



WHISTLER SLIDING CENTRE SHOWCASES SUSTAINABLE PRACTICE & INNOVATION ON WORLD-CLASS SCALE



Under construction, Summer 2007. Photo courtesy of Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games.



Track sections under construction. Above photos courtesy of Stantec.

The pursuit of sustainability inspires industry leaders the world over to develop innovative practices that build a greener future. Project owners and designers are taking a multi-disciplinary approach to construction projects and demanding high-performance results to last a lifetime.

The Vancouver Olympic Committee (VanOC) is a case in point; with the 2010 Olympics fast approaching, construction of required facilities is well underway. VanOC's race track at the Whistler Sliding Centre combines performance-driven design with innovative construction practices to present a world-class facility that exemplifies sustainable practice.

Maximizing this project's potential involved a collaboration of VanOC representatives^[1], design engineering and construction specialists^[2] and experts in the Olympic sports of bobsleigh, luge and skeleton. Track specifications include a 100-year design life for a safe and challenging world-class course.

Embracing sustainability from the outset, VanOC's Whistler Sliding Centre design balances its economic and social potential with minimal environmental impact. Sustainable practice informed every aspect of the project's execution, from its compact design to the recycling and restoration of original flora indigenous to the site: "The track location is carved out of the forest to minimize tree removal during construction. Tree tagging, sediment control measures, as well as remediation of aged storage areas, wood chipping and composting onsite,"^[3] helped to reduce the venue's "footprint". Energy efficient lighting and sound systems are designed to be as non-intrusive as possible while yielding the visibility and acoustic capacities required of world-class sport venues.

From an engineering standpoint, the Sliding Centre merits further acclaim. The track's U-shaped structure varies throughout its 1450 metre length over a 175 metre vertical drop. Track wall heights range from 60 cm. on straightaways to nearly 3

metres on its 16 curves. Track floors and walls are comprised of refrigeration pipes with 2 layers of reinforcing steel at each face, all encased within a 150 mm. concrete shell.^[2]

Constructing this complex shape over rugged, downhill terrain presented an array of challenges. Each of the track's 23 structural sections has a fixed, reinforced concrete foundation at the middle and flexible supports at 5 metre spacing from the centre to both ends. A designed gap of 50 mm. between sections allows the track to expand and contract with variable weather conditions. Pendulum concrete columns, or walls with neoprene pads on reinforced concrete footings, support and accommodate track movement under varying loads.

Materials selection, design, spacing and location of reinforcing bars, was crucial to:

- accommodate the dynamic geometry of the track,
- ensure compatibility with the layout of refrigerant pipes,
- facilitate placement of the concrete, while minimizing shrinkage cracks, and
- meet stringent International Olympic Committee requirements for concrete density, cover and finish.

Cast-in-place shotcrete concrete, using 15% Fly Ash, was selected for the track structure. **Fly Ash Shotcrete is an excellent material choice for the specialized placement, long-term performance and improved sustainability**^[4] required for this high profile project.

Fly Ash "increases the workability and slump compared to... concrete without Fly Ash. This is generally attributed to the spherical shape and smooth surface of Fly Ash particles...resulting in a better surface appearance."^[5]

Prolonged workability was critical to successful application of the thin shotcrete layer over refrigerant pipes, used to freeze the track's surface. The concrete cover,

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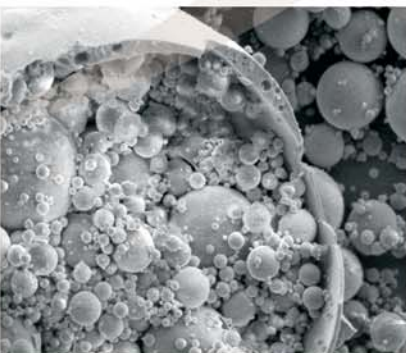
SUSTAINABLE PRACTICE AT WORK: VANOC'S WHISTLER SLIDING CENTRE



View from Starting Gate. Photo courtesy of Stantec.



Whistler Sliding Centre construction was completed in Dec. 2007. Under construction, Summer 2007. Photo courtesy of Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games.



Electron micrograph of Fly Ash particle. Photo courtesy of Natural Resources Canada.

just 25 mm. thick, minimizes the energy required to freeze the track's surface. And its remarkably smooth finish will contribute to optimum sliding conditions for 2010 athletes.

The technical properties Fly Ash imparts to concrete will benefit this project well beyond the construction phase, by enhancing its durability throughout its designed service-life. Fly Ash content in shotcrete improves long term performance by minimizing thermal cracking, increasing the ultimate strength (MPa) and improving the impermeability of the cured concrete:

- "Due to reduced water demand, Fly Ash concrete will significantly reduce shrinkage compared to Portland Cement concrete."^[5]
- the pozzolanic reaction of Fly Ash in concrete "increase[s] compressive strength at later ages."^[5]
- less permeability at later ages...will provide better corrosion protection for reinforcing steel.^[5]

Measuring 51 MPa at 28 days, the concrete surface is strong and durable, having exceeded its 35 MPa (28 day) design strength. As chemical reactions in the concrete progress over coming months, the track will "cure" to gain structural strength.

Fly Ash is a mineral product of coal-fired electricity generation. **From a sustainability perspective, the use of ash in concrete increases the recycled content of the mix and reduces the GHG emissions per cubic metre of concrete,** to improve the environmental footprint, compared to conventional Portland Cement concrete.^[6] Indeed, the GHG emission reductions and carbon offsets attributable to Fly Ash used in concrete is attracting increasing interest from environmentally-minded manufacturing, design/building professionals and policy makers across North America.^[6,7,8,9]

The BC Ready-Mixed Concrete Association acknowledged VanOC's achievement in May 2008 with its inaugural "Century Award" for Excellence in Concrete Construction."^[9]

With all of this going for it, VanOC's Whistler Sliding Centre is a prime example of the Olympian dictum: pursuit of excellence.

References:

1. Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games <http://www.vanoc.com>
2. K. T. (Ray) Chan, Senior Structural Engineer Associate, Stantec (Surrey, BC) <http://www.stantec.com/>
3. Resort Municipality of Whistler <http://www.whistler.ca/content/view/104/135>
4. "When Fly Ash replaces cement in concrete, the environmental impact improves along with the energy efficiency & durability of the concrete", Naik, T.R. et al. "Long Term Performance of HVFA concrete pavements" ACI Mater. J., 100 (2) 150-155, 2003
5. Use of Fly Ash and Slag in Concrete: A Best Practice Guide, N. Bouzoubaa & S. Foo, Materials Technology Laboratory, January, 2005: <http://scm-ac.gc.ca/docs/bestpractices.pdf>
6. "Industry has recognized the value of cementitious material substitutions for Portland Cement as a means to enhance concrete from both a performance and environmental perspective...The use of Supplementary Cementing Materials (SCMs) in concrete as a partial substitution for Portland Cement reduce[s] GHG emissions associated with the use of concrete." A synthesis of Data on the Use of SCMs in Concrete Pavement Applications Exposed to Freeze/Thaw and Deicing Chemicals, N. MacLeod, P.Eng., for Cement Association of Canada, March 2005: <http://scm-ac.gc.ca/docs/pavements.pdf>
7. North America's leading green building program, Leadership in Energy Efficient Design (LEED) is promoted by Canada Green Building Council: <http://www.cagbc.org>
8. Sustainable Coal Ash, CIRCA, May 2008: <http://www.circainfo.ca/factsheets.htm>
9. BC Ready-Mixed Concrete Association <http://www.bcrmca.bc.ca/index.php?Id=64>

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