15	-191.32	-13.30	0.999	768.27
3	1.07	77.46	-128.21	-5.10	0.999	1186.43
4	1.07	75.76	-96.33	-0.96	0.999	1581.53
5	1.59	81.26	-11500.16	-1744.88	1.000	1939.93
6	1.59	79.56	-376.05	-45.91	1.000	2356.69
7	1.59	77.87	-191.06	-17.66	0.999	2760.22
8	1.59	76.17	-127.95	-8.02	0.999	3161.65
9	1.59	74.48	-96.07	-3.15	0.999	3543.24
10	1.59	72.78	-76.81	-0.21	0.998	3874.36
11	2.15	79.91	-11499.88	-2022.31	1.000	3835.77
12	2.15	78.22	-375.78	-54.98	1.000	4226.76
13	2.15	76.52	-190.78	-22.26	0.999	4596.97
14	2.15	74.83	-127.67	-11.10	0.999	4956.63
15	2.15	73.13	-95.79	-5.46	0.999	5308.40
16	2.15	71.44	-76.54	-2.06	0.999	5639.79
17	2.74	78.50	-11499.59	-2316.10	1.000	5574.83
18	2.74	76.81	-375.48	-64.58	1.000	5942.63
19	2.74	75.11	-190.49	-27.14	0.999	6279.73
20	2.74	73.42	-127.38	-14.36	0.999	6596.96
21	2.74	71.72	-95.50	-7.91	0.998	6911.65
22	2.74	70.03	-76.24	-4.01	0.998	7227.70
23	2.74	68.33	-63.33	-1.40	0.998	7476.42
24	3.36	77.02	-11499.28	-2627.77	1.000	7155.97
25	3.36	75.32	-375.17	-74.77	1.000	7492.02
26	3.36	73.63	-190.18	-32.31	0.999	7801.77
27	3.36	71.93	-127.07	-17.83	0.999	8094.07
28	3.36	70.24	-95.19	-10.51	0.998	8359.38
29	3.36	68.54	-75.93	-6.09	0.998	8611.81
30	3.36	66.85	-63.02	-3.13	0.998	8863.33
31	3.36	65.15	-53.75	-1.00	0.997	9002.79
32	4.02	75.46	-11498.95	-2959.03	1.000	8570.68
33	4.02	73.76	-374.84	-85.60	0.999	8869.72
34	4.02	72.07	-189.85	-37.81	0.999	9156.02
35	4.02	70.37	-126.73	-21.51	0.999	9404.62
36	4.02	68.68	-94.86	-13.27	0.998	9635.87
37	4.02	66.98	-75.60	-8.30	0.998	9849.61
38	4.02	65.29	-62.69	-4.96	0.998	10033.98
39	4.02	63.59	-53.41	-2.57	0.998	10210.64
40	4.02	61.90	-46.42	-0.76	0.997	10269.62
41	4.73	73.82	-11498.59	-3311.92	1.000	9826.53
42	4.73	72.13	-374.49	-97.13	0.999	10087.39
43	4.73	70.43	-189.49	-43.67	0.999	10309.13
44	4.73	68.74	-126.38	-25.43	0.999	10529.09
45	4.73	67.04	-94.50	-16.22	0.998	10698.03
46	4.73	65.35	-75.25	-10.65	0.998	10877.96
47	4.73	63.65	-62.33	-6.92	0.998	11037.26
48	4.73	61.96	-53.06	-4.24	0.997	11173.51
49	4.73	60.26	-46.07	-2.22	0.997	11256.19
50	4.73	58.57	-40.60	-0.64	0.997	11222.79
51	5.48	72.11	-11498.22	-3688.79	1.000	10907.40
52	5.48	70.41	-374.11	-109.45	0.999	11125.47
53	5.48	68.72	-189.12	-49.92	0.999	11309.63

54	5.48	67.02	-126.00	-29.62	0.998	11457.83
55	5.48	65.33	-94.13	-19.36	0.998	11614.36
56	5.48	63.63	-74.87	-13.16	0.997	11706.13
57	5.48	61.94	-61.96	-9.01	0.998	11810.16
58	5.48	60.24	-52.68	-6.02	0.997	11859.75
