June 17, 2019 Project No. 19-1514

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STONEWALL
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Ken Houston
Tarheel Basement Systems
540 Pylon Dr.
Raleigh, NC 27606

Re: Structural Observation — *45 Orchard Falls Drive, Spring Lake, NC 28390*

Mr. Houston,

At your request, on June 10th, 2019 we performed a visual structural observation of signs of structural movement in the perimeter foundation at the Spring Lake residence noted above. The structure is a conventionally framed, detached, single family residence with raised first floor framing over a pier/girder foundation system with perimeter masonry foundation walls *(see picture 1)*.

Our observations are listed below. Indicators such as "left," "right," "front," and "back" are referenced as viewing the front of the home.

PERIMETER FOUNDATION

- Gaps were noted in the siding along the right wall of the garage and beneath the right garage wall sill plate. Cracks were noted in the foundation wall along the right side of the house and along the back wall of the garage *(see pictures 2-4 for examples)*.
    - Investigation in the crawlspace revealed a large void near the back-right corner of the garage *(see pictures 5-6 for examples)*.
        - Measurement by laser level indicated that the right end of the back wall of the garage was down as much as approximately 7/8" relative to the crack adjacent to the rightmost pilaster *(see picture 7 for example)*.
        - Measurement by laser level also indicated that the front end of the right foundation wall in the crawlspace was down as much as approximately ½" relative to the crack located approximately 6' from the front end of the wall *(see picture 8 for example)*.
    - Personal property and cabinetry along the right wall of the garage prevented measurement of the foundation wall in this area at the time of our observation *(see picture 9 for example)*.
    - Various signs of water intrusion were noted along most of the walls of the crawlspace *(see pictures 10-11 for examples)*.
        - Roof gutter downspouts were installed for discharge at the foundation onto soils that were inadequately sloped away from the home *(see pictures 12-13 for examples)*.

ADDITIONAL OBSERVATIONS

- Various holes as deep as approximately 2' were noted in the crawlspace soils and in the backyard, which is consistent with a previously wooded lot *(see pictures 14-15 for examples)*.

- Various cracks were noted in the garage slab *(see picture 16 for example).*
  - Measurement by laser level indicated that the front-right corner of the garage slab was down as much as approximately 2¾" relative to the back-middle portion of the slab.
- The bottom of various floor joists were noted to be discolored, and had signs of organic growth *(see pictures 17 for example).*
  - Various foundation vents were noted to be closed at the time of our observation *(see picture 18 for example).*

Upon completion of our analysis we have concluded the following:

- The above-noted gaps in the siding and cracks in the perimeter foundation and garage slab have been the result of differential settlement of the perimeter foundation and the slab which can be accelerated by inadequate management of rainwater runoff around the perimeter of a home.
  - Soils in this area tend to expand when wetted and contract when dried. These cyclical movements can cause short term cosmetic damage and long term structural damage at areas around the structure with poor exterior drainage which can cause differential settlement to occur as parts of the structure settle at faster rates than at other locations.
  - The void beneath the foundation wall may be the result of decomposing organic material, exacerbated by drainage issues.

We recommend the following work be performed by a qualified general contractor *(see picture 19 for repair schematic)*:

- Install a series of (8) galvanized steel push piers under the back wall of the garage and along the right foundation wall to stabilize the structure against additional differential settlement.
  - Piers should be driven until engagement of the structure with lift indicating adequate depth and frictional resistance along the shafts of the piers.
  - The contractor should locate and avoid utilities prior to work.
  - Avoid installing piers under windows, doors, or crawlspace vents.
  - Install piers at approximately 6' on center (maximum), at the following locations:
    - (6) along the right wall of the garage and right foundation wall, with (1) at the crack located approximately 6' behind the back wall of the garage, and (1) at the intersection of the back and right garage walls,
    - And (2) along the back wall of the garage, with (1) at the crack next to the rightmost pilaster.
      - After push piers have been installed, fill the void beneath the foundation wall footings using adequately tamped clean gravel.
- Settled portions of the garage slab may be raised to the desired level by pressure grouting or structural polyurethane foam injection. Any remaining slab edges should be ground smooth and closed with flexible epoxy as needed.
  - Alternatively, the slab may be removed and replaced with a 4" thick reinforced concrete slab over properly compacted base material and 4" clean gravel.

