TULSA PORT OF CATOOSA

DOLPHIN REMOVAL & REPLACEMENT STUDY

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C.A. 0049 (ARCH) RENEWAL DATE: 06-30-2019
C.A. 262 (PE) RENEWAL DATE: 06-30-2020

2/1/19

January 2019

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Executive Summary

The Tulsa Port of Catoosa wishes to remove and replace several failing or deteriorating mooring dolphins in the main channel. In the summer of 2014 the Port conducted an underwater inspection of 15 dolphins. The aerial in Figure 1 depicts all of the dolphins inspected with yellow numbers. The inspection report is in Appendix A and referred to as *Marcan Report.* All of the inspected Dolphins showed signs of deterioration, some requiring immediate repair or decommissioning. The scope of this study is to investigate construction methods for removal and replacement of the dolphins, determine the most feasible construction methods and the associated opinion of probable cost and recommend project phasing.

Our investigation included speaking with three local contractors that were recommended as the most capable of this construction, meeting with industries that will be impacted by the construction and will be using the proposed new dolphins, speaking with the City of Tulsa planning division about impacts to the Spavinaw water supply lines that cross the main channel, reviewing plans for the existing structures and recently constructed dolphins, site visits to familiarize ourselves with the existing dolphin configuration and how they are used, reviewing existing geotechnical reports for soil borings in the channel and reviewing the underwater inspection reports.

Based on our investigation we concluded that Phase I construction plans should be produced for the following items:

- The removal of eight existing dolphins, constructed with eight 24" diameter piers each with platforms at the normal water level and steel truss towers extending above, known as tower dolphins. These are shown as Dolphins 0-3, 4 and 5, 14 and 15.
- Removal of one existing, tipped-over can dolphin near the Galvilon West loading structure.
- Reconstruction of five seven ft. diameter piers drilled twelve feet into shale and extending at least 35 ft. above the normal water line (known as can dolphins) similar to the most recent dolphins constructed at the port and depicted in Photo 5 and Appendix D at locations near existing dolphins 4, 5, 14 and 15.
- The reconstruction plans and details should have new dolphins lined up with the front of existing dolphins and spaced as close to 100ft. centers as possible. The proposed location of these structures is shown in figure 3.

Phase II construction plans should be produced for the following items

- The removal of four existing dolphins, shown as dolphins 10-13 in Figure 1 at the north end of the channel. These existing dolphins are constructed with eight 24 inch diameter piers each with platforms at the normal water level and steel truss towers extending above, known as tower dolphins.
- Reconstruction of two seven ft. diameter dolphins near dolphins 12 and 13 with a platform between them constructed on smaller diameter piers. The platform would serve two industries with transport pipes for product, water and electricity and be equipped with at least one jib crane.

Add Alternates for Phase I or Phase II to include the following:

- Up to 13 additional can dolphins on the west bank in the space that is currently served by shore wires.

All design documents should include specifications for the removal of the existing dolphins that minimize the impact to the Spavinaw water lines and the adjacent industries but should not limit means and methods. And the documents should have construction sequencing that limits the impact to channel traffic and Port industries.

The estimated construction cost for the above recommendations with 20% contingency is:

- Phase I base amount: $1,800,000.00
- Phase II base amount: $1,400,000.00
- Add Alternate for Phase I or II (construction of 13 additional dolphins): $2,340,000.00

Introduction

The Port wishes to eventually remove and replace all of the original "tower" type mooring dolphins in the channel. The purpose of this study is to investigate construction methods for removal and replacement of the dolphins, determine the most feasible methods and the associated opinion of probable cost and recommend construction project phasing.

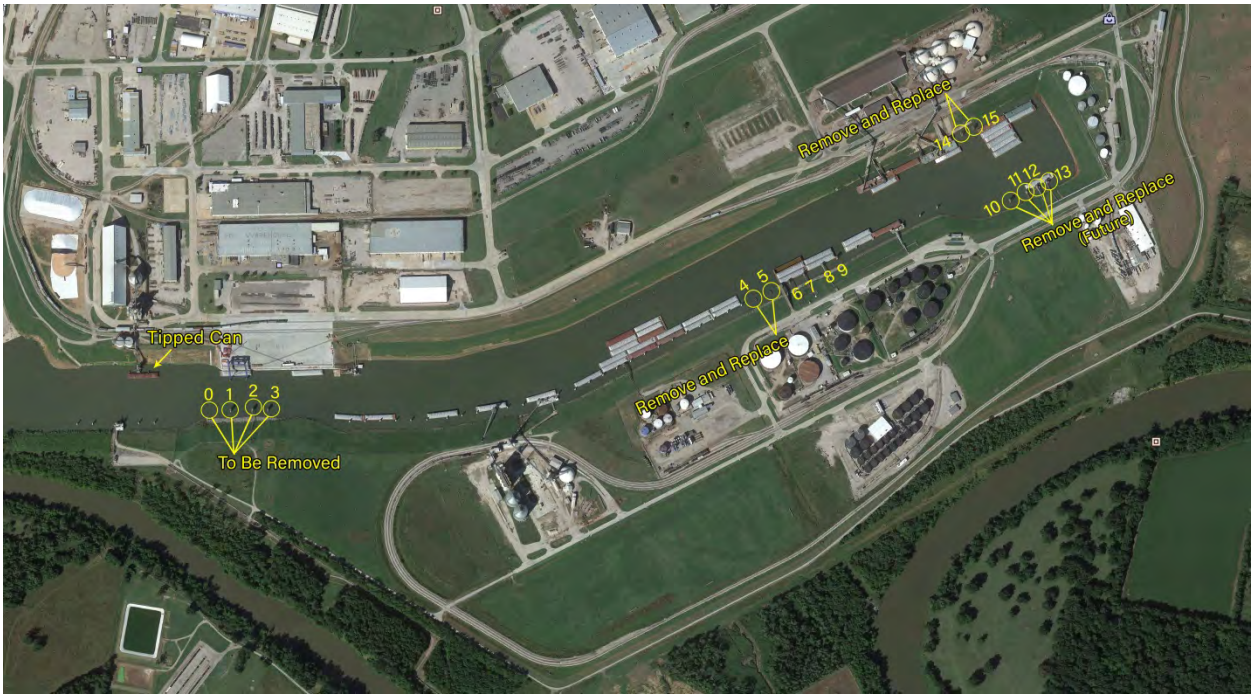
We began by reviewing the Marcan Report shown in Appendix A to determine the dolphins requiring the most immediate need of replacement. The aerial in Figure 1 depicts all of the dolphins inspected with yellow numbers. Two dolphins had clearly failed by the time of inspection and were not included in the 15 inspected. Dolphins 1, 2, and 3 have already been decommissioned due to disrepair These are tower structures on concrete piers with a concrete platform and truss type construction tying them together. Because they are in an area of the channel that is narrow, causing a bottleneck to the barge traffic, they are to be removed but not replaced. A forth dolphin, noted as "0", in this area has been removed above the water and the materials drug to the bank. This Dolphin also needs to be removed down to the stream bed and the steel superstructure removed from the site.

Dolphins 10-13 in the northeast corner of the channel are identified as needing to be replaced. They currently serve two port industries. Discussions with these industries and with the Port staff about future plans led us to propose replacing these four dolphins with two can dolphins connected by a platform.

The Port wishes to remove the failing can dolphin circled north of the Galvilon West loading structure but not replace it. There is another can dolphin south of the Galvilon West loading structure that has completely failed and is under water. Removal of this structure is not currently considered necessary.

Dolphins 4, 5, 14 and 15 are also tower structures and they are to be removed and replaced. The remaining dolphins inspected, 6 through 9 are currently serving industries and will be the last to be replaced.

Figure 1



Existing Structures

The existing tower structures are represented in Photos 1-3 and in the isometric drawing in Figure 2. They were constructed at the same time and in a similar fashion to the T-Head Wharf. Plans for the T-Head Wharf structure are included in Appendix B. We don't have access to as-built plans for the actual tower dolphins. In the summer of 2014 the Port conducted an underwater inspection of 15 dolphins. This report is in Appendix A and referred to as *Marcan Report.* All of the inspected Dolphins showed signs of deterioration, some requiring immediate repair or decommissioning. We know these structures were not constructed strictly according to the plans (they don't have a battered pile) so using the Marcan dive report and physical observations, we created the isometric drawing in Figure 2. They are in various states of disrepair as indicated in the photos and in the dive report. The Port has identified Dolphins 0-4, 4, 5, 14 and 15 as most needing to be removed or removed and replaced. Dolphins 10-13 have had some pier encasement done to prolong their life.

The existing tower structures appear to be platforms about two feet above the normal water elevation. The platforms are approximately 12 ft. by 16 ft. resting on eight 24 in. diameter piers that are socketed five ft. into rock and belled at the bottom. Above the platform, is a tower constructed of steel pipes with a wood bumper system tied to the channel face of the tower from the platform to the top of the tower.

The existing tipped can structure is shown in Photo 4 and in the details in Appendix C – 1973 Caisson Details. The can pictured is on the north side of the Galvilon West loading structure. The one on the south side is completely under water. These two structures were constructed in 1973 and both were hit by barges. The as-built plans indicated that they are made of steel casing with a concrete bottom and top with aggregate in between. The as-built plans called for them to be anchored to the channel bottom with eight six-inch diameter holes filled with concrete with one #11 rebar in each hole. According to the Marcan Report, the north can structure is still attached to one (or more) of the six-inch holes. The Port is not interested in moving the south structure but wants to remove the north structure.

Figure 2

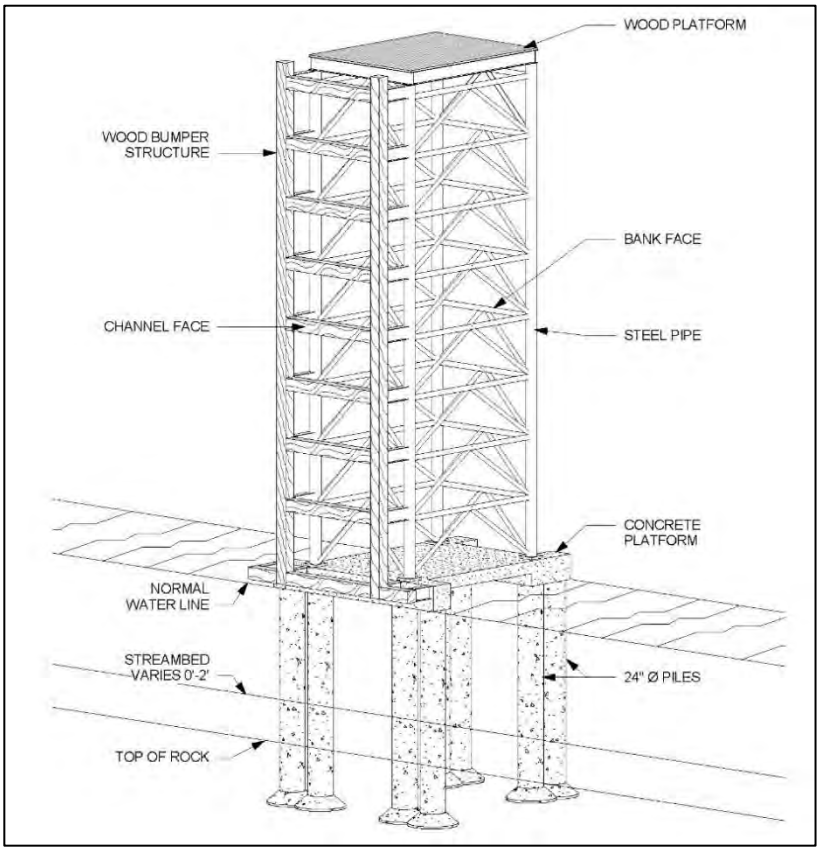


Photo 1 – Tower Dolphin

Photo 2 – Tower Dolphin

Photo 3 – Tower Dolphin

Photo 4 – Tipped Can Dolphin

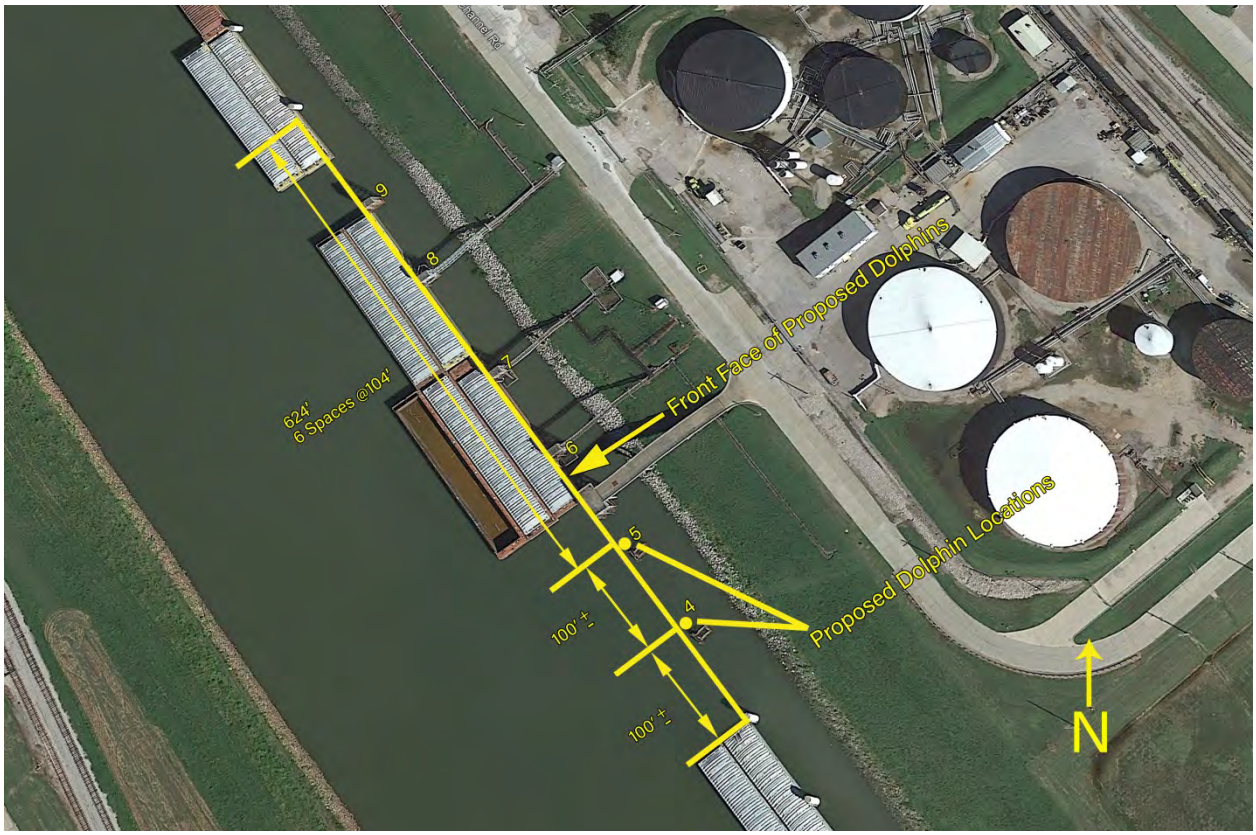
Proposed Structures

Location

Mooring dolphins constructed more recently at the Port of Catoosa are spaced close to 100ft. on center. The plans in Appendix D – Seven ft. Diameter "Can" Dolphin As-Built Plans, show the spacing varies from 98.28 ft. to 130.94 ft. but most spacings are close to 100 ft.

Dolphins 4 and 5: The distance between the two existing can dolphins flanking tower dolphins 4 and 5 is approximately 832 ft. When all of the tower dolphins are eventually replaced the desired spacing of new dolphins between these two existing can dolphins is approximately eight spaces at 104 ft. Replacing dolphins 4 and 5 at 104 ft. from the existing dolphin to the south and 104 ft between each new dolphin will put the replacements very close to the existing tower dolphin locations. New construction will probably conflict with the existing piers if they are left in place. The proposed locations for structures replacing Dolphins 3 and 4 are shown in Figure 3.

Figure 3

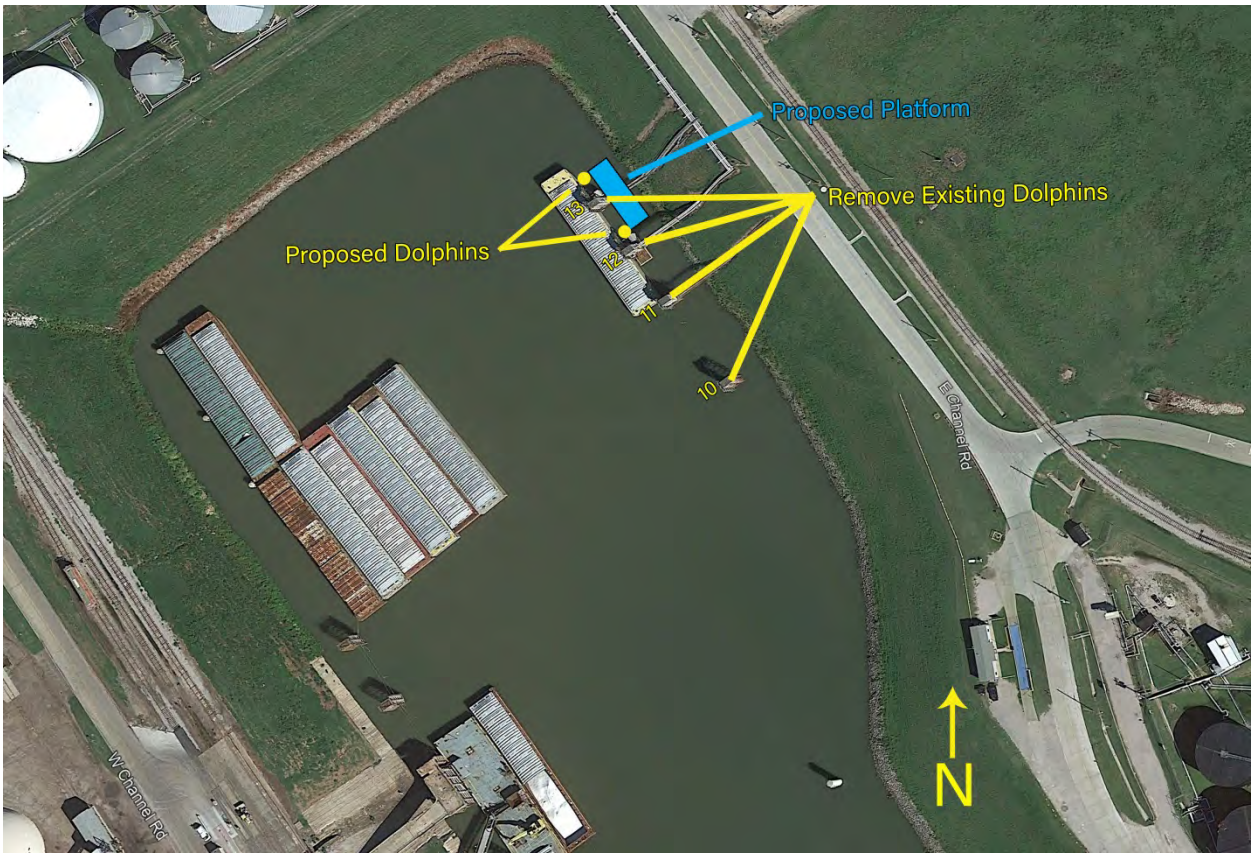


Dolphins 14 and 15: The spacing between the north Gavalon loading facility and the nearest seven ft. diameter can dolphin to the north is approximately 400 ft. Three new can dolphins installed at approximately 100ft centers between the loading facility and the next existing can dolphin to the north would allow continuous dolphins at approximately 100ft centers on the west side of the north channel. The proposed locations for structures replacing Dolphins 14 and 15 are shown in Figure 4.

Figure 4

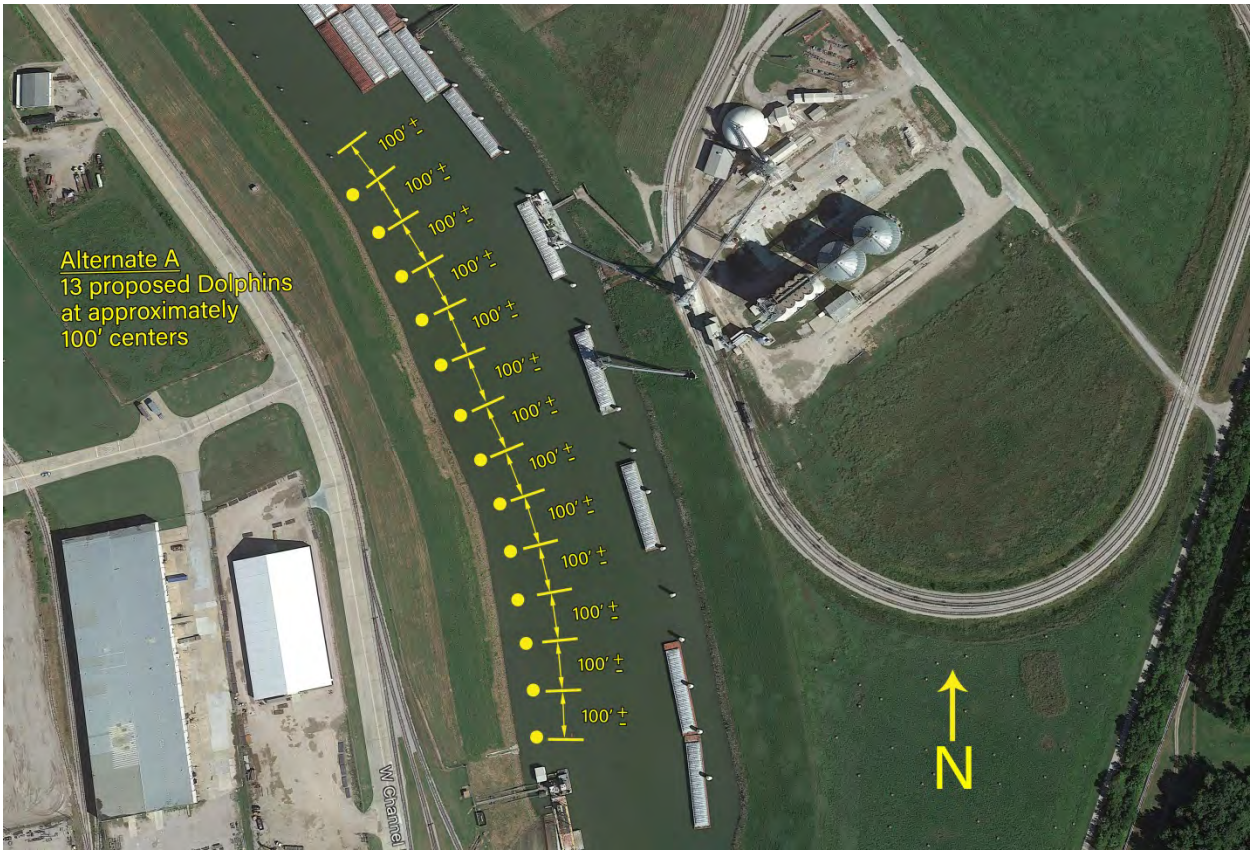
Dolphins 10-13: These four dolphins currently serve Brenntag and Holly Energy Partners. Currently only one barge can load or unload at these structures at a time. After meeting with Port staff and representatives from Brenntag and Holly Energy, we propose to replace dolphins 10-13 with two dolphins connected by a platform that would serve both industries similar to the platform north of these that currently serves Blue Knight Energy. The proposed location for new dolphins serving Brenntag and Holly Energy Partners are shown in Figure 5.

Figure 5



Additional Dolphins: The port would like to construct thirteen new dolphins on the west bank in the location currently served by shore wires from the north side of the main dock to the can dolphin closest to the main dock on the north. This project does not require removal of any existing structures and could be added to a removal and replacement construction phase as an alternate with a unit price per new dolphin.

Figure 6



Construction

The options considered for new dolphin construction are as follows:

1. Seven ft. diameter "can" dolphin similar to the ones most recently constructed at the port as the channel was widened. These are depicted in Photo 5 and the as-built plans for these are shown in Appendix D.
   a. Advantages
      i. They have been in operation for several years with little to no maintenance other than painting.
      ii. They are easy to see and contrast well with the water.
      iii. The circular design distributes impact load.
      iv. Larger diameter provides more protection from corrosion.
      v. The whole mooring dolphin from top to bottom is one type of construction.
   b. Disadvantages
      i. Some contractors may not have the equipment to drill seven feet diameter.
      ii. If placed close to the location of the existing "tower" dolphins, the pier would have a greater chance of hitting existing concrete from the existing piers if they are not completely removed.

Photo 5 – Can Dolphin

2. A concrete platform one ft. above normal water elevation, placed on three to four 36" to 42" diameter piers, with a truss type tower structure above similar to the existing "tower" structures.
   a. Advantages
      i. The smaller 36" to 42" piers could be drilled around the existing 24" piers that may be left in place below the rock line.
      ii. The smaller 36" to 42" piers are more common and most bridge contractors are capable of constructing them.
      iii. Three to four piers instead of one provides some redundancy.
      iv. Impact to the platform or truss structure above could be distributed to the foundation in a wider area than seven ft.
   b. Disadvantages
      i. Drilling, encasing and placing concrete and reinforcing in three to four holes instead of one.
      ii. The dolphin is constructed in stages and involves several different types of construction.

The dolphins replacing existing structures 10-13 are anticipated to be two mooring dolphins with a platform resting on an independent pier system and extending between the two dolphins similar to the platform that currently serves Blue Knight Energy. We discussed this project with representatives from Holly Energy Partners and Brenntag. Based on our discussion and investigation of the current services at Dolphins 10-13 and of the configuration of the platform that serves Blue Knight Energy, we listed the following design considerations for this structure.

- Both industries are not using the dolphins regularly at this time. Brenntag has had only two barges in 2018 and Holly has had none. They are planning to use the facility in the future but the current rate of use would provide easy access for construction.

  - Currently, it is difficult for Brenntag to find barges for the product. The barges are booked weeks in advance for areas close to the ocean harbors.
  - Rail is currently cheaper than barges for Brenntag
  - Holly has contracted with a consultant to assess the existing dolphins for the feasibility of upgrading to be able to load barges in the near future.
- The barge size is the typical 35' x 195' and is limited to 3 million pounds due to the 9ft. draft.
- Both companies use a tank type barge.
- Brenntag only unloads; Holly only loads.
- A past high shipping average was two barges per month for Brenntag.
- Brenntag ships caustic soda. In the past, they have shipped methanol and may do so in the future.
- Holly only loads hydrocarbons including crude oil.
- The port would likely provide space for pipes and the industries would provide the pipes from the platform.
- The typical offload time is six hours.
- Currently neither company loads or offloads at night. Lights and other night appurtenances may be a consideration for future construction. Electricity should be provided.
- Both companies would like a shed or storage building approximately 6ft. x 8ft. for extinguishers, life preservers and other items that could be stored on the platform. Air conditioning is desired for the building but the electrical supply to the platform should be kept at a minimum to limit the possibility of sparks.
- The platform should have two elevations one at loaded barge level and one at empty barge level.
- Typically, there are four personnel on the platform during connection and disconnection and two during load and off-loading.
- Electrical service and water supply are desired for the platform.
- Everything must be explosion proof.
- Both companies need a jib crane with a free-swinging arm. The crane should be able to carry two tons and should have an electric motor to raise and lower a hose.
- The hose needs to have a containment structure with a 110 barrel capacity. They are currently using a tub.
- A gangway access to the platform is needed. The companies can share one gangway.
- All of the barges for both companies will have a dedicated tow.
- The port's "flushing" channel, a structure that connects the Verdigris River to the channel on the east, is located just south of dolphin 10.
- Advance notice for barges would be required with the shared platform but that is the condition presently. Brenntag's lead time is 10-14 days and Holly's is 8-10 days.
- We discussed having shared functions in the center of the platform with pipes and individual functions on each end. Security would need to meet Coast Guard standards but could likely be provided with fencing on the platform.
- The design rise in water level will be ten ft. Anything above would not support barge traffic.

Photo 6 – Dolphins 11 and 12

Photo 7 – Blue Knight Platform

Existing Conditions

All previous Mooring Dolphin projects have been constructed in the dry or mostly dry, before the adjacent bank was excavated. This project will require demolition and construction in up to twelve feet of water. We spoke to representatives from three local contracting companies and all said they would do at least some of the work from barges. Some of the work may be able to be done from the bank with outriggers or supports in the water.

The geotechnical exploration report in Appendix E shows that shale lies just below the stream bed at the location of the Main Dock. Based on discussions with Port staff and contractors that have worked in the channel in the past, the top of rock varies from inches below the stream bed at the north end of the channel to about two feet below the stream bed at the south end of the channel. In borings 3 and 4 of the report, the shale extends approximately twenty-six feet below the streambed where the borings in the channel were terminated. Immediately adjacent to the channel borings at the Main Dock location, borings 1 and 2 were drilled from the top of bank. These two borings showed fill to about twenty-six feet below the steam bed and limestone for twelve feet and then shale to the termination at approximately 81 feet from the surface.

Sherwood Construction had the contract to build the latest "can" dolphins. The contractors said that the rock below the stream bed is very hard.

Construction Methods

We spoke with representatives of three local contracting companies:

- Todd Saxton with Manhattan Road and Bridge;
- Brad Peterson, Mike Nissen and Gene Spitza with Jensen Bridge; and
- Ron Egge with Sherwood Construction.

We left a message with Becco but did not receive a response. Our discussion with each contractor was centered around methods that are available locally for both demolition and construction. The only local company, to our knowledge and theirs, that owns barges is Jensen Bridge. However, other local contractors can rent barges. Our findings from these discussions are summarized below:

Demolition

Removal of the existing dolphins consists of dismantling the steel truss structure above the platform, saw cutting and removing the concrete platform and removal of the piers. Demolition methods for removing the piers are described here:

Manhattan Road and Bridge – Diamond blade saw at just below the stream bed and leave the piers in place below the top of rock. The diamond cutting could be done from a barge and possibly from the bank with outriggers.

- Requires divers
- Could be barge mounted
- Prefer to shore mount and use outriggers
- Estimated $125K/dolphin to remove including material disposal
- Anything below mud has to be jackhammered
- Most likely need to leave everything below mud

Jensen Bridge –Would use either a crane mounted cutter to remove the piers or blast them.

Crane mounted cutter:

- Divers not required
- Could be barge mounted
- Cut piles at streambed

- Rig is about $50,000/month – Jensen has to rent it but they own the barges

Blasting

- Jensen does this on bridge piers and the impact of the blast is not noticeable to adjacent properties.
- COT Flowline probably not let us blast the piers for dolphins 0-4 because they are too close to the Spavinaw supply lines.
- We are not replacing 0-4 so the piers could just be cut at the streambed line.
- Cost of blasting would be $5-$10K per pier or $40,000-$80,000 per dolphin.

Blasting the piers is Jensen's preferred method and this would enable them to remove the concrete from below the top of rock assuming the piers are only socketed five feet into rock as the T-Head Wharf plans indicate. Jensen could also cut the piers at the top of rock if blasting is not allowed

For removal of the tipped-over can dolphin, they can hook on to the exposed top and drag it to the bank, cut it open and remove the gravel before hauling away.

Sherwood Construction – Didn't believe that the City of Tulsa would allow blasting anywhere in the channel because of the Spavinaw water supply lines that cross the channel at the south end.

- Ron thought that construction of the new dolphins would not be a problem as long at the drilled perimeter did not cut through existing concrete.
- Not specifying the removal of concrete below the top of rock but leaving that as a "means and methods" will keep more bidders in the project.

We spoke with Anthony Wilkins with the City of Tulsa Planning Department about blasting in the channel. He said that the City decides to allow or disallow blasting based on individual circumstances and that any contract for removal that allows blasting must require the contractor to be responsible for any damage. A City of Tulsa blasting specification is in Appendix F. In order for blasting to be allowed on this project, The Port's Engineers must submit the following documents and calculations to the City of Tulsa:

- The geotechnical report for the dolphin design project with borings at the new dolphin locations.
- A plan showing the locations of blasting and the location of the water supply lines crossing the channel.
- A cross section showing the proximity of the waterlines, horizontal and vertical, to the piers being blasted.
- A calculation of the impact zone from the blast(s) which is affected by the hardness of the rock holding the piers and all medium between the piers and the water supply lines.

Construction

Proposed construction of replacement dolphins consists of two types: seven ft. diameter cans similar to the more recently constructed dolphins and platforms built on three to four smaller diameter piers and supporting a steel tower type structure above the water. Most of the replacement dolphins can be placed between the existing dolphins for this phase of construction but the desirable location of some of the replacement dolphins may conflict with material left below the stream bed from the removed structures in Phase I or in future phases. Discussions with the three contractors about construction of replacement dolphins are described here:

Manhattan Road and Bridge –

- Drilling through existing concrete is difficult with unpredictable results.
- The Port may get better bids for the platform, tower type dolphin with smaller diameter piers because more contractors will have the equipment to drill the smaller piers and they could be placed between any existing piers left in place.
- A seven ft. diameter pier placed between existing piers would not line up with the other dolphins on the channel face so a cantilever structure would be required.

Jensen Bridge –

- Drilling through existing concrete is not recommended.
- Would prefer to construct the seven ft. diameter cans because it is all one type of construction.
- If the existing piers are blasted, they would not be a problem for drilling large diameter piers.

Sherwood Construction –

- Would also prefer to construct the seven ft. diameter cans. They constructed the last installation and they have the equipment to perform this work.
- As long as the perimeter of the seven ft. diameter can does not cut through existing concrete, Sherwood can drill the piers and install the casing so that the casing acts as a cofferdam to allow them to remove the existing piers from below rock.

General

Discussions with all three contractors and with Port staff involved general requirements for Phase I removal and reconstruction. These requirements are listed here:

- A greater number of new dolphins in the bid package will probably get better prices per dolphin. The Port suggested adding an additional 13 can type dolphins along the west bank at 100 ft. spacing in the area that is currently served by shore wires.
- Prequalifying the contractors is recommended. ODOT did this for the railroad bridge over SH 235 in Oklahoma City. Suggested qualifiers were experience with barge construction and port experience.
- A work exclusion area will be mapped out so the contractor will know where he can put barges, boats, equipment, etc. without disturbing navigation.
- All of the piers for both types of construction should be encased and filled with concrete and reinforcing cages. The casing for the seven ft. diameter piers should be at least 5/8" thick to prevent "ovaling" during shipping and storage.
- The pier casing should be painted with either Coal Tar Epoxy or a Marine quality epoxy paint. ForsField TZ-904 by Chevron,a polysulfide-modified novolac epoxy coating, is less harmful to the environment, easier to apply and on-going test results imply that it requires less maintenance over time. It is more expensive at $100/sf at 90 mils to $25/sf at 90mils for Coal Tar Epoxy.

Phasing

Replacement of the tower dolphins will require project phasing due to construction costs, barge traffic and impact to the industries. The phasing options discussed for this report are listed below:

1. Remove Dolphins 0-3, 4, 5, 15 and 16 and replace these with five new dolphins in the areas depicted in figures 3 and 4 in phase I. Construct thirteen additional dolphins as an ad-alternate to phase I. Replace Dolphins 10-13 with two new dolphins and a connecting platform in Phase II or a later phase. Replace dolphins 6-9 in a later phase.
    a. Advantages
        i. Removing Dolphins 0-3 would clear the bottleneck in the channel sooner.
        ii. Construction of the five new dolphins could be similar to recent dolphin construction but in wet conditions so the learning curve would be limited to the barge construction aspect.
        iii. No dolphins that currently serve industry would be impacted in the first phase.
        iv. Adding the thirteen additional dolphins in any construction phase would reduce the cost per dolphin.

b. Disadvantages
    i. The industries served by dolphins 10-13 may begin shipping product between phases 1 and 2 and would suffer greater impact from construction.
    ii. The thirteen additional dolphins may not be budgeted for in the first phase.

2. Remove Dolphins 1-3, 10-13 and the tipped over can dolphin. Replace Dolphins 10-13 with two new dolphins and a connecting platform in Phase I. Remove Dolphins 4, 5, 15 and 16 and replace with five new dolphins in Phase II or a later phase. Replace Dolphins 6-9 in a later phase.
    a. Advantages
        i. Dolphins 10-13, currently serving Brentag and Holly Energy Partners, could be removed and replaced in a year that they are not being used.
        ii. Holly Energy Partners has been tasked with updating their existing dolphin for future use and this construction project may prevent duplication of effort.
        iii. Removal of dolphins 0-3 in Phase I would clear the bottleneck in the channel sooner.
        iv. Dolphins 4, 5, 15 and 16 are not currently serving any industry so there is little demand for replacement.
    b. Disadvantages
        i. Construction of a shipping platform is a project that the Port has not undertaken themselves. Design time for this project would take longer and the learning curve for construction in wet conditions would be coupled with constructing a shipping platform.
        ii. Dolphins 10-13 have been rehabilitated to add additional life span, Dolphins 4, 5, 15 and 16 have not been rehabilitated.

Cost Estimate

With input from the Port staff, BKL sent the following scope of work to both Jensen Bridge and Sherwood Construction with associated exhibits.. The contractor's estimated costs are shown below.

Scope:

The scope of this phase will be to remove eight "tower" type dolphins and one tipped over can and replace 4 of the tower dolphins with "can" type structures. *We would also like to know the additional cost for construction 13 more "can" structures on the west bank in the space that is currently served by shore wires.*

Jensen Bridge Estimate:

$1,400,000.00 for Phase I work and if done under the same contract, each additional dolphin could be constructed for $150,000 each.
Total Base Bid = $1,400,000
Alternate A = $1,950,000

Sherwood Construction Estimate:

Dolphin installation $300,000 each x 4 = 1,200,000
Demolition of towers 4,5,14 and 15 $32,000 each = $128,000.00
Demolition of towers 1, 2 and 3 $32,000 each = $128,000.00 including dolphin 0
Demolition of tipped can dolphin $28,000
Installation of 13 additional can dolphins $300,000 each = $3,900,000.
Total Base Cost (no contingency) = $1,474,000.
Alternate A = $3,900.000

Holly Energy Partners and Brenntag Phase Construction Estimate:

ITEM NO.	SPEC. NO.	DESCRIPTION	UNITS	UNIT PRICE	ESTIMATED QUANTITY	EXTENSION
1		DEMOLITION EXISTING TOWERS	EA	$32,000.00	8	$256,000.00
2		DENIOLITION TIPPED CAN STRUCTURE	EA	$28,000.00	1	$28,000.00
3		SURVEY	LSUM	$10,000.00	1	$10,000.00
4		PIPE STUBOUTS	LSUM	$10,000.00	1	$10,000.00
5		MISC PIPE EQUIPMENT	LSUM	$20,000.00	1	$20,000.00
6		CONCRET BEAMS	LF	$850.00	67	$56,950.00
7		24" PIERS	LF	$240.00	160	$38,400.00
8		7' DIAMETER CAN DOLPHIN WITH CASING AND PAING	EA	$300,000.00	2	$600,000.00
9		CONCRETE PLATFORM AND PEDESTALS	CY	$850.00	10	$8,500.00
10		ALUMINUM GRATING	SY	$55.00	2500	$137,500.00
11		METAL GANGWWAY	EA	$30,000.00	1	$30,000.00
12		HANDRAIL	LF	$55.00	350	$19,250.00
13		CHAINLINK FENCE	LF	$50.00	100	$5,000.00
14		ALUIMINUM FRAMING	LBS	$16,000.00	4	$56,000.00
15		LADDERS	EA	$2.00	1000	$2,000.00
16		SIGNAGE	LSUM	$4,000.00	1	$4,000.00
17		12' X 12' SHED	EA	$30,000.00	1	$30,000.00
18		JIB CRANE AND HOIST	EA	$40,000.00	2	$80,000.00
19		ELECTRICAL/FIRE PROTECTION	LSUM	$30,000.00	1	$30,000.00

TOTAL ITEMS	**$1,165,600.00**
20% CONTINGENCY	**$233,120.00**
TOTAL W/ CONTINGENCY	**$1,398,720.00**

Conclusions

Based on our investigation we concluded that Phase I construction plans should be produced for the following items:

- The removal of Dolphins 0-3, 4 and 5, 14 and 15.
- Removal of the existing, tipped-over can dolphin near the Galvilon West loading structure.
- Reconstruction of five seven ft. diameter can dolphins drilled twelve feet into shale and extending at least 35 ft. above the normal water line at locations near existing dolphins 4, 5, 14 and 15.
- The reconstruction plans and details should have new dolphins lined up with the front of existing dolphins and spaced as close to 100ft. centers as possible. The proposed location of these structures is shown in figure 3.
- The cost of Phase I is estimated to be approximately $1.7 Million.

Phase II construction plans should be produced for the following items

- The removal of Dolphins 10-13 in Figure 1 at the north end of the channel.
- Reconstruction of two seven ft. diameter dolphins near dolphins 12 and 13 with a platform between them constructed on smaller diameter piers.
- The cost of Phase II construction is estimated to be approximately $1.4 Million.

Add Alternates for Phase I or Phase II to include the following:

- Up to 13 additional can dolphins on the west bank in the space that is currently served by shore wires.
- The cost of the additional dolphins is estimated to be between $150,000 and $300,000 each.

All design documents should include specifications for the removal of the existing dolphins that minimize the impact to the Spavinaw water lines and the adjacent industries but should not limit means and methods. Documents should include prequalification for barge construction and the documents should have construction sequencing that limits the impact to channel traffic and Port industries.

Appendix A

Marcan Report
Underwater Dolphin Inspections

MarCan Underwater Services LLC
PORT INSPECTION AT THE TULSA PORT OF CATOOSA

INSPECTED 15 MOORING STRUCTURES AND FRONT STRUCTURES FOR 200-TON CRANE

INSPECTION DATES: JULY 16, 2014- JULY 18,2014

MarCan

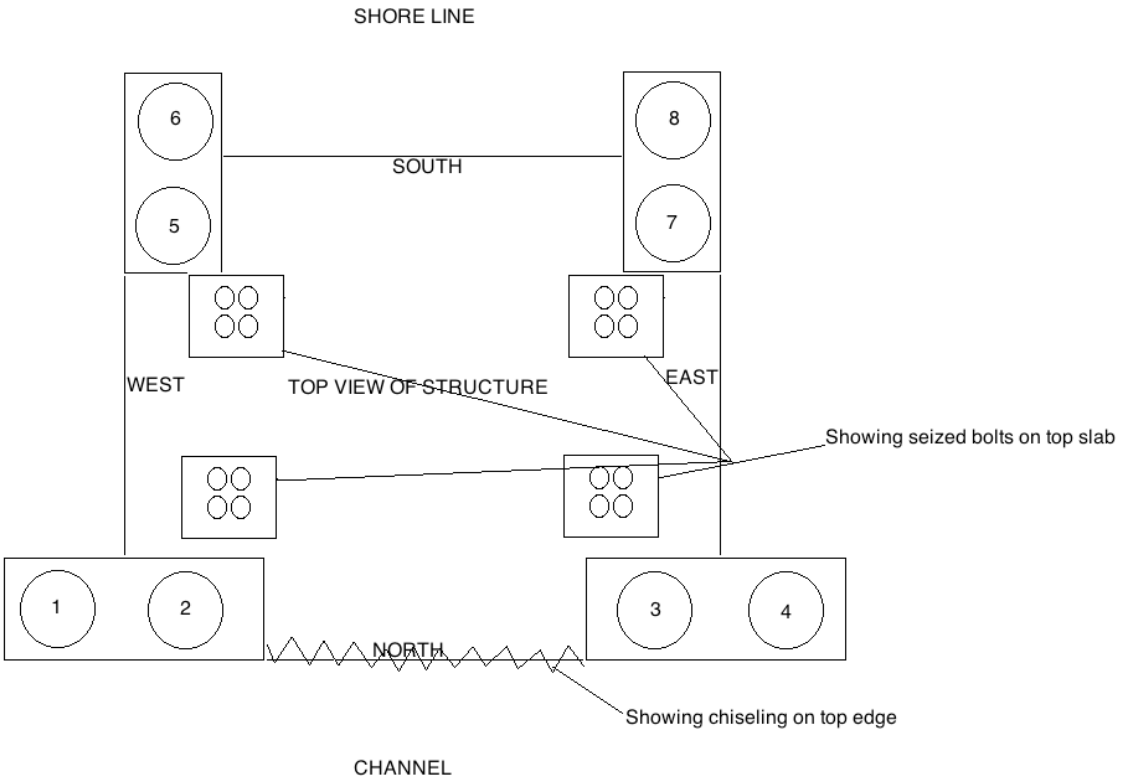
Underwater Services LLC.

Starting on July 16, 2014 MarCan Underwater Service started an inspection of the 15 structure mooring system at The Tulsa Port of Catoosa.

In this packet you will find a detailed report of our finding on each dolphin, along with a corresponding still life photograph in order to better indicate the structure under inspection.

After reviewing this report we urge you to contact our office at (936) 404-9514 in order to discuss your options for extending the longevity of your structures and measures that can be taken to protect the structures you currently have in use.

MOORING STRUCTURE #1



Top Slab

WATERLINE TO MUDLINE IS ROUGHLY 7.5' DEEP ON THE CHANNEL SIDE

Showed chiseling on the north top edge facing the channel.

Note all bolt sets were rusted and appeared seized.

Debris was found submersed under the structure and consisted of logs.

MOORING STRUCTURE #1

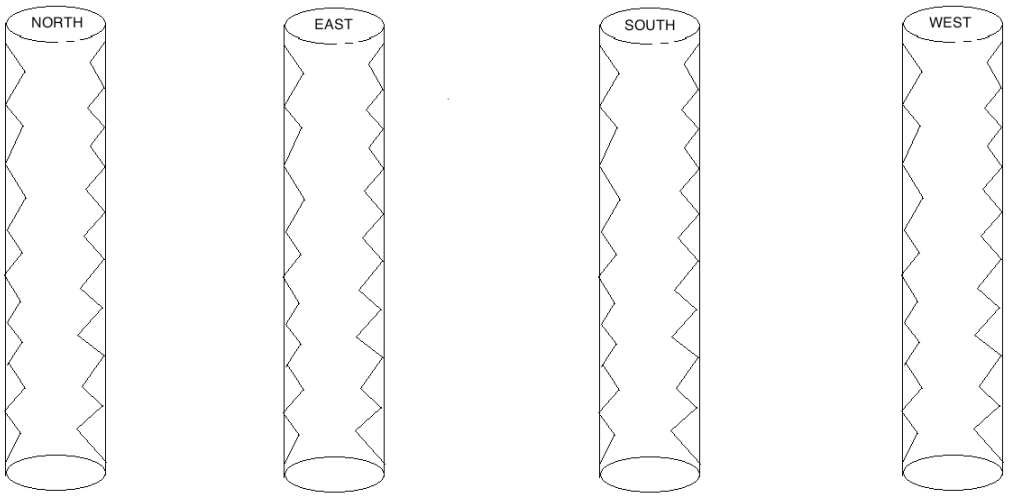
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #1

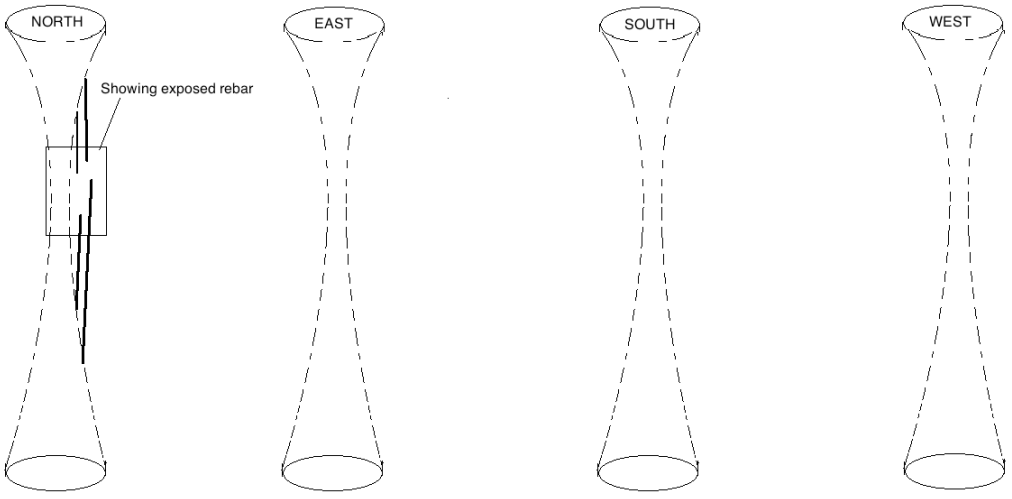
Pile #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.



MOORING STRUCTURE #1

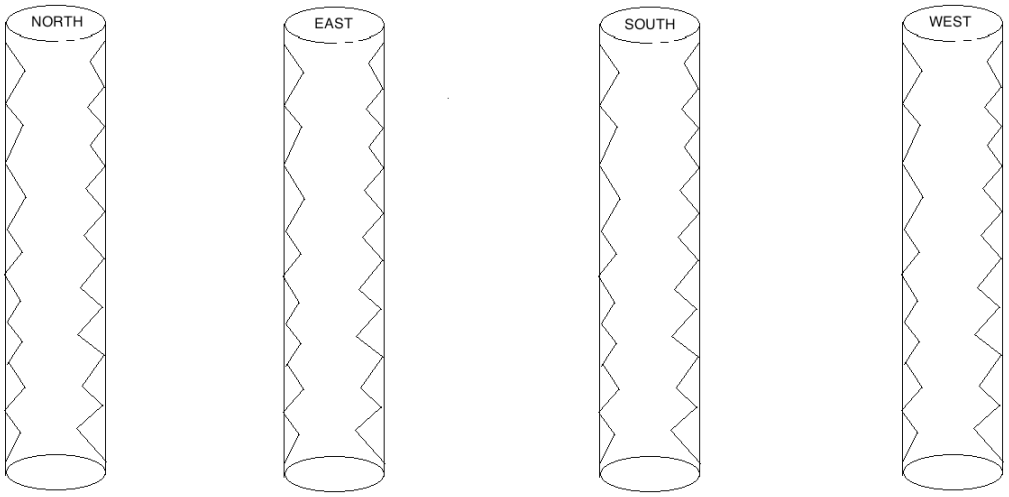
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #1

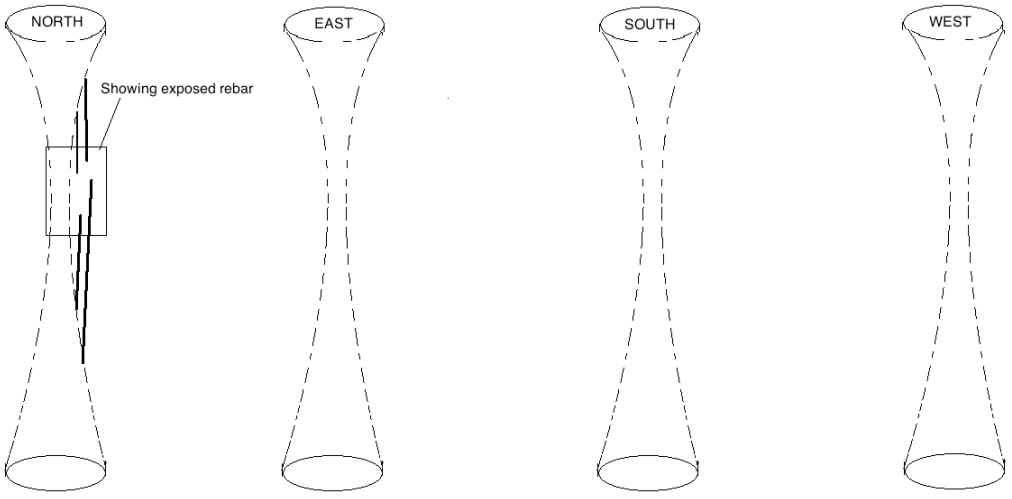
Pile #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.



MOORING STRUCTURE #1

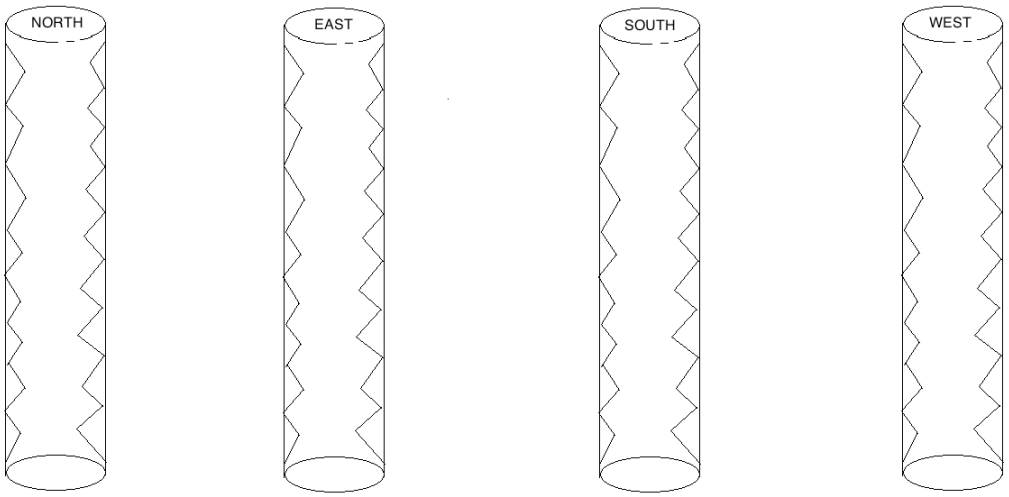
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #1

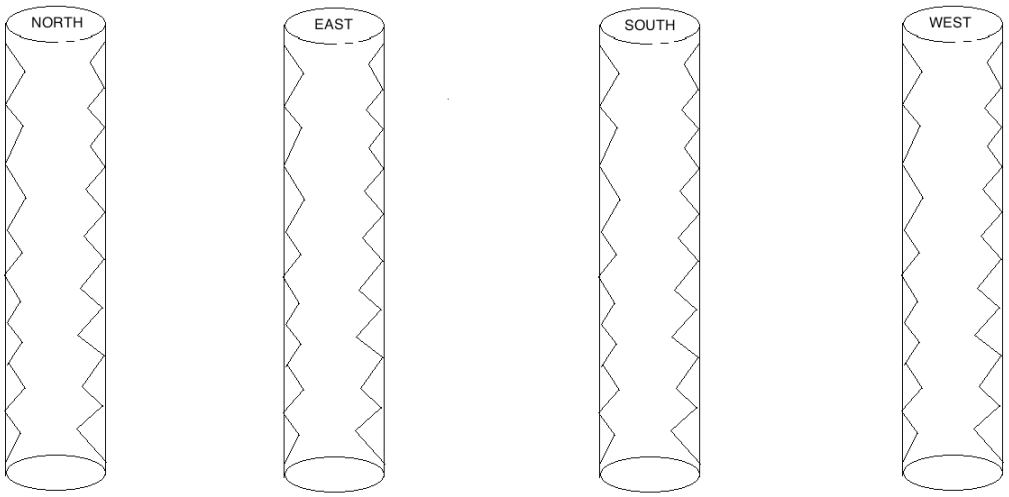
PILE #6

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #1

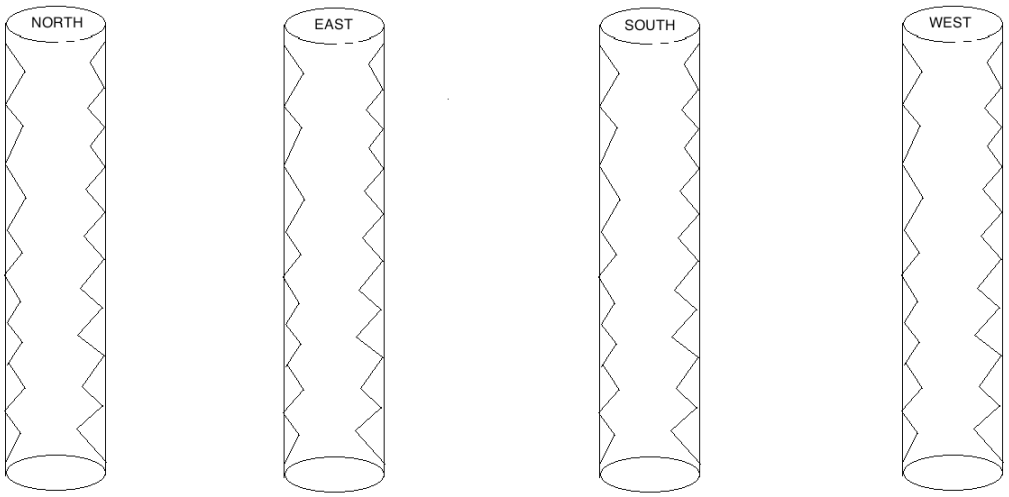
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #1

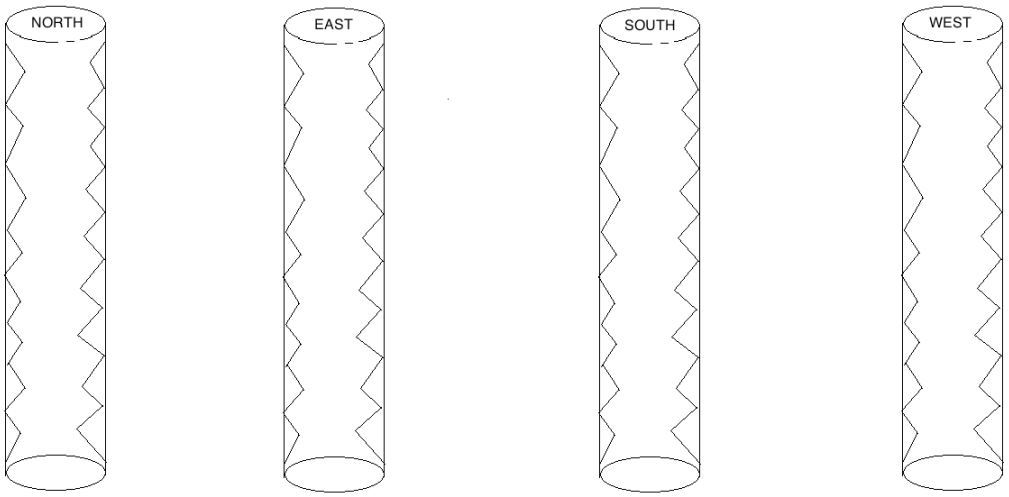
PILE #8

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

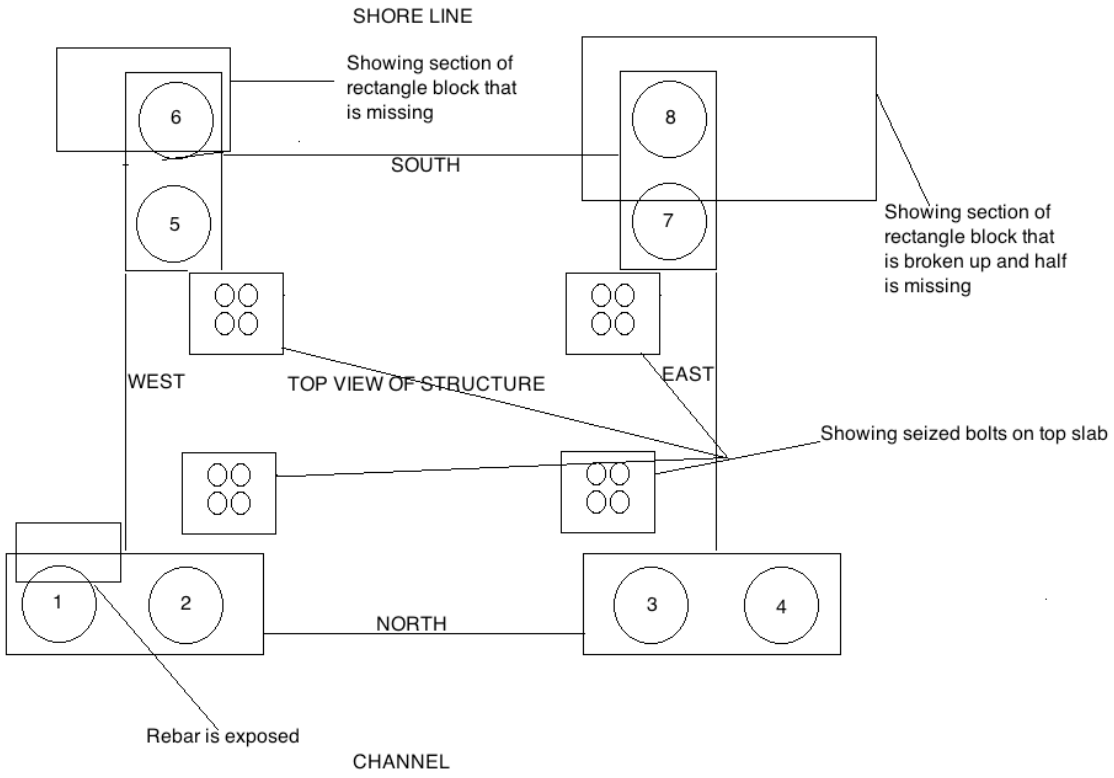
East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #2



Top Slab

WATERLINE TO MUDLINE IS ROUGHLY 7-7.5' DEEP

Note all bolt sets were rusted and appeared seized.

10'' in from the west side of the rectangle block over pile 1 on the south side has exposed rebar

Section of rectangle block over pile number 6 is missing.

Rectangle block of piles 7 and 8 is broken up crumbling and is half missing, showing exposed rebar.

MOORING STRUCTURE #2

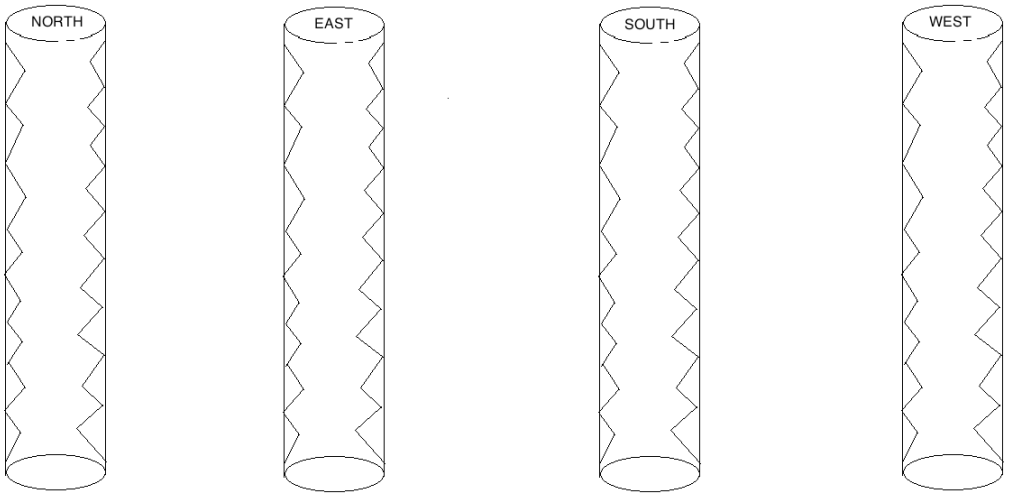
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #2

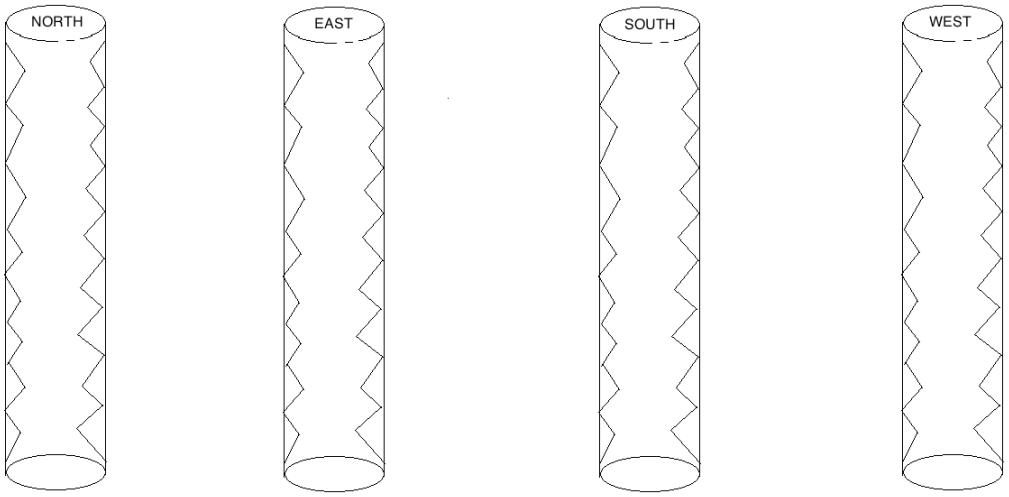
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #2

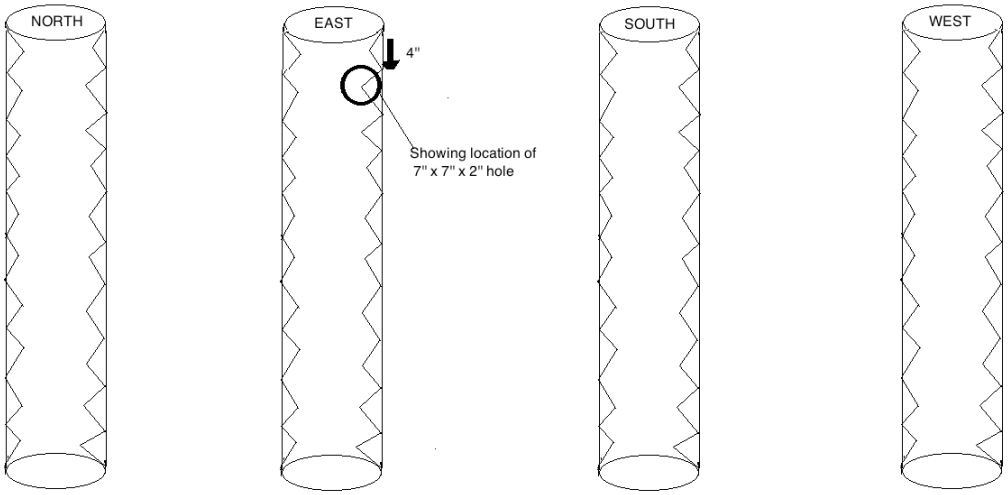
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also noted was a 7'' long by 7'' wide by 2'' deep hole. Located 4'' down from the bottom of the rectangle block.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #2

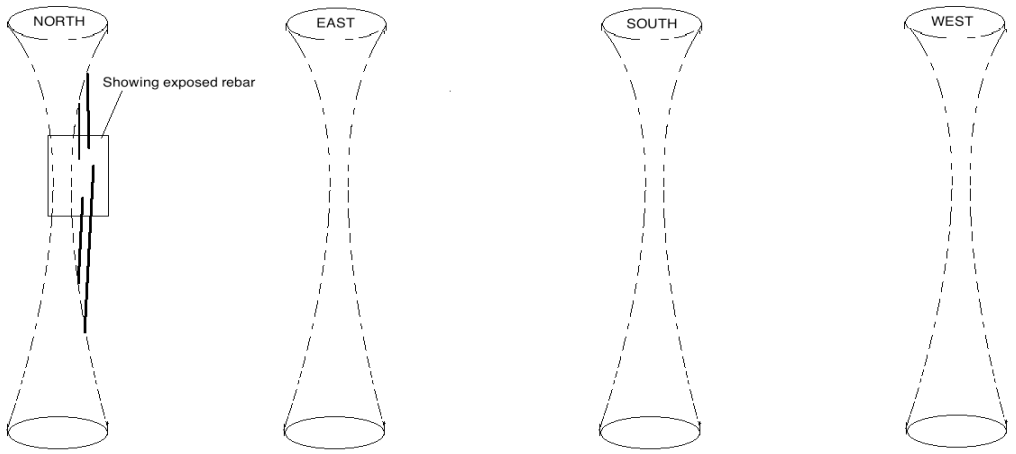
Pile #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar 10'' down from the bottom of the rectangular block. This is a sign of structural failure.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar 10'' down from the bottom of the rectangular block. This is a sign of structural failure.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar 10'' down from the bottom of the rectangular block. This is a sign of structural failure.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar 10'' down from the bottom of the rectangular block. This is a sign of structural failure.



MOORING STRUCTURE #2

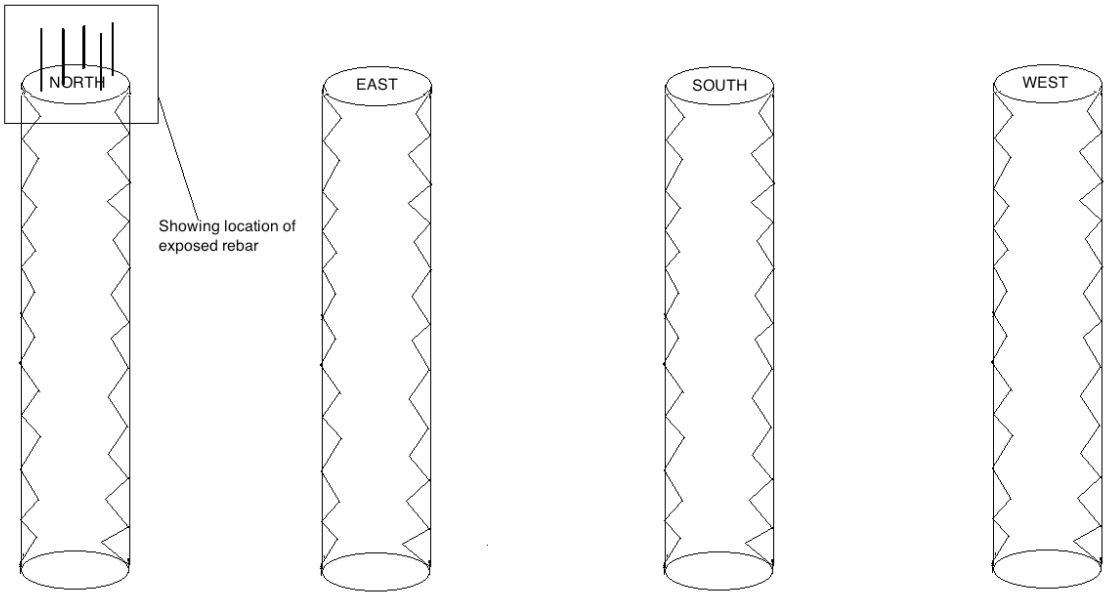
Pile #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. 6'' gap from top of pile to the bottom of the rectangular block, showing exposed broken off rebar. This is a sign of structural failure.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. 6'' gap from top of pile to the bottom of the rectangular block, showing exposed broken off rebar. This is a sign of structural failure.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. 6'' gap from top of pile to the bottom of the rectangular block, showing exposed broken off rebar. This is a sign of structural failure.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. 6'' gap from top of pile to the bottom of the rectangular block, showing exposed broken off rebar. This is a sign of structural failure.



