SEALY ENGINEERING
3818 Glen Arbor #5
Houston, Texas 77025
Telephone: 713 6673994, Fax: 713 6672905
sealyeng.com

Enclosed is the report of the visual inspection that was conducted on the structural foundation of the residence located at Houston, Texas, by Taylor Sealy, PE. This inspection was conducted for you on the date of .

The information you need should be contained in the attached report. A summary of the items of concern may be found in Section 4.0 near the end. Information specific to this house starts in Section 2.0. If you should have any questions, however, please give us a call. It was a pleasure to have done business with you, and we hope we may be of additional service to you some time in the future.

Taylor Sealy
Licensed Professional Engineer

TS/eas

FOUNDATION INSPECTION REPORT

1.0 INTRODUCTION

The purpose of this report is to describe the results of an inspection that was conducted on the foundation of the residence described below. This inspection was conducted at the request of the client to provide an opinion regarding the performance of this foundation as a primary load-bearing structural member of this building.

In the conduct of this work, Sealy Engineering has acted as an engineering consultant to provide information to the client for use as the client may see fit. As such, Sealy Engineering involvement in any activities related to this residence shall terminate when the final report is submitted unless otherwise requested in writing by the client. Monitoring of repairs is not included in this inspection. As a consultant to the client, it is the sole function of Sealy Engineering to provide information to the client regarding the condition of the foundation and not to make any binding judgments on any condition reported nor to determine the need for repair. Such judgments are, of course, left to the client.

This inspection consisted of a visual examination of the accessible portions of the foundation and the remainder of the structure. The clients should understand that we could miss something during the inspection and it is our policy not to reimburse the clients for such items. In such an examination, it is recognized that a diagnosis of foundation performance can possibly be compromised by the inability to gain access to large portions of the foundation for visual examination, the lack of definition of design and construction parameters that often govern the foundation performance, and inherent limitations to the state of the art of engineering analysis of foundation performance. For safety reasons we do not inspect within the foundation crawl space of pier and beam type houses but will look underneath if an access hatch is readily accessible. Condition of the subfloor framing on these houses is generally reported by the pest control inspectors since wood deterioration is the main cause of distress usually noted within that area. Sealy Engineering has conscientiously utilized all visual data available to every extent reasonable and has attempted to acquire available information such that a reasonably accurate diagnosis could be made. Where specifically requested by the client, Sealy Engineering has provided recommendations for remedial action, should such be warranted. Such recommendations are provided for information, and Sealy Engineering assumes no responsibility in the event such repair work should be done. Finally, this report was written to satisfy the specific objectives of the client. Neither the author of this report nor Sealy Engineering assume any responsibility whatsoever for the use of this report by any third party person. The client(s) agrees in using this report that Sealy Engineering is not required to give testimony or attendance in court or at any other hearing with reference to matters discussed herein, unless prior arrangements are made.

2.0 PROJECT DESCRIPTION

The residence inspected was located at , Houston, Texas. The client for this inspection was . The residence was not occupied and the client was present.

The residence inspected was a one-story, single family wood frame dwelling with brick veneer and vinyl siding. An artificial fireplace was located at the back of the rear family room. The structure had a gable roof with a composition shingle covering. A patio was located by the carport on the side of the house. The structure had a reinforced concrete slab on grade foundation. The house was built in 1964 according to HCAD. The residence outline is depicted in the attached sketch.