59	5.48	58.55	-45.69	-3.77	0.997	11935.88
60	5.48	56.85	-40.22	-2.01	0.997	11931.62
61	5.48	55.16	-35.82	-0.60	0.997	11799.96
62	6.29	70.30	-11497.81	-4092.41	1.000	11817.99
63	6.29	68.61	-373.71	-122.64	0.999	11994.93
64	6.29	66.91	-188.71	-56.62	0.999	12146.02
65	6.29	65.22	-125.60	-34.10	0.998	12245.02
66	6.29	63.52	-93.72	-22.73	0.997	12303.76
67	6.29	61.83	-74.47	-15.85	0.997	12383.17
68	6.29	60.13	-61.55	-11.25	0.996	12341.14
69	6.29	58.44	-52.28	-7.94	0.997	12388.37
70	6.29	56.74	-45.29	-5.44	0.996	12355.23
71	6.29	55.05	-39.82	-3.49	0.996	12342.21
72	6.29	53.35	-35.41	-1.92	0.995	12177.63
73	6.29	51.66	-31.79	-0.62	0.995	11960.56
74	10.51	68.41	-15745.70	-6207.31	1.000	13981.67
75	10.51	66.71	-510.51	-195.88	0.999	14048.21
76	10.51	65.02	-257.15	-95.91	0.999	14079.74
77	10.51	63.32	-170.72	-61.80	0.998	13989.17
78	10.51	61.63	-127.06	-44.58	0.998	13883.12
79	10.51	59.93	-100.68	-34.17	0.998	13776.65
80	10.51	58.24	-83.00	-27.19	0.997	13562.48
81	10.51	56.54	-70.30	-22.18	0.997	13319.92
82	10.51	54.85	-60.72	-18.40	0.997	13114.88
83	10.51	53.15	-53.23	-15.45	0.996	12783.13
84	10.51	51.46	-47.20	-13.07	0.999	12705.67
85	10.51	49.76	-42.23	-11.11	0.998	12384.59
86	10.51	48.07	-38.06	-9.46	0.998	11952.37
87	11.79	66.42	-15745.06	-6847.92	1.000	14328.34
88	11.79	64.73	-509.87	-216.82	0.999	14303.97
89	11.79	63.03	-256.51	-106.54	0.999	14251.56
90	11.79	61.34	-170.07	-68.92	0.998	14111.16
91	11.79	59.64	-126.42	-49.92	0.998	13930.59
92	11.79	57.95	-100.04	-38.44	0.998	13787.88
93	11.79	56.25	-82.36	-30.74	0.997	13571.73
94	11.79	54.56	-69.66	-25.22	0.997	13382.79
95	11.79	52.86	-60.08	-21.05	0.998	13188.60
96	11.79	51.17	-52.59	-17.79	0.998	12862.38
97	11.79	49.47	-46.56	-15.16	0.996	12211.82
98	11.79	47.78	-41.59	-13.00	0.997	11766.58
99	11.79	46.08	-37.42	-11.18	0.997	11300.03
100	11.79	44.39	-33.87	-9.64	0.997	10808.95
101	13.18	64.33	-15744.37	-7541.76	1.000	14454.57
102	13.18	62.64	-509.18	-239.50	1.000	14363.12
103	13.18	60.94	-255.82	-118.06	0.999	14245.56
104	13.18	59.25	-169.38	-76.63	0.999	14113.71
105	13.18	57.55	-125.72	-55.71	0.999	13973.89
106	13.18	55.86	-99.35	-43.07	0.998	13756.39
107	13.18	54.16	-81.66	-34.59	0.997	13476.60
108	13.18	52.47	-68.96	-28.50	0.998	13066.88
109	13.18	50.77	-59.39	-23.91	0.997	12672.19
110	13.18	49.08	-51.89	-20.32	0.997	12196.68
111	13.18	47.38	-45.86	-17.43	0.996	11673.61
112	13.18	45.69	-40.89	-15.05	0.997	11243.70
113	13.18	43.99	-36.73	-13.05	0.997	10723.10