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- Due to the infeasibility of achieving adequate cross-ventilation of the crawlspace, we recommend installation of a Code-approved closed crawlspace system with adequate vapor barrier and mechanical drying measures to help avoid future occasions of advanced framing deterioration due to wood rot.
- Provide drainage improvements around the perimeter of the structure such that rainwater runoff is adequately diverted from the perimeter of the home. Drainage improvements are intended to help avoid the need for extensive foundation repair/stabilization work in the future.
    - Current building standards require 6" of fall within the first 10' from a structure or use of drains and swales. A system of exterior perimeter "French" drains and/or catch basins installed at low points in the grade may be necessary to achieve adequate drainage. Any low spots in the grade adjacent to the home should be filled for positive drainage away from the structure.
    - Extend roof gutter downspouts and any HVAC condensation drains for discharge at least 5' from the perimeter of the structure onto soils adequately graded away from the home.
    - We recommend installing a perforated interior perimeter crawlspace drain system with discharge through the low point of the perimeter foundation system at least 5' from the perimeter of the home onto soils adequately graded away from the structure. Transition to non-perforated pipe outside the footprint of the structure.
        - A sump pump may be necessary to remove collected water from the crawlspace.

The above-listed recommendations are not intended to be implemented in lieu of a regular home maintenance schedule. Most serious and costly structural damage in this area occurs due to improperly maintained drainage. Roof gutter systems and any in-ground drains should always remain clear of debris and should be periodically checked to verify positive flow. This can be done by visual examination during or immediately following rainstorms. If standing water, backed-up drainage, or surface water which flows within 5' of the home's foundation is ever found, this should be addressed right away by consulting with a drainage specialist.

The above-listed determinations were made in accordance with common engineering principles and the intent of the 2018 edition of the *North Carolina Residential Building Code*. Sequencing, and means and methods of construction are considered to be beyond the scope of this report. Contractor is to provide adequate temporary shoring prior to cutting or removing any structural load-bearing elements. All work is to conform to applicable provisions of current building standards. Please feel free to contact us, should you have any questions or concerns regarding this matter.

Sincerely,
Chuck LaVerdiere, PE
Stonewall Structural Engineering, PLLC
Lic. #P-0951

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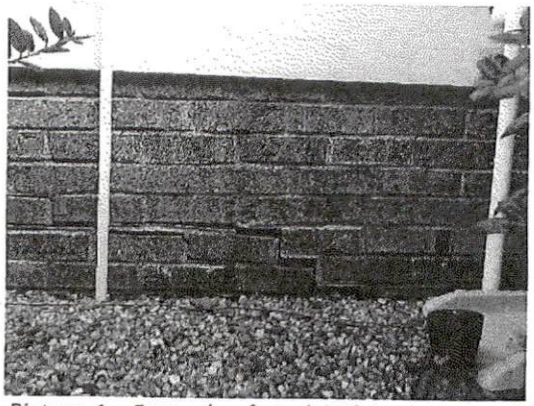
PICTURE ADDENDUM

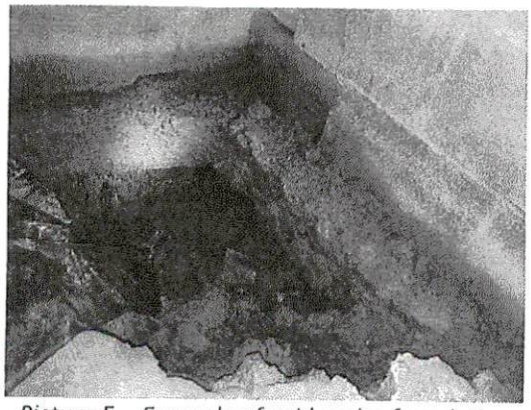
Picture 1 – 45 Orchard Falls Drive, Spring Lake, NC

