

FPA-SC-06

**Homebuyers' Guide
for
Foundation Evaluation**

Presented to the
Foundation Performance Association
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by:

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FPA-SC-06 Committee History

- n 11/02 - Sanctioned as an ad hoc subcommittee by the Structural Committee
- n 3/04 - First draft (Rev. A) issued to SC
- n 7/05 - Issued Rev. S for FPA Peer Review
- n 10/05 - Published Rev. 0 on FPA website

Download Paper No. FPA-SC-06 Rev. 0 at:

http://www.foundationperformance.org/committee_papers.html

Audience

- n Buyers of homes and low-rise buildings,
- n Lenders,
- n Realtors,
- n Landscape contractors
- n Landscape architects,
- n Real estate investors
- n Other interested parties
- n Applicable to the purchase of other low-rise structures with similar foundations.

Purpose

- n This paper provides the homebuyer with:
a list of appropriate foundation-related questions to ask.
- n a cursory guide for looking at a house with an informed view for evidence of foundation-related problems
- n documents to ask for prior to purchase of a house
- n comments on finding a qualified Professional Engineer (P.E.) and/or Licensed Real Estate Inspector
- n a glossary of terms used in this paper.

Other Relevant FPA Papers

- n FPA-SC-07, *Foundation Maintenance and Inspection Guide for Residential and Other Low-Rise Buildings*
- n FPA-SC-03, *Distress Phenomena Mistakenly Attributed to Foundation Movement.*
- n FPA-SC-01 *Foundation Design Options for Residential and Other Low-Rise Buildings on Expansive Soils*

Glossary

- n **Brick Veneer:** Non-structural wall covering formed from bricks and mortar. Other common exterior finishes include siding, plaster (stucco), and stone.
- n **Crawl Space:** A space between the structural floor and underlying soil large enough for an adult person to access.
- n **Differential Elevation:** Vertical elevation difference of one area of a foundation relative to other areas, typically measured in inches.
- n **Differential Movement (Foundation Movement):** A change in position of a foundation system that is detectable by changes in elevation and may be accompanied by visible signs of distress.
- n **Distress:** Cracks or separations in drywall, exterior veneer, foundations, grade beams and trim, door and window misalignments, and noticeable distortion in framing. These are some of the more common forms of distress that occur in a residential structure subjected to differential movement. Also referred to as negative phenomena.

Glossary (cont'd)

- n **Drywall:** Gypsum sheets used to cover walls and ceilings, commonly called sheetrock.
- n **Elevation:** A vertical distance above or below a point of reference.
- n **Existing Homes:** Homes that are pre-owned or which were newly built but not occupied for a period of approximately one or more years after completion of the home.
- n **Expansive Clay:** Clay that exhibits a volume change when dried or wetted.
- n **Foundation:** That part of a building located between the superstructure and soil that transfers load between the superstructure and soil.
- n **New Homes:** Homes that are typically less than one year old and have not been previously occupied.

Glossary (cont'd)

- n **Piers:** The reinforced concrete component of a deeply supported foundation that may have a straight or underreamed shaft, which transfers the building loads between the foundation and deeper soils. Also called piles, caissons, drilled shafts or drilled piers.

- n **Plasticity Index (PI):** A scale used to measure the potential for volume change for expansive clays. Clayey soils with a PI less than 15 percent are considered non-expansive, clayey soils with a PI between 15 and 25 percent are considered to be moderately expansive, and clayey soils with a PI above 26 percent is considered highly expansive.

- n **Professional Engineer (P.E.):** Under current Texas law, a licensed Professional Engineer will have met certain educational and professional standards. Refer to the website of the Texas State Board of Professional Engineers (TBPE) at www.tbpe.org for more information. By Texas law, only a licensed professional engineer is allowed to represent himself as a Professional Engineer and use the title, "P.E." after his name.

