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STRUCTURAL ENGINEERING FOUNDATION PERFORMANCE EVALUATION

Client: Shane Jaime

relation of client to property: owner
property located at

18106 Quiet Grove Court
Humble, Texas

The space to the right contains a computer-generated professional engineering seal. The seal was authorized by Matt Gray, P.E. (102077) on Monday, August 14, 2017. It is a violation of law to copy or alter this seal in any manner.

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PROJECT DESCRIPTION

Building Type: detached single family home
Number of Stories: 2
Was Building Occupied?: no
Year House was Built: 1999
Was Client Present?: no
Was the Owner Present? no

This Engineering Property Condition Report was prepared pursuant to the **PROFESSIONAL ENGINEERING CONSULTING AGREEMENT** (hereafter referred to as the "agreement") between the Client and Matt Gray. The last page of this report is a signed copy of the agreement unless this is a draft report.

PURPOSE AND SCOPE OF THE REPORT

The purpose of this report is to provide you with independent, unbiased, subjective opinions regarding the structural performance of the subject foundation. My intent is to provide you information that will allow you to better understand the performance of the foundation addressed in the report.

The report is based on my observations of the visible and apparent performance of the components and systems addressed in the report. In the conduct of my work, I do not perform any action that, in my judgment, could damage the property or endanger the safety of me or any other person.

Although care is taken in preparing this report, I make no representations regarding any latent, concealed or obstructed defects that may exist. This report is not fully exhaustive; not every possible defect was discovered and reported. The content of the report should be considered as a first impression opinion of the condition of the property.

The opinions formulated by me are based on perceived conditions as compared to my training, knowledge and experience; my opinions are, therefore, subjective. They are not based upon any code requirements, manufacturer requirements and/or performance standards and/or compliance with any federal, state or local codes, lender requirements and/or other legal requirements unless otherwise stated in the report. A different professional may have different opinions regarding the performance of the foundation.

Texas Real Estate Commission Statement Regarding Home Inspections

The following is from a statement published by the Texas Real Estate Commission concerning home inspections. I have reworded it to apply specifically to engineering foundation reports.

> This inspection is not an exhaustive inspection of the foundation. The inspection may not reveal all deficiencies. A foundation performance evaluation helps to reduce some of the risk involved in purchasing a home, but it cannot eliminate

these risks, nor can the inspection anticipate future events or changes in performance due to changes in use or occupancy.

It is recommended that you obtain as much information as is available about this property, including any seller's disclosures, previous inspection reports, engineering reports, building/remodeling permits, and reports performed for or by relocation companies, municipal inspection departments, lenders, insurers, and appraisers. You should also attempt to determine whether repairs, renovation, remodeling, additions, or other such activities have taken place at this property. It is not the inspector's responsibility to confirm that information obtained from these sources is complete or accurate or that this inspection is consistent with the opinions expressed in previous or future reports.

Property conditions change with time and use. For example, foundations tilt and bend as changes in the moisture content of the soil causes it to shrink and swell. Most foundation movement is a consequence of changes in the moisture content of the soil; soil moisture changes are mainly driven by changes in the weather.

Foundation bending will stress wall coverings such as drywall and brick veneer. In some cases the stress may not be enough to fracture the drywall or brick veneer, but these materials may fracture with only a small degree of additional movement.

This report is provided for the specific benefit of the client named above and is based on observations at the time of the inspection. Any reader of this report other than the client should understand that relying on this report may provide incomplete or outdated information and may not meet your specific needs. Repairs, professional opinions or additional inspection reports may affect the meaning of the information in this report. It is recommended that you hire a licensed inspector to perform an inspection to meet your specific needs and to provide you with current information concerning this property.

A BRIEF EXPLANATION OF HOW I EVALUATE THE STRUCTURAL PERFORMANCE OF A SLAB FOUNDATION

My report is a Level B evaluation as defined in the Texas Section of the American Society of Civil Engineers publication *Guidelines for the Evaluation and Repair of Residential Foundations.*[1] My engineering performance evaluation is mostly visual with some elevation measurements.

