17TH ICAAR
OTTAWA 2024
50TH ANNIVERSARY

TECHNICAL VISIT

MAY 25 TO 27 | 2024

17th International Conference on Alkali-Aggregate Reaction in Concrete

May 18th - 24th, 2024 | Ottawa, Ontario, Canada

Detailed Tour Program

25th MAY

- 9:00-11:30: Exposure site visit
- 11:30-12:30 Lunch at TBD
- 13:30-14:30 Henri Seguin bridge
- 15:30-17:30 Beauharnois dam
- 18:00-19:00 Hotel Check-in
- 20:00-22:00 Dinner at TBD

26th MAY

- 9:00-11:30: Nun's Island (Darwin bridge)
- 12:00-13:30 Esplanade Tranquille
- 14:00-16:00 Biodome
- 16:00-18:00 Olympic Stadium
- 18:30-19:30 Heading Back to Hotel
- 20:00-22:00 Dinner at TBD

27th MAY

- 9:00-11:30: Seaway Montreal
- 12:00-13:30 Lunch at TBD
- 14:00-15:00 Jacques Cartier Bridge
- 17:00: Ottawa downtown

DAY 1: SATURDAY, MAY 25

1.1 Exposure Site in Ottawa

The post conference tour starts with a guided visit to a concrete block exposure site conveniently located within an hour of the conference hotel. Concrete blocks representing a variety of mix designs (SCM's, alkali contents), aggregate reactivity levels and preventative treatments will be available showcasing the natural progression of ASR in Canadian climatic conditions. We are excited to showcase expansion and cracking noted as part of ongoing monitoring of these blocks and a visit to this site promises to provide participants with firsthand experience of the long-term condition of ASR affected concrete in non-laboratory environment.

Duration of visit: 2:30 hours

(Photo credit: Fournier)

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→ *Upon returning to the Westin, tour participants will have a quick lunch, retrieve their bags and board the coach bus to the trip to* ***Montreal****. Our first stop on the drive to Montreal will be at the J. Henri Sequin Bridge.*

1.2 The J. Henri Séguin Bridge

The J. Henri Séguin Bridge, constructed in 1969, spans the South Nation River in the township of South Plantagenet (Nation), Ontario, Canada. This bridge is classified as a tied arch bridge, a subtype of suspension bridge, and was constructed by the Bertrand Construction Company. Reports indicate that the concrete members of the bridge exhibit cracking similar to those associated with alkali-silica reaction (ASR) affected concrete. It is noted that the cement used for this bridge ranged from approximately 310 to 410 kg/m³, with an alkali content estimated to be between 0.9% and 1.0% Na_2O. Just 17 years after its construction, signs of ASR-related cracking patterns were observed in various components of the bridge, including the barriers (both inside and outside), abutments, and soffits of the deck. Additionally, regularly spaced vertical cracks, corresponding to the reinforcing steel, were reported in the barrier wall.

Further evidence of ASR, such as deck movement, was validated by the closing of the north expansion joint concurrent with the opening of the south joint. Over the years, numerous rehabilitation works have been undertaken to address these issues. These rehabilitation efforts include but are not limited to the following: removal of asphalt, deck, curbs, and parapets; repair of concrete; strengthening of floor beams; addition of stringers; replacement of elastomeric bearings; construction of a new deck using hydrophobic concrete; installation of new parapets; replacement of embedded joints; and stabilization of embankments. A visit to the bridge presents an opportunity to observe the comprehensive rehabilitation efforts undertaken to address the impact of ASR.

Duration of visit: 1 hour

Figure 1:Overview of the J. Henri Séguin Bridge

Figure 1b: Cracks observed in 1986 (Photo credit: ICAAR 1986)

Figure 1c: After recent rehabilitation (Photo credit: waymarking)

→ *Our second stop on the way to Montreal will be a visit to* ***Beauharnois dam*** *and* ***Generating Station****.*

1.2 Beauharnois dam

Beauharnois Power Development National Historic Site of Canada is a dam on the St. Lawrence River close to Lake St. Louis constructed in 1929 and about 50 km upstream from Montreal. The town of Melocheville is located on the western canal bank and the town of Beauharnois on the eastern bank. Situated on both banks and across the canal, this imposing Art Deco structure has its powerhouses built in three stages, encased between two concrete wing walls on the right and left abutments. The colossal project contains 38 generating units set in a structure that stretches 900 metres.

