Entuitive Corporation
150 9th Avenue SW, Suite 1610
Calgary, AB T2P 3H9 Canada
T. +1 403. 879.1270

ENTUITIVE

August 1, 2019

Westmount Place Condominium
c/o Sandra Williams
Montgomery Ross and Associates
1414 – 8th Street SW, Suite 400
Calgary, AB T2E 1J6

Re: Westmount Place (1100 8th Avenue SW)
Post Tension System Update
Consulting Structural Engineering Services
Our Project No. C019-0896

Dear Ms. Williams,

As outlined in our proposal dated March 15th, 2019 Entuitive has completed an investigation update testing of the post tensioned strands at the Westmount Place mixed use building. Site work was completed by July 22, 2019. The following is a summary of our review.

1. DESCRIPTION OF STRUCTURE

The Westmount Place condominium building consists of one high-rise building overtop of a multi-level below grade parkade. Structural drawings produced by Cosentino Bruyer Partnership dated November 1979 were available for our review. The drawings indicate the floor system is a post tensioned slab with banded post tensioned strands in the east-west directions and distributed post tensioned strands in the north-south directions. The floor system is supported by reinforced concrete columns and a central core through the height of the building. The columns are reinforced using conventional mild steel.

2. DESCRIPTION OF POST TENSION SYSTEMS

Unbonded post-tensioned strands are placed in their final locations prior casting of concrete. Once the concrete is placed and cured, the strands are tensioned to provide structural capacity to the floor slab. The strands are fabricated from multiple wires enclosed in a plastic sheathing. The space between the strand and the sheathing contains grease to lubricate the strand and inhibit corrosion.

Post-tension strands are susceptible to corrosion deterioration in higher-risk exposure conditions such as parking decks, below grade construction, and discontinuities in the building envelope. Moisture can access the strands at end anchorages or through cracks in the concrete where the strand sheath has been compromised. Damage can also occur due to improper handling during construction, strand slippage at the anchors during original stressing, brittle wire cracking, or coring/drilling after construction.

Strand failure (i.e. loss in strand tension) can result from one or more of the above noted occurrences. A loss in strand tension will reduce the load carrying capacity of the structure. Consequently, periodic monitoring is recommended to identify any changes in strand tension in a timely manner.

3. OBSERVATIONS

The following observations and discussion are based on our assessment of the unbonded post-tension strands accessible at inspection recesses installed on the underside of the ground floor and suspended parking level slabs. The exposed lengths of the strands were checked for tension deficiencies by a penetration test. The results of our investigation are presented below.

3.1 EXISTING POST TENSION SYSTEM RECESSES

3.1.1. Ground Floor and Suspended Parking Levels

Penetration testing was completed on 552 strands at 118 available inspection recesses in the ground floor and suspended parking levels. Twelve (12) additional inspection recesses were available, however, could not be tested as they were obstructed or inaccessible at the time of our testing.

As of the current testing, the following tension deficiencies are detected:

Full tension deficiencies:	16
Partial tension deficiencies:	16

This represent an increase of fifteen (15) fully tension deficient and eleven (11) partially deficient strands identified from previous testing. We note that one (1) of the partially deficient strands identified is within an obstructed or inaccessible recess; and therefore, is assumed to still be partially deficient.

Two (2) of the fully tension deficient stands identified in the testing noted above were replaced in 2017 and subsequently tested in 2018 with no signs of tension deficiencies. At this time, it is unclear of what cause the two (2) previously replaced strands to become tension deficient. Further investigation of the strands, as discussed in section 4, can be completed to determine the possible cause of strand failure.

3.1.2. Level 5 Slab

Penetration testing was completed on the 12 strands of the 5th floor slab banded group recess. Two (2) strands are noted to be fully tension deficient, which indicates no change in strand deficiency between our previous year testing.

3.2 EXPANDED INVESTIGATION

A total of 65 post tensioned strands were inspected at 21 new inspection recesses chipped into the underside of select slabs. Indications of water, emulsified grease, corrosion, or pitting of the strand were reviewed and recorded. The exposed lengths of the strands were checked for tension deficiencies via a penetration test. The results of our investigation are presented below.

The information gathered at the strand inspection recess locations summarized below only reflects the strand condition at the specific locations examined. Conditions of the strands in areas not exposed may vary from those observed at the recess locations. The level of deterioration observed may not constitute the most server condition of the strand.