MOORING STRUCTURE #2

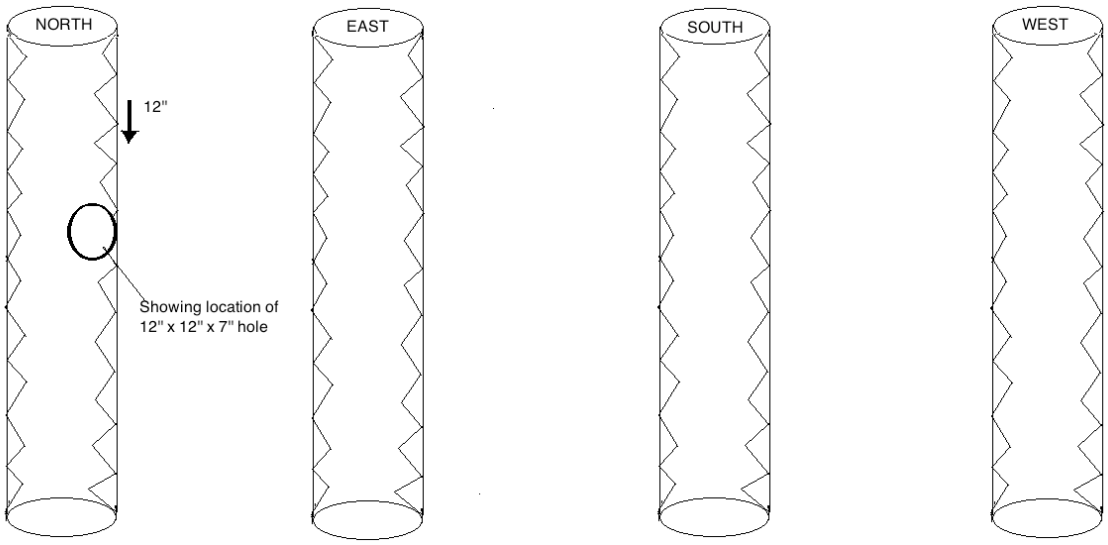
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also noted was a 12'' long by 12'' wide by 7'' deep hole. Located 12'' down from the bottom of the rectangle block. Showing exposed rebar. This is a sign of structural failure.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #2

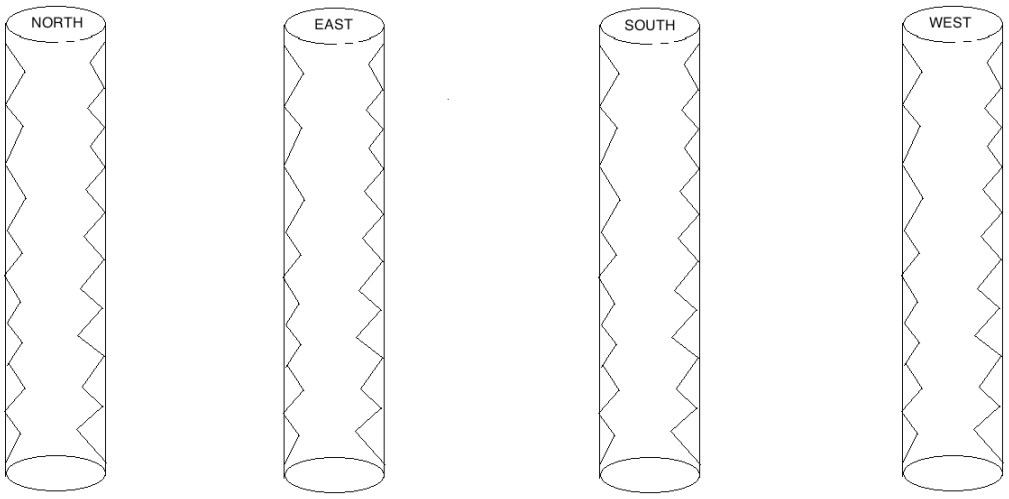
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #2

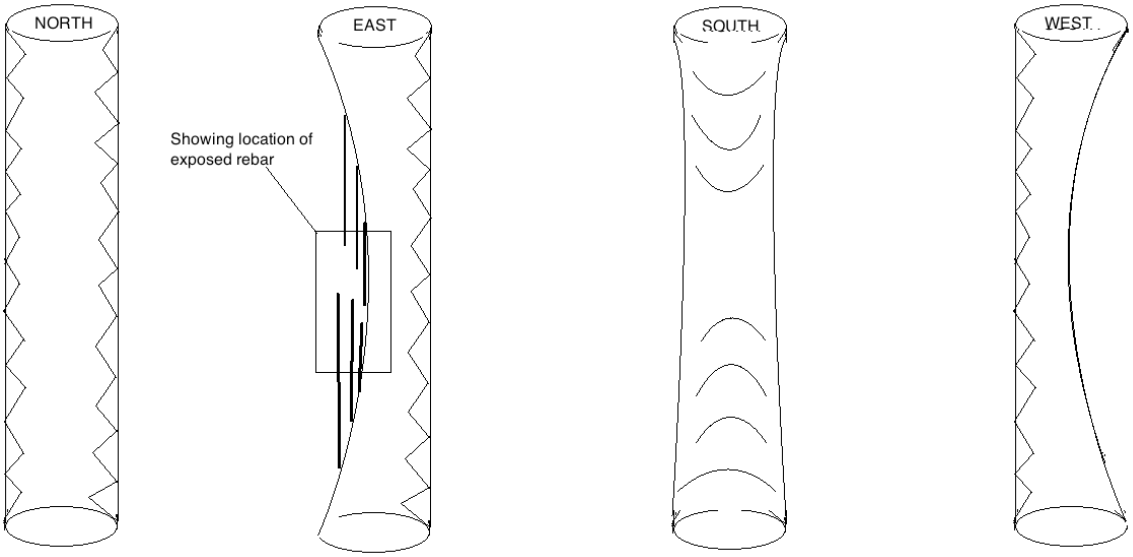
PILE #8

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

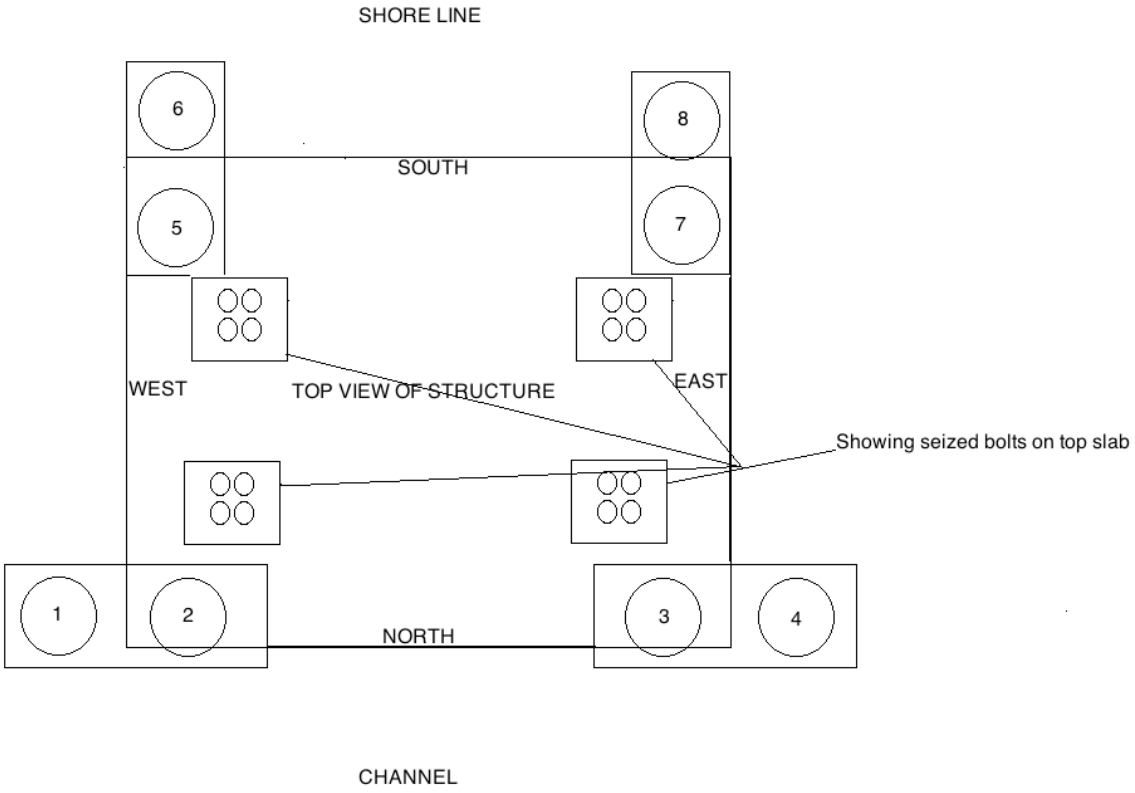
East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted the backside of the pile was chiseled away from deterioration, leaving behind corroded rebar.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted the face of the pile was chiseled away from deterioration, leaving behind corroded rebar.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted the backside of the pile was chiseled away from deterioration, leaving behind corroded rebar.



MOORING STRUCTURE #3



Top slab

WATERLINE TO MUDLINE IS ROUGHLY 6.5'-7' DEEP ON THE CHANNEL SIDE.

Note all bolt sets were rusted and appeared seized.

Debris was found submersed under the structured and consisted of logs.

MOORING STRUCTURE #3

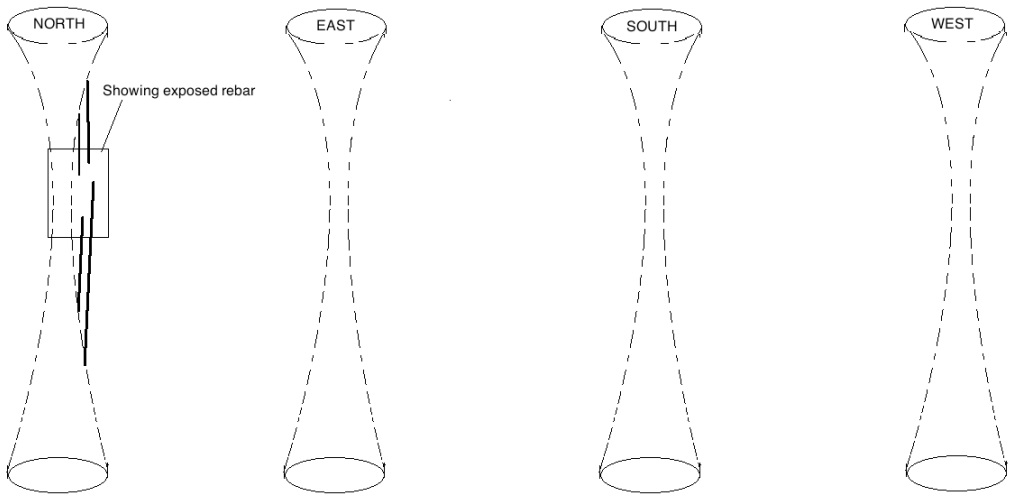
Pile #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.



MOORING STRUCTURE #3

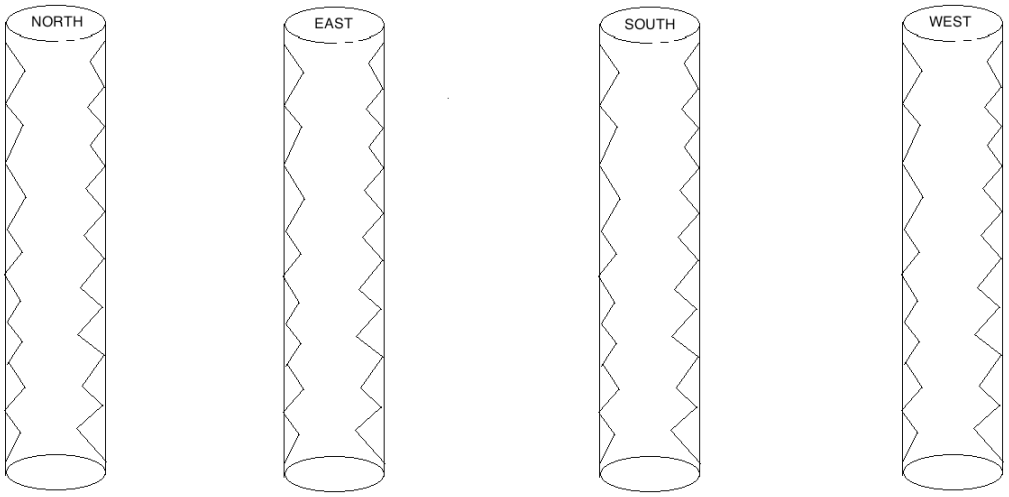
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #3

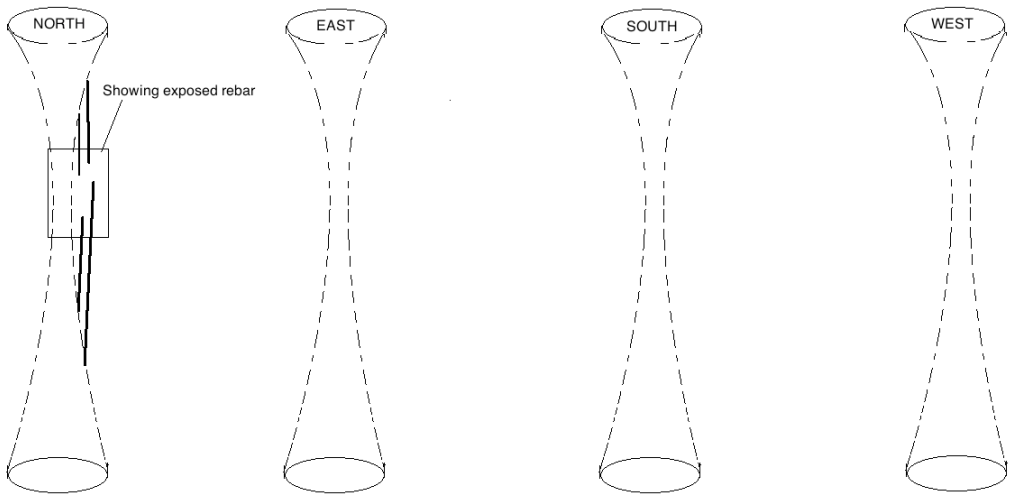
Pile #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.



MOORING STRUCTURE #3

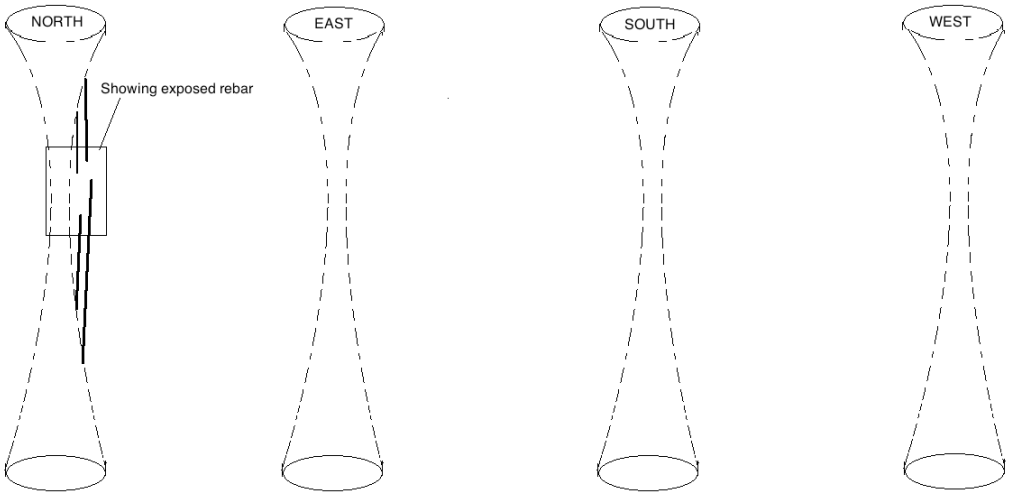
Pile #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.



MOORING STRUCTURE #3

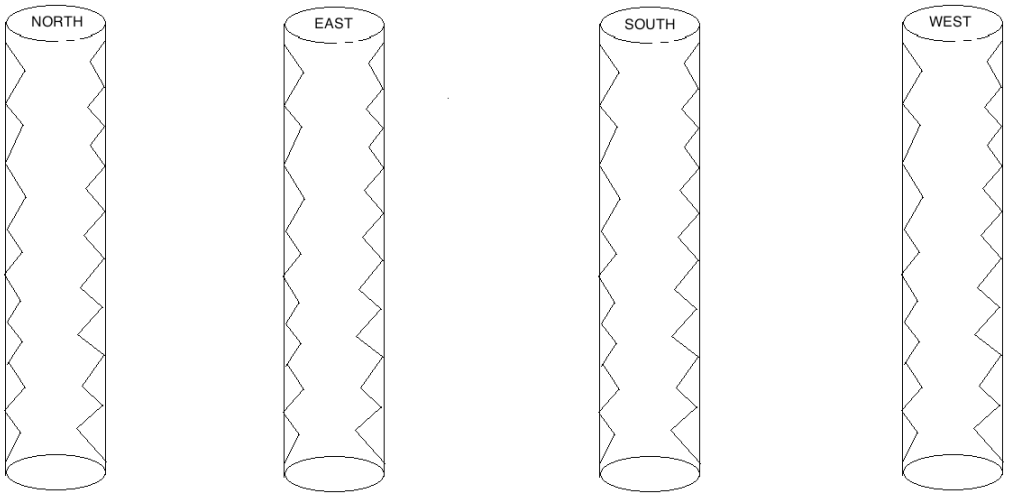
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #3

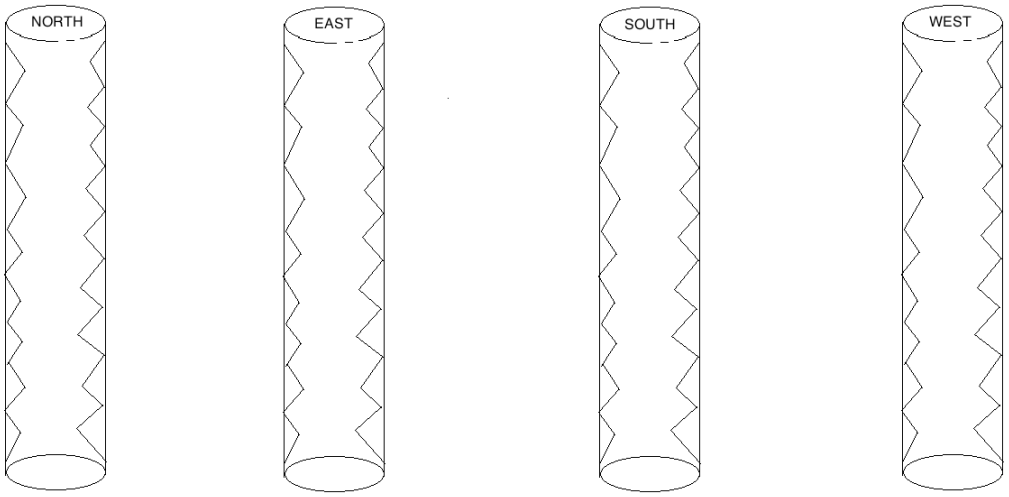
PILE #6

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #3

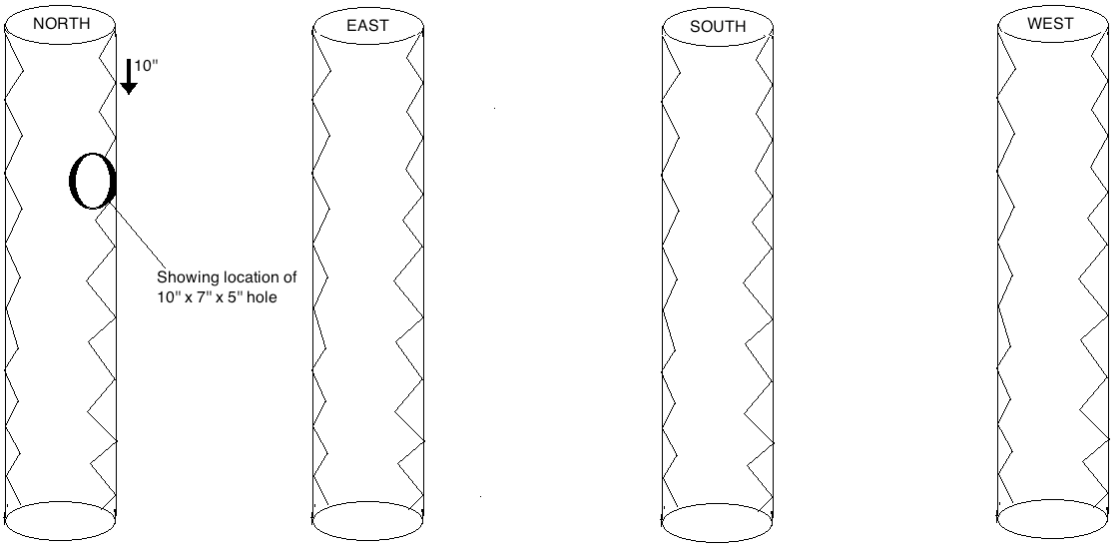
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted a 10'' long by 7'' wide by 5'' deep hole, 10'' down from the bottom of the rectangular block.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #3

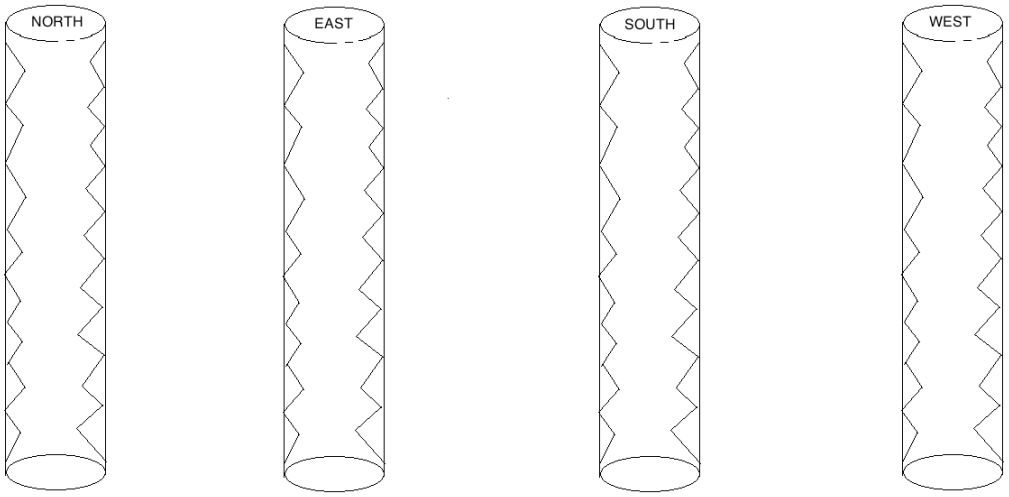
PILE #8

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

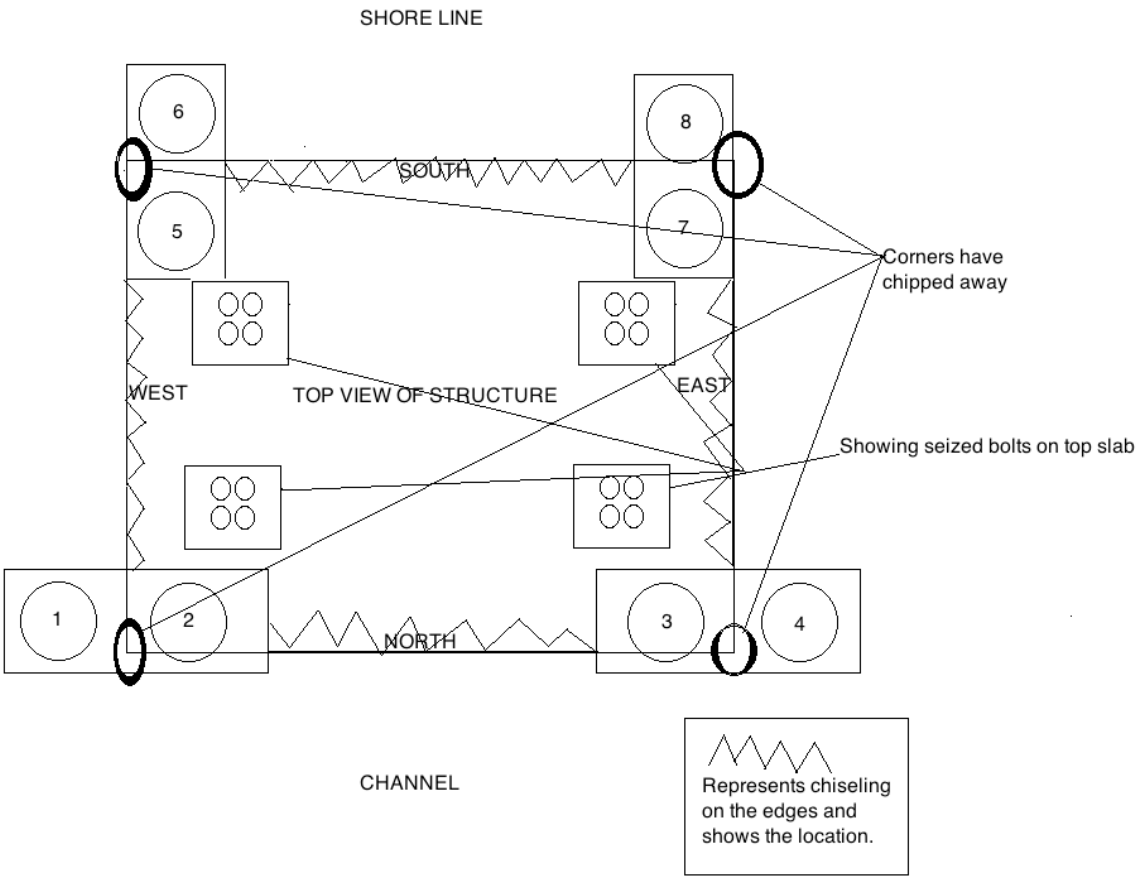
East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #4



Top slab

WATERLINE TO MUDLINE IS ROUGHLY 10’ DEEP ON THE CHANNEL SIDE

Note all bolt sets were rusted and appeared seized.

Showed chiseling on all top edges of the top slab.

All four corners have chipped away on the top slab.

MOORING STRUCTURE #4

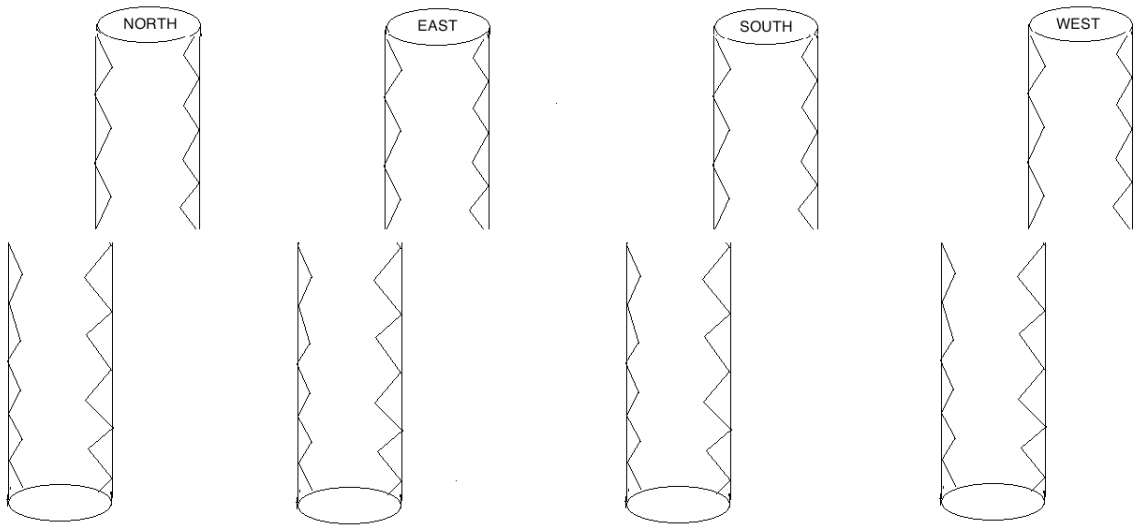
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.



MOORING STRUCTURE #4

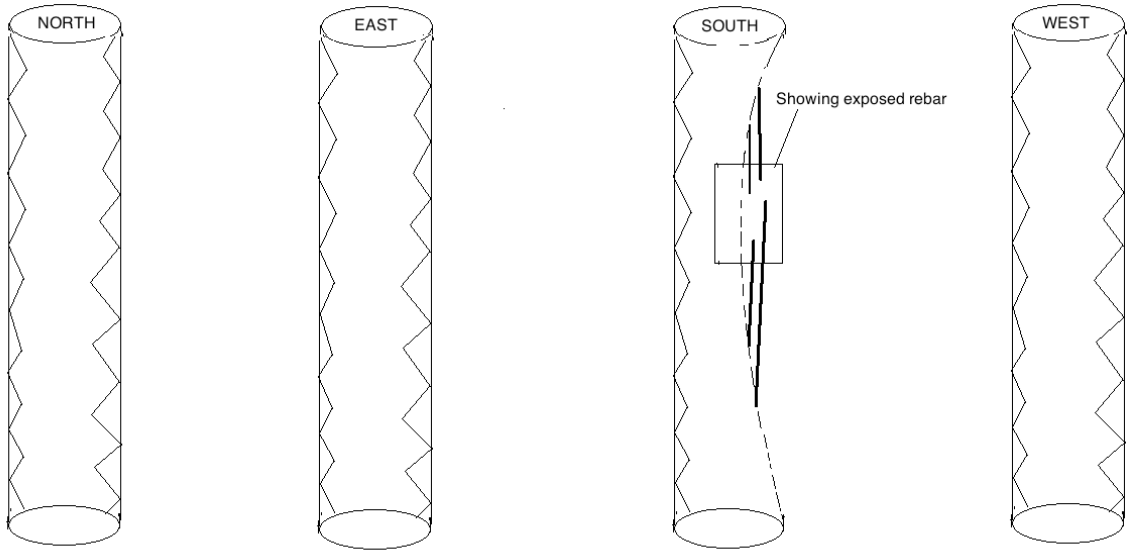
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, south side revealed exposed rebar.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #4

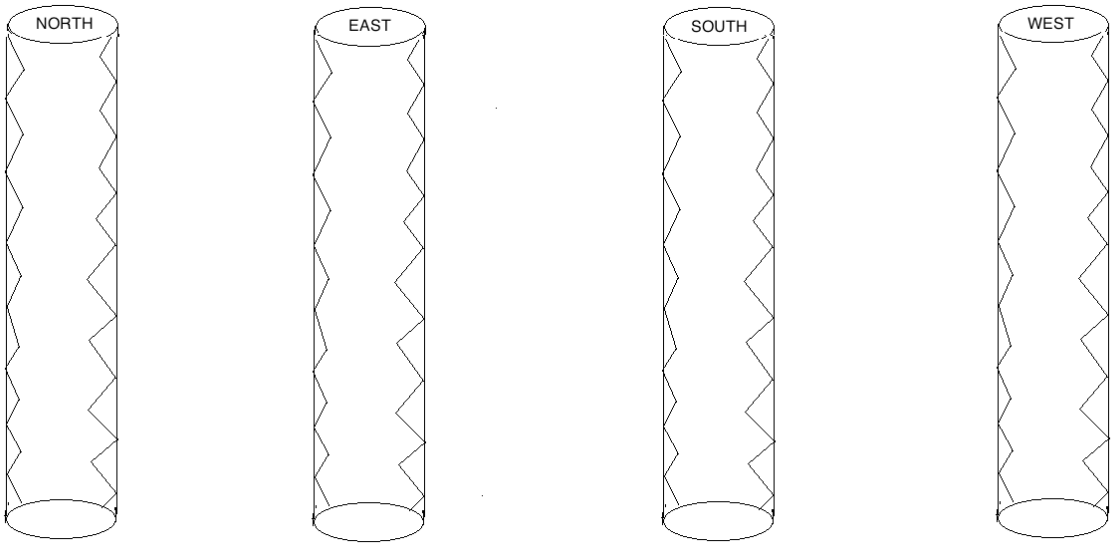
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #4

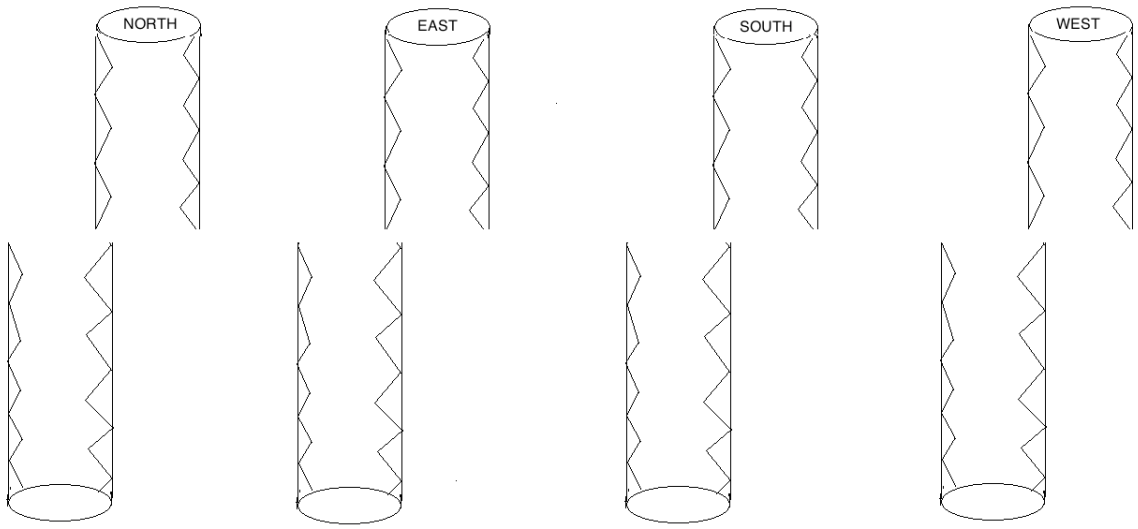
PILE #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.



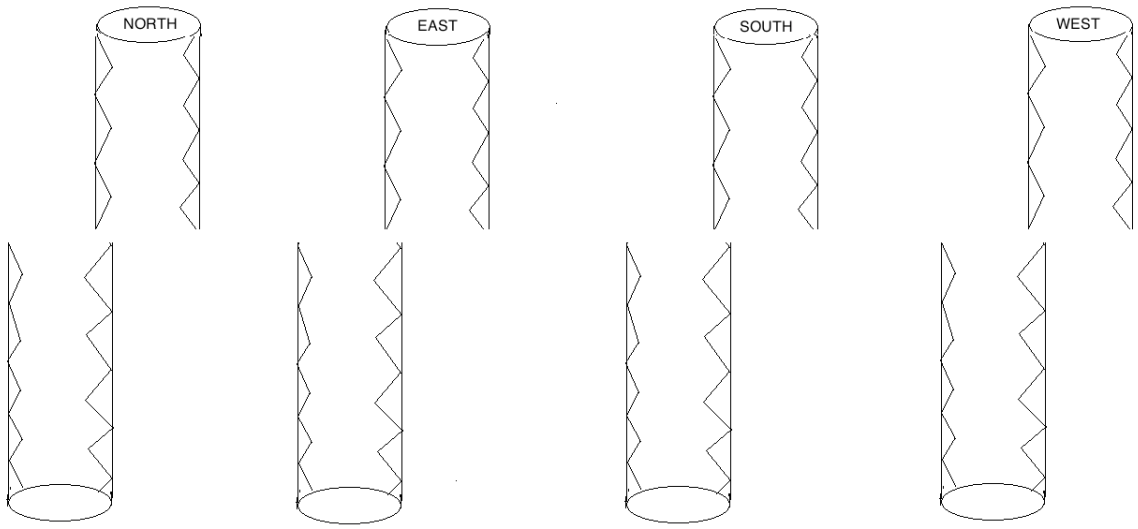
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.



Pile 6

Note : * This piling is missing as a structure, there was however a pile of rubble, leading to the conclusion that this pile has crumbled away*******

MOORING STRUCTURE #4

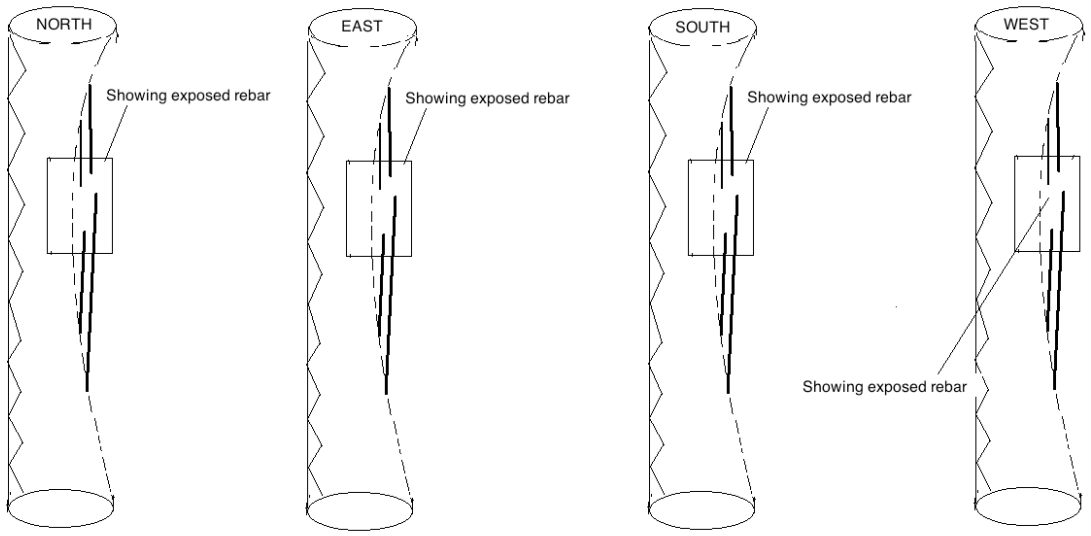
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.



MOORING STRUCTURE #4

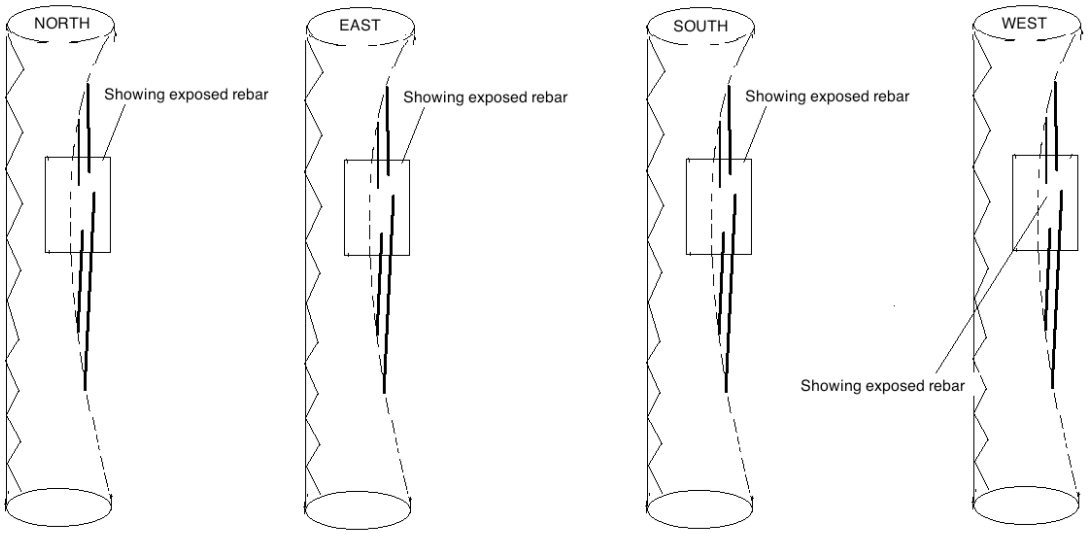
PILE #8

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

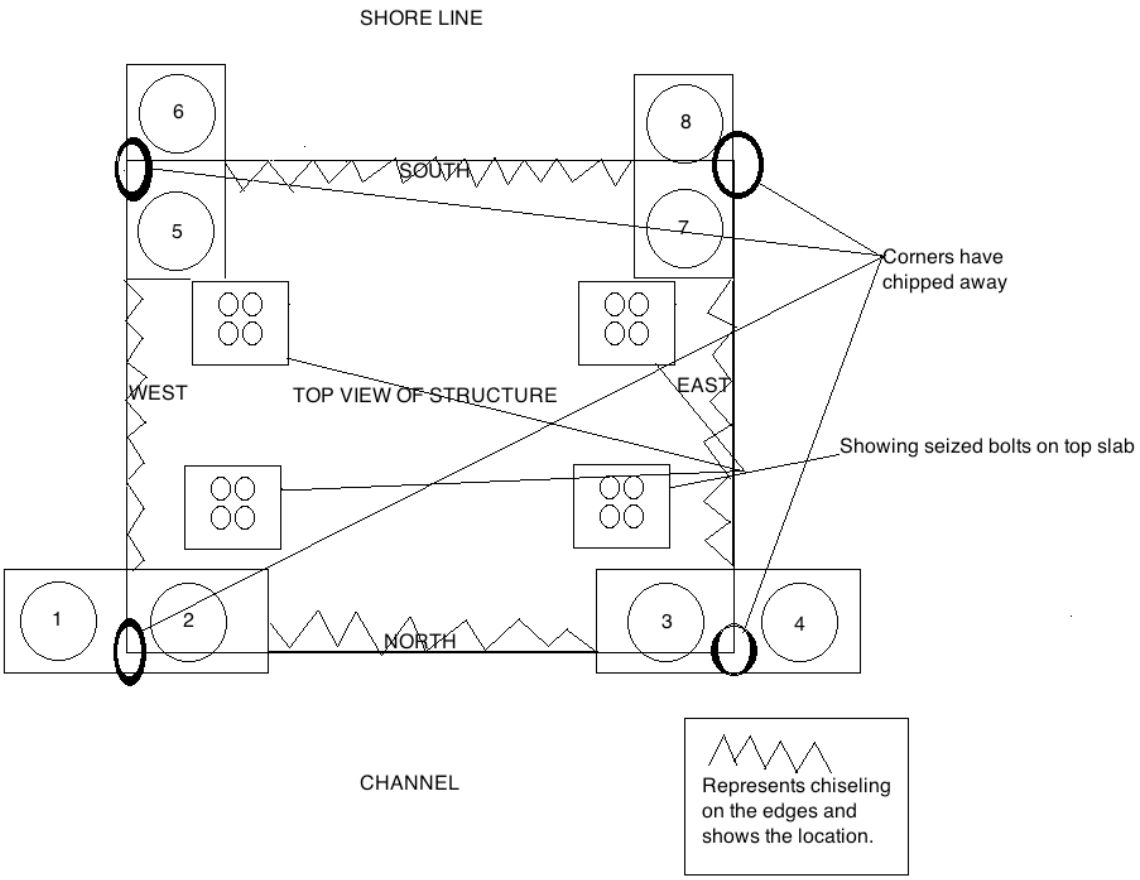
South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.




DANGER
CONDEMNED
STRUCTURE
NO MOORING

MOORING STRUCTURE #5



Top slab

WATERLINE TO MUDLINE IS ROUGHLY 10’ DEEP ON THE CHANNEL SIDE

Note all bolt sets were rusted and appeared seized.

Showed chiseling on all top edges of the top slab.

All four corners have chipped away on the top slab.

MOORING STRUCTURE #5

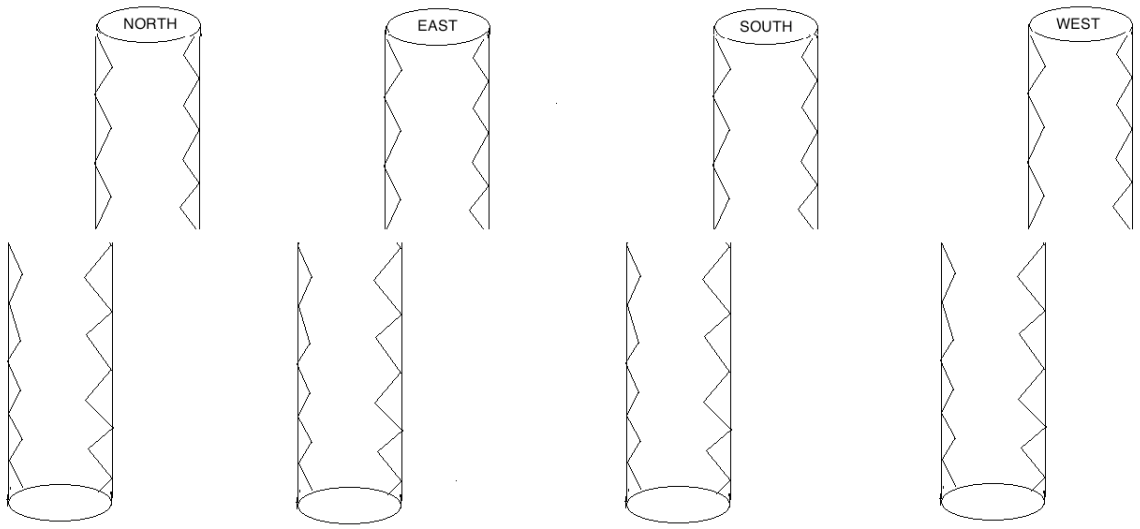
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was broken in half all the way through and offset from its top half.



MOORING STRUCTURE #5

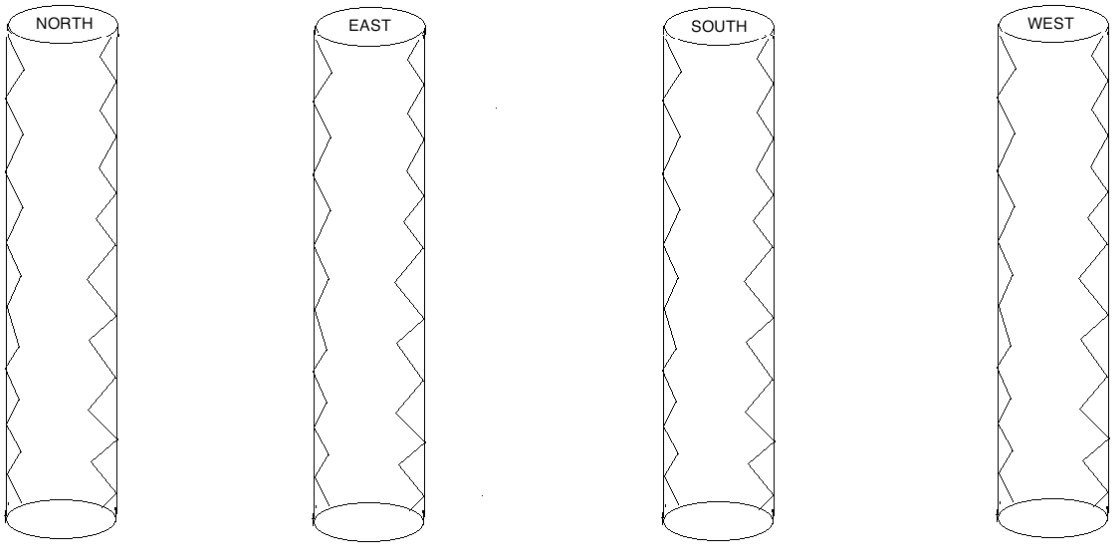
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #5

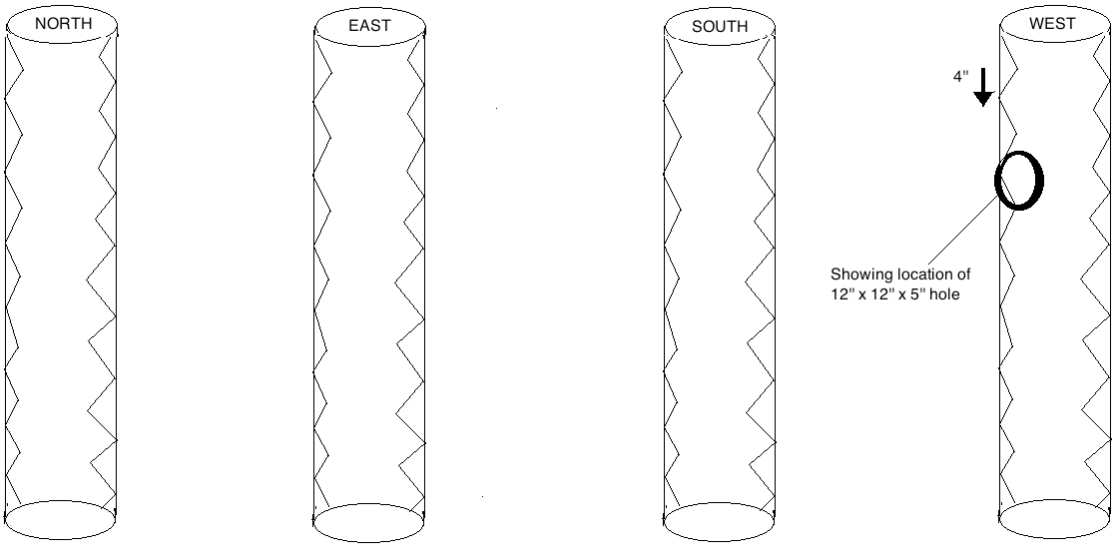
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note in the illustration below, a 12'' long by 12'' wide by 5'' deep hole. Located 4'' down from the bottom of the rectangular block.



MOORING STRUCTURE #5

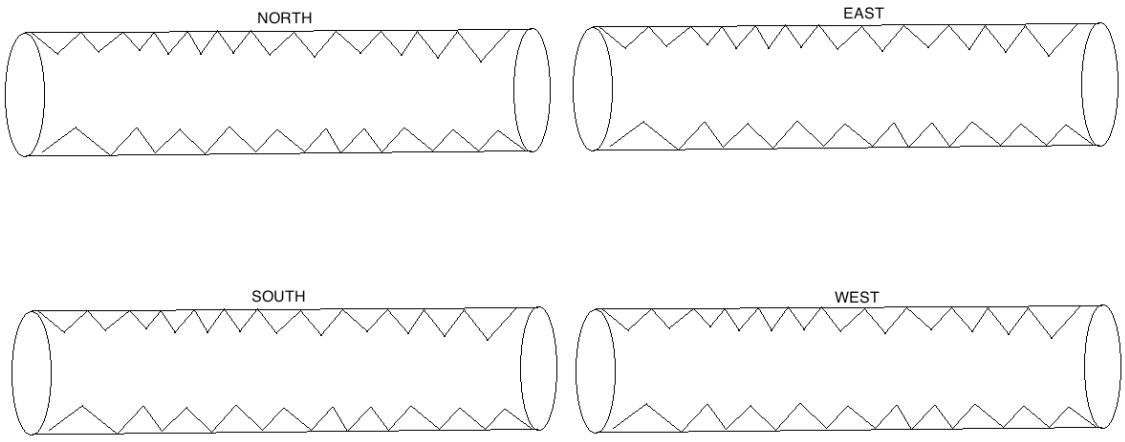
PILE #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was not attached and laying over on its side at the mud line.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was not attached and laying over on its side at the mud line.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was not attached and laying over on its side at the mud line.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noticed as illustrated below that pile 1 was not attached and laying over on its side at the mud line.



MOORING STRUCTURE #5

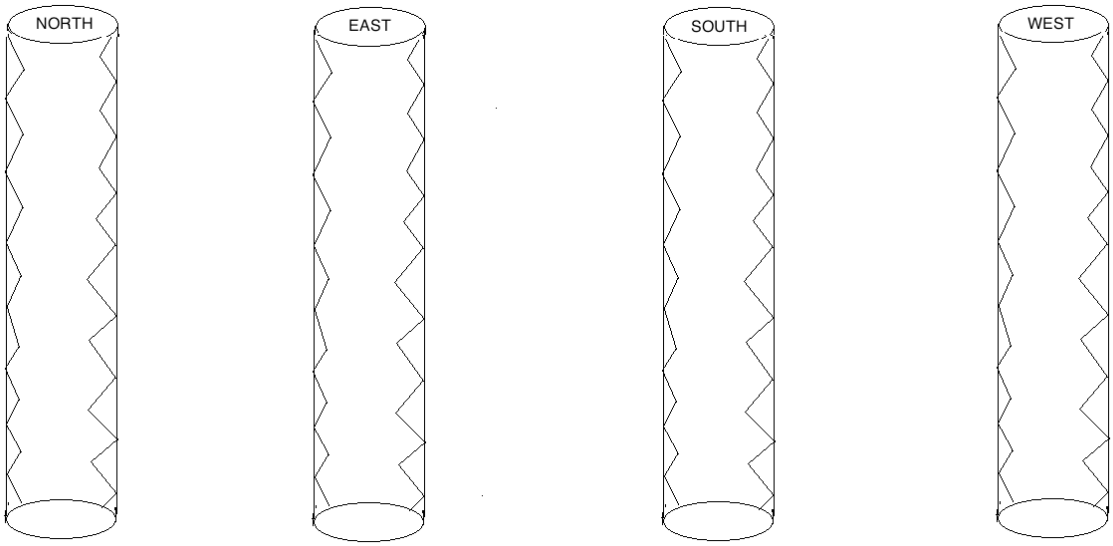
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #5

Pile 6

Note : * This piling is missing as a structure, there was however a pile of rubble, leading to the conclusion that this pile has crumbled away*******

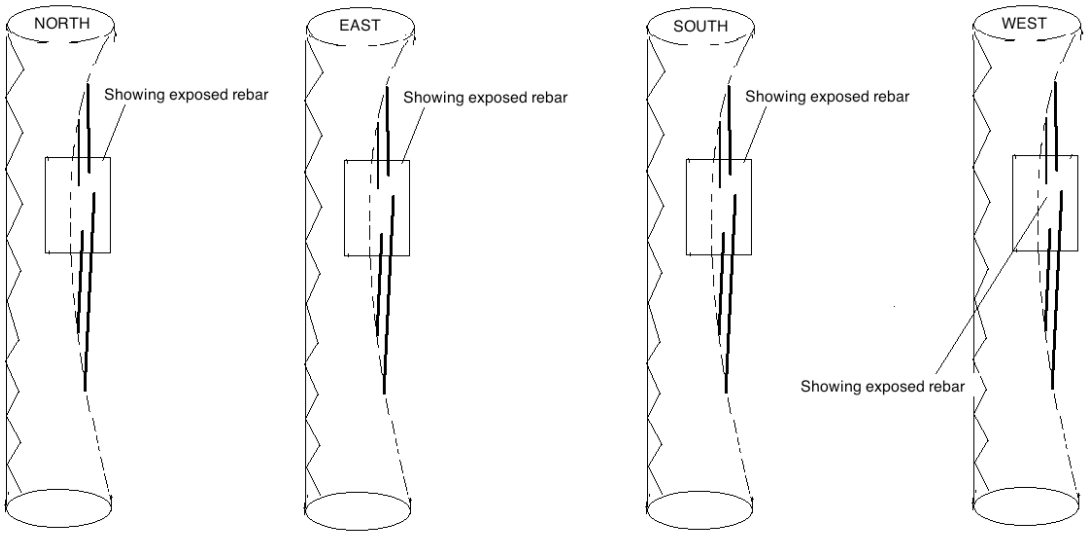
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

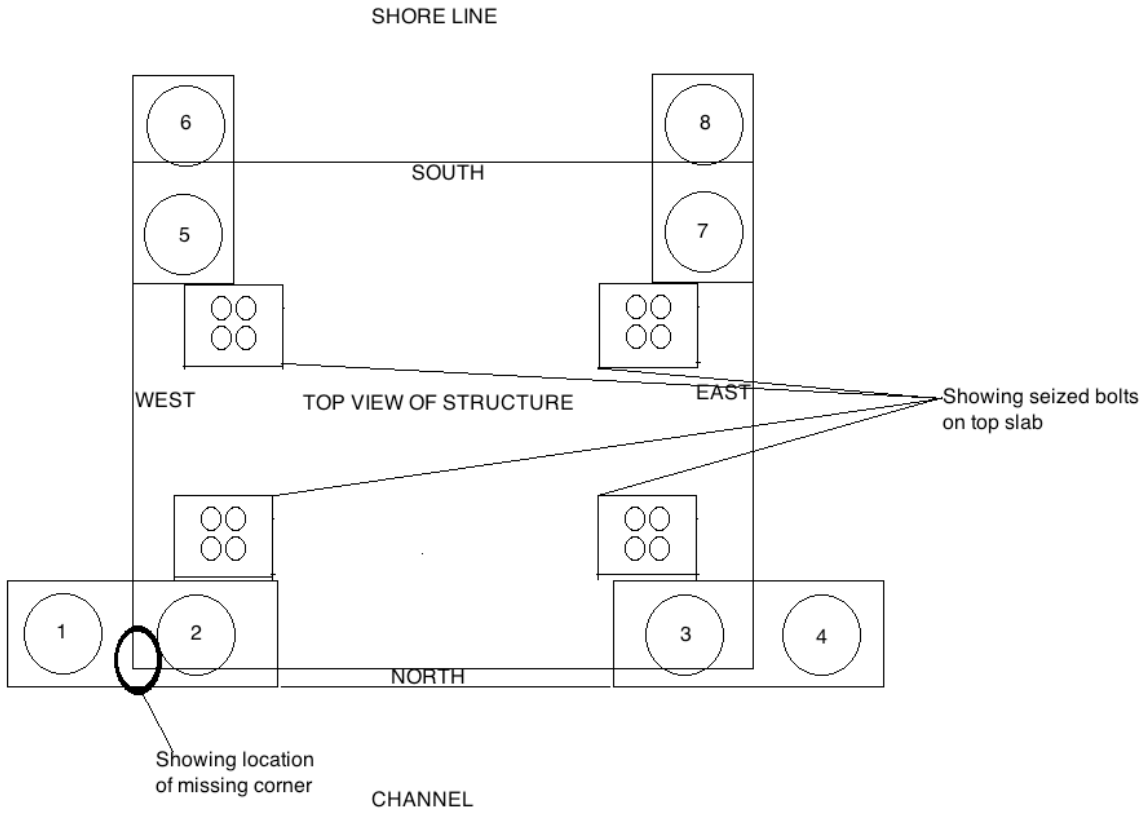
West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.



PILE #8

Note : * This piling is missing as a structure, there was however a pile of rubble, leading to the conclusion that this pile has crumbled away*******

MOORING STRUCTURE #6



Top slab

WATERLINE TO MUD LINE IS ROUGHLY 10' DEEP ON THE CHANNEL SIDE

Note all bolt sets were rusted and appeared seized.

Debris was found submersed under the structured and consisted of logs and wire rope.

Northwest corner has been chipped away on top slab.

MOORING STRUCTURE #6

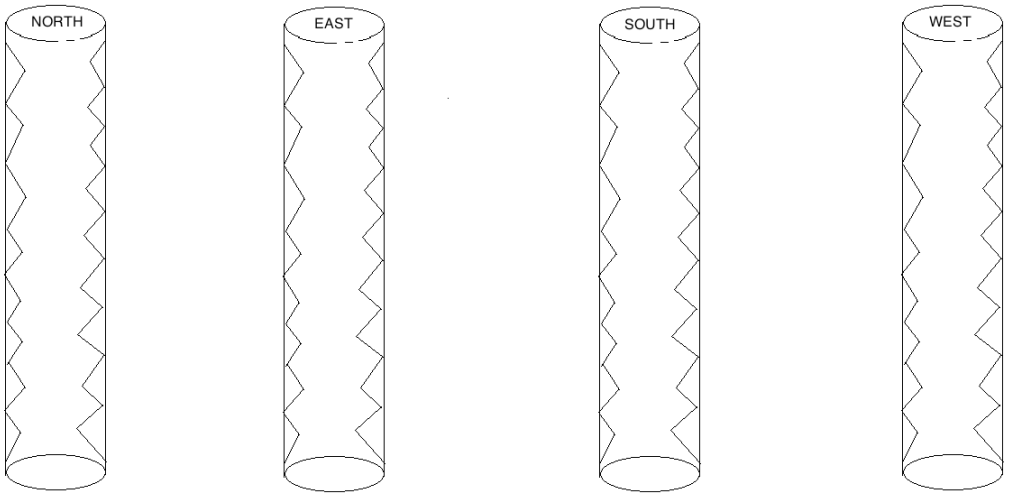
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #6

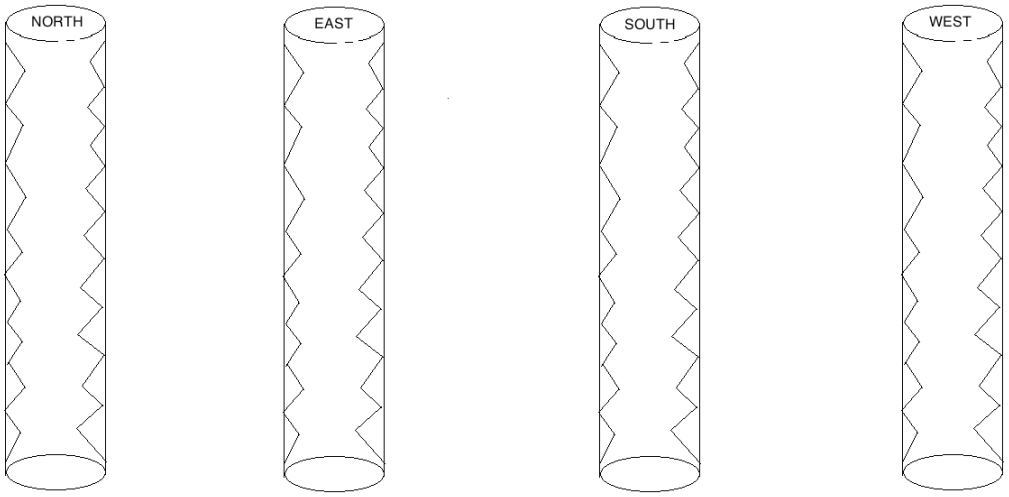
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #6

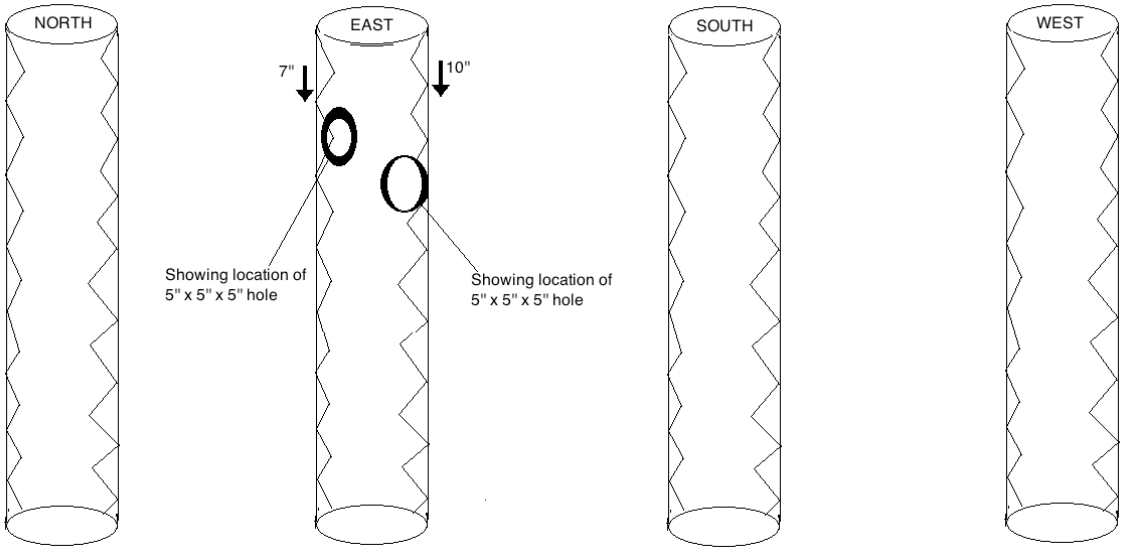
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted was a 5'' long by 5'' wide by 5'' deep hole, located 7'' and 10'' down from the bottom of the rectangular block.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #6

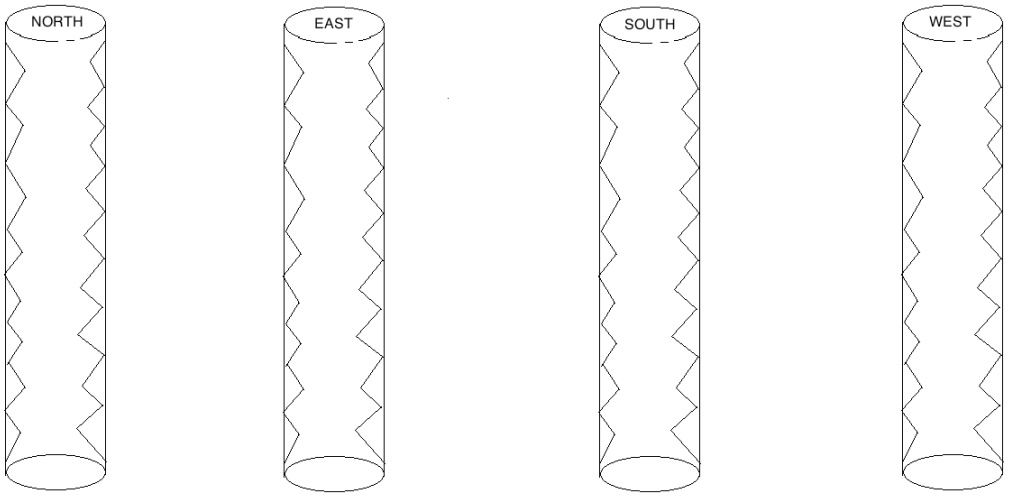
PILE #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #6

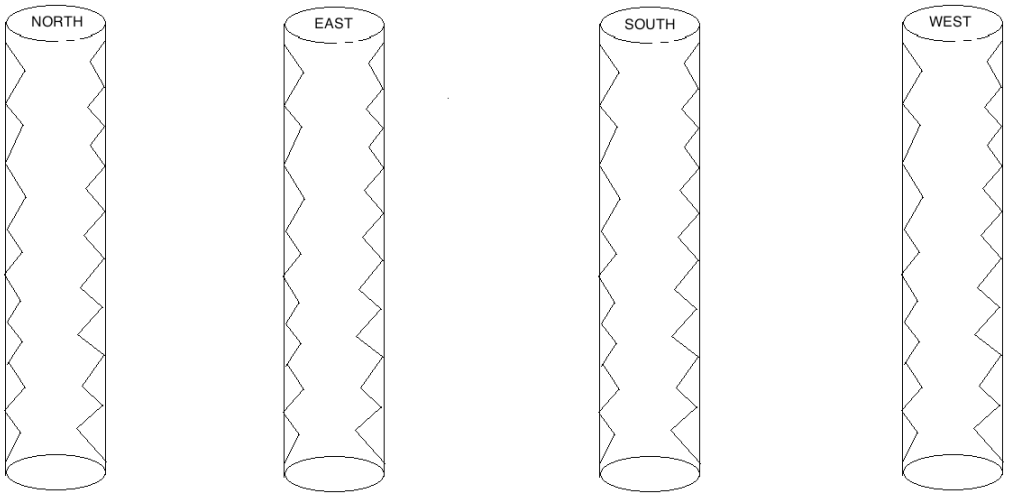
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #6

PILE #6

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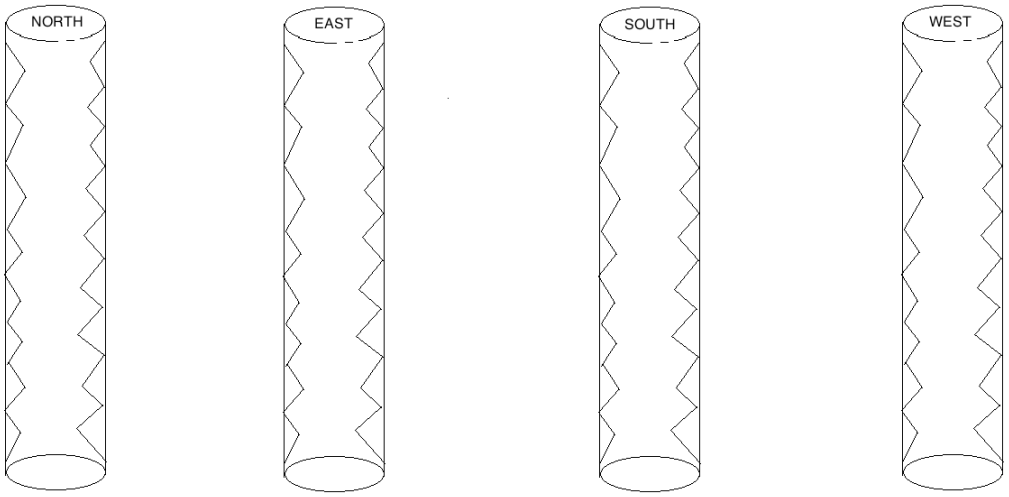
East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #6

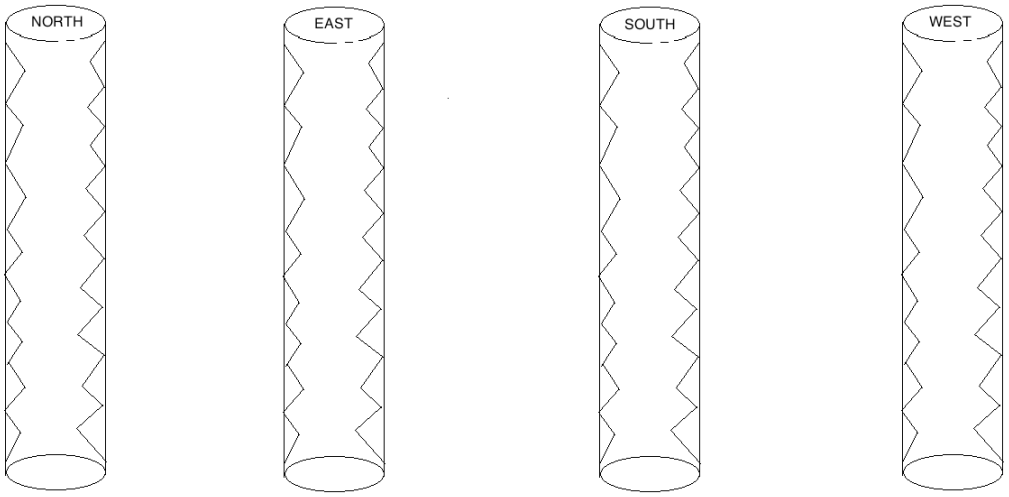
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #6

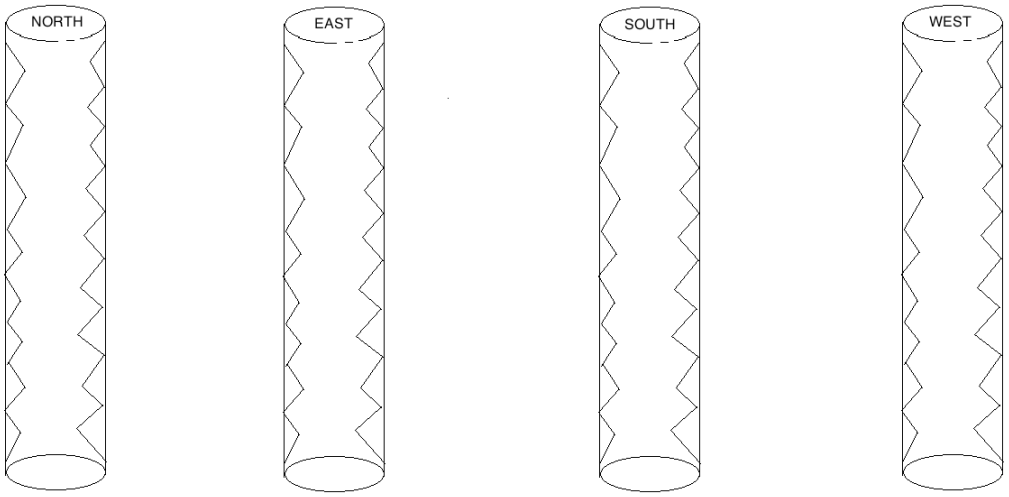
PILE #8

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

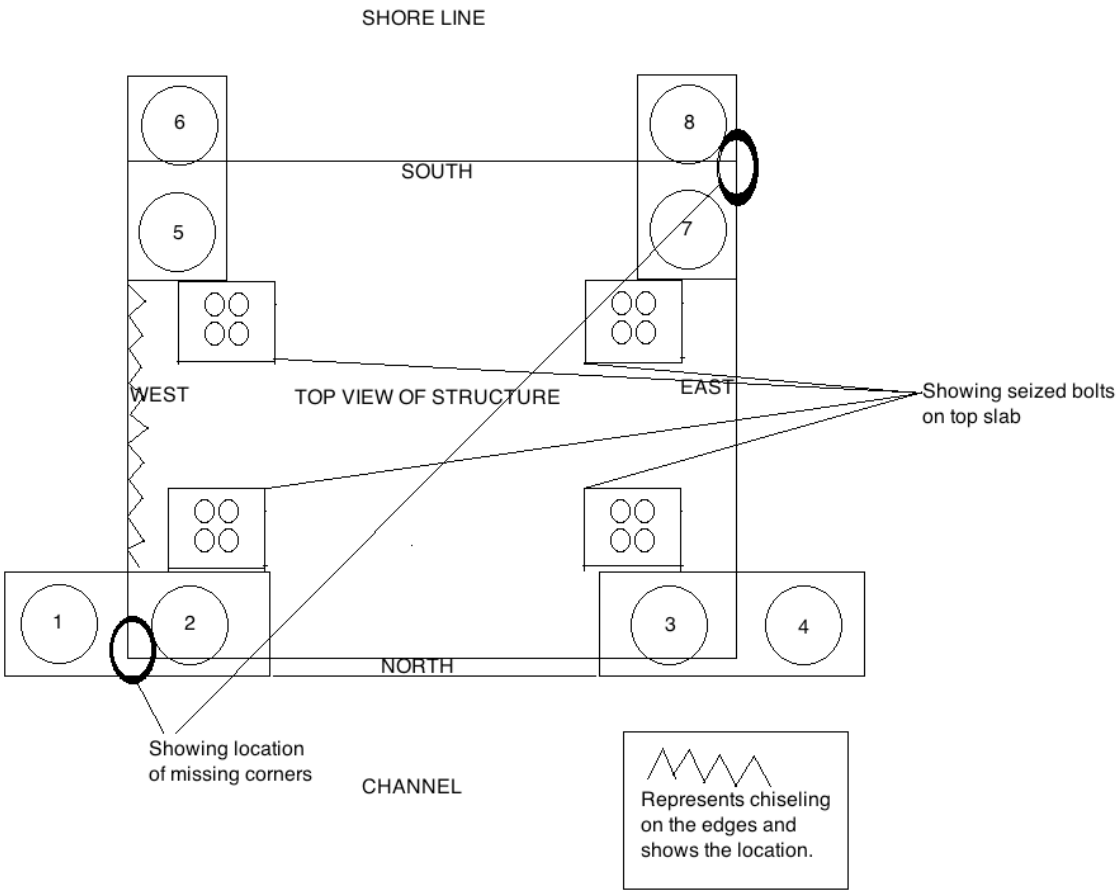
South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.