Glossary (cont'd)

- n **Slope:** Ratio of height to distance. As an example, a 3-foot drop over 100 feet is a slope of 3 percent (3%). Often used in reference to drainage.
- n **Superstructure:** That part of a building that is above and supported by the foundation.
- n **Settling:** Downward foundation movement.
- n **Real Estate Inspector:** An inspector licensed by the state of Texas under authority of the Texas Real Estate Commission (TREC)
- n **Uplift:** Upward movement of the foundation, also called heave.

Buyer Inspection of Newly Constructed Homes

Important Questions

- n Any written inspection reports from either a Licensed Real Estate Inspector or a Professional Engineer
- n Seller's Disclosure Notice
- n Ground slopes
- n Was foundation designed by a PE using a soils report
- n location of all drains and downspouts

Foundation Types

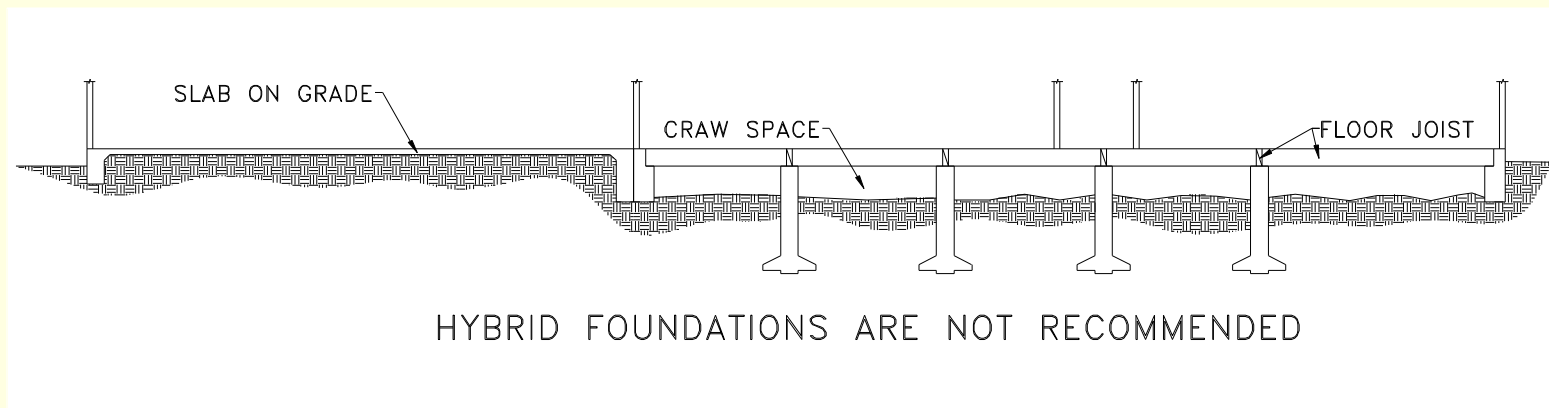
- 1) Slab-on-Grade
- 2) “Post Tensioned” slab-on-grade
- 3) Slab-on-Grade supported by piers
- 4) Structurally isolated slab with a void space under the floors, supported by piers
- 5) Crawl space (often incorrectly referred to as “pier and beam”)

Crawl Space



Mixed Foundation Type

- n Does more than one type of foundation system support the house



Additional Questions

- n Was the foundation designed by a Professional Engineer based on a site-specific soil report?”

Design and Construction Documentation

Request copies of:

1. Sealed design drawings
2. Sealed soils report
3. Construction schedule
4. Post tensioning records
5. Certificates of completion
6. Inspection and observation reports.

7. Aerial Photographs



Independent Design and Construction Review

8. Independent design and construction review can be helpful to determine if builder followed generally accepted design and construction methods

Determine or find out

- n if the house was built in an area that was originally a pond, ditch, canal, or swampy area
- n if large trees were removed inside or near the foundation footprint prior to construction
- n Observe for the presence of barren soils near the foundation

Elevation Check

- n Spot check the floor slopes on the lowest floor using a four-foot carpenter's level and a measuring tape to determine if the foundation is substantially out of level



The image displays two hand-drawn floor plans of a building, likely a school or institutional structure, with various rooms and corridors. The plans are drawn on a grid background.