Figure 2: Overview of the Beauharnois dam (Photo credit: Hydro Quebec)

In the early 1940s, approximately a decade after the construction of the south bulkhead and stage one, leaks began to emerge through ASR-induced cracks in the bulkhead. Concurrently, cracks were also noticed in the water intake structure upstream from the powerhouse, with a separation observed at a construction joint, as well as in the administration building located to the south of the structure. Since then, ongoing cracking and deformation have persisted.

Over several decades, various remedial measures were implemented, including filling joints with asphalt, injecting openings, drilling holes into the bulkhead to remove water, and installing post-tensioned cables to mitigate crack expansion. In 1970 an instrumentation network was implemented, and since then regular inspections made it possible to follow

the progress of the deformations and detect abnormalities. Several aggressive approaches have been adopted to mitigate the AAR-related deteriorations. A visit to this historic dam offers insight into its significant deterioration and the maintenance strategies implemented over the years.

Duration of visit: 2hours

Figure 2b: Section of a dam affected by ASR (Photo credit: Matthieu Argouges, Civil Engineer, Hydro Quebec)

Figure 2c: Beauharnois dam (Photo credit: Hydro Quebec)

→ *After leaving the dam, we will head into the city of Montreal and end day 1 at our hotel (TBD). We will have a group dinner at the restaurant (TBD).*

DAY 2: SUNDAY, MAY 26

→ *Day 2 will start with a visit to **Nun's Island's Darwin Bridge***

2.1 Nun's Island (Darwin bridge)

Duration of visit: 2:30 hours

The Darwin Bridges serves as the meeting place at the crossroads of a Nuns' Island urban boulevard and pedestrian and cycling path. By replacing the old structures that had reached the end of their respective lifespans, the Darwin bridges, a curved parapet in the shape of an arch, now creates a safe space more than 4 meters from the traffic lanes, resulting in a unique elegant movement effect spanning the 37-meter length of the infrastructure.

Figure 3: The Twin Darwin Bridges (Photo Credit: Google)

The reconstruction of the Darwin bridges uses locally sourced recycled glass, becoming the first in the world to use glass powder concrete, a new material that incorporates fine ground recycled glass. This type of concrete, also referred to as ground glass pozzolan (GGP), replaces 10% of the ternary binder required with recycled glass powder. By using GGP, approximately 40,000 kg of concrete were saved and a total of nearly 40,000 kg of recycled glass were used– the equivalent of 70,000 wine bottles. The architectural team also developed the whitest GGP possible for the bridges, characterized by a less raw colour than traditional aggregates. Due to the addition of

stainless-steel bars to reinforce the lifespan of the bridges, it is also more solid and estimated at over 125 years, compared to 75 years for a typical concrete structure. The design is currently a candidate for ENVISION environmental certification, the urban infrastructure equivalent of LEED.

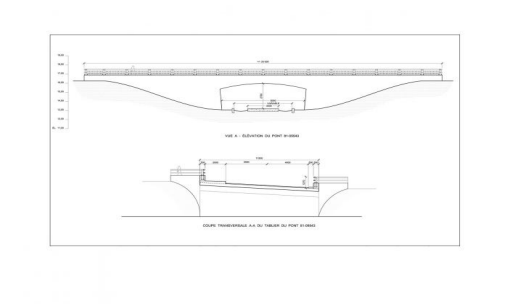

Figure 4: Elevation and Cross Section

Between the two lanes of the bridges, the central strip opens and deepens, drawing in two arches from the road, which then slope down towards the cycling path. Complex geometric precast concrete retaining walls are installed between the bridges to create vegetation-lined levels.

The landscaping of the site was also designed to serve as a wetland area and rain garden for the harvesting of runoff water. The pathway is illuminated at night with long-lasting LED lighting, to prevent pedestrians and cyclists from experiencing a tunnel sensation.

Figure 5: The Twin Darwin Bridges (Photo Credit: Google)

→ *After leaving Nuns Island, we will head to* ***Esplanade Tranquille.***

2.2 Esplanade Tranquille

This new public space, Esplanade Tranquille in the heart of the Quartier des Spectacles is a versatile, all-ages destination open year-round. It is a welcoming spot with a diverse cultural program.