Picture 2 – Example of gaps in siding along garage

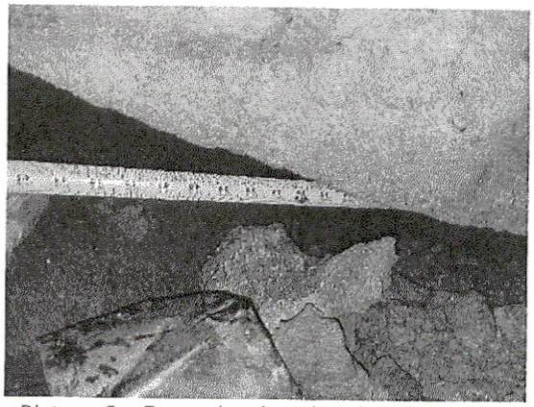
Picture 3 – Example of gap between sill plate and foundation wall



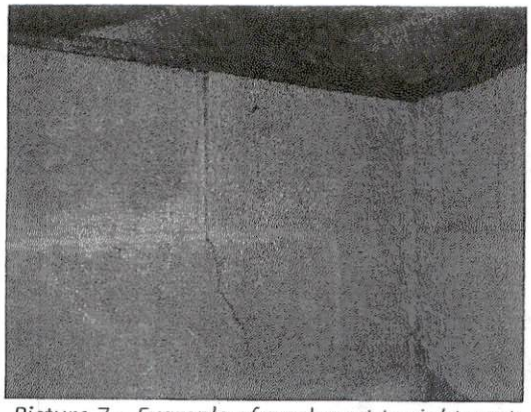
Picture 4 – Example of crack in foundation wall



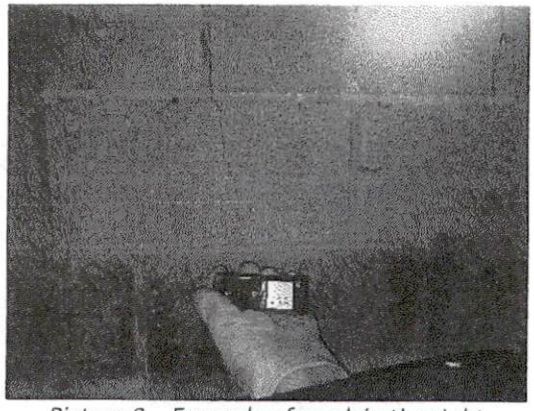
Picture 5 – Example of void under foundation wall footings



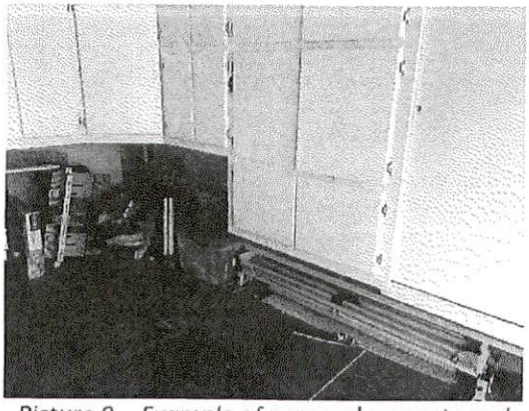
Picture 6 – Example of void under foundation wall footings



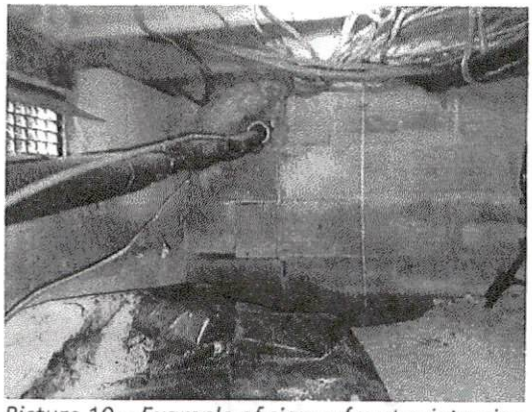
Picture 7 – Example of crack next to rightmost pilaster along back of garage



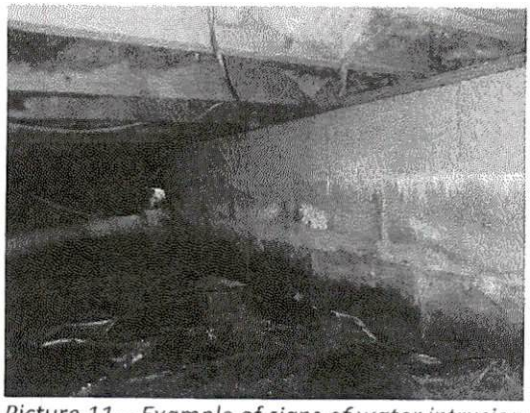
Picture 8 – Example of crack in the right foundation wall behind area with void