Left Floor Plan:

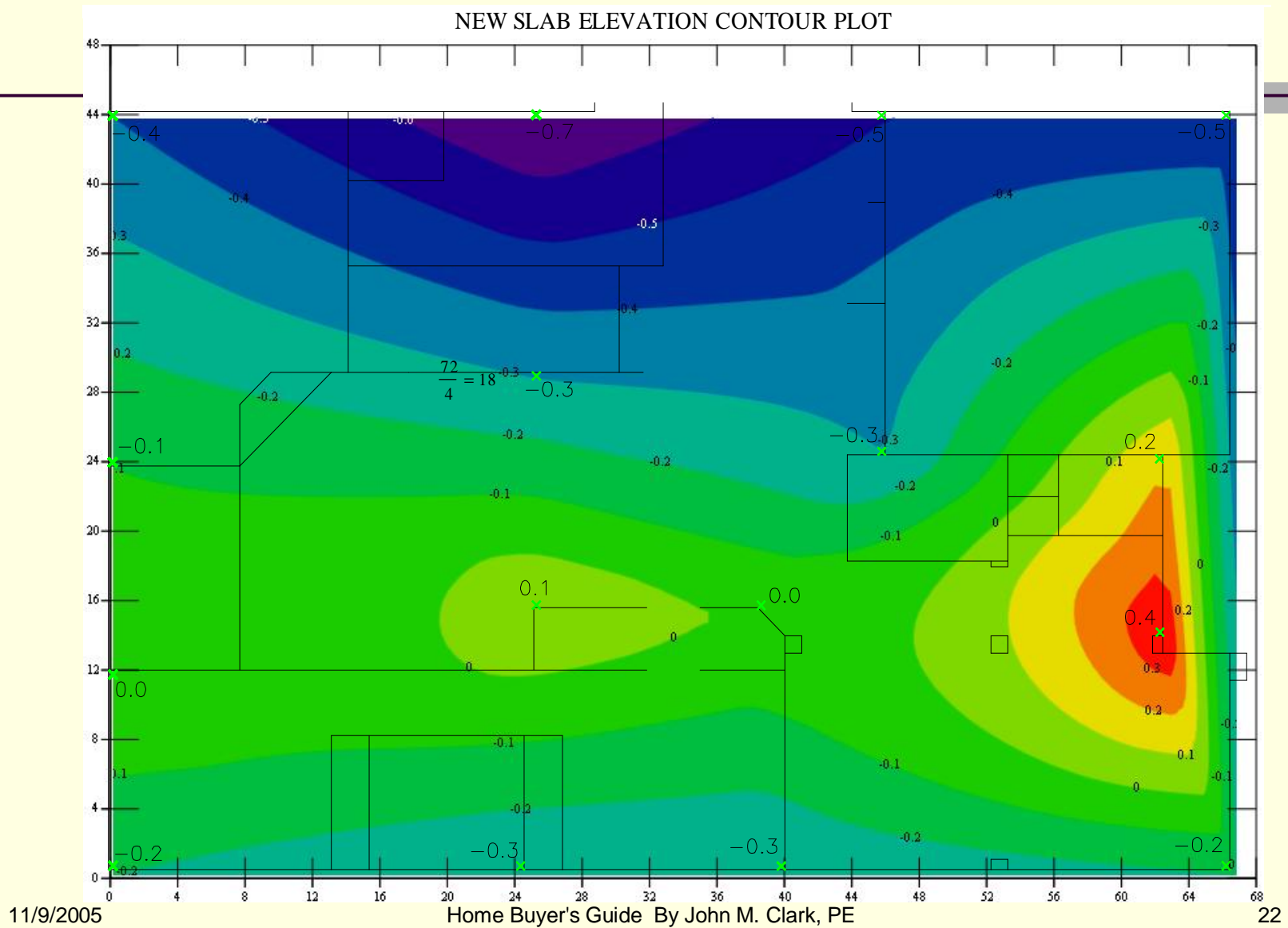
- Top Left:** A large rectangular room labeled -0.4 .
- Top Right:** A rectangular room labeled -0.7 .
- Middle Left:** A rectangular room labeled -0.1 .
- Middle Right:** A rectangular room labeled -0.3 .
- Bottom Left:** A rectangular room labeled 0.0 .
- Bottom Center:** A rectangular room labeled 0.1 .
- Bottom Right:** A rectangular room labeled -0.3 .
- Bottom Left Corner:** A small rectangular room labeled -0.2 .