The public space pays tribute to Librairie Tranquille, a bookstore once located on the site, and its owner, Henri Tranquille (1916-2005). It is an important place in contemporary Quebec history, since the store hosted the launch of the *Refus global* manifesto in 1948.

In the winter months, it will be a sprawling refrigerated skating rink illuminated by projections on the ice. In the warmer months, it will be converted into an urban terrace. Visitors can sunbathe, grab a snack, or attend a cultural event.

Duration of visit: 1:30 hours

Figure 6: Esplanade Tranquille [Photo Credit: Google]

→ *After a quick lunch break, we will head to the* ***BioDome*** *and* ***Olympic Stadium.***

2.2 Biodome

An oasis in the heart of the city, near the Olympic Stadium, the Biodome which is one of the Montreal must-see tourist attractions, offers an immersive visit through five ecosystems: Aisha-Savoie-Weider Gallery or the Tropical Rain Forest, Gulf of St. Lawrence - the heart of marine life, Laurentian Maple Forest - changing with the seasons, Labrador Coast and the Sub-Antarctic Islands.

Duration of visit: 2 hours

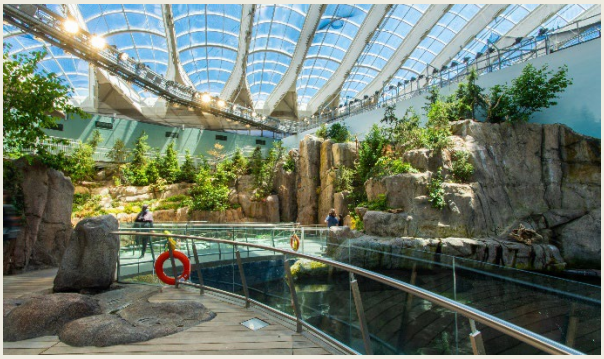

Figure 7: Biodome [Photo Credit: Google]

The Biodome was created by the City of Montréal and the Régie des installations olympiques in what was formerly the velodrome for the 1976 Olympic Games. The design of this exceptional building is the work of French architect Roger Taillibert, who also designed the adjacent Olympic Stadium.

Figure 8: Biodome [Photo Credit: Google]

Inaugurated in 1992, the Biodome was already innovating with its concept of "ecosystem" management, a world first at the time. Today, this ecosystem approach remains unparalleled, either in the faithful and complex way in which it represents the natural environment or in how both the animal species themselves and the animal and plant species interact.

2.3 Olympic Stadium

Duration of visit: 2 hours

Figure 9: Parc Olympique Montreal. Top view [Source: Google]

An international symbol of Montréal, the Olympic Stadium and its Tower, the world's tallest inclined tower at 165-metre (541 ft) was designed by French architect, Roger Taillibert, and built in the 1970s as the main venue for the 1976 Summer Olympics.

It is known by locals as "The Big O", a nickname that references both the Olympics and the circular shape of its roof. Its Esplanade, an urban park made up of nine platforms, also offers a breathtaking view of the Stadium and the Tower.

A visit to the Olympic Stadium not only allows you to remember important events, but to discover that this witness to the history of the city still vibrates with true vitality. Its architectural, historical and patrimonial value is undeniable.

Figure 10: Parc Olympique Montreal [Source: Google Map]

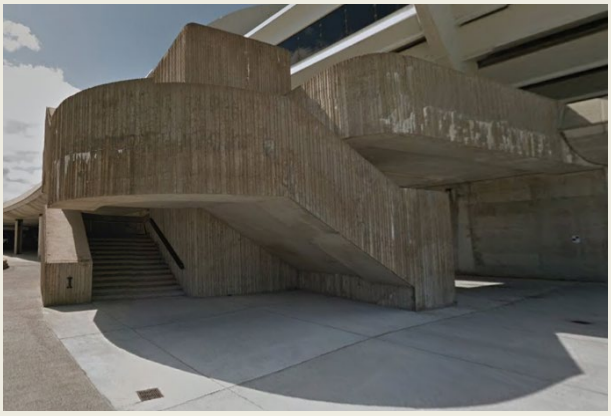

Figure 11: Deteriorated Concrete Surface with Map Cracking at Parc Olympic Stadium

→ *After leaving the Olympic Stadium, we will head back to Hotel XXX for some well- earned rest and relaxation before heading to Restaurant XXX for dinner.*

International travellers may wish to depart for home from Montreal's International airport or stay with the tour for its final leg Monday.