1 I try to comply with requirements of a Level B investigation as closely as I can. Full compliance is not possible in the large majority of foundations I investigate. The most common problem is the lack of reliable historical information concerning the house.

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Finish Floor Elevation Measurements: I make elevation measurements on the finish floor using a digitized, electronic manometer. I use the measurements for the following:

- **Determine Dominant Expansive Soil Movement Distortion Mode:** Slab-on-ground foundations on expansive soils exhibit a long-run a and a short-run distortion mode. Most older slab foundations in the Greater Houston Area will exhibit a surface shape of an upside down bowl as shown below. This shape (see figure #1) is known as a center lift or long-run distortion mode. When the weather is exceptionally wet, the surface shape may invert to that of a right-side up bowl. This shape is known as an edge lift or short-term distortion mode. I use the elevation measurements to determine the dominant distortion mode in two principle directions.

figure #1
center-lift
(long-run distortion mode)

figure #2
edge-lift
(short-run distortion mode)

- **Evaluate Foundation Levelness:** When a slab-on-ground foundation reacts to expansive soil movement, the foundation surface and the finish floor may become less level. I use the measurements to assess the levelness of the foundation as compared to my experience with other foundations of a similar age, construction and location.
- **Estimate Foundation Tilt Due To Expansive Soil Movement:** All slab-on-ground foundations tilt when they react to expansive soil foundation movement. Tilt is rarely a significant issue, but I use the elevation measurements to estimate how much the foundation has tilted in two principle directions.

figure #3
level foundation – no tilt

figure #4
tilted foundation

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- **Estimate Foundation Bending (Deflection) Due To Expansive Soil Movement:** Bending causes damage to the house. I use the elevation measurements to estimate how much bending the foundation exhibits in two principle directions.

Distress Evaluation:

I make judgments about the performance of a foundation based on visible damage to the supported structure consistent with the apparent foundation distortion mode.

1. Maximum and cumulative crack widths in the brick veneer, stone veneer and/or stucco exterior walls. I use cumulative crack widths to make an estimate of how much bending the foundation exhibits.
2. The number and maximum width of cracks in the interior drywall.
3. The number of doors that stick or bind.
4. The degree of rotation of the fireplace chimney away from the house structure.
5. Significant structural damage to the load-carrying capacity of the wood frame structure.
6. Levelness of normally level surfaces, specifically sills and countertops.

The data from items 1 and 4 are used primarily to make estimates of how much bending the foundation exhibits. The data from items 2, 3, 5 and 6 are used primarily to judge how reliable the various estimates of foundation tilt and bending are.

WHAT I DO NOT DO IN MY FOUNDATION PERFORMANCE EVALUATION

- **I Do Not Provide an Engineered Repair Plan:** While I normally provide a general description of needed repairs, the report is not intended to be used as an engineering design document for the repair of the foundation. The Rules of the Texas Board of Professional Engineers require that foundation repair contractors who operate in expansive soil areas have a permanent employee who is a Professional Engineer for the purpose of making repair plans.
- **I Evaluate Foundation Distortion Due To Expansive Soil Movement Only:** My foundation performance evaluation is directed to performance issues due to foundation distortion caused by expansive soil movement. Expansive soil movement is the cause of virtually all significant foundation performance issues in the Greater Houston Area.

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FOUNDATION PERFORMANCE EVALUATION EXECUTIVE SUMMARY

This section is an executive summary of the report. The executive summary includes a summary of the engineering performance evaluation of the foundation.

