ZAHL-FORD, inc.
Structural Investigators & Consultants

September 26, 2011

Mr. Mike Enneking
Director of Facilities Management
Oklahoma Department of Central Services
Construction and Properties Division
P.O. Box 53187
Oklahoma City, Oklahoma 73152

Re: State Capitol Building
Structural Inspection of South Portico Façade
DCS# ID12115 – DCSOFM

Zahl-Ford Project #11179

Dear Mr. Enneking,

On September 14 and September 19, 2011, Zahl-Ford, Inc. (ZFI) performed a limited-scope, visual-only, structural inspection of the above referenced building. We were informed by John Morrison of your department that pieces of limestone and grout from the east and west corners of the south portico of the Capitol had fallen onto the south portico steps and sidewalks. Mr. Morrison requested that we investigate the source and cause of this falling debris.

Structurally, the south portico portion of the Capitol is a concrete-frame building with in-fill clay masonry (brick and tile) walls. Refer to Photos 1 through 3. Architecturally, the building is designed in the classic Greco-Roman style with white limestone cladding above a base of pink granite and entrance colonnades at the north and south porticos with closely spaced white limestone columns.

The source of the falling debris was reportedly from the east and west corners of the band of limestone cladding just above the south portico colonnade columns. Refer to Photos 4 and 5.

Observations
Lippert Bros., Inc provided a boom lift and boom lift operator that lifted us up to the upper east and west corners of the south portico colonnade to inspect the condition of the limestone cladding at those locations.

We observed the following:

1. All mortar joints between limestone panels are severely deteriorated. The cementitious mortar that remains in the joints is severely cracked and eroded from weathering. Mortar is missing entirely along significant portions of joints. A surface sealer that was applied to the joints in the past has failed and is in a rigid and cracked state with open edges indicating that it has deteriorated due to sun and weather exposure. Refer to Photos 6 through 15.

2. The upper corners of several limestone panels at the southwest corner and one panel at the southeast corner have broken off. In most cases the broken corners have exposed steel block-to-block ties. The exposed steel ties have corroded severely to the point that the exposed steel flakes off when disturbed. The broken limestone panel corner at the southeast portico corner has been filled with caulking or putty, which covers the steel tie. Consequently the condition of the block-to-block tie at that location is not known. Refer to Photos 6 through 9, and 13.
3. We did not conduct a comprehensive investigation of the entire building, but we did observe deteriorated mortar joints at many other locations beyond the upper southwest and southeast corners of the south portico.
4. Evidence of water infiltration that has occurred as the result of the opened mortar joints is visible in the attic space at the end wall of the south portico. The brick wall that provides the back-up wall support for the exterior cladding has a significant amount of efflorescence, which has occurred as the result of water passing through the deteriorated joints of the exterior limestone cladding and through the brick wall, leaching out the lime in the mortar. The observed efflorescence is not directly attributable to water infiltration through joints in the limestone veneer at the southeast and southwest corners but is attributable to failed mortar joints in the limestone veneer located in the triangular area of the gabled end wall of the south portico. This condition supports our observation that the problems with deteriorating joints extend beyond the two corners of the south portico. Refer to Photos 2 and 3.
5. The surfaces of the southeast corner limestone panel and the southeast limestone ledge are spalling due to the effects of freeze-thaw cycles. Refer to Photos 13 through 15.
6. Zahl-Ford, Inc. (ZFI) inspected the exterior soffit of the south portico in 1990 and reported problems with cracks in the limestone soffit lintels. Our findings, presented in a report dated February 5, 1990, were nearly identical to our findings in our most recent investigation. In our 1990 report, we found that that the cracks in limestone lintels were associated with deteriorated mortar joints and the water infiltration that occurred as the result of that deterioration. The report indicates that the damage at that time was not yet significant but that the problems with deteriorating joints would worsen over time if not addressed. Additionally, the report mentions an upcoming scheduled application of a waterproofing repair. We suspect that the waterproofing repair referenced in the report was likely the application of the mortar joint sealant that is now also weathered and deteriorated.
7. Scaffolding has been erected at the sidewalk level of the southeast corner of the portico to protect the handicap access from falling debris. Refer to Photos 16 and 17. The scaffolding appears sufficient to protect the public from the small pieces of debris that have been falling from the limestone veneer above and the scaffolding appears to have been erected in accordance with industry standards.

Conclusions

1. The falling debris at the southeast and southwest corners of the south portico is the result of seriously deteriorated mortar joints in the limestone cladding. The degree of deterioration of the joints at these locations is significant. Based on a report prepared by ZFI in 1990, the deterioration of mortar joints has been occurring, and steadily worsening, for a period of at least 20 years.
2. Stone cladding anchorage typically consists of steel clips that tie the stone veneer to a back-up wall. These clips are typically located at the ¼ points of the stone blocks and prevent the stone veneer from rotating outward and falling off the building. Another set of steel clips is used at the corners to tie blocks together to maintain alignment of adjacent blocks relative to each other. The heavily corroded steel ties that we observed (refer to item 2 above in the Observations section) are likely the block-to-block ties used to maintain alignment between blocks. While we were unable to directly observe the condition of any of the steel tie-back clips, we did not observe any indication that the tie-back clips were corroding. However, given the severity of the deterioration of the mortar joints, the degree of water infiltration that is occurring, and the length of time the problem has likely existed, corrosion of the tie-back clips that hold the limestone veneer against the building at these locations is highly likely.
3. The need for corrective action at the southwest and southeast corners of the south portico is immediate. Another winter season of water infiltration coupled with freeze-thaw cycles will cause further degradation of an already poor condition and has a high probability of causing additional falling bebris.

If you have any questions concerning this matter, please call.

Sincerely,
Zahl-Ford, Inc.
Cert. of Auth. #CA-994 exp. 6/30/12

Christopher M. Harris, P.E.

Photo 1 Concrete Frame with Clay Tile Infill

Photo 2 Concrete Roof and Beams with Clay Brick Infill

Photo 3 Concrete Roof and Beams with Clay Brick Infill

Photo 4 West Corner of South Portico

Photo 5 East Corner of South Portico

Photo 6 Southwest Corner: Corroded Steel Tie at Upper Corners of Limestone Blocks

Photo 7 Southwest Corner: Broken Limestone Corner and Exposed and Corroded Steel Tie

Photos 8 Southwest Corner: Deteriorated Mortar Joints, Crack Limestone Block Corners, Exposed and Corroded Steel Tie

Photo 9 Southwest Corner: Deteriorated Mortar Joints and Crack Limestone Block Corners

Photo 10 Southwest Corner: Deteriorated Mortar Joint Between Limestone Blocks

Photo 11 Southwest Corner: Deteriorated Mortar Joint Between Limestone Cornice Pieces

Photo 12 Southwest Corner: Deteriorated Mortar Joints in Limestone Ledge

Photo 13 Southeast Corner: Patched Broken Limestone Block Corner

Photo 14 Southeast Corner: Deteriorated Mortar Joint Between Limestone Blocks, Spalling of Limestone Block Face, Spalling at Limestone Ledge

Photo 15 Southeast Corner: Deteriorated Mortar Joint and Spalling Face of Limestone Block

Photo 16 Debris Protection Scaffolding

Photo 17 Debris Protection Scaffolding