THMPER™

Mobile bridge response testing and evaluation for load ratings

ASCE

Winner of the 2017
Charles Pankow Award for Innovation

THMPER™ is a system for portable, rapid bridge evaluation. It uses custom software to process test data and calibrate finite element models on the spot. THMPER™ can determine bridge load ratings faster, more economically, and with less traffic disruption than other current methods.

The Targeted Hits for Modal Parameter Estimation and Rating (THMPER™) system is the first technology of its kind. As its name implies, the device delivers a forceful impact to the bridge, causing it to vibrate. That vibration response reveals a lot about the bridge's load capacity.

The methods and practices THMPER combines—modal impact testing, refined analysis, and calibration of finite element models—are noted in the AASHTO *Manual for Bridge Evaluation* as accepted standards for determining bridge load ratings. But THMPER combines all three approaches in one platform that is portable, fast, cost effective, and accurate.

THMPER's pistoned drop weight delivers a concentrated impact, generating a free vibration response in the bridge. The concept is somewhat analogous to plucking a guitar string and then recording its distinct vibration profile. Capturing the frequency of the vibrations and the shapes the bridge assumes at various frequencies provides key performance measures regarding the stiffness and mass of the structure.

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How THMPER measures up to current methods

Technology		Est. prep time	Est. test time	Est. report time	Access equip needed?	Bridge closure
Quasi-static with displacement transducers	Ambient monitoring	5–10 days	2–5 days	3–5 days	Yes	Only underside
	Load testing	5–10 days	1 day	3–5 days	Yes	Partial, 2 hrs
Dynamic	Ambient vibration	5–7 days	2–5 days	5–7 days	Yes	Only underside
	MIMO impact	5–7 days	1 day	5–7 days	Yes	Partial, 2 hrs
	THMPER	**Under 1 day**	**30 mins/span**	**1 day**	**No**	**Slowdowns only**

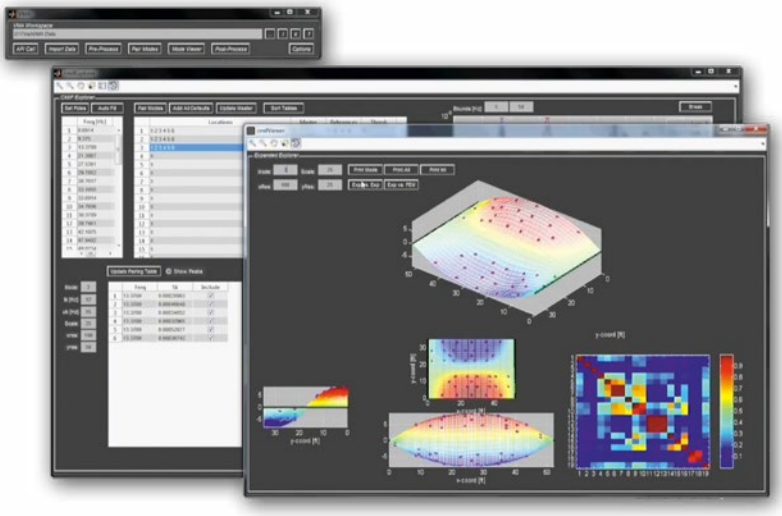
How it works

The crew "thumps" the bridge at predetermined locations across the span, and sensors record its dynamic vibration signature. THMPER is particularly good at picking up key aspects of the bridge's response in the torsional and so-called butterfly mode, i.e., how the girders share the load transversely.

Sensors feed the recorded information directly to technicians in the control van. There, the data are processed and applied to calibrate a refined finite element (FE) model, which in turn indicates how much load a bridge can safely carry.

THMPER provides quantitative data that accurately represents a bridge's load capacity. **It can test a 100-foot-long, three-lane bridge in about 45 minutes and can evaluate an estimated 300-plus bridges per year at about 25 percent the cost of current testing methods.** Plus, it minimizes traffic disruptions.

With all of that going for it, THMPER could revolutionize how America's 600,000-plus bridges are regularly assessed, rated, and prioritized for repair or replacement.



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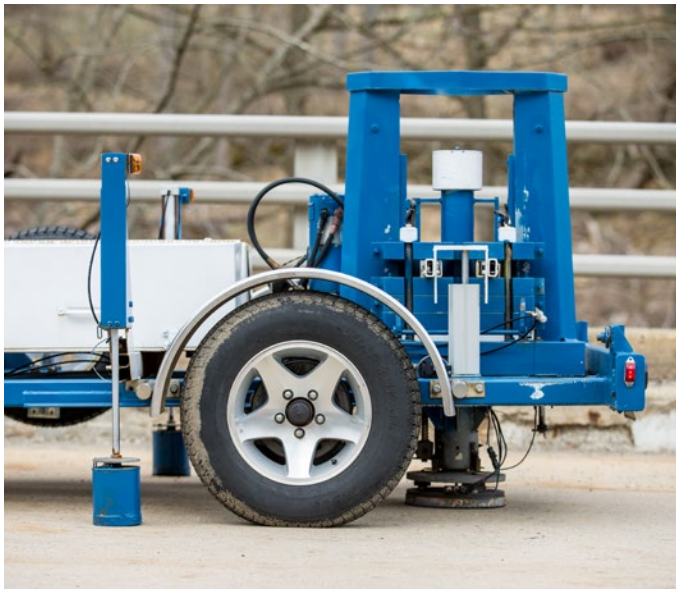

The THMPER™ story

THMPER was created by Dr. Franklin Moon and collaborators IIS, Pennoni, and Rutgers CAIT. Development began when Moon was teaching at Drexel University and concurrently working as an affiliated researcher with CAIT on the FHWA Long-Term Bridge Performance Program. Moon joined the Rutgers School of Engineering civil and environmental engineering faculty in January 2016. The initial project was funded by a grant from the National Institute for Standards and Technology's Technology Innovation Program (NIST-TIP).

Learn more

To date, THMPER has been used to assess more than 30 bridges in Delaware, Maryland, New Jersey, Oregon, Pennsylvania, and Washington under cooperative pilot programs with federal, state, and local transportation agencies.

For technical questions or information on THMPER testing contact Dr. Franklin Moon, franklin.moon@rutgers.edu.