3.0 INSPECTION RESULTS

The foundation of this residence was observed to have incurred deflections which caused damage to other structural components. The level deviations were measured using an electronic version of a waterlevel, either a Stanley Compulevel or a Ziplevel by Technidea in this case, and the results have been superimposed upon an attached sketch. Compensation was made for variations in the height of the floor coverings so that the measurements shown should reflect the relative height of the top of the concrete slab. To better understand the significance of these measurements, contours of equal height were drawn and these are shown in another attached sketch. From these sketches, it can be seen that the slab was measured to be level within approximately 2.8" from the high point to the low point. Based upon my experience, this is more than would normally be expected for a house of this size, with a more typical average usually being in the range of about 1.5". That also is the recommended slab construction tolerance given by the American Concrete Institute. The high area was located at the front of the house around the living room and utility room and the low areas were at the rear and on the northwest side of the bedroom wing. Brick cracks to about 3/8" in size were noted. The front and rear brick lines are straight and the northwest brick line along the bedrooms dips in the middle. The brick line at the front of the bedroom wing is straight but slopes downward to the north corner. Sheetrock cracks to about 1/8" were also seen, along with door misalignments to about 3/8". We observed no exposed slab reinforcement steel or honeycombing in the edge of the slab. Large cracks were not observed in the visible part of the foundation grade beam. Cosmetic slab corner cracks are present. As far as other cracks which may be present in the grade beam it should be understood that cracks can be extremely difficult to see and could possibly be detected by the client at some time after the inspection has been completed. Since cracking is a normal property of brittle materials such as concrete, neither the author nor Sealy Engineering assume any responsibility whatsoever should cracks be found which were not mentioned. It is our opinion that other indications are more important in determining whether a house has a foundation problem since cracks may be present in slabs due to shrinkage or minor movements.

In its report titled "Soil Survey of Harris County", the U. S. Natural Resources Conservation Service (formerly Soil Conservation Service) has classified the soil in this general area to be a member of the Gessner loam family of soils. This area is also near on the soil map to one showing Addicks soil which is somewhat expansive. This does not count the layer of sand which is present under all slabs in this part of the country. The sand is very porous and highly erodible in the presence of sewer line breaks. Cast iron sewer lines, such as would be present under a house of this age, deteriorate over time and are being replaced all across the city for that reason. In view of the low area by the bathrooms and the low brick crack by the utility room, it is suggested that testing of the underslab sewer lines be carried out by means of a hydrostatic test and a video survey of the condition of the lines. In the event any breaks are found it is suggested that as much as possible of the cast iron system be replaced at this time to avoid future foundation problems from that cause. The soil maps are generally considered to be accurate enough for most purposes, although only a soil analysis by means of a boring at the specific site can determine the precise characteristics. The report shows soils in this classification to have low shrink/swell potentials because of the low percentage of expansive clays present. Sandier soils such as this do not tend to change in volume with changes in moisture as clays do. This type of soil is known to be one of the least expansive clay soils so classified in this area. Foundation watering and excluding tree roots from under foundations are not effective in preventing damage to structures due to moisture variations in this type of soil, as long as the soil maps are accurate for this location. Trees are generally capable of affecting house foundations in areas with expansive soil out to about the limits of their untrimmed limbs, although their roots may extend farther. Trees act on house foundations by withdrawing moisture from the expansive clay, which then shrinks and allows the foundation to settle. Cutting of trees or their roots does not apply to those which may have existed on the site

before construction or foundation repairs involving slurry or foam injections since heave can result in such cases as soil moisture returns. Again, these considerations do not apply if expansive clays are not present, as believed. The only trees close enough to affect the foundation under ordinary conditions are opposite the west corner of the house in the neighbor's yard. That area is one of the ones which does not seem to have settled, which could either confirm the lack of expansive soils here or could indicate the possibility that the foundation was built with exterior builder piers or that foundation repairs may have been carried out in the past. The corner could be dug up to determine whether or not a pier of either type may be present. If repair piers are present then further digging is recommended to the thinner part of the slab behind the grade beam to determine if the gap is present between the ground and soil or if mud slurry injection may have been used. This would be important to determine whether it would be safe to cut the tree roots to protect the foundation from them. If no piers of either type are found then it is likely that non-expansive soils are present at this location, in agreement with the soil map. In that case, cutting of the tree roots would not be necessary since the tree should have no effect on the foundation. In that event, sewer line problems are about the only thing that can result in foundation settlement by means of washout under the slab. However, recent movement was reported in all areas and some expansive soils are suspected.

