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Grand Opening of VTTI's Center for Injury Biomechanics Crash Sled Lab

Blacksburg, Va., September 14, 2009: The grand opening of the Virginia Tech Transportation Institute's (VTTI) Center for Injury Biomechanics (CIB) Crash Sled Lab (primarily funded by the National Highway Traffic Safety Administration) was held today at its facility in the Corporate Research Center (CRC) in Blacksburg. University administrators, state officials, government and private sponsors, stakeholders and many others attended and were able to tour the lab and office space, hear about the research being conducted and see a demonstration of the "sled."

The new 10,000 square foot CIB facility houses offices, conference rooms, an impact laboratory, and a high-speed biplane x-ray suite. The facility itself was designed with several characteristics to reduce energy consumption. These include a custom lighting system that uses 50% less power than standard sled lighting systems; a highly efficient heating and cooling system that recaptures heat from the exhaust air; and a custom cooling system designed for the hydraulic testing device that will save over three thousand gallons of water each day.

The jewel in this research showcase, however, is a 1.4 mega newton (MN) *ServoSled* System crash sled manufactured by Seattle Safety. This sled is used primarily in the study of transportation-related trauma with its chief applications found in the automotive environment.

Transportation-related trauma remains a significant problem to society. The mortality and morbidity associated with automobile use represents substantial cost in monetary as well as human terms. Automobile passengers, pedestrians, pedecyclists, and motorcyclists alike will benefit from the knowledge gained through research conducted at the new sled laboratory. These benefits are not limited to the automotive environment; the new sled facility can be used to help improve the safety of travel by rail and air, and even in space. Furthermore, injuries experienced by military personnel both in theater and as civilians can be reduced through the efforts of CIB researchers.

"The motivation and goal of our research is to save lives and reduce injuries. This new facility will allow our investigators to answer any impact question from automobile safety to military restraint design" said Dr. Stefan Duma, Head of the Virginia Tech – Wake Forest School of Biomedical Engineering and Sciences (SBES). "This is the only facility in the world with the unique capabilities of high rate impact testing to high rate imaging. These tools will allow our researchers to be leaders in nationally- and internationally-funded research," says Duma. He also introduced the new Directors for the CIB. "We are extremely fortunate to have two of the world's best researchers directing the research here; Dr. Warren Hardy, Associate

Professor in Mechanical Engineering at Virginia Tech and Dr. Joel Stitzel, Associate Professor of Biomedical Engineering at Wake Forest."

The general theme for the new crash sled lab is "Saving Lives and Preserving the Planet" and the *ServoSled* System crash sled will help the CIB to better understand the mechanisms of injury and to develop better mitigation schemes and protection systems, thereby saving lives. It can be used to recreate crash pulses from real-world crashes where people sustain serious injuries. This is of great interest and use to government agencies and private industry. For example, the Toyota-Wake Forest University (WFU) School of Medicine Crash Injury Research and Engineering Network (CIREN) Center enrolls 40 cases a year where crashes are investigated and reconstructed, and injuries are analyzed. Those real-world crashes can be reconstructed using the sled to better relate the crash conditions to the risk of injury as well as the actual injuries sustained.

VTTI Director Tom Dingus said, "The new VTTI facility will also allow the VT-WFU CIB to 'close the loop' on injuries allowing complete analysis from the most basic biomechanics and prediction tools, to the outcome of real-world patients. It is a capability that few other groups in the world have. With VTTI's existing expertise in crash avoidance research and CIB's expertise in crash survivability, we now have great synergy to help reduce automotive injuries and fatalities."

Although the *ServoSled* System is often used for basic research, more applied studies are conducted using reinforced vehicle structures or "bucks" fastened to the deck of the sled which can accommodate up to a 2500-kg payload. The bucks are used to evaluate vehicle interior components and restraint systems. The sled starts from rest and is pneumatically driven to the desired speed while following a prescribed acceleration pulse. The pulse is shaped using a hydraulic braking system and high-frequency closed-loop control of acceleration and brake pressure. The acceleration pulse is selected to mimic the crash performance of a specific vehicle or other impact event and the pulse is quickly and easily modified and programmed to suit.

Unlike other sled systems, the *ServoSled* can provide large acceleration late in an event and is capable of producing bipolar acceleration pulses. Frontal, rear, and side-impact car crashes can be simulated using human surrogates, including crash dummies. More than 200 transducer channels can be collected using onboard signal conditioning and data acquisition hardware. Multiple high-speed video cameras positioned both on and off the sled are used to capture event kinematics. The *ServoSled* System is capable of delivering 475,000 N-m, which translates to a maximum 90 kph and 93 g (20 g/ms) within a 2-m driving stroke. At full payload the sled can achieve 57 kph and 37 g. This system is designed to provide late-event and negative acceleration, both of which are typically unattainable by other systems.

"Given the interdisciplinary nature of our research, this new facility would not have been possible without the enthusiasm and cooperation of Virginia Tech and Wake Forest University, as well as our federal and private sponsors. The plans for this facility began over four years ago and include a wide range of partners in the region. With VTTI leading the effort, we received strong support from the Virginia Tech Research Division, Wake Forest University, the Virginia

College of Osteopathic Medicine (VCOM), and Institute for Critical Technologies and Applies Sciences (ICTAS)," says Duma.

The Virginia Tech – Wake Forest University Center for Injury Biomechanics investigates the mechanical and injury responses and mechanisms associated with trauma on multiple scales. Inherent in this are the study of human tolerance, and the development of injury metrics and functions to assess the potential for injury under specific loading conditions. An extension of this is injury mitigation, for which tools for design and evaluation of environments and equipment are developed, such as physical and numerical models or human surrogates. This work contributes to a better understanding of injury that can lead to improved diagnosis and can provide a foundation for new treatment regimes. Applications of this research include design of protective equipment and safer environments, sports biomechanics, military countermeasures, and automobile safety.

The Center for Injury Biomechanics was founded in 2003 by Dr. Stefan Duma, making use of the resources of the College of Engineering at Virginia Tech and the Wake Forest University School of Medicine. It began with collaboration between Duma at Virginia Tech and Dr. Joel Stitzel at Wake Forest University. Since that time, the CIB has added numerous primary researchers and a large network of affiliated researchers that represent a variety of world-class institutions, including the Virginia College of Osteopathic Medicine. The CIB averages nearly $5 million in annual research expenditures.

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