Issues	summary comments
1. What type of foundation is this?	**This is a slab-on-ground foundation.** Slab-on-ground foundations are the most common house foundation in the Greater Houston Area. These foundations bend and tilt as the underlying soil shrinks and swells. When slab-on-ground foundations rest on expansive soils they are likely to cause some degree of damage. The damage is normally cosmetic damage with some minor functional damage in the form of door issues.
2. Does the house show damage that is probably due to foundation movement?	Based on my observations of the house, it is my engineering judgment that **the house does exhibit visible damage due to foundation movement.**
3. What kinds of damage does the house exhibit due to foundation movement?	It is my judgment that **the visible damage to the house resulting from foundation movement is cosmetic.**
4. Engineer's opinion of the visually apparent foundation performance.	In my opinion, **the foundation is performing in a serviceability sense within what I consider to be an acceptable range of structural performance** given the apparent age, construction and location of the structure.
5. Is the foundation performance adequate in terms of usability and serviceability of the house?	It is my judgment that **the foundation is performing in a way that does not impair the usability and serviceability of the house.**
6. Is the foundation performance adequate in terms of structural damage to the house?	It is my judgment that **the foundation is performing in a way that is not significantly impairing the ability of the structural frame of the house to carry normal imposed loads in a safe manner.**

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Issues	summary comments
7. Is the apparent geometry of the foundation surface as indicated by finish floor elevation profiles consistent with normal foundation performance?	**The finish floor elevation profiles, in my opinion, are consistent with normal foundation surface geometry** taking into consideration published ACI construction tolerances and expected foundation surface distortion for foundations in this area and age.
8. Is foundation underpinning structurally necessary?	**It is my judgment that foundation underpinning is not structurally necessary for this house.** It is my judgment that this question should be answered in the affirmative only if foundation movement is clearly causing significant structural damage to the house or if the foundation movement is resulting in structural safety issues that cannot be addressed without underpinning the foundation.
9. Is foundation underpinning recommended?	**I do not recommend underpinning the foundation for this house.** It is my judgment that **any improvement in the future performance of the foundation is outweighed by the risk of damage to both the house and the foundation that could result as an unintended consequence of the foundation underpinning process.** In my opinion, a foundation should not be underpinned unless it is clearly distorting to a degree that foundation underpinning is likely to make a significant improvement to the future performance of the foundation.

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Issues	summary comments
10. What options are available for repairing the visible foundation distress?	Since there is no visible damage to the house due to foundation movement, this question is not applicable.
11. Are any concrete repairs recommended?	No.
12. Comments concerning previous reports.	There were no previous reports available.

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ENGINEERING FOUNDATION PERFORMANCE EVALUATION

SIGNIFICANT OBSERVATIONS

My Understanding of The Structural History of the House	
1. Past underpinning of the foundation?: none	5. Past masonry fireplace chimney rotation: no
2. Past brick veneer, stone veneer and/or stucco cracking: yes	6. Were site-specific soils reports available?: no
3. Past drywall cracking: yes	7. Were previous engineering reports available?: no
4. Past door sticking, door binding and door latching: no	8. Has owner received a foundation repair proposal? unknown

1. Foundation Cracking and Levelness	
number of distinct cracks	**no structurally significant cracks were observed**; as is normally the case, most of the foundation surface was concealed from view; see the comment below concerning cracks in concrete
width of largest crack	not applicable
visible floor tile cracking	none
levelness	based on walking the floor, the slab surface appeared to not have been severely distorted by foundation movement

comment #1: wedge cracks and hairline or very tight cracks are not structurally significant to the performance of the foundation and are not reported; cracks covered by floor coverings are not visible and are not reported; should floor coverings be removed and it is desired for me to evaluate these cracks, this can be done for an additional fee.

comment #2: ceramic and other brittle floor tiles will crack even with very minor foundation movement; to a significant extent floor tile cracking can be avoided by using a flexible thinset, as well as a separation membrane such as the type you can find here.

comment #3: how level a foundation floor surface should be is a matter of personal taste; if the levelness of the floor surfaces is important to you, make sure you walk all

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the floors to make sure the floor levelness is acceptable to you; when the normally level surfaces (such as sills and countertops) are level, any unlevelness of the floor surface, in my opinion, can be largely attributed to original construction and not to foundation movement.

