



WHERE THE RUBBER MEETS THE ROAD

BY LESLIE SWEET

Wide-base tires are the next big thing for the trucking industry, and CEE researchers are North America's foremost experts on the subject

The wide-base tire, as a replacement for the conventional dual-tire system on commercial trucks, is an innovative technology that benefits the environment through fuel efficiency. To pave the way for optimal implementation of this new tire technology, researchers at the Illinois Center for Transportation (ICT) are taking the lead on U.S. and international research related to the wide-base tire.

"By quantifying the wide-base tire's impact on pavements and easing related concerns, the ICT has provided the wide-base tire with even more potential to benefit the nation's trucking industry and the environment," says Imad L. Al-Qadi, ICT Director and U of I Founder Professor of Engineering.

What is a wide-base tire?

A wide-base tire is simply a wider tire that replaces the dual-tire system. Traditionally, dual-tire systems have been used on

commercial semi-truck trailers to provide an adequate footprint to carry heavy loads and distribute axle load over a large area of the pavement. However, the wide-base tire is proving itself as a good economic option for the trucking industry for several reasons. For one, a single wide-base tire and wheel combination is lighter than two standard tires and wheels, and the conserved weight may be used either to reduce fuel consumption or to increase cargo capacity for trucks. Using one tire increases the truck stability as the clearance between the wheel centers increases. Additionally, the trucking industry can realize savings through tire repair and recycling.

The evolution of wide-base-tires

Wide-base tires have evolved considerably since their introduction in the early 1980s. The early wide-base tires were found to cause a significant increase in pavement

damage compared to the dual-tire system. This led many transportation agencies to discourage their use, Al-Qadi says. An improved generation of wide-base tire, introduced in 2000, was found to result in an improved load distribution and better handling. These tires were tested extensively at the heavily instrumented Virginia Smart Road—designed and instrumented by Al-Qadi and his students—to quantify the response of different pavement designs to various tire configurations. Based on that research, a new generation of wide-base tires evolved and was introduced in 2003.

Through ICT, Al-Qadi and his students continued to conduct extensive testing and advanced modeling research on this new generation of wide-base tires. They used three-dimensional tire-pavement measured stresses to model, for the first time, the pavement loading with moving tires at various loadings, tire pressures, and speeds. The researchers were able to identify the critical locations where the pavement damage is usually initiated, which have always been assumed—in most cases erroneously. Researchers at ICT, led by Al-Qadi and his students, validated the modeling outcome by constructing flexible pavement test sections at the ATREL facility in Rantoul, Ill. The test sections were then loaded with the Accelerated Transportation Loading ASsembly (ATLAS) which can imitate real-life traffic loading using various tire types and systems under different loading conditions.

Publicizing wide-base tire research

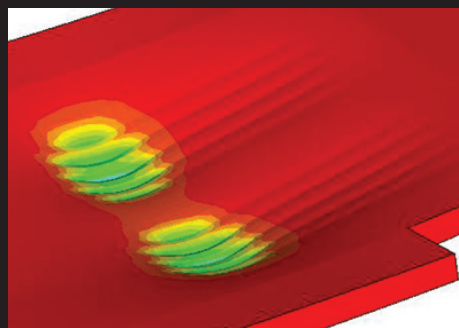
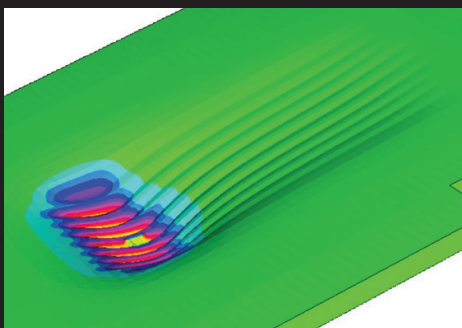
As a result of full-scale testing and advanced modeling, Al-Qadi and his students have concluded that the newest generation of wide-base tire would result in a similar level of pavement impact as the conventional dual-tire system; but with a varying

pattern of damage. Furthermore, Al-Qadi recommends that a wide-base tire be used in the steering axle, because in addition to providing better handling, it would significantly reduce damage to the pavement. His research has demonstrated that a significant portion of the pavement damage related to traffic loading is caused by the steering axle, which applies more load per unit area.

Due to the environmental, economical, and safety advantages of the newest generation of wide-base tires, their use in the U.S. will rapidly increase, Al-Qadi predicts. With the support of the Federal Highway Administration (FHWA), he led a discussion in late October on the wide-base tire's future in the U.S. and related research strategies. Ten leading international researchers on pavement-tire interaction were invited to participate, along with scientists from the trucking and tire industries, and environmental and FHWA researchers. The Illinois Department of Transportation was also invited, because Illinois is the leading state in this effort.

Europe has been using a different design of wide-base tire for the past two decades because of an axle-load limit difference, Al-Qadi says. But acceptance has taken longer in the States, partly because of the disappointing attempt to introduce improperly designed wide-base tires in the 1980s.

"The good news is that the use of the new generation of wide-base tires has been growing substantially, and many stakeholders are interested in the technology, including the trucking industry, EPA, FHWA, and pavement researchers," Al-Qadi says. "The ICT will continue leading the research efforts in this field, collaborating with other world-renowned researchers on the tire-pavement interaction, and disseminating the outcome of its research in North America and the world."



Finite element simulation of wide-base tire (left) and dual-tire assembly (right) loading on viscoelastic flexible (asphaltic) pavements using three dimension stresses applied by each tire rib.



The Illinois Center for Transportation (ICT) is an innovative partnership between the Illinois Department of Transportation (IDOT) and the University of Illinois at Urbana-Champaign.

Located at the Advanced Transportation Research and Engineering Laboratory (ATREL) in Rantoul, Ill., the center sponsors research in transportation issues, such as safety, pavements, bridges, congestion, environment and materials. Students and faculty from diverse backgrounds work together with the goals of ensuring the continuous growth of the transportation economy, maximizing the use of taxpayer dollars, and achieving distinction at both national and international levels.

ICT builds on the renowned experts in transportation and related fields at the University of Illinois, IDOT, and other universities and agencies by providing the appropriate tools and support required for objective advanced and innovative transportation research.

Since its inception in fall 2005, ICT has rapidly grown to be the largest engineering center at the University of Illinois.

The wide-base tire is just one example of how the ICT takes a proactive role in protecting our environment by developing technologies that serve to conserve resources. Tires, pavements, and even rest areas all contain opportunities for environmentally friendly practices, and ICT's research encourages these ideas.

<http://ict.uiuc.edu>