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RESIDENTIAL STRUCTURE INVESTIGATION

Prepared For:

MR. & MRS. HOLLAMON

Site Location:

111 Southwick Court
Cary, North Carolina 27513

Prepared By:

**CARTER ENGINEERING & CONSULTING, PLLC
STRUCTURAL + CIVIL**



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I. SCOPE

- 1) **Assessment Date:** 13 May 2020
- 2) **Subject:** Investigation of the structural condition of the residential home.
- 3) **Location:** 111 Southwick Court, Cary, North Carolina 27513
- 4) **Response:** Provide opinion from visual observations of the structural condition of the residence, particularly to foundation cracks and garage floor cracks.

II. LIMITATIONS, TERMS & CONDITIONS RESTRICTIONS QUALIFICATIONS

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Recommendations rendered from work performed in no way eliminate hazards or the owner's obligation to federal, state, or local laws. The property owner is solely responsible for notifying the proper authorities of any conditions, which violate current applicable laws and regulations.

This is not a warranty as to the total absence of structural or other deficiencies, wood-destroying insects, organic growth, or damage or health related concerns from such existence. No other warranty, expressed or implied, is made.

Data and information regarding current site conditions and operations may be obtained by CEC in part from the Client and other sources. As is customary, CEC has assumed such data and information to be complete and factually correct. The conclusions rendered from such data and information is subject to professional opinion, and thus, could result in differing interpretations. Additionally, the conclusions rendered from this work are based on qualitative information gathered on or near the date of this report.

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III. CONSIDERATIONS

A. Environment

The environment of this home includes seasonal cyclical temperature and moisture fluctuations. The effects of abnormal and extreme (too dry or too wet) precipitation levels on local soil optimum moisture content are soils that compress where moisture loss has left voids, or soils that shift [pump] when over saturated. These dynamics promote soil migration and foundation movement (settlement) that subject the exterior and interior materials to cracking. This area of North Carolina is known for expansive clay soils that tend to influence foundation movement and crack developments compared to other regions.

B. Drainage

Surface drainage from precipitation events can cause erosion, foundation deterioration and instability, and structural failure. Yard and roof drainage should convey water away from a structures foundation. Incorrect site grading, a lack of gutters, or downspouts without leaders can result in excessive water / moisture in the soil within the foundation zone that can adversely affect the properties of the construction materials, the soil and masonry. Maintaining good drainage around the house will help prevent or minimize moisture and pest infiltrations, foundation settlement, and interior distresses.

IV. FINDINGS & RECOMMENDATIONS:

Primary:

1. Within the garage, cracks have developed through the concrete slab-on-grade floor, quartering the slab. The front-to-back oriented crack measured 14.6-mm wide with 9.3-mm surface shear. The slab appears constructed without control joints, which would have otherwise helped to dictate the location of expected shrinkage cracking that occurs during the construction curing process [as the concrete hardens]. Generally, the exterior perimeter soil presented firm and stable appearance. Foundation settlement that occurs shortly after completion of construction as the foundation supporting soils compress under the weight of the house influences crack development (widening, shearing) as does deficient yard and roof surface drainage controls over the life of the house. At the time of this visit, visual assessment found no current structural concern with this matter. Consider grinding the surface of the concrete to relieve vertical differences across the cracks, and fill the cracks with a flexible polyurethane product. Alternatively, consider leveling the surface with a concrete overlay using Quikrete Floor Resurfacer or similar latex modified concrete product. Application of products shall be in conformance with the manufacturer's specifications.
2. Along the exterior and within the crawlspace, cracks have developed through the masonry [brick veneer and concrete masonry unit] perimeter foundation:
 - a. Exterior left wall, 13.5-ft from the rear corner at the foundation vent by the HVAC unit, vertical measured 3.2-mm wide;
 - b. Exterior rear wall, 16.4-ft from the right corner, stair-step/vertical measured 1.5-mm wide;
 - c. Exterior rear wall, 8.5-ft from the right corner, vertical measured 10.0-mm wide;
 - d. Garage, rear wall, 7.7-ft from the right wall, vertical measured 5.0-mm wide;
 - e. Crawlspace rear wall, 23-ft from the left wall, vertical measured 0.7-mm wide;
 - f. Crawlspace left wall, 12.5-ft from the rear wall, stair-step measured 4.6-mm wide.

Others may exist but were considered insignificant or concealed at the time of the assessment. In the crawlspace, notable cracks were marked for future reference. Generally, these are indicative of

perimeter foundation movement (settlement) attributable to soil conditions influenced by moisture saturation that reduces the surface bearing capacity of the immediate foundation soil, which corresponds to roof and yard drainage control deficiencies. The width of the crack "c" is prominent, but consistent with the evident volume of moisture exposure over the life of the house.

The grade adjacent to the foundation presented a generally firm condition. Soil testing or coring was not part of this scope of work. The dynamic expansion and contraction of the earthen material may react to large fluctuations between the rise and fall of the water level, which may lead to relief cracks along the perimeter foundation. Relative to the crack developments, visual assessment of the inside face of the exterior walls and adjacent floors found insignificant distress suggestive of excessive movement or settlement related to this matter.

