



## RESIDENTIAL STRUCTURE INVESTIGATION

### Prepared For:

**MR. & MRS. MACILVENNIE**

*c/o: Mrs. S. Danzey ~ Space Exchange Realty*

### Site Location:

1403 Maple Avenue  
Apex, North Carolina 27502

### Prepared By:

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



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## I. SCOPE

- 1) **Assessment Date:** 20 October 2021
- 2) **Subject:** Investigation of the structural condition of the residential home.
- 3) **Location:** 1403 Maple Avenue, Apex, North Carolina 27502
- 4) **Response:** Provide opinion of visually observable structural conditions of the residence, particularly to foundation stability.

## 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.

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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.

#### C. Telescopic Screw Jacks

The North Carolina Residential Building code requires permanent structural steel columns to be at minimum 3 inches in diameter, be corrosion resistant, the top and bottom plate secured to the supported joist and foundation block, have less than 3 inches of the screw thread exposed, and the screw and telescoping junctions welded. Failing these conditions, the jacks can buckle and collapse and cause serious injury and damage.

#### D. Construction

The intent of this visit is to identify readily visibly observable concerns for user wellbeing [personal safety] and structural stability, rather than [current] code compliance or code departure.

### IV. FINDINGS & RECOMMENDATIONS:

#### **Primary:**

1. Within the crawlspace at the rear left corner an 8-inch section of the masonry block foundation wall has been removed apparently for access to plumbing. This has compromised the structural performance of the foundation system. Repair the first three courses of the foundation by:
  - a. Setting a row of three 16-inch #4 dowels horizontally and embedded 4-inch into the remnant blocks on each side of the knockout at one dowel per course;
  - b. Filling the first cell of each remnant block on each side of the knockout with non-shrink structural mortar or concrete (3500-psi);
  - c. Fill the knockout with solid poured concrete (3500-psi) using temporary forms to contain the concrete.



2. Within the crawlspace at the left side and 12-ft from the front, a metal telescopic screw jack is positioned to provide primary support to the main floor beam [girder]. This jack is rusting, the screw head is over-extended, the base and top are not secured, and the base is undersized and inappropriate for permanent use. This jack does not meet the NCBC standards for permanent structural use and has no documentation to validate use as a permanent structural member. To minimize potential for personal injury and costly structural damage, replace this jack with a compliant structural member, such as a mortared 8x16 masonry pier on a solid poured 12x20x8 concrete (3500-psi) footing. At the time of replacement, adjust the supported girder to satisfactorily level the first floor surface.



3. Within the crawlspace at the right side 11-ft from the front wall exists a perimeter masonry pier original to construction. The central side-to-side girder is not bearing on the pier. This is likely a construction layout flaw that was never corrected. The girder exhibits splaying between the two lumber plies, typical of deflection that result from improper end bearing. To minimize potential for personal injury and costly structural damage, construct a mortared 8x16 masonry pier on a solid poured 8-inch thick concrete (3500-psi) footing with a minimum 2-inch project from the pier. At the time of replacement, adjust the supported girder to satisfactorily level the first floor surface.



4. Within the crawlspace, the interior ends of the floor joists are supported by ledger strips that are attached to the center side-to-side oriented girder. The ledger strips exhibit slip and deflection, attributable to age and loading. This slip promotes floor surface irregularities and other interior distresses. Press the ledger strip upward and snug to the girder and floor joist, removing and floor surface sag, and secure in place with three 10d framing nails generally below each supported joist. Alternatively, install metal mechanical joist hangers that correspond to the joist dimension and with hanger manufacturer specified fasteners.



5. Within the crawlspace at the right wall and 9.8-ft from the rear wall exists a frame consisting of a 4x4 beam set on metal telescopic screw jacks. The frame is perpendicular to and within the interior span of the floor joists. This is a typical response to improve floor framing sag or deflection resulting from a heavy load or fatigue. In this location the frame is considered to be providing supplemental deflection resistance to the floor joists. These screw jacks do not meet the NCBC specifications for use as structural supports and is not installed in accordance with “off-the-shelf” product specifications.

Visual examination found no immediate structural concern with the intent of this frame. However, to comply with the building code and minimize the occurrence of structural damage related to deterioration of these jacks, at minimum replace these telescopic jacks with foundation grade 6x6 lumber posts, set on minimum 10”x10”X6” solid placed 3000-psi concrete bases. Adjust the post height to correct floor sags.



