



ENGINEERS ■ ARCHITECTS ■ ENVIRONMENTAL CONSULTANTS

August 10, 2009

The Reverend Nicholas Beasley  
The Church of the Resurrection  
700 Main Street  
Greenwood, South Carolina 29648

**Re: Parish Hall Moisture Intrusion  
ABS Project No. 650.0915**

Dear Father Beasley:

As you recall, I visited your parish in late June. The purpose of my visit was twofold. I measured building pressures to determine if the HVAC system created conditions that exacerbated moisture intrusion. I also surveyed the interior and exterior in order to correlate conditions that may contribute to moisture intrusion.

### **Description**

The subject facility is a two-story, masonry structure which was reportedly constructed in the mid-1950's. The majority of the roof is steeply pitched and covered with slate shingles. The exterior walls are parged with portland cement plaster (stucco). The structure has experienced water intrusion for many years. Several repairs, including the application of subgrade waterproofing have been attempted. For orientation purposes, the north (Marion Street) elevation is considered the front.

### **Observations**

I visited the site on June 26, 2009. I made observations of selected areas of the interior and exterior. Below is a summary of my most significant observations.

1. I measured the interior/exterior pressure difference using an Energy Conservatory, DG-700 micromanometer. Measurements were taken on both floors and on each elevation. At each measurement location, a series of readings were made with the HVAC off, only

the first level HVAC on, only the second level HVAC on and with all HVAC on. There was no significant change in the building pressure as a result of HVAC operation.

2. The building's footprint is generally depressed with respect to the surrounding grade. Grade slopes immediately adjacent to the structure are approximately level with moderate to steep slopes toward the building in the yard along the front, right and rear elevations. It was reported to me that some type of a perimeter drainage system had been installed. No details were available on the construction of this drain. I noted that downspouts from the roof gutters extended below grade and, as such, these may tie into the drain system.
3. It was further reported that subgrade waterproofing had been applied during the drain installation effort. The top edge of the waterproofing was visible in many areas along the base of the exterior walls. The waterproofing appeared either to be a membrane or a fiber reinforced, fluid applied system. The exposed portions of the waterproofing exhibited damage associated with lawn maintenance and failures in its adhesion to the foundation. It appeared likely that water, which might accumulate against the foundation, could circumvent the waterproofing.
4. Areas of the exterior stucco exhibited cracking. Cracks generally extend from window corners and follow the joints in the masonry walls. The cracks do not appear to suggest substantial structural settling as there are only a few corresponding interior cracks. Rather it appears that the building has undergone long-term, minor settling and natural deterioration of the stucco finish.
5. I surveyed the interior spaces and documented the areas of visible damage. On the second level, several rooms had been retrofit with furred-in walls; this condition limited my ability to assess the water penetration in these areas. The north elevation classroom (second door on left after entering at Cloister) had such a wall with evidence of deterioration near the floor below the west window. None of the other furred-in wall areas exhibit damages near the walls. A former roof leak stained areas of the ceiling in the Chapel and the adjacent classroom to the south. These leaks are reportedly not active. The southwest corner in the Chapel exhibited moisture damage that may be related to the previous roof leak. A steep slope and lower slope roof intersect above this location and drain into a short gutter. If the leak remains active, this intersection is the likely source. Isolated cracking was observed in the exterior walls. The age of the cracks is unknown but they do not appear to be active.
6. Observations on the first level revealed areas of moderate to high severity moisture damage. The damages consisted primarily of blistering and peeling paint with eruptions of efflorescence. Efflorescence is the deposition of calcium salts on the drying surface of

masonry. As moisture passes through the masonry, it dissolves salts from the cementitious media. Once on the surface, the moisture evaporates leaving the crystalline salts behind. This type of moisture transfer can develop significant vapor pressure and osmotic pressure differences that blister coatings applied to the drying surface. The damages observed can be characterized as follows:

- a. Moderate to high severity damage was observed in every exterior building corner except in the nursery near the kitchen. However, that corner extends to a small exterior storage area and covered stairway.
- b. Moderate to high severity efflorescence was observe below each window except in the northwest classroom and the south window on the west wall of the youth room.
- c. No damage was evident in walls along the mechanical room and below the Cloister. No damage was evident in the closet below the interior stairs on the front elevation. Also, no damage was evident on interior walls.

### **Conclusions and Recommendations**

Based on my site survey and experience with similar problems, it appears that liquid water penetration through the walls at or below grade is the most likely source of moisture that is damaging the Parish Hall. It is unlikely that the mechanical system is a significant source of moisture. Significant efforts are required to identify the failures in the subgrade waterproofing and implement a repair.

