Sled design led by UC professor slides in to Sochi for the Olympics

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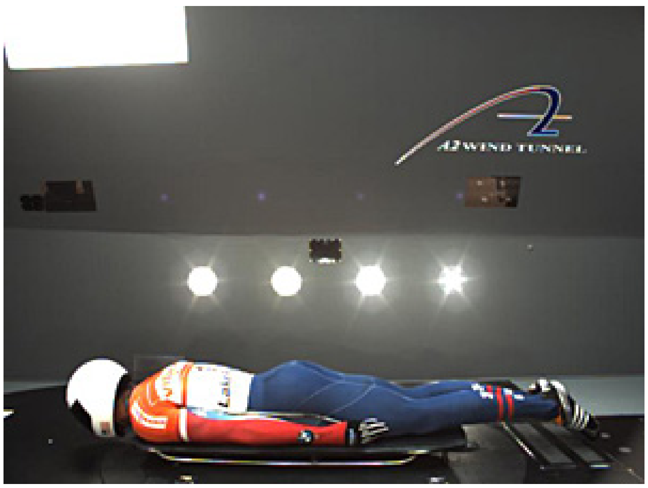

A2 Wind Tunnel

A design team led by a University of Cincinnati professor will be avidly watching its latest creation at the 2014 Winter Olympics in Sochi, Russia. But it will be gone in a flash on your TV screen.

The ProtoStar V5 skeleton sled will be used by three U.S. athletes in Sochi: Matt Antoine, Katie Uhlaender and John Daly. The skeleton sled competitions in Sochi are scheduled to take place Feb. 13-15.

The sled design team, led by Grant Schaffner, an assistant professor in UC's Department of Aerospace Engineering and Engineering Mechanics, and Tuffy Latour, the head skeleton coach for the U.S. Bobsled and

Skeleton Federation (USBSF), are already celebrating the gold and bronze medal awarded to the ProtoStar V5 skeleton sled last fall in World Cup competition.

Schaffner says the ProtoStar V5 is a greatly improved design over the X2 skeleton sled that was introduced – a design Schaffner also led – at the 2010 Winter Olympics in Vancouver.

The development of the skeleton sled is a partnership between Cincinnati-based ProtoStar Engineering (the lead company for the technology team), UC's College of Engineering and Applied Sciences (CEAS), Fairfield-based Machintek Corporation, deBotech Inc. of North Carolina and Carpenter Technology Corporation of Pennsylvania. Testing got underway last September at the A2 Wind Tunnel, a premiere aerodynamics testing facility in Mooresville, N.C.

Face Plant at Warp Speed

A skeleton sled is a one-person sled that uses the same track in competition that is used by bobsled or luge. The skeleton sled has a speed range between 70-to-90 miles per hour. It supports the rider's upper body as he or she races head-first and face-down on the sled toward the finish line.

A2 Wind Tunnel

To steer the sled during a competition run, the athlete applies shoulder and knee pressure to warp the sled frame, which in turn changes the amount of drag on the ice from spines cut into the rear portion of round steel runners that support the sled.

Schaffner says competitors also can help steer the sled by using their head like a wind vane, or by tapping their toes to create additional drag on the ice.

"The length of a track is typically about one-to-one-and-a-half kilometers, so the length of the race is about one minute," says Schaffner. There's no steering wheel to navigate around the slick situation. "The shoulder and knee are used to work the sled, so no actual steering mechanism is allowed.

"You're constantly tweaking the sled during the race. You're going very fast, and when you go through the turns, you usually pull as much as four Gs or even slightly more," Schaffner explains. "Your body weight is four times more than what you would normally weigh – about 600 pounds – and on a sled, that can be a lot of force. Plus, the track surface is not very smooth, so competitors are often hitting abrupt bumps, which can make the ride quite rough."

Schaffner says that for the past four years, the sled development effort has greatly benefitted from a strong collaboration between the coaches and athletes of the USBSF and the technology partners. Schaffner guided the design effort by ProtoStar engineers and also worked with UC professors Randall Allemang and Allyn Phillips of the UC Structural Dynamics Research Lab to better understand the sled's characteristics related to vibration.

"We had designed the X2 sled (used in the 2010 Olympic Games) to smooth out the bumps and make it steerable and controllable, and it performed extremely well in that regard, but the metal would bend. Then, we turned to Carpenter Technology, a company that specializes in high-strength steel alloys that have eliminated the frame-bending issues. Making a fast sled is more than just a matter of design," Schaffner says, "it also requires very high precision machining, and that is provided by the Machintek Corporation."

In addition, deBotech, a company that specializes in fabricating carbon fiber composite parts and has worked with NASCAR and the America's Cup sailboat races, provides the '"pod" or aerodynamic fairing on the underside of the sled. Schaffner worked closely with Hans de Bot, the company president, to optimize both the aerodynamics and structural stability of the pod.

Schaffner further explained that one of the founding principles of the design was to bolt it together, rather than weld it together, making it easier to change out parts. "This has allowed for a continuing improvement process, whereby we can adjust the structural characteristics of the sled from one race to the next, or try things out during test sessions, to find out what works best," says Schaffner.

The work out of UC's Structural Dynamics Research Lab was supported by funding from the USBSF and the U.S. Olympic Committee. Schaffner adds that UC graduate and co-op students in engineering participated in the design research in the Structural Dynamics Research Lab. The lab develops, investigates and evaluates experimental approaches to the estimation of the dynamic properties of structural systems.

The sled has made a worldly impression. Schaffner received the 2010 U.S. Olympic Committee "Doc" Counsilman Science Award for his innovations and contributions to sport science.

Provided by University of Cincinnati

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