6. Within the crawlspace, wood floor framing exhibited elevated moisture content with initial stages of wood deterioration. 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, as is evident. 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. Install a dehumidistat controlled crawlspace fan [toward the left middle of the crawlspace area] to improve air circulation. Consider installation of a programmable dehumidifier set to achieve 40% relative humidity to help condition the crawlspace air. Ensure all foundation vents and other foundation wall penetrations are closed when operating a dehumidifier.



7. No access was discovered to permit assessment of the main roof attic space. Request the owner install required access for structural and mechanical evaluations.

**Secondary:**

8. Cracks have developed through the perimeter brick veneer bonded to the masonry foundation wall:
- Ext. rear wall 11.2-ft from the right corner, stair-step sealed with mortar;
  - Ext. rear wall 27.3-ft from the left corner, stair-step sealed with caulk, with openings at the window sill;
  - Ext. left wall at upper front corner of side door, vertical/stair-step sealed with caulk;
  - Ext. left wall behind fireplace base, brick infill;
  - Ext. left wall at front of fireplace base, vertical construction joint with house filled with mortar;
  - Crawlspace right wall at front corner, stair-step measured 0.5-mm wide;
  - Crawlspace right wall 10.3-ft from the front wall, vertical/stair-step measured 5.0-mm wide.

Generally, these cracks 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. The walls exhibited no abnormal distortions (bulging, shearing, sagging, etc.), but increased moisture exposure indicated from the buildup of efflorescence and staining. The moisture is related to deficiencies in yard and roof drainage controls.

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 soils in this area may react to large fluctuations of moisture presence, which leads to relief cracks along the perimeter foundation. Relative to the crack developments, visual assessment within the living area of the inside face of the exterior walls and adjacent floors found insignificant distress suggestive of excessive movement or settlement related to this matter.

Noted cracks through the foundation wall presented no current structural concern. Cracks above the foundation and along window sills allow moisture into the wall assembly where moisture can cause organic growth, wood rot, and insect/pest presence concealed within the walls. Treat cracks and separations by removing any loose debris and debonding agents from openings, cleaning and drying the openings, and sealing with a suitable mortar. Grout patching compounds include Quickrete Mortar Mix or any non-shrink grout. Application of products shall be in conformance with the manufacturer's recommendations. Address yard and roof drainage control improvement measures and regularly maintain to promote foundation soil stability that influences foundation movement and prevent concentrated overflow that can penetrate behind the brick veneer.



9. Generally, the grade slopes down from the rear yard, across the foundation footprint, and down to the front yard. Exterior yard and roof drainage has the potential to pond and accumulate along the foundation, particularly along the rear by the HVAC unit. When yard and roof drainage is allowed to pond and accumulate along the foundation, the moisture exposure often leads to erosion and unstable oversaturated soil conditions that creates foundation issues (settlement, shifting, cracking, rotation, etc.), as noted. Periodically ensure stormwater flows around and away from the foundation. Raise the grade [particularly along the rear] where depressions develop along the base of the foundation to flow surface drainage away from the foundation. Fill depressions and build up flat areas against the foundation with compactable dense soils that is free from organic material. Ensure soil, not mulch or stone or gravel, at the base of the foundation slopes down and away from the foundation. Perform regular maintenance to ensure proper drainage and promote foundation soils and constructed foundation stability. Underground drainage catchment systems [French drains] are not recommended.



10. 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. Downspouts that discharge at the foundation base often causes soil scour and saturation, promoting foundation movement. All downspouts should have a leader extension. Downspouts should be securely attached to leaders to discharge drainage at least 4-feet from the foundation. 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. If connecting several downspouts to one collector pipe, the collector pipe must be sized to accept the potential increase water volume (at least 6-in diameter). Underground piping may be terminated with “pop-top” dissipation devices. 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.
11. Within the crawlspace the base of the perimeter foundation walls exhibit indications (discolorations, efflorescence, soil depressions, damp soil, etc.) of moisture [past or present] along the foundation. These are results of exterior surface drainage moisture accumulation along and penetration through the foundation, into the crawlspace, which can overtime develop into structural movement and concerns. This moisture can navigate toward interior piers, evident by paths of soft soils. The foundation supporting soils overall presented a firm condition. Excessive moisture in the crawlspace promotes pest/insect presence and organic growth, which deteriorate the structural wood framing that leads 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.