DANGER
LOADING
IN
PROGRESS

MOORING STRUCTURE #7



Top slab

WATERLINE TO MUD LINE IS ROUGHLY 10' DEEP ON THE CHANNEL SIDE

Note all bolt sets are rusted and appeared seized.

The west top edge of the top slab has chiseling and deterioration.

The northwest and the southeast corner have chipped away on the top slab.

MOORING STRUCTURE #7

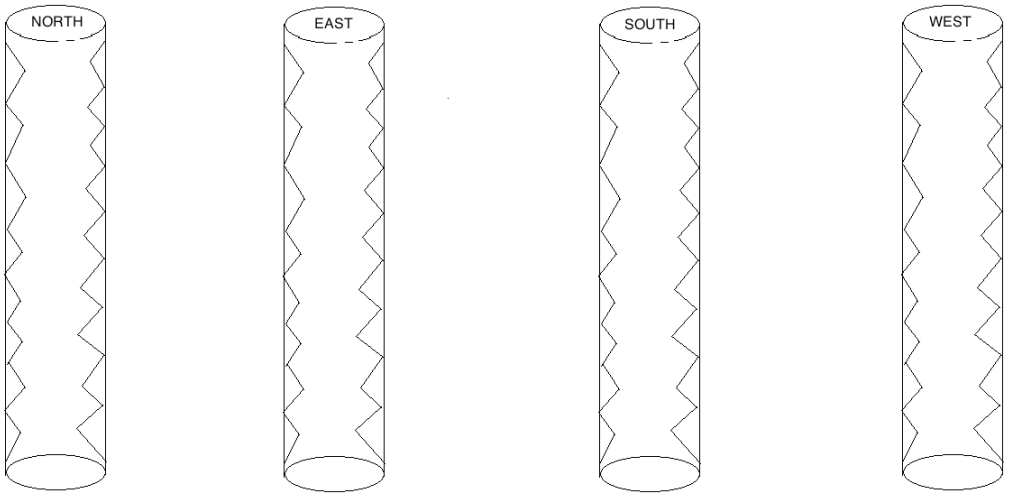
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #7

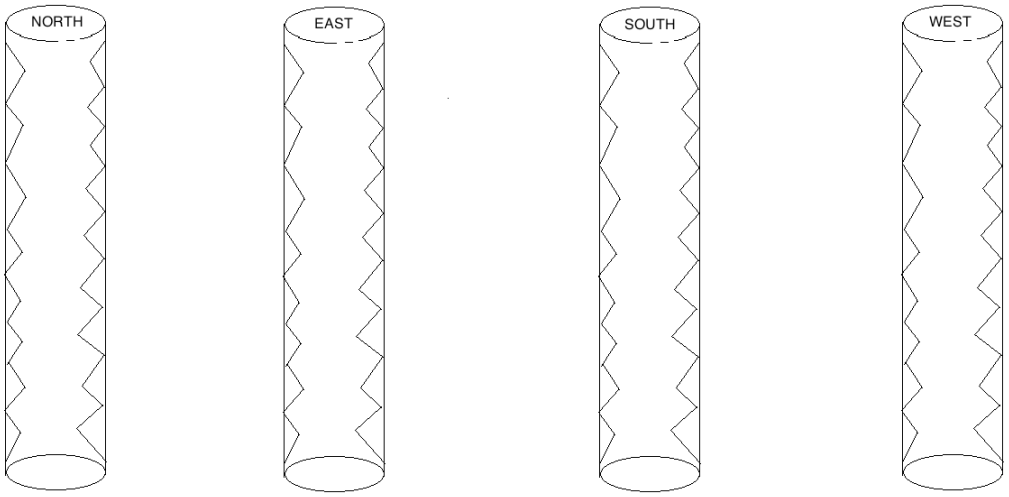
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #7

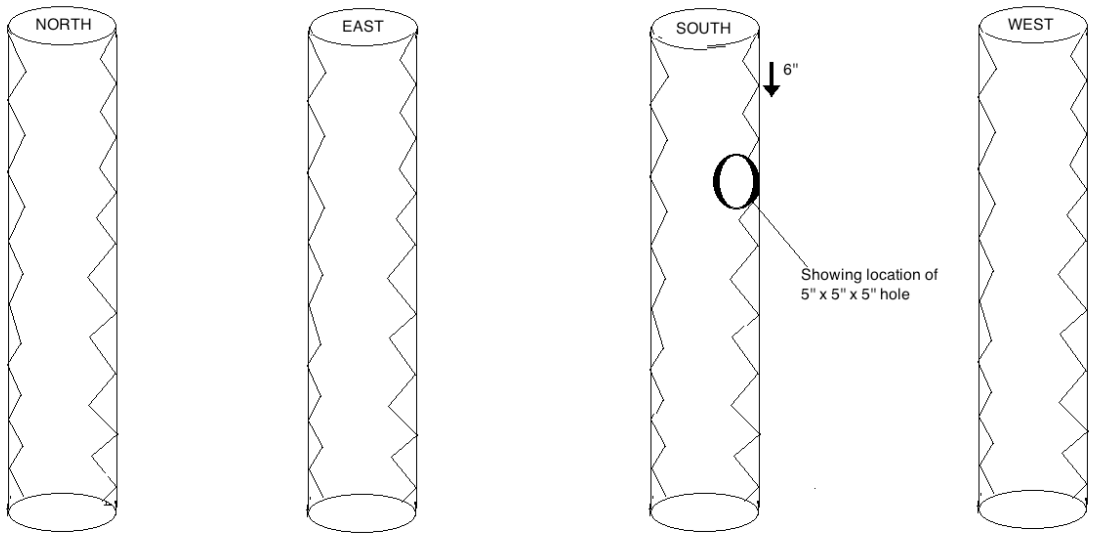
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 5'' long by 5'' wide by 5'' deep hole located 6'' below the bottom of the rectangular block.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #7

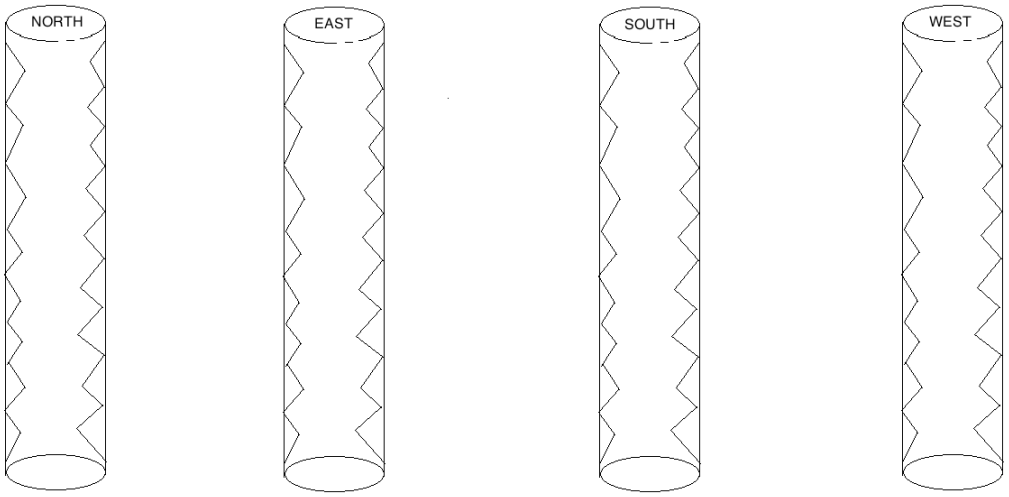
PILE #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #7

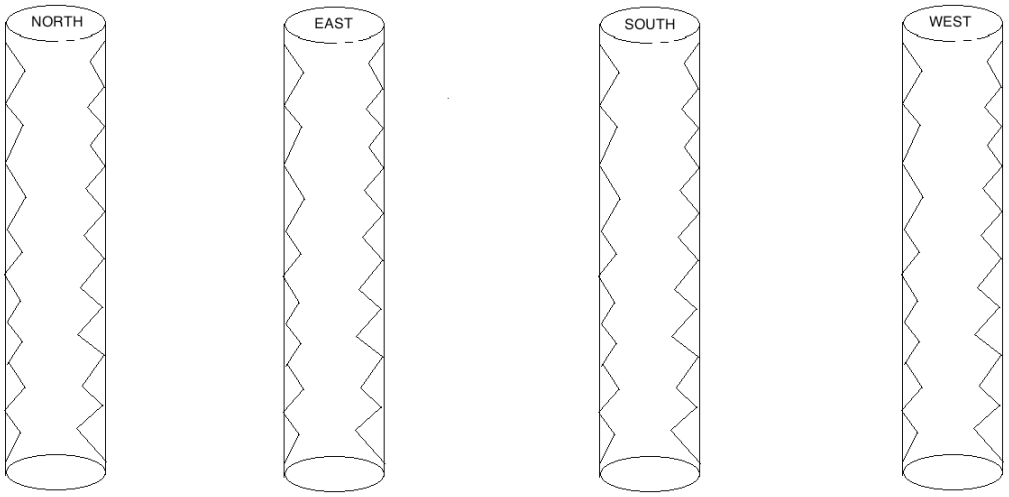
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #7

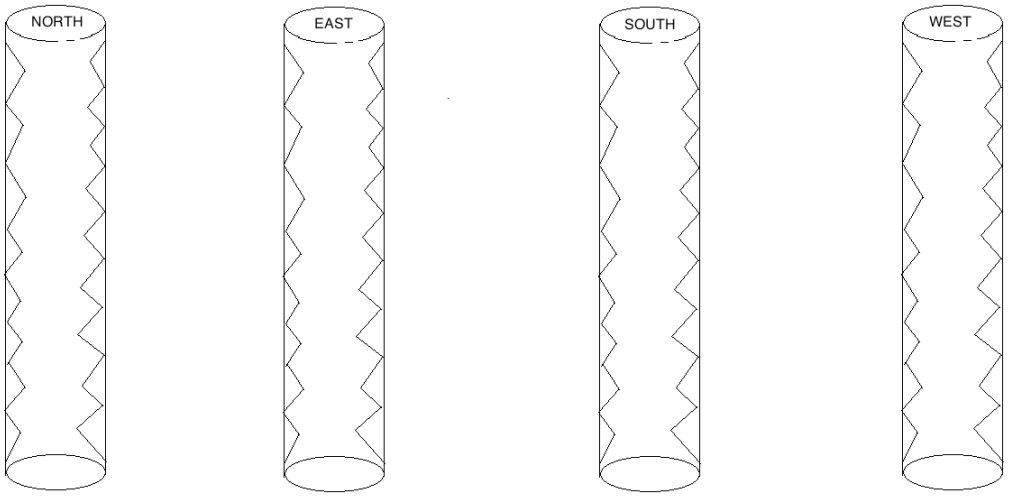
PILE #6

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #7

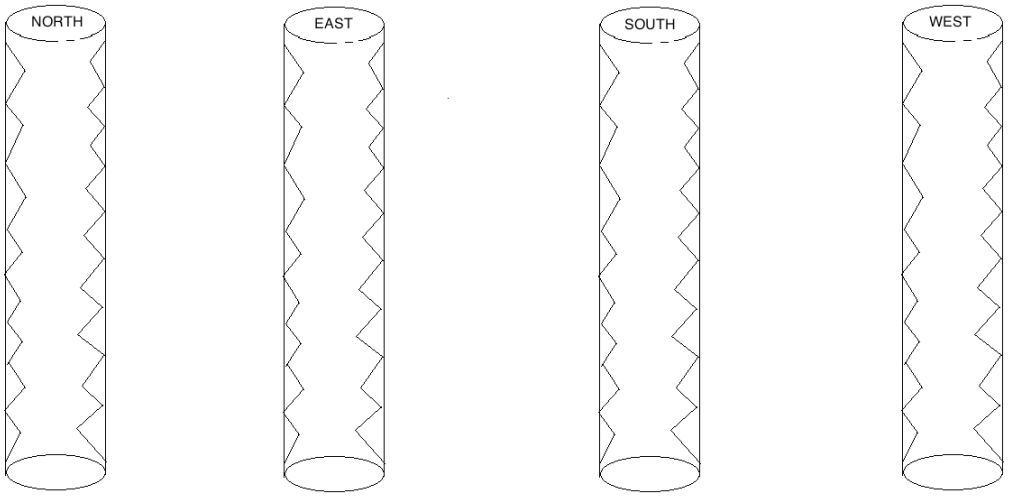
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



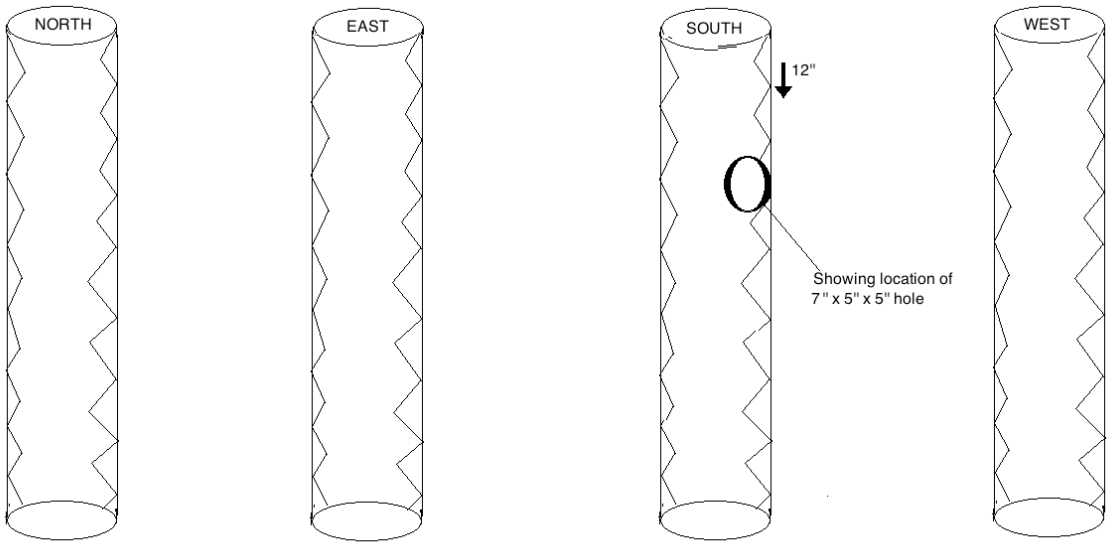
PILE #8

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

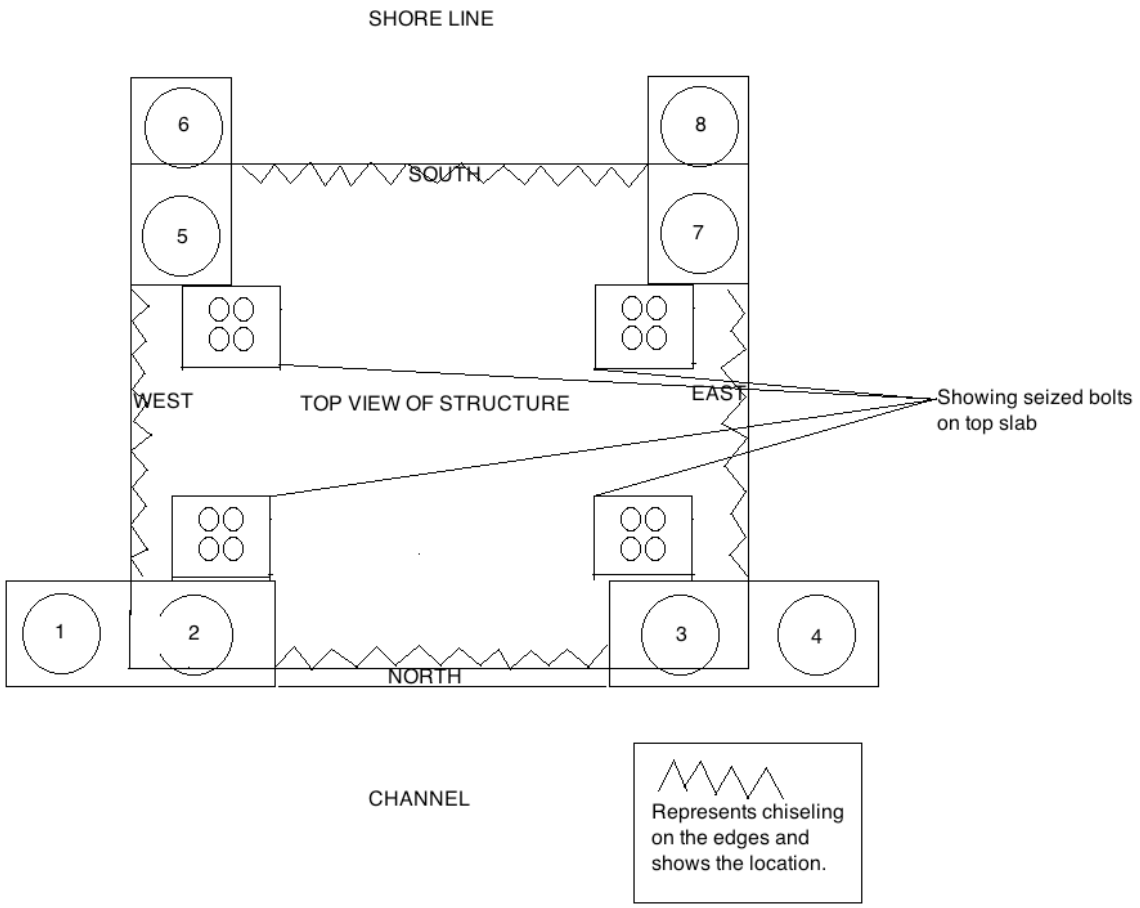
East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 7'' long by 5'' wide by 5'' deep, located 12'' below the bottom of the rectangular block.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #8



Top slab

WATERLINE TO MUD LINE IS ROUGHLY 10’ DEEP ON THE CHANNEL SIDE

Note all blot sets are rusted and appeared seized.

Chiseling has occurred on all top edges on all sides of the top slab.

MOORING STRUCTURE #8

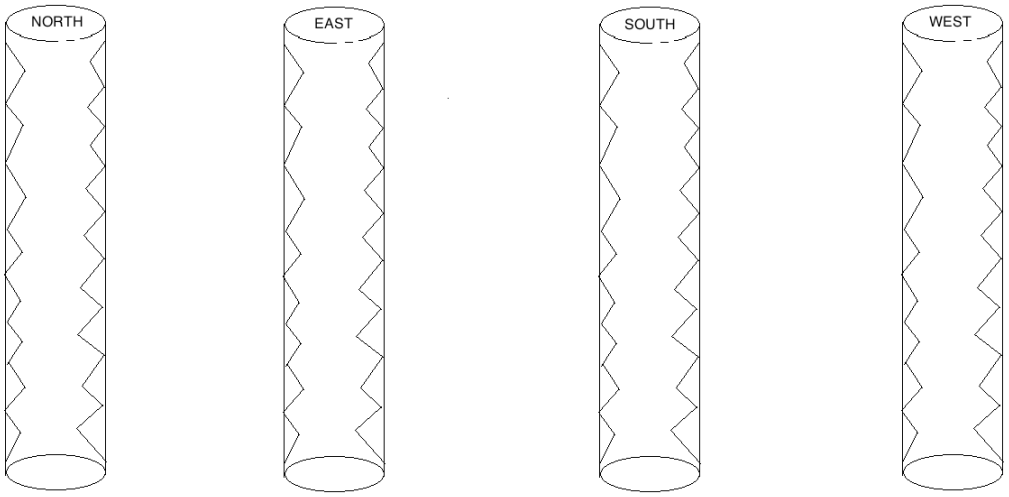
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #8

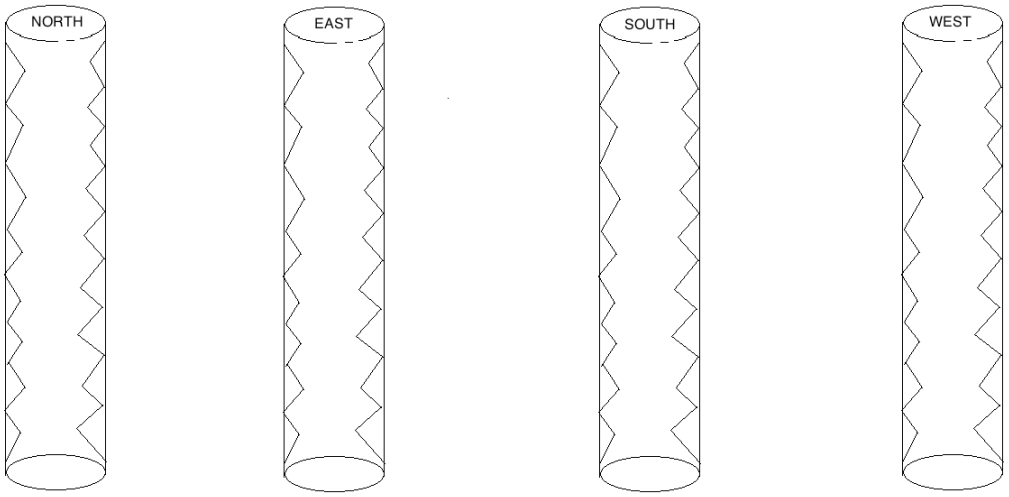
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #8

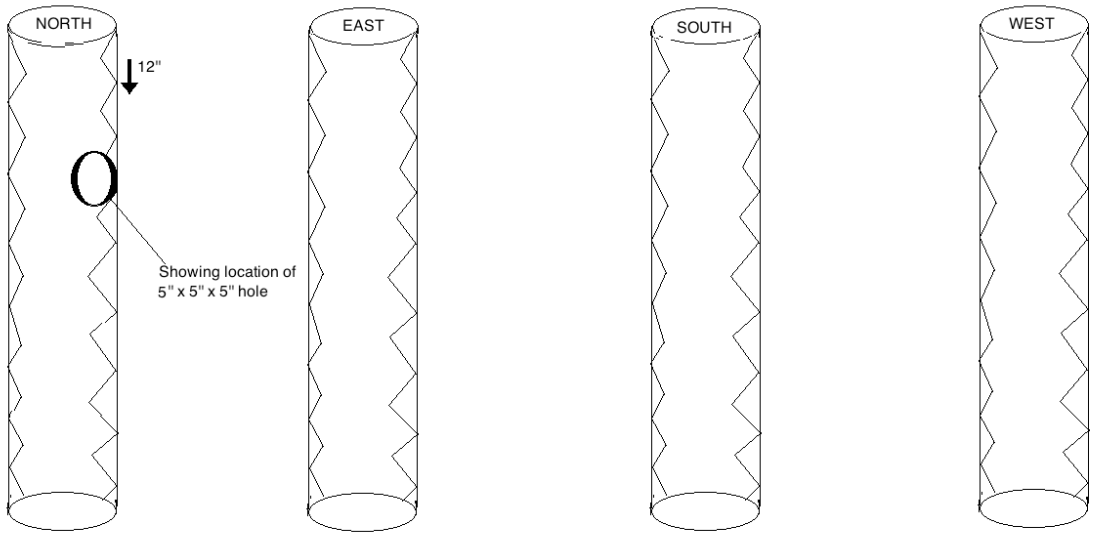
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 5'' long by 5'' wide by 5'' deep hole, located 12'' below the bottom of the rectangular block.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #8

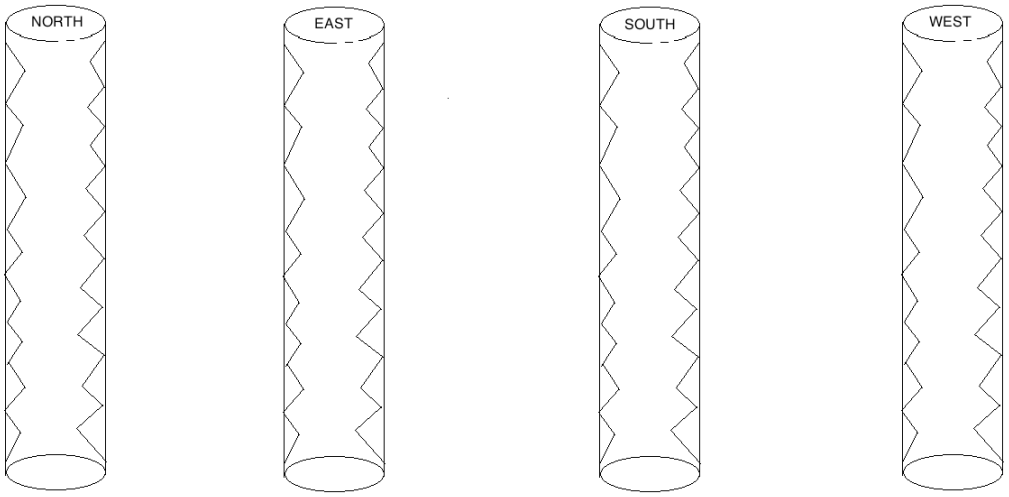
PILE #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #8

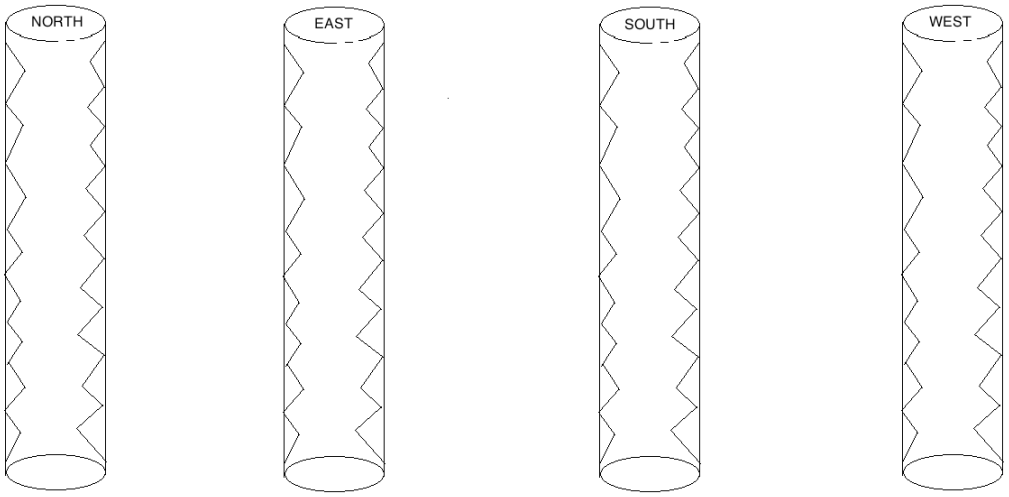
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #8

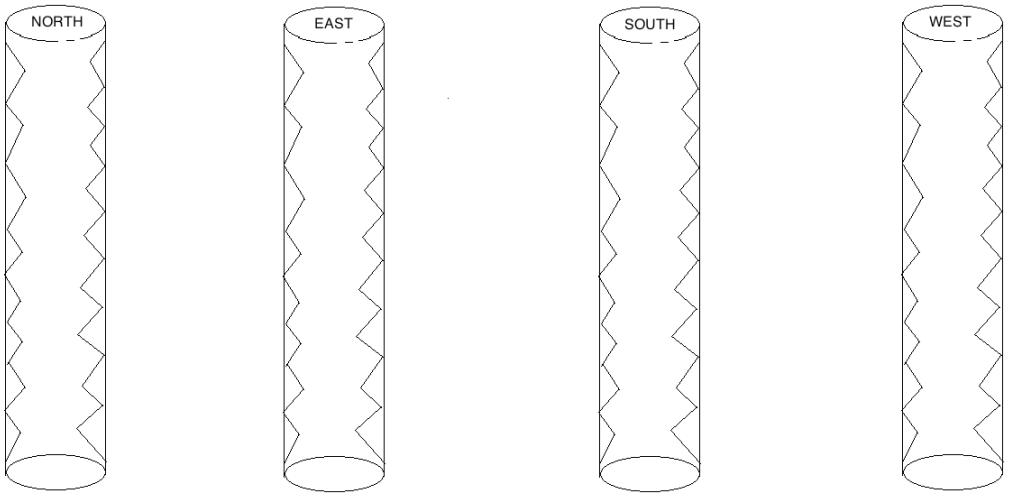
PILE #6

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #8

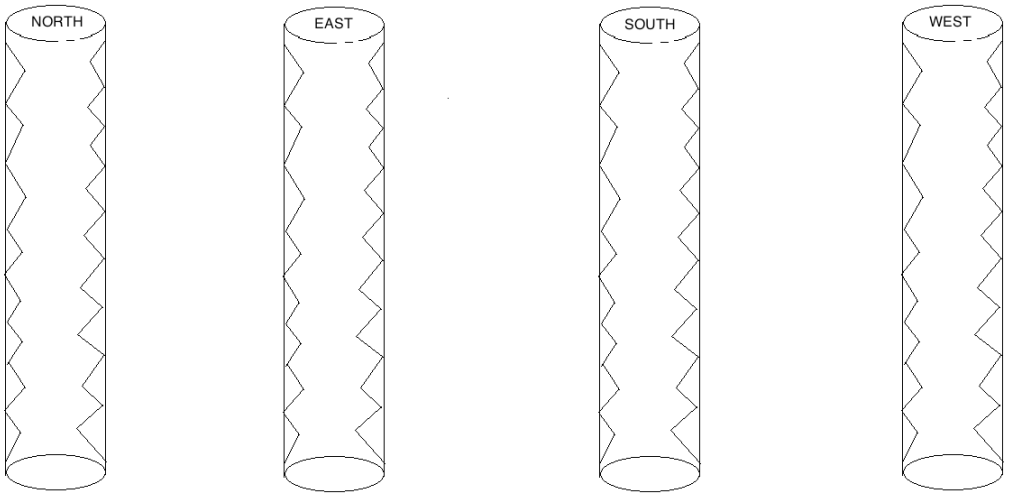
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #8

PILE #8

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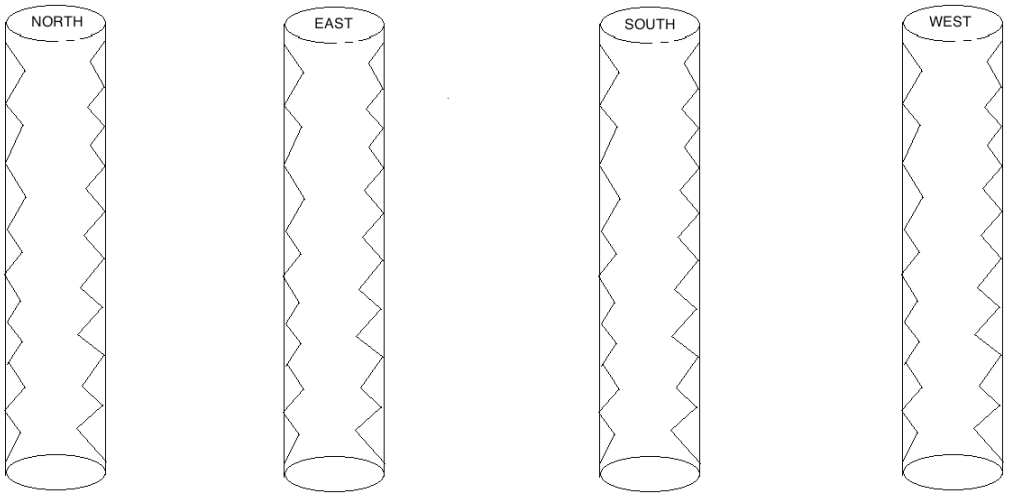
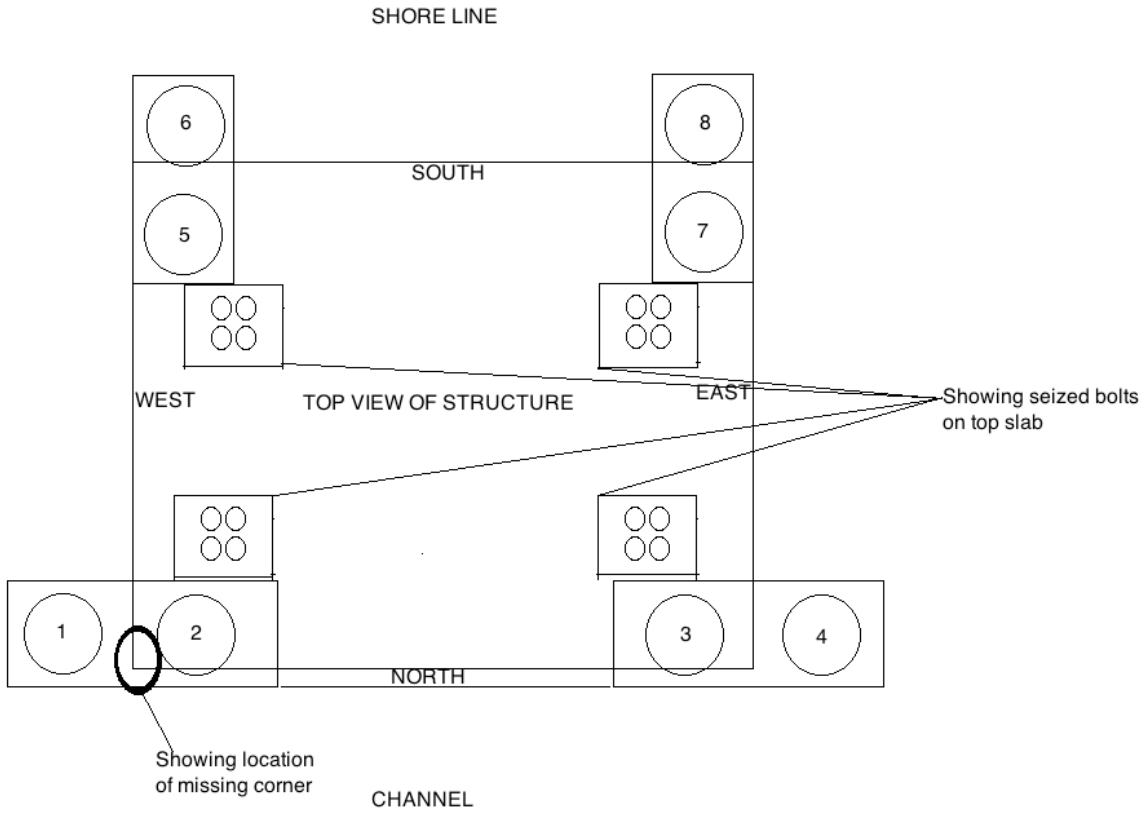
East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STURCTURE #9



Top Slab

WATERLINE TO MUD LINE IS ROUGHLY 10’ DEEP ON THE CHANNEL SIDE

Note, all bolt sets are rusted and appeared seized.

Northwest corner has been chipped away as shown in above illustration.

MOORING STURCTURE #9

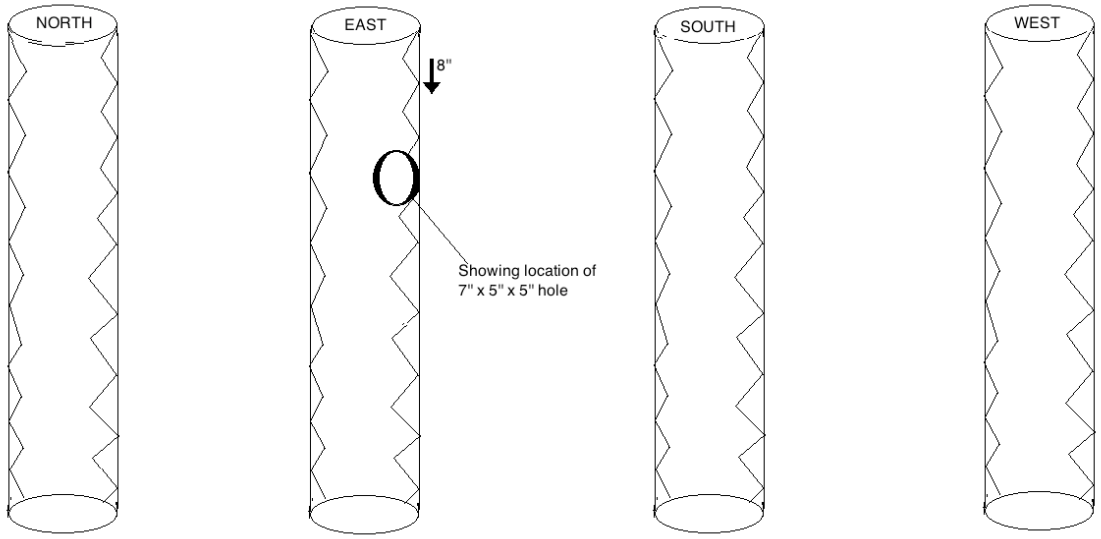
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 7'' long by 5'' wide by 5'' deep hole, located 8'' below the bottom of the rectangular block.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STURCTURE #9

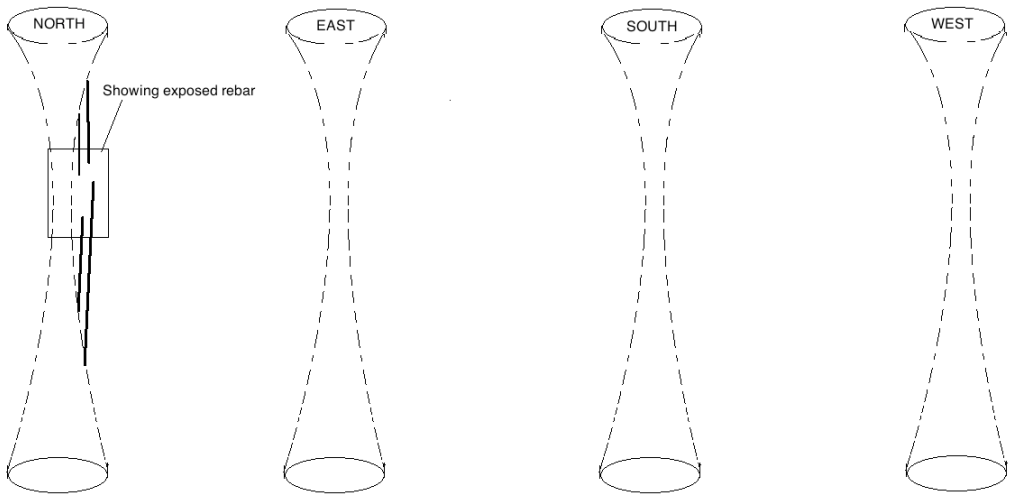
Pile #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Pile formed an hourglass shape as noted in illustration and showing exposed rebar. This is a sign of structural failure.



MOORING STURCTURE #9

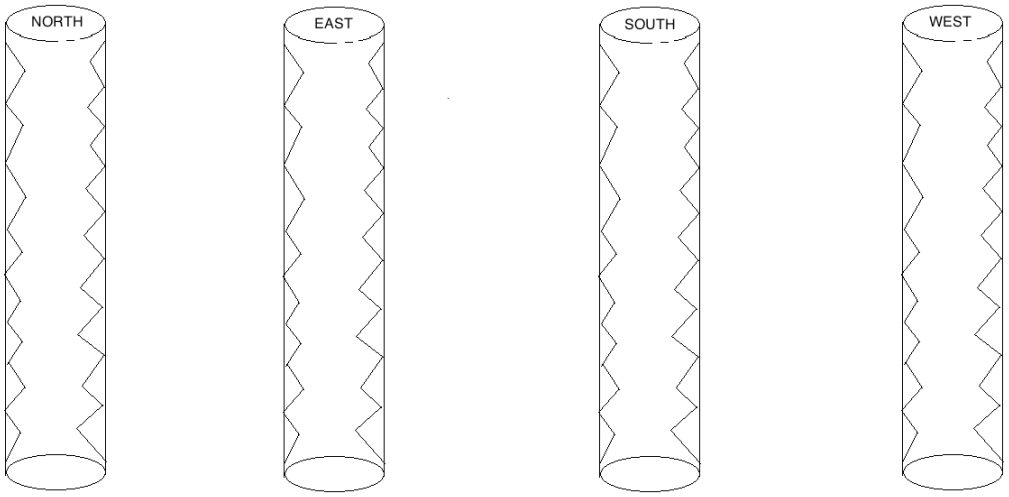
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STURCTURE #9

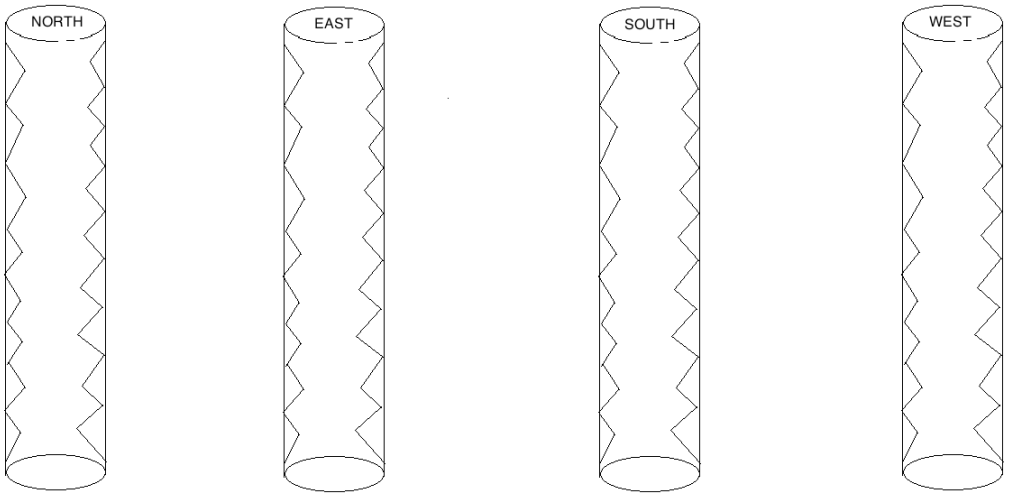
PILE #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STURCTURE #9

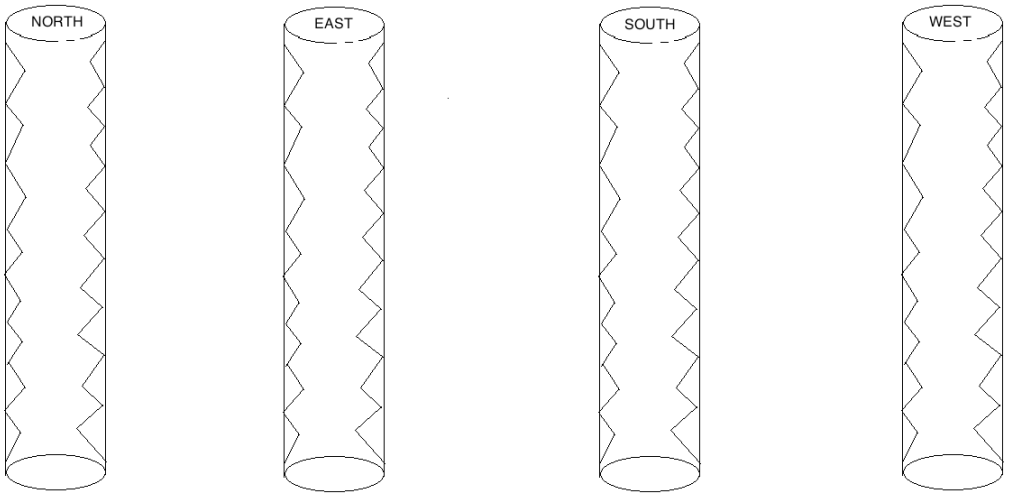
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STURCTURE #9

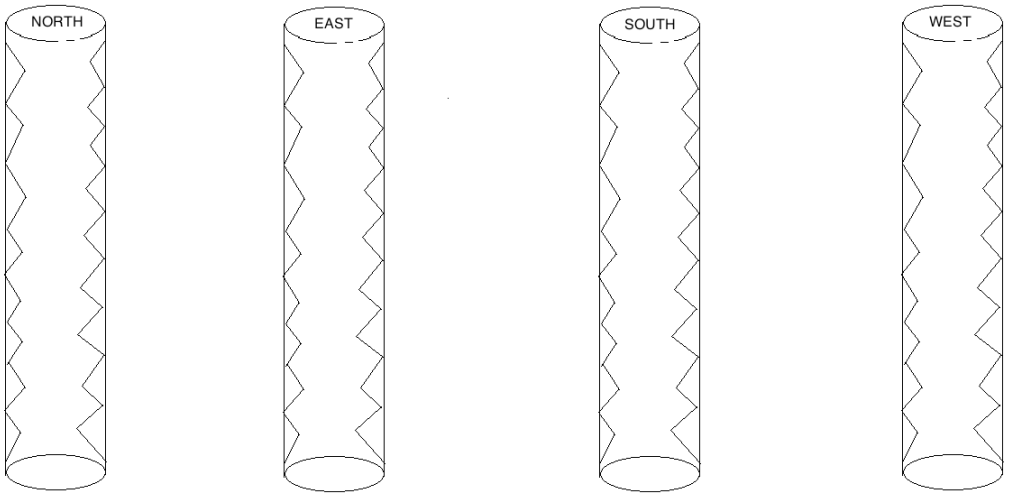
PILE #6

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STURCTURE #9

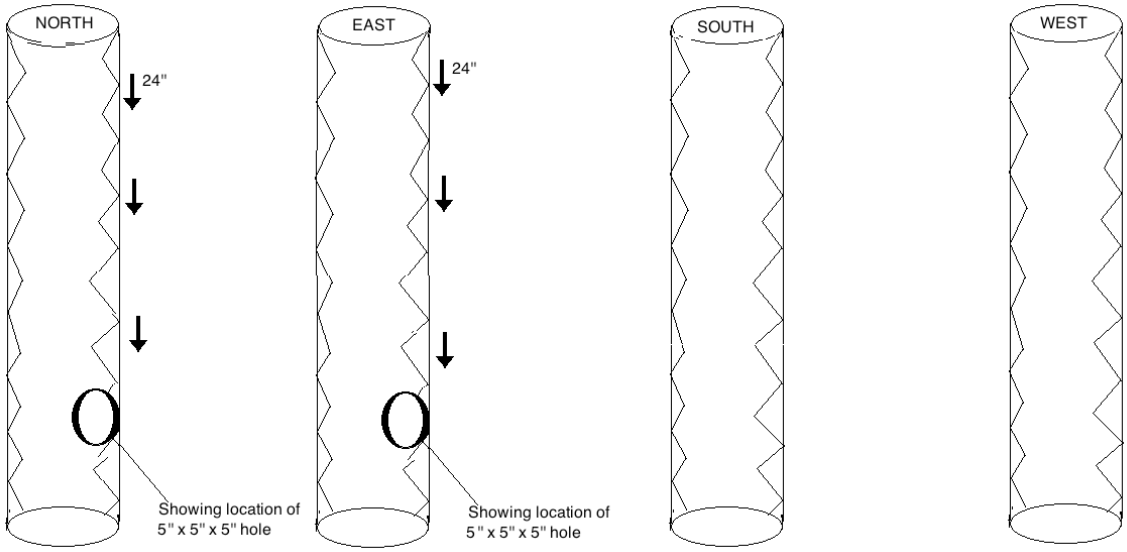
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 5'' long by 5'' wide by 5'' deep hole, located 24'' below the bottom of the rectangular block.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. . Also, note the 5'' long by 5'' wide by 5'' deep hole, located 24'' below the bottom of the rectangular block.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STURCTURE #9

PILE #8

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

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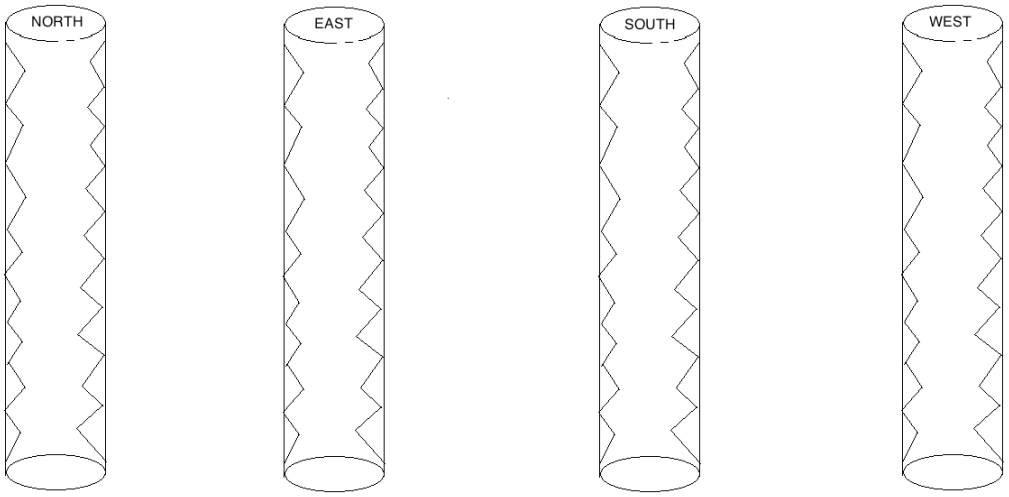
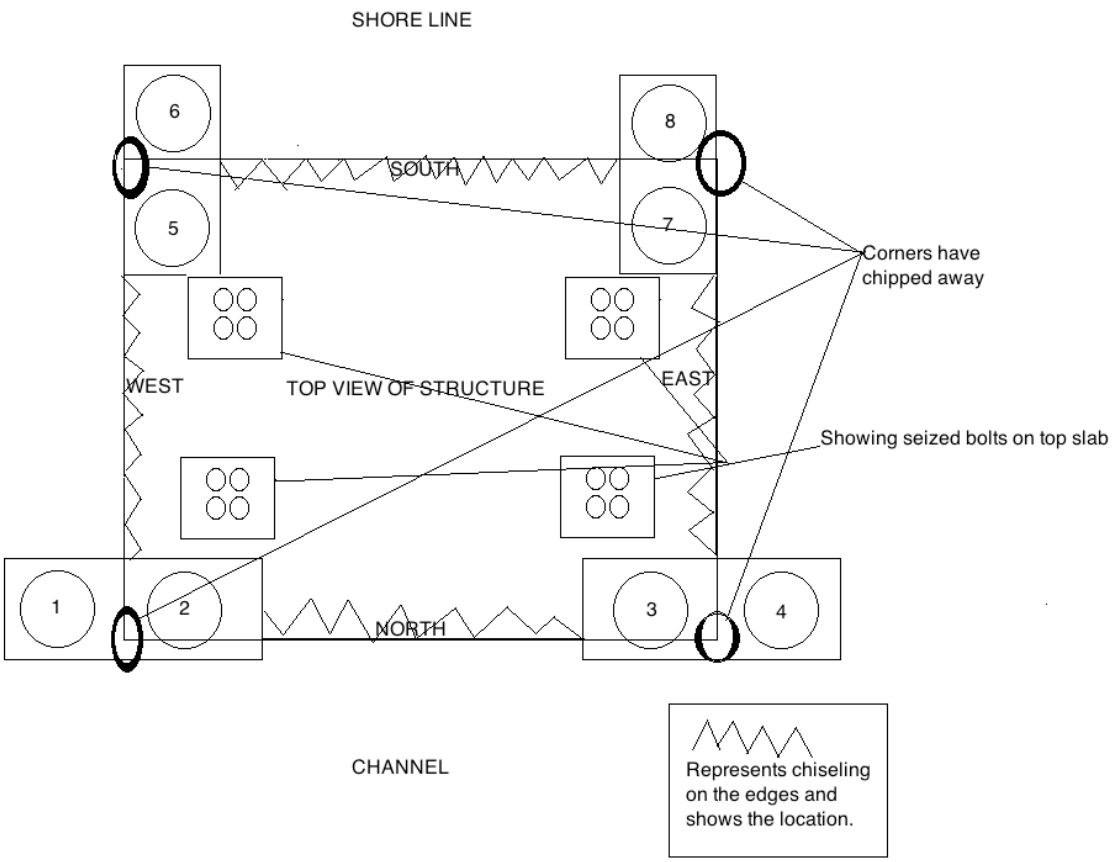
West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.




MTC 704

MOORING STRUCTURE #10



Top slab

WATERLING TO MUD LINE IS ROUGHLY 10’6’’ DEEP ON THE CHANNEL SIDE

Note all bolt sets are rusted and appeared seized.

All four corners have been chipped away along with chiseling on all four top edges on the top slab.

Debris was found submersed under the structure and consisted of logs, steel scrap and wire rope.

MOORING STRUCTURE #10

PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

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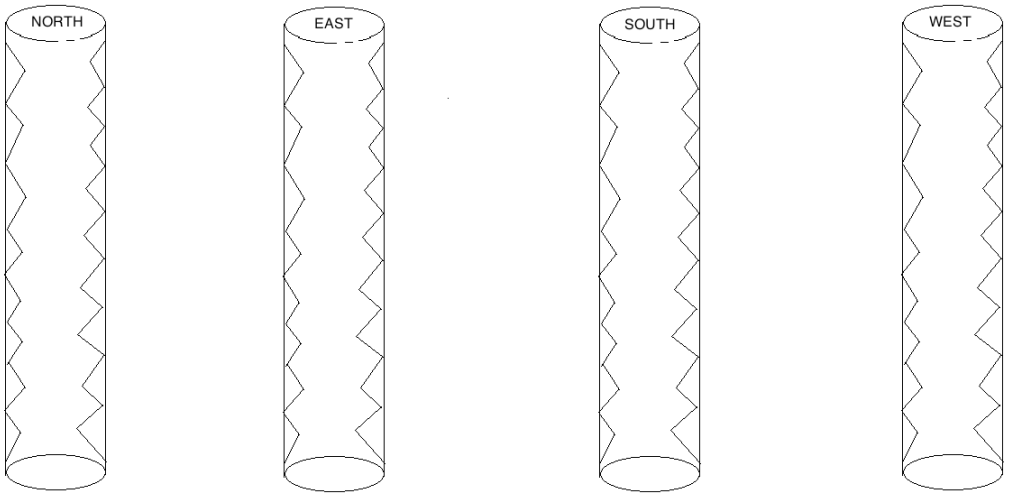

MOORING STRUCTURE #10

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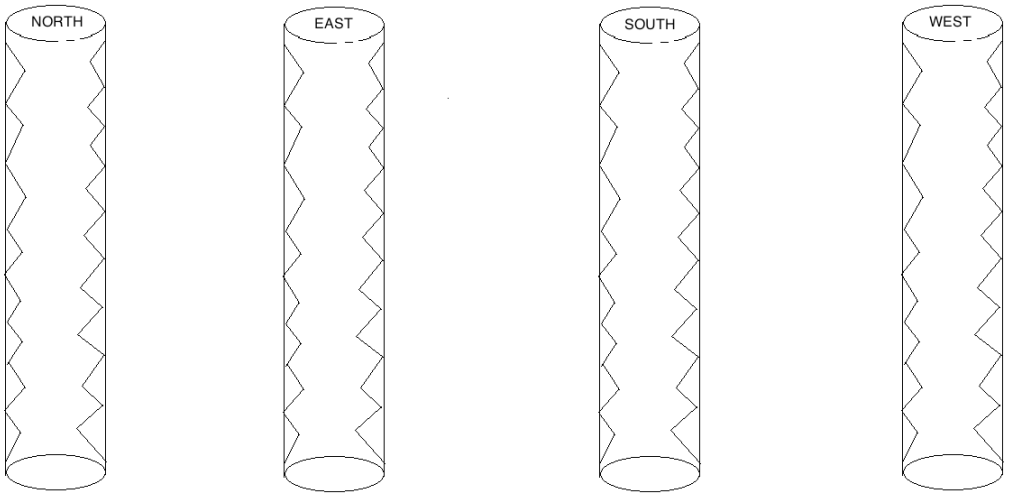

MOORING STRUCTURE #10

PILE #3

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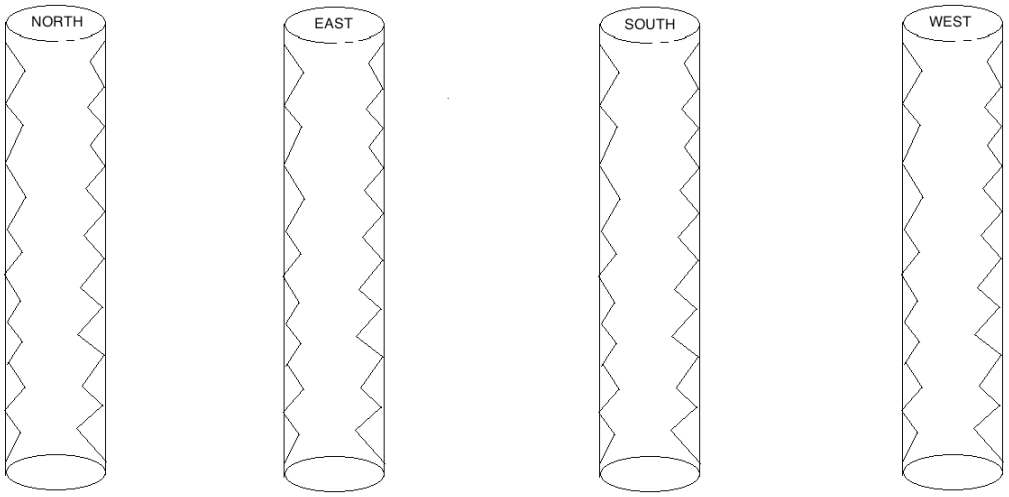
West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



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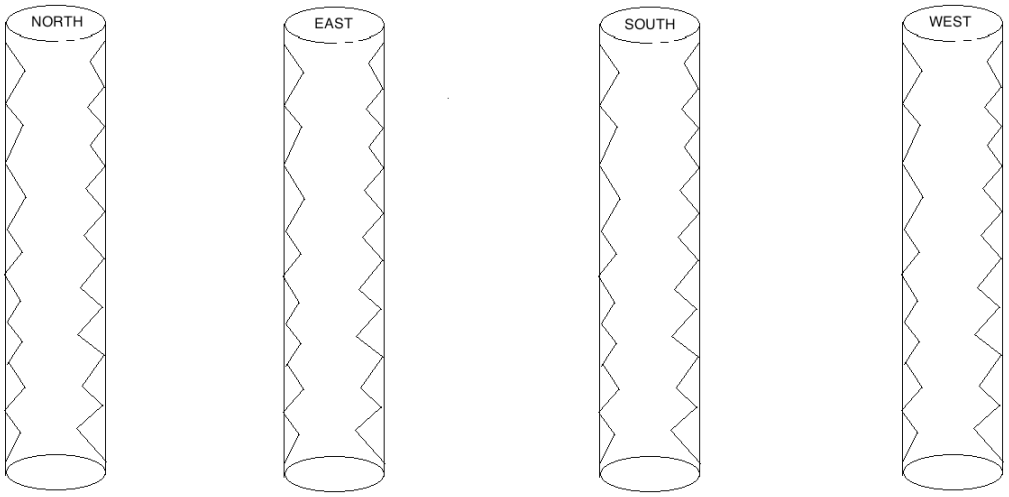

MOORING STRUCTURE #10

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East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

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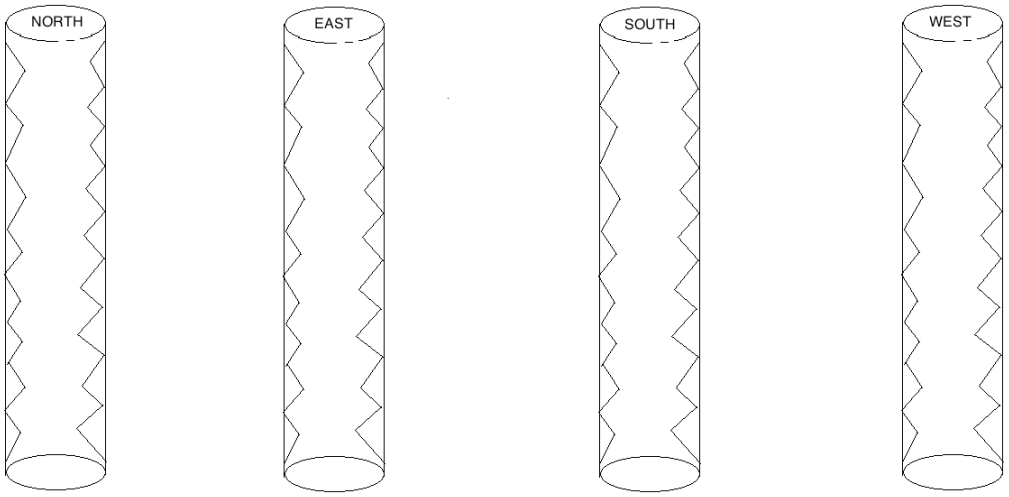
West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #10

PILE #6

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East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

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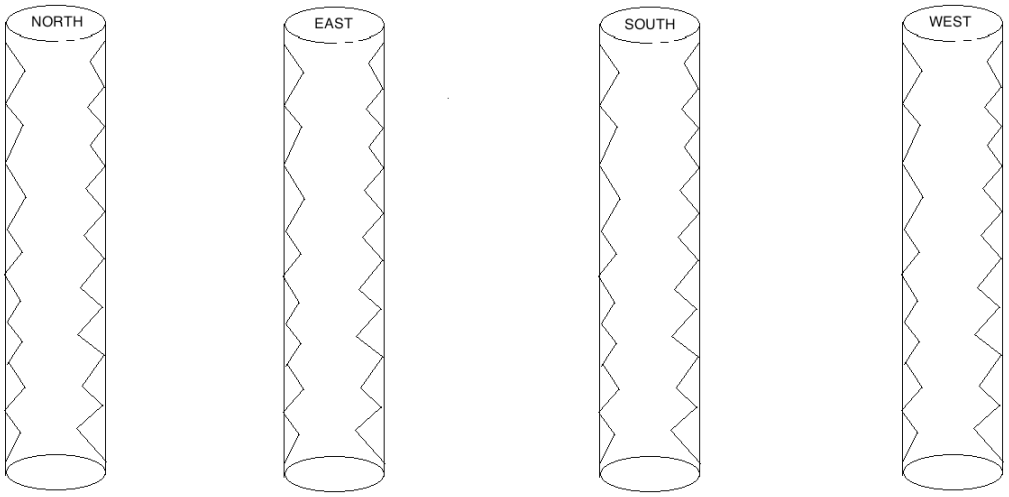

MOORING STRUCTURE #10

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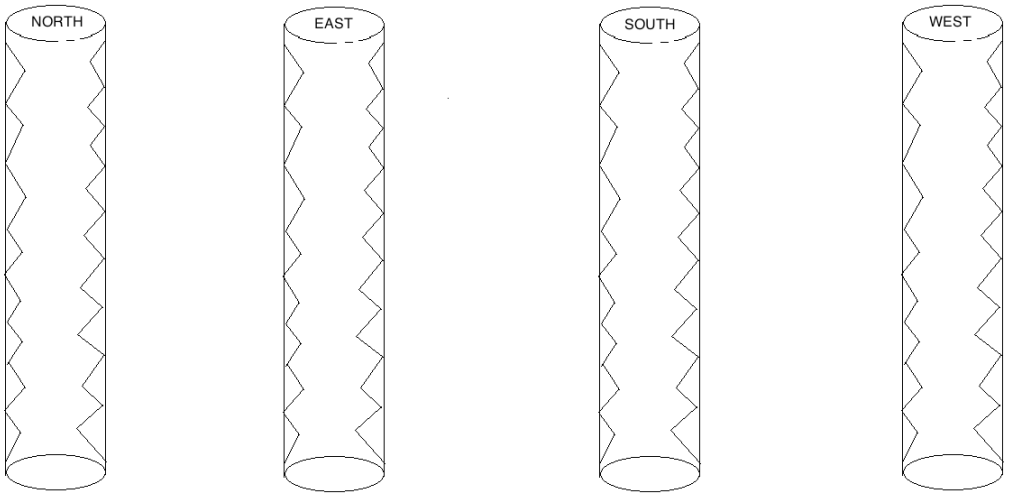

MOORING STRUCTURE #10

PILE #8

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East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

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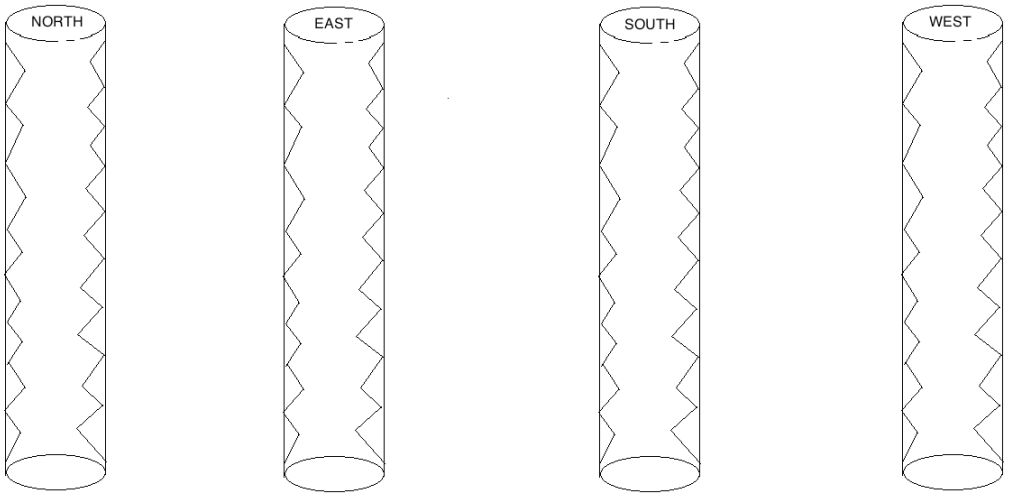
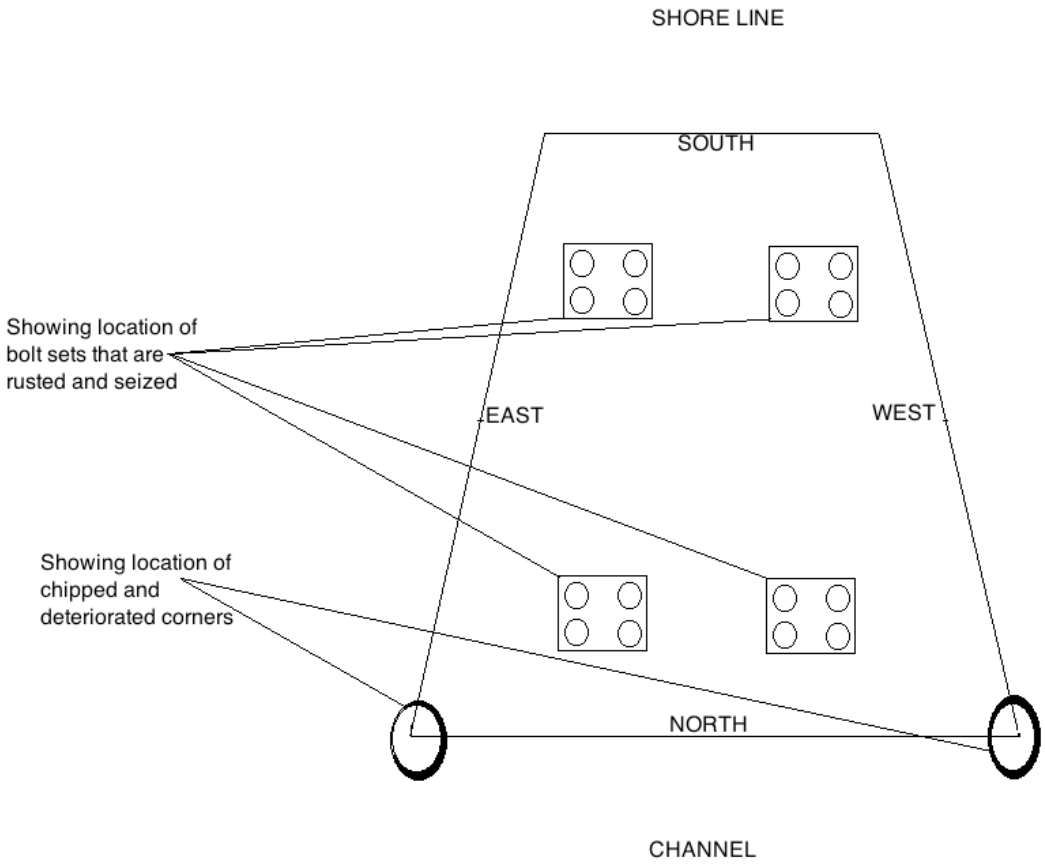


MOORING STRUCTURE #11



Top slab

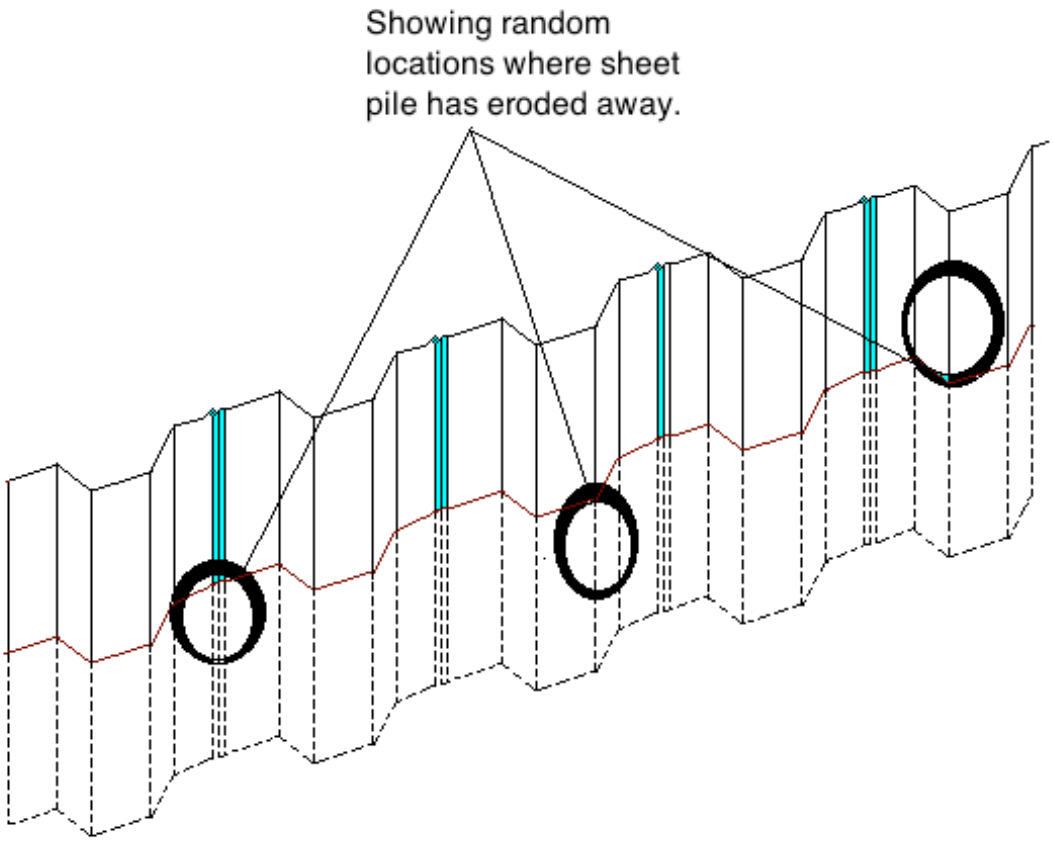
WATERLINE TO MUD LINE IS ROUGHLY 10' 6'' DEEP ON CHANNEL SIDE

This top slab is a different design from mooring structures 1-10 and 12-15. The underneath of this mooring structure was inaccessible due to having been encased by interlocking sheet pile that extends beneath the mud line. There was erosion and deterioration to some areas of the sheet pile as soon on the next page.

