

RESTORATION OF SIR GEORGE-ÉTIENNE CARTIER MONUMENT

BY JACQUES BERTRAND AND PIERRE LACROIX

The monument honoring Sir George-Étienne Cartier is located on the East side of Mount-Royal Park adjacent to downtown Montréal, QC, Canada. The construction of the monument started in 1912 and was completed in 1920, with work interrupted during World War I. The Canadian sculptor George W. Hill, in collaboration with architects Edward and W.S. Maxwell and sculptor Joseph Brunet, designed this work of art. Numerous countries of the British Empire, as well as the United States, subscribed the funds for this monument.

The monument honors Sir George-Étienne Cartier (1814-1873), who was a founding father of the Canadian Confederation. The monument is composed of an obelisk resting on a massive pedestal. The pedestal and obelisk were built with granite blocks from the Stanstead Quarry (salt and pepper granite texture) in Stanstead, QC, and its core is filled with concrete. Atop the obelisk is a large angel named “La Renommée,” and at the base of the pedestal are 17 bronze personages, including a sculpture of Sir George-Étienne Cartier. A terrace



Sir George-Étienne Cartier monument before restoration
Photo courtesy of the city of Montréal

at the base of the monument, as well as stairs of granite leading to the monument, complement the area in the natural setting of Mount-Royal Park.

With the sculpture approaching 90 years old, the monument and bronze personages showed signs of aging and deterioration. A structural analysis was performed to determine the condition and integrity of the masonry elements and structural components of the monument.

NONDESTRUCTIVE EVALUATION

The restoration work was performed in the spirit of maintaining the historical character and nature of this monument. The historical nature of the restoration necessitated a thorough analysis of the structure and required a judicious choice of repair materials and construction methods to preserve the historical and aesthetic nature of the monument.

Several nondestructive methods of evaluation were used prior to and during this project to determine the status and condition of anchorage of La Renommée as well as the structure.

Among the tests performed were:

- A geophysical electrical test to locate the anchorage for La Renommée;
- An X-ray of the base of La Renommée to determine the diameter of the anchor;
- A radar survey was done to establish the length of the anchor as well as to determine the presence of voids before and after grouting; and
- Cores were taken through the structure to determine the quality of the concrete at the core of the obelisk, at the base of the pedestal, and for the terrace. This also served to validate and corroborate the radar survey results.

The investigations revealed a weakened support and jointing for the masonry elements as well as poor quality concrete with numerous voids in the core concrete of the obelisk and pedestal.

THE REPAIR PROJECT

Considering the age and condition of the terrace, the deteriorated state of the existing concrete, and poor quality of previous repairs to concrete and masonry elements of the terrace, the wear of the stairs leading to the monument, the deterioration due to freeze-thaw activity, and the use of deicing salts in the winter, the terrace was completely

reconstructed; this work necessitated the work of artists to build the complex formwork required to recreate the aesthetics and geometrical shapes of the initial structure. A complete topographic survey was done before demolition and the terrace was reconstructed as it was in its original design to preserve its historical character and appearance.

All the original granite blocks for the stairs and the terrace area were removed and stored on-site while the concrete foundation was rebuilt; these stones were reinstalled to recreate the original appearance of the structure.

A membrane was applied over the concrete foundation of the terrace and, in keeping with the general principles for restoration, the granite blocks for the stairs and the terrace were placed on a bed of crushed scoria, which provided drainage under the granite. The masonry joints were filled with a lime-based mortar that was developed and extensively tested in the City of Montréal materials laboratory. Also, numerous test samples were made to find a concrete that matched the color and texture of the concrete for the terrace. Due to the complexity of the terrace layout, it was not possible to use a stamped concrete to replicate the joints. The joints' texture was handcrafted to create the block texture similar to the pedestal.

Similarly, the grouting materials were developed and tested in the laboratory before field use. The structural investigations revealed the need for grouting of the voids in the structure. Over 2113 gal. (8000 L) of microfine and cementitious grout were placed in the obelisk and pedestal structure.