2. Drywall cracks and cabinet/wall separation	
number of distinct cracks and/or cabinet/wall separations	none due to foundation movement
width of largest wall crack or cabinet/wall separation	not applicable
stress marks	yes, but not due to foundation movement
corner bead distress	none
inside corner distress	none
comment #1: whether cracks of this nature are related to foundation movement is largely a matter of judgment; I do not report cracks that, in my judgment, are clearly not related to foundation movement. I also do not report cracks that are less than 6-inches in length. comment #2: vertical and horizontal drywall cracks, in my experience, are usually caused by something other than expansive soil foundation movement; more likely causes include poor drywall fastening, poor drywall finishing, concentrated load paths in the framing, normal shrinkage of wood framing and normal construction errors in the framing. comment #3: drywall cracks in ceilings, in my engineering judgment, are frequently not related to expansive soil foundation movement; they are usually related to framing details and drywall application.	

3. Doors	
number of doors sticking or not latching properly	none
inoperable doors	none
doors modified	none
strike plates altered	none
visible first story door frame distortion	none
comment #1: door distress that is not related to foundation movement such as hardware defects or moisture problems is not reported.	

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comment #2: door frame distortion can indicate foundation movement but may not be indicative of excessive foundation movement.

comment #3: in my engineering judgment, door frame distortion upstairs in a multistory house is usually not related to expansive soil foundation movement.

4.Cracks and Separations in Exterior Walls					
wall	**number of cracks and separations**	**largest crack or separation (inches)**	**cumulative crack/separation width (inches)**	**estimated deflection ratio**	**repaired veneer cracks**
front	**0**	**0**	**0**	**0/360**	**none**
right	**0**	**0**	**0**	**0/360**	**none**
left	**0**	**0**	**0**	**0/360**	**none**
rear	**0**	**0**	**0**	**0/360**	**none**

comment #1: cracks and other openings that appear to be caused by thermal stresses or other non-foundation related causes are not reported.

comment #2: I would not normally consider foundation underpinning as a viable option unless one or more of the estimated deflection ratios exceeded 1/360.

comment #3: the estimated deflection ratios are based on brick/stucco veneer cracks/separations that are visible; it does not take into account repaired brick/stucco veneer cracks/separations.

5. Masonry Fireplace Chimney Rotation	none
gap between house and fireplace chimney	not applicable
height above foundation at which gap was measured	not applicable

6. Visible Evidence of Structural Damage to the Structural Frame	none

It should be noted that the distress and damage reported in this section is not intended to be a complete list of all the foundation movement related distress and damage in the house.

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It should also be understood that it is not unusual for a homeowner to make repairs to the house including repairs to damage that is caused by foundation movement. There is nothing wrong with a homeowner making repairs to the house, but I make no claim that I can detect such repairs. In addition, the owner's disclosure statement does not require the owner to disclose such repairs.

Please also note that some types of damage that many people commonly believe is due to foundation movement, is not accepted by the engineering community as being caused by foundation deflection or tilt. Click here for more information.

TILT/DEFLECTION ANALYSIS USING FINISH FLOOR ELEVATION PROFILES

I made some finish floor elevation measurements and used these to create longitudinal (side to side) and transverse (front to rear) finish floor elevation profiles as shown below. These profiles can be analyzed to make engineering estimates of the apparent deflection and tilt of the foundation across specific profiles of interest.

The use of foundation profiles to assess foundation performance in terms of deflection and tilt is sanctioned in this publication by the Texas Section ASCE.