Note all bolt sets are rusted and appeared seized.

The northwest and northeast corners have been chiseled away.

MOORING STRUCTURE #11



After inspection the sheet pile, we located various spots where the sheet pile has eroded away, exposing concrete from the inside. An inspection was done on the exposed concrete exposed. Our finding were that the concrete seemed to be in decent condition, meaning it was not in soft form and stayed intact when gripped by hand.

The surface was rough showing some signs of deterioration, but was still compressed up against the inside of the sheet pile.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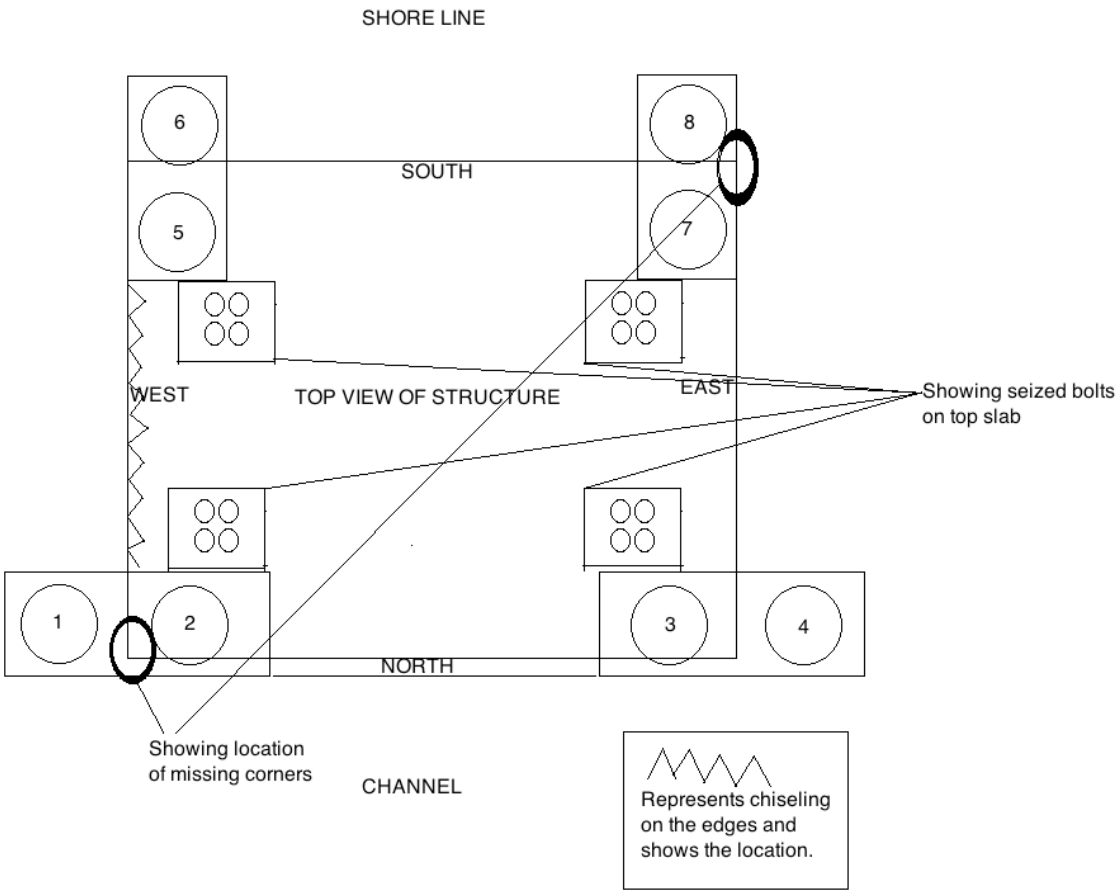
MOORING STRUCTURE #12



Top slab

WATERLINE TO MUD LINE IS ROUGHLY 10’6” DEEP ON THE CHANNEL SIDE

Note all bolt sets are rusted and appeared seized.

The northwest and southeast corners have ben chiseled away.

There is chiseling along the west top edge on the top slab.

Major debris was found under and all around the structure and consisted of logs.

MOORING STRUCTURE #12

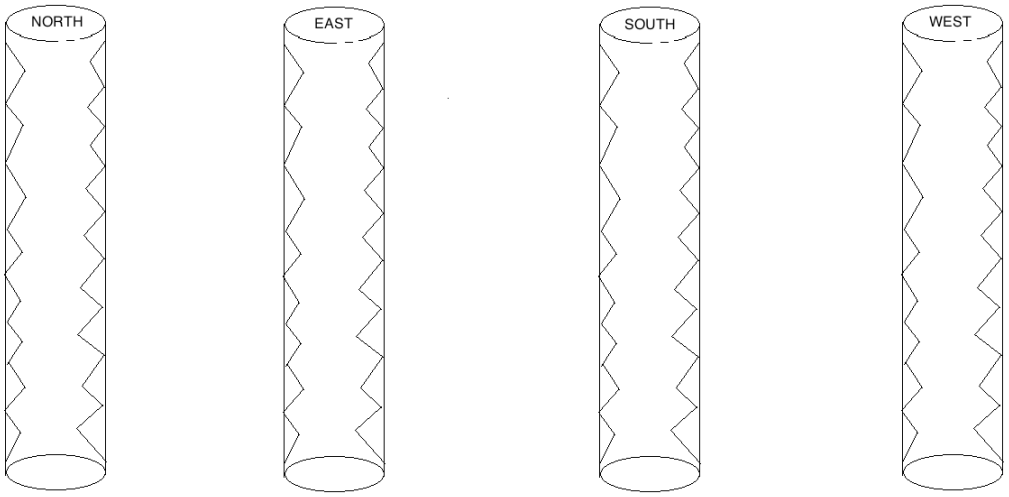
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #12

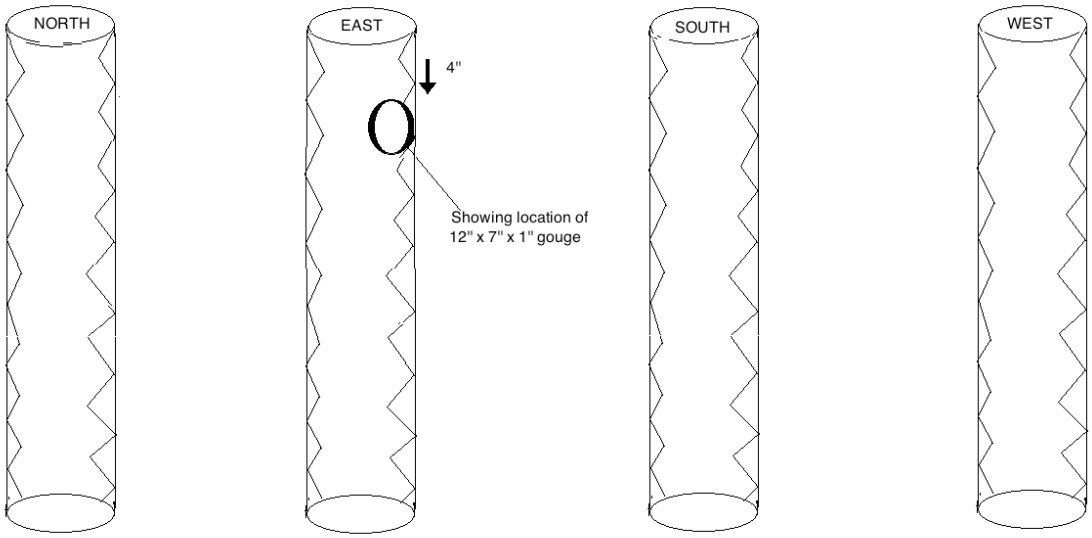
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 12'' long by 7'' wide by 1'' deep gouge, located 4'' below the rectangular block.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #12

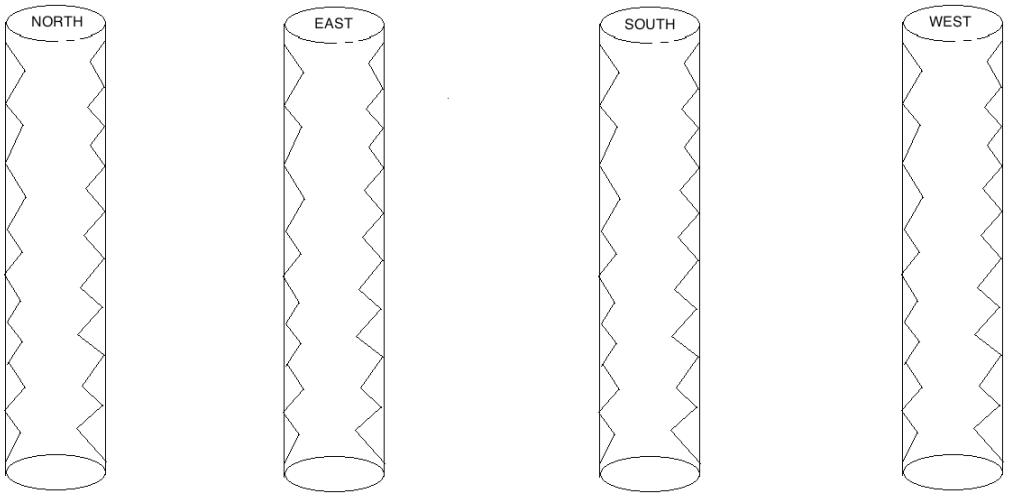
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #12

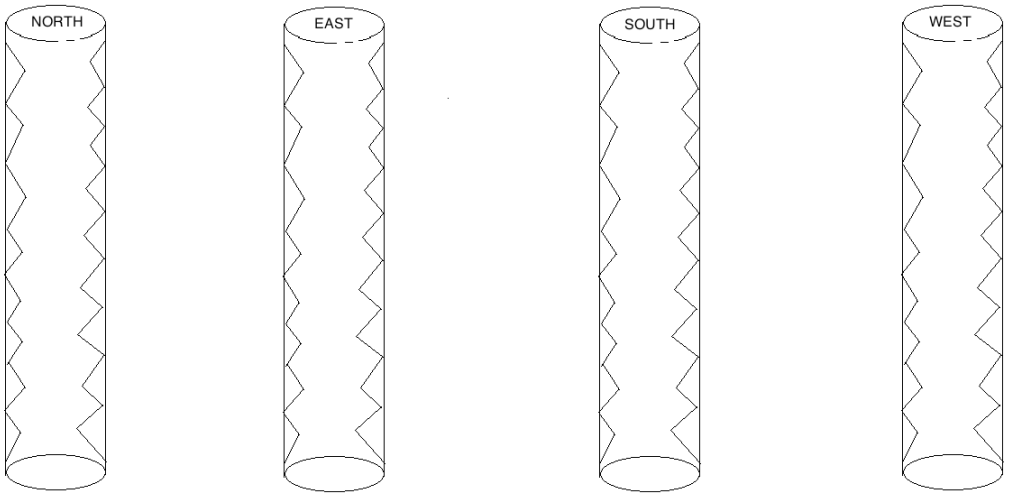
PILE #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #12

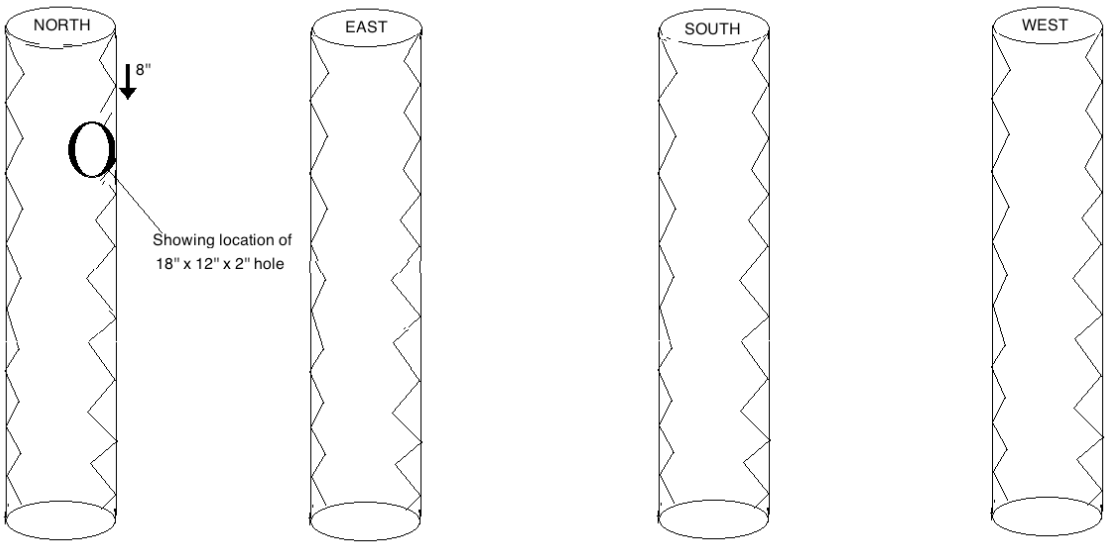
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 18'' long by 12'' wide by 2'' deep hole, located 8'' below the rectangular block.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #12

PILE #6

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East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

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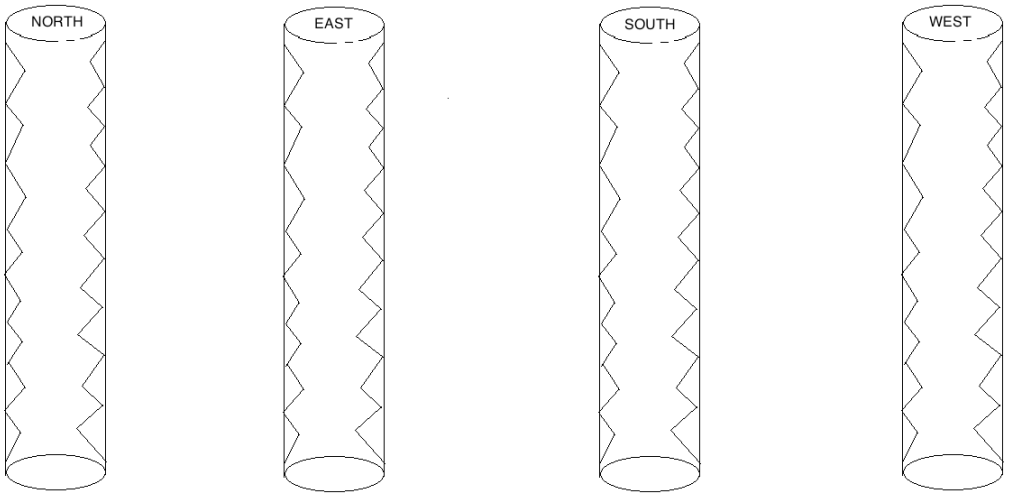

MOORING STRUCTURE #12

PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

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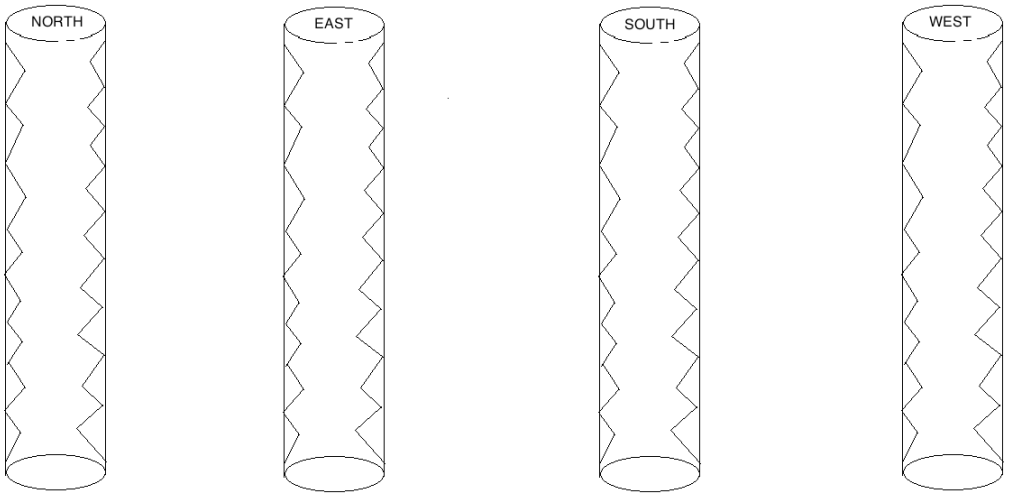

MOORING STRUCTURE #12

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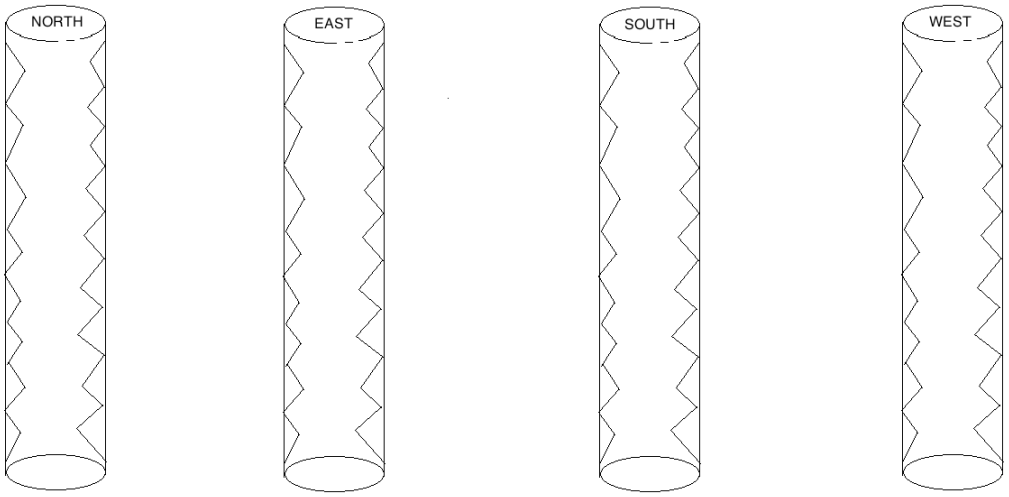
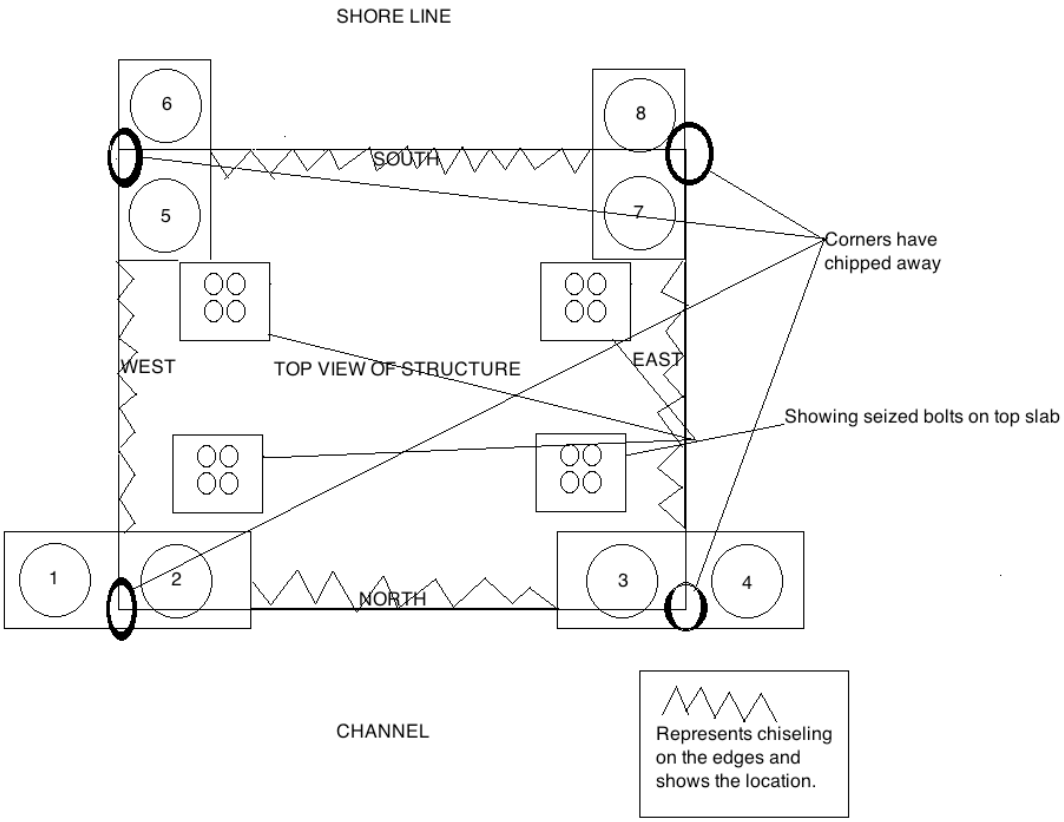


MOORING STRUCTURE #13



Top slab

WATERLINE TO MUDLINE IS ROUGHLY 10’ DEEP ON THE CHANNEL SIDE

Note all bolt sets were rusted and appeared seized.

Showed chiseling on all top edges of the top slab.

All four corners have chipped away on the top slab.

Debris was found submersed under the structure and all around and consisted of logs.

MOORING STRUCTURE #13

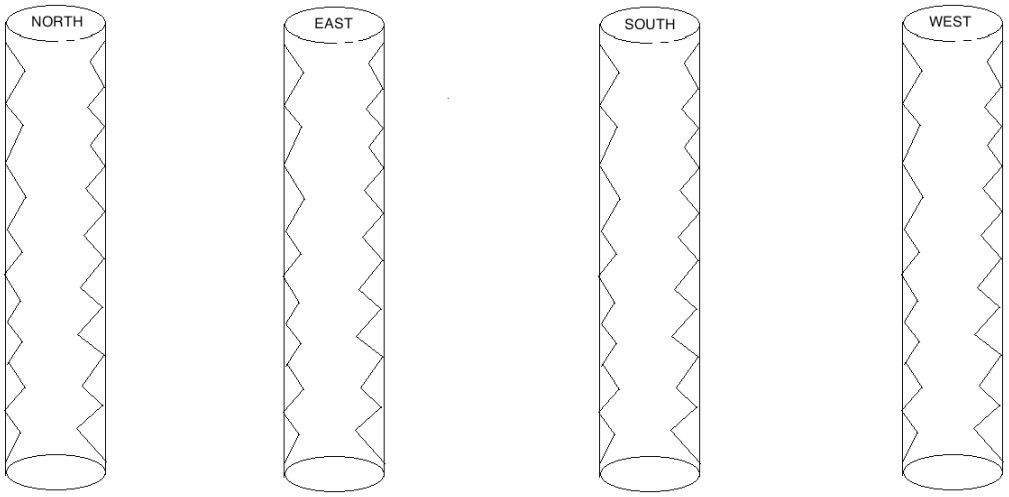
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #13

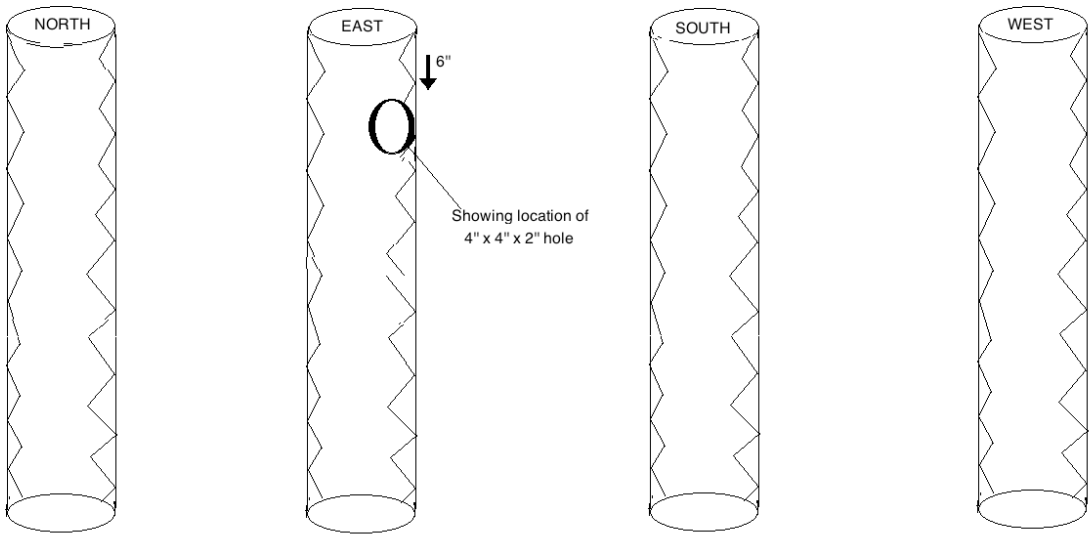
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 4'' long by 4'' wide by 2'' deep hole, located 6'' below the bottom of the rectangular block.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #13

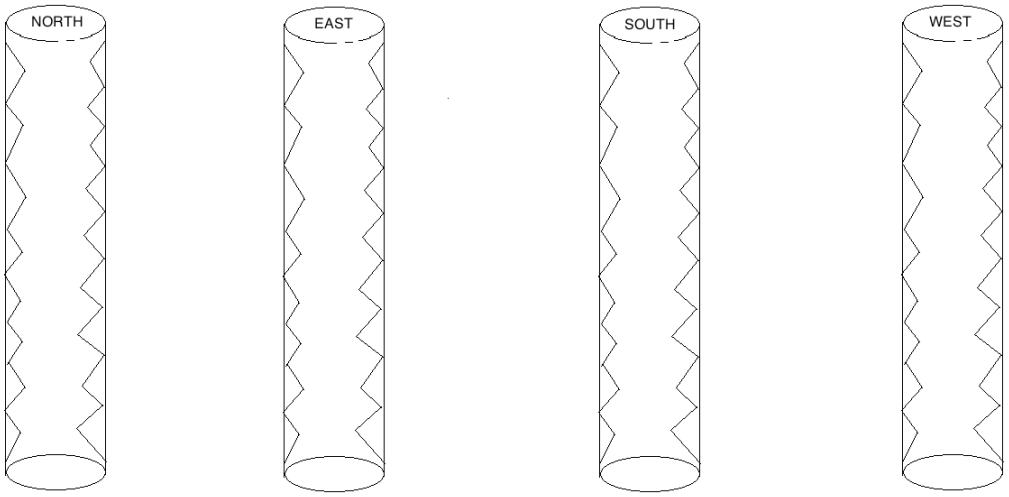
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #13

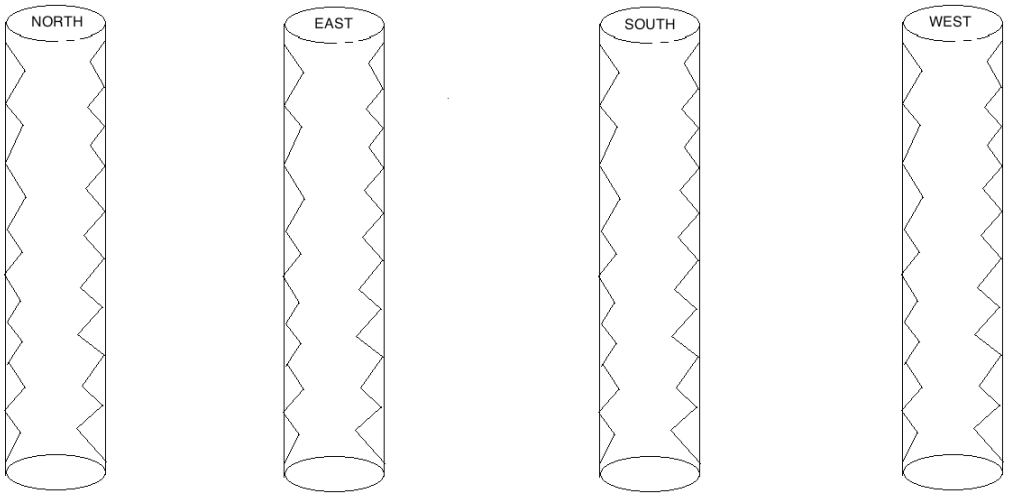
PILE #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #13

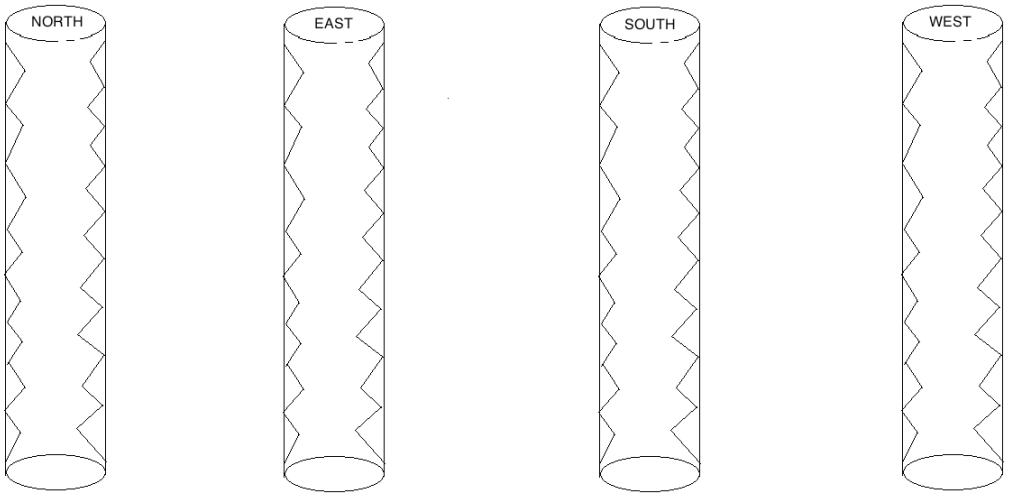
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #13

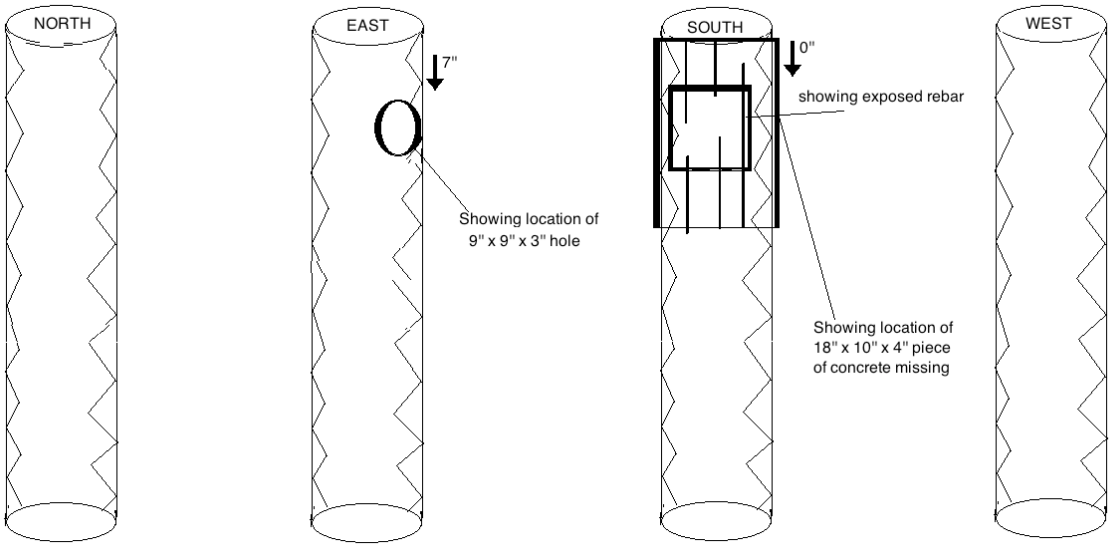
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 9'' long by 9'' wide by 3'' deep hole, located 7'' below the rectangular block.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, not a piece of concrete 18'' long 10'' wide 4'' deep is missing exposing rebar, located directly below the rectangular block.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #13

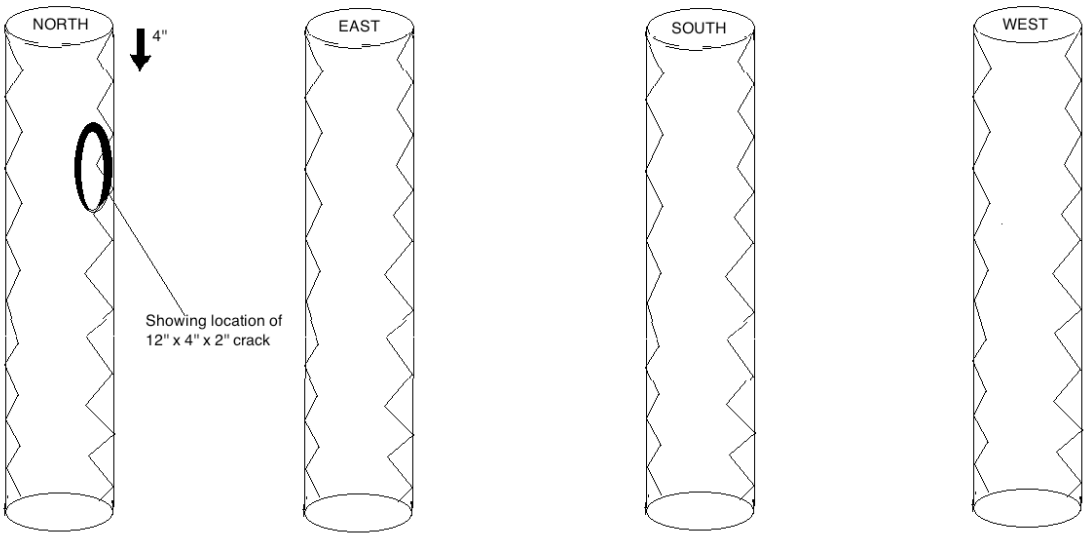
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 12'' long by 4'' wide by 2'' deep crack, located 4'' below the bottom of the rectangular block.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #13

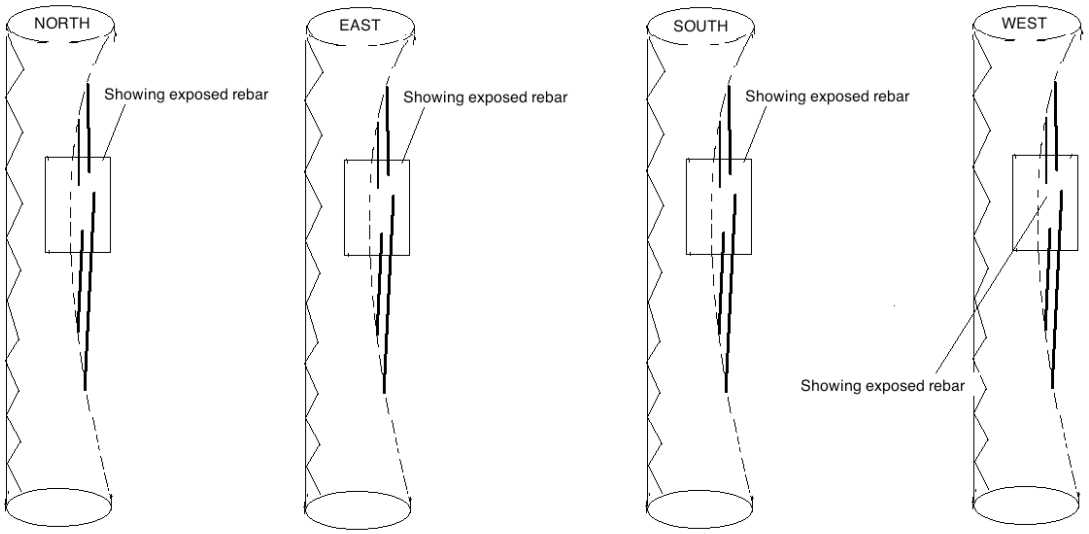
PILE #8

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

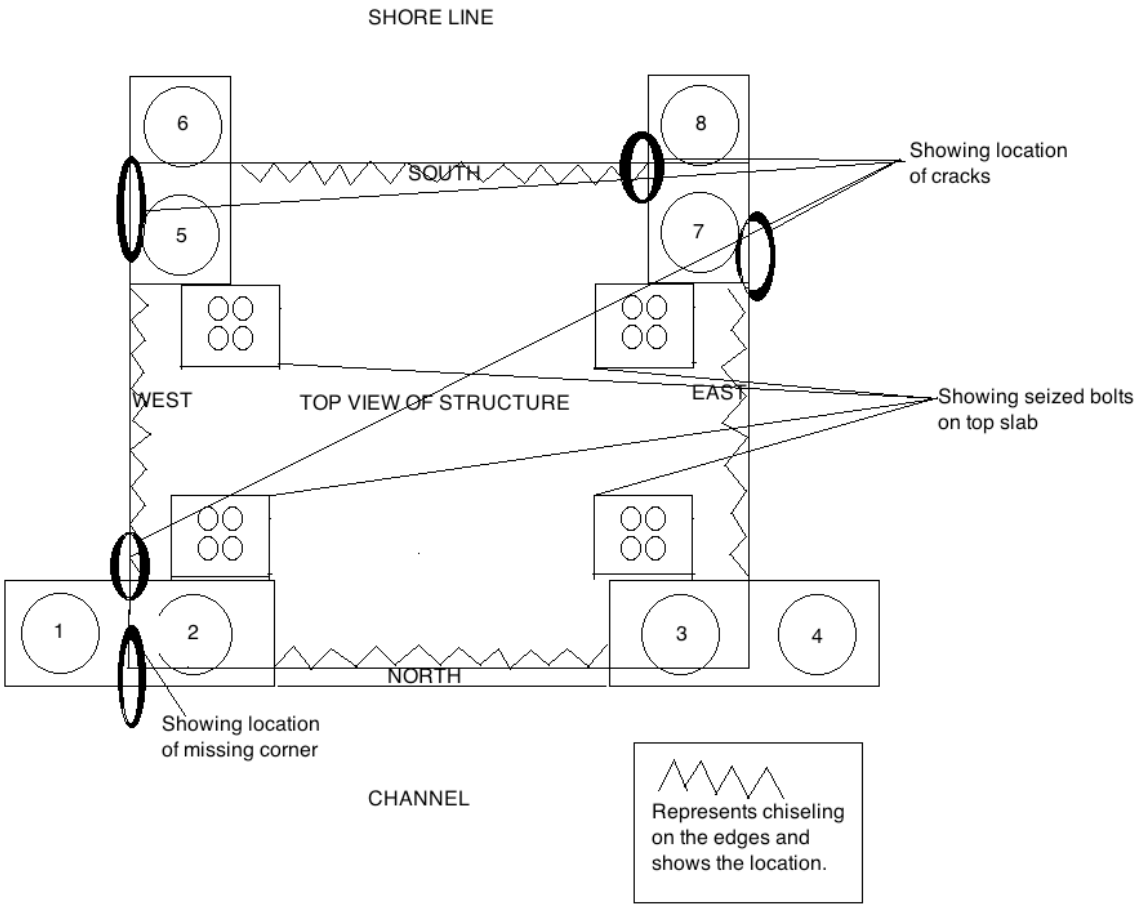
South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, noted in illustration, half of piling has deteriorated away and revealed exposed rebar.




T 13810
BOW
T 13842

MOORING STRUCTURE #14



Top slab

WATERLINE TO MUD LINE IS ROUGHLY 6’ 6’’ DEEP ON CHANNEL SIDE.

Note all bolt sets are rusted and appeared seized.

The northwest corner has been chiseled away and left rebar exposed due to deterioration.

A crack has formed on the west side of the top slab near the north corner, the west side near the south corner, the south side near the east corner, and the east side near the south corner. All noted in the illustration above. All cracks start at the bolt head on the deck and continue over the sides towards the waterline.

Chiseling has occurred on all top edges on all sides of the top slab.

MOORING STRUCTURE #14

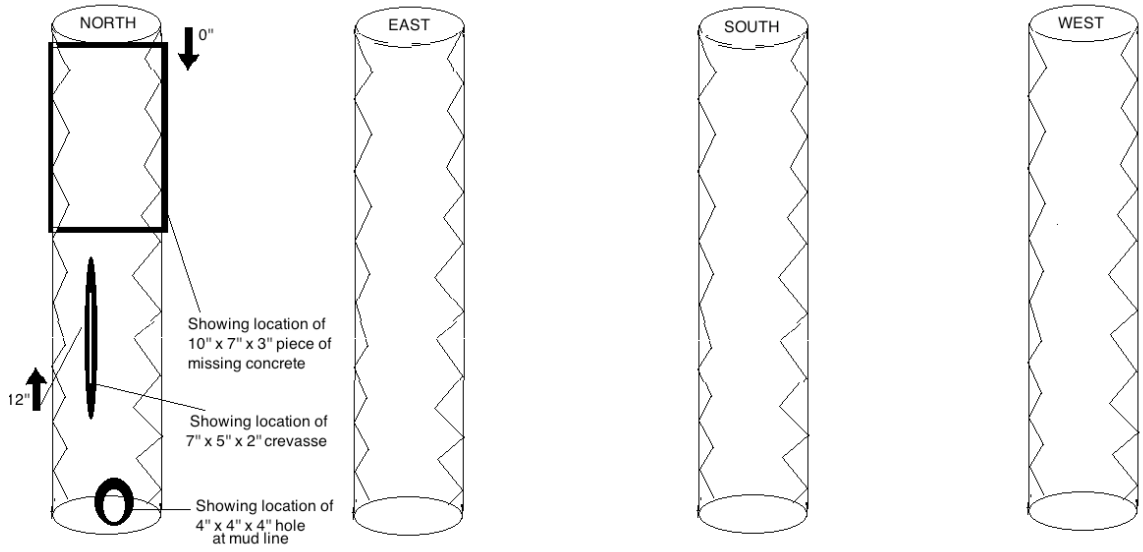
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 10'' long by 7'' wide by 3'' deep piece of concrete missing, located directly below the rectangular block. Another notation is the 7'' long by 5'' wide by 2'' deep crevasse located 12'' up from the mud line along with a 4'' long by 4'' wide by 4'' deep hole located at the mud line.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #14

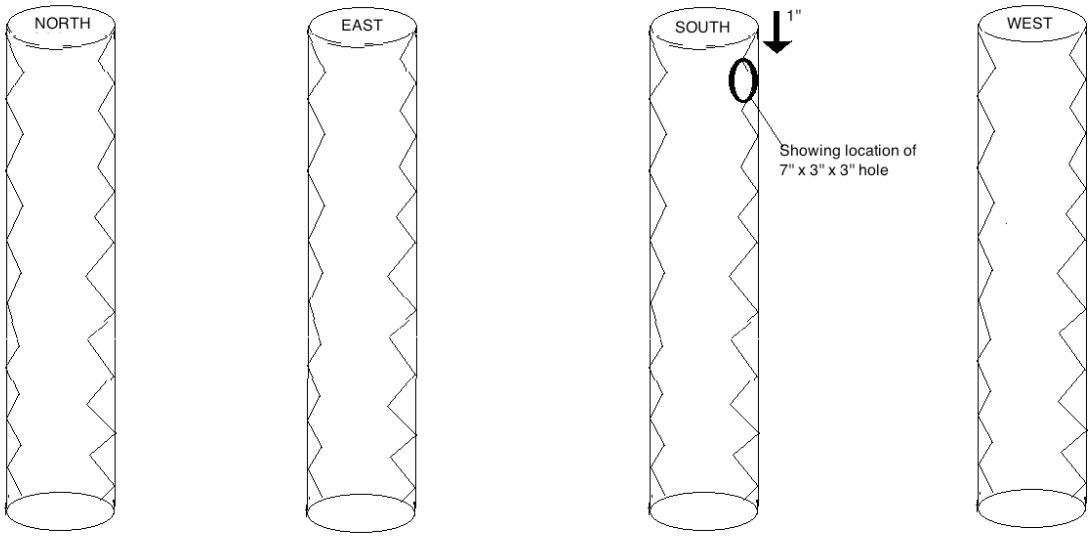
PILE #2

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also note the 7'' long by 3'' wide by 3'' deep hole. Located 1'' below the rectangular block.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



PILE #3

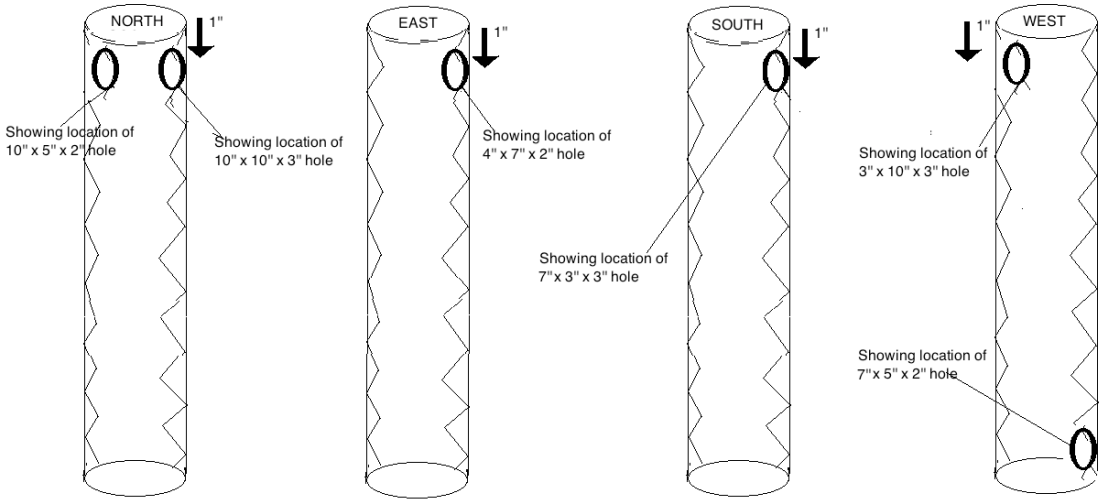
MOORING STRUCTURE #14

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 10'' long by 10'' wide by 3'' deep hole, located 1'' below the rectangular block. Along with a 10'' long by 5'' wide by 2'' deep hole, located directly next to it on the right.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 7'' long by 4'' wide by 2'' deep hole, located 1'' below the rectangular block.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also note the 7'' long by 3'' wide by 3'' deep hole. Located 1'' below the rectangular block.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 3'' long by 10'' wide by 3'' deep crack, located 1'' below the rectangular block. Along with the 7'' long by 5'' wide by 2'' deep hole, located at the mud line.



PILE #4

This pile was not accounted for, nor was there a pile of concrete debris, from this information we are giving our opinion that this pile was not constructed on this mooring structure.

PILE #5

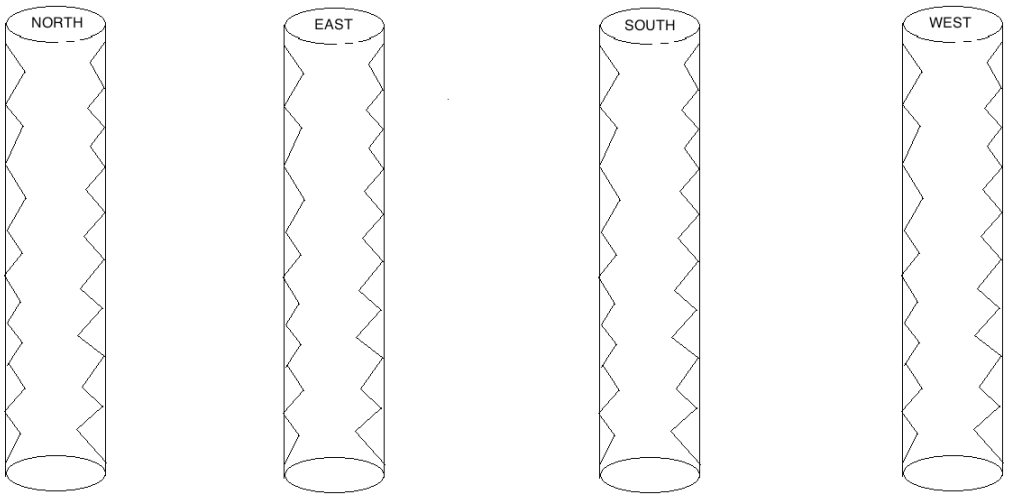
MOORING STRUCTURE #14

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



PILE #6

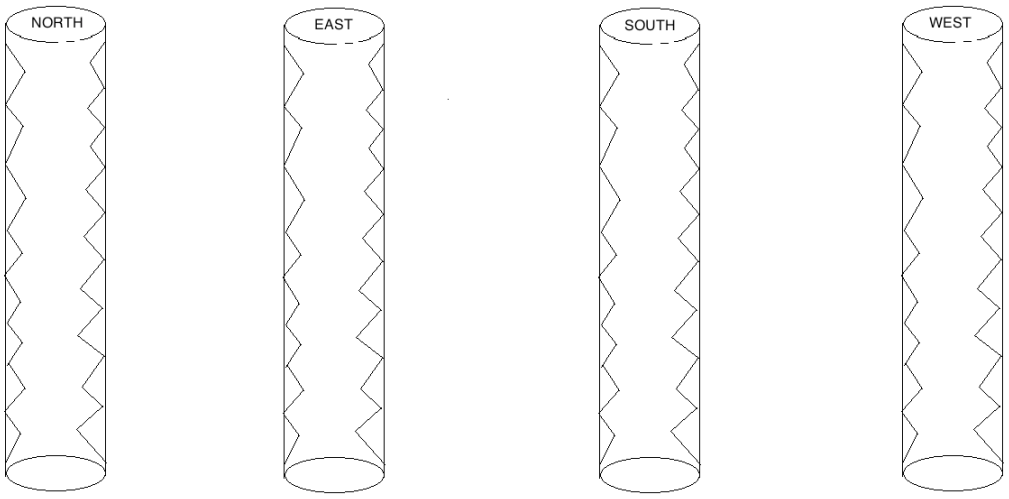
MOORING STRUCTURE #14

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



PILE #7

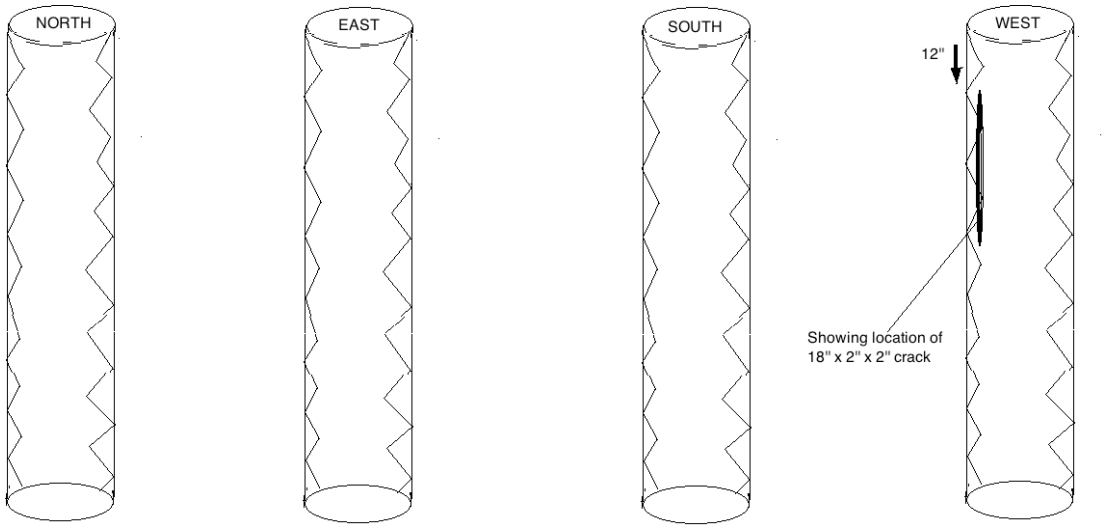
MOORING STRUCTURE #14

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 18'' long by 2'' wide by 2'' deep crack, located 12'' below the rectangular block.



PILE #8

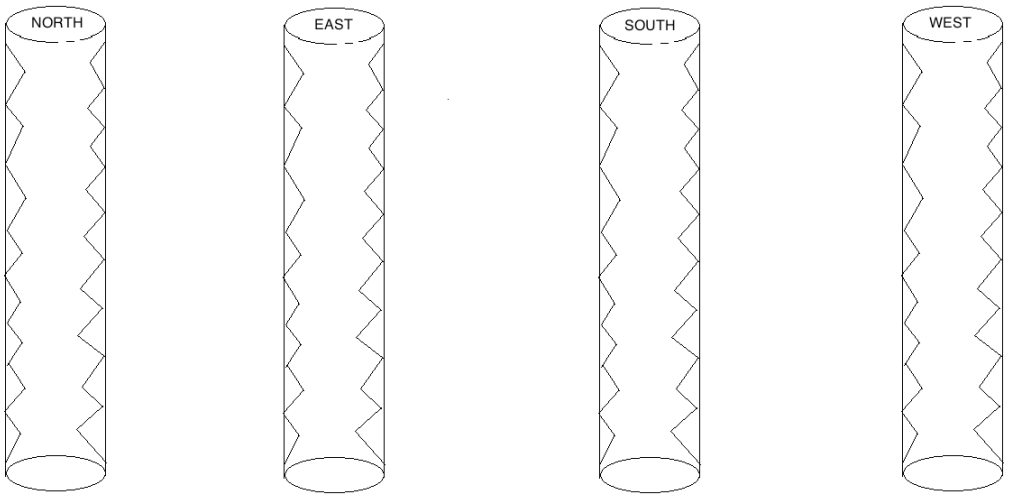
MOORING STRUCTURE #14

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

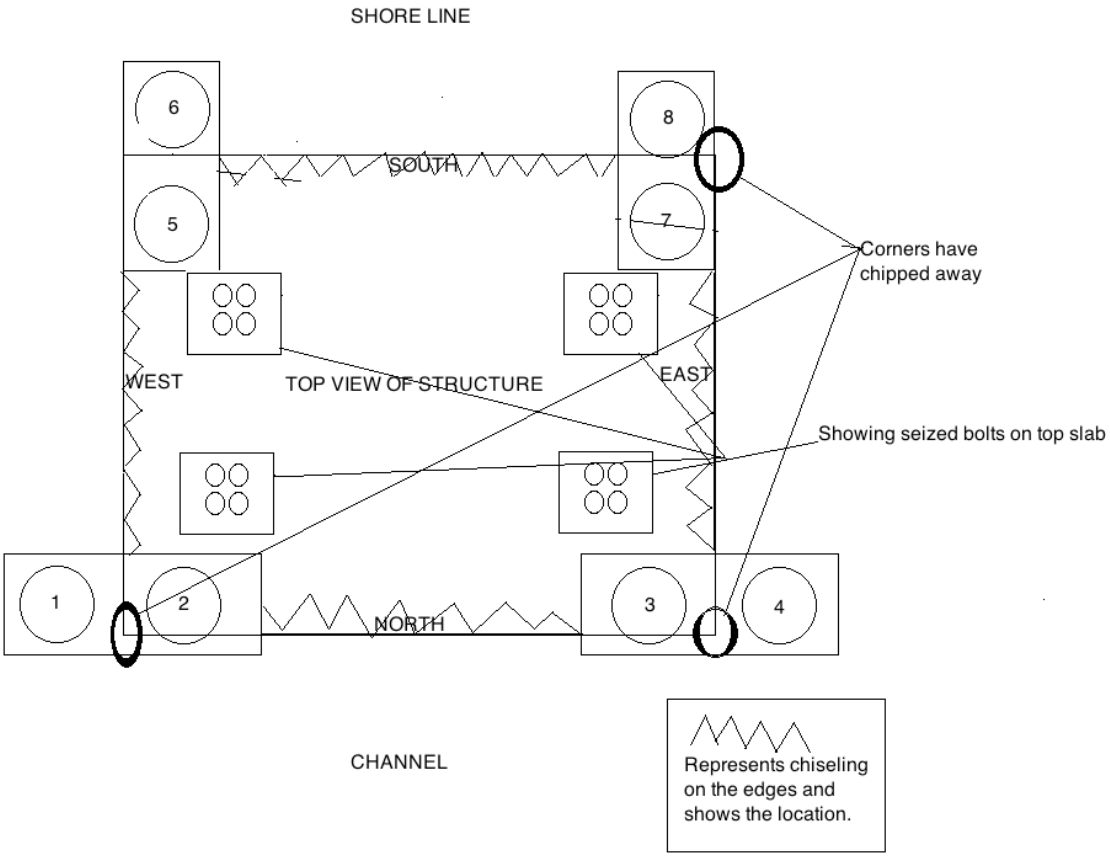
South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.




STERN

MOORING STRUCTURE #15



Top slab

WATERLINE TO MUD LINE IS ROUGHLY 10' DEEP ON CHANNEL SIDE.

Note all bolt sets are rusted and appeared seized.

The northwest, northeast, and southeast corners has been chiseled away and left rebar exposed due to deterioration.

Chiseling has occurred on all top edges on all sides of the top slab.

MOORING STRUCTURE #15

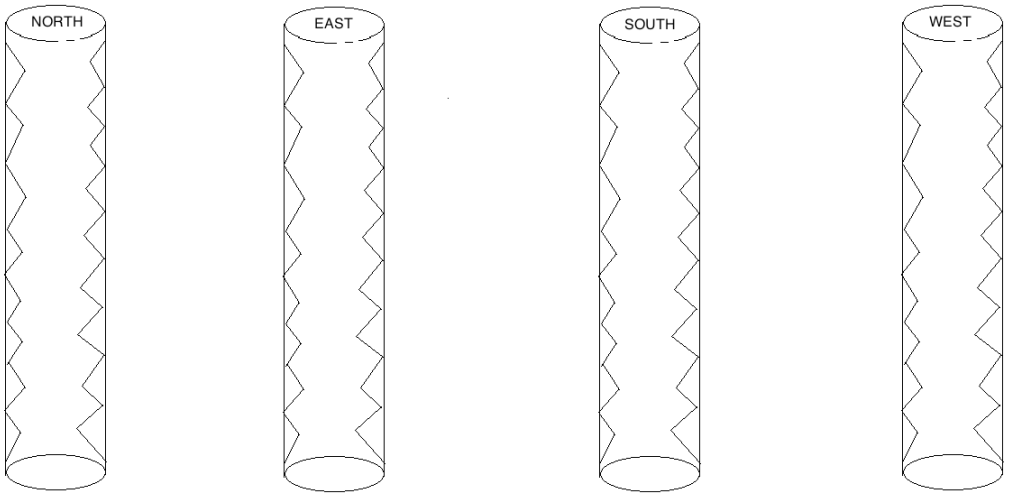
PILE #1

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #15

PILE #2

This pile was not accounted for, nor was there a pile of concrete debris, from this information we are giving our opinion that this pile was not constructed on this mooring structure.

MOORING STRUCTURE #15

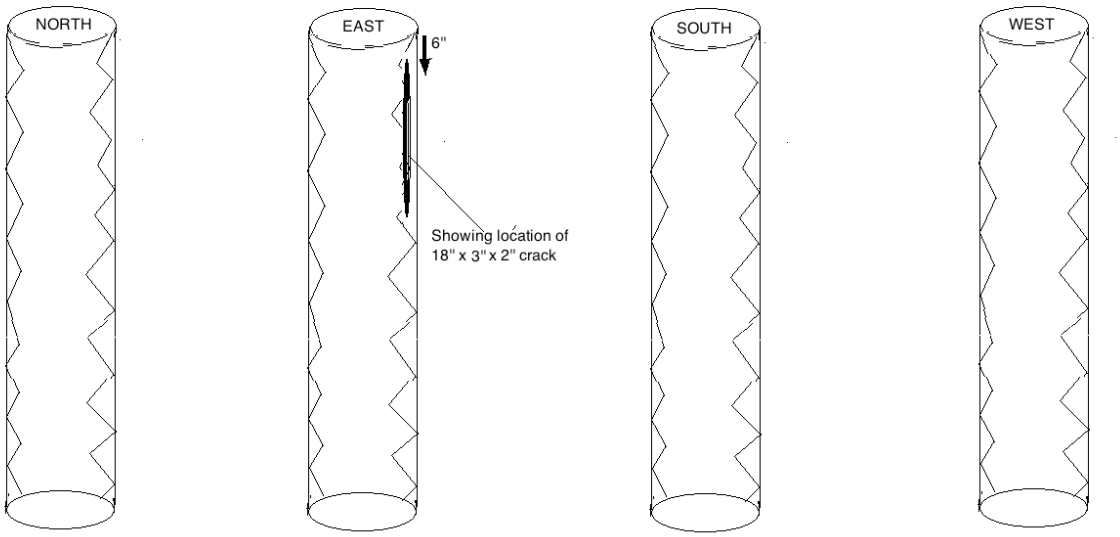
PILE #3

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 18'' long by 3'' wide by 2'' deep crack, located 6'' below the rectangular block.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #15

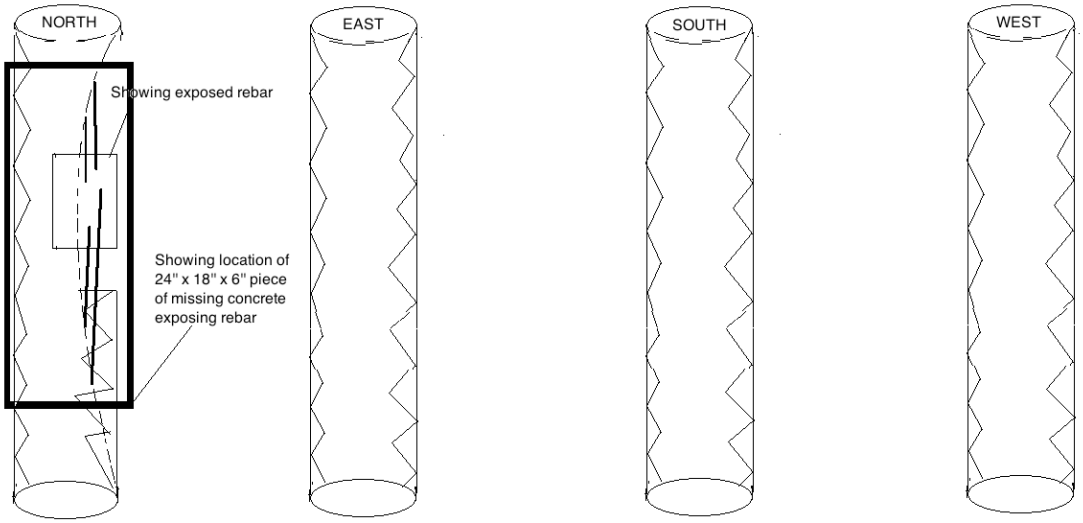
PILE #4

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch. Also, note the 24'' long by 18'' wide by 6'' deep piece of concrete missing located 12'' below the rectangular block.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #15

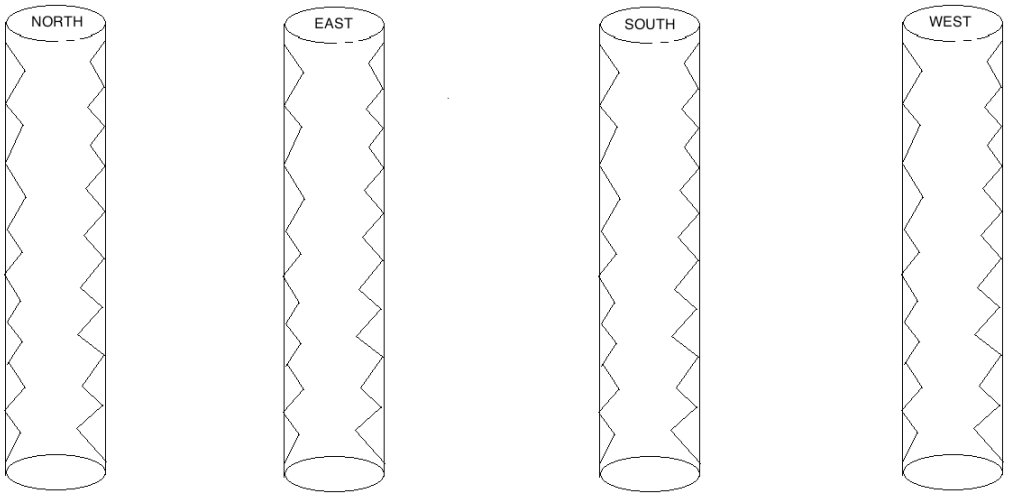
PILE #5

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #15

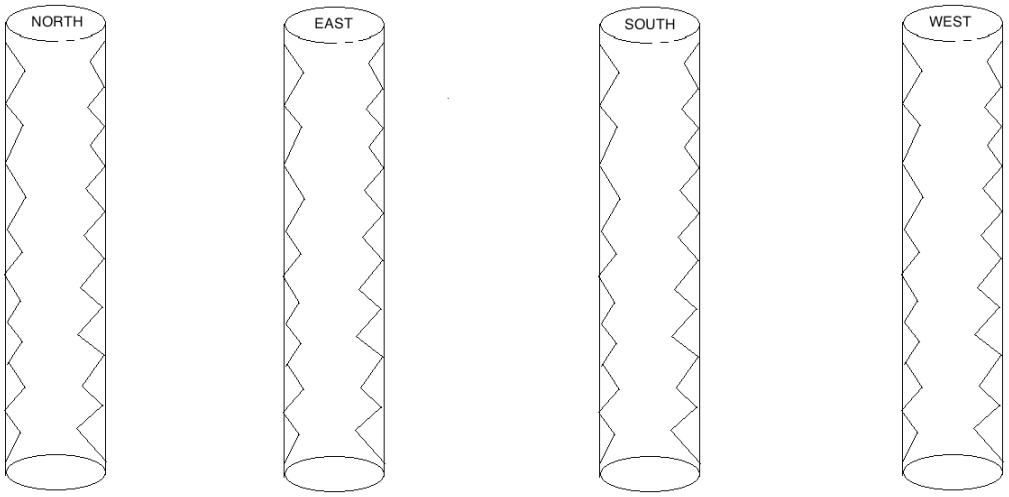
PILE #6

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #15

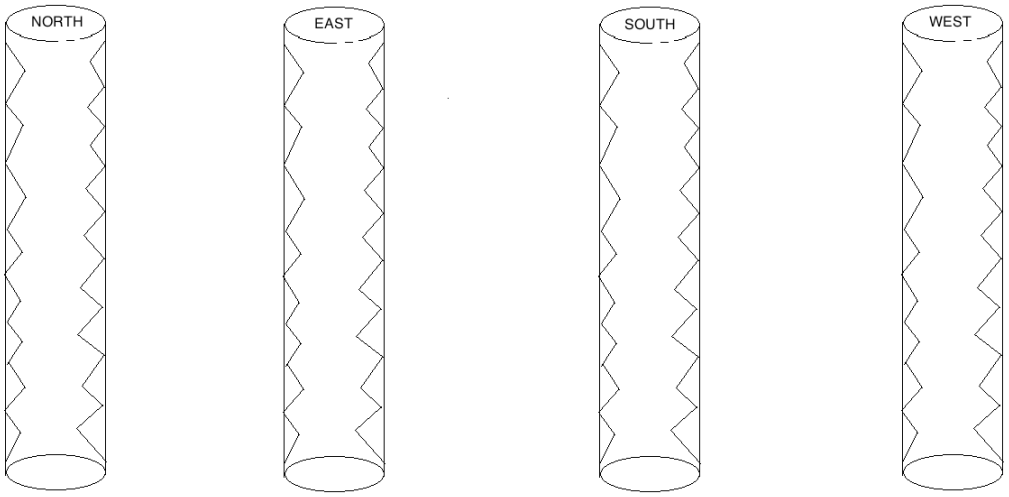
PILE #7

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



MOORING STRUCTURE #15

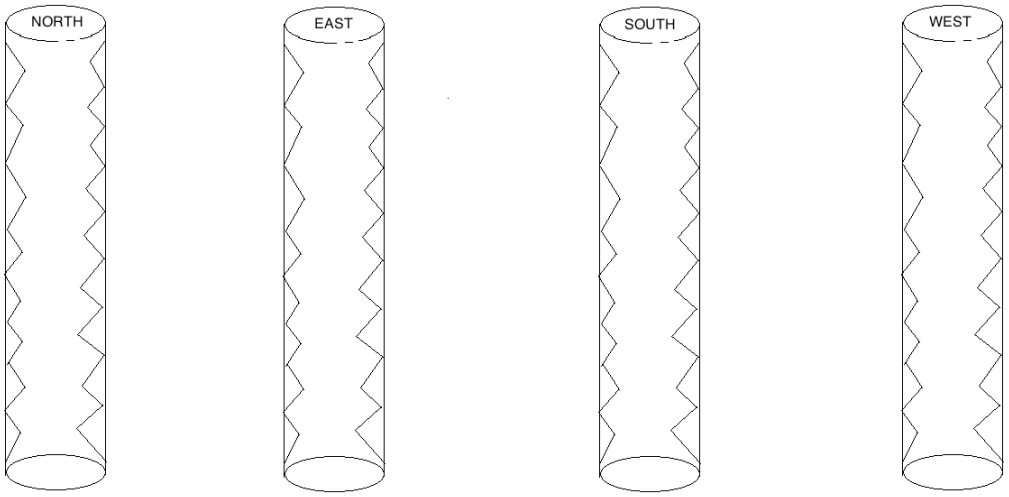
PILE #8

North side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

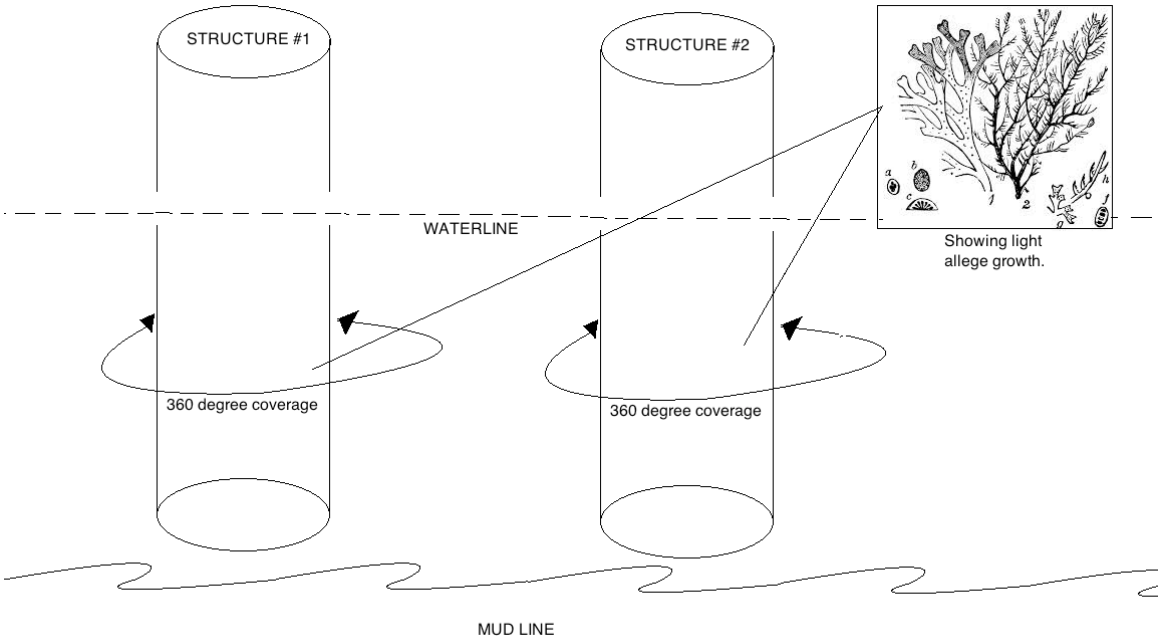
East side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

South side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.