3.2.1. Ground Floor and Suspended Parking Levels

STRAND CONDITION SUMMARY TABLE	
STRANDS DISPLAYING PARTIAL TENSION DEFICIENCIES	0 (0 %)
STRANDS DISPLAYING FULL TENSION DEFICIENCIES	1 (5 %)
STRANDS DISPLAYING WATER, CORROSION, EMULSIFIED GREASE OR SURFACE PITTING	10 (48 %)
STRANDS WITH DEFICIENCIES OBSERVED	1 (5 %)
TOTAL NUMBER OF STRANDS OBSERVED	21 (100 %)

4. DISCUSSION

Tension deficiencies could be the result of mechanical damage, strand slippage, stressing defects, or moisture contact during original construction or through defects in the waterproofing. Removal of a tension deficient strand could also be completed to determine the cause of the tension deficiency. In cases where strands have been removed for full length examination, moisture, if present, is typically observed at anchor locations as well as along various locations of the strand (i.e. the strand may be exposed to moisture even though it was not identified in the inspection recess).

Partially tension deficient strands are classified as strands where one or more of the individual wires comprising the strand are tension deficient but at least one of the wires remains under

tension. All wires without tension in a strand are classified as fully tension deficient. Indication of partial tension deficiency can be susceptible to variances in the test method and results may vary between inspections.

Overall, a total of seventeen (17) full deficient and fifteen (16) partial deficient post-tension strands were detected in the parkade and ground floor slabs. This represents less than 7 percent of the strands tested. The fully and partially tension deficient strands have reduced the local load carrying capacity of the slabs. Our office previously completed a capacity review to determine the amount of tolerable strand breakage prior to removal and replacement of the strands being required. We found that any fully tension deficient strands in the parkade must be replaced to ensure that the slabs can support full design loads. Based on these results, replacement of the fully tension deficient strands detected in the parkade is required.

Overall, a total of two (2) full deficient strands are present on the level 5 slab along grid line 'B'. These tension deficiencies have reduced the load carrying capacity of the slab along the grid area. Based on our discussion, we understand that the option to reduce the live load capacity of the level 5 north patio areas from 4.8 kPa (100 psf) to 4.0 kPa (80 psf) has been implemented. Should the original design capacity be desired, replacement of the strands will be required.

Regular testing of the strand tension at all existing recesses will provide an indication if loss in tension is occurring and allow a timely initiation of remedial repairs.

5. RECOMMENDATIONS

In light of the above observations and discussion, the following recommendations are presented for your consideration. Please note that GST would be in addition to the budget presented below.

5.1 POST TENSTION SYSTEM MONITORING – GROUND FLOOR AND SUSPENDED PARKING LEVELS

Given the current tension deficiencies noted, tension testing of the post-tension strands at existing recesses is recommended on an annual basis. The next update test should be scheduled for July 2020.

Engineering fee – Update Testing $7,800

5.2 POST TENSION SYSTEM MONITORING – UPPER FLOORS AND ROOF LEVEL

Tension testing of the post-tension strands at existing recesses in the upper floors and roof level is recommended on an bi-annual basis, except for the banded recess on level 5, which is to be completed annually. The next update test should be scheduled for July 2020.

Engineering fee – Update Testing $4,900

5.3 POST TENSION STRAND REPLACEMENT

Replacement of 17 fully tension deficient strands is recommended to restore the slab carrying capacity in these areas. We note that these strands are contained in groups, so replacement of adjacent strands may be required in order to facilitate replacement of the tension deficient strands and to prevent cross contamination. During the process of strand removal, investigation into the cause of the strand failure will be completed.

The cost below includes an allowance for engineering and contingency. We note that the cost could vary depending on the number of additional strands that have to be replaced to access the tension deficient strands.

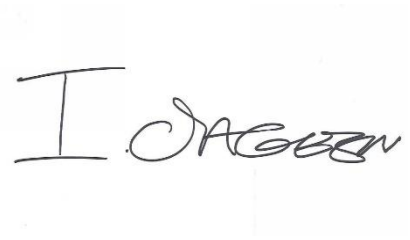
Order of Magnitude Construction Cost: $50,000 to $70,000

6. CLOSURE

Trusting the above addresses your immediate requirements; we remain available to answer any questions or to proceed with the recommendations presented above.

Sincerely,

Entuitive
APEGA Permit to Practice: P11274



Imisi Olagesin
Designer
Imisi.Olagesin@entuitive.com
C: 403.604.3075

Reviewed By:



August 1, 2019

Gary Twomey, P. Eng.
Senior Engineer
Gary.Twomey@entuitive.com
C: 587.896.1777