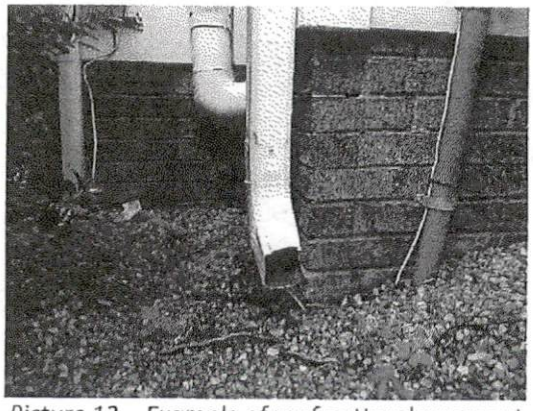
Picture 9 – Example of personal property and cabinetry in garage



Picture 10 – Example of signs of water intrusion

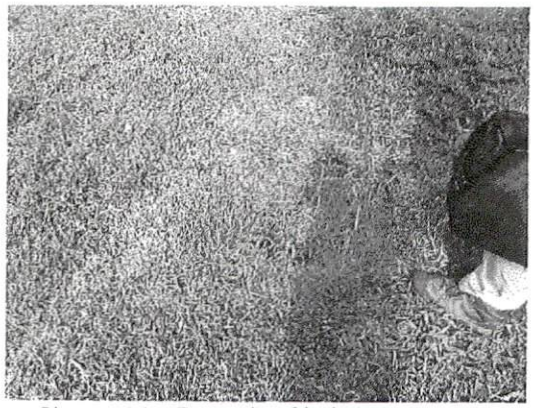


Picture 11 – Example of signs of water intrusion



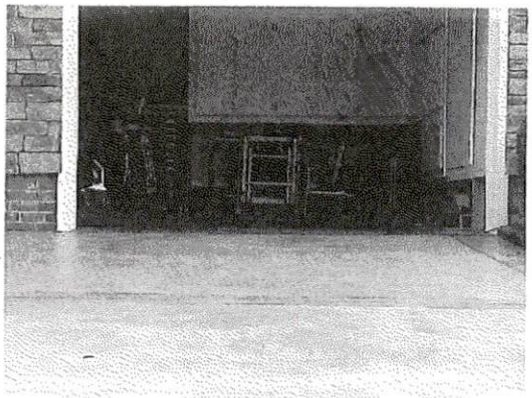
Picture 12 – Example of roof gutter downspout installed for discharge at the foundation

Picture 13 – Example of roof gutter downspout installed for discharge at the foundation

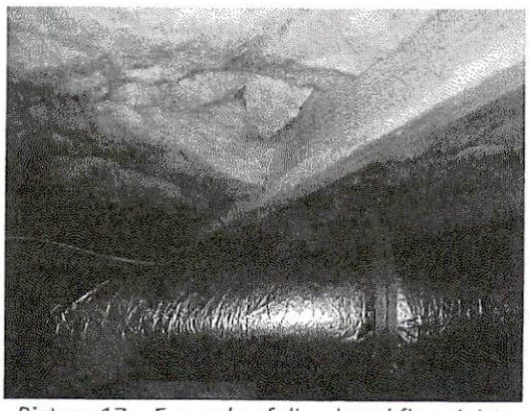


Picture 14 – Example of hole in back yard, possibly from organic void

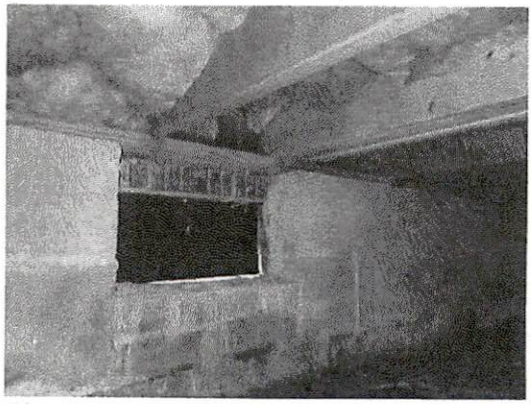
Picture 15 – Example of hole in crawlspace soils, possibly from organic void