Right Floor Plan:

- Top Left:** A rectangular room labeled -0.5 .
- Top Right:** A rectangular room labeled -0.5 .
- Middle Left:** A rectangular room labeled -0.3 .
- Middle Right:** A rectangular room labeled 0.2 .
- Bottom Left:** A rectangular room labeled 0.4 .
- Bottom Center:** A rectangular room labeled -0.2 .
- Bottom Right:** A rectangular room labeled -0.2 .
- Bottom Left Corner:** A small rectangular room labeled -0.3 .

Both plans include dimensions and labels for various rooms and areas, such as $13' - 6\frac{1}{2}"$, $10' - 1"$, $8' - 7"$, and $6' - 7"$.

New Slab Elevation Contour Plot



Buyer Inspection of Existing Homes

Common strategy

- n Engage a licensed real estate inspector or a professional engineer

Prior to Engaging a Professional Inspection

- n Identify distress inside:
in sheet rock



n Misaligned doors



n Floor Cracks



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n Exterior brick cracks



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n Mortar Repair



n Grade Beam Crack



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Questions to Ask

Same as for new houses

- n Any written inspection reports from either a Licensed Real Estate Inspector or a Professional Engineer
- n Seller's Disclosure Notice
- n Foundation Type
- n Ground slopes

Questions to Ask (cont'd)

- n Was foundation designed by a PE using a soils report
- n Is there more than one foundation type?
(HYBRID FOUNDATIONS are not recommended)

Other Observations

- n Separations in exterior trim
- n Separations around garage doors
- n Uneven separations around door and window frames
- n Note for proper grade beam embedment
- n Note existence of nearby trees
- n Note Tree Stumps

Nearby Trees



Tree Stumps



Observations

- n Note planters adjacent to the house
- n Note the location of all drains and downspouts
- n Note the location of sprinkler heads relative to the foundation
- n Note the use of cobblestones and other types of rock fills as decorative landscaping

- n Note areas, such as split-levels or sunken rooms where the finished floor elevation is below the final grade of the backfill or paving



Interior Inspection

- n Drywall cracks
- n recently repainted?
- n wallpaper that is distorted

Sewer Leak Test

- n hydrostatic leak test done if movement is suspected , or
- n if the home was built prior to 1985.
- n relatively inexpensive and can help diagnose a problem if one exists.

Professional Structural Inspection of a Residential Foundation

- n Engage a licensed Professional Engineer and/or a licensed professional real estate inspector
- n Usually includes both an elevation survey and a distress survey.

Elevation Survey

- n Typically use an electronic digital level
- n Plot data on contour map
- n Second elevation survey in six to twelve months can help determine if foundation is moving
- n Correlate with distress survey