The restoration of the Sir George-Étienne Cartier monument required the selection and validation of numerous concrete repair materials, as well as unusual and innovative concrete repair methods, including:

- Hiring of artists to design and build formwork for the terrace and stairs of the monument;
- The use of a bed of scoria under the granite stairs to allow proper drainage. This bed of scoria was contained by mortar at the perimeter;
- Construction of a textured concrete slab built with joints created with steel edgers to recreate the original joints in the terrace;
- The use of complex scaffolding to access work areas;
- Concrete and masonry cleaning materials and application sealers and anti-graffiti products;
- Pointing of the mortar joint with a low-modulus-of-elasticity mortar;
- Grouting the inner core and pedestal with a conventional grout applied under low pressure;
- Secondary grouting of the inner core and pedestal with microfine cement;
- Inspection with nondestructive testing after each stage of grouting;



Cofferdam at the base and protection of the obelisk with wood and straps, spring 2006
Photo courtesy of the city of Montréal



Detail of cofferdam, spring 2006
Photo courtesy of the city of Montréal



Detail of terrace and stairs, spring 2006
Photo courtesy of the city of Montréal

- Grouting of the pedestal and anchor for “La Renommée” with microfine cement;
- Epoxy grouting of some masonry elements;
- Development of an epoxy grout to match the existing color and texture for the repair of spalls and defects of masonry units;
- Reconstruction of the pedestal under “La Renommée”; and
- Removal, cleaning, and reinstalling of numerous granite units to preserve the original aesthetics and character of the monument. When a masonry block needed to be replaced, care was taken to match the existing color and texture of the original block.

The challenges to retain the heritage and historical character of the monument and its aesthetics, the diversity of materials used, the extensive testing for the selection of materials, and the construction

methods used for the restoration of the Sir George-Étienne Cartier monument make this project unique.

It involved numerous disciplines, specialty contractors, and craftsmen with a deep understanding of the complexity of the work as well as a respect for the cultural heritage and pride that this monument provides for the citizens of Montréal.

The project used state-of-the-art nondestructive testing before and during the project to ensure a proper assessment of the existing structure and that repairs were performed satisfactorily.

Extensive research and testing was done before and during project to meet the challenges presented by the rigor of Montréal’s winters with its numerous freeze-thaw cycles and use of deicing salts in public areas.

Numerous design changes were incorporated during the construction to adjust to the site’s conditions encountered, as revealed by ongoing technical investigations.

The cost for the restoration was \$3 million (Canadian).

This monument and its terrace is a very popular meeting place for the citizens of Montréal and is host to a weekly Sunday gathering of the Tamtams, where a gathering of participants of varied ethnic backgrounds come and play their musical instruments and join in the weekly festivities.

The restoration of the Sir George-Étienne Cartier monument allows the people of Montréal to continue their gathering and express their artistic talents in a natural environment in one of Canada’s most renowned parks, at the heart and center of Montréal and in the shadow of a tribute to one of Canada’s founding fathers of the confederation, Sir George-Étienne Cartier.



Reinstallation of granite blocks on crushed scoria
Photo courtesy of the city of Montréal



Hand crafted joints in the terrace
Photo courtesy of the city of Montréal



Detail of scaffolding, spring 2007
Photo courtesy of Michael DuBreuil



Jacques Bertrand is a Civil Engineer. He graduated from Queen's University in Kingston, ON, Canada, in 1967. He has over 40 years of experience in mining, tunneling, civil engineering, and concrete repair projects. He is the Owner and President of Béton

Mobile du Québec, Inc., and Ambex Concrete Technologies, Inc. Both firms are involved in the supply of shotcrete and specialty concretes for the repair and rehabilitation of concrete structures in Canada and the U.S.

Bertrand is a Director of the ICRI Quebec Province Chapter. He is also a member of the American Shotcrete Association (ASA), American Concrete Institute (ACI), Canadian Tunnelling Association, and the Order of Engineers of Québec. Bertrand participated in the Industrial Chair at Laval University on "Shotcrete and Concrete Repairs" from 1995 to 2002. He has authored numerous papers in Canada and internationally.



Pierre Lacroix is an Engineer for the City of Montréal materials laboratory and has over 30 years of experience in the concrete repair industry. He is a Past President of the ICRI Québec Province Chapter and is also a member of ACI and the Order of Engineers of Québec.



Sir George-Étienne Cartier monument after restoration, spring 2008
Photo courtesy of Michael DuBreuil

Sir George-Étienne Cartier Monument

RESTORATION CONTRACTOR FOR
CONCRETE AND MASONRY
2005-2006—L.M. Sauve (1964) Ltée
2007-2008—Rainville & Frères Inc.

CONSTRUCTION MANAGER
Construction Garnier Inc. (Phase 1)
Rainville & Frères Inc. (Phase 2)

OWNER
City of Montréal

ARCHITECT
Fournier Gersovitz Moss and Associates

ENGINEER
Martoni Cyr and Associates Inc.

RESTORATION OF BRONZE STATUES
Dolléans Art Conservation

GROUT SUPPLIERS
Ambex Concrete Technologies Inc.
Jahn Materials