Liquid water penetration through the exterior walls is the likely cause of the visible interior damage. The second floor exhibits only minor and localized damages from issues that appear to have been repaired. The first floor, however, has widespread damage which is moderately to highly severe. There is no correlation between the second floor staining and the first floor damage. The blistering and efflorescence are characteristic of capillary flow of liquid moisture through masonry; the salts do not stay in solution when water converts from liquid to vapor state. The low elevation of the Parish Hall with respect to the surrounding terrain makes waterproofing critical and challenging for this structure.

The exterior corners are consistently a location of higher severity damage. Four of the six corners are provide with decorative buttresses that extend below grade. It's possible that water sheeting over the buttresses increases absorption in these areas. However, the southeast corner (at the nursery) exhibits similar damage with no buttress. Two other conditions could be further explored. The first is that the subgrade waterproofing was not properly detailed at the corners and gaps have developed that allow additional water intrusion. The second is that roof downspouts extend below grade at each of these locations. It is unknown how water is conveyed

away from the downspouts. The water should be managed in non-perforated piping that is routed to a sump or other proper receiver for storm water. The downspouts should not be tied into perforated piping that is intended to absorb water from the French drain's drainage media. The grade would need to be excavated away from the structure to assess these conditions.

The interfaces of the first level window sills and the subgrade waterproofing also appears to allow water intrusion. The first level windows are provided with sills that slope away from the window and extend slightly outboard of the wall plane. The subgrade waterproofing terminates at the bottom of the sill. Without dynamic water testing it is difficult to determine if the dominant source of leakage is below the sills or at the waterproofing termination between the sills; damage patterns on the interior suggest that either or both is possible. However, in neither location (sills or field between windows) is the waterproofing termination a robust installation. Age and lawn maintenance have deteriorated the seal between the waterproofing and the foundation. A reglet should have been cut into the wall to allow a metal counter flashing to lap over the waterproofing. The existing conditions appear vulnerable to groundwater accumulation along the foundation and wind driven rain sheeting down the walls.

The HVAC system does not appear to contribute to interior moisture levels in a significant manner. No measurable pressure changes developed based on HVAC operation. In some instances, negative pressurization can induce moisture flow toward the interior of a structure; there was no such evidence at the Parish Hall. Isolated condensation was visible on areas of the chilled water piping within the mechanical room. This moisture did not drain toward the occupied portion of the building. Additional pipe insulation and/or dehumidification of the mechanical room could resolve the minor condensation issues.

Significant repairs are need at the Parish Hall. Without more knowledge of the subgrade conditions a detailed scope is not possible. However, I recommend the following general scope:

1. Excavate along the foundation to expose the subgrade waterproofing and drainage system. Repair/rehabilitate the waterproofing. Extend the waterproofing as high as aesthetically possible. Cut a reglet into the foundation along the top edge of the waterproofing. Install copper counter flashing and seal the reglet.
2. Ensure that the roof leaders tie into non-perforated drain lines that route to a storm water receiver. Confirm that any existing drain lines are properly sized for the building code prescribed roofwater load. Check that all pipe joints are tightly sealed and that the pipes slope  $\frac{1}{4}$  inch per foot toward the storm water receiver.
3. Install perforated drain piping wrapped with a water permeable geotextile fabric in the bottom of the French drain. Ensure that the pipes slope  $\frac{1}{4}$  inch per foot toward the storm water receiver.

4. Remove any sealants from window perimeters or other penetrations. Chip away any loose or cracked stucco from the exterior. Prepare and/or prime the substrate materials as required by the stucco manufacturer to receive new stucco. Apply new scratch and brown coats in equal thicknesses to bring the repair area level with the surrounding stucco. Embed fiberglass reinforcing mesh in the base coats to span across any substrate cracking. Apply a new finish coat over the entire wall area at the Parish Hall. Install new sealants.

ABS can, upon request, provide more detailed specifications for this work. We would need to examine the subgrade conditions after the excavation has been completed in order to specify subgrade repairs.

As I mentioned to you on site, it is possible to repair the building. However, the exterior rehabilitation alone is likely to be expensive. Clearly the interior is also in need of restoration. I recommend that you consider your space needs and determine if the existing Parish Hall can be configured to serve those needs. Updating the building to be accessible for handicapped or elderly parishioners should be included in your thoughts. While it wouldn't be economically possible to replace the Parish Hall with a masonry structure, the cost of repairing the existing structure may approach the cost of a new framed structure.

I hope that this summary provides insight for your Vestry to make prayerfully considered decisions about the future of your campus. Please call with any questions that you may have. I would also be happy to participate in a telephone conference with your Vestry or Building Committee.

With kindest regards,

**APPLIED BUILDING SCIENCES, INC.**

J. Lawrence Elkin, PE