DAY 3: MONDAY, MAY 27

→ On Day 3, the tour will leave the hotel at 9 AM and go to the Montreal seaway

3.1 SEAWAY MONTREAL

The Great Lakes St. Lawrence Seaway System has remained a vital waterborne transportation link for moving goods between North America's heartland and international markets since it opened in 1959. The St. Lawrence Seaway is a system of locks, canals, and channels in Canada and the United States that permits oceangoing vessels to travel from the Atlantic Ocean to the Great Lakes of North America, as far inland as Duluth, Minnesota, at the western end of Lake Superior. The Seaway System is connected by six short canals with a length of less than 60 nautical miles.

The system is not merely a passive waterway; it is a marvel of engineering ingenuity, boasting a sophisticated lock system that enables the seamless navigation of vessels across varying water levels. At the heart of this system are the locks, which play a pivotal role in overcoming the natural elevation differences along the waterway. The locks operate based on the principle of water displacement, allowing ships to traverse the varying water depths and elevations between the Great Lakes and the Atlantic Ocean. As a vessel approaches a lock, it enters a chamber that can be sealed off from the rest of the waterway. This chamber is then filled with water or drained, depending on the direction of travel. The lock systems are equipped with massive gates at each end of the chambers, which can be opened and closed using hydraulic mechanisms or electric motors.

These gates serve to seal off the chamber during the filling or draining process, preventing water from entering or exiting until the desired water level is reached. What makes these lock systems truly fascinating is their sheer size and scale. Some of the locks are large

enough to accommodate oceangoing vessels and bulk carriers, which can be hundreds of feet long and carry thousands of tons of cargo. Despite their immense size, the locks operate with precision and reliability, allowing vessels of varying sizes to navigate through the seaway safely. A visit to the seaway offers a unique and unforgettable sightseeing experience, allowing visitors to explore stunning landscapes, and fascinating historical sites.

Duration of visit: 2:30 hours

Figure 12: Overview of Montreal seaway (Photo credit: Wikipedia)

→ After leaving the seaway, we will visit the Jacques Cartier Bridge before departing the city and returning to Ottawa.

3.2 The Jacques Cartier Bridge

The Jacques Cartier Bridge, a five-lane bridge with a total length of 3.4 km (11240 ft.) that opened in 1930, spans the St. Lawrence River between the cities of Montreal and Longueuil. Its signature feature is a cantilever bridge with a main span of 334.4 m (1097 ft) and anchor spans of 128 m (420 ft.). A testament to Montréal's many changes, the Jacques Cartier Bridge stands as one of the city's most iconic symbols today. It is safe to say that the Jacques Cartier Bridge is no ordinary bridge: in 2017, it became the world's first "connected" bridge, when it was outfitted with a cutting-edge lighting system that moves to Montréal's own dynamic beat.

Come dusk, you can see the city's energy expressed through an intricate system of LED lights pulsing across its delicate, web-like structure. The data used to create these luminous choreographies is culled from numerous sources, including traffic, weather, news and social media. The bridge changes with the seasons thanks to a 365-colour calendar. Day after day, it gradually changes from an energizing spring green to a radiant summer orange, a voluptuous fall red, and finally an icy winter blue. The light subtly evokes the passage of time. The Jacques Cartier Bridge is an iconic symbol of Eastern Canada and a remarkable feat of engineering. It provides visitors with an opportunity to appreciate its structural innovation, and the engineering ingenuity required for its construction.

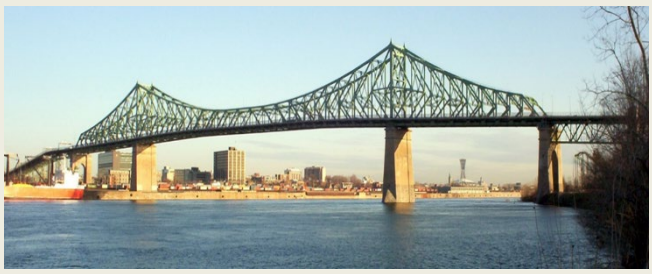

Figure 13: The Jacques Cartier Bridge (Photo credit: Wikipedia)

Figure 14: Lighted Jacques Cartier Bridge (Photo credit: JCCBI)

Duration of visit: 1 hour

REFERENCES