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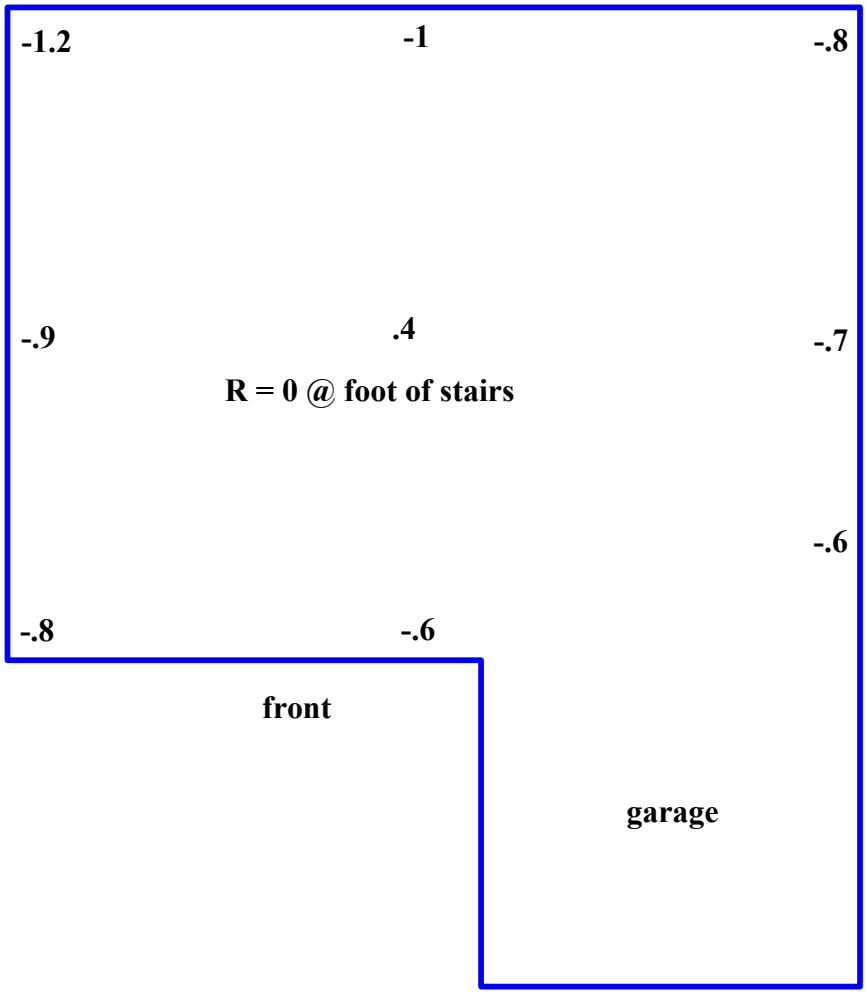
Elevation Measurements (in inches) Showing Overall Shape of Foundation



