MANTICORE
ENGINEERING LTD.

Project No. 5041.10

July 13, 2010

OCP 831 0969 (o/a Westmount Place)
420, 1100 - 8th Avenue SW
Calgary, Alberta
T2P 3T8

Attention: Ms. Twylla Walker

RE: WESTMOUNT PLACE – POST-TENSIONING SYSTEM REVIEW

1.0 Introduction

At the request of OCP 831 0969 (o/a Westmount Place), a review of the post-tensioning system in the main floor slab and the suspended parking slabs was completed. The purpose of the review program was to qualify the condition of the subject slabs, and to provide recommendations for analysis, repair, replacement, upgrading, or additional investigations.

2.0 Description of Structure

Westmount Place is located at 1100 – 8th Avenue SW in Calgary. The facility is a 28 storey residential/commercial building with four levels of underground parking. The main floor and the three suspended parking levels are post-tensioned concrete construction. The lowest parking level is a concrete slab-on-grade.

Drawings for this site were not provided. The type of construction used for the tower is not known.

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3.0 Background

Unbonded post-tensioned slab construction became popular in the early 1960's because it provided a more economical alternative to conventionally reinforced slab construction. Post-tensioning also minimizes the number and size of cracks and therefore reduces moisture and chloride (de-icer salt) penetration into the concrete which threatens the durability of the slab.

In recent years there has been a growing awareness of durability problems associated with unbonded post-tensioned construction. The reduced durability has been noted with certain installations and has generally been a result of poor design details, unintentional exposure to corrosive environments, or poor construction practices.

Reduced durability results from moisture contacting the cables leading to corrosion and fracture. Moisture can potentially enter the plastic sheath that surrounds the cables during transportation of the material to site, and/or while stored on site, and/or while in place on the formwork before concrete placement.

Moisture can also enter the sheath and contact the cables following construction through stressing anchorages, through the concrete pore structure, or through cracks in the concrete. Experience with post-tensioned slabs indicates that the greatest frequency of damage corresponds to systems that contain unprotected stressing anchorages at or below grade.

A limited sampling or evaluation of cables at inspection recesses provides non-conservative results. An individual cable is reviewed by exposing approximately 200 mm of its total length (inspection recess), therefore, only a small fraction of its total length is observed. A cable in good condition at the inspection recess may be corroded at a location nearby and it is the corroded location that governs the durability of the cable. Corrosion damage can only be confirmed if the cable is corroded at the inspection recess or if the cable is completely removed for examination.

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4.0 Review Methodology

The review program consisted of three parts:

- View Engineering Reports prepared by Manticore Engineering Ltd., dated December 1995, July, 2000, October, 2005, and August, 2008
- Viewing post-tensioning cables at existing recesses in the subject floor slabs
- Viewing condition of the subject concrete slab surfaces and soffits

Steel plates that cover the cables at the existing recesses were removed. The condition of the cables and the presence of moisture and corrosion were observed at the recesses. Penetration tests were conducted on the cables to qualify stress. After the test the steel cover plates were reattached to conceal each recess opening.

The environment around the cables within the recesses can change as a result of the original exposure. There is a possibility that moisture observed within the sheaths during the initial exposure has evaporated over time. Thus, comparisons of observations regarding the presence of moisture from the initial investigation to subsequent reviews are not made.

5.0 Observations & Discussions

5.1 Post-Tension Cable Conditions

The condition of 219 cables was reviewed at 70 existing recesses. Table 1 summarizes the condition of the cables observed within the recesses.

Table 1
Summary of Observed Cable Conditions

Cable Location	# of Cables Viewed	# of Cables Unstressed
Main Floor Slab	75	2 (0%)†
P-1 Level Slab	41	2 (0%)
P-2 Level Slab	48	0 (0%)
P-3 Level Slab	55	1 (0%)

† *One cable was removed in 1996*

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Ninety eight percent (98%) of the cables viewed appear stressed. Five fully unstressed cables are present. Two unstressed cables are located in the main floor slab, two are located in the P-1 slab, and one is located in the P-3 slab. One of the cables in the main floor slab was removed in 1996 and identified in our previous reports.

Some of the cables display evidence of corrosion. These are located at cracks in the slab where through slab leakage appears to be occurring or has occurred in the past.

5.2 Waterproofing

New waterproofing membrane is present on the surfaces of the post-tensioned parking slabs (P1, P2, P3). The waterproofing appears to be a liquid applied traffic-grade coating.

Injection ports were observed along the soffit of the slabs indicating that a crack injection program had been completed in the past.

A review of the majority of the main floor waterproofing system was not performed as the waterproofing is located below hard and soft landscaping around the exterior of the tower. However, the north wall slab edge is exposed and has not been waterproofed. Two concrete pads providing access to the building via man door, along the north wall are also not waterproofed.

5.3 Concrete Slab Edge

The north wall slab edge is at the approximate elevation of pedestrian traffic. It is possible for cables to fail and project out from cable anchors at the slab edges. The potential exists for injury to pedestrians at this locations.

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6.0 Conclusions & Recommendations

6.1 Post-Tension Cables

Deterioration of the post-tensioning system has occurred since our 2008 review, new surface corrosion has been identified on two cables previously not corroded. No additional unstressed strands were identified. Based on the cables reviewed, repairs or replacement of post-tensioning cables are not presently required.

Ongoing monitoring of the post-tensioning system is essential to reduce the risk that unsafe conditions develop due to corrosion induced deterioration. On-going deterioration may be occurring at areas along the length of the cable, other than at the recesses. Biennial review of the post-tensioning system is recommended. The next cable review is due in June 2012. The estimated cost to review the cables within the existing recesses is $3,500 per event.

6.2 Waterproofing

It is recommended that the main floor slab edge, and man door concrete pads along the north exterior wall be waterproofed with a liquid applied traffic-grade waterproofing membrane.

6.3 Concrete Slab Edge

Installation of steel plates over the anchor pockets at the north main floor is recommended. This is to reduce the risk of injury from the possible eruption of cables.

7.0 Closure

The evaluation program has not included a review of the structural design of the slab. It has been assumed that the slab was designed and constructed in accordance with all standards and codes of practice applicable at the time of construction.

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The intent of this reporting was to identify situations that are obvious to a professional engineer under the current terms of reference. The conclusions and recommendations presented are based on a limited strand sample size and may not represent all strand conditions within the slabs, and conditions may vary widely away from the recess locations.

This report has been prepared on the behalf of OCP 831 0969, and is only for the exclusive use of OCP 831 0969. No other representations are made to any other parties and no other party may rely on this report without the express written permission of Manticore. Any use a third party makes of this report, or any resulting reliance or decisions made based on the information provided herein, is the responsibility of the third party. This report is the exclusive property of Manticore Engineering Ltd. and shall not be reproduced in whole or in part without the written consent of Manticore Engineering Ltd.

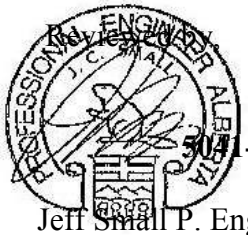
We trust this information meets with your present requirements. Should you have any questions please contact Manticore Engineering Ltd. at (403) 252-8454.

Yours truly,

MANTICORE ENGINEERING LTD.



Jesse Ball, A.T.



Reviewed **5071-10**

Jeff Small P. Eng
Principal
July 13, 2010

APEGGA Permit to Practice No. P5567

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