West side of pile one shows major deterioration, with a loss in circumference greater than 6'' and consisted of heavy chiseling and softening of concrete. Pieces were falling off by touch.



200 TON CRANE FRONT STRUCTURES



After completing the investigative dive on the two front structures of the 200-ton crane, we have noted that our finding only show light marine growth encompassing the cylindrical structures. There were no signs of damage or break in structural integrity.

We do suggest that you have anodes installed subsurface on these structures in order to keep the erosion at an absolute minimum. Over time these steel structures will erode away unless there is an object in place to take its place.

Sacrificial Anodes are highly active metals that are used to prevent a less active material surface from corroding. Sacrificial Anodes are created from a metal alloy with a more negative electrochemical potential than the other metal it will be used to protect. The sacrificial anode will be consumed in place of the metal it is protecting

200 TON CRANE FRONT STRUCTURES

STRUCTURE #1

200 TON CRANE FRONT STRUCTURES

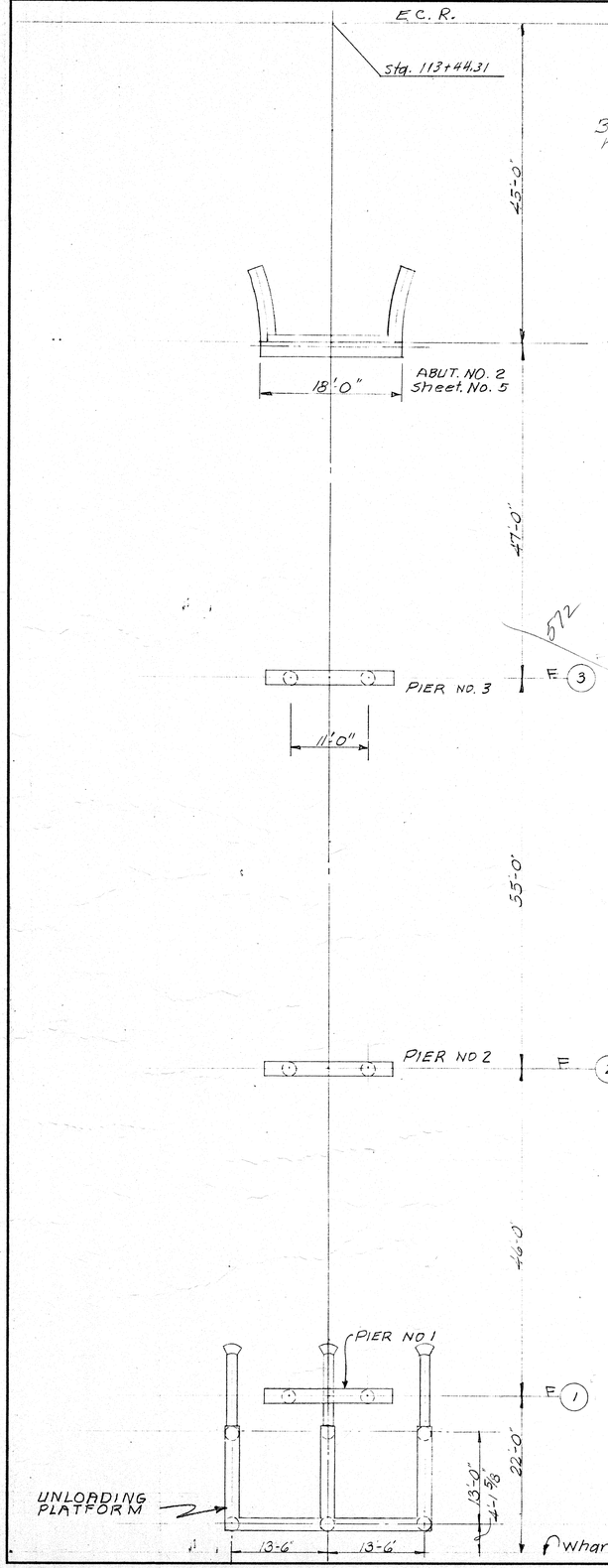
STRUCTURE #2

Appendix B

T-Head Wharf As-Built Plans

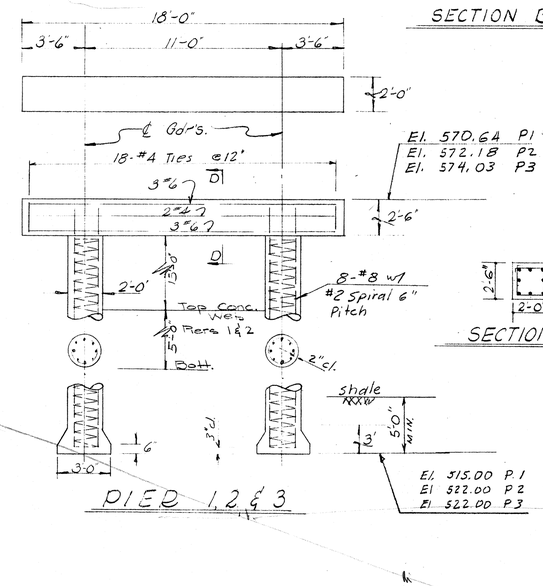
Ridgway's

67 WP 15

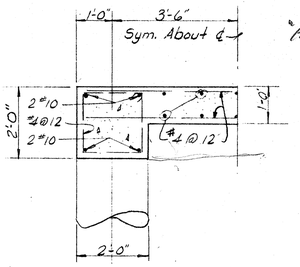


FOUNDATION PLAN

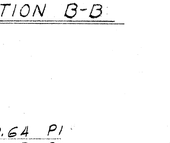
Backfill around Abutment shall be hand tamped to 100% Standard Density.



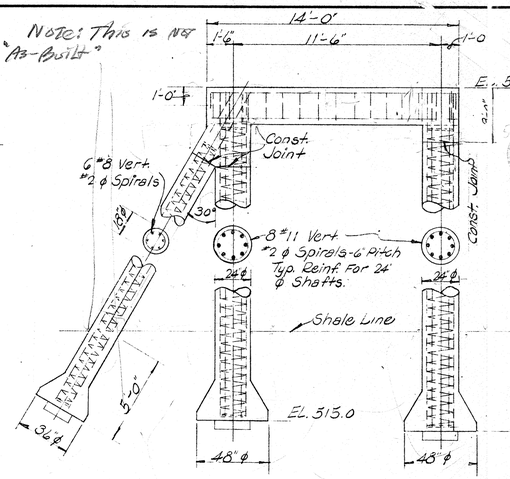
PIER 1, 2 & 3



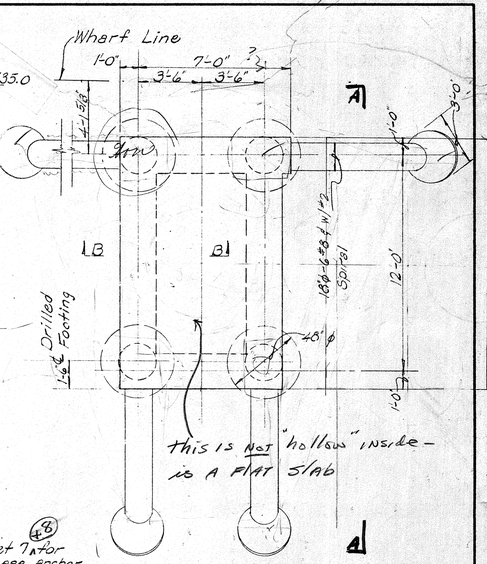
SECTION B-B



SECTION D-D



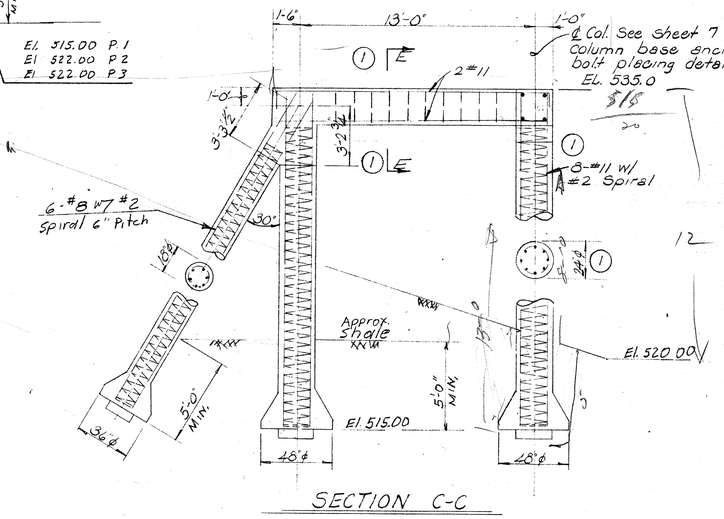
ELEVATION A-A



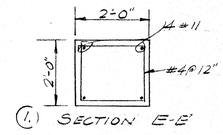
See Sheet 7 for Column base anchor bolt placing details. (4B)

FOUNDATION PLAN

BREASTING DOLPHIN FOUNDATION



SECTION C-C



1 SECTION E-E

1. All concrete shall have a minimum compressive strength 3000 p.s.i.
2. All reinforcing steel ASTM A615 Grade 60 except tie & stirrup shall be Grade 40.

BENT FOUNDATION FOR UNLOADING PLATFORM

REVISION	BY	DATE
① Gen. Rev.		9-9-70

PORT OF CATOOSA

FOUNDATION PLANS

CITY OF TULSA, OKLAHOMA

PLANS & ESTIMATE PREPARED BY:
WILLIAM J. FELL & ASSOCIATES
LOCKWOOD, ANDREWS & NEWNAM INC.

PLAN SCALE:
PROFILE SCALE
HORIZON
VERTICAL
RECOMMENDED
ENGINEERING DIRECTOR
APPROVED:
CITY ENGINEER
SUPT. OF WATERWORKS AND SEWERAGE
FILE: DRAWING:
ATLAS PAGE NO:
DATE SEPT. 1970
SHEET 4 OF 11 SHEETS

67 WP 15

(4)

Appendix C

1973 Caisson Details

N

62'-0"
31'-0"
31'-0"

25'-0"
℄ TRUCK DUMP PIT

24" ϕ MIN. CAISSON WITH INNER STEEL CASING; LOCATE AND CONSTRUCT TO SUIT " STRAIGHT ENGINEERING CO." TRUCK DUMPER.

247'-6" (N.T.S.)

33'-4" (VERIFY)

2'-6"

℄ CONVEYOR

CUT-OFF ELEV. 562'-4" (2 INDICATED THUS)

25'-7" DIAM. TYPICAL

12 / 12

7½ / 12

11'-6" 11'-6" 8'-0" 11'-6"

5'-9" 5'-9"

10'-6"

7'-0" 7'-6"

25'-7"

CUT-OFF ELEV. 562'-4" (2 INDICATED THUS)

CUT-OFF ELEV. 570'-11" (56 INDICATED THUS)

2'-6" ϕ STORAGE CAISSONS

352'-0"

PLAN
⅛" = 1'-0"

3/4" CHAIN GALV.

3/8" PL

3/4" PL

Pc. W8x58

MIN. 8'-0" DIA. (NOMINAL)

3/4" CHAIN

RUBBER BUMPERS 10" ϕ W/5" CORE OR 10" ϕ W/4" CORE

ELEV. 546'-0"

16" WIDE LADDER, 3/4" ϕ RUNGS, DOWN TO ELEV. 534'-0"

HIGH WATER, ELEV. 545'-0"

LOW WATER ELEV 532'-0"

#5 @ 12" oc

ELEV 546'-0"

10" RUBBER BUMPER (TYP.)

NOTE:
ENERGY ABSORPTION FORCE = 42 K APPLIED ANY PLACE, ANY DIRECTION.
WIND LOAD BASED UPON 20 LBS. PER SQ. FT. ON 195'x12' BARGE
EXPOSED SURFACE = 23.4 K APPLIED AT TOP OF DOLPHIN IN ANY DIRECTION, OPTIONAL DESIGN CAPABLE OF RESISTING THE ABOVE LOADS. MAYBE SUBMITTED - SUBJECT TO ENGINEERS APPROVAL

CRUSHED ROCK FILL

TREMIE CONC.

ESTIMATED TOP OF SHALE IN CHANNEL (BASE BID) ELEV. 520'-0"

L3x3x½ - WELD TO INSIDE TANK W/ 3/16" WELDS (6" @ 12" CTRS.)

6" DIA. HOLES FILLED W/ CONCRETE (TYP) SPACED AT 45° (8 REQ'D)

#11 BAR

DOLPHIN DETAILS
(2-REQ'D.)

SECTION
⅛" = 1'-0"

not done this way, see shop dwg

"MISTAKE - forgot the channel bank slopes 3:1. Thus dolphins not on "flat" but on slope"

70'-6" (N.T.S.)

DOLPHIN

℄ LADDER

(1-THUS) AS DIMENSIONED

Fc. OF BUMPERS

20'-0" 13'-2"

LOADING FOR EACH CASSION
108 K TOTAL DEAD LOAD & LIVE LOAD
113 K WIND LOAD

75'-0"

185'-0" (ALTERNATE)

2'-0" ϕ BRIDGE CAISSONS

MARINE CAISSONS

Note:
PROVIDE ANCHORAGE FOR MECHANICAL EQUIPT. MOUNTING, TYPICAL

DOLPHIN

℄ LADDER

(1-THUS) AS DIMENSIONED

As Built Plans

ORIGINAL GRADE, ELEV. 574.0" ±

CUT-OFF ELEV., (SEE PLAN)

2'-0"

2'-6" ϕ

4-#6 VERT. #3 @ 18" cc - TIES

12'-0" (MINIMUM SHALE PENETRATION)

TOP OF SHALE ELEV. 548'-6" (BASE BID)

STORAGE FOUNDATION CAISSON
¼" = 1'-0"
(64 REQ'D.)

CAISSON PLAN
⅛" = 1'-0"

NUT & STD. WASHER

4½"

2'-0"

1" ϕ

4" x 4" x ½" PL.

ANC. BOLT DETAIL
1" = 1'-0"

2-1" ϕ A.B. @ 6" cc W/ 4" x 4" x ½" PL.

4½" Proj.

3-#3 @ 4" cc TIES

EL. 549'-10½"

1'-6" ϕ PIER

TOP OF SHALE ELEV. 552.0 (BASE BID)

CUT-OFF, ELEV. 552.0

8'-0" MIN

(MINIMUM SHALE PENETRATION)

4'-0"

2'-0" ϕ

4-#7 VERT. #3 @ 18" cc, TIES

BRIDGE CAISSON
¼" = 1'-0"
(2 REQ'D.)

ELEV. 545'-0" (HIGH WATER)

ELEV. 535'-4½"

4½" Proj.

2-1" ϕ A.B. @ 6" cc W/ 4" x 4" x ½" PL.

CUT-OFF ELEV. 535'-10"

3-#4 TIES @ 6" cc

ELEV. 532'-0" (LOW & NORMAL) WATER

4'-0" ϕ I.D.

3/8" PL. CASING

12-#11, VERT. #4 @ 24" cc, TIES

TOP OF SHALE ELEV. 524.10 (BASE BID)

8'-0" MINIMUM

MARINE CAISSON
¼" = 1'-0"
(4 REQ'D.)

72E-504

STATE OF MISSOURI
HENRY G. LEMBECK, JR.
NUMBER E-9549
PROFESSIONAL ENGINEER

OKLAHOMA TEMPORARY PERMIT No. 18

REVISION	BY	DATE
GENERAL REVISION; ADDED LOADING FOR DOLPHINS & CASSIONS MOVED LADDERS ON DOLPHINS.	J.B.	2-16-79
LENGTH OF ANCHORS INCREASED	A.L.H	

CAISSON PLAN AND DETAILS

PORT OF CATOOSA
GRAIN STORAGE AND HANDLING FACILITY

CITY OF TULSA, OKLAHOMA

PLANS & ESTIMATE PREPARED BY:
Hudgins, Thompson, Ball and Associates, Inc.
WEITZ-HETTELSATER ENGINEERS

PLAN SCALE: AS NOTED	DRAWN	PFB	APPROVED:
	DESIGNED	A.L.H	
	SURVEY		
PROFILE SCALE:	FIELD ENGR.		
HORIZONTAL:	OFFICE ENGR.		
"	CHIEF ENGR.	HGL	
VERTICAL:	RECOMMENDED:		CITY ENGINEER
"	ENGINEERING DIRECTOR		
FILE:	DRAWING: S-1		DATE:
ATLAS PAGE NO:			SHEET 12 OF 40 SHEETS

Dolphin Design

9-2

E.S

E TIE T3
T)

BRACKET E1 TYP

30°

8'-0 O.D.

30°

L1

LADDER @ NORTH DOLPHIN

10" RUBBER BUMPER G1

3/4" GALV. CHAIN F1

N

K1

LADDER @ SOUTH DOLPHIN

SECT F-F

5/16 TYP

5/16 TYP

FIELD NOTE!
FIELD CUT AS REQD TO OBTAIN ELEVATION

HOLD!
ELEV 546'-0

F

LADDER K1

F

TOP OF LADDER @ EL. 546'-0

2'-0

1'-6 CONCRETE

2'-0

2-#5 x 7-8
4-#5 x 7-5
4-#5 x 6-7
4-#5 x 4-10
@ 12" CTRS
EA WAY

6½" 6½"

BRACKET (TYP) E1

℄ DOLPHIN

4'-0

4'-0

4'-0

4'-0

3/4" CHAIN F1

10" RUBBER BUMPERS G1

PAINT W/2 COATS MOBIL TAR COAT 78-J-2 OR EQUAL PRIOR TO INSTALLATION

FIELD NOTE!
FIELD CUT AS REQD TO OBTAIN ELEVATION

27'-6 ±

21'-0 ± CRUSHED ROCK

PAINT W/2 COATS MOBIL TAR COAT 78-1-2 OR EQUAL

2-1" ø A.E.S M.K.A. (ON CAISSON)

78-J-2

ELEV. 530-0?

DOLPHIN H1

TOP OF 12' CASING FILLED WITH CONC. ELEV. 533-0? (REQ'D)

12' CASING

TOP OF CONCRETE

4-¾ø x 0'-4 NELSON STUDS @ EA. LOCATION (TYP)

11'-0"

1'-6

1'-6

1'-6

TOP OF SHALE EL 520:0 ± (BASE BID)

5'-0 CONCRETE

ETM OF DOLPHIN

16'-0

12-#3 TIES T&B @ 18" CTRS.

10" DIA HOLES SPACED @ 45° REQ'D FOR DOLPHIN FILLED WITH CONC. (TYP.)

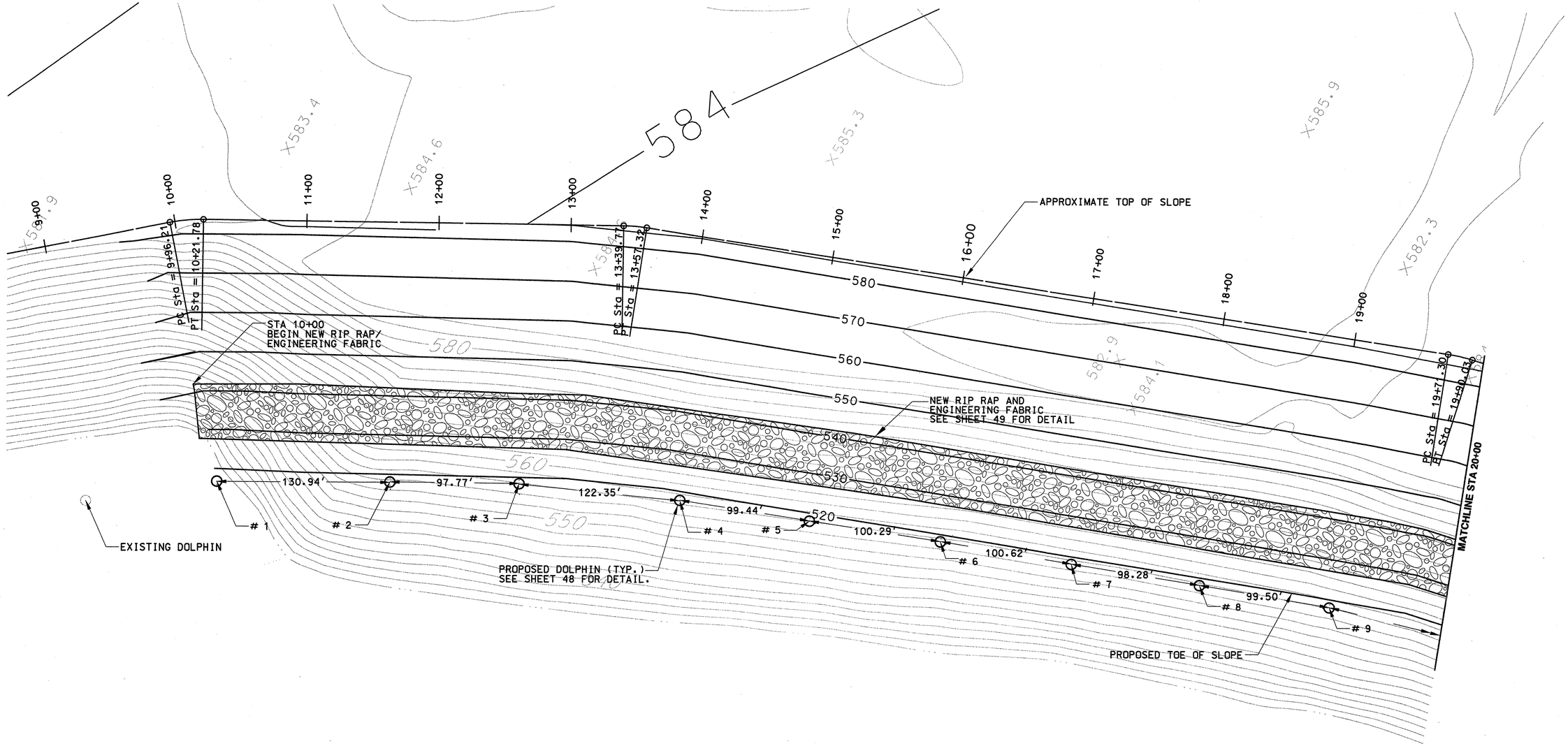
4-#11 x 17'-6

SECTION E-E
(2 PLACES)

SHOP DRAWINGS REVIEW

Appendix D

Seven ft. Diameter "Can" Dolphin As-Built Plans



DOLPHIN	NORTHING	EASTING
1	281124.65	122681.96
2	281009.62	122744.51
3	280923.36	122790.53
4	280810.80	122838.49
5	280716.58	122871.58
6	580623.02	122906.53
7	280528.13	122939.99
8	280435.55	122972.97
9	280343.67	123004.42

N

0 20' 40' 80' 120'

REGISTERED PROFESSIONAL ENGINEER
RICHARD G. PETRICK
JR
14557
OKLAHOMA

DDG PROJECT NO. T1027

REVISION	BY	DATE

CITY OF TULSA - ROGERS COUNTY PORT AUTHORITY
2003 WHARF CUT AND DOLPHIN CONST PROJECT

DOLPHIN ALIGNMENT

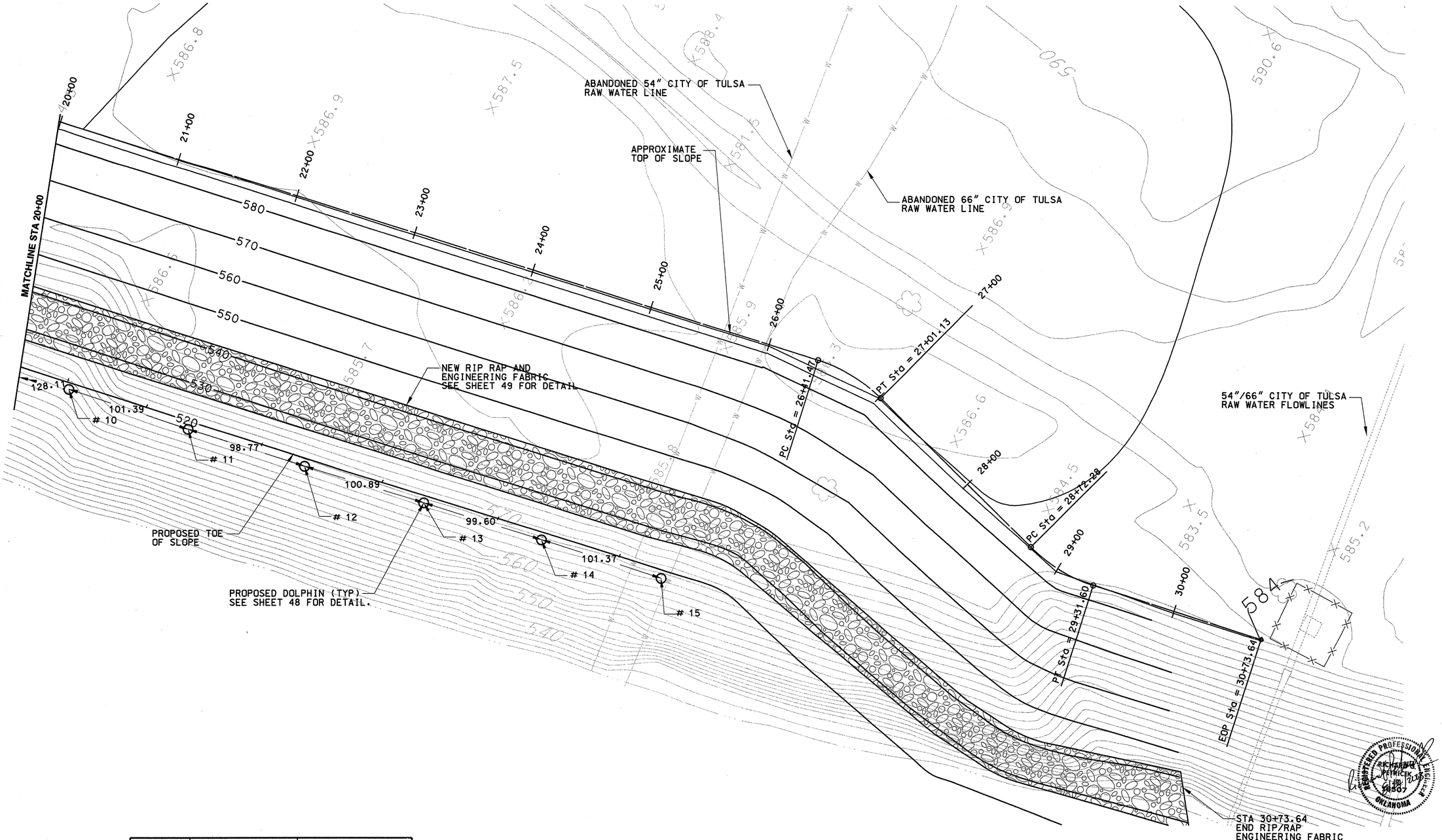
E.D.A. PROJECT NO. 08-01-03778
PORT PROJECT NO. 2500-94

PLANS AND ESTIMATES PREPARED BY:

Dewberry
Dewberry Design Group Incorporated
1350 South Boulder - Suite 600
Tulsa, Oklahoma 74119 - 3218
918.587.7283 - fax 918.587.0071

PLAN SCALE: 1" = 40'		PROFILE SCALE:	HORIZ. VERT.
DESIGNED: RGP	DRAWN: DC/MD	APPROVED: DMA	DATE: AUGUST 21, 2003
			SHEET 46 OF 53 SHEETS

08/22/2003 n:\DATA\ENG\T1027\DOLPHIN ALIGN-01.dgn



DOLPHIN	NORTHING	EASTING
10	280217.81	123038.73
11	280118.71	123057.21
12	280020.67	123075.50
13	279923.18	123095.51
14	279825.39	123115.22
15	279729.22	123135.70

N

0 20' 40' 80' 120'

REGISTERED PROFESSIONAL ENGINEER
RICHARD G. PATRICK
GPE 21287
OKLAHOMA

DDG PROJECT NO. T1027

REVISION	BY	DATE

CITY OF TULSA - ROGERS COUNTY PORT AUTHORITY
2003 WHARF CUT AND DOLPHIN CONST PROJECT

DOLPHIN ALIGNMENT

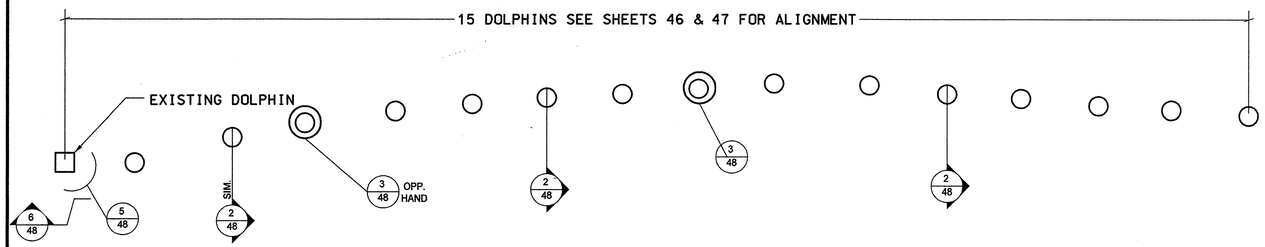
E.D.A. PROJECT NO. 08-01-03778
PORT PROJECT NO. 2500-94

PLANS AND ESTIMATES PREPARED BY:

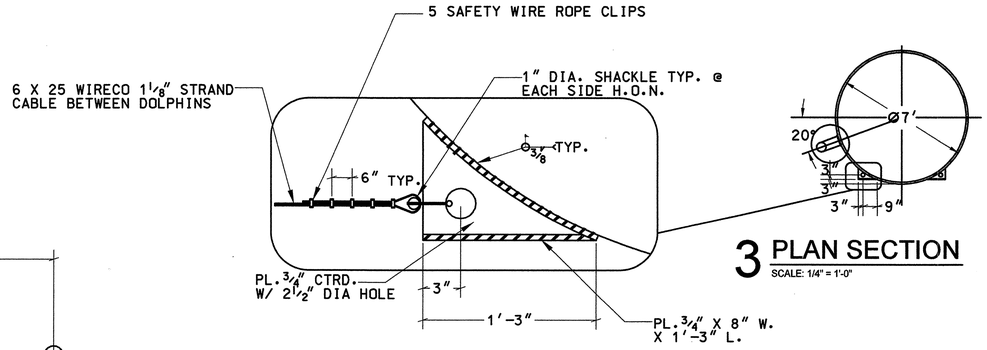
Dewberry
Dewberry Design Group Incorporated
1350 South Boulder - Suite 600
Tulsa, Oklahoma 74119 - 3216
918.587.7283 - fax 918.587.0071

PLAN SCALE: 1" = 40'	PROFILE SCALE: HORIZ.	VERT.
DESIGNED: RGP	DRAWN: DC/MO	APPROVED: DMA
DATE: AUGUST 21, 2003	SHEET 47 OF 53 SHEETS	

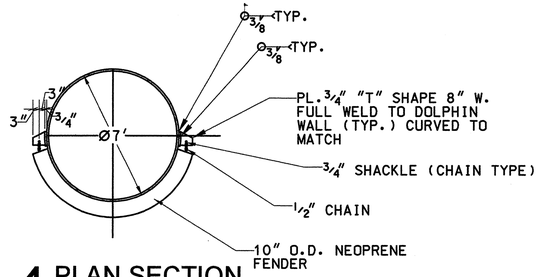
08/22/2003 n:\DATA\ENG\T1027\DOLPHIN ALIGN-02.dgn



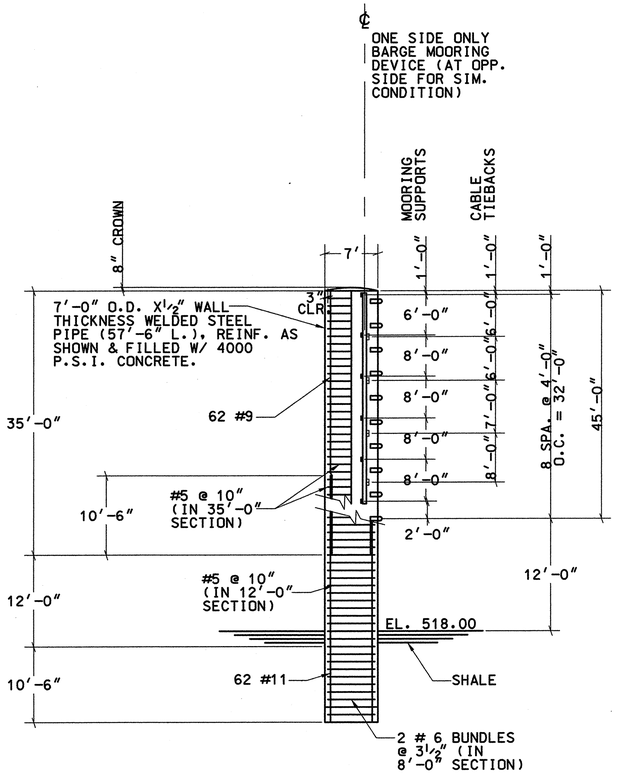
1 PLAN @ DOLPHINS
SCALE: 1" = 100'-0"



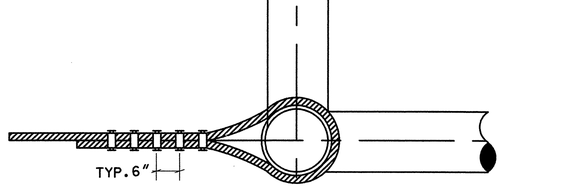
3 PLAN SECTION
SCALE: 1/4" = 1'-0"



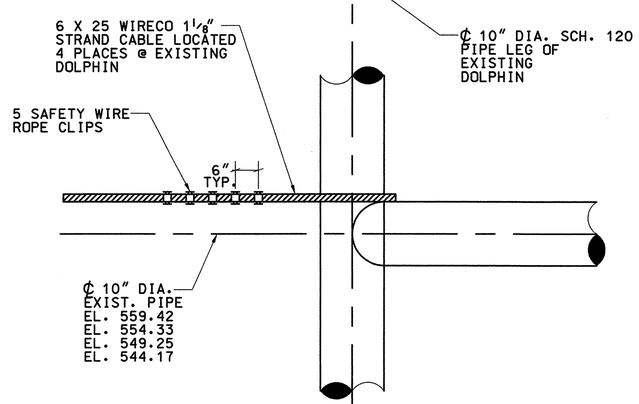
4 PLAN SECTION
SCALE: 1/4" = 1'-0"



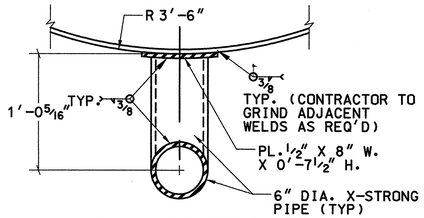
2 ELEVATION DETAIL
SCALE: 1" = 10'-0"



5 PLAN
N.T.S.



6 ELEV.
N.T.S.



NOTE: PAINT ASSEMBLY TO MATCH DOLPHIN STEEL.

7 PLAN DETAIL BARGE MOORING DEVICE
SCALE: 1 1/2" = 1'-0"

REGISTERED PROFESSIONAL ENGINEER — RICHARD G. PATRICK — 19867 — OKLAHOMA

DDG PROJECT NO. T1027

REVISION	BY	DATE

CITY OF TULSA - ROGERS COUNTY PORT AUTHORITY
2003 WHARF CUT AND DOLPHIN CONST PROJECT

DOLPHIN DETAILS

E.D.A. PROJECT NO. 08-01-03778
PORT PROJECT NO. 2500-94

PLANS AND ESTIMATES PREPARED BY:

Dewberry
Dewberry Design Group Incorporated
1350 South Boulder - Suite 600
Tulsa, Oklahoma 74119 - 3216
918.587.7283 - fax 918.587.0071

PLAN SCALE:		PROFILE SCALE: HORIZ.	VERT.
DESIGNED: RGP	DRAWN: DC/MO	APPROVED: DMA	DATE: SHEET 48 OF 53 SHEETS

08/22/2003 n:\data\eng\t1027\dolphin-det.dgn

Appendix E

Geotechnical Report
for
Main Dock Construction

GEOTECHNICAL ENGINEERING REPORT
PROPOSED GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CATOOSA, OKLAHOMA
KLF Project No. 20150761

August 27, 2014

KLEINFELDER
Bright People. Right Solutions.

August 27, 2014
File No. 20150761

Mr. Craig Swengle, PE
Dewberry Engineers, Inc.
1350 South Boulder Avenue, Suite 600
Tulsa, Oklahoma 74119

Subject: **Geotechnical Engineering Report**
Proposed Gantry Crane Installation
Port of Catoosa, Catoosa, Oklahoma

Dear Mr. Swengle:

Kleinfelder completed the authorized subsurface exploration and geotechnical engineering evaluation for the above-referenced project. The purpose of the geotechnical study was to explore and evaluate the subsurface conditions at four column locations proposed to support the gantry cranes at the site, and develop geotechnical design and construction recommendations for the proposed project. The attached Kleinfelder report contains a description of the findings of our field exploration and laboratory testing program, our engineering interpretation of the results with respect to the project characteristics, our geotechnical site development and foundation design recommendations as well as construction guidelines for the planned project.

Recommendations provided herein are contingent on the provisions outlined in the ADDITIONAL SERVICES and LIMITATIONS sections of this report. The project Owner should become familiar with these provisions in order to assess further involvement by Kleinfelder and other potential impacts to the proposed project.

We appreciate the opportunity to be of service to you on this project and are prepared to provide the recommended additional services. Please call us if you have any questions concerning this report.

Sincerely,
KLEINFELDER, INC.
Certificate of Authorization #3036, Expires 6/30/15

Karthik Radhakrishnan, PE*, GE*
Project Manager
*Not Licensed in Oklahoma

Samuel F. Cain, PE
Oklahoma: 26720

LICENSED PROFESSIONAL ENGINEER
SAMUEL F. CAIN
8-27-14
26720
OKLAHOMA

KR/SFC:wlt

Interchange Business Park, 10835 East Independence, Suite 102, Tulsa, OK 74116-5680 p | 918.627.6161 f | 918.627.6262

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2.1 SITE LOCATION AND DESCRIPTION 3
2.2 SUBSURFACE CONDITIONS 3
2.3 GROUNDWATER OBSERVATIONS 4

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4.2 CONSTRUCTION OBSERVATION AND TESTING 10

5. LIMITATIONS 11

FIGURES
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Figure 2 – Boring Location Diagram

APPENDIX A
Field Exploration Program
Subsurface Cross Section
Graphics Key
Soil Description Key
Rock Decription Key
Boring Logs
Rock Core Photographs

APPENDIX B
Laboratory Testing Program

APPENDIX C
LPILE Results

APPENDIX D
ASFE Document

GEOTECHNICAL ENGINEERING REPORT
PROPOSED GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CATOOSA, OKLAHOMA

1. INTRODUCTION

1.1 GENERAL

Kleinfelder has completed the authorized subsurface exploration and geotechnical engineering evaluation for the proposed gantry crane installation to be constructed east of an existing storage warehouse at Tulsa Port of Catoosa. The services provided by Kleinfelder were in general accordance with our proposal (No. TUL14P00217) dated May 12, 2014. Conclusions and recommendations presented in the report are based on the subsurface information encountered at the location of our explorations and the provision and requirements outlined in the ADDITIONAL SERVICES and LIMITATIONS sections of this report. In addition, an article prepared by The Association of Engineering Firms Practicing in the Geosciences (ASFE), *Important Information About Your Geotechnical Engineering Report*, has been included in APPENDIX D. We recommend that all individuals read the report limitations along with the included ASFE document.

1.2 PROJECT DESCRIPTION

The proposed crane will be supported on four columns. Two columns will be placed within the dry dock, west of the existing channel, and two columns will be placed east of the dock face, approximately 75 feet into the channel. The structural loads and moments provided to us by Dewberry Engineers are summarized in Table 1-1 below. A drilled shaft diameter of eight feet has been assumed for our analysis.

We understand that a new gantry crane will be constructed at the Tulsa Port of Catoosa. The proposed location of the project is on the eastern side of the existing storage warehouse located at 5640 West Channel Road. We understand that the new gantry crane will be constructed following the demolition of the existing warehouse.

Table 1-1: Summary of Structural Loads and Moments

Load Type	Service Limit State	Strength I Limit State
Dry Dock Side		
Axial Compressive Load (kips)	1223.4	1742.1
Shear Load at Pile Top (kips)	139.8	206.6
Moment at Pile Top (kip-ft)	7537.0	11164.0
Water Side		
Axial Compressive Load (kips)	1397.9	1960.3
Shear Load at Pile Top (kips)	91.3	134.9
Moment at Pile Top (kip-ft)	4110.1	6070.2

Note: Loads provided by Dewberry Engineers

2. GENERAL SITE CONDITIONS

2.1 SITE LOCATION AND DESCRIPTION

The proposed location of the project is on the eastern side of the existing storage warehouse located at 5640 West Channel Road within the Tulsa Port of Catoosa, Catoosa, Oklahoma. We understand that the new gantry crane will be constructed following the demolition of the existing warehouse. The approximate site location is shown on the Figure 1, Site Location Diagram. The site is bounded by the channel to the east, existing channel banks to the north and south, and an open lot to the west. The channel bank is retained by a 45-foot high retaining wall to the east of the existing warehouse.

2.2 SUBSURFACE CONDITIONS

Kleinfelder explored the subsurface conditions at the site by drilling and sampling two borings on the dry dock side on May 14 and 15, 2014. The approximate location of the borings (labeled B-1 and B-2) are shown on Figure 2, Boring Location Diagram. The borings in the channels (B-3 and B-4) were drilled using a barge on May 29 and 30, 2014. Details of the field exploration and laboratory testing programs are presented in APPENDIX A and APPENDIX B of this report, respectively.

The following presents a general summary of the major strata encountered during our subsurface exploration and includes a discussion of the results of field and laboratory tests conducted. Specific subsurface conditions encountered at the boring location are presented on the boring log in APPENDIX A. The stratification lines shown on the log represent the approximate boundaries between material types. In-situ, the transitions may vary or be gradual.

Approximately 44 feet and 24 feet of existing fill soils comprising of medium dense to dense poorly graded sand with clay and gravel were encountered at borings B-1 and B-2, respectively. Native soils consisting of lean clay were encountered at boring B-2 below the fill soils to approximate depth of 45 feet. The consistency of the clay soils ranges from soft to firm and was a combination of brown, and tan in color.

Limestone bedrock was encountered below the native clay soils and continued to a depth of approximately 52 to 57 feet below the existing ground surface. Dark gray shale bedrock underlies the limestone bedrock to the maximum depth explored (74 to 80 feet below ground surface). The shale bedrock was generally slightly to moderately weathered and was generally soft and becoming moderately hard with depth.

In the channel borings B-3 and B-4, dark gray shale bedrock was encountered from approximately 14 feet below the water surface to the maximum depth explored ranging from 39 to 44 feet below the water surface.

2.3 GROUNDWATER OBSERVATIONS

Groundwater observations were made during and after our drilling operations at the dry dock side. Groundwater was encountered at 43 feet below ground surface during our drilling operations at boring B-2. The materials encountered in the boring have a wide range of permeabilities and observations over an extended period of time through use of piezometers or cased borings would be required to better define groundwater conditions. However, we anticipated that the groundwater elevation will closely match that of the water elevation in the navigation channel.

Fluctuations of groundwater levels can occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the boring was performed. Groundwater may be perched above the limestone bedrock encountered on the dry dock side, especially during rainy seasons. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 GENERAL

Based on the results of our field exploration, laboratory testing and engineering analyses, it is our professional opinion that the subsurface conditions will be able to support the gantry crane columns on the proposed 96-inch diameter drilled shafts extending to the underlying limestone and shale bedrock encountered below depths of about 45 feet below existing grades at the dry dock side and 15 feet below the existing water level on the water side. Recommendations, regarding geotechnical aspects of the foundation design and construction, are presented in the following sections.

The following recommendations are limited to the construction of the planned gantry crane columns. Our scope of services did not include analysis of any associated support building, or surface improvements.

3.2 FOUNDATION DESIGN RECOMMENDATIONS

Based on the subsurface conditions encountered and range of structural loads anticipated, it appears that a drilled shaft support will be used for each of the 4 columns supporting the proposed gantry crane girders. The following sections provide the drilled shaft foundation design parameters.

3.2.1 Axial Capacity

We anticipate that the drilled shafts will be installed using temporary casing throughout the soil overburden materials. Thus, axial loads can be resisted through a combination of side resistance and end bearing in the soil and rock materials. If permanent casing is used, the soil resistance should be neglected. Drilled shaft capacity estimates and recommendations are based on the methods and guidance in *AASHTO LRFD Bridge Design Specifications, 5th Edition* (2010). Resistance factors for the subsurface soils and bedrock vary with soil/rock type and location (side versus tip). Strength limit state resistance factors in accordance with Table 10.5.5.2.4-1 of AASHTO (2010) were used to develop the capacity curves and are listed in Table 3-1.

Table 3-1: Summary of Resistance Factors

Description	Condition	Resistance Factor
Axial Compressive Resistance of Single Drilled Shafts	Side Resistance in Rock Tip Resistance in Rock	0.55 0.5
Uplift Resistance of Single Drilled Shaft	Rock	0.4
Horizontal Geotechnical Resistance	All Materials	1.0

Table 3-2 summarizes the factored side resistance and factored end bearing for the encountered subsurface strata. Based on the settlement requirements of the project, we recommend that all drilled shafts bear a minimum of 9 feet into the limestone/shale bedrock strata encountered below the fill on the dry dock side or 23 feet into the shale bedrock encountered at about 15 feet below the water level on the water side. Drilled shafts meeting this criterion are anticipated to settle less than ½-inch.

Table 3-2: Geotechnical Design Parameters

Material	Depth Range (ft)	Factored Skin Resistance (ksf)		Factored End Bearing (ksf)
		Compression	Uplift	
Limestone	45-52 (Dry Dock Side)	7.6	5.6	-
Shale	Below 52 (Dry Dock Side) Below 15 (Water Side)	2.8	2.0	14.8

The factored and nominal axial resistances are estimated and the recommended embedment lengths of the shaft into the rock are summarized in Table 3-3.

Table 3-3: Summary of Axial Capacity Analyses

Location	Pile Size and Type	Service Limit State Load (kips)	Strength Limit State Load (kips)	Factored Resistance in Compression (kips)	Nominal Resistance in Compression (kips)	Rock Socket Length (ft)
Dry Dock Side	8-ft. Diameter Drilled Shaft	1224	1742	1860	3450	9.0
Water Side	8-ft. Diameter Drilled Shaft	1398	1960	1990	3690	23.0

3.2.2 Lateral Capacity

The drilled shaft foundations were analyzed for lateral deflection under design loading conditions with the LPILE computer program (Version 2013) by Ensoft, Inc. This program analyzes deflection as a function of the design loads, foundation construction, and subsurface conditions. The geotechnical parameters used in the evaluation of lateral load capacity and deflection are presented in Tables 3-4 and 3-5. The following parameters are included: the effective soil/bedrock unit weight (γ'), undrained shear strength (Su), friction angle, the strain at 50% of maximum strength (E50), and the unconfined compressive strength of hard rock (qu). The values provided are based on our analysis of the existing subsurface conditions and were estimated, or calculated, based on generally accepted engineering correlations. The elevations at which clay soils, shale, and limestone bedrock were encountered varied across the proposed project site. Consult the logs of the borings that are nearest to the structure being analyzed to determine the appropriate depths of the various soil and rock types.

Table 3-4: L-Pile Soil Parameters (Dry Dock Side)

Material	Material Type	Effective Unit Weight γ' (pcf)	Undrained Shear Strength (psf)	Friction Angle (degrees)	Static Soil Modulus k_h (pci)	E_{50}
Overburden Soils	Medium Dense Sand	120	-	33	60	-
Overburden Soils	Firm Clay	120	600	-	-	0.01

Table 3-5: L-Pile Rock Parameters (Dry Dock and Water Sides)

Material	Material Type	Effective Unit Weight γ' (pcf)	Unconfined Compressive Strength (psi)	RQD	Young's Modulus (E_{rm})	k_{rm}
Limestone	Strong Rock	140	5,000	-	-	-
Shale	Weak Rock	130	1,000	20%	2500 psi	0.00005

The summary of lateral pile capacity analyses are presented in Table 3-6. Lateral pile capacity calculation outputs are provided in Appendix C. The LPILE analyses are based on an assumption of about 1.1% steel reinforcement ratio.

Table 3-6: Summary of Lateral Capacity Analyses

Location	Foundation Type	Loading Condition Limit State	Shear Force at Pile Head (kips)	Lateral Deflection at Pile Head (inches)	Maximum Bending Moment (Kip-ft)	Depth to Maximum Moment* (ft)
Dry Dock Side	8-ft-Dia. Drilled Shaft	Service Strength	139.8 206.6	0.95 1.72	8526 12852	11 12
Water Side	8-ft-Dia. Drilled Shaft	Service Strength	91.3 134.9	0.02 0.04	4168 6148	1 1

*Depth from Pile Top

3.2.3 Construction Considerations

Drilled shaft excavation is not expected to be unusually difficult. Conventional drilling equipment should be able to penetrate the soil and bedrock to the required depth for bearing. Some water seepage should be anticipated during excavation of the foundations and use of temporary dewatering techniques should be anticipated. Temporary steel casing may be needed to advance drilled pier excavations. The bottom of the shaft excavation should be cleaned of water and loose material before placing concrete. To minimize disturbance to the bearing surfaces caused by ponding of water, it is recommended that concrete be placed the same day that the shafts are drilled.

We strongly recommend that the foundation excavations be monitored by the geotechnical engineer in order to determine that the design requirements have been achieved. To aid in evaluation of the bearing materials, probe holes should be drilled into the bottom of the limestone formations. Generally, probe holes are drilled in 25 percent of the drilled shafts supported in limestone. Should isolated areas of unsuitable material be encountered at planned depths, it will be necessary to deepen the drilled shafts to suitable bearing material. Construction drawings should include design loading conditions so that adjustments can be made in the field if soil conditions differ from those anticipated.

3.3 SEISMIC DESIGN PARAMETERS

Based on the subsurface conditions encountered in the borings, we recommend using a Seismic Site Class Definition of “D” per IBC 2012. There is no significant risk of liquefaction or mass movement of the on-site soils due to a seismic event.

4. ADDITIONAL SERVICES

4.1 PLANS AND SPECIFICATIONS REVIEW

We recommend that Kleinfelder conduct a general review of the final plans and specifications to evaluate that our foundation recommendations have been properly interpreted and implemented during design. In the event Kleinfelder is not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

4.2 CONSTRUCTION OBSERVATION AND TESTING

To effectively achieve the intent of the geotechnical recommendations presented in this report and to maintain continuity from design through construction, Kleinfelder should be retained to provide observation and testing services during construction. This will provide Kleinfelder with the opportunity to observe the subsurface conditions encountered during construction, evaluate the applicability of the geotechnical recommendations presented in our report as they relate to the soil conditions encountered, and to provide follow up recommendations if conditions differ from those described in our report.

5. LIMITATIONS

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil conditions could vary between or beyond the points explored. If soil conditions are encountered during construction that differ from those described herein, we should be notified immediately in order that a review may be made and any supplemental recommendations provided. If the scope of the proposed construction, including the proposed loads or structural locations, changes from that described in this report, our recommendations should also be reviewed.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty is expressed or implied. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by Kleinfelder during the construction phase in order to evaluate compliance with our recommendations. The scope of our services did not include any environmental assessment or exploration for the presence of hazardous or toxic materials in the soil, surface water, groundwater or air, on, below or around this site.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than 3 years from the date of report. Land use, site conditions (both on-site and off-site), regulations, or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and client agrees to defend, indemnify and hold harmless Kleinfelder from any claim or liability associated with such unauthorized or non-compliance.

FIGURES

FIGURE 1 – SITE VICINITY MAP
FIGURE 2 –SITE PLAN AND BORING LOCATIONS

TULSA, OKLAHOMA

NOT TO SCALE

Source: USGS

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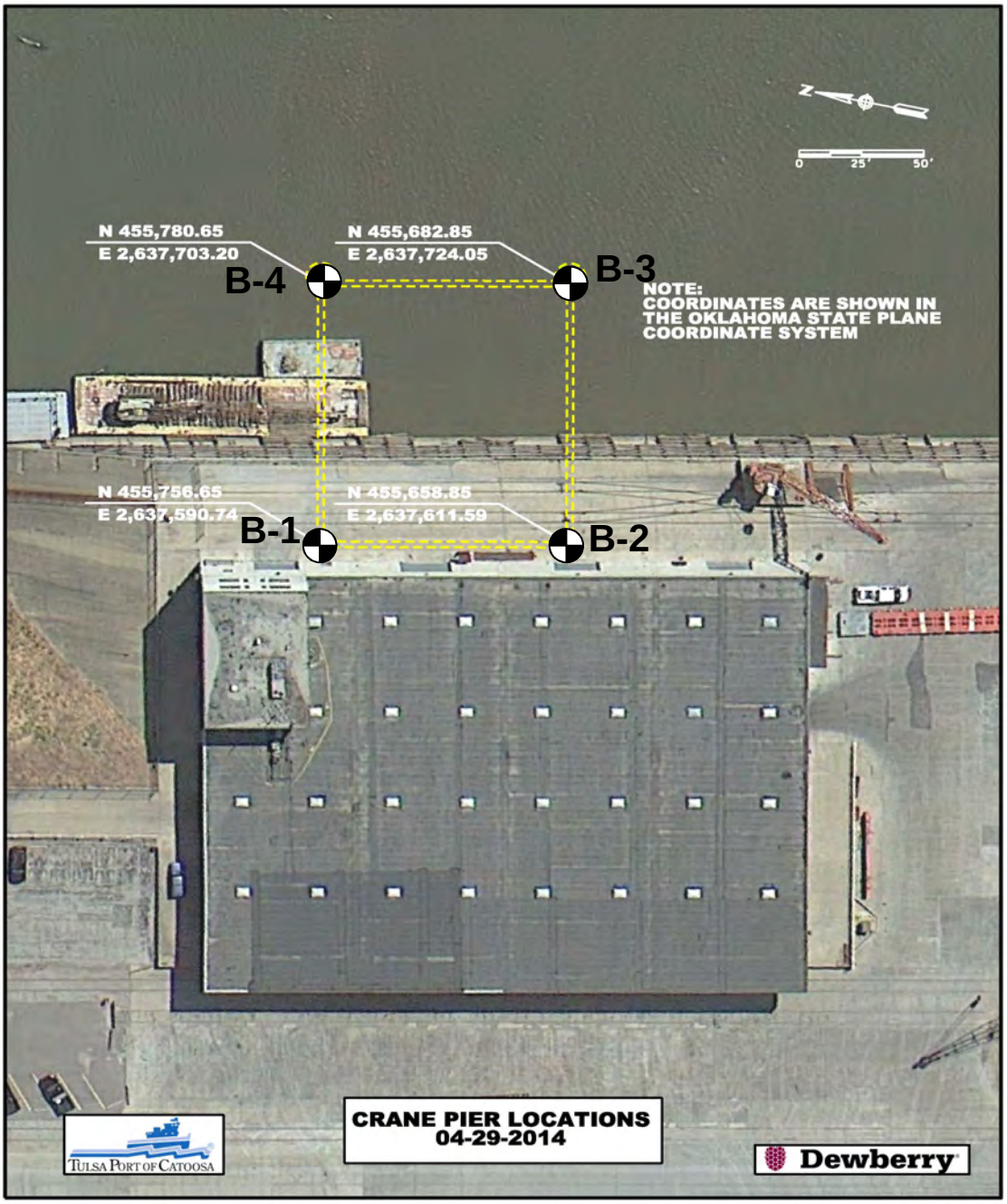
DRAWN:	6/24/2014
DRAWN BY:	WLT
CHECKED BY:	KR
FILE NAME:	20150761

SITE LOCATION DIAGRAM

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CASTOOSA, OKLAHOMA

FIGURE

1



Source: Dewberry

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BORING LOCATION DIAGRAM

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CATOOSA, OKLAHOMA

FIGURE

2

APPENDIX A

FIELD EXPLORATION PROGRAM
SUBSURFACE CROSS SECTION
GRAPHICS KEY
SOIL DESCRIPTION KEY
ROCK DESCRIPTION KEY
BORING LOGS
ROCK CORE PHOTOGRAPHS

FIELD EXPLORATION PROGRAM

Kleinfelder conducted the fieldwork for this study on May 14, 15 and 29, 2014. The exploration consisted of 4 borings drilled to depths of between 39 and 81 feet below existing grades. Representatives of Kleinfelder established the location of the borings in the field by GPS coordinates.

The borings were performed with a truck-mounted (CME 750), rotary drill rig using solid-stem augers to advance the boreholes on the dry dock side. On the water side, drilling was performed using a drilling equipment mounted on a barge. Representative samples were obtained by split-barrel procedures in accordance with ASTM D1586. The split-barrel sampling procedure utilizes a standard 2-inch O.D. split-barrel sampler that is driven into the bottom of the boring with a 140-pound cathead falling a distance of 30 inches. The number of blows required to advance the sampler the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Resistance Value (N). These "N" values are indicated on the boring logs at their depth of occurrence and provide an indication of the relative density of the material.

The bedrock encountered in the borings was cored using NQ-diamond bit coring procedures. This diameter core barrel provides a sample having an approximate diameter of 2 inches. Description of the rock core is presented on the boring log in addition to recovery and Rock Quality Designation (RQD) for the core recovered. Recovery is defined as the length of core obtained expressed as a percentage of the total length cored. Rock Quality Designation is defined as the total length of core pieces, 4 inches or greater in length, expressed as a percentage of the total length cored. Rock Quality Designation provides an indication of the integrity of the rock mass and relative extent of seams and bedding planes.

The samples were sealed and returned to our laboratory for further examination, classification and testing. Boring logs included in this appendix present such data as soil descriptions, consistency evaluations, depths, sampling intervals and observed groundwater conditions. Conditions encountered in each of the borings were monitored and recorded by the field engineer. Field logs included visual classification of the materials encountered during drilling, as well as drilling characteristics. Our final boring logs, as presented in this appendix, represent

an interpretation of the field logs combined with laboratory observation and testing of the samples. Stratification boundaries indicated on the boring logs were based on observations during our fieldwork, an extrapolation of information obtained by examining samples from the borings and comparisons of soils with similar engineering characteristics. Locations of these boundaries are approximate, and the transitions between material types may be gradual rather than clearly defined. The Graphics and Soil Description Keys identifying terms and symbols used on the logs are also included in this appendix.

NOTE:
REFER TO INDIVIDUAL LOGS FOR DETAILED INFORMATION AND THE GRAPHIC LEGEND KEYS FOR GRAPHICAL SYMBOL INFORMATION.

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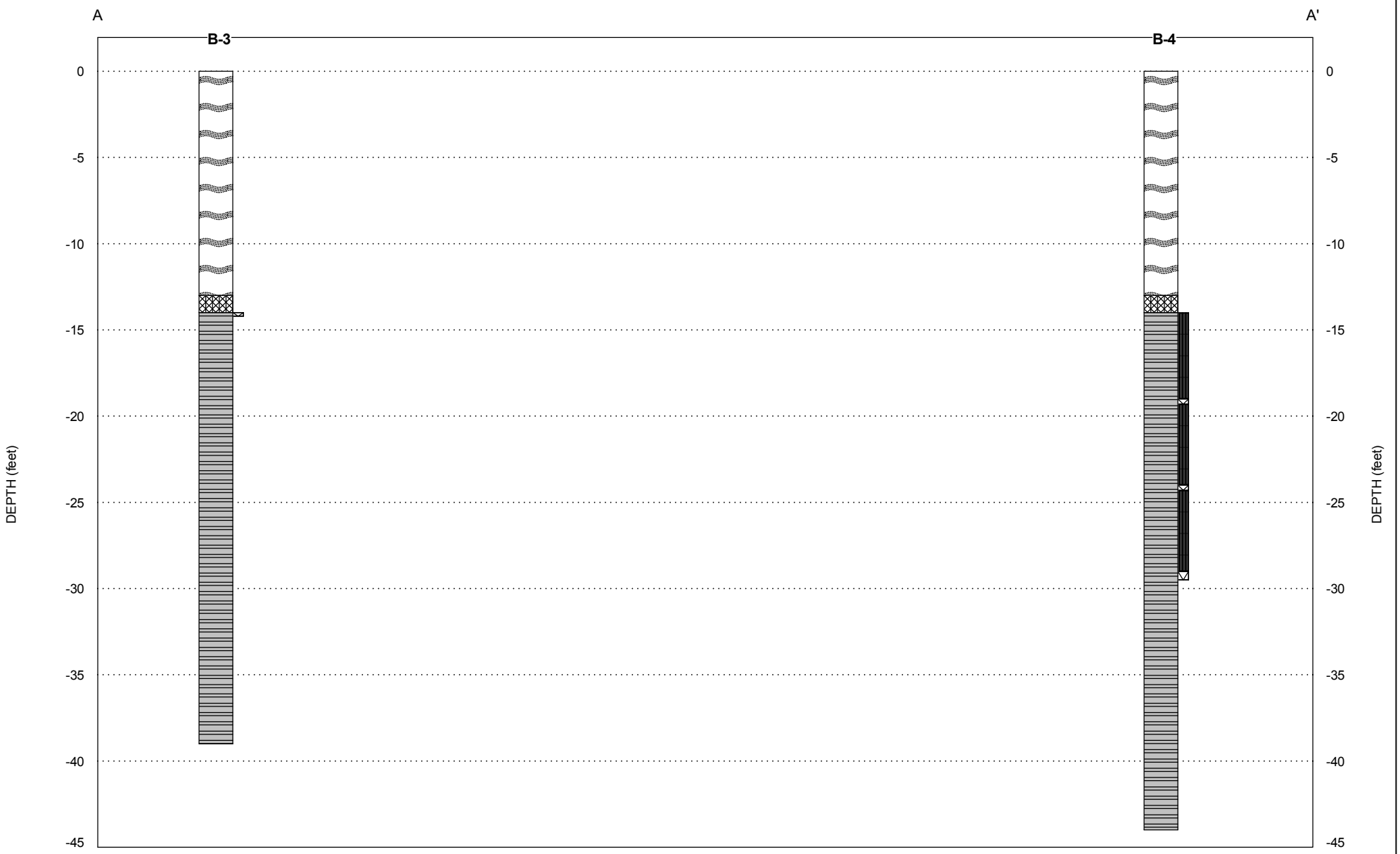
REVISED:	-

SUBSURFACE CROSS-SECTION

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

FIGURE

A-1a



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SUBSURFACE CROSS-SECTION

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

FIGURE

A-1b

SAMPLE/SAMPLER TYPE GRAPHICS

NQ CORE SAMPLE
(1.874 in. (47.6 mm.) core diameter)

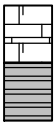
HOLLOW STEM AUGER

STANDARD PENETRATION SPLIT SPOON SAMPLER
(2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

TEXAS CONE PENETRATION

WASH BIN

ROCK LITHOLOGY GRAPHICS



LIMESTONE

SHALE

GROUND WATER GRAPHICS

WATER LEVEL (level where first observed)

WATER LEVEL (level after exploration completion)

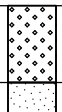
WATER LEVEL (additional levels after exploration)

OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches
- TCP-Texas Cone Penetrometer

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	**GRAVELS** (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu ≥4 and 1≤ Cc≤3		**GW**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu <4 and/ or 1>Cc >3		**GP**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	Cu ≥4 and 1≤ Cc≤3		**GW-GM**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
					GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			Cu <4 and/ or 1>Cc >3		**GP-GM**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
					GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES			**GM**	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
					GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
					GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu ≥6 and 1≤ Cc≤3		**SW**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu <6 and/ or 1>Cc >3		**SP**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu ≥6 and 1≤ Cc≤3		**SW-SM**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
					SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			Cu <6 and/ or 1>Cc >3		**SP-SM**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
					SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES			**SM**	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
					SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
					SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		**ML**	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit greater than 50)		**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

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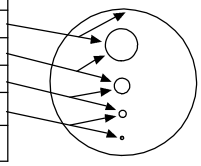
GRAPHICS KEY

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

A-2

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #10	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



Munsell Color

NAME	ABBR
Red	R
Yellow Red	YR
Yellow	Y
Green Yellow	GY
Green	G
Blue Green	BG
Blue	B
Purple Blue	PB
Purple	P
Red Purple	RP
Black	N

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

NOTE: AFTER TERZAGHI AND PECK, 1948

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (q_u)(psf)	CRITERIA
Very Soft	< 1000	Thumb will penetrate soil more than 1 in. (25 mm.)
Soft	1000 - 2000	Thumb will penetrate soil about 1 in. (25 mm.)
Firm	2000 - 4000	Thumb will indent soil about 1/4-in. (6 mm.)
Hard	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail
Very Hard	> 8000	Thumbnail will not indent soil

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

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SOIL DESCRIPTION KEY

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

A-3

INFILLING TYPE

NAME	ABBR	NAME	ABBR
Albite	Al	Muscovite	Mus
Apatite	Ap	None	No
Biotite	Bi	Pyrite	Py
Clay	Cl	Quartz	Qz
Calcite	Ca	Sand	Sd
Chlorite	Ch	Sericite	Ser
Epidote	Ep	Silt	Si
Iron Oxide	Fe	Talc	Ta
Manganese	Mn	Unknown	Uk

BEDDING CHARACTERISTICS

TERM	Thickness (in.)	Thickness (mm.)
Very Thick Bedded	> 36	> 915
Thick Bedded	12 - 36	305 - 915
Moderately Bedded	4 - 12	102 - 305
Thin Bedded	1 - 4	25 - 102
Very Thin Bedded	0.4 - 1	10 - 25
Laminated	0.1 - 0.4	2.5 - 10
Thinly Laminated	< 0.1	< 2.5

Bedding Planes — Planes dividing the individual layers, beds, or stratigraphy of rocks.
Joint — Fracture in rock, generally more or less vertical or traverse to bedding.
Seam — Applies to bedding plane with unspecified degree of weather.

DENSITY/SPACING OF DISCONTINUITIES

DESCRIPTION	SPACING CRITERIA
Unfractured	> 6 ft. (> 1.83 meters)
Slightly Fractured	2 - 6 ft. (.061 - 1.83 meters)
Moderately Fractured	8 in - 2 ft. (203.20 - 609.60 mm.)
Highly Fractured	2 - 8 in. (50.80 - 203.30 mm.)
Intensely Fractured	< 2 in. (< 50.80 mm.)