Sewer leaks can cause either heave or settlement of a foundation, based upon my experience. Settlement in the presence of sewer line breaks is much more common than heave. Heave, or lifting, of the foundation occurs when excessive moisture from the sewer leak cause expansive clay underneath to swell. Settlement can occur from erosion of the soil or sand fill under a slab into the hole in the sewer line. This may be responsible for the low level readings in the bathroom area and possibly for the low brick crack at the front of the utility room by the porch. This can occur from the action of either the sewer water or rain water running under the slab. In the case of rain water, settlement can occur in areas far from the leak and is often accompanied by washout holes next to the slab where flowing water has entered. Such erosive flow of water does not occur in the absence of a lower area to which the water can flow, such as a hole in the sewer line. The large sinkhole which formed under Almeda Road in the fall of 2002 was the result of a city sewer main break, according to the Houston public works department. The fact that sewer leaks can cause foundation settlement is also documented in the two references which follow:

"Ask Norm", Norm Abram, This Old House Books, 2001 pgs. 37,38

"Forensic Geotechnical and Foundation Engineering", Robert W. Day, McGraw-Hill, 1999, p. 319

Expansive soils are known to be present in this area based upon other inspections and it is very possible that they are present here in spite of the indications on the soil maps. It was reported that trees have been removed from the lot in the past although the locations of the trees are not known at this time. It is possible that the settlement at the rear of the kitchen area may be due to trees which were previously present if expansive soils are present here. Some of the other low areas may be that way due to sewer line problems causing washout and the lines should be checked.

There are two accepted methods for correcting conditions such as this. One is to underpin the residential foundation using drilled piers or driven piles. This type of repair can be very expensive and requires attention to detail in order to properly level the foundation. The other approach which can be applied if trees and expansive soils are present is to eliminate moisture withdrawal by the tree roots. Root barriers or trenches simply cutting the roots may be placed between the trees and the house to help accomplish that. The owner of the residence should then conscientiously keep the soil adjacent to the foundation in a moist condition. During the dry months, this will require adding tap water to the soil when the rainfall is not sufficient. Use of a soaker hose can limit water use involved in such an undertaking, but even yard sprinklers will serve the purpose. As the

moisture is returned to the soil, it then tends to migrate under the foundation. As the desiccated soil receives additional water, one of the two following events will occur: 1) either the downward deflections of the foundation will be mitigated or 2) the soils swell and heave the foundation back towards its original level condition. This can take months or years to occur, however, depending upon the extent of settlement. If sewer line breaks are found in the suspected areas then it is possible settlement is occurring there due to washout and rebound of the soil in those areas would not be expected. Watering and dealing with tree roots would not affect that condition. Therefore if sewer line deterioration is found then, if the client desires to level the house, it will be necessary to underpin it by means of pilings. However, simply rerouting all the underslab cast iron lines would prevent further settlement due to that cause if the current levelness is acceptable to the client. Further investigation around the west corner of the house to determine if piers may be present could indicate the presence or lack of expansive soils at this location and therefore the need for cutting of tree roots.

