Laboratory Facilities

Ultrasonics Laboratory, 410 EES Building, Rose director – The Ultrasonics Lab has nondestructive evaluation and structural health monitoring capabilities for aircraft, , civil infrastructure, mechanical equipment, rail, and manufacturing quality assurance applications. A whole series of piezoelectric sensors and electro magnetic acoustic transducers are available over a frequency range from 50 KHz to 25 MHz. Five shock and tone burst instrumentation systems are available. It also has an 8 channel phased array tone burst system to do focusing in pipe, a laser based ultrasonic test system, and a set of air coupled sensors. Computer modeling and computational software are also available to generate dispersion curves and wave structures for all sorts of geometries including plates, pipe, multiple layer structures, rail, rods and other shapes. Programs for anisotropic and viscoelastic structures can also be integrated into the programs. Elastodynamic wave propagation and scattering finite element and boundary element codes are also available for wave propagation and wave scattering from defects for a whole series of different wave guides. Both ABAQUS and ANSYS finite element analysis software packages are available.

Acoustic Microscopy Lab, 311 EES Building, Tittmann director – The Acoustic Microscopy Lab houses three acoustic microscopes for teaching and research: (1) the Ultran System for acoustic microscopy of large samples and low resolution (100 micron and up), (2) the Olympus UH-3 System for acoustic microscopy of small samples and high resolution (1 micron and up), and (3) the Ultrasonic Atomic Force Microscope U-AFM for acoustic microscopy of small samples and super resolution (10 nanometers and up). These instruments are being used to investigate thin films, coatings, bio-cells, and semiconductors.

Acousto-Optics Lab, 310 EES Building, Tittmann director – The Acousto-Optics Lab features the Microscopic Electronic Speckle Pattern Interferometer (MESPI) for measuring holographically the dynamic surface deformation (0.1 micron resolution) in-situ. For example, during laser drilling and cutting surface deformation results from thermal stress. Another feature instrument is a system for the detection of cracks in locomotive wheel tires with the use of electromagnetic acoustic transducers (EMATs).

Nondestructive Evaluation Teaching Lab, 406 EES Building, Tittmann director – The Nondestructive Evaluation Teaching Lab features an X-ray instrument and an acoustic emission system. These instruments are part of the laboratory hands-on demonstrations for the course E MCH/MATSE 440: Survey of NDE Techniques.

Axial-Torsion Fatigue Laboratory, 110 EES Building, Lissenden director – A fully equipped mechanical testing facility is available in the Engineering Science and Mechanics Department at Penn State for testing metals, composites, ceramics, and polymers. Test results are typically deformation, stiffness, strength, fracture toughness, or fatigue related. Both materials constitutive behavior tests and structural component tests are feasible.

Laboratory for Parallel Computational Mechanics (LPCM), 408 EES Building, Costanzo co-director – A high performance computing cluster containing 18 Apple X-servers with 36 processors. The Xserves run Mac OS X, which is built upon BSD UNIX. The Xserves are

connected to one another via high speed Ethernet through two switches. Members of LPCM run parallel finite element codes and have developed custom software for parallel molecular dynamics simulations. The LPCM cluster is capable of approximately 17 Gflops on scalar code and can achieve much higher performance on vector code. Currently, Prof. Costanzo is supervising a Ph.D. student and a post-doc who have been developing in-house nonlinear parallel finite element codes for the solution of fully coupled and fully dynamic thermo-mechanical problems with evolving damage and fracture.

USMC Vehicles, Reichard – ARL currently has use of two USMC tactical wheeled vehicles: a HMMWV and an MTVR medium tactical truck. These vehicles are instrumented for vehicle health monitoring studies. In the past, ARL has also had an LAV, light armored vehicle, and a HEMTT, heavy tactical truck.

Machinery Diagnostics Test Beds, Reichard – Test beds for conducting run-to-failure testing on gear boxes, shafts, bearings and motors. Drive force can be provided by either an electric motor or a diesel engine; load is provided by an electric motor used as an electrical generator.

Electrical Power Test Beds, Reichard – Test beds for studying faults in motors, electrical generators, electrical power systems and batteries. Faults can be inserted in the electrical motor or generator. Batteries can be run through accelerated life testing at various electrical loads and under different thermal conditions.

