US Army Corps of Engineers®
Engineer Research and Development Center

Triaxial Earthquake and Shock Simulator (TESS)

Purpose

The Triaxial Earthquake and Shock Simulator (TESS) — an experimental 3-dimensional "shake table" — is used to test the ability of systems and facilities to survive under realistic conditions of weapons-induced shock and vibration, and earthquake ground motion. TESS serves in a wide variety of testing roles, including testing shock survivability of computer equipment (shown below), computer floors, and shock isolation systems in military facilities; studying the behavior of structural building models and components in seismic environments with a focus on ways to increase the seismic resistance of steel, reinforced concrete, and masonry structures; subjecting full-size electronic systems to simulated transportation and seismic environments; and determining the effects of shipboard vibrations on naval systems.

Specifications

In its biaxial mode, this unique dual-mode shock and vibration test facility simulates a wide range of transient shock vibrations typical of military applications requiring large accelerations over a wide frequency range with moderately heavy test specimens. In the triaxial mode, it can simulate a variety of vibration environments including earthquakes and random vibrations, as well as log-sweep and resonant searches. In this mode, the TESS can test larger specimens over larger displacement ranges more typical of seismic vibrations. The TESS combines a high payload capability with a broad frequency range, high acceleration performance, a wide displacement range, and simultaneous, independent control of up to three axes of vibration. Biaxial performance is rated with a 12,000 lb payload, and the triaxial performance with a 120,000 lb payload. Larger payloads can be tested at lower acceleration levels, while smaller payloads can be tested at up to twice the rated accelerations.

Benefits

TESS is currently available for cooperative use by any government agency or university. The facility is also available to private companies if their requirements are unique and cannot be performed by nongovernment facilities. Work on TESS is done on a cost-reimbursable basis.

TESS provides the capability to test equipment and structural models of various sizes under controlled, realistic shock, seismic, and vibration environments that cannot be economically produced in field tests. The integrated analog and digital systems provide the capability to measure and analyze large volumes of test response data using a variety of time and frequency analysis procedures. TESS can independently control three axes simultaneously. This provides a more realistic simulation of real-world vibration environments without having to make engineering assumptions about test performance in the unexcited axes.

Success Stories

TESS is most frequently used in four research areas:

1. *Facility Evaluation*. For example, TESS was used to investigate the influence of flexible diaphragms on masonry buildings subjected to seismic motions.

2. *Building Rehabilitation*. TESS was used to investigate the applicability of fiber-reinforced polymer (FRP) composite retrofit systems to strengthen unreinforced walls made of concrete masonry units or clay brick.

3. *New Facility Design and Construction*. These projects are associated with seismic design of new facilities, for example, to investigate cold-formed shear panel behavior under simulated seismic loading.

4. *Equipment Qualification and Upgrade Development*. TESS is used to investigate the vulnerability of critical equipment subjected to seismic and shock loading, as well as to develop upgrade technology to protect the equipment.

Point of Contact

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