schematic; not to scale

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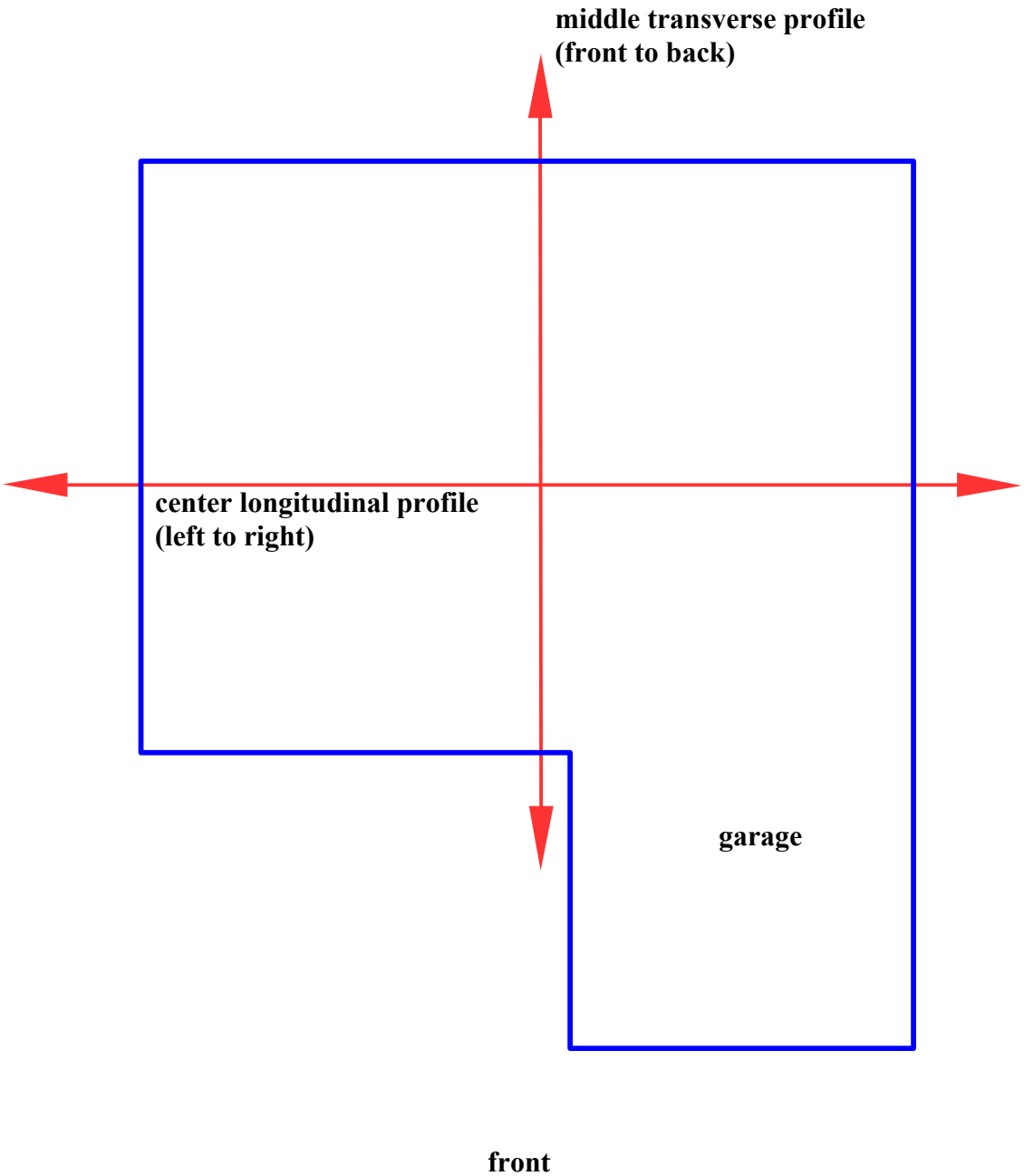
Approximate Profile Locations



schematic; not to scale

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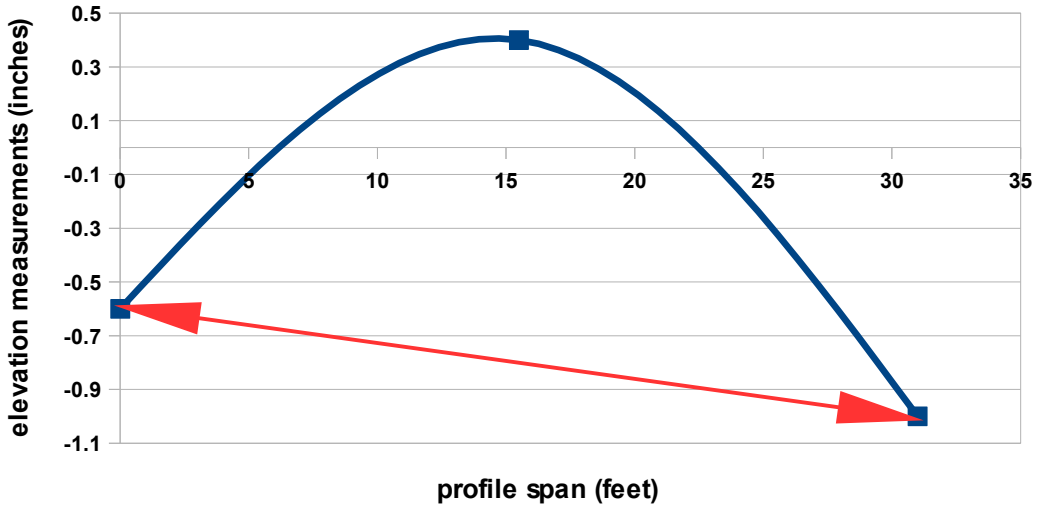
Middle Transverse (Front to Back) Deflection/Tilt Profile