114	13.18	42.30	-33.17	-11.35	0.996	10072.61
115	13.18	40.60	-30.10	-9.88	0.997	9483.55
116	13.18	38.91	-27.42	-8.59	0.998	8843.94

117	14.69	62.14	-15743.61	-8296.91	1.000	14378.82
118	14.69	60.45	-508.42	-264.18	0.999	14265.27
119	14.69	58.75	-255.06	-130.60	0.999	14141.43
120	14.69	57.06	-168.63	-85.02	0.999	13940.27
121	14.69	55.36	-124.97	-62.00	0.998	13581.78
122	14.69	53.67	-98.59	-48.10	0.999	13320.44
123	14.69	51.97	-80.91	-38.78	0.998	12931.43
124	14.69	50.28	-68.21	-32.08	0.997	12489.27
125	14.69	48.58	-58.63	-27.03	0.997	12062.47
126	14.69	46.89	-51.14	-23.08	0.996	11511.13
127	14.69	45.19	-45.11	-19.90	0.998	11137.87
128	14.69	43.50	-40.14	-17.28	0.997	10511.22
129	14.69	41.80	-35.97	-15.08	0.998	9917.67
130	14.69	40.11	-32.42	-13.21	0.997	9200.23
131	14.69	38.41	-29.35	-11.59	0.997	8527.81
132	14.69	36.72	-26.66	-10.17	0.997	7817.19
133	14.69	35.02	-24.29	-8.92	0.997	7041.81
134	16.34	59.84	-15742.78	-9123.37	1.000	14146.79
135	16.34	58.15	-507.60	-291.20	1.000	13905.76
136	16.34	56.45	-254.24	-144.32	0.999	13653.39
137	16.34	54.76	-167.80	-94.21	0.999	13410.38
138	16.34	53.06	-124.14	-68.90	0.999	13056.46
139	16.34	51.37	-97.77	-53.61	0.998	12646.81
140	16.34	49.67	-80.08	-43.36	0.998	12202.83
141	16.34	47.98	-67.38	-35.99	0.998	11776.83
142	16.34	46.28	-57.80	-30.44	0.998	11301.25
143	16.34	44.59	-50.31	-26.10	0.998	10760.87
144	16.34	42.89	-44.28	-22.60	0.998	10160.57
145	16.34	41.20	-39.31	-19.72	0.998	9535.62
146	16.34	39.50	-35.14	-17.30	0.996	8741.02
147	16.34	37.81	-31.59	-15.24	0.996	8034.83
148	16.34	36.11	-28.52	-13.46	0.997	7411.92
149	16.34	34.41	-25.83	-11.91	0.998	6642.56
150	16.34	32.72	-23.46	-10.53	0.995	5602.18
151	16.34	31.02	-21.35	-9.31	0.995	4747.74
152	18.16	57.42	-15741.87	-10033.69	1.000	13545.97
153	18.16	55.73	-506.69	-320.95	1.000	13321.30
154	18.16	54.03	-253.33	-159.43	1.000	13006.17
155	18.16	52.34	-166.89	-104.32	1.000	12635.37
156	18.16	50.64	-123.23	-76.49	0.999	12214.63
157	18.16	48.95	-96.86	-59.67	0.999	11804.36
158	18.16	47.25	-79.17	-48.40	0.999	11367.91
159	18.16	45.56	-66.47	-40.30	0.999	10845.12
160	18.16	43.86	-56.89	-34.20	0.997	10165.83
161	18.16	42.17	-49.40	-29.42	0.997	9558.54
162	18.16	40.47	-43.37	-25.58	0.997	8910.02
163	18.16	38.78	-38.40	-22.41	0.995	8077.14
164	18.16	37.08	-34.23	-19.75	0.994	7312.30
165	18.16	35.39	-30.68	-17.49	0.993	6525.07
166	18.16	33.69	-27.61	-15.53	0.993	5697.08
167	18.16	32.00	-24.92	-13.82	0.993	4822.26