In the event the client decides to carry out foundation repairs, the attached sketch shows a reasonable arrangement for the piles. It is suggested that interior piles, if any, be installed by means of tunneling to avoid additional damage to the foundation. That type of additional damage can sometimes limit the degree of levelness which can be obtained during the foundation repairs. If contractors feel they can adequately level the foundation by means of piles installed through the floor of the slab, that approach would be much cheaper. If rerouting of the underslab sewer lines is necessary in the bathroom area then coordination between the foundation repairs and the rerouting might be carried out to make use of the rerouting tunnels in order to install the pilings from underneath. A complete copy of the report should be given to any prospective contractor. This information may be used by the client for the process of obtaining bids for this work. The client may wish to resolve any significant differences between our suggestions and the recommendations made by the contractor. It is important to understand that this arrangement is based upon our engineering judgement; however, the warranty will be provided by the contractor who is solely responsible for the work and should, therefore, make the final selection. The degree of levelness to be expected from the foundation repairs should be discussed in advance with the contractor in order to avoid any misunderstandings. No foundation repair contracts or warranties with which I am familiar discuss the degree of levelness to be obtained during the repairs. We have found that most new houses of this size are level within about 1.5" and it should be possible in our opinion to level the house with the pile layout shown to within approximately that range, keeping in mind that other considerations come into play when trying to determine the original position of the house. After leveling, brick lines should be straight and approximately level. Other components of the house, such as door frames, window sills, counters, etc. should also be level after foundation repairs. Overlifting in an attempt to close cracks should be avoided since debris in them can sometimes prevent them from closing. Additional sheetrock cracks can be expected as a result of this operation. It is important that any void space created by foundation leveling not be filled in order that foundation heave will not result from future changes in soil moisture. This would not apply to any void created by sewer leaks. It is recommended that another foundation inspection be carried out after the leveling, both in order to verify their adequacy and in order to give an independent set of level readings to the client for warranty purposed with the contractor. In any case, neither the author nor Sealy Engineering assumes any responsibility whatsoever for the results of the work of the contractor.

4.0 CONCLUSIONS

Based upon the observations made during this inspection, it is our opinion that sufficient unlevelness and resulting damage is present in the house such that foundation leveling could be justified. As an alternative, dealing with tree roots and increasing watering during dry periods might be effective in preventing further settlement and allow for some rebound of the foundation if trees

are causing the observed movement. Since movement has been noticed recently, it is likely that there are at least some expansive soils on the lot. Testing of the underslab sewer lines is also recommended due to the locations of settled areas, such as the bathroom and possibly the beginnings of settlement at the front of the utility room. If problems are found it may be necessary to reroute the underslab plumbing lines. A pile layout is given in this report to accomplish leveling the foundation if that course of action is chosen.

The drawing at the end of this report is provided to aid in determining the condition of the foundation. "R" on the drawing represents the reference point from which all other level readings are taken and it is arbitrary. Changes in floor coverings such as the transition from carpet to tile etc. are taken into consideration when taking level readings. Taking the largest positive reading and adding the largest negative reading will give the overall levelness of the structure. Generally, when new houses are finished, a certain amount of slope is built in. This slope is generally in the range of 1.5 inches for the average size house. Level readings are valuable not only as a diagnostic tool but can be used as a reference for any suspected foundation movement that may occur in the future. Readings can also verify the stability of a house. Please note that the scale of the drawings can change with faxing or copying of the original sketches.

The foregoing discussion is based upon an analysis of information which was obtained through a visual inspection of the foundation and its associated structure combined with such engineering information that was otherwise available. Although this process yields reliable results the majority of the time, it must be recognized that occasionally latent defects may exist which are not always amenable through detection during a visual inspection of this type. Thus, any inspection of this type is essentially an opinion upon which the client may place a reasonable degree of reliance; but, under no conditions can such an opinion be considered absolute nor can such opinion be used without any assumption of risk.

5.0 CERTIFICATION

I hereby certify that I did conduct the assessment of the foundation performance of the residence located at , Houston, Texas on the date of .I am a Licensed Professional Engineer in the State of Texas, whose registration number is 64962. I further certify that the findings and conclusions contained in this report have been, to the best of my knowledge, correctly and completely stated without bias and are based upon my observations and my experience. No responsibility is assumed for events that occur subsequent to the submission of this report and no warranty, either expressed or implied, is hereby made.