Picture 16 – Example of cracked and settled garage slab



Picture 17 – Example of discolored floor joists



Picture 18 – Example of closed foundation vent

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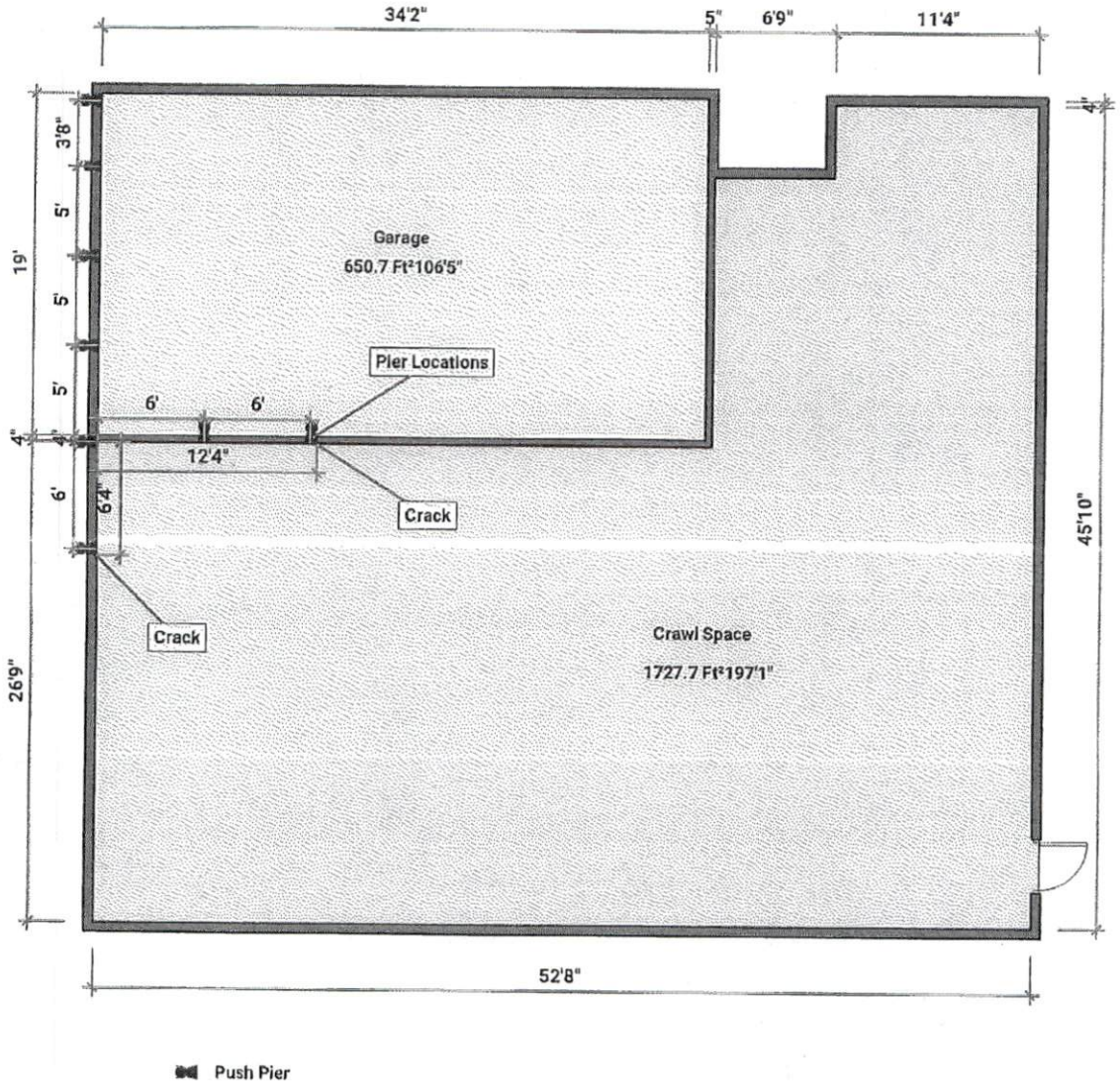

Picture 19 – Repair schematic
(contractor to verify dimensions prior to work)