Torsional Vibration Test Bed, Reichard – Test bed for conducting tosional vibration studies includes variable length and diameter shafts, driven by an electric motor. This test bed has been used for the development of torsional vibration health monitoring algorithms and sensor development, evaluation and testing

Sensory Materials Laboratory, Zhang – A range of characterization and fabrication facilities for polymer, thin films and nanocomposites, and for electroactive polymer and composites micro-devices. The characterization facilities include: dielectric, electromechanical, pyroelectric, and polarization vs electric field, temperature measurement set-ups; electric field induced strain measurement under different load condition and temperature (-100 ^{o}C to 150 ^{o}C) and over broad frequency range (from near static to 1 MHz) with small probe size, Impedance analyzers for transducer characterization, High voltage power supplies and amplifiers, dielectric and piezoelectric spectroscopies, current-voltage (I-V) measurement system, thermally stimulated discharging current (TSCD) set-up, DSC, DMA, optical microscope, atomic force microscope, Instron mechanical test system.

Chehab, Laman, Linzell, Lopez, and Schokker – The Department of Civil and Environmental Engineering and its associated research centers and institutes provide a number of excellent field facilities and experimental laboratories for evaluating new, proposed, or re-engineered construction related materials and products. The materials and testing laboratories provide facilities for simulation/modeling, full-scale, and bench testing for research involving materials used in nearly all civil structures: cement and concrete materials and systems, aggregate characterization, asphalt paving materials and fabrics, composite materials and systems, industrial chemicals, recycled/reclaimed materials, and other bridge materials including steel and

wood. The laboratories, equipped with facilities, equipment, and instrumentation for a full range of scale and full-size testing of materials, are housed in:

- The Civil Infrastructure Testing and Evaluation Laboratory (CITEL) includes a 56,000-square-foot, large-scale testing facility and five other laboratories for smaller-scale structural testing. The laboratories are equipped with reaction floors and the necessary loading and data acquisition equipment to simulate any effects that a structure would encounter. MTS servo-controlled actuators, with capacities upwards of 220,000 pounds, and a variety of hydraulic rams, pendulums and a drop-hammer are used to apply the loads.
- Northeast Center for Excellence in Pavement Technology (NECEPT)
- Materials Testing Laboratory (MRL)
- Pavement Durability Test Track (PTI)
- Composite Materials Laboratory The laboratories of Penn State's Composites Manufacturing Technology Center contain a wide range of equipment for the fabrication, testing, and evaluation of fiber-reinforced structural composite materials, including structural shapes, prestressing tendons, reinforcement bars, and external repair/rehabilitation materials. The types of projects carried out in recent years include fabrication and characterization of fiber-reinforced polymers (FRP) and durability evaluation of FRP reinforced concrete elements subjected to simultaneous long-term sustained load and environmental exposure.

STRUCTURAL MATERIALS

Penn State's expertise includes testing and evaluation of the effects of materials, construction practices, design parameters, static/dynamic/repeated loadings and environmental effects on response and behavior. Latest research has focused on evaluation of steel, concrete, wood, masonry, and composite structures and subassemblies This has been possible in part to a 56,000-square-foot, large-scale testing facility and five other laboratories for smaller-scale structural testing. The laboratories are equipped with reaction floors and the necessary loading and data acquisition equipment to simulate any effects that a structure would encounter. MTS servo-controlled actuators, with capacities upwards of 220,000 pounds, and a variety of hydraulic rams, pendulums and a drop-hammer are used to apply the loads. Laboratory corrosion testing capabilities are enabled through the Accelerated Corrosion Testing System.

PAVEMENT/GEOTECHNICAL MATERIALS

The pavement laboratory facilities include a state-of-the-art binder and mixtures laboratory that is equipped and staffed to perform all of the SHRP Superpave tests as well as specialized binder, mixture, and other pavement material characterization tests. It houses conventional asphalt binder and mixture test equipment as well as advanced testing systems and sophisticated one-of-a-kind research instrumentation.

The accelerated pavement tester MMLS3 (Model Mobile Load Simulator, third scale) allows accelerated testing of laboratory-fabricated slabs and field pavement sections by applying accelerated wheel trafficking. Pavement materials recently tested include steel construction plates, geogrids, paving fabrics, engineered bituminous mixtures, and surface treatment materials.

The geotechnical laboratories are capable of evaluating characteristics and properties of a broad range of geotechnical materials including soil, aggregate, geotextiles, and recycled material Additionally, three mobile laboratories are available for in-situ testing of subsurface and surface evaluation of other infrastructure materials.

CEMENTITIOUS MATERIALS AND CONCRETE

The laboratories are equipped with a full range of AASHTO and ASTM cement, grout, mortar, masonry and concrete testing. In addition, the laboratories contain research equipment that is capable of conducting full-scale or component structural testing, detailed petrographic materials evaluations, and in-situ non-destructive evaluations of structures.