profile span (feet)	deflection (inches)	deflection ratio (over 360)	tilt (%)
31	1.2	**1.16**	0.11

dominant distortion mode

high center lift with tilt

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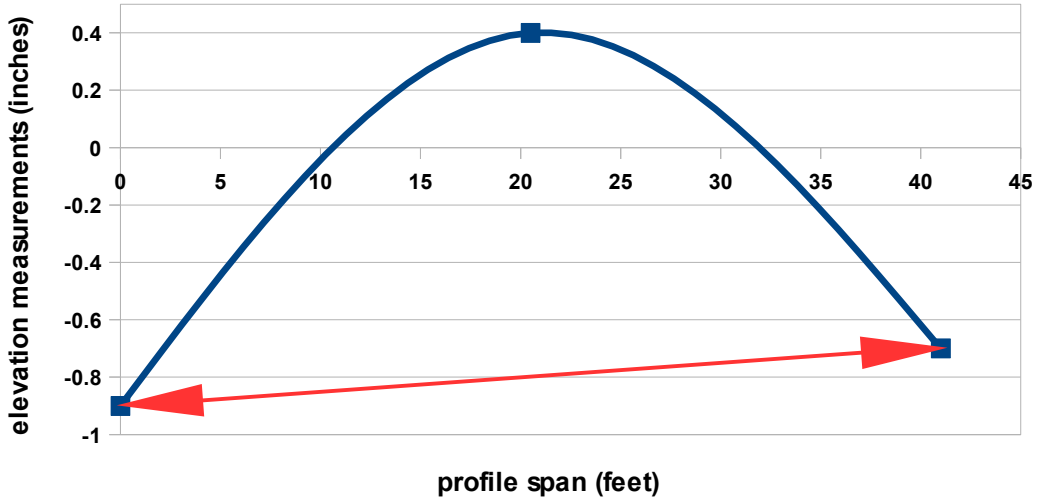
Center Longitudinal (Left to Right) Deflection/Tilt Profile



profile span (feet)	deflection (inches)	deflection ratio (over 360)	tilt (%)
41	1.2	**0.88**	0.04

dominant distortion mode

high center lift with tilt

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Other Observations

The following observations were noted at the house. Please note that any of these conditions could have an adverse effect on the future performance of the foundation.

- **Area:** This building is located in an area which is known to contain active or expansive soils. This means that the building is at a higher risk for foundation induced distress, especially if the foundation is not properly maintained. Please visit houstonslabfoundations.com for more information about how to properly maintain your foundation.

- **Trees and Other Vegetation:** There are trees and large shrubs close enough to the foundation that they could cause additional foundation movement, especially in dry periods. One option is to leave them in place. Another option is to remove them. If the trees are adult trees, removing them could create more problems especially if the trees and the foundation seem to be getting along with little or no damage to the house. A third option is to install a root barrier between the foundation and the tree. Visit houstonslabfoundations.com for more information on using root barriers to maintain your foundation.

- **Drought:** The Greater Houston Area periodically experiences a severe drought. In expansive soil areas, this type of weather can result in soil movement that can cause foundation movement that is significantly in excess of what foundations are normally expected to experience. In drought situations, foundations are at risk of experiencing rapid and severe movement that, in turn, can result in damage to the house in the forms of cracks in wall covering materials (especially brick veneer, stone veneer, stucco and drywall) and floor tile.