168	18.16	30.30	-22.55	-12.31	0.995	3989.84
169	18.16	28.61	-20.44	-10.96	0.996	3070.78
170	18.16	26.91	-18.54	-9.75	0.997	2115.05
171	18.16	25.22	-16.83	-8.66	0.994	926.28
172	20.18	54.89	-15740.86	-11043.84	1.000	12707.03
173	20.18	53.19	-505.68	-353.97	1.000	12372.47
174	20.18	51.50	-252.32	-176.20	1.000	12014.80
175	20.18	49.80	-165.88	-115.55	1.000	11647.75
176	20.18	48.11	-122.22	-84.91	0.999	11123.53
177	20.18	46.41	-95.85	-66.41	0.999	10620.73
178	20.18	44.72	-78.16	-54.00	0.999	10078.91
179	20.18	43.02	-65.46	-45.09	0.997	9411.41

180	20.18	41.33	-55.88	-38.37	0.997	8777.42
181	20.18	39.63	-48.39	-33.11	0.997	8098.10
182	20.18	37.94	-42.36	-28.88	0.996	7335.09
183	20.18	36.24	-37.39	-25.39	0.995	6535.05
184	20.18	34.55	-33.22	-22.47	0.995	5729.28
185	20.18	32.85	-29.67	-19.97	0.995	4886.79
186	20.18	31.16	-26.60	-17.82	0.996	4055.49
187	20.18	29.46	-23.91	-15.94	0.994	3005.88
188	20.18	27.77	-21.54	-14.27	0.995	2040.43
189	20.18	26.07	-19.43	-12.79	0.995	1034.84
190	22.44	52.22	-15739.73	-12174.46	1.000	11502.67
191	22.44	50.53	-504.55	-390.92	1.000	11112.50
192	22.44	48.83	-251.19	-194.96	1.000	10674.16
193	22.44	47.14	-164.75	-128.11	0.999	10170.38
194	22.44	45.44	-121.09	-94.34	0.999	9645.76
195	22.44	43.75	-94.72	-73.94	0.999	9081.48
196	22.44	42.05	-77.03	-60.27	0.999	8466.82
197	22.44	40.36	-64.33	-50.44	0.998	7733.15
198	22.44	38.66	-54.75	-43.03	0.997	7034.72
199	22.44	36.97	-47.26	-37.24	0.997	6296.63
200	22.44	35.27	-41.23	-32.57	0.997	5519.84
201	22.44	33.58	-36.26	-28.73	0.998	4723.41
202	22.44	31.88	-32.09	-25.51	0.996	3705.06
203	22.44	30.19	-28.54	-22.76	0.996	2783.21
204	22.44	28.49	-25.47	-20.39	0.996	1843.34
205	22.44	26.80	-22.78	-18.31	0.997	850.44
206	25.00	49.43	-15738.46	-13452.75	1.000	9858.74
207	25.00	47.73	-503.27	-432.71	1.000	9399.21
208	25.00	46.04	-249.91	-216.18	1.000	8880.74
209	25.00	44.34	-163.47	-142.31	1.000	8340.21
210	25.00	42.65	-119.81	-105.00	0.999	7699.65
211	25.00	40.95	-93.44	-82.46	0.999	7090.14
212	25.00	39.26	-75.75	-67.35	1.000	6465.21
213	25.00	37.56	-63.05	-56.50	0.997	5597.97
214	25.00	35.86	-53.47	-48.31	0.997	4803.55
215	25.00	34.17	-45.98	-41.91	0.996	3972.24
216	25.00	32.47	-39.95	-36.75	0.998	3174.00
217	25.00	30.78	-34.98	-32.51	0.998	2295.44
218	25.00	29.08	-30.81	-28.95	0.998	1317.58
219	25.00	27.39	-27.26	-25.91	0.998	343.29

Nail Forces

Nail No.	Circle No.	Nail Force
1	74	11319.54
2	117	12285.53
3	134	11655.80
4	119	13036.98
5	117	10946.98