APERTURE

DESCRIPTION	CRITERIA [in.(mm.)]
Tight	< 0.04 (< 1)
Open	0.04 - 0.20 (1 - 5)
Wide	> 0.20 (> 5)

ADDITIONAL TEXTURAL ADJECTIVES

DESCRIPTION	RECOGNITION
Pit (Pitted)	Pinhole to 0.03 ft. (3/8 in.) (>1 to 10 mm.) openings
Vug (Vuggy)	Small openings (usually lined with crystals) ranging in diameter from 0.03 ft. (3/8 in.) to 0.33 ft. (4 in.) (10 to 100 mm.)
Cavity	An opening larger than 0.33 ft. (4 in.) (100 mm.), size descriptions are required, and adjectives such as small, large, etc., may be used
Honeycombed	If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form
Vesicle (Vesicular)	Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification

DISCONTINUITY TYPE

DESCRIPTION
Fault
Joint
Shear
Foliation
Vein
Bedding

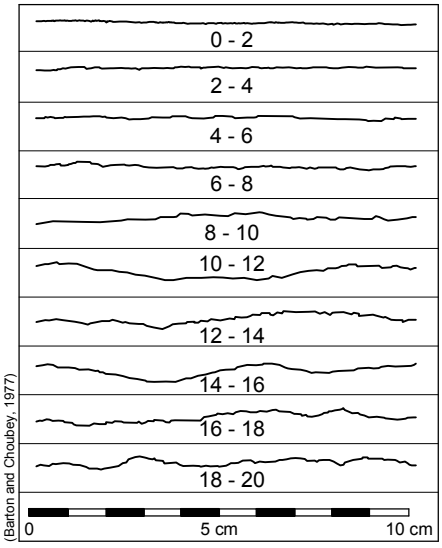
INFILLING AMOUNT

DESCRIPTION
Surface Stain
Spotty
Partially Filled
Filled
None

ROCK QUALITY DESIGNATION (RQD)

DESCRIPTION	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

JOINT ROUGHNESS COEFFICIENT (JRC)



RQD — Rock-quality designation (RQD) Rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 10 cm. or more.

DEGREES OF WEATHERING

DESCRIPTION	CRITERIA
Unweathered	No evidence of chemical/mechanical alternation; rings with hammer blow.
Slightly Weathered	Slight discoloration on surface; slight alteration along discontinuities; <10% rock volume altered.
Moderately Weathered	Discoloring evident; surface pitted and alteration penetration well below surface; Weathering "halos" evident; 10-50% rock altered.
Highly Weathered	Entire mass discolored; Alteration pervading most rock, some slight weathering pockets; some minerals may be leached out.
Decomposed	Rock reduced to soil with relict rock texture/structure; Generally molded and crumbled by hand.

RELATIVE HARDNESS / STRENGTH DESCRIPTIONS

GRADE		UCS (MPa)	FIELD TEST
R0	Extremely Weak	0.25 - 1.0	Indented by thumbnail
R1	Very Weak	1.0 - 5.0	Crumbles under firm blows of geological hammer, can be peeled by a pocket knife
R2	Weak	5.0 - 25	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer
R3	Medium Strong	25 - 50	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of a geological hammer
R4	Strong	50 - 100	Specimen requires more than one blow of geological hammer to fracture it
R5	Very Strong	100 - 250	Specimen requires many blows of geological hammer to fracture it
R6	Extremely Strong	> 250	Specimen can only be chipped with a geological hammer

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ROCK DESCRIPTION KEY

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

A-4

Date Begin - End:	5/14/2014 - 5/15/2014	**Drilling Company:**	DSO	**BORING LOG B-1**	
Logged By:	S. Wang	**Drill Crew:**	T. Simpson		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-750	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Not Available	**Exploration Diameter:**			

Latitude: 36.23058° N
Longitude: -95.73119° W
Ground Surface Elevation Not Available

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		FILL **Poorly-graded SAND with Clay and Gravel**: gray and brown, medium dense											
		- clay seams from 3.0 to 4.5 feet		BC=2 2 25	14"		18.7						
5		- cobbles at 4.5 feet											
		FILL **Silty SAND**: gray and brown, moist, loose		BC=4 4 4	12"	SM	9.8		98	23	15	2	
10													
		FILL **Poorly-graded SAND with Clay and Gravel**: gray and brown, moist, loose to very dense		BC=16 17 16	12"		9.1						
15													
				BC=11 27 47	15"		11.8						
20													
				BC=5 6 8	9"		9.1						
25													
				BC=8 13 13	3"		6.0						
30													
				BC=2 2 4	2"		19.6						

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BORING LOG B-1

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-1

Date Begin - End:	5/14/2014 - 5/15/2014	**Drilling Company:**	DSO		
Logged By:	S. Wang	**Drill Crew:**	T. Simpson		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-750	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Not Available	**Exploration Diameter:**			

Latitude: 36.23058° N
Longitude: -95.73119° W
Ground Surface Elevation Not Available

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		FILL **Poorly-graded SAND with Clay and Gravel**: gray and brown, moist, loose to very dense											
				BC=5 5 6	NR		19.8						
40													
		Sandy Lean CLAY (CL): dark gray, moist, soft		BC=3 2 17	14"	CL	21.8		99	69	27	9	
45													
		LIMESTONE: gray, fine-grained, slightly to moderately weathered, massive, highly to intensely fractured, medium strong		BC=50/0.5" RQD=7	NR 40"								**Unc. Comp. Str.=** q_u: 19050 psi
50													
				RQD=65	54"								
55													**Unc. Comp. Str.=** q_u: 6010 psi
				RQD=50	60"								
		SHALE with Oil Seams: dark gray, fine-grained, slightly to moderately weathered, laminated, highly to intensely fractured, extremely weak to weak											**Unc. Comp. Str.=** q_u: 14380 psi
60													
				RQD=7	60"								
65													**Unc. Comp. Str.=** q_u: 0 psi
				RQD=60	56"								

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BORING LOG B-1

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-1

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Date Begin - End:	5/14/2014 - 5/15/2014	**Drilling Company:**	DSO	**BORING LOG B-1**	
Logged By:	S. Wang	**Drill Crew:**	T. Simpson		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-750	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Not Available	**Exploration Diameter:**			

FIELD EXPLORATION

Latitude: 36.23058° N
Longitude: -95.73119° W
Ground Surface Elevation Not Available

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
75		**SHALE with Oil Seams**: dark gray, fine-grained, slightly to moderately weathered, laminated, highly to intensely fractured, extremely weak to weak			56" *(cont.)*								**Unc. Comp. Str.=** q_u: 2490 psi
				RQD=0	59"								
80				RQD=0	59"								**Unc. Comp. Str.=** q_u: 2290 psi
85													
90													
95													
100													

The exploration was terminated at approximately 81 ft. below ground surface. The exploration was backfilled with bentonite on May 14, 2014.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
Rock Classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

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BORING LOG B-1

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-1

BORING LOG B-2

Date Begin - End:	5/15/2014	**Drilling Company:**	DSO		
Logged By:	S. Wang	**Drill Crew:**	T. Simpson		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-750	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Not Available	**Exploration Diameter:**			

Latitude: 36.23033° N
Longitude: -95.73110° W
Ground Surface Elevation Not Available

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		FILL **Clayey SAND with Gravel**: brown and yellowish brown, moist											
				BC=31 10 8	13"		5.8						
5													
		FILL **Silty SAND**: brown and yellowish brown, moist		BC=2 7 7	14"	SM	7.3		97	22	15	2	
10													
				BC=16 23 15	16"		6.8						
15													
				BC=3 9 25	15"		8.5						
20													
				BC=5 3 1	18"		21.4						
25		**Lean CLAY (CL)**: brown and tan, soft											
				BC=1 3 5	18"	CL	19.9			86	42	26	
30													
				BC=0 2 3	1"		18.4						

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BORING LOG B-2

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-2

Date Begin - End:	5/15/2014	**Drilling Company:**	DSO	**BORING LOG B-2**	
Logged By:	S. Wang	**Drill Crew:**	T. Simpson		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-750	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Not Available	**Exploration Diameter:**			

FIELD EXPLORATION

Latitude: 36.23033° N
Longitude: -95.73110° W
Ground Surface Elevation Not Available

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)
		Lean CLAY (CL): brown and tan, soft			
				BC=1 2 3	18"
40					
		LIMESTONE: gray, fine-grained, slightly weathered, very thickly bedded, highly to intensely fractured, medium strong		BC=50/2.5" RQD=19	NR 46"
45					
				RQD=48	58"
50					
		SHALE with Oil Seams: dark gray, fine-grained, unweathered to slightly weathered, laminated, highly to intensely fractured, extremely weak to weak		RQD=48	59"
55					
				BC=50/2.5" RQD=57	2" 54"
60					
				BC=50/2" RQD=56	2" 56"
65					
				BC=50/1.75" RQD=65	1"

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	25.3						
	2.3						**Unc. Comp. Str.=** q_u: 8620 psi
							Unc. Comp. Str.= q_u: 6140 psi
							Unc. Comp. Str.= q_u: 4240 psi
							Unc. Comp. Str.= q_u: 1210 psi
							Unc. Comp. Str.= q_u: 1060 psi

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BORING LOG B-2

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-2

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BORING LOG B-2

Date Begin - End:	5/15/2014	**Drilling Company:**	DSO		
Logged By:	S. Wang	**Drill Crew:**	T. Simpson		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-750	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Not Available	**Exploration Diameter:**			

FIELD EXPLORATION

Latitude: 36.23033° N
Longitude: -95.73110° W
Ground Surface Elevation Not Available

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		SHALE with Oil Seams: dark gray, fine-grained, unweathered to slightly weathered, laminated, highly to intensely fractured, extremely weak to weak			51" *(cont.)*								**Unc. Comp. Str.=** q_u: 2850 psi
				BC=50/1.5"	1"								
75		The exploration was terminated at approximately 74 ft. below ground surface. The exploration was backfilled with bentonite on May 15, 2014.											
80													
85													
90													
95													
100													

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 43 ft. below ground surface during drilling.

GENERAL NOTES:
Rock Classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

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BORING LOG B-2

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-2

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BORING LOG B-3

Date Begin - End:	5/29/2014	**Drilling Company:**	Triangle		
Logged By:	S. Wang	**Drill Crew:**	Henry		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**		**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Not Available	**Exploration Diameter:**			

FIELD EXPLORATION | LABORATORY RESULTS

Coordinates Not Available
Ground Surface Elevation Not Available

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		WATER											
5													
10													
		SLURRY											
15		**SHALE**: dark gray, moderately hard		TC=50/2" 50/0.25"									
20													
25													
30													

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PROJECT NO.:	20150761
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DATE:	6/3/2014
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BORING LOG B-3

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-3

BORING LOG B-3

Date Begin - End:	5/29/2014	**Drilling Company:**	Triangle		
Logged By:	S. Wang	**Drill Crew:**	Henry		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**		**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Not Available	**Exploration Diameter:**			

Depth (feet)	Graphical Log	FIELD EXPLORATION: Coordinates Not Available, Ground Surface Elevation Not Available; Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		SHALE: dark gray, moderately hard											
40		The exploration was terminated at approximately 39 ft. below ground surface. The exploration was backfilled with bentonite on May 29, 2014.											
45													
50													
55													
60													
65													

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
Rock Classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

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PROJECT NO.:	20150761
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BORING LOG B-3

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-3

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BORING LOG B-4

Date Begin - End:	5/29/2014	**Drilling Company:**	Triangle		
Logged By:	S. Wang	**Drill Crew:**	Henry		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**		**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Not Available	**Exploration Diameter:**			

FIELD EXPLORATION

Coordinates Not Available
Ground Surface Elevation Not Available

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)
		WATER			
5					
10					
		SLURRY			
15		**SHALE**: dark gray, fine-grained, unweathered to slightly weathered, intensely fractured, no covity		RQD=0	30"
20				TC=50/3" 50/0.5" RQD=0	9"
25				TC=50/3.5" 50/0.5" RQD=0	11"
30				TC=50/3.25" 50/2.25"	

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks

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PROJECT NO.:	20150761
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CHECKED BY:	SYW
DATE:	6/3/2014
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BORING LOG B-4

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-4

BORING LOG B-4

Date Begin - End:	5/29/2014	**Drilling Company:**	Triangle		
Logged By:	S. Wang	**Drill Crew:**	Henry		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**		**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Not Available	**Exploration Diameter:**			

Depth (feet)	Graphical Log	FIELD EXPLORATION: Coordinates Not Available, Ground Surface Elevation Not Available; Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Texas Cone(TC)= blows/6 RQD=%	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
40		**SHALE**: dark gray, fine-grained, unweathered to slightly weathered, intensely fractured, no covity											
45		The exploration was terminated at approximately 44 ft. below ground surface. The exploration was backfilled with bentonite on May 29, 2014.											
50													
55													
60													
65													

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
Rock Classification is based on drilling characteristics and visual observation of disturbed samples. Core samples would be required for exact classification.

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PROJECT NO.:	20150761
DRAWN BY:	BJM
CHECKED BY:	SYW
DATE:	6/3/2014
REVISED:	-

BORING LOG B-4

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

B-4

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TULSA, OKLAHOMA

Source: Kleinfelder

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PROJECT NO.	20150761
DRAWN:	8/19/2014
DRAWN BY:	WLT
CHECKED BY:	KR
FILE NAME:	20150761

BORING B-1
ROCK CORE PHOTOGRAPH

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CASTOOSA, OKLAHOMA

FIGURE

A5

TULSA, OKLAHOMA

Source: Kleinfelder

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PROJECT NO.	20150761
DRAWN:	8/19/2014
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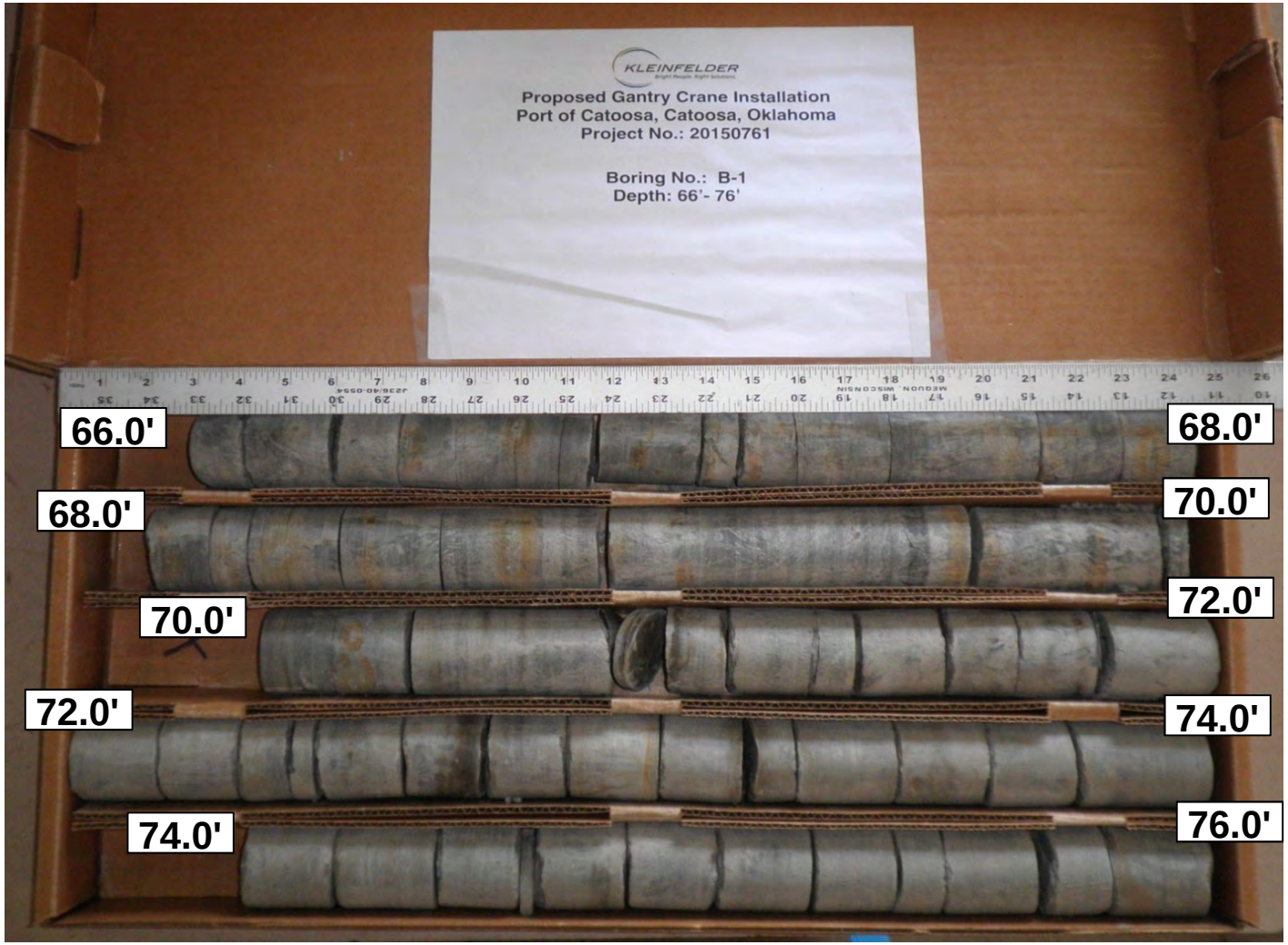
BORING B-1
ROCK CORE PHOTOGRAPH

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CASTOOSA, OKLAHOMA

FIGURE

A6

TULSA, OKLAHOMA



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BORING B-1
ROCK CORE PHOTOGRAPH

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CASTOOSA, OKLAHOMA

FIGURE

A7

TULSA, OKLAHOMA

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BORING B-1
ROCK CORE PHOTOGRAPH

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CASTOOSA, OKLAHOMA

FIGURE

A8

TULSA, OKLAHOMA

Source: Kleinfelder

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BORING B-2
ROCK CORE PHOTOGRAPH

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CASTOOSA, OKLAHOMA

FIGURE

A9

TULSA, OKLAHOMA

Source: Kleinfelder

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BORING B-2
ROCK CORE PHOTOGRAPH

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CASTOOSA, OKLAHOMA

FIGURE

A10

TULSA, OKLAHOMA

Source: Kleinfelder

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BORING B-2
ROCK CORE PHOTOGRAPH

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CASTOOSA, OKLAHOMA

FIGURE

A11

TULSA, OKLAHOMA

Source: Kleinfelder

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FILE NAME:	20150761

BORING B-4
ROCK CORE PHOTOGRAPH

GANTRY CRANE INSTALLATION
PORT OF CATOOSA
CASTOOSA, OKLAHOMA

FIGURE

A12

APPENDIX B

LABORATORY TESTING PROGRAM

LABORATORY TESTING PROGRAM

Laboratory tests were performed on select, representative samples to aid in soil classification and to evaluate physical properties of the soils that may affect the geotechnical aspects of project design and construction. Laboratory tests were performed in general accordance with applicable standards, and the results are presented on the respective boring logs. The laboratory testing program consisted of the following:

- **Rock Unconfined Compression**, ASTM D2938, Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens
- **Dry density determinations,** as outlined in the sample preparation procedures in ASTM D2166
- **Moisture content tests,** ASTM D2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- **Atterberg limits,** ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- **Particle Size Analysis of Soils,** ASTM D422, Standard Test Method for Particle Size Analysis of Soils.
- **Visual classification,** ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

Exploration ID	Depth (ft.)	Sample Description	USCS	AASHTO	OKLAHOMA SOIL INDEX (OSI)	Water Content (%)	Atterberg Limits			Sieve Analysis (%)				
							Liquid Limits	Plastic Limits	Plasticity Index	Passing #4	Passing #10	Passing #40	Passing #100	Passing #200
B-1	3.5					18.7								
B-1	8.5	SILTY SAND	SM	A-1-b		9.8	15	13	2	98	75	38	26	23
B-1	13.5					9.1								
B-1	18.5					11.8								
B-1	23.5					9.1								
B-1	28.5					6.0								
B-1	33.5					19.6								
B-1	38.5					19.8								
B-1	44.0	SANDY LEAN CLAY	CL	A-4		21.8	27	18	9	99	92	85	81	69
B-2	3.5					5.8								
B-2	8.5	SILTY SAND	SM	A-1-b		7.3	15	13	2	97	72	38	25	22
B-2	13.5					6.8								
B-2	18.5					8.5								
B-2	23.5					21.4								
B-2	28.5	LEAN CLAY	CL	A-7-6		19.9	42	16	26		100	99	95	86
B-2	33.5					18.4								
B-2	38.5					25.3								
B-2	43.5					2.3								

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = Nonplastic

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PROJECT NO.: 20150761
DRAWN BY: BJM
CHECKED BY: SYW
DATE: 5/19/2014
REVISED: -

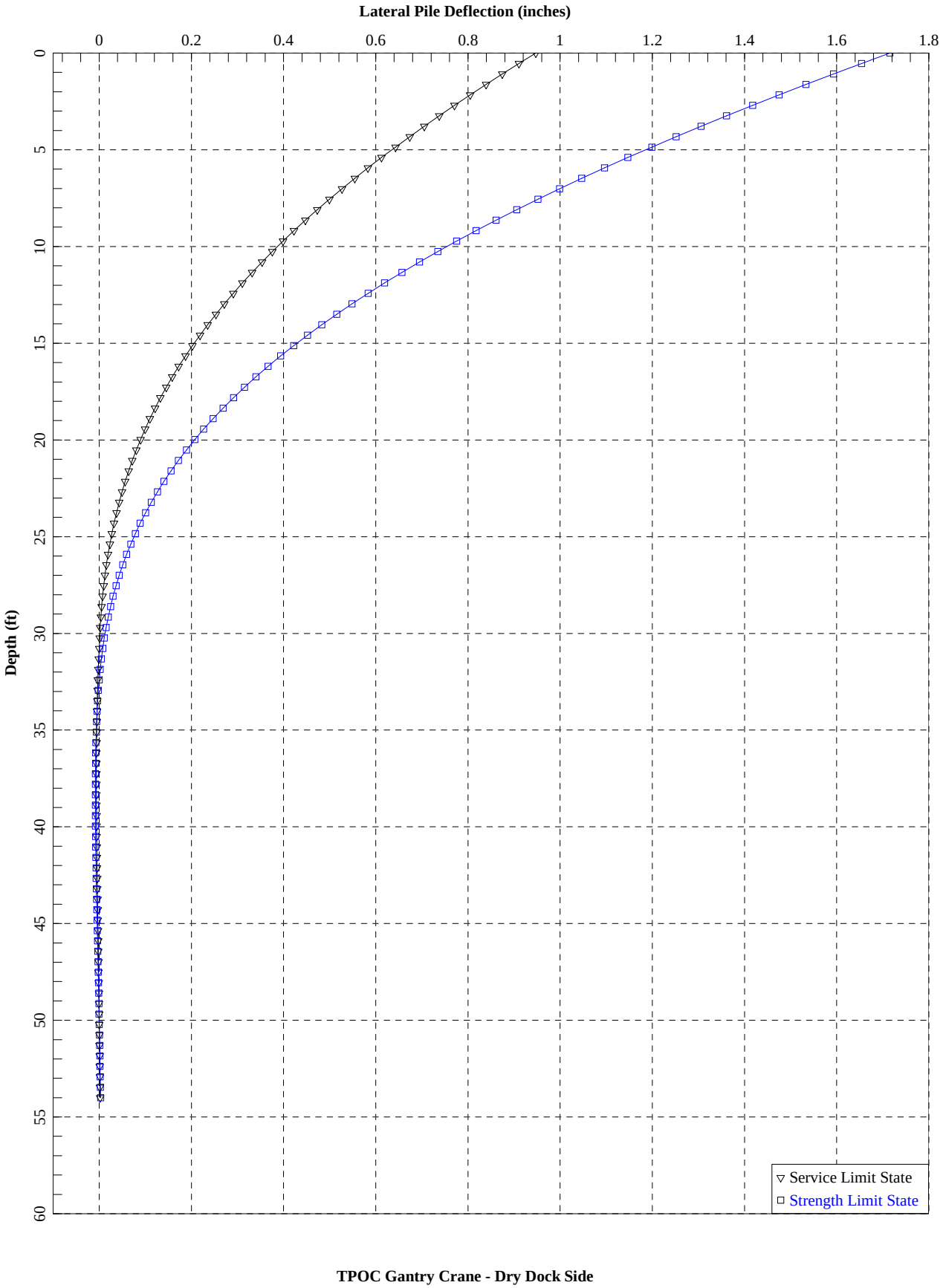
LABORATORY TEST RESULT SUMMARY

Gantry Crane Installation
Port of Catoosa
Catoosa, Oklahoma

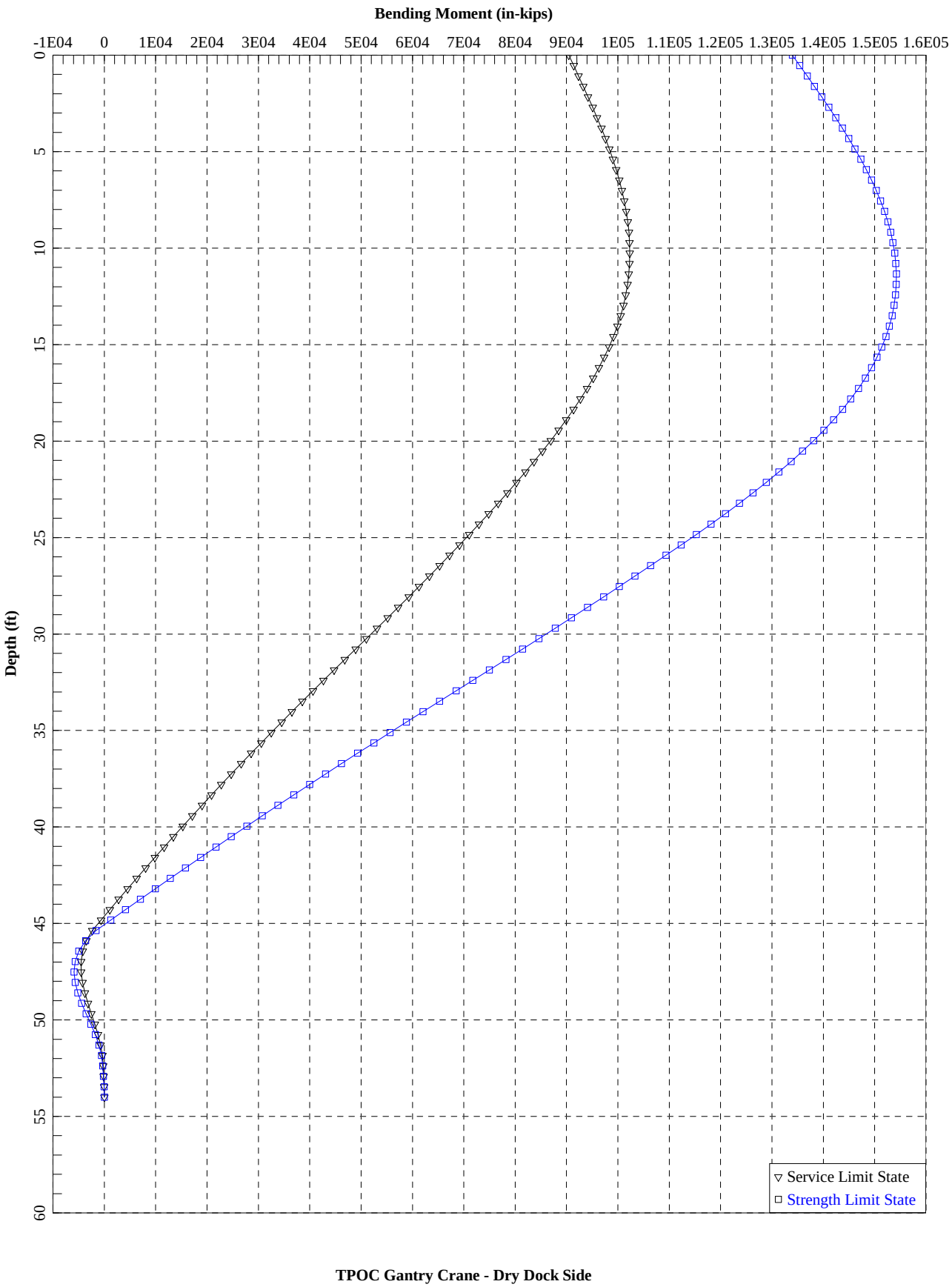
TABLE
B-1

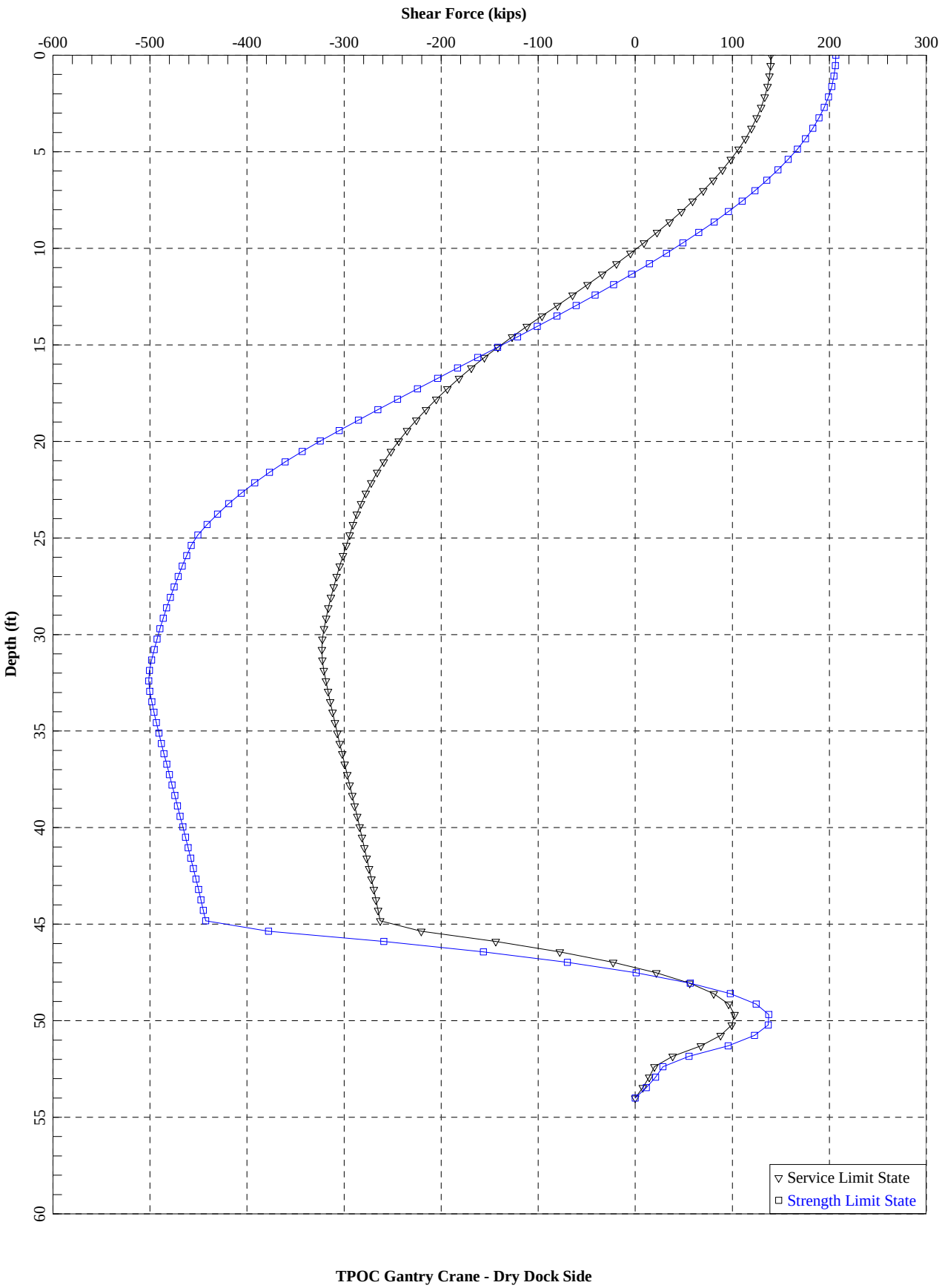
APPENDIX C

LPILE RESULTS



TPOC Gantry Crane - Dry Dock Side


Bending Moment (in-kips)
-1E04
0
1E04
2E04
3E04
4E04
5E04
6E04
7E04
8E04
9E04
1E05
1.1E05
1.2E05
1.3E05
1.4E05
1.5E05
1.6E05
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Service Limit State
Strength Limit State
TPOC Gantry Crane - Dry Dock Side



TPOC Gantry Crane - Dry Dock Side

LPile Plus for Windows, Version 2013-07.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

This copy of LPile is used by:

Kleinfelder
Tulsa

Serial Number of Security Device: 239146276
This copy of LPile is licensed for exclusive use by: Kleinfelder, Various, Global Lic

Use of this program by any entity other than Kleinfelder, Various, Global Lic
is forbidden by the software license agreement.

Files Used for Analysis

Path to file locations: \\tulsa\TULSA-DATA\WORKING\2014\Geotechnical Working - 2014\20150761_TPOC Gantry Crane\Calcs\LPILE\
Name of input data file: Drydock_Side.lp7d
Name of output report file: Drydock_Side.lp7o
Name of plot output file: Drydock_Side.lp7p
Name of runtime messeage file: Drydock_Side.lp7r

Date and Time of Analysis

Date: August 18, 2014 Time: 11:27:38

Problem Title

Project Name: TPOC Gantry Crane

Job Number: 20150761

Client:

Engineer: KR

Description: Dry Dock Side

Program Options and Settings

Engineering Units of Input Data and Computations:
- Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

Computational Options:
- Use unfactored loads in computations (conventional analysis)
- Compute pile response under loading and nonlinear bending properties of pile (only if nonlinear pile properties are input)
- Analysis uses p-y modification factors for p-y curves
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- No p-y curves to be computed and reported for user-specified depths
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1

Pile Structural Properties and Geometry

Total number of pile sections = 1

Total length of pile = 54.00 ft

Depth of ground surface below top of pile = 0.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile.

Point	Depth X ft	Pile Diameter in
1	0.00000	94.0000000
2	54.000000	94.0000000

Input Structural Properties:

Pile Section No. 1:

Section Type = Drilled Shaft (Bored Pile)
Section Length = 54.00000 ft
Section Diameter = 94.00000 in

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 25.00000 ft
Effective unit weight at top of layer = 57.60000 pcf
Effective unit weight at bottom of layer = 57.60000 pcf
Friction angle at top of layer = 33.00000 deg.
Friction angle at bottom of layer = 33.00000 deg.
Subgrade k at top of layer = 60.00000 pci
Subgrade k at bottom of layer = 60.00000 pci

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer = 25.00000 ft
Distance from top of pile to bottom of layer = 45.00000 ft
Effective unit weight at top of layer = 57.60000 pcf
Effective unit weight at bottom of layer = 57.60000 pcf
Undrained cohesion at top of layer = 600.00000 psf
Undrained cohesion at bottom of layer = 600.00000 psf
Epsilon-50 at top of layer = 0.01000
Epsilon-50 at bottom of layer = 0.01000

Layer 3 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 45.00000 ft
Distance from top of pile to bottom of layer = 52.00000 ft
Effective unit weight at top of layer = 77.60000 pcf
Effective unit weight at bottom of layer = 77.60000 pcf
Uniaxial compressive strength at top of layer = 5000.00000 psi
Uniaxial compressive strength at bottom of layer = 5000.00000 psi

Layer 4 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer = 52.00000 ft
Distance from top of pile to bottom of layer = 100.00000 ft
Effective unit weight at top of layer = 67.60000 pcf
Effective unit weight at bottom of layer = 67.60000 pcf
Uniaxial compressive strength at top of layer = 1000.00000 psi

Uniaxial compressive strength at bottom of layer = 1000.00000 psi
Initial modulus of rock at top of layer = 2500.00000 psi
Initial modulus of rock at bottom of layer = 2500.00000 psi
RQD of rock at top of layer = 20.00000 %
RQD of rock at bottom of layer = 20.00000 %
k rm of rock at top of layer = 0.0000500
k rm of rock at bottom of layer = 0.0000500

(Depth of lowest soil layer extends 46.00 ft below pile tip)

Summary of Soil Properties

Layer Num.	Soil Type (p-y Curve Criteria)	Uniaxial qu or GSI	RQD % or Strain Factor Epsilon 50	kpy pci	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.
					Rock Mass Rock Emass krm psi			
1	Sand (Reese, et al.)				0.00	57.600	--	33.000
--	--	--	--	60.000	--	--		
					25.000	57.600	--	33.000
--	--	--	--	60.000	--	--		
2	Stiff Clay w/o Free Water				25.000	57.600	600.000	--
--	--	0.01000	--		--	--		
					45.000	57.600	600.000	--
--	--	0.01000	--		--	--		
3	Vuggy Limestone				45.000	77.600	--	--
5000.000	--	--	--		--	--		
					52.000	77.600	--	--
5000.000	--	--	--		--	--		
4	Weak Rock				52.000	67.600	--	--
1000.000	20.000	--	--		2500.000	5.00E-05		
					100.000	67.600	--	--
1000.000	20.000	--	--		2500.000	5.00E-05		

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	1.0000	1.0000
2	80.000	1.0000	1.0000

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 139800. lbs	M = 90444000. in-lbs	1223400.	No
2	1	V = 206600. lbs	M = 133968000. in-lbs	1742100.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	54.00000 ft
Shaft Diameter	=	94.00000 in
Concrete Cover Thickness	=	3.00000 in
Number of Reinforcing Bars	=	60 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	6939.77817 sq. in.
Total Area of Reinforcing Steel	=	76.20000 sq. in.
Area Ratio of Steel Reinforcement	=	1.10 percent
Edge-to-Edge Bar Spacing	=	6.53178 in
Maximum Concrete Aggregate Size	=	0.75000 in
Ratio of Bar Spacing to Aggregate Size	=	8.71
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	27908.166 kips
Tensile Load for Cracking of Concrete	=	-3109.573 kips
Nominal Axial Tensile Capacity	=	-4572.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.27000	1.27000	43.36035	-0.63498
2	1.27000	1.27000	43.36035	0.63498
3	1.27000	1.27000	42.54484	8.39402
4	1.27000	1.27000	42.28080	9.63623
5	1.27000	1.27000	39.86992	17.05616
6	1.27000	1.27000	39.35338	18.21632
7	1.27000	1.27000	35.45249	24.97287
8	1.27000	1.27000	34.70603	26.00028
9	1.27000	1.27000	29.48562	31.79814
10	1.27000	1.27000	28.54186	32.64790
11	1.27000	1.27000	22.23008	37.23368
12	1.27000	1.27000	21.13027	37.86865
13	1.27000	1.27000	14.00298	41.04193
14	1.27000	1.27000	12.79519	41.43436
15	1.27000	1.27000	5.16389	43.05645
16	1.27000	1.27000	3.90089	43.18919
17	1.27000	1.27000	-3.90089	43.18919
18	1.27000	1.27000	-5.16389	43.05645
19	1.27000	1.27000	-12.79519	41.43436
20	1.27000	1.27000	-14.00298	41.04193
21	1.27000	1.27000	-21.13027	37.86865
22	1.27000	1.27000	-22.23008	37.23368
23	1.27000	1.27000	-28.54186	32.64790
24	1.27000	1.27000	-29.48562	31.79814
25	1.27000	1.27000	-34.70603	26.00028
26	1.27000	1.27000	-35.45249	24.97287
27	1.27000	1.27000	-39.35338	18.21632
28	1.27000	1.27000	-39.86992	17.05616
29	1.27000	1.27000	-42.28080	9.63623
30	1.27000	1.27000	-42.54484	8.39402
31	1.27000	1.27000	-43.36035	0.63498
32	1.27000	1.27000	-43.36035	-0.63498
33	1.27000	1.27000	-42.54484	-8.39402
34	1.27000	1.27000	-42.28080	-9.63623
35	1.27000	1.27000	-39.86992	-17.05616
36	1.27000	1.27000	-39.35338	-18.21632
37	1.27000	1.27000	-35.45249	-24.97287
38	1.27000	1.27000	-34.70603	-26.00028
39	1.27000	1.27000	-29.48562	-31.79814
40	1.27000	1.27000	-28.54186	-32.64790
41	1.27000	1.27000	-22.23008	-37.23368
42	1.27000	1.27000	-21.13027	-37.86865
43	1.27000	1.27000	-14.00298	-41.04193
44	1.27000	1.27000	-12.79519	-41.43436
45	1.27000	1.27000	-5.16389	-43.05645
46	1.27000	1.27000	-3.90089	-43.18919
47	1.27000	1.27000	3.90089	-43.18919
48	1.27000	1.27000	5.16389	-43.05645
49	1.27000	1.27000	12.79519	-41.43436
50	1.27000	1.27000	14.00298	-41.04193
51	1.27000	1.27000	21.13027	-37.86865
52	1.27000	1.27000	22.23008	-37.23368
53	1.27000	1.27000	28.54186	-32.64790
54	1.27000	1.27000	29.48562	-31.79814
55	1.27000	1.27000	34.70603	-26.00028
56	1.27000	1.27000	35.45249	-24.97287
57	1.27000	1.27000	39.35338	-18.21632
58	1.27000	1.27000	39.86992	-17.05616
59	1.27000	1.27000	42.28080	-9.63623
60	1.27000	1.27000	42.54484	-8.39402

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = -0.0000454 inches between Bars 1 and 2

Spacing to aggregate size ratio = -0.0000605

Concrete Properties:

Compressive Strength of Concrete	=	4000.00000 psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.34164 psi
Compression Strain at Peak Stress	=	0.00189
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.75000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	1223.400
2	1742.100

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318-08 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than than 0.003. See ACI 318-08, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 1223.400 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Concrete Stress ksi	Max Steel Stress ksi	Run Msg
0.000000313	5530.4277197	17697368703.	173.2682481	0.0000541	0.0000248	0.2257428	1.5659841	
0.000000625	11061.	17697121257.	110.1986906	0.0000689	0.0000101	0.2855739	1.9888325	
0.000000938	16590.	17696516165.	89.2041434	0.0000836	-0.000004496	0.3450358	2.4124595	
0.000001250	22114.	17691266747.	78.7249122	0.0000984	-0.0000191	0.4041086	2.8367406	

0.000001563	27620.	17677008450.	72.4455692	0.0001132	-0.0000337	0.4627512	3.2613930	
0.000001875	33104.	17655539161.	68.2632216	0.0001280	-0.0000483	0.5209405	3.6862564	
0.000002188	38564.	17629050457.	65.2779432	0.0001428	-0.0000628	0.5786653	4.1112539	
0.000002500	43998.	17599077022.	63.0402742	0.0001576	-0.0000774	0.6359197	4.5363449	
0.000002813	49406.	17566630797.	61.3007332	0.0001724	-0.0000920	0.6927005	4.9615067	
0.000003125	54789.	17532380179.	59.9097270	0.0001872	-0.0001065	0.7490054	5.3867253	
0.000003438	54789.	15938527435.	51.3477122	0.0001765	-0.0001466	0.7073608	5.0718719	C
0.000003750	54789.	14610316816.	49.7004287	0.0001864	-0.0001661	0.7446641	5.3538091	C
0.000004063	54789.	13486446291.	48.2601326	0.0001961	-0.0001858	0.7810371	5.6302749	C
0.000004375	54789.	12523128699.	46.9848090	0.0002056	-0.0002057	0.8165307	-5.9054211	C
0.000004688	54789.	11688253453.	45.8501053	0.0002149	-0.0002257	0.8513085	-6.4814857	C
0.000005000	54789.	10957737612.	44.8314597	0.0002242	-0.0002458	0.8854130	-7.0612884	C
0.000005313	54789.	10313164811.	43.9103556	0.0002333	-0.0002661	0.9188908	-7.6445265	C
0.000005625	54789.	9740211210.	43.0728403	0.0002423	-0.0002865	0.9517971	-8.2308242	C
0.000005938	54789.	9227568515.	42.3081717	0.0002512	-0.0003069	0.9841919	-8.8197586	C
0.000006250	54789.	8766190089.	41.6080103	0.0002601	-0.0003274	1.0161399	-9.4108606	C
0.000006563	54789.	8348752466.	40.9638312	0.0002688	-0.0003480	1.0476619	-10.0039990	C
0.000006875	54789.	7969263718.	40.3649699	0.0002775	-0.0003687	1.0786865	-10.5997779	C
0.000007188	55404.	7708442441.	39.8133870	0.0002862	-0.0003895	1.1094230	-11.1965565	C
0.000007500	56733.	7564368295.	39.2977649	0.0002947	-0.0004103	1.1397278	-11.7955111	C
0.000007813	58054.	7430878043.	38.8188136	0.0003033	-0.0004311	1.1697453	-12.3955032	C
0.000008125	59364.	7306379686.	38.3698013	0.0003118	-0.0004520	1.1994054	-12.9971218	C
0.000008438	60670.	7190511749.	37.9513463	0.0003202	-0.0004729	1.2288288	-13.5994018	C
0.000008750	61965.	7081677014.	37.5552668	0.0003286	-0.0004939	1.2578659	-14.2035885	C
0.000009063	63258.	6980235029.	37.1871190	0.0003370	-0.0005149	1.2867695	-14.8076134	C
0.000009375	64541.	6884365768.	36.8354955	0.0003453	-0.0005359	1.3152588	-15.4138184	C
0.000009688	65821.	6794377305.	36.5055137	0.0003536	-0.0005570	1.3435629	-16.0203166	C
0.0000100	67099.	6709913638.	36.1967032	0.0003620	-0.0005780	1.3717357	-16.6266560	C
0.0000103	68366.	6629456018.	35.8981738	0.0003702	-0.0005992	1.3994609	-17.2355180	C
0.0000106	69632.	6553618176.	35.6175109	0.0003784	-0.0006203	1.4270502	-17.8442857	C
0.0000109	70897.	6482025751.	35.3533781	0.0003867	-0.0006414	1.4545105	-18.4528972	C
0.0000113	72156.	6413841606.	35.0996473	0.0003949	-0.0006626	1.4816618		

-19.0629025 C						
0.0000116	73410.	6348937724.	34.8569038	0.0004030	-0.0006838	1.5085619
-19.6738225 C						
0.0000119	74663.	6287371127.	34.6273836	0.0004112	-0.0007050	1.5353353
-20.2845885 C						
0.0000122	75915.	6228884863.	34.4100708	0.0004194	-0.0007263	1.5619817
-20.8951999 C						
0.0000128	78404.	6119337194.	33.9983352	0.0004356	-0.0007688	1.6144660
-22.1197343 C						
0.0000134	80886.	6019433647.	33.6234219	0.0004518	-0.0008113	1.6663149
-23.3448446 C						
0.0000141	83361.	5927912567.	33.2803309	0.0004680	-0.0008539	1.7175263
-24.5705682 C						
0.0000147	85823.	5843301872.	32.9598384	0.0004841	-0.0008965	1.7678625
-25.7991032 C						
0.0000153	88282.	5765365281.	32.6668928	0.0005002	-0.0009392	1.8177038
-27.0270235 C						
0.0000159	90736.	5693238924.	32.3971192	0.0005163	-0.0009818	1.8669920
-28.2548533 C						
0.0000166	93177.	5625810589.	32.1411359	0.0005323	-0.0010245	1.9153841
-29.4858387 C						
0.0000172	95615.	5563082409.	31.9050157	0.0005484	-0.0010673	1.9632858
-30.7162031 C						
0.0000178	98050.	5504558402.	31.6866748	0.0005644	-0.0011100	2.0106951
-31.9459426 C						
0.0000184	100481.	5449797814.	31.4840999	0.0005805	-0.0011526	2.0575986
-33.1751672 C						
0.0000191	102900.	5398057196.	31.2891084	0.0005964	-0.0011954	2.1036253
-34.4075428 C						
0.0000197	105317.	5349425515.	31.1076111	0.0006124	-0.0012382	2.1491633
-35.6392826 C						
0.0000203	107730.	5303614711.	30.9383693	0.0006284	-0.0012809	2.1942108
-36.8703824 C						
0.0000209	110139.	5260371110.	30.7802924	0.0006445	-0.0013237	2.2387659
-38.1008380 C						
0.0000216	112545.	5219470439.	30.6324162	0.0006605	-0.0013664	2.2828265
-39.3306453 C						
0.0000222	114945.	5180616193.	30.4917210	0.0006765	-0.0014091	2.3262590
-40.5611926 C						
0.0000228	117338.	5143602513.	30.3567389	0.0006925	-0.0014519	2.3690118
-41.7930605 C						
0.0000234	119728.	5108413757.	30.2299355	0.0007085	-0.0014946	2.4112729
-43.0242625 C						
0.0000241	122115.	5074906777.	30.1106802	0.0007245	-0.0015373	2.4530402
-44.2547941 C						
0.0000247	124498.	5042952906.	29.9984062	0.0007406	-0.0015800	2.4943118
-45.4846503 C						
0.0000253	126877.	5012436174.	29.8926031	0.0007567	-0.0016227	2.5350855
-46.7138266 C						
0.0000259	129253.	4983251780.	29.7928095	0.0007728	-0.0016654	2.5753594
-47.9423179 C						
0.0000266	131625.	4955304773.	29.6986077	0.0007889	-0.0017080	2.6151312
-49.1701193 C						
0.0000272	133994.	4928508417.	29.6096031	0.0008050	-0.0017506	2.6543980
-50.3972379 C						
0.0000278	136356.	4902674517.	29.5221069	0.0008211	-0.0017933	2.6929320
-51.6263662 C						
0.0000284	138714.	4877849765.	29.4393249	0.0008372	-0.0018359	2.7309651
-52.8547785 C						
0.0000291	141068.	4853968197.	29.3609597	0.0008533	-0.0018786	2.7684953
-54.0824692 C						
0.0000297	143419.	4830969392.	29.2867387	0.0008695	-0.0019212	2.8055203
-55.3094327 C						

0.0000303	145767.	4808797901.	29.2164121	0.0008856	-0.0019638	2.8420379
-56.5356633 C						
0.0000309	148110.	4787402746.	29.1497504	0.0009018	-0.0020063	2.8780458
-57.7611551 C						
0.0000316	150450.	4766736974.	29.0865424	0.0009180	-0.0020488	2.9135417
-58.9859022 C						
0.0000322	152786.	4746757271.	29.0265931	0.0009343	-0.0020913	2.9485233
-60.0000000 CY						
0.0000328	155119.	4727423609.	28.9697229	0.0009506	-0.0021338	2.9829884
-60.0000000 CY						
0.0000334	157447.	4708698943.	28.9157654	0.0009669	-0.0021763	3.0169344
-60.0000000 CY						
0.0000341	159599.	4685461484.	28.8549864	0.0009829	-0.0022190	3.0496846
-60.0000000 CY						
0.0000347	161486.	4655438559.	28.7827183	0.0009984	-0.0022622	3.0809156
-60.0000000 CY						
0.0000353	163154.	4620278202.	28.7016788	0.0010135	-0.0023058	3.1108249
-60.0000000 CY						
0.0000359	164708.	4583167383.	28.6157937	0.0010284	-0.0023497	3.1396979
-60.0000000 CY						
0.0000366	166257.	4547203293.	28.5320568	0.0010432	-0.0023937	3.1680385
-60.0000000 CY						
0.0000372	167642.	4508030581.	28.4422713	0.0010577	-0.0024379	3.1952777
-60.0000000 CY						
0.0000397	172417.	4344376991.	28.0748307	0.0011142	-0.0026164	3.2971220
-60.0000000 CY						
0.0000422	176294.	4178819774.	27.7072257	0.0011689	-0.0027967	3.3890255
-60.0000000 CY						
0.0000447	179778.	4023004786.	27.3523011	0.0012223	-0.0029783	3.4725363
-60.0000000 CY						
0.0000472	182655.	3870839646.	27.0047875	0.0012743	-0.0031613	3.5478834
-60.0000000 CY						
0.0000497	185106.	3725397078.	26.6676164	0.0013250	-0.0033456	3.6158197
-60.0000000 CY						
0.0000522	187514.	3593073792.	26.3568495	0.0013755	-0.0035301	3.6778576
-60.0000000 CY						
0.0000547	189612.	3467192218.	26.0596134	0.0014251	-0.0037155	3.7335459
-60.0000000 CY						
0.0000572	191262.	3344464061.	25.7599117	0.0014731	-0.0039025	3.7823467
-60.0000000 CY						
0.0000597	192841.	3230847282.	25.4757112	0.0015206	-0.0040900	3.8257084
-60.0000000 CY						
0.0000622	194406.	3126133538.	25.2180297	0.0015682	-0.0042774	3.8644363
-60.0000000 CY						
0.0000647	195957.	3029285182.	24.9838580	0.0016161	-0.0044645	3.8984618
-60.0000000 CY						
0.0000672	197240.	2935665854.	24.7435548	0.0016625	-0.0046532	3.9266729
-60.0000000 CY						
0.0000697	198271.	2845138507.	24.5015367	0.0017075	-0.0048432	3.9496762
-60.0000000 CY						
0.0000722	199233.	2759942413.	24.2749594	0.0017523	-0.0050333	3.9683265
-60.0000000 CY						
0.0000747	200185.	2680300355.	24.0664509	0.0017975	-0.0052232	3.9827388
-60.0000000 CY						
0.0000772	201110.	2605474345.	23.8673815	0.0018423	-0.0054134	3.9927535
-60.0000000 CY						
0.0000797	202010.	2535024145.	23.6770722	0.0018868	-0.0056039	3.9984645
-60.0000000 CY						
0.0000822	202898.	2468721900.	23.5011152	0.0019315	-0.0057941	3.9979311
-60.0000000 CY						
0.0000847	203748.	2405881808.	23.3362922	0.0019763	-0.0059843	3.9990291
-60.0000000 CY						
0.0000872	204492.	2345425809.	23.1752470	0.0020206	-0.0061750	3.9964300

-60.0000000	CY						
0.0000897		205110.	2286942314.	23.0149592	0.0020642	-0.0063665	3.9987844
-60.0000000	CY						
0.0000922		205627.	2230532068.	22.8478364	0.0021063	-0.0065593	3.9989424
-60.0000000	CY						
0.0000947		206115.	2176791154.	22.6903081	0.0021485	-0.0067521	3.9972671
60.0000000	CY						
0.0000972		206597.	2125758544.	22.5425955	0.0021909	-0.0069448	3.9997416
60.0000000	CY						
0.0000997		207071.	2077205577.	22.4044359	0.0022334	-0.0071372	3.9939805
60.0000000	CY						
0.0001022		207539.	2030961865.	22.2749096	0.0022762	-0.0073294	3.9979878
60.0000000	CY						
0.0001047		208002.	1986881000.	22.1530384	0.0023191	-0.0075215	3.9998886
60.0000000	CY						
0.0001072		208448.	1944701391.	22.0342454	0.0023618	-0.0077138	3.9930644
60.0000000	CY						
0.0001097		208878.	1904302244.	21.9169881	0.0024040	-0.0079066	3.9972636
60.0000000	CY						
0.0001122		209298.	1865613331.	21.8074063	0.0024465	-0.0080991	3.9995610
60.0000000	CY						
0.0001147		209693.	1828387508.	21.7079650	0.0024896	-0.0082910	3.9967309
60.0000000	CY						
0.0001172		210082.	1792696640.	21.6144882	0.0025329	-0.0084827	3.9945949
60.0000000	CY						
0.0001197		210444.	1758280633.	21.5236345	0.0025761	-0.0086745	3.9980683
60.0000000	CY						
0.0001222		210738.	1724709001.	21.4417946	0.0026199	-0.0088657	3.9998124
60.0000000	CY						
0.0001247		211011.	1692317694.	21.3629430	0.0026637	-0.0090569	3.9951152
60.0000000	CY						
0.0001272		211239.	1660850691.	21.2835710	0.0027070	-0.0092486	3.9935170
60.0000000	CY						
0.0001297		211458.	1630518438.	21.2097614	0.0027506	-0.0094400	3.9971977
60.0000000	CY						
0.0001322		211610.	1600833433.	21.1346373	0.0027937	-0.0096319	3.9993275
60.0000000	CY						
0.0001347		211746.	1572124881.	21.0558149	0.0028360	-0.0098247	3.9999570
60.0000000	CY						
0.0001372		211876.	1544423867.	20.9816479	0.0028784	-0.0100172	3.9921691
60.0000000	CY						
0.0001522		212476.	1396142970.	20.6367920	0.0031407	-0.0111650	3.9879567
60.0000000	CYT						
0.0001672		212969.	1273830492.	20.3873443	0.0034085	-0.0123071	3.9908282
60.0000000	CYT						
0.0001822		213400.	1171319167.	20.1990049	0.0036800	-0.0134456	3.9999777
60.0000000	CYT						
0.0001972		213400.	1082217234.	20.1762030	0.0039785	-0.0145571	3.9982572
60.0000000	CYT						

Axial Thrust Force = 1742.100 kips

Bending Max Steel Curvature Stress	Run Msg	Bending Moment	Bending Stiffness	Depth to N Axis	Max Comp Strain	Max Tens Strain	Max Concrete Stress
rad/in. ksi		in-kip	kip-in2	in	in/in	in/in	ksi
0.000000313 2.0578906	5485.5744058	17553838098.	227.5475888	0.0000711	0.0000417	0.2952999	

0.000000625		10971.	17553628221.	137.3389160	0.0000858	0.0000271	0.3545763
2.4807491							
0.000000938		16456.	17553099307.	107.2982925	0.0001006	0.0000125	0.4134836
2.9043942							
0.000001250		21940.	17552316022.	92.2996817	0.0001154	-0.000002125	0.4720190
3.3288260							
0.000001563		27421.	17549603559.	83.3165896	0.0001302	-0.0000167	0.5301721
3.7539861							
0.000001875		32889.	17540982321.	77.3372261	0.0001450	-0.0000312	0.5879107
4.1796554							
0.000002188		38338.	17526072722.	73.0714849	0.0001598	-0.0000458	0.6452093
4.6056567							
0.000002500		43765.	17505974971.	69.8753265	0.0001747	-0.0000603	0.7020531
5.0318862							
0.000002813		49168.	17481845555.	67.3914687	0.0001895	-0.0000748	0.7584331
5.4582823							
0.000003125		54546.	17454608982.	65.4057954	0.0002044	-0.0000894	0.8143437
5.8848065							
0.000003438		59898.	17424961907.	63.7821872	0.0002193	-0.0001039	0.8697812
6.3114337							
0.000003750		59898.	15972881748.	57.1670270	0.0002144	-0.0001381	0.8509119
6.1658017	C						
0.000004063		59898.	14744198536.	55.3969914	0.0002251	-0.0001568	0.8904019
6.4710862	C						
0.000004375		59898.	13691041498.	53.8314033	0.0002355	-0.0001757	0.9288556
6.7702280	C						
0.000004688		59898.	12778305398.	52.4326663	0.0002458	-0.0001948	0.9663448
7.0636749	C						
0.000005000		59898.	11979661311.	51.1760815	0.0002559	-0.0002141	1.0030038
7.3523818	C						
0.000005313		59898.	11274975351.	50.0357080	0.0002658	-0.0002336	1.0388269
7.6362169	C						
0.000005625		59898.	10648587832.	48.9984429	0.0002756	-0.0002531	1.0739532
7.9162023	C						
0.000005938		59898.	10088135841.	48.0498073	0.0002853	-0.0002728	1.1084297
8.1926481	C						
0.000006250		60510.	9681544303.	47.1785458	0.0002949	-0.0002926	1.1423101
8.4659239	C						
0.000006563		62018.	9450288402.	46.3757325	0.0003043	-0.0003125	1.1756510
-8.9740465	C						
0.000006875		63499.	9236279673.	45.6330282	0.0003137	-0.0003325	1.2084827
-9.5494587	C						
0.000007188		64953.	9036918112.	44.9402399	0.0003230	-0.0003526	1.2407511
-10.1279282	C						
0.000007500		66388.	8851769280.	44.2963716	0.0003322	-0.0003728	1.2726005
-10.7083142	C						
0.000007813		67810.	8679659513.	43.6977966	0.0003414	-0.0003930	1.3040960
-11.2901086	C						
0.000008125		69206.	8517644382.	43.1319579	0.0003504	-0.0004133	1.3350342
-11.8750386	C						
0.000008438		70593.	8366623874.	42.6045139	0.0003595	-0.0004336	1.3656916
-12.4608299	C						
0.000008750		71964.	8224472009.	42.1064818	0.0003684	-0.0004541	1.3959244
-13.0487177	C						
0.000009063		73325.	8091044059.	41.6383830	0.0003773	-0.0004745	1.4258465
-13.6377656	C						
0.000009375		74673.	7965080642.	41.1950662	0.0003862	-0.0004950	1.4553920
-14.2285601	C						
0.000009688		76014.	7846594251.	40.7779287	0.0003950	-0.0005156	1.4846880
-14.8200350	C						
0.0000100		77340.	7734024395.	40.3793928	0.0004038	-0.0005362	1.5135647
-15.4136761	C						
0.0000103		78665.	7628160547.	40.0056225	0.0004126	-0.0005568	1.5422956

-16.0071341	C						
0.0000106		79975.	7527070999.	39.6458067	0.0004212	-0.0005775	1.5705775
-16.6030671	C						
0.0000109		81281.	7431414182.	39.3055858	0.0004299	-0.0005982	1.5986610
-17.1993064	C						
0.0000113		82585.	7340862175.	38.9840713	0.0004386	-0.0006189	1.6265741
-17.7956092	C						
0.0000116		83874.	7253931610.	38.6722278	0.0004471	-0.0006397	1.6540345
-18.3944967	C						
0.0000119		85161.	7171481522.	38.3773039	0.0004557	-0.0006605	1.6813546
-18.9932097	C						
0.0000122		86448.	7093166909.	38.0979991	0.0004643	-0.0006813	1.7085340
-19.5917478	C						
0.0000128		88993.	6945818612.	37.5668874	0.0004813	-0.0007230	1.7618685
-20.7937942	C						
0.0000134		91531.	6811591292.	37.0848146	0.0004983	-0.0007648	1.8145595
-21.9959832	C						
0.0000141		94043.	6687536870.	36.6349166	0.0005152	-0.0008067	1.8661578
-23.2025262	C						
0.0000147		96552.	6573749641.	36.2248982	0.0005321	-0.0008486	1.9172112
-24.4083918	C						
0.0000153		99038.	6467798415.	35.8387091	0.0005488	-0.0008906	1.9672001
-25.6185390	C						
0.0000159		101518.	6369785699.	35.4832071	0.0005655	-0.0009326	2.0166007
-26.8285020	C						
0.0000166		103990.	6278620425.	35.1527519	0.0005822	-0.0009747	2.0653065
-28.0393219	C						
0.0000172		106445.	6193164972.	34.8403644	0.0005988	-0.0010168	2.1131082
-29.2531152	C						
0.0000178		108896.	6113478054.	34.5511964	0.0006154	-0.0010589	2.1603784
-30.4662382	C						
0.0000184		111342.	6038894044.	34.2819434	0.0006321	-0.0011011	2.2070653
-31.6791952	C						
0.0000191		113772.	5968346312.	34.0236812	0.0006486	-0.0011433	2.2527959
-32.8958368	C						
0.0000197		116197.	5902075221.	33.7829968	0.0006651	-0.0011855	2.2980001
-34.1118046	C						
0.0000203		118619.	5839684688.	33.5582743	0.0006817	-0.0012277	2.3426756
-35.3270946	C						
0.0000209		121035.	5780770249.	33.3472934	0.0006982	-0.0012699	2.3867753
-36.5421871	C						
0.0000216		123437.	5724636979.	33.1431964	0.0007147	-0.0013122	2.4299740
-37.7606231	C						
0.0000222		125836.	5671488390.	32.9516635	0.0007311	-0.0013545	2.4726484
-38.9783733	C						
0.0000228		128231.	5621078001.	32.7716688	0.0007476	-0.0013968	2.5147964
-40.1954334	C						
0.0000234		130622.	5573185614.	32.6022958	0.0007641	-0.0014390	2.5564156
-41.4117989	C						
0.0000241		133008.	5527613894.	32.4427235	0.0007807	-0.0014812	2.5975040
-42.6274651	C						
0.0000247		135383.	5483883833.	32.2869682	0.0007971	-0.0015235	2.6377387
-43.8461831	C						
0.0000253		137754.	5442131158.	32.1394106	0.0008135	-0.0015658	2.6774191
-45.0645295	C						
0.0000259		140121.	5402237775.	31.9999123	0.0008300	-0.0016081	2.7165720
-46.2821628	C						
0.0000266		142483.	5364071440.	31.8679111	0.0008465	-0.0016504	2.7551953
-47.4990778	C						
0.0000272		144842.	5327512031.	31.7428963	0.0008630	-0.0016926	2.7932867
-48.7152695	C						
0.0000278		147196.	5292450211.	31.6244035	0.0008796	-0.0017348	2.8308437
-49.9307326	C						

0.0000284		149547.	5258786244.	31.5120088	0.0008961	-0.0017770	2.8678641
-51.1454620	C						
0.0000291		151889.	5226275629.	31.4019418	0.0009126	-0.0018193	2.9041272
-52.3623040	C						
0.0000297		154225.	5194960553.	31.2965409	0.0009291	-0.0018615	2.9398022
-53.5791186	C						
0.0000303		156558.	5164803737.	31.1963462	0.0009456	-0.0019037	2.9749427
-54.7951774	C						
0.0000309		158887.	5135734060.	31.1010488	0.0009622	-0.0019459	3.0095465
-56.0104746	C						
0.0000316		161211.	5107686009.	31.0103641	0.0009788	-0.0019881	3.0436110
-57.2250042	C						
0.0000322		163532.	5080599146.	30.9240299	0.0009954	-0.0020303	3.0771337
-58.4387601	C						
0.0000328		165848.	5054417629.	30.8418041	0.0010120	-0.0020724	3.1101122
-59.6517363	C						
0.0000334		168160.	5029089776.	30.7634628	0.0010287	-0.0021145	3.1425440
-60.0000000	CY						
0.0000341		170468.	5004567688.	30.6887984	0.0010453	-0.0021565	3.1744263
-60.0000000	CY						
0.0000347		172715.	4979177541.	30.6146738	0.0010619	-0.0021987	3.2055637
-60.0000000	CY						
0.0000353		174737.	4948291175.	30.5317739	0.0010782	-0.0022412	3.2353562
-60.0000000	CY						
0.0000359		176545.	4912565060.	30.4388014	0.0010939	-0.0022842	3.2637325
-60.0000000	CY						
0.0000366		178113.	4871470529.	30.3368226	0.0011092	-0.0023277	3.2907768
-60.0000000	CY						
0.0000372		179653.	4831007281.	30.2375411	0.0011245	-0.0023712	3.3172675
-60.0000000	CY						
0.0000397		184874.	4658243662.	29.8288451	0.0011838	-0.0025468	3.4154348
-60.0000000	CY						
0.0000422		189333.	4487891757.	29.4316586	0.0012416	-0.0027240	3.5036618
-60.0000000	CY						
0.0000447		192833.	4315142256.	29.0271809	0.0012972	-0.0029035	3.5815100
-60.0000000	CY						
0.0000472		196204.	4157957133.	28.6658865	0.0013527	-0.0030830	3.6527407
-60.0000000	CY						
0.0000497		198755.	4000095704.	28.2859731	0.0014055	-0.0032652	3.7142430
-60.0000000	CY						
0.0000522		201183.	3855012360.	27.9420342	0.0014582	-0.0034474	3.7697332
-60.0000000	CY						
0.0000547		203575.	3722507422.	27.6292107	0.0015110	-0.0036297	3.8192226
-60.0000000	CY						
0.0000572		205500.	3593438829.	27.3106581	0.0015618	-0.0038138	3.8612415
-60.0000000	CY						
0.0000597		207111.	3469915370.	27.0042673	0.0016118	-0.0039988	3.8971221
-60.0000000	CY						
0.0000622		208691.	3355839891.	26.7226730	0.0016618	-0.0041838	3.9276508
-60.0000000	CY						
0.0000647		210224.	3249841503.	26.4548768	0.0017113	-0.0043693	3.9525820
-60.0000000	CY						
0.0000672		211739.	3151470854.	26.2109646	0.0017610	-0.0045546	3.9723597
-60.0000000	CY						
0.0000697		213035.	3057009859.	25.9738611	0.0018101	-0.0047406	3.9866503
-60.0000000	CY						
0.0000722		214079.	2965591661.	25.7336742	0.0018576	-0.0049280	3.9956015
-60.0000000	CY						
0.0000747		215017.	2878885420.	25.4997464	0.0019045	-0.0051161	3.9996804
-60.0000000	CY						
0.0000772		215939.	2797596757.	25.2844995	0.0019516	-0.0053040	3.9978768
-60.0000000	CY						
0.0000797		216848.	2721230031.	25.0860274	0.0019990	-0.0054916	3.9998707

-60.0000000	CY						
0.0000822		217738.	2649280402.	24.9028153	0.0020467	-0.0056789	3.9987970
-60.0000000	CY						
0.0000847		218586.	2581091856.	24.7211041	0.0020936	-0.0058671	3.9974034
-60.0000000	CY						
0.0000872		219415.	2516587140.	24.5526404	0.0021407	-0.0060549	3.9988173
60.0000000	CY						
0.0000897		220204.	2455230846.	24.3935755	0.0021878	-0.0062428	3.9979759
60.0000000	CY						
0.0000922		220860.	2395764386.	24.2355611	0.0022342	-0.0064314	3.9980161
60.0000000	CY						
0.0000947		221416.	2338382279.	24.0795645	0.0022800	-0.0066206	3.9999485
60.0000000	CY						
0.0000972		221916.	2283378772.	23.9274419	0.0023254	-0.0068102	3.9954979
60.0000000	CY						
0.0000997		222376.	2230729318.	23.7744927	0.0023700	-0.0070006	3.9988749
60.0000000	CY						
0.0001022		222823.	2180529837.	23.6320430	0.0024149	-0.0071907	3.9999000
60.0000000	CY						
0.0001047		223238.	2132419760.	23.5028478	0.0024605	-0.0073802	3.9951831
60.0000000	CY						
0.0001072		223648.	2086513605.	23.3810814	0.0025062	-0.0075695	3.9986207
60.0000000	CY						
0.0001097		224029.	2042430488.	23.2707485	0.0025525	-0.0077581	3.9999824
60.0000000	CY						
0.0001122		224380.	2000040574.	23.1713675	0.0025995	-0.0079461	3.9932206
60.0000000	CY						
0.0001147		224725.	1959456706.	23.0777410	0.0026467	-0.0081339	3.9974001
60.0000000	CY						
0.0001172		225045.	1920385910.	22.9881611	0.0026939	-0.0083217	3.9996145
60.0000000	CY						
0.0001197		225340.	1882736874.	22.9016500	0.0027410	-0.0085096	3.9965596
60.0000000	CY						
0.0001222		225628.	1846573898.	22.8205706	0.0027884	-0.0086972	3.9938170
60.0000000	CY						
0.0001247		225907.	1811785335.	22.7451286	0.0028360	-0.0088846	3.9975701
60.0000000	CY						
0.0001272		226143.	1778025585.	22.6796142	0.0028846	-0.0090711	3.9996384
60.0000000	CY						
0.0001297		226339.	1745264306.	22.6136363	0.0029327	-0.0092579	3.9967921
60.0000000	CY						
0.0001322		226529.	1713695944.	22.5519345	0.0029811	-0.0094445	3.9917583
60.0000000	CY						
0.0001347		226688.	1683066461.	22.4894120	0.0030290	-0.0096316	3.9959545
60.0000000	CYT						
0.0001372		226827.	1653407606.	22.4276608	0.0030768	-0.0098188	3.9986572
60.0000000	CYT						
0.0001522		227384.	1494102417.	22.0909549	0.0033620	-0.0109437	3.9992168
60.0000000	CYT						
0.0001672		227709.	1361998125.	21.8144252	0.0036471	-0.0120685	3.9975724
60.0000000	CYT						
0.0001822		227709.	1249861058.	21.7510709	0.0039628	-0.0131629	3.9953662
60.0000000	CYT						

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load	Axial Thrust	Nominal Mom. Cap.	Max. Comp.