Example



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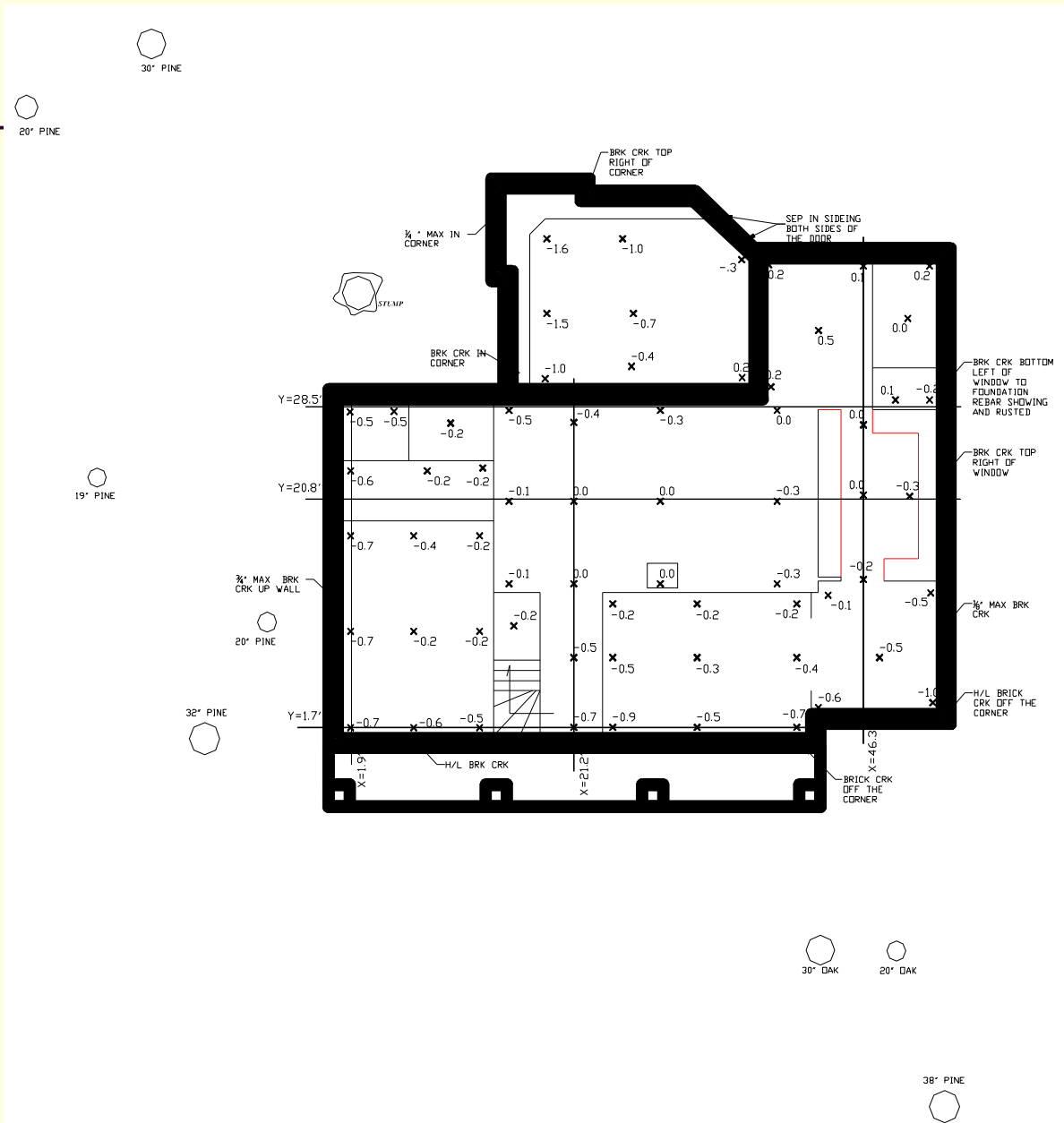