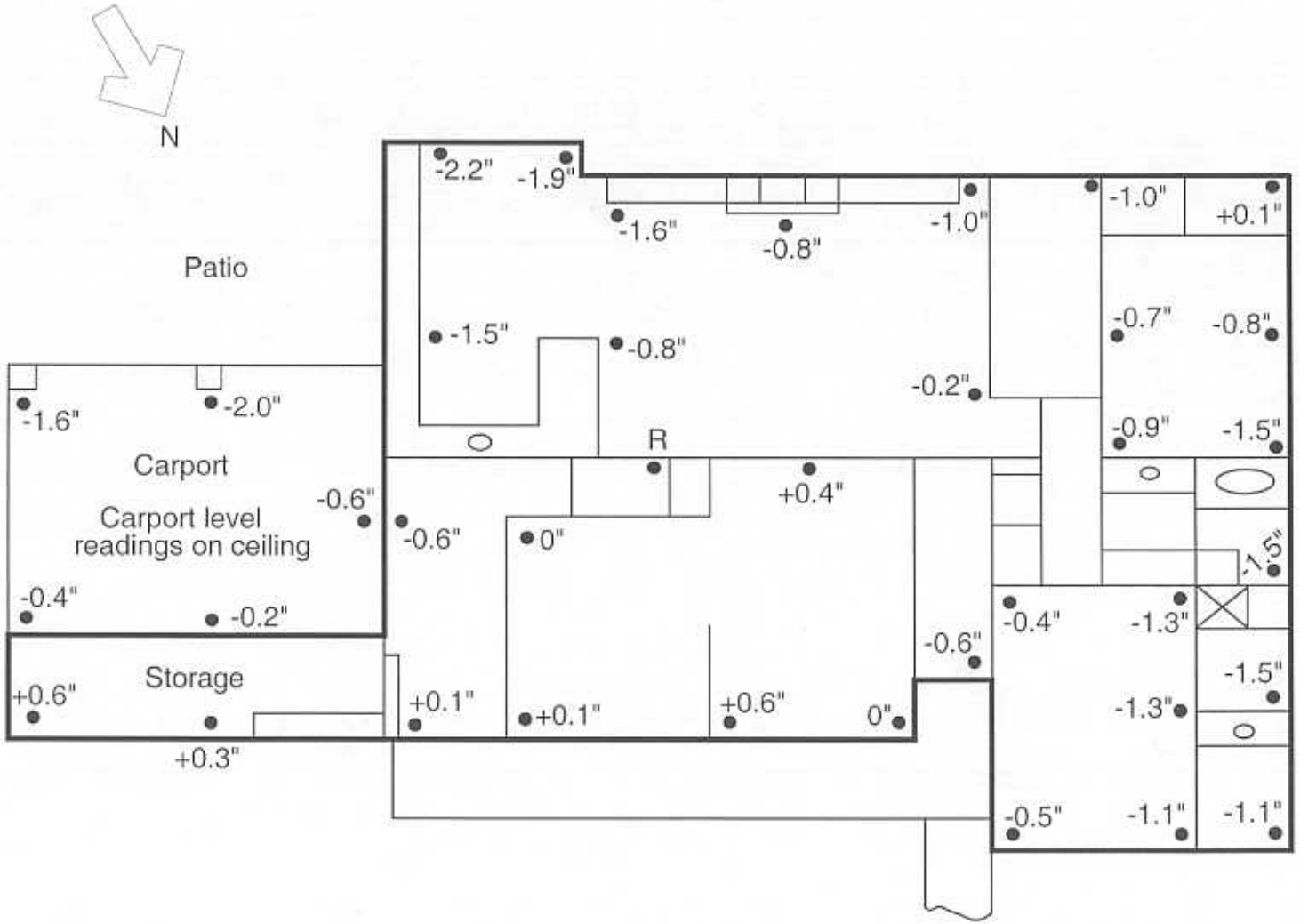
Taylor Sealy
Licensed Professional Engineer