No.	kips	in-kip	Strain
1	1223.400	212153.755	0.00300000
2	1742.100	226591.830	0.00300000

Note note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318-08, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318-08, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resistance Factor for Moment	Nominal Moment Capacity in-kip	Ultimate (Factored) Axial Thrust kips	Ultimate (Factored) Moment Capacity in-kip	Bending Stiffness at Ult. Mom. Cap. kip-in^2
1	0.65	212153.755	795.210	137899.936	4886417798.685
2	0.65	226591.830	1132.365	147284.684	5291183944.138
1	0.70	212153.755	856.380	148507.626	4783893302.912
2	0.70	226591.830	1219.470	158614.278	5139135726.915
1	0.75	212153.755	917.550	159115.316	4690680711.386
2	0.75	226591.830	1306.575	169943.872	5010137621.455

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 139800.0 lbs
Applied moment at pile head = 90444000.0 in-lbs
Axial thrust load on pile head = 1223400.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. p	Soil Spr. Distrib. Es*h
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/in	Lat. Load lb/inch

0.00	0.9472	90444000.	139800.	-0.005703	0.000	5.702E+12	0.000	0.000	
0.000									
0.540	0.9106	91394710.	139409.	-0.005600	0.000	5.702E+12	-120.8174	859.7819	
0.000									
1.080	0.8746	92339524.	138220.	-0.005495	0.000	5.648E+12	-246.0680	1823.0914	
0.000									
1.620	0.8394	93273165.	136209.	-0.005388	0.000	5.623E+12	-374.5558	2891.6346	
0.000									
2.160	0.8048	94190226.	133359.	-0.005280	0.000	5.599E+12	-505.0975	4066.9319	
0.000									
2.700	0.7709	95085214.	129660.	-0.005170	0.000	5.576E+12	-636.5240	5350.2627	
0.000									
3.240	0.7378	95952599.	125110.	-0.005059	0.000	5.555E+12	-767.6821	6742.6010	
0.000									
3.780	0.7054	96786860.	119715.	-0.004947	0.000	5.534E+12	-897.4372	8244.5392	
0.000									
4.320	0.6737	97582540.	113478.	-0.004833	0.000	5.515E+12	-1027.7196	9885.4871	
0.000									
4.860	0.6427	98334156.	106400.	-0.004717	0.000	5.498E+12	-1156.7784	11663.	
0.000									
5.400	0.6125	99036279.	98496.	-0.004601	0.000	5.482E+12	-1282.8839	13571.	
0.000									
5.940	0.5831	99683606.	89786.	-0.004483	0.000	5.467E+12	-1405.1881	15616.	
0.000									
6.480	0.5544	1.003E+08	80299.	-0.004365	0.000	5.454E+12	-1522.8737	17799.	
0.000									
7.020	0.5265	1.008E+08	70067.	-0.004245	0.000	5.443E+12	-1635.1563	20123.	
0.000									
7.560	0.4994	1.012E+08	59128.	-0.004125	0.000	5.433E+12	-1741.2857	22593.	
0.000									
8.100	0.4731	1.016E+08	47515.	-0.004004	0.000	5.425E+12	-1842.7826	25241.	
0.000									
8.640	0.4475	1.019E+08	35260.	-0.003882	0.000	5.418E+12	-1939.6578	28085.	
0.000									
9.180	0.4228	1.021E+08	22401.	-0.003760	0.000	5.414E+12	-2029.2254	31102.	
0.000									
9.720	0.3988	1.023E+08	8986.9855	-0.003637	0.000	5.411E+12	-2110.9203	34299.	
0.000									
10.260	0.3756	1.023E+08	-4929.2565	-0.003515	0.000	5.410E+12	-2184.2161	37679.	
0.000									
10.800	0.3533	1.023E+08	-19292.	-0.003392	0.000	5.411E+12	-2248.6265	41248.	
0.000									
11.340	0.3317	1.021E+08	-34041.	-0.003270	0.000	5.414E+12	-2303.7075	45008.	
0.000									
11.880	0.3109	1.019E+08	-49126.	-0.003148	0.000	5.419E+12	-2352.0957	49027.	
0.000									
12.420	0.2909	1.015E+08	-64525.	-0.003027	0.000	5.427E+12	-2400.7457	53483.	
0.000									
12.960	0.2717	1.011E+08	-80210.	-0.002906	0.000	5.436E+12	-2440.2127	58208.	
0.000									
13.500	0.2532	1.005E+08	-96091.	-0.002786	0.000	5.448E+12	-2461.2700	62986.	
0.000									
14.040	0.2356	99888666.	-111780.	-0.002667	0.000	5.463E+12	-2381.1656	65505.	
0.000									
14.580	0.2187	99135007.	-126932.	-0.002549	0.000	5.480E+12	-2295.3862	68024.	
0.000									
15.120	0.2025	98284035.	-141513.	-0.002432	0.000	5.499E+12	-2204.7390	70544.	
0.000									
15.660	0.1871	97339566.	-155492.	-0.002317	0.000	5.521E+12	-2110.0063	73063.	
0.000									
16.200	0.1725	96305592.	-168848.	-0.002204	0.000	5.546E+12	-2011.9448	75583.	
0.000									

16.740	0.1586	95186243.	-181559.	-0.002092	0.000	5.574E+12	-1911.2835	78102.	
0.000									
17.280	0.1454	93985762.	-193612.	-0.001983	0.000	5.604E+12	-1808.7229	80622.	
0.000									
17.820	0.1329	92708470.	-204996.	-0.001875	0.000	5.638E+12	-1704.9336	83141.	
0.000									
18.360	0.1211	91358742.	-215706.	-0.001769	0.000	5.676E+12	-1600.5554	85660.	
0.000									
18.900	0.1099	89940980.	-225739.	-0.001666	0.000	5.716E+12	-1496.1960	88180.	
0.000									
19.440	0.0995	88459583.	-235098.	-0.001566	0.000	5.760E+12	-1392.4312	90699.	
0.000									
19.980	0.0897	86918929.	-243789.	-0.001467	0.000	5.808E+12	-1289.8037	93219.	
0.000									
20.520	0.0805	85323347.	-251819.	-0.001372	0.000	5.860E+12	-1188.8226	95738.	
0.000									
21.060	0.0719	83677097.	-259203.	-0.001279	0.000	5.917E+12	-1089.9629	98258.	
0.000									
21.600	0.0639	81984353.	-265954.	-0.001188	0.000	5.978E+12	-993.6648	100777.	
0.000									
22.140	0.0565	80249180.	-272090.	-0.001101	0.000	6.044E+12	-900.3345	103296.	
0.000									
22.680	0.0496	78475520.	-277633.	-0.001016	0.000	6.116E+12	-810.3437	105816.	
0.000									
23.220	0.0433	76667173.	-282604.	-0.000935	0.000	6.195E+12	-724.0292	108335.	
0.000									
23.760	0.0375	74827789.	-287029.	-0.000856	0.000	6.279E+12	-641.6932	110855.	
0.000									
24.300	0.0322	72960848.	-290934.	-0.000780	0.000	6.372E+12	-563.6037	113374.	
0.000									
24.840	0.0274	71069652.	-294348.	-0.000708	0.000	6.472E+12	-489.9948	115894.	
0.000									
25.380	0.0230	69157317.	-297733.	-0.000638	0.000	6.581E+12	-554.6193	155971.	
0.000									
25.920	0.0191	67221154.	-301245.	-0.000571	0.000	6.702E+12	-529.3966	179338.	
0.000									
26.460	0.0156	65262246.	-304591.	-0.000508	0.000	6.833E+12	-503.3703	208610.	
0.000									
27.000	0.0125	63281711.	-307765.	-0.000448	0.000	6.978E+12	-476.3901	246083.	
0.000									
27.540	0.009834	61280705.	-310761.	-0.000391	0.000	7.138E+12	-448.2488	295372.	
0.000									
28.080	0.007484	59260437.	-313570.	-0.000336	0.000	7.316E+12	-418.6482	362501.	
0.000									
28.620	0.005474	57222174.	-316181.	-0.000286	0.000	7.514E+12	-387.1328	458312.	
0.000									
29.160	0.003783	55167263.	-318579.	-0.000238	0.000	7.830E+12	-352.9461	604519.	
0.000									
29.700	0.002389	53097170.	-320741.	-0.000205	0.000	1.754E+13	-314.5772	853304.	
0.000									
30.240	0.001122	51013712.	-322333.	-0.000186	0.000	1.756E+13	-176.8376	1021689.	
0.000									
30.780	-2.372E-05	48922680.	-322894.	-0.000168	0.000	1.757E+13	3.7404	1021689.	
0.000									
31.320	-0.001052	46831661.	-322345.	-0.000150	0.000	1.758E+13	165.8832	1021689.	
0.000									
31.860	-0.001969	44747472.	-320835.	-0.000133	0.000	1.759E+13	299.9761	987409.	
0.000									
32.400	-0.002778	42675747.	-318804.	-0.000117	0.000	1.761E+13	326.9133	762462.	
0.000									
32.940	-0.003486	40617626.	-316624.	-0.000102	0.000	1.762E+13	345.9765	643065.	
0.000									
33.480	-0.004097	38573913.	-314336.	-8.722E-05	0.000	1.763E+13	360.2178	569674.	

0.000									
34.020	-0.004617	36545214.	-311966.	-7.342E-05	0.000	1.764E+13	371.1143	520895.	
0.000									
34.560	-0.005049	34531992.	-309534.	-6.037E-05	0.000	1.765E+13	379.5040	487068.	
0.000									
35.100	-0.005399	32534605.	-307055.	-4.806E-05	0.000	1.766E+13	385.9124	463176.	
0.000									
35.640	-0.005672	30553327.	-304538.	-3.648E-05	0.000	1.766E+13	390.6915	446365.	
0.000									
36.180	-0.005872	28588366.	-301996.	-2.564E-05	0.000	1.767E+13	394.0889	434904.	
0.000									
36.720	-0.006004	26639870.	-299435.	-1.551E-05	0.000	1.768E+13	396.2849	427701.	
0.000									
37.260	-0.006073	24707937.	-296863.	-6.105E-06	0.000	1.768E+13	397.4143	424054.	
0.000									
37.800	-0.006083	22792620.	-294287.	2.597E-06	0.000	1.769E+13	397.5792	423517.	
0.000									
38.340	-0.006039	20893930.	-291713.	1.060E-05	0.000	1.769E+13	396.8584	425821.	
0.000									
38.880	-0.005946	19011845.	-289147.	1.791E-05	0.000	1.769E+13	395.3122	430830.	
0.000									
39.420	-0.005807	17146303.	-286593.	2.453E-05	0.000	1.770E+13	392.9868	438517.	
0.000									
39.960	-0.005628	15297214.	-284056.	3.047E-05	0.000	1.770E+13	389.9168	448951.	
0.000									
40.500	-0.005412	13464453.	-281542.	3.573E-05	0.000	1.770E+13	386.1269	462295.	
0.000									
41.040	-0.005165	11647866.	-279054.	4.033E-05	0.000	1.770E+13	381.6335	478813.	
0.000									
41.580	-0.004890	9847270.	-276598.	4.427E-05	0.000	1.770E+13	376.4448	498881.	
0.000									
42.120	-0.004591	8062453.	-274178.	4.754E-05	0.000	1.770E+13	370.5619	523016.	
0.000									
42.660	-0.004273	6293173.	-271798.	5.017E-05	0.000	1.770E+13	363.9781	551910.	
0.000									
43.200	-0.003941	4539158.	-269463.	5.216E-05	0.000	1.770E+13	356.6792	586485.	
0.000									
43.740	-0.003598	2800107.	-267178.	5.350E-05	0.000	1.770E+13	348.6419	627983.	
0.000									
44.280	-0.003248	1075687.	-264947.	5.421E-05	0.000	1.770E+13	339.8334	678087.	
0.000									
44.820	-0.002895	-634466.	-262776.	5.429E-05	0.000	1.770E+13	330.2085	739121.	
0.000									
45.360	-0.002544	-2330752.	-220494.	5.375E-05	0.000	1.770E+13	12720.	32400000.	
0.000									
45.900	-0.002198	-3492923.	-143668.	5.268E-05	0.000	1.770E+13	10992.	32400000.	
0.000									
46.440	-0.001861	-4193520.	-77902.	5.127E-05	0.000	1.770E+13	9306.0229	32400000.	
0.000									
46.980	-0.001534	-4503340.	-22900.	4.968E-05	0.000	1.770E+13	7669.6304	32400000.	
0.000									
47.520	-0.001217	-4491096.	21670.	4.803E-05	0.000	1.770E+13	6086.6631	32400000.	
0.000									
48.060	-0.000911	-4223258.	56155.	4.644E-05	0.000	1.770E+13	4556.9758	32400000.	
0.000									
48.600	-0.000615	-3764059.	80891.	4.498E-05	0.000	1.770E+13	3077.3909	32400000.	
0.000									
49.140	-0.000328	-3175628.	96183.	4.371E-05	0.000	1.770E+13	1642.4608	32400000.	
0.000									
49.680	-4.904E-05	-2518219.	102299.	4.266E-05	0.000	1.770E+13	245.2046	32400000.	
0.000									
50.220	0.000224	-1850508.	99458.	4.186E-05	0.000	1.770E+13	-1122.1768	32400000.	
0.000									

50.760	0.000494	-1229911.	87827.	4.130E-05	0.000	1.770E+13	-2467.6048	32400000.	
0.000									
51.300	0.000760	-712927.	67525.	4.094E-05	0.000	1.770E+13	-3798.4418	32400000.	
0.000									
51.840	0.001024	-355439.	38626.	4.075E-05	0.000	1.770E+13	-5120.8210	32400000.	
0.000									
52.380	0.001288	-212975.	19682.	4.065E-05	0.000	1.770E+13	-726.3721	3654996.	
0.000									
52.920	0.001551	-101011.	14378.	4.059E-05	0.000	1.770E+13	-910.4253	3803898.	
0.000									
53.460	0.001814	-27276.	7843.6842	4.056E-05	0.000	1.770E+13	-1106.4249	3952800.	
0.000									
54.000	0.002077	0.000	0.000	4.056E-05	0.000	1.770E+13	-1314.4652	2050851.	
0.000									

* This analysis computed pile response using nonlinear moment-curvature relationships.
Values of total stress due to combined axial and bending stresses are computed only
for elastic sections only and do not equal the actual stresses in concrete and steel.
Stresses in concrete and steel may be interpolated from the output for nonlinear
bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection	=	0.9472000 inches
Computed slope at pile head	=	-0.0057033 radians
Maximum bending moment	=	102317844. inch-lbs
Maximum shear force	=	-322894. lbs
Depth of maximum bending moment	=	10.2600000 feet below pile head
Depth of maximum shear force	=	30.7800000 feet below pile head
Number of iterations	=	59
Number of zero deflection points	=	2

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head	=	206600.0 lbs
Applied moment at pile head	=	133968000.0 in-lbs
Axial thrust load on pile head	=	1742100.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. p	Soil Spr. Es*h
Distrib. Lat. Load feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/in	lb/inch
lb/inch								
0.00	1.7154	1.340E+08	206600.	-0.009598	0.000	5.510E+12	0.000	0.000
0.000								
0.540	1.6538	1.354E+08	206142.	-0.009440	0.000	5.510E+12	-141.2265	553.3759
0.000								
1.080	1.5931	1.369E+08	204751.	-0.009279	0.000	5.458E+12	-288.3473	1172.8650
0.000								
1.620	1.5335	1.383E+08	202390.	-0.009115	0.000	5.433E+12	-440.1584	1859.9478
0.000								
2.160	1.4750	1.397E+08	199035.	-0.008949	0.000	5.409E+12	-595.3505	2615.5670

0.000									
2.700	1.4175	1.411E+08	194668.	-0.008781	0.000	5.387E+12	-752.6328	3440.5656	
0.000									
3.240	1.3612	1.424E+08	189278.	-0.008610	0.000	5.365E+12	-910.7336	4335.6538	
0.000									
3.780	1.3059	1.437E+08	182866.	-0.008437	0.000	5.345E+12	-1068.3940	5301.3357	
0.000									
4.320	1.2518	1.450E+08	175431.	-0.008261	0.000	5.326E+12	-1226.3657	6348.1950	
0.000									
4.860	1.1989	1.462E+08	166976.	-0.008084	0.000	5.308E+12	-1383.1263	7475.9483	
0.000									
5.400	1.1471	1.473E+08	157515.	-0.007905	0.000	5.291E+12	-1537.1186	8683.5314	
0.000									
5.940	1.0964	1.484E+08	147067.	-0.007723	0.000	5.275E+12	-1687.3596	9972.5136	
0.000									
6.480	1.0470	1.494E+08	135662.	-0.007540	0.000	5.261E+12	-1832.8976	11344.	
0.000									
7.020	0.9987	1.503E+08	123331.	-0.007355	0.000	5.248E+12	-1972.8140	12800.	
0.000									
7.560	0.9516	1.512E+08	110115.	-0.007169	0.000	5.236E+12	-2106.2241	14342.	
0.000									
8.100	0.9058	1.519E+08	96051.	-0.006981	0.000	5.226E+12	-2234.6041	15986.	
0.000									
8.640	0.8612	1.526E+08	81171.	-0.006792	0.000	5.217E+12	-2357.8786	17742.	
0.000									
9.180	0.8178	1.531E+08	65519.	-0.006602	0.000	5.210E+12	-2473.1595	19597.	
0.000									
9.720	0.7756	1.536E+08	49147.	-0.006412	0.000	5.204E+12	-2579.7583	21553.	
0.000									
10.260	0.7347	1.539E+08	32115.	-0.006220	0.000	5.199E+12	-2677.0258	23612.	
0.000									
10.800	0.6950	1.541E+08	14485.	-0.006028	0.000	5.196E+12	-2764.3542	25775.	
0.000									
11.340	0.6565	1.542E+08	-3676.7684	-0.005836	0.000	5.195E+12	-2841.1781	28042.	
0.000									
11.880	0.6194	1.542E+08	-22313.	-0.005643	0.000	5.195E+12	-2910.7638	30454.	
0.000									
12.420	0.5834	1.541E+08	-41405.	-0.005451	0.000	5.197E+12	-2981.7944	33119.	
0.000									
12.960	0.5487	1.538E+08	-60924.	-0.005259	0.000	5.201E+12	-3042.4883	35930.	
0.000									
13.500	0.5152	1.534E+08	-80801.	-0.005068	0.000	5.206E+12	-3092.4299	38892.	
0.000									
14.040	0.4830	1.528E+08	-100965.	-0.004878	0.000	5.213E+12	-3131.2464	42007.	
0.000									
14.580	0.4520	1.522E+08	-121345.	-0.004688	0.000	5.222E+12	-3158.6092	45279.	
0.000									
15.120	0.4223	1.514E+08	-141863.	-0.004500	0.000	5.233E+12	-3174.2368	48711.	
0.000									
15.660	0.3937	1.504E+08	-162444.	-0.004313	0.000	5.246E+12	-3177.8974	52304.	
0.000									
16.200	0.3664	1.494E+08	-183070.	-0.004129	0.000	5.261E+12	-3188.2119	56391.	
0.000									
16.740	0.3402	1.482E+08	-203730.	-0.003946	0.000	5.278E+12	-3188.1891	60726.	
0.000									
17.280	0.3152	1.468E+08	-224355.	-0.003765	0.000	5.298E+12	-3177.5104	65319.	
0.000									
17.820	0.2914	1.453E+08	-244876.	-0.003587	0.000	5.320E+12	-3156.1260	70181.	
0.000									
18.360	0.2687	1.437E+08	-265223.	-0.003411	0.000	5.345E+12	-3124.0326	75327.	
0.000									
18.900	0.2472	1.420E+08	-285328.	-0.003238	0.000	5.372E+12	-3081.2742	80769.	
0.000									

19.440	0.2268	1.401E+08	-305122.	-0.003069	0.000	5.402E+12	-3027.9449	86521.	
0.000									
19.980	0.2074	1.381E+08	-324541.	-0.002902	0.000	5.436E+12	-2965.3990	92634.	
0.000									
20.520	0.1892	1.360E+08	-343204.	-0.002739	0.000	5.473E+12	-2794.8152	95738.	
0.000									
21.060	0.1719	1.337E+08	-360706.	-0.002580	0.000	5.514E+12	-2607.1067	98258.	
0.000									
21.600	0.1557	1.313E+08	-377000.	-0.002425	0.000	5.559E+12	-2421.8351	100777.	
0.000									
22.140	0.1405	1.289E+08	-392103.	-0.002274	0.000	5.608E+12	-2239.7732	103296.	
0.000									
22.680	0.1263	1.263E+08	-406040.	-0.002127	0.000	5.661E+12	-2061.6357	105816.	
0.000									
23.220	0.1129	1.237E+08	-418837.	-0.001985	0.000	5.719E+12	-1888.0784	108335.	
0.000									
23.760	0.1005	1.209E+08	-430526.	-0.001847	0.000	5.783E+12	-1719.6978	110855.	
0.000									
24.300	0.0890	1.181E+08	-441143.	-0.001714	0.000	5.852E+12	-1557.0309	113374.	
0.000									
24.840	0.0783	1.153E+08	-450725.	-0.001586	0.000	5.927E+12	-1400.5570	115894.	
0.000									
25.380	0.0684	1.123E+08	-457622.	-0.001462	0.000	6.010E+12	-728.1152	68936.	
0.000									
25.920	0.0594	1.094E+08	-462258.	-0.001343	0.000	6.099E+12	-702.6563	76704.	
0.000									
26.460	0.0510	1.064E+08	-466727.	-0.001230	0.000	6.196E+12	-676.5934	85915.	
0.000									
27.000	0.0434	1.033E+08	-471024.	-0.001121	0.000	6.302E+12	-649.8279	96975.	
0.000									
27.540	0.0365	1.003E+08	-475146.	-0.001017	0.000	6.418E+12	-622.2300	110459.	
0.000									
28.080	0.0302	97203373.	-479085.	-0.000919	0.000	6.545E+12	-593.6243	127211.	
0.000									
28.620	0.0246	94096263.	-482835.	-0.000825	0.000	6.685E+12	-563.7659	148513.	
0.000									
29.160	0.0195	90964451.	-486386.	-0.000736	0.000	6.840E+12	-532.2989	176441.	
0.000									
29.700	0.0151	87809314.	-489727.	-0.000652	0.000	7.013E+12	-498.6772	214592.	
0.000									
30.240	0.0111	84632322.	-492839.	-0.000574	0.000	7.205E+12	-462.0010	269867.	
0.000									
30.780	0.007622	81435071.	-495699.	-0.000500	0.000	7.420E+12	-420.6219	357614.	
0.000									
31.320	0.004611	78219355.	-498264.	-0.000432	0.000	7.663E+12	-370.9599	521348.	
0.000									
31.860	0.002028	74987316.	-500445.	-0.000368	0.000	7.937E+12	-302.1258	965157.	
0.000									
32.400	-0.000157	71741899.	-501343.	-0.000309	0.000	8.247E+12	24.7757	1021689.	
0.000									
32.940	-0.001977	68496886.	-500290.	-0.000255	0.000	8.598E+12	300.1795	983678.	
0.000									
33.480	-0.003463	65263895.	-498199.	-0.000206	0.000	8.995E+12	345.3320	646146.	
0.000									
34.020	-0.004644	62044874.	-495876.	-0.000161	0.000	9.449E+12	371.6237	518503.	
0.000									
34.560	-0.005550	58840977.	-493413.	-0.000129	0.000	1.743E+13	388.5431	453667.	
0.000									
35.100	-0.006313	55653148.	-490854.	-0.000108	0.000	1.745E+13	401.2693	411853.	
0.000									
35.640	-0.006943	52481936.	-488223.	-8.745E-05	0.000	1.746E+13	410.9208	383506.	
0.000									
36.180	-0.007447	49327758.	-485536.	-6.857E-05	0.000	1.748E+13	418.1763	363886.	

0.000									
36.720	-0.007832	46190933.	-482809.	-5.087E-05	0.000	1.749E+13	423.4800	350383.	
0.000									
37.260	-0.008106	43071698.	-480053.	-3.434E-05	0.000	1.751E+13	427.1386	341455.	
0.000									
37.800	-0.008277	39970218.	-477278.	-1.898E-05	0.000	1.752E+13	429.3721	336153.	
0.000									
38.340	-0.008352	36886600.	-474493.	-4.772E-06	0.000	1.753E+13	430.3426	333884.	
0.000									
38.880	-0.008339	33820899.	-471705.	8.293E-06	0.000	1.754E+13	430.1716	334281.	
0.000									
39.420	-0.008245	30773120.	-468921.	2.022E-05	0.000	1.754E+13	428.9510	337143.	
0.000									
39.960	-0.008077	27743225.	-466149.	3.103E-05	0.000	1.755E+13	426.7503	342385.	
0.000									
40.500	-0.007842	24731133.	-463393.	4.072E-05	0.000	1.755E+13	423.6214	350027.	
0.000									
41.040	-0.007549	21736726.	-460661.	4.930E-05	0.000	1.755E+13	419.6019	360182.	
0.000									
41.580	-0.007204	18759848.	-457958.	5.677E-05	0.000	1.755E+13	414.7170	373060.	
0.000									
42.120	-0.006813	15800306.	-455289.	6.315E-05	0.000	1.755E+13	408.9813	388977.	
0.000									
42.660	-0.006385	12857871.	-452661.	6.844E-05	0.000	1.755E+13	402.3995	408377.	
0.000									
43.200	-0.005926	9932280.	-450077.	7.265E-05	0.000	1.755E+13	394.9663	431870.	
0.000									
43.740	-0.005444	7023232.	-447545.	7.578E-05	0.000	1.755E+13	386.6670	460280.	
0.000									
44.280	-0.004944	4130391.	-445069.	7.783E-05	0.000	1.755E+13	377.4756	494727.	
0.000									
44.820	-0.004435	1253383.	-442656.	7.883E-05	0.000	1.755E+13	367.3547	536754.	
0.000									
45.360	-0.003923	-1608204.	-377919.	7.876E-05	0.000	1.755E+13	19613.	32400000.	
0.000									
45.900	-0.003414	-3646226.	-259064.	7.779E-05	0.000	1.755E+13	17071.	32400000.	
0.000									
46.440	-0.002914	-4967425.	-156541.	7.620E-05	0.000	1.755E+13	14572.	32400000.	
0.000									
46.980	-0.002427	-5676716.	-70017.	7.424E-05	0.000	1.755E+13	12133.	32400000.	
0.000									
47.520	-0.001952	-5876524.	919.9053	7.211E-05	0.000	1.755E+13	9761.3997	32400000.	
0.000									
48.060	-0.001492	-5666422.	56718.	6.998E-05	0.000	1.755E+13	7460.3059	32400000.	
0.000									
48.600	-0.001045	-5143036.	97825.	6.798E-05	0.000	1.755E+13	5226.9853	32400000.	
0.000									
49.140	-0.000611	-4400144.	124659.	6.622E-05	0.000	1.755E+13	3055.1777	32400000.	
0.000									
49.680	-0.000187	-3528947.	137591.	6.476E-05	0.000	1.755E+13	935.9978	32400000.	
0.000									
50.220	0.000228	-2618431.	136927.	6.362E-05	0.000	1.755E+13	-1140.9742	32400000.	
0.000									
50.760	0.000637	-1755815.	122905.	6.281E-05	0.000	1.755E+13	-3186.6285	32400000.	
0.000									
51.300	0.001042	-1026999.	95696.	6.230E-05	0.000	1.755E+13	-5211.2825	32400000.	
0.000									
51.840	0.001445	-517003.	55407.	6.201E-05	0.000	1.755E+13	-7223.6532	32400000.	
0.000									
52.380	0.001846	-310329.	28629.	6.186E-05	0.000	1.755E+13	-1041.2045	3654996.	
0.000									
52.920	0.002246	-147374.	20982.	6.178E-05	0.000	1.755E+13	-1318.7216	3803898.	
0.000									

53.460	0.002647	-39792.	11479.	6.174E-05	0.000	1.755E+13	-1614.4294	3952800.	
0.000									
54.000	0.003047	0.000	0.000	6.174E-05	0.000	1.755E+13	-1928.4665	2050851.	
0.000									

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection	=	1.7154402 inches
Computed slope at pile head	=	-0.0095983 radians
Maximum bending moment	=	154214475. inch-lbs
Maximum shear force	=	-501343. lbs
Depth of maximum bending moment	=	11.3400000 feet below pile head
Depth of maximum shear force	=	32.4000000 feet below pile head
Number of iterations	=	25
Number of zero deflection points	=	2

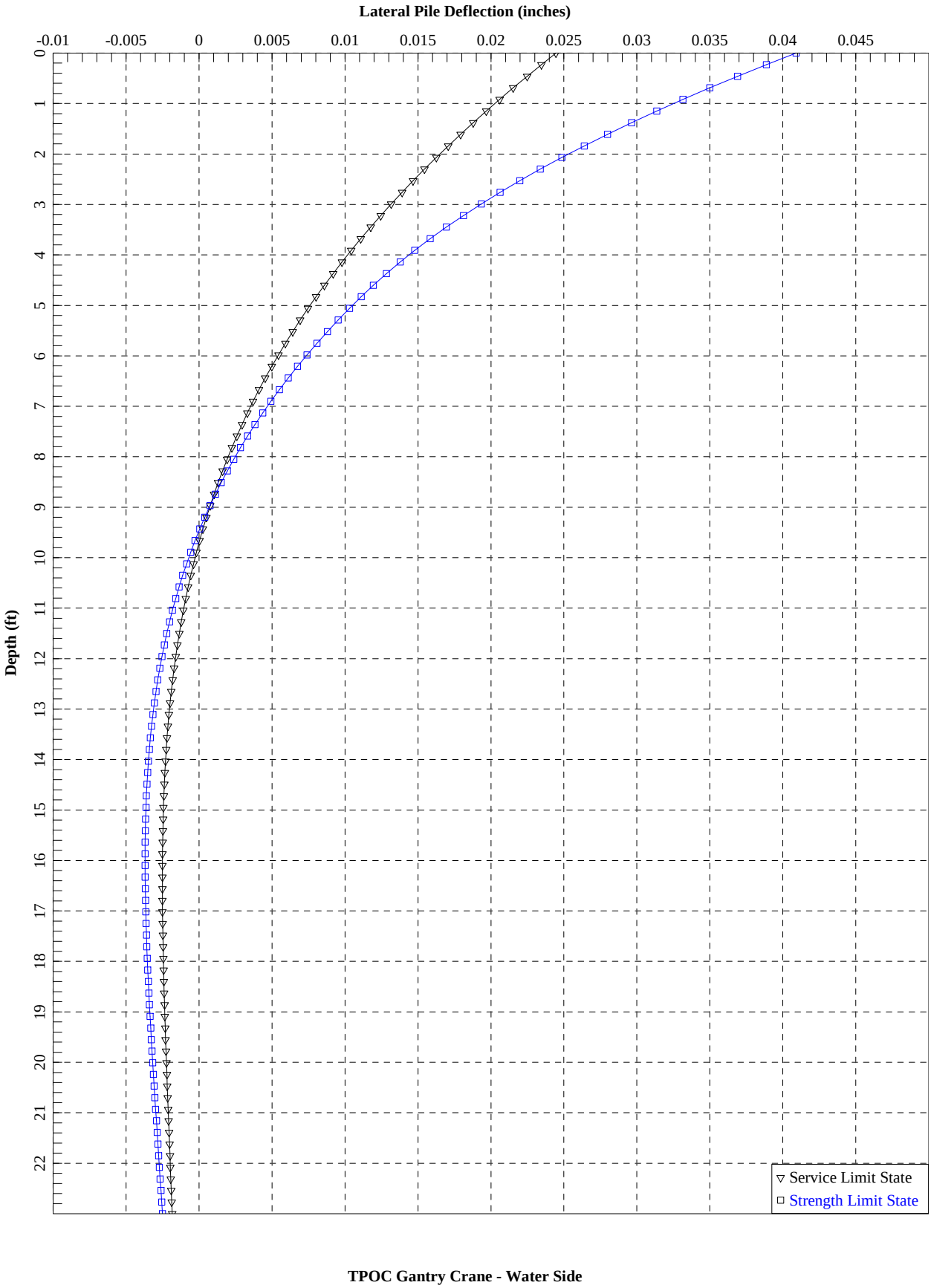
Summary of Pile Response(s)

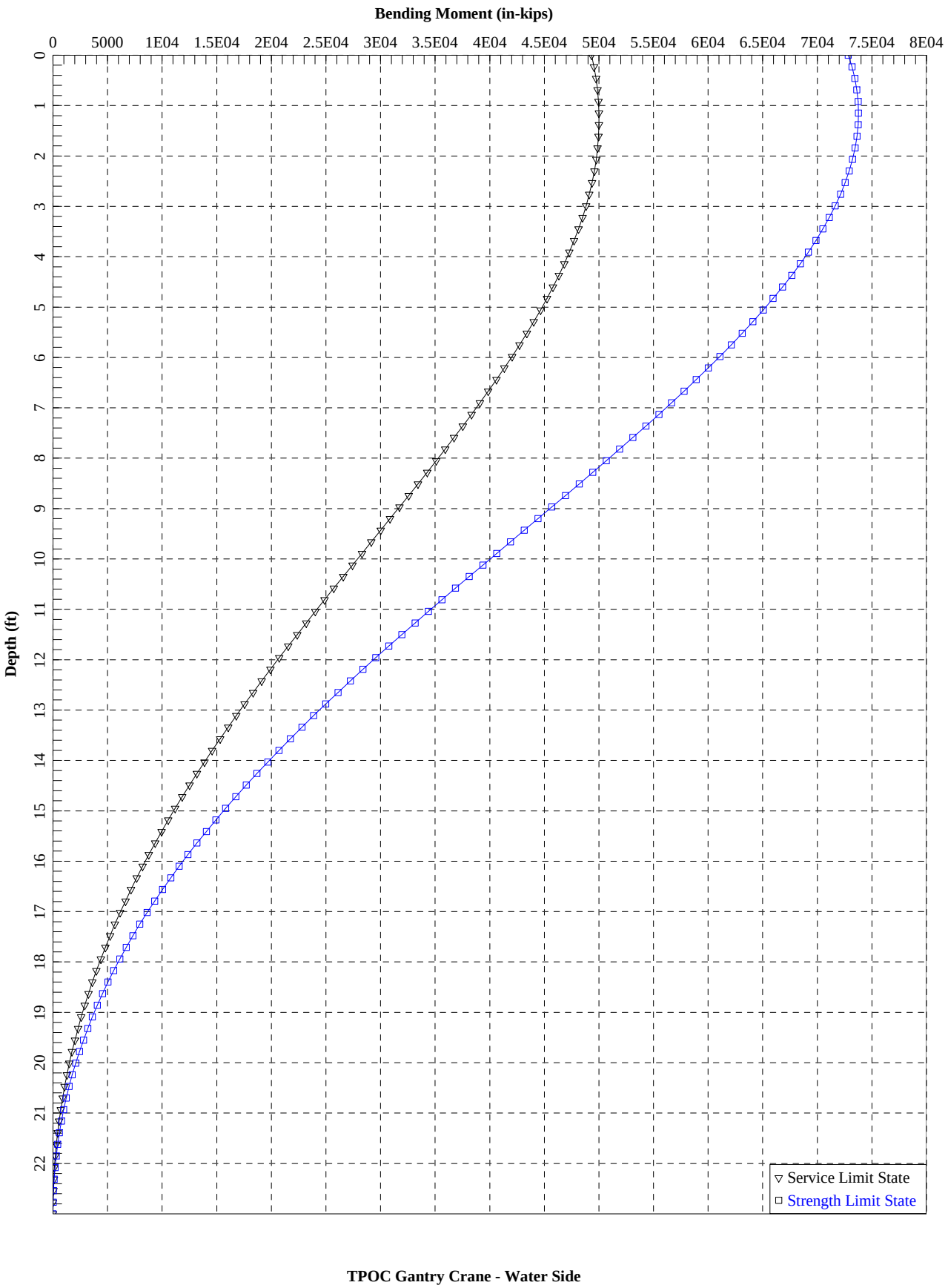
Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

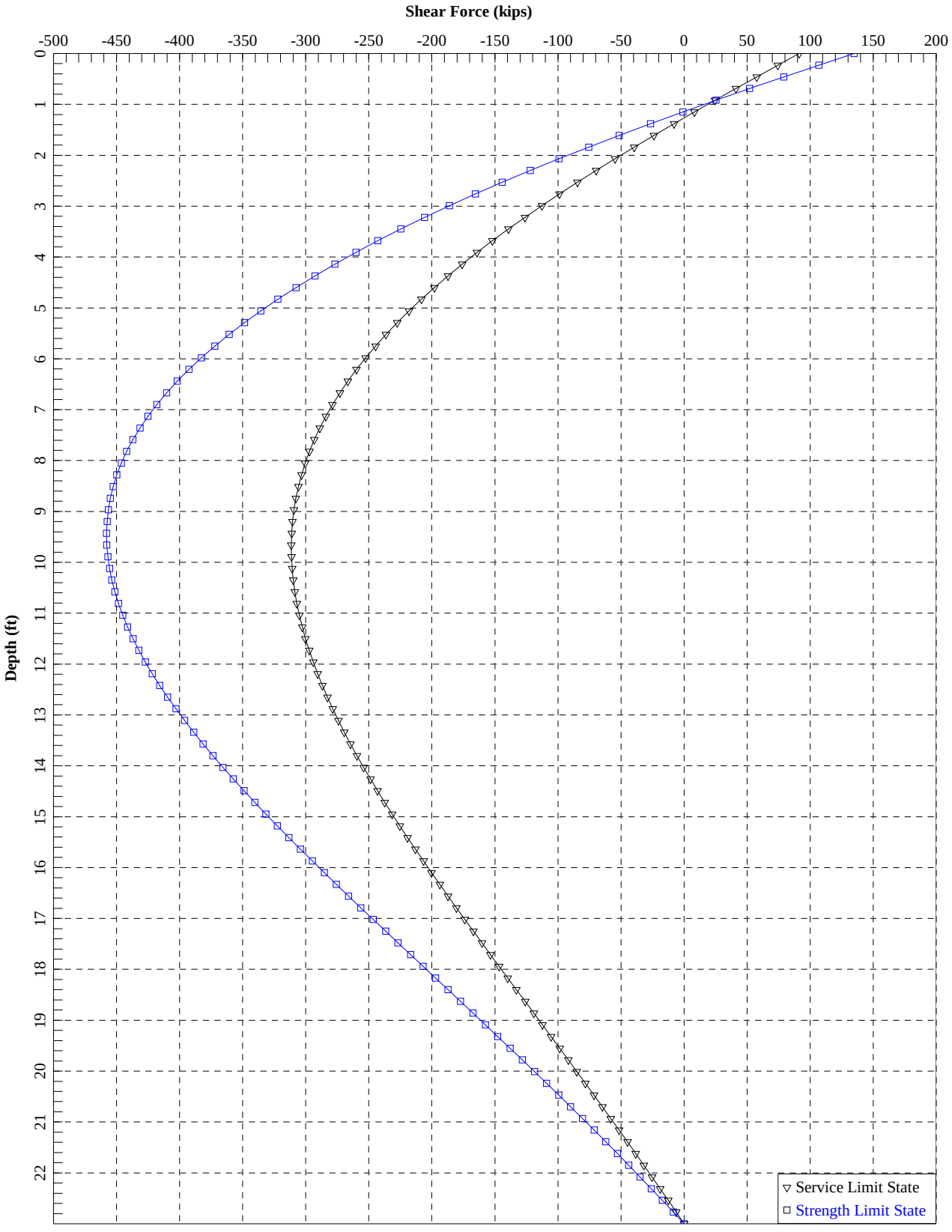
Load Case	Load Type	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Pile-head Shear Rotation radians
1	1	V = 139800.	M = 90444000.	1223400.	0.94720004	102317844.	-322894. -0.00570330
2	1	V = 206600.	M = 1.340E+08	1742100.	1.71544021	154214475.	-501343. -0.00959827

The analysis ended normally.


Lateral Pile Deflection (inches)
-0.01
-0.005
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
Service Limit State
Strength Limit State
TPOC Gantry Crane - Water Side



TPOC Gantry Crane - Water Side



TPOC Gantry Crane - Water Side

LPile Plus for Windows, Version 2013-07.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Tulsa

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Files Used for Analysis

Path to file locations: W:\2014\Geotechnical Working - 2014\20150761_TPOC Gantry Crane\Calcs\LPILE\
Name of input data file: Water_Side.lp7d
Name of output report file: Water_Side.lp7o
Name of plot output file: Water_Side.lp7p
Name of runtime messeage file: Water_Side.lp7r

Date and Time of Analysis

Date: August 18, 2014 Time: 12:05:27

Problem Title

Project Name: TPOC Gantry Crane - Water Side

Job Number: 20150761

Client:

Engineer: KR

Description:

Program Options and Settings

Engineering Units of Input Data and Computations:
- Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

Computational Options:
- Use unfactored loads in computations (conventional analysis)
- Compute pile response under loading and nonlinear bending properties of pile (only if nonlinear pile properties are input)
- Analysis uses p-y modification factors for p-y curves
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- No p-y curves to be computed and reported for user-specified depths
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1

Pile Structural Properties and Geometry

Total number of pile sections = 1

Total length of pile = 23.00 ft

Depth of ground surface below top of pile = 0.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile.

Point	Depth X ft	Pile Diameter in
1	0.00000	94.0000000
2	23.000000	94.0000000

Input Structural Properties:

Pile Section No. 1:

Section Type = Drilled Shaft (Bored Pile)
Section Length = 23.00000 ft
Section Diameter = 94.00000 in

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 1 layers

Layer 1 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 40.00000 ft
Effective unit weight at top of layer = 67.60000 pcf
Effective unit weight at bottom of layer = 67.60000 pcf
Uniaxial compressive strength at top of layer = 1000.00000 psi
Uniaxial compressive strength at bottom of layer = 1000.00000 psi
Initial modulus of rock at top of layer = 2500.00000 psi
Initial modulus of rock at bottom of layer = 2500.00000 psi
RQD of rock at top of layer = 20.00000 %
RQD of rock at bottom of layer = 20.00000 %
k rm of rock at top of layer = 0.0000500
k rm of rock at bottom of layer = 0.0000500

(Depth of lowest soil layer extends 17.00 ft below pile tip)

Summary of Soil Properties

Layer Num.	Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Uniaxial qu psi	RQD % or GSI	Rock Mass Layer Emass psi	krm
1	Weak Rock	0.00	67.600	1000.000	20.000	2500.000	5.00E-05
		40.000	67.600	1000.000	20.000	2500.000	5.00E-05

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	1.0000	1.0000
2	80.000	1.0000	1.0000

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 91300. lbs	M =	49321200. in-lbs		1397900.	No
2	1	V = 134900. lbs	M =	72842400. in-lbs		1960300.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section = 23.00000 ft
Shaft Diameter = 94.00000 in
Concrete Cover Thickness = 3.00000 in
Number of Reinforcing Bars = 60 bars
Yield Stress of Reinforcing Bars = 60000. psi
Modulus of Elasticity of Reinforcing Bars = 29000000. psi
Gross Area of Shaft = 6939.77817 sq. in.

Total Area of Reinforcing Steel = 76.20000 sq. in.
Area Ratio of Steel Reinforcement = 1.10 percent
Edge-to-Edge Bar Spacing = 6.53178 in
Maximum Concrete Aggregate Size = 0.75000 in
Ratio of Bar Spacing to Aggregate Size = 8.71
Offset of Center of Rebar Cage from Center of Pile = 0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 27908.166 kips
Tensile Load for Cracking of Concrete = -3109.573 kips
Nominal Axial Tensile Capacity = -4572.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.27000	1.27000	43.36035	-0.63498
2	1.27000	1.27000	43.36035	0.63498
3	1.27000	1.27000	42.54484	8.39402
4	1.27000	1.27000	42.28080	9.63623
5	1.27000	1.27000	39.86992	17.05616
6	1.27000	1.27000	39.35338	18.21632
7	1.27000	1.27000	35.45249	24.97287
8	1.27000	1.27000	34.70603	26.00028
9	1.27000	1.27000	29.48562	31.79814
10	1.27000	1.27000	28.54186	32.64790
11	1.27000	1.27000	22.23008	37.23368
12	1.27000	1.27000	21.13027	37.86865
13	1.27000	1.27000	14.00298	41.04193
14	1.27000	1.27000	12.79519	41.43436
15	1.27000	1.27000	5.16389	43.05645
16	1.27000	1.27000	3.90089	43.18919
17	1.27000	1.27000	-3.90089	43.18919
18	1.27000	1.27000	-5.16389	43.05645
19	1.27000	1.27000	-12.79519	41.43436
20	1.27000	1.27000	-14.00298	41.04193
21	1.27000	1.27000	-21.13027	37.86865
22	1.27000	1.27000	-22.23008	37.23368
23	1.27000	1.27000	-28.54186	32.64790
24	1.27000	1.27000	-29.48562	31.79814
25	1.27000	1.27000	-34.70603	26.00028
26	1.27000	1.27000	-35.45249	24.97287
27	1.27000	1.27000	-39.35338	18.21632
28	1.27000	1.27000	-39.86992	17.05616
29	1.27000	1.27000	-42.28080	9.63623
30	1.27000	1.27000	-42.54484	8.39402
31	1.27000	1.27000	-43.36035	0.63498
32	1.27000	1.27000	-43.36035	-0.63498
33	1.27000	1.27000	-42.54484	-8.39402
34	1.27000	1.27000	-42.28080	-9.63623
35	1.27000	1.27000	-39.86992	-17.05616
36	1.27000	1.27000	-39.35338	-18.21632
37	1.27000	1.27000	-35.45249	-24.97287
38	1.27000	1.27000	-34.70603	-26.00028
39	1.27000	1.27000	-29.48562	-31.79814
40	1.27000	1.27000	-28.54186	-32.64790
41	1.27000	1.27000	-22.23008	-37.23368
42	1.27000	1.27000	-21.13027	-37.86865
43	1.27000	1.27000	-14.00298	-41.04193

44	1.27000	1.27000	-12.79519	-41.43436
45	1.27000	1.27000	-5.16389	-43.05645
46	1.27000	1.27000	-3.90089	-43.18919
47	1.27000	1.27000	3.90089	-43.18919
48	1.27000	1.27000	5.16389	-43.05645
49	1.27000	1.27000	12.79519	-41.43436
50	1.27000	1.27000	14.00298	-41.04193
51	1.27000	1.27000	21.13027	-37.86865
52	1.27000	1.27000	22.23008	-37.23368
53	1.27000	1.27000	28.54186	-32.64790
54	1.27000	1.27000	29.48562	-31.79814
55	1.27000	1.27000	34.70603	-26.00028
56	1.27000	1.27000	35.45249	-24.97287
57	1.27000	1.27000	39.35338	-18.21632
58	1.27000	1.27000	39.86992	-17.05616
59	1.27000	1.27000	42.28080	-9.63623
60	1.27000	1.27000	42.54484	-8.39402

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = -0.0000454 inches between Bars 1 and 2

Spacing to aggregate size ratio = -0.0000605

Concrete Properties:

Compressive Strength of Concrete = 4000.00000 psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34164 psi
Compression Strain at Peak Stress = 0.00189
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.75000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	1397.900
2	1960.300

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318-08 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than than 0.003. See ACI 318-08, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 1397.900 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Concrete Stress ksi	Max Steel Stress ksi	Run Msg
0.000000313	5515.3810604	17649219393.	191.4770026	0.0000598	0.0000305	0.2491488	1.7310010	
0.000000625	11031.	17648984549.	119.3032530	0.0000746	0.0000158	0.3087938	2.1538527	
0.000000938	16545.	17648449919.	95.2741061	0.0000893	0.000001194	0.3680698	2.5774866	
0.000001250	22058.	17646294013.	83.2800713	0.0001041	-0.0000134	0.4269689	3.0018651	
0.000001563	27558.	17637032330.	76.0948563	0.0001189	-0.0000280	0.4854560	3.4267513	
0.000001875	33038.	17620206513.	71.3101894	0.0001337	-0.0000425	0.5435011	3.8519353	
0.000002188	38495.	17597611267.	67.8955498	0.0001485	-0.0000571	0.6010882	4.2773083	
0.000002500	43927.	17570837475.	65.3363686	0.0001633	-0.0000717	0.6582091	4.7028117	
0.000002813	49334.	17541025498.	63.3470809	0.0001782	-0.0000862	0.7148587	5.1284119	
0.000003125	54716.	17508965276.	61.7564937	0.0001930	-0.0001008	0.7710341	5.5540885	
0.000003438	60071.	17475206455.	60.4557400	0.0002078	-0.0001153	0.8267333	5.9798285	
0.000003750	60071.	16018939251.	52.3368352	0.0001963	-0.0001562	0.7823808	5.6405183	C
0.000004063	60071.	14786713155.	50.7777789	0.0002063	-0.0001756	0.8198332	5.9268852	C
0.000004375	60071.	13730519358.	49.4012134	0.0002161	-0.0001951	0.8564045	6.2081477	C
0.000004688	60071.	12815151401.	48.1697130	0.0002258	-0.0002148	0.8920901	6.4841796	C
0.000005000	60071.	12014204438.	47.0639264	0.0002353	-0.0002347	0.9270474	6.7561193	C
0.000005313	60071.	11307486530.	46.0649050	0.0002447	-0.0002547	0.9613489	-7.3125912	C
0.000005625	60071.	10679292834.	45.1567577	0.0002540	-0.0002747	0.9950417	-7.8908851	C
0.000005938	60071.	10117224790.	44.3271095	0.0002632	-0.0002949	1.0281757	-8.4721227	C
0.000006250	60071.	9611363550.	43.5664506	0.0002723	-0.0003152	1.0608084	-9.0558933	C
0.000006563	60071.	9153679572.	42.8648645	0.0002813	-0.0003356	1.0929437	-9.6422086	C
0.000006875	60071.	8737603228.	42.2136654	0.0002902	-0.0003560	1.1245712	-10.2311942	C
0.000007188	60071.	8357707435.	41.6119342	0.0002991	-0.0003765	1.1558418	-10.8216718	C
0.000007500	60098.	8013067929.	41.0516442	0.0003079	-0.0003971	1.1867092	-11.4140424	C
0.000007813	61445.	7864999960.	40.5271303	0.0003166	-0.0004178	1.2171582	-12.0084627	C
0.000008125	62786.	7727455730.	40.0395589	0.0003253	-0.0004384	1.2473442	-12.6036852	C
0.000008438	64111.	7598299820.	39.5784744	0.0003339	-0.0004592	1.2770813	-13.2012640	C

0.000008750	65431.	7477858923.	39.1486245	0.0003426	-0.0004799	1.3066051	-13.7992740	C
0.000009063	66741.	7364484649.	38.7415227	0.0003511	-0.0005008	1.3357517	-14.3990967	C
0.000009375	68044.	7257999911.	38.3584402	0.0003596	-0.0005216	1.3646389	-14.9997678	C
0.000009688	69343.	7157995733.	37.9986207	0.0003681	-0.0005425	1.3933206	-15.6008468	C
0.0000100	70631.	7063053697.	37.6538639	0.0003765	-0.0005635	1.4215924	-16.2040794	C
0.0000103	71917.	6973764228.	37.3305528	0.0003850	-0.0005844	1.4497294	-16.8071471	C
0.0000106	73198.	6889242329.	37.0236562	0.0003934	-0.0006054	1.4776188	-17.4110172	C
0.0000109	74471.	6808750097.	36.7290618	0.0004017	-0.0006264	1.5051631	-18.0165475	C
0.0000113	75742.	6732639385.	36.4513300	0.0004101	-0.0006474	1.5325748	-18.6219160	C
0.0000116	77013.	6660551420.	36.1890657	0.0004184	-0.0006684	1.5598525	-19.2271320	C
0.0000119	78272.	6591295130.	35.9331554	0.0004267	-0.0006895	1.5866871	-19.8349133	C
0.0000122	79530.	6525509682.	35.6908196	0.0004350	-0.0007106	1.6133914	-20.4425353	C
0.0000128	82042.	6403311209.	35.2426687	0.0004515	-0.0007528	1.6663981	-21.6573865	C
0.0000134	84534.	6290885409.	34.8246699	0.0004680	-0.0007952	1.7183131	-22.8767333	C
0.0000141	87021.	6188179753.	34.4453793	0.0004844	-0.0008375	1.7697132	-24.0954468	C
0.0000147	89496.	6093326403.	34.0926880	0.0005007	-0.0008799	1.8202665	-25.3165801	C
0.0000153	91961.	6005600987.	33.7659753	0.0005170	-0.0009223	1.8701070	-26.5389622	C
0.0000159	94422.	5924519753.	33.4662582	0.0005334	-0.0009648	1.9194380	-27.7607106	C
0.0000166	96872.	5848849149.	33.1841455	0.0005496	-0.0010073	1.9679398	-28.9848683	C
0.0000172	99313.	5778228994.	32.9206787	0.0005658	-0.0010498	2.0157735	-30.2099585	C
0.0000178	101751.	5712357321.	32.6769356	0.0005821	-0.0010923	2.0631025	-31.4344110	C
0.0000184	104186.	5650749980.	32.4509175	0.0005983	-0.0011348	2.1099246	-32.6582219	C
0.0000191	106608.	5592541043.	32.2339509	0.0006145	-0.0011774	2.1558571	-33.8852222	C
0.0000197	109025.	5537797361.	32.0311755	0.0006306	-0.0012200	2.2012480	-35.1119850	C
0.0000203	111439.	5486242690.	31.8419826	0.0006468	-0.0012626	2.2461362	-36.3380977	C
0.0000209	113850.	5437590361.	31.6651625	0.0006630	-0.0013051	2.2905197	-37.5635559	C
0.0000216	116256.	5391586893.	31.4996462	0.0006792	-0.0013477	2.3343966	-38.7883556	C
0.0000222	118652.	5347714174.	31.3389243	0.0006953	-0.0013903	2.3774316	-40.0160703	C
0.0000228	121045.	5306068192.	31.1876722	0.0007115	-0.0014329	2.4199437	-41.2433462	C
0.0000234	123433.	5266487687.	31.0454768	0.0007276	-0.0014755	2.4619524	-42.4699493	C
0.0000241	125818.	5228810741.	30.9116391	0.0007438	-0.0015181	2.5034557	-43.6958749	C
0.0000247	128200.	5192891795.	30.7855309	0.0007600	-0.0015606	2.5444516		

-44.9211183	C						
0.0000253		130577.	5158599657.	30.6665861	0.0007762	-0.0016031	2.5849379
-46.1456747	C						
0.0000259		132951.	5125815766.	30.5542933	0.0007925	-0.0016456	2.6249124
-47.3695393	C						
0.0000266		135316.	5094267760.	30.4441565	0.0008087	-0.0016882	2.6641106
-48.5958138	C						
0.0000272		137678.	5064028000.	30.3398204	0.0008249	-0.0017308	2.7027904
-49.8215072	C						
0.0000278		140036.	5035013865.	30.2410584	0.0008411	-0.0017733	2.7409604
-51.0464869	C						
0.0000284		142391.	5007143660.	30.1475097	0.0008573	-0.0018158	2.7786187
-52.2707474	C						
0.0000291		144741.	4980342693.	30.0588443	0.0008736	-0.0018583	2.8157628
-53.4942833	C						
0.0000297		147088.	4954542547.	29.9747602	0.0008899	-0.0019007	2.8523905
-54.7170892	C						
0.0000303		149431.	4929680441.	29.8949805	0.0009062	-0.0019432	2.8884996
-55.9391592	C						
0.0000309		151770.	4905698651.	29.8192506	0.0009225	-0.0019856	2.9240877
-57.1604879	C						
0.0000316		154105.	4882544018.	29.7473363	0.0009389	-0.0020280	2.9591526
-58.3810693	C						
0.0000322		156437.	4860167500.	29.6790216	0.0009553	-0.0020703	2.9936918
-59.6008976	C						
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0.0000341		163342.	4795367553.	29.4855509	0.0010044	-0.0021975	3.0935673
-60.0000000	CY						
0.0000347		165364.	4767253146.	29.4113542	0.0010202	-0.0022404	3.1247118
-60.0000000	CY						
0.0000353		167175.	4734169517.	29.3290069	0.0010357	-0.0022837	3.1545701
-60.0000000	CY						
0.0000359		168733.	4695172093.	29.2362072	0.0010507	-0.0023274	3.1829931
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0.0000366		170281.	4657265863.	29.1468226	0.0010657	-0.0023712	3.2109469
-60.0000000	CY						
0.0000372		171770.	4619012967.	29.0577528	0.0010806	-0.0024150	3.2382290
-60.0000000	CY						
0.0000397		176662.	4451327870.	28.6788201	0.0011382	-0.0025924	3.3390926
-60.0000000	CY						
0.0000422		180719.	4283698650.	28.2925100	0.0011936	-0.0027720	3.4292679
-60.0000000	CY						
0.0000447		184221.	4122420091.	27.9262526	0.0012480	-0.0029527	3.5112983
-60.0000000	CY						
0.0000472		187292.	3969094162.	27.5737355	0.0013011	-0.0031345	3.5853539
-60.0000000	CY						
0.0000497		189741.	3818676881.	27.2178704	0.0013524	-0.0033182	3.6509157
-60.0000000	CY						
0.0000522		192166.	3682221987.	26.9008420	0.0014039	-0.0035017	3.7111210
-60.0000000	CY						
0.0000547		194411.	3554948505.	26.5983771	0.0014546	-0.0036860	3.7648217
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0.0000572		196097.	3429010779.	26.2859437	0.0015032	-0.0038724	3.8110906
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0.0000597		197697.	3312198911.	25.9991500	0.0015518	-0.0040588	3.8522704
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0.0000622		199266.	3204275069.	25.7324218	0.0016002	-0.0042454	3.8882620
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0.0000647		200800.	3104149806.	25.4815632	0.0016483	-0.0044323	3.9190517
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0.0000672		202205.	3009565629.	25.2446035	0.0016961	-0.0046195	3.9447299
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0.0000697		203323.	2917641240.	25.0079708	0.0017427	-0.0048079	3.9650648
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0.0000722		204286.	2829938871.	24.7731870	0.0017883	-0.0049973	3.9804458
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0.0000747		205222.	2747746048.	24.5508669	0.0018336	-0.0051870	3.9913471
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0.0000772		206147.	2670725535.	24.3459069	0.0018792	-0.0053764	3.9978874
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0.0000797		207059.	2598385675.	24.1567398	0.0019250	-0.0055656	3.9996030
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0.0000822		207956.	2530267521.	23.9823132	0.0019710	-0.0057546	3.9989120
-60.0000000	CY						
0.0000847		208810.	2465655720.	23.8091699	0.0020163	-0.0059443	3.9966582
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0.0000872		209606.	2404085158.	23.6443018	0.0020615	-0.0061341	3.9990101
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0.0000897		210279.	2344574977.	23.4810709	0.0021060	-0.0063247	3.9972027
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0.0000922		210822.	2286880691.	23.3186231	0.0021497	-0.0065159	3.9982118
60.0000000	CY						
0.0000947		211332.	2231887841.	23.1642534	0.0021934	-0.0067073	3.9999780
60.0000000	CY						
0.0000972		211823.	2179529707.	23.0188743	0.0022371	-0.0068985	3.9959221
60.0000000	CY						
0.0000997		212284.	2129499396.	22.8714918	0.0022800	-0.0070906	3.9991219
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0.0001022		212740.	2081863639.	22.7329998	0.0023230	-0.0072826	3.9985878
60.0000000	CY						
0.0001047		213188.	2036424898.	22.6033083	0.0023663	-0.0074743	3.9957863
60.0000000	CY						
0.0001072		213632.	1993067710.	22.4810010	0.0024097	-0.0076659	3.9989371
60.0000000	CY						
0.0001097		214052.	1951475522.	22.3689943	0.0024536	-0.0078570	3.9999236
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0.0001122		214455.	1911572665.	22.2658913	0.0024980	-0.0080477	3.9938800
60.0000000	CY						
0.0001147		214853.	1873377094.	22.1684667	0.0025424	-0.0082382	3.9977672
60.0000000	CY						
0.0001172		215218.	1836524255.	22.0806503	0.0025876	-0.0084280	3.9997567
60.0000000	CY						
0.0001197		215550.	1800941342.	21.9936382	0.0026324	-0.0086183	3.9953592
60.0000000	CY						
0.0001222		215859.	1766622924.	21.9094675	0.0026771	-0.0088086	3.9943918
60.0000000	CY						
0.0001247		216131.	1733381303.	21.8273042	0.0027216	-0.0089990	3.9978505
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0.0001272		216376.	1701234375.	21.7521327	0.0027666	-0.0091890	3.9996997
60.0000000	CY						
0.0001297		216570.	1669936741.	21.6751798	0.0028110	-0.0093796	3.9967293
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0.0001322		216759.	1639786341.	21.6026442	0.0028556	-0.0095700	3.9915202
60.0000000	CY						
0.0001347		216905.	1610429363.	21.5309807	0.0029000	-0.0097607	3.9956127
60.0000000	CY						
0.0001372		217008.	1581838616.	21.4656057	0.0029448	-0.0099508	3.9984118
60.0000000	CY						
0.0001522		217569.	1429612402.	21.1369958	0.0032168	-0.0110888	3.9990856
60.0000000	CYT						
0.0001672		218012.	1303996060.	20.8612859	0.0034877	-0.0122279	3.9973375
60.0000000	CYT						
0.0001822		218354.	1198511293.	20.6653574	0.0037650	-0.0133607	3.9907418

60.0000000 CYT
0.0001972 218354. 1107340862. 20.6501791 0.0040720 -0.0144637 3.9830417
60.0000000 CYT

Axial Thrust Force = 1960.300 kips

Bending Max Steel Curvature rad/in.	Bending Run Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Concrete Stress ksi	Msg
0.000000313	5466.5904391	17493089405.	250.5210655	0.0000783	0.0000489	0.3245448	
2.2660878							
0.000000625	10933.	17492895432.	148.8258922	0.0000930	0.0000343	0.3835864	
2.6889505							
0.000000938	16399.	17492370143.	114.9565408	0.0001078	0.0000196	0.4422588	
3.1126028							
0.000001250	21864.	17491589322.	98.0436472	0.0001226	0.000005055	0.5005594	
3.5370447							
0.000001563	27329.	17490316055.	87.9131529	0.0001374	-0.000009511	0.5584844	
3.9622679							
0.000001875	32785.	17485544617.	81.1713888	0.0001522	-0.0000241	0.6160130	
4.3881380							
0.000002188	38227.	17475068095.	76.3628388	0.0001670	-0.0000386	0.6731158	
4.8144520							
0.000002500	43648.	17459180584.	72.7606747	0.0001819	-0.0000531	0.7297735	
5.2410739							
0.000002813	49047.	17438808383.	69.9617384	0.0001968	-0.0000676	0.7859740	
5.6679199							
0.000003125	54421.	17414858970.	67.7244785	0.0002116	-0.0000821	0.8417096	
6.0949371							
0.000003438	59771.	17388071245.	65.8953586	0.0002265	-0.0000966	0.8969753	
6.5220904							
0.000003750	65096.	17359021173.	64.3721249	0.0002414	-0.0001111	0.9517675	
6.9493561							
0.000004063	65096.	16023711852.	58.1329667	0.0002362	-0.0001457	0.9318267	
6.7934183 C							
0.000004375	65096.	14879161006.	56.4554009	0.0002470	-0.0001643	0.9713701	
7.1031476 C							
0.000004688	65096.	13887216939.	54.9598637	0.0002576	-0.0001830	1.0099412	
7.4072158 C							
0.000005000	65096.	13019265880.	53.6109241	0.0002681	-0.0002019	1.0475302	
7.7054340 C							
0.000005313	65096.	12253426711.	52.3917697	0.0002783	-0.0002210	1.0843253	
7.9991976 C							
0.000005625	65096.	11572680782.	51.2821242	0.0002885	-0.0002403	1.1203643	
8.2887277 C							
0.000005938	65096.	10963592320.	50.2656033	0.0002985	-0.0002597	1.1556763	
8.5741804 C							
0.000006250	65096.	10415412704.	49.3308475	0.0003083	-0.0002792	1.1903288	
8.8560286 C							
0.000006563	65598.	9995934970.	48.4675673	0.0003181	-0.0002988	1.2243620	
9.1345370 C							
0.000006875	67140.	9765823075.	47.6671226	0.0003277	-0.0003185	1.2578101	
9.4099262 C							
0.000007188	68654.	9551832027.	46.9237108	0.0003373	-0.0003384	1.2907402	
-9.7144984 C							
0.000007500	70144.	9352594478.	46.2321160	0.0003467	-0.0003583	1.3232076	
-10.2872898 C							

0.000007813	71617.	9166916910.	45.5881224	0.0003562	-0.0003782	1.3552711
-10.8618316 C						
0.000008125	73059.	8991850885.	44.9798070	0.0003655	-0.0003983	1.3867554
-11.4396392 C						
0.000008438	74488.	8828255526.	44.4114352	0.0003747	-0.0004184	1.4179041
-12.0186988 C						
0.000008750	75901.	8674439639.	43.8766004	0.0003839	-0.0004386	1.4486568
-12.5995501 C						
0.000009063	77297.	8529269403.	43.3706938	0.0003930	-0.0004588	1.4789824
-13.1824927 C						
0.000009375	78682.	8392782438.	42.8951493	0.0004021	-0.0004791	1.5090211
-13.7663500 C						
0.000009688	80051.	8263292258.	42.4423346	0.0004112	-0.0004995	1.5386236
-14.3524410 C						
0.0000100	81412.	8141150412.	42.0153147	0.0004202	-0.0005198	1.5679663
-14.9392587 C						
0.0000103	82760.	8025210273.	41.6088263	0.0004291	-0.0005403	1.5969517
-15.5276760 C						
0.0000106	84098.	7915100559.	41.2220087	0.0004380	-0.0005608	1.6256161
-16.1173998 C						
0.0000109	85433.	7811014301.	40.8569785	0.0004469	-0.0005813	1.6540973
-16.7072240 C						
0.0000113	86750.	7711114436.	40.5038230	0.0004557	-0.0006018	1.6821013
-17.2997902 C						
0.0000116	88066.	7616508187.	40.1703131	0.0004645	-0.0006224	1.7099579
-17.8921700 C						
0.0000119	89375.	7526350652.	39.8520934	0.0004732	-0.0006430	1.7375603
-18.4853291 C						
0.0000122	90672.	7439780960.	39.5445511	0.0004819	-0.0006637	1.7647774
-19.0804820 C						
0.0000128	93261.	7278889147.	38.9749294	0.0004994	-0.0007050	1.8187358
-20.2706184 C						
0.0000134	95817.	7130604173.	38.4457052	0.0005166	-0.0007465	1.8715116
-21.4656611 C						
0.0000141	98364.	6994764406.	37.9620727	0.0005338	-0.0007880	1.9235787
-22.6612953 C						
0.0000147	100886.	6868847260.	37.5107589	0.0005509	-0.0008297	1.9746092
-23.8606955 C						
0.0000153	103402.	6752798165.	37.0968634	0.0005680	-0.0008713	2.0250311
-25.0598397 C						
0.0000159	105894.	6644312907.	36.7059074	0.0005850	-0.0009131	2.0743709
-26.2633852 C						
0.0000166	108381.	6543749341.	36.3459099	0.0006020	-0.0009549	2.1231564
-27.4662332 C						
0.0000172	110853.	6449644544.	36.0076176	0.0006189	-0.0009967	2.1710953
-28.6713125 C						
0.0000178	113313.	6361411629.	35.6895886	0.0006357	-0.0010387	2.2182388
-29.8781875 C						
0.0000184	115768.	6278926624.	35.3944220	0.0006526	-0.0010805	2.2648337
-31.0843668 C						
0.0000191	118211.	6201221303.	35.1153877	0.0006694	-0.0011225	2.3106419
-32.2923279 C						
0.0000197	120641.	6127818007.	34.8506343	0.0006861	-0.0011645	2.3556534
-33.5022503 C						
0.0000203	123068.	6058723681.	34.6033574	0.0007029	-0.0012065	2.4001217
-34.7114754 C						
0.0000209	125490.	5993551064.	34.3719987	0.0007197	-0.0012485	2.4440444
-35.9199988 C						
0.0000216	127899.	5931529214.	34.1496347	0.0007364	-0.0012905	2.4871073
-37.1312847 C						
0.0000222	130299.	5872652044.	33.9388022	0.0007530	-0.0013326	2.5295091
-38.3432113 C						
0.0000228	132696.	5816817854.	33.7405916	0.0007697	-0.0013747	2.5713701

-39.5544304	C						
0.0000234		135089.	5763781999.	33.5540000	0.0007864	-0.0014167	2.6126879
-40.7649374	C						
0.0000241		137477.	5713325214.	33.3781285	0.0008032	-0.0014587	2.6534603
-41.9747278	C						
0.0000247		139851.	5664866692.	33.2062763	0.0008198	-0.0015008	2.6933322
-43.1880160	C						
0.0000253		142221.	5618618924.	33.0436082	0.0008364	-0.0015430	2.7326470
-44.4007919	C						
0.0000259		144587.	5574439290.	32.8897475	0.0008531	-0.0015850	2.7714203
-45.6128399	C						
0.0000266		146949.	5532180743.	32.7440790	0.0008698	-0.0016271	2.8096498
-46.8241547	C						
0.0000272		149306.	5491709707.	32.6060444	0.0008865	-0.0016691	2.8473330
-48.0347312	C						
0.0000278		151659.	5452904601.	32.4751352	0.0009032	-0.0017112	2.8844675
-49.2445643	C						
0.0000284		154003.	5415490764.	32.3477977	0.0009199	-0.0017532	2.9208572
-50.4561974	C						
0.0000291		156340.	5379452683.	32.2251528	0.0009365	-0.0017953	2.9565942
-51.6684915	C						
0.0000297		158673.	5344790491.	32.1085569	0.0009532	-0.0018374	2.9917854
-52.8800236	C						
0.0000303		161002.	5311418092.	31.9976423	0.0009699	-0.0018794	3.0264283
-54.0907881	C						
0.0000309		163327.	5279256323.	31.8920713	0.0009867	-0.0019215	3.0605204
-55.3007791	C						
0.0000316		165647.	5248232279.	31.7915329	0.0010034	-0.0019635	3.0940592
-56.5099906	C						
0.0000322		167963.	5218278705.	31.6957404	0.0010202	-0.0020054	3.1270420
-57.7184166	C						
0.0000328		170275.	5189333459.	31.6044291	0.0010370	-0.0020474	3.1594663
-58.9260510	C						
0.0000334		172582.	5161339030.	31.5173540	0.0010539	-0.0020893	3.1913295
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0.0000341		174882.	5134150171.	31.4319859	0.0010707	-0.0021312	3.2224822
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0.0000347		177176.	5107772521.	31.3494234	0.0010874	-0.0021732	3.2530058
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0.0000353		179356.	5079113666.	31.2649006	0.0011040	-0.0022153	3.2826085
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0.0000359		181273.	5044129937.	31.1706046	0.0011202	-0.0022579	3.3108086
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0.0000366		182991.	5004887242.	31.0699977	0.0011360	-0.0023009	3.3378419
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0.0000372		184531.	4962180405.	30.9643123	0.0011515	-0.0023441	3.3638024
-60.0000000	CY						
0.0000397		190004.	4787512864.	30.5464130	0.0012123	-0.0025183	3.4606962
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0.0000422		194614.	4613078991.	30.1291289	0.0012711	-0.0026946	3.5466481
-60.0000000	CY						
0.0000447		198210.	4435460800.	29.7134999	0.0013278	-0.0028728	3.6225262
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0.0000472		201643.	4273236210.	29.3302984	0.0013840	-0.0030516	3.6908141
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0.0000497		204372.	4113151908.	28.9488740	0.0014384	-0.0032322	3.7503613
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0.0000522		206811.	3962849904.	28.5914155	0.0014921	-0.0034135	3.8029276
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0.0000547		209191.	3825207251.	28.2586896	0.0015454	-0.0035952	3.8489286
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0.0000572		211320.	3695210958.	27.9458091	0.0015982	-0.0037775	3.8884505
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0.0000597		212982.	3568288624.	27.6316765	0.0016493	-0.0039614	3.9210168
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0.0000622		214549.	3450031795.	27.3326396	0.0016997	-0.0041459	3.9476694
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0.0000647		216096.	3340621953.	27.0609992	0.0017505	-0.0043301	3.9689591
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0.0000672		217625.	3239063577.	26.8137823	0.0018016	-0.0045141	3.9847946
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0.0000697		219017.	3142842505.	26.5691726	0.0018515	-0.0046991	3.9948801
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0.0000722		220162.	3049858721.	26.3274422	0.0019005	-0.0048851	3.9995643
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0.0000747		221114.	2960526394.	26.0929707	0.0019488	-0.0050718	3.9979443
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0.0000772		222051.	2876771602.	25.8773022	0.0019974	-0.0052582	3.9992792
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0.0000797		222938.	2797648100.	25.6667170	0.0020453	-0.0054453	3.9991047
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0.0000822		223805.	2723108211.	25.4703852	0.0020933	-0.0056323	3.9956308
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0.0000847		224658.	2652789032.	25.2890097	0.0021417	-0.0058190	3.9993933
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0.0000872		225497.	2586347483.	25.1210793	0.0021902	-0.0060054	3.9952750
60.0000000	CY						
0.0000897		226308.	2523293529.	24.9641926	0.0022390	-0.0061916	3.9992002
60.0000000	CY						
0.0000922		227040.	2462810076.	24.8064004	0.0022868	-0.0063788	3.9966716
60.0000000	CY						
0.0000947		227662.	2404352883.	24.6473954	0.0023338	-0.0065668	3.9980164
60.0000000	CY						
0.0000972		228169.	2347720475.	24.4883900	0.0023800	-0.0067557	3.9999136
60.0000000	CY						
0.0000997		228621.	2293374269.	24.3421981	0.0024266	-0.0069440	3.9946865
60.0000000	CY						
0.0001022		229051.	2241477305.	24.2055746	0.0024735	-0.0071321	3.9984502
60.0000000	CY						
0.0001047		229464.	2191896218.	24.0790970	0.0025208	-0.0073198	3.9999704
60.0000000	CY						
0.0001072		229829.	2144178768.	23.9670284	0.0025690	-0.0075067	3.9940128
60.0000000	CY						
0.0001097		230170.	2098415399.	23.8516373	0.0026162	-0.0076944	3.9978882
60.0000000	CY						
0.0001122		230495.	2054549075.	23.7450591	0.0026639	-0.0078817	3.9998013
60.0000000	CY						
0.0001147		230796.	2012390952.	23.6482338	0.0027122	-0.0080685	3.9945638
60.0000000	CY						
0.0001172		231091.	1971977994.	23.5573241	0.0027606	-0.0082550	3.9956820
60.0000000	CY						
0.0001197		231371.	1933127383.	23.4736545	0.0028095	-0.0084411	3.9987704
60.0000000	CY						
0.0001222		231616.	1895582032.	23.4005912	0.0028593	-0.0086264	3.9999878
60.0000000	CY						
0.0001247		231853.	1859468774.	23.3328391	0.0029093	-0.0088113	3.9916009
60.0000000	CY						
0.0001272		232084.	1824741681.	23.2690454	0.0029595	-0.0089961	3.9956052
60.0000000	CY						
0.0001297		232312.	1791324309.	23.2088861	0.0030099	-0.0091807	3.9986636
60.0000000	CYT						
0.0001322		232515.	1758978249.	23.1492390	0.0030600	-0.0093656	3.9999501
60.0000000	CYT						
0.0001347		232695.	1727664815.	23.0916205	0.0031102	-0.0095505	3.9933776
60.0000000	CYT						
0.0001372		232871.	1697464267.	23.0372856	0.0031604	-0.0097352	3.9928258

60.0000000	CYT						
0.0001522		233429.	1533828197.	22.6820844	0.0034519	-0.0108537	3.9928968
60.0000000	CYT						
0.0001672		233651.	1397540155.	22.4295585	0.0037499	-0.0119657	3.9885812
60.0000000	CYT						
0.0001822		233651.	1282476814.	22.5829030	0.0041143	-0.0130113	3.9920849
60.0000000	CYT						

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	1397.900	217122.249	0.00300000
2	1960.300	232267.541	0.00300000

Note note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318-08, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318-08, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resistance Factor for Moment	Nominal Moment Capacity in-kip	Ultimate (Factored) Axial Thrust kips	Ultimate (Factored) Moment Capacity in-kip	Bending Stiffness at Ult. Mom. Cap. kip-in^2
1	0.65	217122.249	908.635	141129.457	5022073483.384
2	0.65	232267.541	1274.195	150973.896	5464201421.344
1	0.70	217122.249	978.530	151985.572	4903561707.463
2	0.70	232267.541	1372.210	162587.276	5289490456.457
1	0.75	217122.249	1048.425	162841.687	4800276836.648
2	0.75	232267.541	1470.225	174200.656	5142205382.773

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 91300.0 lbs
Applied moment at pile head = 49321200.0 in-lbs
Axial thrust load on pile head = 1397900.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.0245	49321200.	91300.	-0.000365	0.000	1.754E+13	-6112.7580	345000.	0.000
0.230	0.0235	49551300.	74456.	-0.000357	0.000	1.754E+13	-6092.9773	717013.	0.000
0.460	0.0225	49734956.	57686.	-0.000350	0.000	1.754E+13	-6059.4756	744026.	0.000
0.690	0.0215	49872423.	41026.	-0.000342	0.000	1.754E+13	-6012.9080	771038.	0.000
0.920	0.0206	49964056.	24512.	-0.000334	0.000	1.754E+13	-5953.9263	798051.	0.000
1.150	0.0197	50010304.	8176.3748	-0.000326	0.000	1.754E+13	-5883.1788	825064.	0.000
1.380	0.0188	50011705.	-7948.2182	-0.000318	0.000	1.754E+13	-5801.3089	852077.	0.000
1.610	0.0179	49968885.	-23832.	-0.000310	0.000	1.754E+13	-5708.9547	879089.	0.000
1.840	0.0171	49882545.	-39448.	-0.000302	0.000	1.754E+13	-5606.7479	906102.	0.000
2.070	0.0163	49753466.	-54769.	-0.000295	0.000	1.754E+13	-5495.3129	933115.	0.000
2.300	0.0155	49582495.	-69770.	-0.000287	0.000	1.754E+13	-5375.2659	960128.	0.000
2.530	0.0147	49370547.	-84429.	-0.000279	0.000	1.754E+13	-5247.2144	987140.	0.000
2.760	0.0139	49118598.	-98725.	-0.000271	0.000	1.754E+13	-5111.7563	1014153.	0.000
2.990	0.0132	48827680.	-112637.	-0.000264	0.000	1.754E+13	-4969.4792	1041166.	0.000
3.220	0.0125	48498877.	-126148.	-0.000256	0.000	1.755E+13	-4820.9598	1068179.	0.000
3.450	0.0118	48133320.	-139241.	-0.000248	0.000	1.755E+13	-4666.7632	1095191.	0.000
3.680	0.0111	47732184.	-151901.	-0.000241	0.000	1.755E+13	-4507.4423	1122204.	0.000
3.910	0.0104	47296684.	-164115.	-0.000233	0.000	1.755E+13	-4343.5369	1149217.	0.000
4.140	0.009798	46828068.	-175872.	-0.000226	0.000	1.755E+13	-4175.5738	1176230.	0.000
4.370	0.009185	46327615.	-187160.	-0.000219	0.000	1.756E+13	-4004.0658	1203243.	0.000
4.600	0.008591	45796633.	-197970.	-0.000211	0.000	1.756E+13	-3829.5112	1230255.	0.000
4.830	0.008018	45236451.	-208295.	-0.000204	0.000	1.756E+13	-3652.3938	1257268.	0.000
5.060	0.007464	44648420.	-218128.	-0.000197	0.000	1.757E+13	-3473.1823	1284281.	