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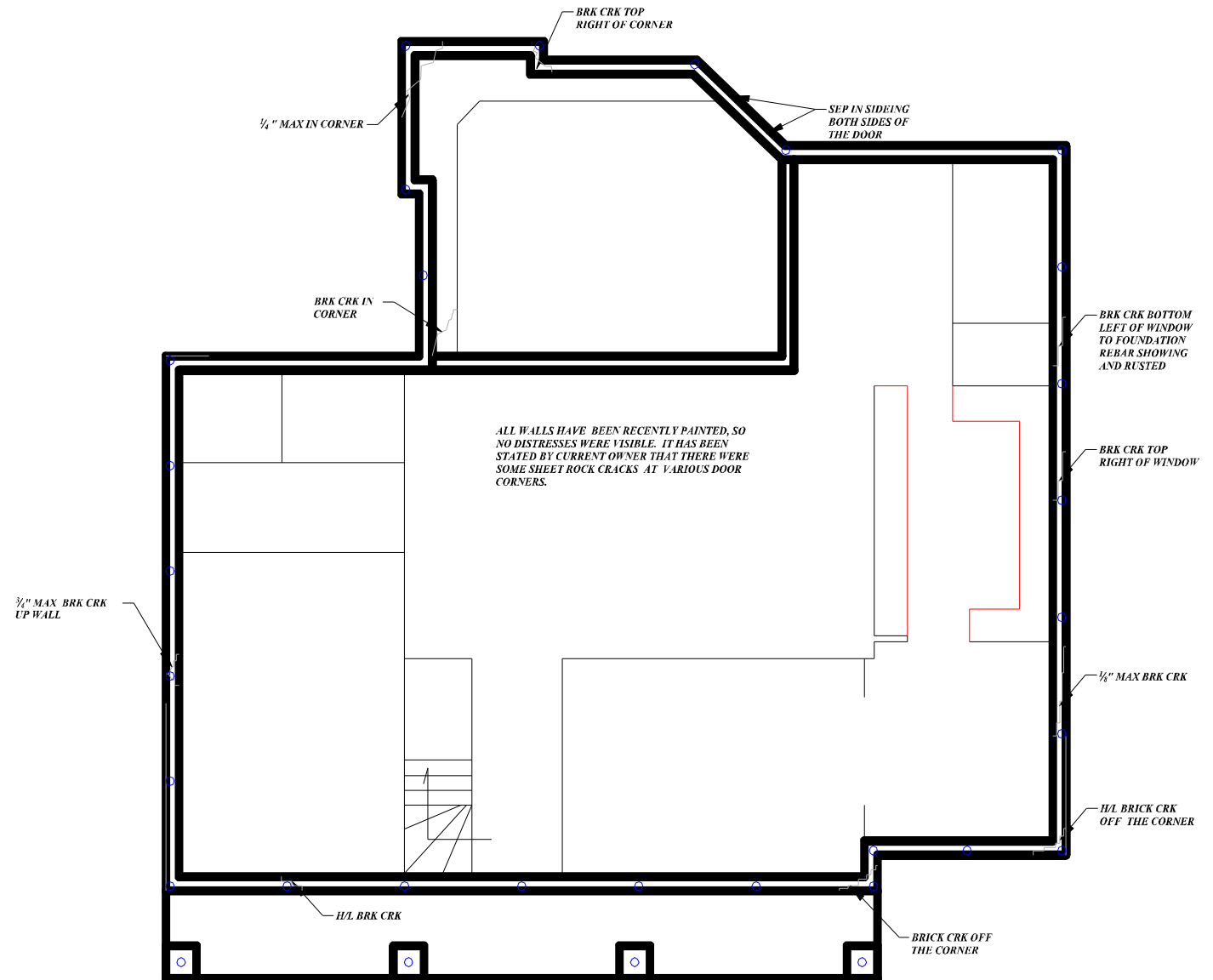
42