  Click here to learn more about watering your foundation. Also, check out this article for more information about how droughts affect Houston area foundations.

- **Foundation Maintenance:** The performance of this foundation could probably be improved if the recommendations in my foundation maintenance website houstonslabfoundations.com were followed.

- **Low Slab Clearance:** There was inadequate slab clearance in some locations. This condition is conducive to moisture penetration. 4- to 6-inches of slab clearance is recommended.

- **Wedge Crack:** The wedge crack at the front right corner of the foundation was caused by differential thermodynamic expansion and contraction of the brick veneer and the concrete foundation. Wedge cracks are not indicative of poor foundation performance. If the wedge comes loose, non-shrink mortar should be used to patch the area so that the brick above remains fully supported.

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PHOTOS

Wedge crack at front right corner

Inadequate slab clearance; note the ground in contact with the brick

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PROFESSIONAL ENGINEERING CONSULTING AGREEMENT

(please read carefully – this is a binding legal agreement)

DEFINITIONS: When used in this agreement, the words "we", "us", "my", "I", "me", "our", "engineer" or "the engineer" refer to Matt Gray, PE. The terms "client", "you" and "your" refer to the client named below.

OWNERSHIP OF ANY REPORT: This agreement is for the provision of a professional engineering consulting service. Any written report summarizing our findings and opinions will be provided to the client and will be copyrighted by me; the report is and will remain my property. Client may disclose the report to whomever they wish. The report is written to meet the specific needs of the client. Third parties may have different needs and priorities and are not authorized to rely on this report.

POST CONSULTING SERVICE PROCEEDINGS:

Questions and Problems: We are available without charge for telephone consultations.

Assignment: This agreement is a personal agreement between you and Matt Gray. No person other than you has a right to rely on the contents of this agreement or on any report produced by me for you for any reason whatsoever.

Limitation of Consulting Service and Liability: The consulting service is offered for a limited, fixed fee and is performed within a limited amount of time. Our liability is limited by the following terms and conditions.

Maximum Liability: Since the consulting service provided is based in part on a preliminary visual inspection, it is not possible to eliminate all risks involved in the purchase and/or ownership of the subject property. Client agrees, to the fullest extent provided by law, that our liability for all claims, losses, costs, damages of any nature whatsoever or claims expenses from any cause or causes, including attorneys' fees and costs and expert witness fees and costs, so that the total aggregate liability of the engineer to the client shall not exceed the amount of the fee paid for the consulting service. This limitation shall apply regardless of the cause of action or the legal theory pled or asserted specifically including, but not limited to, negligence. This clause is a material inducement for you and me to enter into this agreement.

ACKNOWLEDGMENT. THE UNDERSIGNED HAS REVIEWED THIS DOCUMENT, UNDERSTANDS ITS CONTENT AND AGREES TO THE TERMS AND CONDITIONS CONTAINED HEREIN SPECIFICALLY INCLUDING THE CLAUSE TITLED MAXIMUM LIABILITY. **THE CLIENT FURTHER REPRESENTS AND WARRANTS THAT HE OR SHE HAS FULL AND COMPLETE AUTHORITY TO EXECUTE THIS CONTRACT ON BEHALF OF ANY SPOUSE OR PARTNER, AND TO FULLY BIND ANY SPOUSE OR PARTNER TO ALL THE TERMS, CONDITIONS, EXCLUSIONS AND LIMITATIONS OF THIS AGREEMENT.**

Client Signature	SHANE JAIME Printed Name of Client
Client Email Address:	
Address of Property Inspected: 18106 Quiet Grove Court, Humble, Texas	
Fee: $ 525 (please make check payable to Matt Gray, PE; payment required before report can be issued)	Date: 8/14/17