0.000								
5.290	0.006930	44033904.	-227465.	-0.000190	0.000	1.757E+13	-3292.3295	1311294.
0.000								
5.520	0.006414	43394282.	-236300.	-0.000183	0.000	1.757E+13	-3110.2730	1338306.
0.000								
5.750	0.005918	42730940.	-244632.	-0.000177	0.000	1.758E+13	-2927.4343	1365319.
0.000								
5.980	0.005440	42045273.	-252459.	-0.000170	0.000	1.758E+13	-2744.2193	1392332.
0.000								
6.210	0.004980	41338676.	-259780.	-0.000163	0.000	1.758E+13	-2561.0172	1419345.
0.000								
6.440	0.004538	40612545.	-266597.	-0.000157	0.000	1.759E+13	-2378.2006	1446357.
0.000								
6.670	0.004114	39868274.	-272909.	-0.000151	0.000	1.759E+13	-2196.1256	1473370.
0.000								
6.900	0.003707	39107249.	-278721.	-0.000144	0.000	1.759E+13	-2015.1314	1500383.
0.000								
7.130	0.003317	38330850.	-284035.	-0.000138	0.000	1.760E+13	-1835.5403	1527396.
0.000								
7.360	0.002943	37540445.	-288855.	-0.000132	0.000	1.760E+13	-1657.6581	1554409.
0.000								
7.590	0.002586	36737390.	-293188.	-0.000127	0.000	1.760E+13	-1481.7744	1581421.
0.000								
7.820	0.002245	35923025.	-297038.	-0.000121	0.000	1.761E+13	-1308.1621	1608434.
0.000								
8.050	0.001919	35098674.	-300412.	-0.000115	0.000	1.761E+13	-1137.0774	1635447.
0.000								
8.280	0.001608	34265639.	-303318.	-0.000110	0.000	1.761E+13	-968.7600	1662460.
0.000								
8.510	0.001313	33425205.	-305764.	-0.000105	0.000	1.762E+13	-803.4333	1689472.
0.000								
8.740	0.001031	32578630.	-307758.	-9.939E-05	0.000	1.762E+13	-641.3043	1716485.
0.000								
8.970	0.000764	31727149.	-309309.	-9.435E-05	0.000	1.762E+13	-482.5647	1743498.
0.000								
9.200	0.000510	30871974.	-310426.	-8.945E-05	0.000	1.763E+13	-327.3906	1770511.
0.000								
9.430	0.000270	30014286.	-311121.	-8.468E-05	0.000	1.763E+13	-175.9428	1797523.
0.000								
9.660	4.291E-05	29155240.	-311403.	-8.005E-05	0.000	1.763E+13	-28.3668	1824536.
0.000								
9.890	-0.000172	28295960.	-311283.	-7.556E-05	0.000	1.763E+13	115.2071	1851549.
0.000								
10.120	-0.000374	27437541.	-310773.	-7.119E-05	0.000	1.764E+13	254.6629	1878562.
0.000								
10.350	-0.000565	26581045.	-309883.	-6.697E-05	0.000	1.764E+13	389.8992	1905574.
0.000								
10.580	-0.000744	25727503.	-308626.	-6.288E-05	0.000	1.764E+13	520.8276	1932587.
0.000								
10.810	-0.000912	24877913.	-307014.	-5.892E-05	0.000	1.764E+13	647.3732	1959600.
0.000								
11.040	-0.001069	24033239.	-305059.	-5.509E-05	0.000	1.764E+13	769.4746	1986613.
0.000								
11.270	-0.001216	23194412.	-302773.	-5.140E-05	0.000	1.764E+13	887.0831	2013626.
0.000								
11.500	-0.001353	22362329.	-300168.	-4.783E-05	0.000	1.765E+13	1000.1623	2040638.
0.000								
11.730	-0.001480	21537851.	-297258.	-4.440E-05	0.000	1.765E+13	1108.6882	2067651.
0.000								
11.960	-0.001598	20721806.	-294055.	-4.110E-05	0.000	1.765E+13	1212.6476	2094664.
0.000								
12.190	-0.001707	19914986.	-290571.	-3.792E-05	0.000	1.765E+13	1312.0385	2121677.
0.000								

12.420	-0.001807	19118148.	-286819.	-3.486E-05	0.000	1.765E+13	1406.8695	2148689.
0.000								
12.650	-0.001899	18332016.	-282811.	-3.194E-05	0.000	1.765E+13	1497.1594	2175702.
0.000								
12.880	-0.001983	17557277.	-278561.	-2.913E-05	0.000	1.765E+13	1582.9369	2202715.
0.000								
13.110	-0.002060	16794586.	-274079.	-2.644E-05	0.000	1.765E+13	1664.2399	2229728.
0.000								
13.340	-0.002129	16044563.	-269380.	-2.388E-05	0.000	1.765E+13	1741.1152	2256740.
0.000								
13.570	-0.002192	15307792.	-264475.	-2.142E-05	0.000	1.765E+13	1813.6178	2283753.
0.000								
13.800	-0.002248	14584828.	-259375.	-1.909E-05	0.000	1.765E+13	1881.8108	2310766.
0.000								
14.030	-0.002297	13876190.	-254093.	-1.686E-05	0.000	1.765E+13	1945.7644	2337779.
0.000								
14.260	-0.002341	13182366.	-248640.	-1.475E-05	0.000	1.765E+13	2005.5559	2364791.
0.000								
14.490	-0.002379	12503811.	-243028.	-1.274E-05	0.000	1.765E+13	2061.2690	2391804.
0.000								
14.720	-0.002411	11840951.	-237267.	-1.083E-05	0.000	1.765E+13	2112.9932	2418817.
0.000								
14.950	-0.002438	11194179.	-231369.	-9.033E-06	0.000	1.765E+13	2160.8238	2445830.
0.000								
15.180	-0.002461	10563861.	-225345.	-7.331E-06	0.000	1.765E+13	2204.8607	2472843.
0.000								
15.410	-0.002479	9950333.	-219204.	-5.727E-06	0.000	1.765E+13	2245.2086	2499855.
0.000								
15.640	-0.002493	9353901.	-212956.	-4.218E-06	0.000	1.765E+13	2281.9759	2526868.
0.000								
15.870	-0.002502	8774847.	-206612.	-2.800E-06	0.000	1.765E+13	2315.2749	2553881.
0.000								
16.100	-0.002508	8213425.	-200180.	-1.472E-06	0.000	1.765E+13	2345.2206	2580894.
0.000								
16.330	-0.002510	7669862.	-193671.	-2.301E-07	0.000	1.765E+13	2371.9309	2607906.
0.000								
16.560	-0.002509	7144364.	-187092.	9.282E-07	0.000	1.765E+13	2395.5256	2634919.
0.000								
16.790	-0.002505	6637109.	-180452.	2.006E-06	0.000	1.765E+13	2416.1263	2661932.
0.000								
17.020	-0.002498	6148255.	-173759.	3.005E-06	0.000	1.765E+13	2433.8558	2688945.
0.000								
17.250	-0.002489	5677938.	-167021.	3.930E-06	0.000	1.765E+13	2448.8376	2715957.
0.000								
17.480	-0.002476	5226272.	-160245.	4.783E-06	0.000	1.765E+13	2461.1954	2742970.
0.000								
17.710	-0.002462	4793350.	-153438.	5.566E-06	0.000	1.765E+13	2471.0531	2769983.
0.000								
17.940	-0.002446	4379250.	-146608.	6.283E-06	0.000	1.765E+13	2478.5337	2796996.
0.000								
18.170	-0.002427	3984027.	-139760.	6.937E-06	0.000	1.765E+13	2483.7594	2824009.
0.000								
18.400	-0.002407	3607722.	-132900.	7.531E-06	0.000	1.765E+13	2486.8508	2851021.
0.000								
18.630	-0.002386	3250359.	-126035.	8.067E-06	0.000	1.765E+13	2487.9269	2878034.
0.000								
18.860	-0.002363	2911946.	-119170.	8.549E-06	0.000	1.765E+13	2487.1043	2905047.
0.000								
19.090	-0.002339	2592477.	-112309.	8.979E-06	0.000	1.765E+13	2484.4970	2932060.
0.000								
19.320	-0.002313	2291932.	-105458.	9.361E-06	0.000	1.765E+13	2480.2158	2959072.
0.000								
19.550	-0.002287	2010279.	-98620.	9.698E-06	0.000	1.765E+13	2474.3683	2986085.

0.000								
19.780	-0.002260	1747473.	-91801.	9.992E-06	0.000	1.765E+13	2467.0581	3013098.
0.000								
20.010	-0.002232	1503460.	-85004.	1.025E-05	0.000	1.765E+13	2458.3847	3040111.
0.000								
20.240	-0.002203	1278173.	-78232.	1.046E-05	0.000	1.765E+13	2448.4431	3067123.
0.000								
20.470	-0.002174	1071536.	-71490.	1.065E-05	0.000	1.765E+13	2437.3231	3094136.
0.000								
20.700	-0.002144	883465.	-64780.	1.080E-05	0.000	1.765E+13	2425.1094	3121149.
0.000								
20.930	-0.002115	713867.	-58105.	1.092E-05	0.000	1.765E+13	2411.8810	3148162.
0.000								
21.160	-0.002084	562642.	-51468.	1.102E-05	0.000	1.765E+13	2397.7110	3175174.
0.000								
21.390	-0.002054	429681.	-44871.	1.110E-05	0.000	1.765E+13	2382.6660	3202187.
0.000								
21.620	-0.002023	314869.	-38316.	1.116E-05	0.000	1.765E+13	2366.8061	3229200.
0.000								
21.850	-0.001992	218087.	-31807.	1.120E-05	0.000	1.765E+13	2350.1841	3256213.
0.000								
22.080	-0.001961	139208.	-25344.	1.123E-05	0.000	1.765E+13	2332.8460	3283226.
0.000								
22.310	-0.001930	78099.	-18931.	1.125E-05	0.000	1.765E+13	2314.8296	3310238.
0.000								
22.540	-0.001899	34624.	-12568.	1.126E-05	0.000	1.765E+13	2296.1653	3337251.
0.000								
22.770	-0.001868	8639.7950	-6256.7075	1.126E-05	0.000	1.765E+13	2276.8747	3364264.
0.000								
23.000	-0.001837	0.000	0.000	1.126E-05	0.000	1.765E+13	2256.9713	1695638.
0.000								

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.0244510 inches
Computed slope at pile head = -0.0003652 radians
Maximum bending moment = 50011705. inch-lbs
Maximum shear force = -311403. lbs
Depth of maximum bending moment = 1.3800000 feet below pile head
Depth of maximum shear force = 9.6600000 feet below pile head
Number of iterations = 6
Number of zero deflection points = 1

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 134900.0 lbs
Applied moment at pile head = 72842400.0 in-lbs
Axial thrust load on pile head = 1960300.0 lbs

Depth Distrib. X Lat. Load feet lb/inch	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch
0.00	0.0409	72842400.	134900.	-0.000748	0.000	9.017E+12	-10228.	345000.
0.000								
0.230	0.0389	73179756.	106848.	-0.000726	0.000	9.017E+12	-10100.	717013.
0.000								
0.460	0.0369	73440054.	79181.	-0.000703	0.000	8.947E+12	-9948.6217	744026.
0.000								
0.690	0.0350	73624445.	51961.	-0.000681	0.000	8.926E+12	-9776.2699	771038.
0.000								
0.920	0.0331	73734241.	25242.	-0.000658	0.000	8.913E+12	-9584.7018	798051.
0.000								
1.150	0.0314	73770901.	-923.1302	-0.000635	0.000	8.909E+12	-9375.8170	825064.
0.000								
1.380	0.0296	73736016.	-26491.	-0.000612	0.000	8.913E+12	-9151.4847	852077.
0.000								
1.610	0.0280	73631295.	-51421.	-0.000589	0.000	8.925E+12	-8913.5386	879089.
0.000								
1.840	0.0264	73458551.	-75677.	-0.000567	0.000	8.945E+12	-8663.7719	906102.
0.000								
2.070	0.0249	73219688.	-99231.	-0.000544	0.000	8.973E+12	-8403.9328	933115.
0.000								
2.300	0.0234	72916685.	-122055.	-0.000522	0.000	9.008E+12	-8135.7198	960128.
0.000								
2.530	0.0220	72551586.	-144131.	-0.000499	0.000	9.052E+12	-7860.7785	987140.
0.000								
2.760	0.0206	72126487.	-165440.	-0.000477	0.000	9.103E+12	-7580.6979	1014153.
0.000								
2.990	0.0193	71643524.	-185971.	-0.000456	0.000	9.163E+12	-7297.0064	1041166.
0.000								
3.220	0.0181	71104857.	-205716.	-0.000434	0.000	9.229E+12	-7011.1677	1068179.
0.000								
3.450	0.0169	70512668.	-224672.	-0.000413	0.000	9.304E+12	-6724.5846	1095191.
0.000								
3.680	0.0158	69869140.	-242837.	-0.000392	0.000	9.388E+12	-6438.5911	1122204.
0.000								
3.910	0.0148	69176455.	-260215.	-0.000372	0.000	9.479E+12	-6154.4512	1149217.
0.000								
4.140	0.0138	68436778.	-276814.	-0.000352	0.000	9.581E+12	-5873.3585	1176230.
0.000								
4.370	0.0128	67652254.	-292642.	-0.000333	0.000	9.691E+12	-5596.4324	1203243.
0.000								
4.600	0.0119	66824994.	-307713.	-0.000314	0.000	9.838E+12	-5324.7194	1230255.
0.000								
4.830	0.0111	65957071.	-322043.	-0.000297	0.000	1.218E+13	-5059.1286	1257268.
0.000								
5.060	0.0103	65050529.	-335643.	-0.000284	0.000	1.644E+13	-4796.3022	1284281.
0.000								
5.290	0.009539	64107391.	-348517.	-0.000273	0.000	1.736E+13	-4532.1696	1311294.
0.000								
5.520	0.008799	63129674.	-360659.	-0.000263	0.000	1.737E+13	-4266.6353	1338306.
0.000								
5.750	0.008087	62119401.	-372067.	-0.000253	0.000	1.737E+13	-4000.3091	1365319.
0.000								
5.980	0.007401	61078602.	-382740.	-0.000243	0.000	1.738E+13	-3733.7759	1392332.
0.000								
6.210	0.006743	60009309.	-392678.	-0.000234	0.000	1.739E+13	-3467.5961	1419345.

0.000								
6.440	0.006111	58913548.	-401883.	-0.000224	0.000	1.739E+13	-3202.3053	1446357.
0.000								
6.670	0.005504	57793344.	-410357.	-0.000215	0.000	1.740E+13	-2938.4148	1473370.
0.000								
6.900	0.004923	56650706.	-418105.	-0.000206	0.000	1.740E+13	-2676.4114	1500383.
0.000								
7.130	0.004367	55487632.	-425134.	-0.000197	0.000	1.741E+13	-2416.7567	1527396.
0.000								
7.360	0.003835	54306100.	-431450.	-0.000188	0.000	1.742E+13	-2159.8874	1554409.
0.000								
7.590	0.003327	53108068.	-437061.	-0.000180	0.000	1.742E+13	-1906.2152	1581421.
0.000								
7.820	0.002842	51895471.	-441977.	-0.000172	0.000	1.743E+13	-1656.1283	1608434.
0.000								
8.050	0.002380	50670213.	-446208.	-0.000163	0.000	1.743E+13	-1409.9904	1635447.
0.000								
8.280	0.001939	49434171.	-449766.	-0.000156	0.000	1.744E+13	-1168.1408	1662460.
0.000								
8.510	0.001521	48189188.	-452663.	-0.000148	0.000	1.744E+13	-930.8945	1689472.
0.000								
8.740	0.001123	46937072.	-454911.	-0.000140	0.000	1.745E+13	-698.5437	1716485.
0.000								
8.970	0.000746	45679595.	-456526.	-0.000133	0.000	1.745E+13	-471.3576	1743498.
0.000								
9.200	0.000389	44418489.	-457521.	-0.000126	0.000	1.746E+13	-249.5823	1770511.
0.000								
9.430	5.135E-05	43155443.	-457911.	-0.000119	0.000	1.746E+13	-33.4411	1797523.
0.000								
9.660	-0.000268	41892106.	-457713.	-0.000112	0.000	1.746E+13	176.8645	1824536.
0.000								
9.890	-0.000568	40630080.	-456943.	-0.000106	0.000	1.747E+13	381.1538	1851549.
0.000								
10.120	-0.000851	39370923.	-455618.	-9.939E-05	0.000	1.747E+13	579.2674	1878562.
0.000								
10.350	-0.001117	38116145.	-453754.	-9.327E-05	0.000	1.748E+13	771.0668	1905574.
0.000								
10.580	-0.001366	36867208.	-451370.	-8.735E-05	0.000	1.748E+13	956.4337	1932587.
0.000								
10.810	-0.001599	35625525.	-448484.	-8.163E-05	0.000	1.748E+13	1135.2681	1959600.
0.000								
11.040	-0.001816	34392460.	-445113.	-7.610E-05	0.000	1.748E+13	1307.4894	1986613.
0.000								
11.270	-0.002019	33169325.	-441276.	-7.077E-05	0.000	1.748E+13	1473.0351	2013626.
0.000								
11.500	-0.002207	31957383.	-436991.	-6.563E-05	0.000	1.749E+13	1631.8609	2040638.
0.000								
11.730	-0.002381	30757845.	-432277.	-6.068E-05	0.000	1.749E+13	1783.9389	2067651.
0.000								
11.960	-0.002542	29571869.	-427153.	-5.592E-05	0.000	1.749E+13	1929.2576	2094664.
0.000								
12.190	-0.002690	28400565.	-421637.	-5.134E-05	0.000	1.749E+13	2067.8212	2121677.
0.000								
12.420	-0.002825	27244988.	-415748.	-4.695E-05	0.000	1.749E+13	2199.6493	2148689.
0.000								
12.650	-0.002949	26106144.	-409504.	-4.274E-05	0.000	1.749E+13	2324.7761	2175702.
0.000								
12.880	-0.003061	24984987.	-402924.	-3.871E-05	0.000	1.749E+13	2443.2491	2202715.
0.000								
13.110	-0.003163	23882421.	-396027.	-3.485E-05	0.000	1.749E+13	2555.1291	2229728.
0.000								
13.340	-0.003254	22799298.	-388829.	-3.117E-05	0.000	1.749E+13	2660.4893	2256740.
0.000								

13.570	-0.003335	21736422.	-381350.	-2.766E-05	0.000	1.749E+13	2759.4149	2283753.
0.000								
13.800	-0.003406	20694547.	-373606.	-2.431E-05	0.000	1.749E+13	2852.0018	2310766.
0.000								
14.030	-0.003469	19674381.	-365615.	-2.113E-05	0.000	1.749E+13	2938.3567	2337779.
0.000								
14.260	-0.003523	18676580.	-357395.	-1.810E-05	0.000	1.749E+13	3018.5955	2364791.
0.000								
14.490	-0.003569	17701759.	-348961.	-1.523E-05	0.000	1.749E+13	3092.8433	2391804.
0.000								
14.720	-0.003607	16750482.	-340330.	-1.251E-05	0.000	1.749E+13	3161.2334	2418817.
0.000								
14.950	-0.003638	15823272.	-331519.	-9.942E-06	0.000	1.749E+13	3223.9067	2445830.
0.000								
15.180	-0.003662	14920606.	-322542.	-7.516E-06	0.000	1.749E+13	3281.0107	2472843.
0.000								
15.410	-0.003680	14042922.	-313415.	-5.232E-06	0.000	1.749E+13	3332.6992	2499855.
0.000								
15.640	-0.003691	13190613.	-304153.	-3.083E-06	0.000	1.749E+13	3379.1314	2526868.
0.000								
15.870	-0.003697	12364033.	-294769.	-1.067E-06	0.000	1.749E+13	3420.4712	2553881.
0.000								
16.100	-0.003697	11563498.	-285278.	8.206E-07	0.000	1.749E+13	3456.8865	2580894.
0.000								
16.330	-0.003692	10789287.	-275694.	2.584E-06	0.000	1.749E+13	3488.5487	2607906.
0.000								
16.560	-0.003683	10041641.	-266028.	4.227E-06	0.000	1.749E+13	3515.6318	2634919.
0.000								
16.790	-0.003669	9320767.	-256293.	5.755E-06	0.000	1.749E+13	3538.3119	2661932.
0.000								
17.020	-0.003651	8626839.	-246502.	7.171E-06	0.000	1.749E+13	3556.7664	2688945.
0.000								
17.250	-0.003629	7959997.	-236666.	8.479E-06	0.000	1.749E+13	3571.1735	2715957.
0.000								
17.480	-0.003604	7320352.	-226795.	9.685E-06	0.000	1.749E+13	3581.7115	2742970.
0.000								
17.710	-0.003576	6707985.	-216900.	1.079E-05	0.000	1.749E+13	3588.5583	2769983.
0.000								
17.940	-0.003544	6122949.	-206991.	1.180E-05	0.000	1.749E+13	3591.8903	2796996.
0.000								
18.170	-0.003510	5565269.	-197077.	1.273E-05	0.000	1.749E+13	3591.8826	2824009.
0.000								
18.400	-0.003474	5034945.	-187168.	1.356E-05	0.000	1.749E+13	3588.7077	2851021.
0.000								
18.630	-0.003436	4531955.	-177272.	1.432E-05	0.000	1.749E+13	3582.5353	2878034.
0.000								
18.860	-0.003395	4056251.	-167396.	1.499E-05	0.000	1.749E+13	3573.5315	2905047.
0.000								
19.090	-0.003353	3607765.	-157549.	1.560E-05	0.000	1.749E+13	3561.8585	2932060.
0.000								
19.320	-0.003309	3186409.	-147738.	1.613E-05	0.000	1.749E+13	3547.6738	2959072.
0.000								
19.550	-0.003264	2792076.	-137970.	1.661E-05	0.000	1.749E+13	3531.1298	2986085.
0.000								
19.780	-0.003217	2424638.	-128249.	1.702E-05	0.000	1.749E+13	3512.3731	3013098.
0.000								
20.010	-0.003170	2083954.	-118584.	1.737E-05	0.000	1.749E+13	3491.5444	3040111.
0.000								
20.240	-0.003121	1769866.	-108979.	1.768E-05	0.000	1.749E+13	3468.7774	3067123.
0.000								
20.470	-0.003072	1482200.	-99439.	1.793E-05	0.000	1.749E+13	3444.1990	3094136.
0.000								
20.700	-0.003022	1220769.	-89969.	1.815E-05	0.000	1.749E+13	3417.9281	3121149.

0.000									
20.930	-0.002972	985374.	-80574.	1.832E-05	0.000	1.749E+13	3390.0756	3148162.	
0.000									
21.160	-0.002921	775802.	-71258.	1.846E-05	0.000	1.749E+13	3360.7439	3175174.	
0.000									
21.390	-0.002870	591830.	-62025.	1.857E-05	0.000	1.749E+13	3330.0261	3202187.	
0.000									
21.620	-0.002819	433224.	-52878.	1.865E-05	0.000	1.749E+13	3298.0062	3229200.	
0.000									
21.850	-0.002767	299741.	-43821.	1.871E-05	0.000	1.749E+13	3264.7581	3256213.	
0.000									
22.080	-0.002716	191128.	-34858.	1.875E-05	0.000	1.749E+13	3230.3453	3283226.	
0.000									
22.310	-0.002664	107121.	-25991.	1.877E-05	0.000	1.749E+13	3194.8208	3310238.	
0.000									
22.540	-0.002612	47452.	-17224.	1.878E-05	0.000	1.749E+13	3158.2263	3337251.	
0.000									
22.770	-0.002560	11840.	-8559.4899	1.879E-05	0.000	1.749E+13	3120.5921	3364264.	
0.000									
23.000	-0.002508	0.000	0.000	1.879E-05	0.000	1.749E+13	3081.9368	1695638.	
0.000									

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.0409116 inches
Computed slope at pile head = -0.0007482 radians
Maximum bending moment = 73770901. inch-lbs
Maximum shear force = -457911. lbs
Depth of maximum bending moment = 1.1500000 feet below pile head
Depth of maximum shear force = 9.4300000 feet below pile head
Number of iterations = 23
Number of zero deflection points = 1

Summary of Pile Response(s)

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

Load Case	Load Type	Pile-head Condition 1 V(lbs) or Pile-head Rotation	Pile-head Condition 2 in-lb, rad.,	Axial Loading	Pile-head Deflection	Maximum Moment in Pile	Maximum Shear in Pile

No.	No.	y(inches) or radians	in-lb/rad.	lbs	inches	in-lbs	lbs
1	1	V = 91300.	M = 49321200.	1397900.	0.02445103	50011705.	
-311403.		-0.00036522					
2	1	V = 134900.	M = 72842400.	1960300.	0.04091156	73770901.	
-457911.		-0.00074819					

The analysis ended normally.

APPENDIX D

ASFE DOCUMENT

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you —* should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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IIGER06045.0M

Appendix F

City of Tulsa
Blasting Specification

DIVISION I

GENERAL SPECIFICATIONS

PART 101 - SCOPE AND LOCATION

101.1 The location of the project is in or near the City of Tulsa, Oklahoma. The character and exact location of the project are shown on the Drawings on file in the office of the City Auditor. Said Drawings clearly show the general work involved, but are not intended to show all details of the work.

101.2 The site and/or rights-of-way upon which the work is to be performed is shown on the Drawings. The Contractor agrees that the site and/or rights-of-way provided is adequate for the performance of the work. If any additional working area is required, the Contractor shall, at his expense, make arrangements for such working area. The City will not be liable for additional compensation as a result of any delay in obtaining rights-of-way.

PART 102 - SCOPE, NATURE, AND INTENT OF SPECIFICATIONS AND DRAWINGS

102.1 The Specifications and Drawings are intended to supplement, but not necessarily duplicate each other; and together constitute one complete set of Specifications and Drawings, so that any work exhibited in the one and not in the other shall be executed just as if it had been set forth in both, in order that the work shall be completed according to the complete design or designs as decided and determined by the Engineer.

102.2 The Drawings are not intended to be scaled for dimensions, and if dimensions not shown on the Drawings are required, the Contractor shall request them from the Engineer. Where existing utility lines or other sub-surface obstructions are shown on the Drawings, the same have been located as nearly as practicable from information furnished by owners of such, and from such surface indications as may exist at the work site. Such obstructions are shown for the purpose of advising the Contractor that they may interfere with the work to be done hereunder, but not for the purpose of indicating that the work can be performed without such interference.

102.3 Where soundings are shown on the drawings, the depths are determined by driving a drill rod, using the churn method with water lubrication, to a maximum depth of nine feet or to refusal, whichever is lesser in depth. By showing soundings on the drawings, the City represents only that material of hardness and character which could be penetrated by a drill rod found above the depth of sounding as shown at the point where the drill rod was driven.

102.4 Where exploratory drilling is indicated to have been performed on the plans, boring logs will be available for review at the office of the Engineer. The logs will be furnished for information purposes only, and are not to be construed as a true representation of actual subsurface conditions.

102.5 Should anything be omitted from the Specifications and Drawings which is necessary to a clear understanding of the work, or should it appear various instructions are in conflict, the Contractor shall request written instructions from the Engineer before proceeding with the construction affected by such omissions or discrepancies.

102.6 The Contractor's responsibility for construction covered by conflicting requirements, not provided for by addendums prior to the time of opening bids for the work represented thereby, shall not extend beyond the construction in conformity with the cheaper of the said conflicting requirements. Any increase in cost of work requested to be done in excess of the cheaper of the conflicting requirements will be paid for as Extra Work as provided for herein.

PART 103 - LINES AND GRADES

103.1 All work done under this Contract shall be done to the lines, grades, and elevations shown on the Drawings. All lines and grades shall be furnished by the Engineer, but the Contractor shall provide all batterboards, straight edges, and other materials for lines, levels, and measurements; and shall set all batterboards under direction of the Engineer. The Contractor shall give the Engineer at least forty-eight (48) hours notice as to the location where stakes are required.

PART 104 - SATURDAY, SUNDAY, HOLIDAY AND NIGHT WORK

104.1 No work shall be done between the hours of 6:00 p.m. and 8:00 a.m., nor on Saturday, Sunday, or legal holidays without the written approval or permission of the Engineer in each case, except such work as may be necessary for the proper care, maintenance, and protection of work already done, or of equipment, or in the case of an emergency.

PART 105 - PROTECTION OF PROPERTY

105.1 The protection of City, State and Government monuments, street signs, and other City property is of prime importance, and if the same be damaged, destroyed or removed, they shall be repaired, replaced or paid for by the Contractor. Disturbance to this property must first be approved by the agency that controls it.

105.2 No valve or other control on any utility main or building service line shall be operated for any purpose by the Contractor without written approval or permission of the Engineer in each case.

105.3 At places where the Contractor's operations are adjacent to, or crossing, the path of railway, telegraph, telephone, cable, electric, and gas lines, or water lines, sanitary sewers, and storm sewers, damage to which might result in expense, loss or inconvenience, work shall not be commenced until all arrangements necessary for the protection thereof have been made. Contractor shall notify the

Notification Center of Oklahoma One-Call System, Inc. of any excavation or demolition prior to the commencement of such work. Notification shall be made no sooner than ten (10) days, nor later than forty-eight (48) hours prior to start of work, excluding Saturdays, Sundays, and legal holidays.

105.4 The City has attempted to locate all storm sewers, culverts, buried telephone or electrical conduits, sanitary sewers, water mains, and gas mains that might interfere with the construction of this project. The Contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner and duplication or rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted. The revision and crossings of the various types of lines shall be made as follows:

a) Storm sewers and culverts may be removed at the time of crossing or may be adequately braced and held in position while the pipe is placed beneath them. If the storm sewer or culvert is removed, it shall be replaced with pipe of the same type and size as that removed, and it shall be re-joined to the undisturbed line with a joint satisfactory to the Engineer. Backfill over the main, up to and around the storm sewer, shall be thoroughly compacted in order that no settlement will occur. The revision and crossing shown on the Drawing shall be at the expense of the Contractor. In the event lines, other than those shown on the Drawings, are encountered and fall within the standard trench limit and, in the opinion of the Engineer, revision of the line is necessary for the construction of the project, the Contractor will be reimbursed for the extra cost of the crossing or revision under the "Extra Work" clause of the Contract.

b) All overhead and buried telephone cable and electrical conduits, and gas mains to be revised or crossed by the construction of this project shall be protected in accordance with the directions of the utility company owning the conduits and/or mains. The Contractor shall notify the companies and obtain their permission before making any crossing or revisions. The revision and crossing shown on the Drawing shall be at the expense of the Contractor. In the event lines other than those shown on the Drawing are encountered and fall within the standard trench limit and, in the opinion of the Engineer, revision of the line is necessary for the construction of the project, the Contractor will be reimbursed for the extra cost of the crossings or revision under the "Extra Work" clause of the Contract. Any overhead cables or buried cables or conduits or gas mains damaged by the Contractor shall be repaired at his expense to the satisfaction of the Engineer and of the owner.

c) The Contractor shall not remove any water or sanitary sewer lines except as directed by the Engineer or as required by the Drawings and Specifications, and shall adequately brace and protect them from any damage during construction. Any existing water main or sewer main or lateral damaged by the Contractor's operation will be repaired by the City's maintenance forces. The Contractor shall notify the City immediately after damaging any pipe. The repairs will be made at the Contractor's expense.

105.5 The location of utility service lines serving individual properties may or may not be shown on the Drawings, but the Contractor shall assume that such service lines exist whether or not they are shown on the Drawings, and it shall be the responsibility of the Contractor to make any necessary changes in the line and/or grade of such services, or to secure the necessary changes therein to be made by the particular utility company involved or other owner thereof, or by an agent or individual contractor approved by such utility company or other owner. Contractor shall pay the cost of all such revisions whether performed by contractor, the utility company, or other owner, or an approved contractor. In the event of interruption of a utility service as a result of accidental breakage, Contractor shall promptly notify the Engineer and the owner of the utility, and shall repair or cause the same to be repaired, in the same manner as necessary changes above provided for, and the Contractor shall do all things necessary to see to the restoration of services as promptly as may be reasonably done. All sanitary sewer service lines damaged shall be replaced with cast iron pipe, regardless of type or kind damaged.

105.6 In the event the Contractor in any way fails to comply with the requirements of protecting, repairing, and restoring of any utility or utility service, the Engineer may, upon forty-eight (48) hours' written notice, proceed to protect, repair, rebuild or otherwise restore such utility or utility service as may be deemed necessary, and the cost thereof will be deducted from any money due or which may become due the Contractor pursuant to the terms of his contract.

PART 106 - CONNECTIONS

106.1 All connections to existing water mains shall be made by the Contractor, unless noted otherwise. The Contractor shall perform his work so that these connections may be readily made. All transfer of building service line connections from the existing to the new main shall be made by the Contractor after the main has been backfilled, tested, and chlorinated, but before any sidewalks, driveways, curbs, and/or paved roadways, are replaced.

106.2 The Contractor shall not make any unauthorized connections to a sewer, nor shall he permit any such connections to be made. If the Contractor is properly authorized by the Engineer to make connections by installing tees in the sewer under construction, such installation shall conform to the regulation of the City.

PART 107 - REFERENCES TO OTHER SPECIFICATIONS

107.1 Where a standard such as American Society for Testing Materials, American Concrete Institute, American Standards Association, American Water Works Association, or other agency designation is specified for a material, that designation shall be the current revision, either tentative or adopted. If a referenced specification is in conflict with these specifications, the City of Tulsa specifications shall govern.

PART 108 - PROTECTION OF MATERIALS

108.1 All materials delivered to the site of the work shall be adequately housed and protected against deterioration according to the standard accepted procedures. The Contractor shall keep his storage yards in good order, pile his materials neatly, and protect them from damage.

PART 109 - TESTING

109.1 Materials: All materials required to be tested shall be tested by a laboratory of good reputation, previously approved by the City. No material shall be accepted for construction unless it bears the approval of the laboratory. Reports of tests shall be forwarded to the City. Before final acceptance of the project, all materials shall be tested and shall be found in good and proper condition, or shall be placed in such condition.

109.2 Testing of Manholes: All manholes will be tested using the vacuum test method, following the manufacturer's recommendations for proper and safe procedures. The vacuum tester shall be as manufactured by Cherne Industries or equal.

All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole.

A vacuum of 10 inches of mercury (Hg)(5.0 psi) shall be drawn on the manhole and the time shall be measured for the vacuum to drop to 9 inches of mercury (Hg)(4.5 psi). The manhole shall pass the test if the time measurement exceeds the values indicated in the following table:

Vacuum Test Timetable
Manhole Diameter – Inches

Depth-feet	48 Inches	60 Inches	72 Inches	96 Inches	144 Inches
4	10 sec.	13 sec.	16 sec.	19 sec.	21 sec.
8	20 sec.	26 sec.	32 sec.	38 sec.	44 sec.
12	30 sec.	39 sec.	48 sec.	57 sec.	65 sec.
16	40 sec.	52 sec.	64 sec.	76 sec.	88 sec.
20	50 sec.	65 sec.	80 sec.	95 sec.	110 sec.
24	60 sec.	78 sec.	96 sec.	114 sec.	132 sec.
+Each 2'	+5 sec.	+6.5 sec.	+8.0 sec.	+9.5 sec.	+11 sec.

Manhole depth shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 24 feet, add the values listed on the last line of the table for each 2 feet of additional depth.

If the manhole fails the vacuum test, the contractor shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.

All repairs and testing are the responsibility of the Contractor and will be performed at no additional cost to the City.

No payment will be made for any manholes which have not passed the vacuum test.

109.3 Testing and Chlorinating Water Mains: Testing and chlorinating water mains will be performed by the City, but the Contractor shall lend such assistance as may be required. Water mains shall be testing in accordance with the Standard Specifications for "Installation of Ductile Iron Water Mains and Their Appurtenances," AWWA Designation C-600. The pressure test of 150 psi shall be for thirty minutes' duration. If the line passes the test without significant pressure drop, a leakage test shall be made at the normal operating pressures under which the line is to operate for two hours' duration. Before being placed in service, all mains shall be chlorinated in accordance with "AWWA Standard for Disinfecting Water Mains," AWWA Designation C-651. Where temporary plugs are required for pressure testing, the contractor shall furnish and install the plug and temporary blocking, and remove after testing is complete. The cost shall be included in the unit price bid for pipe. No additional payment will be made.

PART 110 - "OR APPROVED EQUAL" CLAUSE

110.1 When a material is specified or shown on the Drawings by brand or manufacturer's name, any other material that will adequately perform the same function, in the opinion of the City, may be accepted for use.

PART 111 - DEWATERING

111.1 The Contractor shall provide all necessary pumps, drains, dams, well points, and other means for removing water from, or preventing water from entering the trench or other excavation until the project is completed. Sufficient pumps or other works shall be made available at all times to hold the water at a safe level as determined by the Engineer. Water from the excavation shall be properly disposed of so that no damage or interference results to public health, public or private property, completed or uncompleted work, other projects, or streets.

PART 112 - SAFETY

112.1 Excavations: The Contractor shall adequately shore, or sheet, and brace the excavation, or shall slope the sides of the trench in accordance with the State of Oklahoma Department of Labor requirements, and all other applicable requirements.

112.2 Explosives: In handling explosives used during the construction of the project, the Contractor shall adhere to all Federal and State Laws and City Ordinances regulating the purchase, transportation, storage, handling, and use of such

explosives. All blasting shall be done in strict accordance with City Ordinance #19947. No blasting shall be done without obtaining a "Blasting Permit" from the City and presence of the Inspector. All equipment, tools, and materials used shall be of the correct type and in good conditions for the operation. The Contractor shall take all necessary precautions to avoid damage to property resulting from the transportation, storage, handling and use of explosives. Before blasting, the Contractor shall cover the area to be blasted with steel mesh mat or other suitable material, reinforced with timbers of sufficient weight so that rock and debris will be confined to the excavation. Any blasting within ten feet of a water, sewer, gas, or pipe line shall be done with very light charges, and utmost care should be taken to avoid disturbance to these lines. All locations for blasting shall be subject to approval of the Engineer.

112.3 Danger Signals and Protection: When the Contractor is performing any type of construction or excavation work, or is stockpiling or storing any materials or equipment upon or adjacent to any street, alley, sidewalk, residence, public ground, or other location that is likely to be subject to pedestrian or vehicular traffic, he shall furnish, erect, and maintain substantial guard rails, safety fencing, lights, and traffic control devices around the project to protect pedestrians, animals, and vehicles from injury or damage. All traffic control shall be in accordance with the City of Tulsa Traffic Engineering Division's Standards and Procedures for Street Use and Temporary Traffic Control. Safety and traffic control devices shall be installed and removed only at the direction of the Engineer. The Contractor shall provide sufficient proper signals and flagmen for warning during construction, excavation, and blasting operations.

112.4 Power Lines: No person, materials, or equipment shall come within six feet of any power line carrying more than 440 volts unless the electric power services has been first discontinued.

112.5 Fire Prevention and Protection: The Contractor shall take all necessary measures to prevent fire, and shall provide satisfactory fire fighting means at the location of work.

112.6 Interference with Traffic: The Contractor shall construct and maintain adequate and safe bridges or crosswalks over excavations, where required. When a roadway or sidewalk is not closed, the Contractor shall provide a safe substitute route for any portion obstructed by his operations. If a roadway or sidewalk is closed to traffic, the Contractor shall provide and mark detours. As directed by the Engineer, construction across roadways or sidewalks may be done by open excavation.

112.7 Condition of Equipment and Materials: All equipment, tools, appliances, and materials used in connection with the project shall be handled and operated only when they are in safe operating condition and in accordance with a standard safety procedure.

PART 113 - REMOVAL OF CONDEMNED MATERIALS AND STRUCTURES

113.1 The Contractor shall remove from the site of the work, without delay, all rejected and condemned materials or structures of any kind brought to or incorporated in the work. Upon his failure to do so, or to make satisfactory progress in so doing, within forty-eight (48) hours after the service of a written notice from the Engineer ordering such removal, the condemned material or structure may be removed by the City and the cost of such removal will be taken out of the money that may be due or may become due the Contractor. No such rejected or condemned material shall again be offered for use by the Contractor.

PART 114 - REMOVAL AND SALVAGE OF CASTINGS

114.1 All water, sanitary sewer, and storm sewer manhole castings, lids, frames, curb hoods, grates, hydrants, valves, and other fittings removed as part of any construction project are property of the City of Tulsa. Contractor will not take ownership.

114.2 All storm sewer and sanitary sewer castings shall be salvaged and delivered by the contractor to the Underground Collections North Sewer Base Stockyard at 9319 East 42nd Street North. Contractor will coordinate the return of such items with the Stockyard personnel at 918-669-6130.

114.3 All hydrants, valves, and other fittings from abandoned water mains shall be salvaged and delivered by the contractor to the South Yard at 2317 South Jackson Avenue. Contractor will coordinate the return of such items with the South Yard personnel at 918-596-9401.

PART 115 - CLEAN-UP

115.1 Immediately upon installation of any portion of the work, the Contractor shall restore all fills, topsoil, and utilities to their location and condition prior to construction.

115.2 Immediately upon installation of any block in length of the work herein contemplated, the Contractor shall remove all materials, tools, debris, excess excavated material, and equipment; and restore the site in a manner satisfactory to the Engineer.

115.3 Clean-up and restoration of service line transfers shall be made immediately following each transfer installation.

PART 116 - PLACING WORK IN SERVICE

116.1 If desired by the City, portions of the work may be placed in service when completed and the Contractor shall give prior access to the work for this purpose, but such use and operation shall not constitute an acceptance of the work.

PART 117 - SUBMITTALS

117.1 The Contractor shall submit to the Engineer, six (6) copies of material submittals for all material he proposes to use. Construction shall not begin until the Engineer has approved the submittals in writing.

117.2 Submittals for pipe shall consist of notarized certifications, from the manufacturer, that the pipe was manufactured and tested in accordance with the applicable specifications. The certifications shall indicate the pipe diameter, the pressure rating, and the batch number from which the pipe was manufactured. For concrete and steel pipelines 16-inches and larger, a detailed laying schedule prepared by the manufacturer shall be submitted, along with the detail design calculations.

117.3 Submittals for material other than pipe shall consist of manufacturer's product literature or shop drawings, indicating dimensions and material specifications. Submittals shall include reference to compliance with AWWA, ASTM, NSF, and other applicable standards.

117.4 All delivery tickets, including factory certification of ductile iron pipe, shall be surrendered to City Inspector or their representative.

SECTION END

Tulsa, OK
Code of Ordinances

SUPPLEMENT HISTORY TABLE

1989 AMENDED CHARTER

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TITLE 2 - ANIMALS

TITLE 3 - PUBLIC PROPERTY, RECORDS, FLAG, SEAL

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- CHAPTER 12. - RIGHTS-OF-WAY OCCUPANCY MANAGEMENT
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TULSA CODE OF ORDINANCES

CODE COMPARATIVE TABLE

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CHAPTER 14. - LICENSING OF SIGNS WITHIN THE CENTRAL BUSINESS DISTRICT RIGHTS-OF-WAY ›

CHAPTER 13. - BLASTING REGULATIONS

Section 1300. - Purpose.

To protect the general health, safety and welfare of residents of the City of Tulsa from unnecessary and excessive air blasts, ground vibrations and dust which are physically harmful and otherwise detrimental to individuals and the community in the enjoyment of life, property and conduct of business, the City shall:

A. Regulate the detonation of explosives used to demolish structures, fragment rock and excavate for development within the City; and

B. Inform those who are reasonably calculated to be affected by any blasting.

Development shall not create a public hazard upon any property within the City due to the use of explosives. The detonation of explosives shall not result in identifiable damage to property other than the blasting site.

(Ord. No. 19947)

Section 1301. - Definitions.

For purposes of this chapter, the following words and phrases shall have the meanings given herein.

Appeal shall mean a request for a review of the Director's interpretation of any provision of this chapter or a request for a variance.

Blasting Area shall mean the area within three hundred (300) feet of the proposed blasting site as described by the most applicable blasting project scenario listed below:

1. Three hundred (300) feet perpendicular and on each side of the line of the proposed blasting, i.e., blasting performed down the center of a street; or
2. Three hundred (300) feet from each exterior boundary or property line, whichever is greater, of the proposed blasting.

The Director may require a larger area than that described herein if he finds that strict adherence to the distance requirements does not result in a logical boundary. Consideration should be given to proximity of structures to each other, geology or topography of the area, density of development and sensitivity of structures.

Certified Blaster shall mean a person who has certified blaster status pursuant to the State of Oklahoma Explosives and Blasting Regulation Act and implementing regulations thereof.

Department shall mean the Public Works Department of the City of Tulsa.

Department of Mines shall mean the state of Oklahoma agency responsible for the administration, regulation and enforcement of the state of Oklahoma laws and regulations regarding blasting operations.

Development shall mean any manmade changes to improved or unimproved real estate, including but not limited to buildings or other structures, mining, excavation and construction.

Director shall mean the duly appointed Director of the Public Works Department of the City of Tulsa or his designated representative.

Explosives shall mean any substance, chemical compound or mechanical mixture that is commonly used for the purpose of producing an explosion to demolish a structure or to fragment rock for excavation or construction, including initiating devices.

Flyrock shall mean any dirt, mud, stone, fragmented rock or other material that is displaced from the blasting area by being thrown in the air or cast along the ground.

Oklahoma Mining Commission shall mean the state of Oklahoma commission having jurisdiction over mining operations in Oklahoma.

Person shall mean any individual, partnership, firm, association, public or private corporation or institution, municipal corporation, any trust estate or any other legal entity, and any successor, representative, agent or agency of the foregoing.

Underground facility shall mean any underground line, facility, system and appurtenances thereto, for producing, storing, conveying, transmitting or distributing communication, electricity, power, light, heat, gas, oil, petroleum products, water (including storm water), steam, sewage and other commodities.

Variance shall mean a grant of relief to a person from the requirements herein when specific enforcement would result in unnecessary hardship, permitting the use of explosives in a manner otherwise prohibited by this chapter.

Violation shall mean the failure to be in full compliance with any of the provisions of this chapter.

(Ord. No. 19947)

Section 1302. - Scope.

The provisions of this chapter shall apply to and be binding upon every person who seeks to use explosives on lands within the City unless exempted herein. The provisions of this chapter are intended to be consistent with the requirements pertaining to explosives in the most current BOCA National Fire Prevention Code ("Fire Prevention Code"), published by the Building Officials and Code Administrators International, Inc.; the State of Oklahoma Explosives and Blasting Regulation Act, 63 O.S.Supp.1999, §§ 122.1, *et seq.* , amendments thereto, and implementing regulations thereof; and the Oklahoma Underground Facilities Damage Prevention Act, 63 O.S.1991, §§ 142.1, *et seq.* , and amendments thereto.

Unless specifically exempted, a blasting permit as required by this chapter shall be obtained prior to any person detonating explosives within the City. A blasting permit shall not be required for bona fide quarries or mining operations which constitute the principal use of any lot or tract of ground in the City and which meet the requirements of the Oklahoma Mining Commission and the Zoning Code of the City of Tulsa. Additionally, entities exempt from state of Oklahoma regulation pursuant to Section 123.8 of the Oklahoma Explosives and Blasting Regulation Act are exempt from the requirements of this chapter; provided, however, that all contractors using explosives in the performance of work for the City must obtain a blasting permit and comply with the provisions of this chapter.

(Ord. No. 19947)

Section 1303. - Blasting permits.

A.

General Requirements. Application for a blasting permit required under this chapter shall be submitted to the Director of Public Works. The application shall be on a form furnished by the Director, and shall include the following information:

1. A written description of the purpose of the proposed blasting; and
2. Current blasting permit issued by the Oklahoma Department of Mines and applicable to the project for which application is being made; and
3. A copy of the blasting plan submitted with the current blasting permit issued by the Oklahoma Department of Mines; and
4. A current copy of the state of Oklahoma blaster's certification which discloses the blaster's certification number and date of expiration for the blaster who will supervise all blasting operations; and
5. A development site plan consisting of the following:
    a. A project map or aerial photo to scale which depicts the site to be blasted and all real property within seven hundred (700) feet of the blasting area as calculated pursuant to the requirements of this chapter; and
    b. Proposed location of seismographic instruments. Two seismographic instruments are required. Their proposed location shall be shown on the project map. The seismographs shall have a frequency response from 2 to 250 hertz, within -3 dB at 2 hertz. The accuracy shall be +/-5 or +/-0.02 in./sec., whichever is larger, between 4 and 125 hertz; and
6. Proposed blasting schedule; and
7. A copy of the City Fire Marshal permit issued for the blasting project for which application is being made, together with the proof of insurance required in support of such permit; and
8. A certificate of blasting liability insurance coverage as required by the Oklahoma Explosives and Blasting Regulation Act and implementing regulations thereof. The amount shall not be less than One Million Dollars ($1,000,000.00) per occurrence to become available for the payment of all damages to persons or property which may arise from, or be caused by,

the conduct of any act of blasting. The insurance certificate must be executed by a company licensed to do business in the state of Oklahoma and name the City of Tulsa as an additional insured; and

9. A Fifty Dollar ($50.00) non-refundable application fee. This requirement shall be waived for a contractor who is performing blasting work pursuant to a contract with the City.
10. A statement that the applicant has complied with the Oklahoma Underground Facilities Damage Prevention Act, 63 O.S.1991, §§ 142.1, *et seq.* , and amendments thereto. This statement shall specifically verify that any notice required by Section 142.6 of that Act has been mailed to all operators of Underground Facilities having Underground Facilities located within three hundred (300) feet of the blasting site at least three (3) days before the permit application was submitted to the Director.

B. **Inactive Permit Application Denial.** Failure of an applicant to provide all the information required by this section within sixty (60) days of beginning the application process shall result in denial of the application unless an extension is granted in writing by the Director.

C. **Permit Issuance.** Once the application has been approved and the permit fee paid, the Director shall issue the blasting permit. The permit shall be signed by the Director and shall expire thirty (30) days after the projected completion date.

D. **Denial.** Denial of a blasting permit shall be accompanied by a statement of the reasons for the denial.

E. **Transfer.** A blasting permit shall not be transferable either from one location to another, or from one person to another.

(Ord. No. 19947)

Section 1304. - Administrative procedures.

A. **Permit Fees.** Permits authorized by the provisions of this chapter shall be effective only upon payment of a fee of Fifty Dollars ($50.00) for each day of blasting projected in the permit application. This requirement shall be waived for a contractor who is performing blasting work pursuant to a contract with the City.

B.

Blasting Permit Duration. The blasting permit shall show on its face the expiration date, which shall be thirty (30) days after the estimated time of completion provided by the permittee in his application. A blasting permit shall automatically expire if the authorized work is not commenced within six (6) months after issuance of the permit or if the authorized work is suspended or abandoned for a period of six (6) months after the time of commencing the work, unless an extension has been granted in writing by the Director. One six (6) month extension will be routinely granted upon written application by the permittee.

(Ord. No. 19947)

Section 1305. - Standards for blasting permits.

The requirements established within this section apply to the blasting area as depicted in the site plan submitted by the permittee as part of his application. A permittee shall perform both pre-blast and post-blast surveys upon request. A holder of a blasting permit shall adhere to the following:

A. Permittees shall perform pre-blast surveys upon the request of the affected property owner or his representative. The pre-blast survey shall consist of conducting or providing for inspections on structures within the blasting area. The pre-blast survey shall document any damage to and other physical factors of the structure that could reasonably be affected by the blasting.

B. The post-blast survey shall consist of conducting or providing for inspections of structures within the pre-blast survey area. The post-blast survey shall document any changes to or differences in the surveyed structure from the pre-blast survey. Permittees shall perform post-blast surveys when requested by persons previously having had a pre-blast survey performed under the same blasting permit. The post-blast survey shall be requested within thirty (30) days after blasting has been completed.

C. The cost of the pre-blast and post-blast surveys shall be paid by the permittee directly to the individual or organization which is hired to perform the surveys. Pre-blast and post-blast surveys shall be performed by an individual or organization who has expertise in the assessment of the impact of blasting on structures. The Director shall develop administrative regulations for the approval of inspectors and maintain a list of all such approved inspectors.

D. At the beginning of each blasting project the permittee shall perform test blasting to determine the amount of blasting charge required to limit the peak particle velocity to two (2.0) inches per second at the closest structure.

E. The permittee shall abide by the standards required in the most current BOCA National Fire Prevention Code ("Fire Prevention Code") published by the Building Officials and Code Administrators International, Inc.

F. The permittee shall abide by the State of Oklahoma Explosives and Blasting Regulation Act and implementing regulations thereof.

G. Except as otherwise authorized herein, the allowable ground vibration and airblast levels resulting from the detonation of explosives are:

1. **Ground Vibration.** Maximum peak particle velocity for ground vibration shall not exceed two (2.0) inches per second at the closest structure. A seismograph record shall be required for each blast. The maximum peak particle velocity shall be the largest peak particle velocity exhibited by three (3) mutually perpendicular components.
2. **Airblast.** Levels shall not exceed, at anytime, the prescribed limits of the Oklahoma Explosives and Blasting Regulation Act and implementing regulations thereof.

H. **Flyrock.** When blasting operations are performed pursuant to a permit issued under this chapter within three hundred (300) feet of any structure, railway or highway, the blast shall be designed to prevent flyrock from being thrown onto the structure, railway or highway. The blaster shall comply with the Oklahoma Explosives and Blasting Regulation Act and implementing regulations thereof regarding flyrock.

I. A certified blaster and the Director shall be present during the firing of all blasts.

J. The permittee shall notify all property owners in the blasting area that a pre-blast survey is available to them. This notice shall be sent by certified mail, return receipt requested, at least ten (10) working days prior to the anticipated start of the blasting. The notice shall explain that a pre-blast survey is available, and give instructions for scheduling the survey. The notice shall state the anticipated dates of the blasting and specify the blasting location. The certified mail receipts stamped by the U.S. Postal Service or an affidavit wherein the

permittee swears that the notification required by this section has been made and the list of property owners in the blasting area from County tax records shall be furnished to the Director as proof of compliance with this requirement.

1. If the dates of blasting are changed following the notice required by this section, then a notice which specifies the revised dates of blasting shall be mailed to property owners in the blasting area in sufficient time to provide them forty-eight (48) hours notice of the blasting.
2. The permittee shall also give notice of his intent to blast by posting a notice at the blasting site at least seven (7) calendar days before the date of the proposed blasting. The notice shall state:
    a. The dates and anticipated duration of blasting, and place of the proposed blasting; and
    b. Who will conduct the proposed blasting, identified by the name of a contact person, a physical address and a telephone number; and
    c. Instructions on how the reader can contact the blaster and the Director, including a physical address and a telephone number.

K. Except as otherwise authorized by the Director for good cause shown, all blasting activities shall be limited to daylight hours, but no later than 7:00 p.m., Monday through Saturday.

L. The permittee shall monitor any blasting that occurs within the blasting area. Such monitoring must be overseen by a certified blaster and shall measure blast-induced vibration by means of an instrument that senses and records particle velocity in three (3) mutually perpendicular axes. Sound levels shall also be recorded. Violation of the ground vibrations or airblast levels shall be reported to the Director immediately.

M. The Director may conduct tests and shall observe any authorized blasting operations.

N. The permittee shall maintain a record of each blast. All records shall be maintained in conformance with the Oklahoma Explosives and Blasting Regulation Act and implementing regulations thereof. In addition, the permittee shall maintain evidence of the notifications required by this section. These records shall be available for inspection by the Director for a period of three (3) years following expiration of the blasting permit.

O.

The permittee shall keep the blasting permit under file at the site or on display at all times where the blasting operation is located and shall make such permit readily available for inspection by the Director.

(Ord. No. 19947)

Section 1306. - Permit suspension and revocation.

A blasting permit may be revoked or suspended immediately upon occurrence of any of the following events:

A. A violation of any condition of the permit; or

B. A violation of any provision of this chapter or any other applicable law, ordinance, rule or regulation pertaining to the blasting project for which the permit is issued; or

C. The existence of any condition or doing of any act constituting fraud, or creating a nuisance or hazard, or endangering human life or the property of others.

D. **Notice and Order of Revocation or Suspension.** Upon the occurrence of any of the events above listed, the Director may cause to be served upon the permit holder a notice and order immediately suspending or revoking the permit, specifying the grounds for the suspension or revocation, and advising the holder that he is entitled to a hearing before the Director at a time, place and date specified in the notice and order, and further advising the holder that if the holder fails to appear at the time, place and date therein specified, the Director's order for suspension or revocation of the holder's permit shall be final. The date of the hearing shall be no later than five (5) working days from the date of suspension or revocation.

E. **Hearing Before the Director.** At the hearing before the Director, the permit holder shall be afforded the opportunity to respond to the charges of the Director and to present information to show why his permit should not be revoked or suspended. After such hearing, the Director may either affirm, modify or reverse his order for suspension or revocation of the holder's permit, and shall notify the holder in writing of his decision within five (5) working days of the date of the hearing. The Director's decision shall be final unless the permit holder appeals the decision to the City Council as provided herein.

F. **Appeals.** An appeal shall be made by written notice filed with the City Clerk within ten (10) days of the decision of the Director. If no appeal is taken to the City Council as herein provided, the decision of the Director shall be final.

G. **Service.** Notices and orders required by this subsection shall be served upon each party concerned, either personally or by certified mail, addressed to the individual contracting party or permit holder at the address given on the permit application filed with the Director.

H. **Stop Work Order.** Upon the suspension or revocation of a blasting permit by the Director, the Director may issue a stop work order on all construction activity on the subject property which is related to the blasting and which is being performed pursuant to the suspended or revoked blasting permit.

I. **Future Eligibility.** Any permittee who has had his blasting permit revoked pursuant to this chapter shall not be eligible for another blasting permit for a period of one (1) year following such revocation.

(Ord. No. 19947)

Section 1307. - Appeals and variances.

A. **Appeals.** Any person who is aggrieved by a decision, requirement, ruling or interpretation of this chapter may request review thereof by the Director. The determination of the Director may be appealed to the City Council by written notice of appeal filed with the Office of the City Clerk within ten (10) days of decision by the Director.

B. **Variances.** The Director may grant one (1) or more variances from the terms of this chapter upon application and good cause shown by an applicant or permittee. A variance will only be granted if it will not cause detriment to the public good, safety or welfare, nor be contrary to the spirit, purposes and intent of this chapter where by reason of unique and exceptional physical circumstance or condition of a particular property, the literal enforcement of the requirements of this chapter will result in an unreasonable hardship.

1. Application for a variance shall be made by the filing of a written request with the Director. Variances shall be granted only upon:
    a. Showing of good and sufficient cause; and
    b. A finding that failure to grant the variance would result in unreasonable hardship to the applicant or permittee; and

c. A finding that the granting of a variance would not result in additional threats to public safety, extraordinary public expense, creation of a nuisance, fraud or victimization of the public or conflict with existing local laws or ordinances.

Upon consideration of these factors, the Director may attach such conditions to the granting of a variance as he deems necessary to ensure compliance with the purpose and objectives of this chapter.

C. **Appeal and Variance Process.** Upon accepting a notice of appeal or an application for a variance, the Director shall:

1. Require the appellant or applicant to furnish the names and mailing addresses of all owners of the blasting site property and of all owners of the property within the blasting area as shown by County tax records; and
2. Schedule a hearing date before the Director within thirty (30) days of the application; and
3. Mail written notices to all owners of the blasting site property and to all owners of the property within the blasting area indicating that an appeal or variance has been requested and when a hearing will be held.

(Ord. No. 19947)

Section 1308. - Penalties.

A. **Penalty.** Unless otherwise provided herein, every person, firm, corporation or other legal entity violating any of the provisions of this chapter or conditions made pursuant thereto shall be guilty of an offense and, upon conviction, thereof shall be punished by imprisonment in the City jail for a period of not more than ninety (90) days and/or by a fine of not more than Five Hundred Dollars ($500.00), excluding costs.

B. **Fine or Imprisonment not Exclusive Remedies.** In addition to fine or imprisonment, the City may institute appropriate actions or proceedings at law or equity to enforce the provisions of this chapter to correct violations thereof. The conviction and punishment of any person hereunder shall not relieve the person of the responsibility to correct prohibited conditions or to remove prohibited buildings, structures, obstructions or improvements nor prevent the enforcement, correction or removal thereof.

(Ord. No. 19947)

Section 1309. - Warning and disclaimer of liability.

The City recognizes that, although the degree of control on explosive detonation required by this chapter is considered reasonable for regulatory purposes and is based on scientific and engineering considerations, on rare occasions excessive airblast overpressures, ground vibrations and dust can and will occur. These provisions do not imply that land outside the blasting areas or that uses permitted within such areas will be free from damages. These provisions shall not create liability on the part of the City or any officer or employee thereof for any blasting damages that result from reliance on this chapter or any administrative decision lawfully made thereunder.

(Ord. No. 19947)

‹ SCHEDULE A.
CHAPTER 14. - LICENSING OF SIGNS WITHIN THE CENTRAL BUSINESS DISTRICT RIGHTS-OF-WAY ›