n Site Plan showing nearby trees

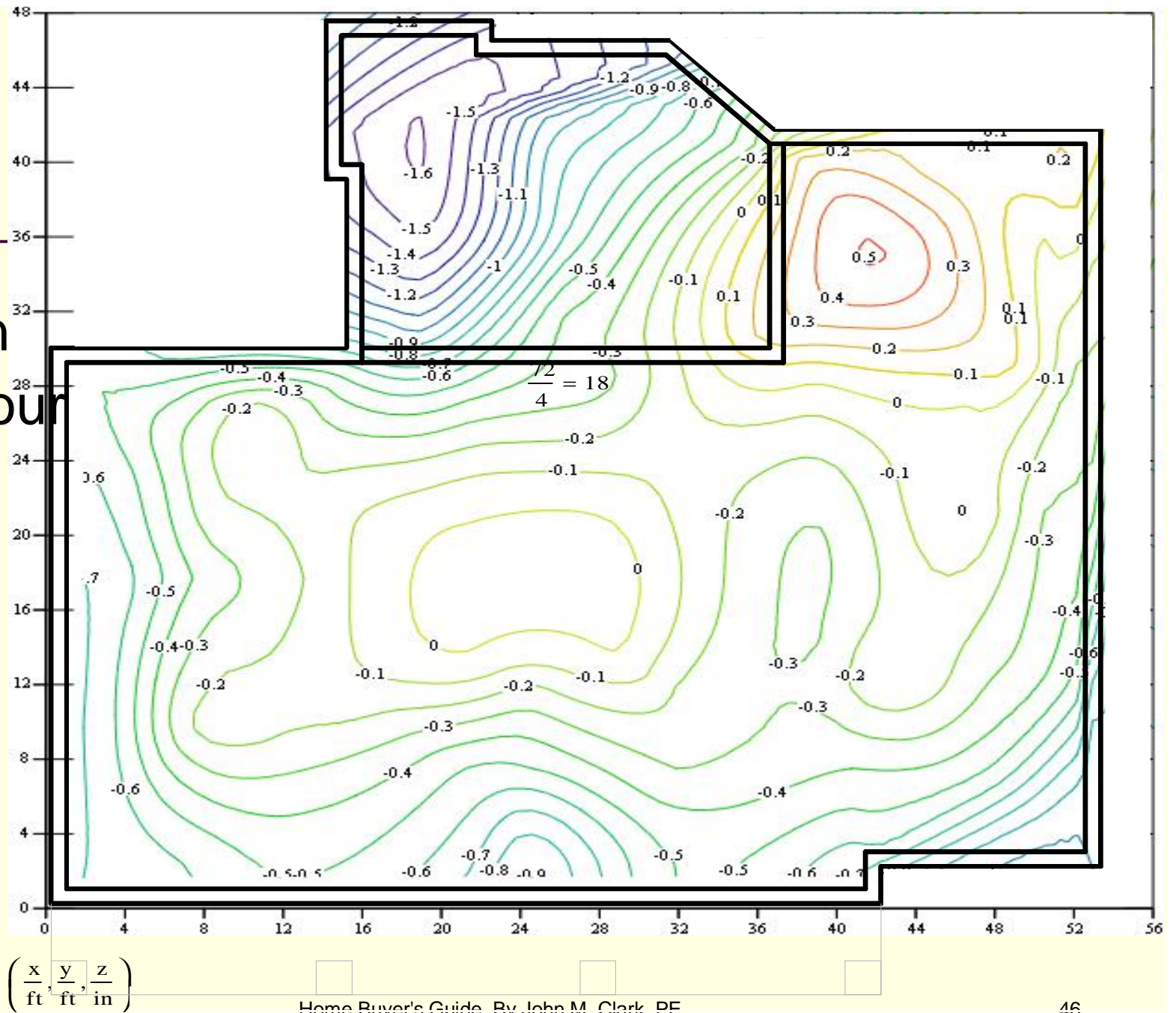


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n Distress survey



n Ele'vn Contour Plot



Geotechnical Investigation

- n Identifies and classifies the engineering properties of the soil
- n Data can be correlated with the elevation and distress surveys
- n Soil sampling is typically done by boring holes twenty feet or more in depth