At the time of this assessment, though having no information to gauge growth rate, visual examination found no current structural concern with these cracks. Address deficient yard and roof drainage control measures and regularly maintain to promote foundation soil stability that influences foundation movement. Note that drying back the foundation soil may result in the foundation acclimating to the new soil condition and develop crack widening or interior surface distresses. Treat separations and cracks by removing any loose debris and debonding agents from openings, cleaning and drying the openings, and sealing with a suitable joint sealant. Sealants should not be brittle or cement grouts that prohibit expansion and contraction. Treat with a polyurethane sealant, such as Sika Crack Weld, Loctite PL S20, or an appropriate grout material, such as Quickrete Mortar Repair, Quickrete Mortar Mix, and GE Concrete and Mortar caulk. Application of products shall be in conformance with the manufacturer's specifications.

3. The front porch concrete deck has settled relative to its brick edging, as much as 26-mm all around. This is attributable to consolidation of the deck supporting base material over time and influenced by surface drainage. This presented no current structural concern for stability or failure of the deck. Consider a concrete surface overlay to raise the elevation to match the brick edging, and with a minimum 1% slope down and away from the wall of the house. Alternatively, the slab may be lifted with a polyurethane expanding dense foam injection.

Secondary:

4. Roof drainage systems (gutters, downspouts, and leader pipes) should collect and convey water away from the foundation. Gutters, downspouts, and leader pipes should be clean and clear to properly flow and discharge. All downspouts should have a leader extension. Downspouts that discharge at the foundation base often causes soil scour and saturation, promoting foundation movement. Downspouts should be securely attached to leaders to discharge drainage at least 4-feet from the foundation. The front right corner downspout discharges onto the concrete walkway where intersecting construction joints allow water to pass down to the foundation. Note that a yard drain exists across from the downspout in front of the walkway, but may be undersized and overwhelmed during heavy precipitation events to receive large water volume. At minimum, seal the construction joints with an exterior grade polyurethane product, and replace the downspout elbow that discharges to the front with one that discharges to the right side yard. Relocation of the downspout from the right side to the left side of the [right side wall] garage man door would improve drainage routing by diverting discharge directly to the rear yard with a leader pipe.

Leader pipes should not have perforations. Leaders should be attached to the vertical down pipe, not the elbow spout. If considering underground piping, recommended piping is solid rigid PVC

with epoxy fused connections. Underground piping may be terminated with "pop-top" dissipation devices. If attaching several downspouts to one collector pipe, the collector pipe must be sized to accommodate the volume [at least a 6-inch diameter pipe]. Ensure leader pipe discharge is not redirected back to the foundation by buildup, roots, or landscaping, but continues to flow away from the foundation. Perform regular maintenance to ensure proper drainage.

5. Generally, the lot slopes from the right side yard, down across the foundation footprint, down to the left side yard. Yard and roof drainage has the potential to pond and accumulate at various areas about the foundation, particularly to the right of the front entry porch. Excessive water movement and pooling near structural foundations causes erosion and unstable oversaturated soil conditions that creates foundation issues (settlement, shifting, cracking, rotation, etc.). Ensure stormwater flows around and away from the foundation. To the right of the porch, raise the grade along the foundation. Generally, raise the grade at the base of the foundation to flow surface drainage away from the foundation, particularly along the front. Ensure soil, not mulch or stone or gravel, at the base of the foundation slopes down and away from the foundation. Fill depressions and build up flat areas against the foundation with compactable dense earth material that is free from organics [roots, leaves, etc]. Perform regular maintenance to ensure proper drainage and promote foundation soils and constructed foundation stability. Underground drainage collection systems [French drains] are not recommended.
6. Within the crawlspace the base of foundation walls exhibit indications (discolorations, efflorescence, etc.) of moisture along the foundation, particularly along the front adjacent to the front porch. These are results of exterior surface drainage moisture accumulation along and penetration through the foundation, into the crawlspace, which can slowly degrade materials and overtime develop into structural movement and concerns. This moisture can navigate toward interior piers and influence pier settlement that can lead to interior floor surface slope and wall cracks. The foundation supporting soils presented a generally firm condition. Excessive moisture in the crawlspace promotes pest/insect presence and organic growth, which deteriorate the structural wood framing that can lead to costly damage repairs. Improve and maintain exterior yard and roof surface drainage controls to promote foundation soil stability and to minimize moisture entry into the crawlspace.
7. Within the crawlspace, wood floor framing exhibited normal condition mild organic growth [primarily along the front entry] related to elevated ambient air moisture content. Normal wood moisture content values for commodity lumber in fair condition and that has been in place for over a year should average 12%. Wood with high moisture content deteriorates and promotes organic growth. Wood moisture content is influenced by the relative humidity levels in the crawlspace. A relative humidity level in the crawlspace above 50% creates an environment for organic growth and pest/insect presence. Monitor the organic growth and consider installing a programmable dehumidifier in the crawlspace to help maintain humidity levels to around 40%, while keeping the foundation vents closed to limit outside humidity entry. Humidity control in the crawlspace will help improve the efficiency and performance of the HVAC system.