Sealy Engineering

Level readings

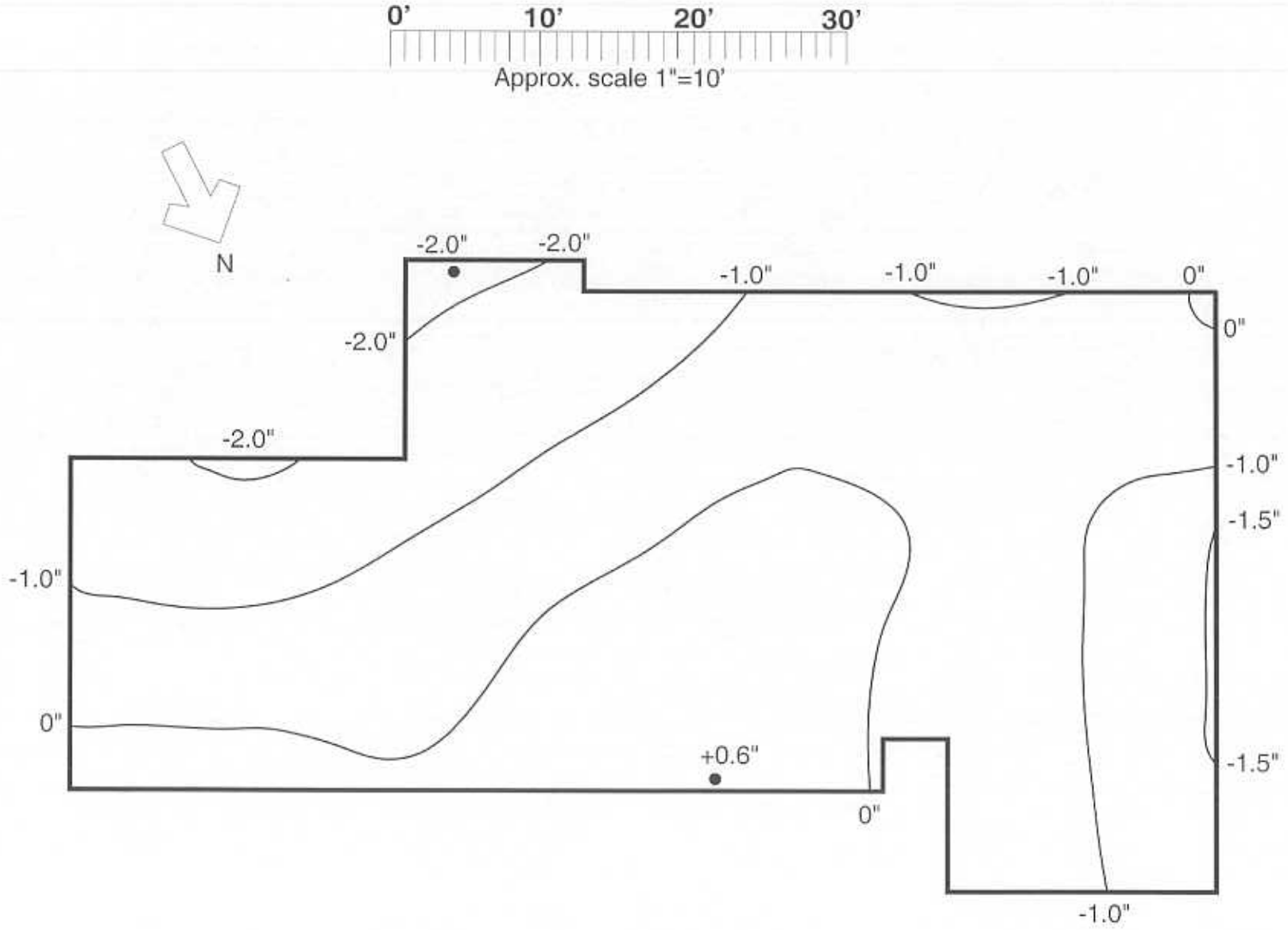
0' 10' 20' 30'

Approx. scale 1"=10'



Sealy Engineering

Contours of equal elevation



Sealy Engineering

Pile layout

0' 10' 20' 30'

Approx. scale 1"=10'