

6 November 2024

Mr. Peter McLaughlin  
Commissioner  
City of Cambridge - Inspectional Services Department  
831 Massachusetts Avenue  
Cambridge, MA 02139

Project 200609.04– Evaluation of Two-Way Slabs, Riverview Condominiums,  
221 Mt. Auburn Street, Cambridge, MA

Dear Mr. McLaughlin:

Thank you for meeting with us on 31 October 2024 to discuss our ongoing evaluation of the two-way slabs at Riverview Condominiums (Riverview). At your request, we prepared this letter to summarize our work to date and project status.

## **1. BACKGROUND**

In 2023, Riverview planned to replace the roofing at the low roof (eighth floor) along with new drains and downleaders. The downleaders were planned to be installed through new core holes in the exterior cantilevered balcony slabs (first floor to eighth floor). During coring operations, Simpson Gumpertz & Heger Inc. (SGH) observed cracks and reinforcement that were low within the cross section of the slab (low reinforcement), where the Coring Contractor inadvertently cut through reinforcement. As a result of these observations and based on information provided by others that low reinforcement occurs at various locations in the building (as reported by Structures North), Riverview asked us to evaluate the two-way slabs.

Our scope of work included the following:

- Ground penetrating radar scans to document the location of the existing reinforcement.
- Concrete compressive strength testing of cores extracted from the existing slabs and corresponding rebound hammer testing to verify the concrete quality/strength throughout the building.
- Reinforcement testing to determine the yield strength of the existing reinforcement.

- Visual observations of the exterior of the concrete structure and aerial drone photography to document the condition of the structure.
- Exploratory openings within the building (since the vast majority of the slabs are concealed by finishes) to make observations of the slabs.
- Analysis of the slabs to assess their capacity to support code-required loads.

## **2. FINDINGS**

Based on our work, we found multiple issues that reduce the structural capacity of the slabs. Below, we summarize the issues that contribute to a reduction of the slab flexural and punching shear capacities:

- Low Reinforcement - Reinforcement placed lower than specified on the design drawings.
- Low Concrete Compressive Strength - Lower than specified concrete strength.
- Deterioration from Leakage and Corrosion - Ongoing leakage through the exterior walls, concrete slabs, and leaking/condensing utilities causing reinforcing steel corrosion inside the building. There is also isolated corrosion damage to the exterior concrete components.
- Utility Penetrations - Penetrations and alterations of the concrete slabs within the critical punching shear perimeter.
- Previous Concrete Repair Work – Slab repairs performed within the critical punching shear zone that may have further weakened the structure.

We performed exploratory openings by removing finishes at nine-column-to-slab connections throughout the building to assess the extent to which damage, if any, had progressed due to the above issues. During our recent exploratory work, we observed cracks consistent with both flexural and punching shear overstresses.

Due to the compounding issues summarized above, at various locations throughout the building, there is a very low (to potentially zero) safety factor when the slabs are subject to code-required loads. Based on new information recently collected and our analysis, we recommend a live-load restriction of 20 lbs per square foot (psf) throughout the building. Based on our work within the building and published data documenting actual in-service live loads, we estimate that the building live load is 20 psf or less in typical units. To our knowledge, residents have continued to comply with the restriction since we first recommended it at the completion of our exploratory work. However, even with this live load restriction, there are many locations

with demand-to-capacity ratios (DCRs) above 1.5 (which are classified as “potentially dangerous” by the American Concrete Institute’s - Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures and Commentary - ACI 562) that require shoring or repairs if the building is to remain occupied.

### **3. INTERIM AND LONG-TERM REPAIRS AND OCCUPANCY**

There are multiple unknowns that need to be considered with respect to building occupancy, shoring, and repairs, summarized below:

- High Roof (Penthouse Roof) - We currently have very little as-built information for the high roof, which leaves uncertainty about the capacity and future performance of the structure.
- Corrosion Damage - There is documented leakage and corrosion at many locations in the building that will continue to weaken the structure. With the information we have, it is unpredictable to know when and where this damage could cause significant structural issues.
- Snow Loads - The building was not required to be designed for snow drift loads at the time of construction. However, we included snow drift in our analysis, specifically at the low roof, where there is documented corrosion damage, a history of leakage, and very high DCRs. The snow drift zones and associated areas with high DCRs are becoming more critical as we near winter with potential snow loads.
- Concealed Conditions - Since the slabs are concealed, documenting the extent of slab damage within the building is difficult due to asbestos-containing material abatement and finish removal to expose the slabs. It is unlikely that additional exploratory openings can be made in a timely fashion to alter the results of our current evaluation. We may consider additional openings during the development of construction documents for the building-wide repairs to confirm other currently unknown conditions.

During our meeting on 31 October 2024, we discussed several scenarios regarding building occupancy. Since our meeting, the Riverview Board of Trustees decided to begin moving tenants out of the building to begin the permanent repairs. The Board set a timeframe of 4 to 6 wks for all tenants to move out. We are now evaluating the need for potential shoring, proceeding with the design of permanent repairs, and working with the project team to determine a schedule to implement repairs.

During our meeting, you requested that we present our work to the City of Cambridge Fire Department. We shall be pleased to meet with you and the Fire Department at your earliest convenience.

Sincerely yours,



John M. Porter, P.E.

Principal

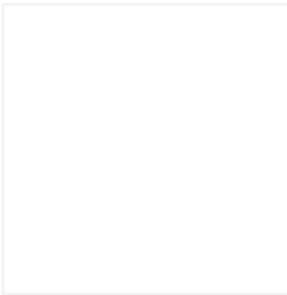
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