Boring Logs

SOIL REPORT									
B-1 BORING LOG 1					B-2 BORING LOG 2				
	QU (tsf)	PI	MC			QU (tsf)	PI	MC	
1 FT		7	9	BROWN CLAYEY SAND (SC)	1 FT			8	BROWN CLAYEY SAND (SC)
2 FT	4.5		12	HARD, LIGHT GRAY, RED & TAN SANDY CLAY (CL)	2 FT	4.5	23	12	HARD, LIGHT GRAY & RED SANDY CLAY (CL)
3 FT	4.5+	60	31	HARD, LIGHT GRAY & TAN CLAY (CH)	3 FT	4.5		31	HARD, LIGHT GRAY, TAN & RED CLAY (CH)
4 FT					4 FT				
5 FT	4.5		34	...SAME	5 FT	4.5		32	...LIGHT GRAY & TAN
6 FT					6 FT				
7 FT	3.5	51	32	...VERY STIFF	7 FT	3.7		25	...VERY STIFF WITH CALCAREOUS DEPOSITS, JOINTED
8 FT					8 FT				
9 FT	4.5		26	...HARD	9 FT				
10 FT					10 FT	7.5	45	27	...HARD
11 FT					11 FT				
12 FT					12 FT				
13 FT					13 FT				
14 FT	4.5		29	...SAME	14 FT	3.8		28	...VERY STIFF, JOINTED
15 FT					15 FT				
16 FT					16 FT				
17 FT					17 FT				
18 FT					18 FT				
19 FT	4.5		29	...SAME	19 FT	4.5		30	...HARD
20 FT				BORING TERMINATED AT 20'	20 FT				BORING TERMINATED AT 20'
				NO WATER ENCOUNTERED					NO WATER ENCOUNTERED

Age of House vs. Degree of Movement

- n A house approximately ten years of age or older, with excessive slope but without any significant areas of distress, or areas that were repaired long ago without new distress, are likely to be performing adequately
- n Same amount of slope for a newer house with distress could be an indication that the house is undergoing excessive differential movement

Age of House vs. Degree of Movement

- n Evaluation is subjective and is usually made by a professional engineer on a case-by-case, site-specific investigation.

Professional Inspections

- n Engaging a licensed real estate inspector
- n Engaging a licensed professional engineer

Real Estate Inspector

- n A licensed real estate inspector must pass an exam proctored by the Texas Real Estate Commission (TREC)
- n No formal educational requirements to be a licensed real estate inspector in Texas
- n Real estate inspector should list his or her license number near the inspector's signature

Licensed Professional Engineer

Many engineers who can provide this type of service

- n residential investigations to the exclusion of other areas of civil/structural engineering
- n specialize in forensic investigations and expert testimony
- n a diversified practice and provide residential investigations and residential foundation design as a part of their practice

PE Requirements

- n A Professional Engineer will have met certain educational and professional standards
- n The written report by the Professional Engineer should include the imprint of his or her Seal with date and signature across the Seal

How to Find a Qualified Licensed Professional Engineer

- n Hire an engineer or engineering firm that has both significant residential design experience and significant inspection experience
- n Discuss with the engineer his or her relevant work experience
- n Ask the engineer for a list of relevant references

Summary

- n Ask the appropriate questions
- n Make careful observations
- n Get copies of all design documents including foundation drawings and geotechnical investigation report
- n Ask if there are any written reports on the house made by a licensed real estate inspector or P.E.

Summary (cont'd)

- n Ask if there have ever been any repairs to the foundation or superstructure
- n if yes:
 - when they were made,
 - where they were made,
 - why they were necessary,
 - who made them, and
 - what is the warranty
- any claims have been made to a home warranty program, and the resolution of those claims

Summary (cont'd)

- n Look for signs of distress on the interior and exterior
- n Look for signs of repairs inside and outside
- n Look how the water is drained or lack of proper drainage
- n Observe for the presence of barren soils near the foundation

Summary (cont'd)

- n Look at the irrigation system. Sprinkler heads should spray away from the foundation
- n Hire a licensed professional if serious problems are evident or suspected

Tools to Take

- n 4 ft carpenter's level
- n retractable tape measure (20 ft to 30 ft is a good size)
- n camera
- n a means to measure crack widths, including coins, feeler gages and credit cards
- n flashlight

QUESTIONS?