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CIRCULAR



Inventory of Special Facilities for Highway Research

**INVENTORY OF SPECIAL FACILITIES
FOR HIGHWAY RESEARCH**

Developed by Committee A5T61
Inventory of Special Facilities for Highway Research

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL
in cooperation with and support from

American Association of State Highway and Transportation Officials'
Research Advisory Committee
and
U.S. Department of Transportation
Federal Highway Administration

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Transportation Research Board
National Research Council
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Inventory of Special Facilities for Highway Research



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INTRODUCTION

Comprehensive transportation research programs are essential to improving the safe and efficient movement of people and goods in the years to come. This fact was recognized by the authors of the National Transportation Policy, who emphasized the critical role played by research in the solution of transportation problems.¹ Transportation research programs have a long history of developing new approaches and identifying innovations to solve operational problems. The successes of the past cannot, however, ensure continued improvements as the nation's roadway system ages and the traffic demands exceed the system's capacity. To meet current and future challenges, the highway community must endorse and support basic and applied research efforts to identify and develop feasible holistic solutions to the complex multidisciplinary transportation problems.

As the highway community makes the transition from building roadway systems to maintaining the current system and improving its efficiency and safety, new methods, technologies and materials must be identified and developed to meet the transportation needs of the twenty-first century. These efforts are heavily dependent on providing state-of-the-art equipment and laboratories and on attracting the best students and imaginative researchers who can bring the curiosity, creativity, imagination, and technical expertise to bear on current and future highway problems. These actions are vital to maintaining and extending the United States' competitive position in the world economy.

In response to these challenges, the Federal Highway Administration (FHWA) recognized the need to develop an inventory of existing state-of-the-art equipment and laboratories that are available to support this nation's future transportation research effort. The FHWA requested that the Transportation Research Board (TRB) in cooperation with the American Association of State Highway and Transportation Officials (AASHTO) conduct this inventory study.

PURPOSE

The purpose of this study was to identify major and unique research, development and testing facilities in the United States, both public and private, that can be utilized to support future highway research efforts. The information generated provides the basic foundation for federal, state and local agencies and private organizations to identify available resources that supplement in-

house research capabilities, and to identify needed facilities.

SCOPE

The complexity of current highway problems and the rate of discovery of new technologies make it difficult to specify precisely what facilities will be required to support highway research activities into the twenty-first century. To circumvent this deficiency a broad definition of highway research and development was used to aid in the identification of those facilities which will most likely be needed. The definition used to identify facilities of interest was:

research equipment, testing devices, and field laboratories and test tracks that are essential to a national highway research program, but are only available at very few locations due to their high costs or limited demand.

The constraints of high costs and limited demand were added to exclude equipment commonly found in well-equipped university and testing laboratories. The intent of the project was not to produce a comprehensive catalog of all laboratory facilities. Only facilities with unique capabilities or an estimated replacement cost of more than \$500,000 were sought.

The inventory includes special facilities currently in use for highway research, as well as planned facilities that will be operational within the next few years. It also includes facilities currently used in non-highway research that may have application for highway research purposes. Facilities owned by governmental agencies, research organizations, universities, and industry were also included.

Table 1 provides examples of the types of facilities sought in the survey. Other facilities of similar scale and uniqueness were included if they were believed of value in future highway research.

The inclusion of research facilities known to each state AASHTO Research Advisory Committee (RAC) representative and those described in national directories provided a comprehensive list of candidate research facilities. Not every research facility in the United States was contacted, and for some of the facilities contacted the responsible individuals may not have recognized the potential application of their facility in future highway research. Therefore, this *Circular* does not contain a complete listing of all facilities in the United States that

INVENTORY OF SPECIAL FACILITIES FOR HIGHWAY RESEARCH

TABLE 1 EXAMPLES OF SPECIAL FACILITIES

Materials and Geotechnical

- ▶ Environmental exposure chambers (walk-in type, 3,000 cubic foot or larger) with controlled temperature or temperature cycling, corrosive agent exposure chambers, ultraviolet or similar capabilities.
- ▶ Large-scale centrifuge equipment (as used in geotechnical model work to exaggerate effects of gravity), 0.5 ton bucket or larger, with acceleration to 30g or greater.
- ▶ Instrumented full-scale structures for soil-structure interaction studies, such as retaining walls, spread footings, pile foundations.
- ▶ Well-equipped outdoor exposure test sites for exposure to sunlight, salt atmosphere, air pollution, temperature extremes, etc., for the investigation of deterioration and corrosion of various materials and of the effectiveness of protective coatings, inhibitors, etc.

Pavements and Structures

- ▶ Large-scale structural test facilities (capable of static loads more than 1 million pounds and controlled repeated or dynamic loads more than 100,000 pounds).
- ▶ Seismic shake tables (10' by 10' or larger, with static specimen load of at least one ton), with random wave form input control and digital data collection and processing capability.
- ▶ Vehicle-pavement dynamic interaction simulators, with capability to carry two or more axles and loads up to 20,000 pounds or more.
- ▶ Pavement accelerated load test equipment or pavement test tracks, including those that provide control of specimen temperature and moisture.
- ▶ Boundary layer wind tunnels (throat 8' by 10' or larger), with precise control (1% of velocity in range 10 to 100 feet per second) and capability to generate controlled scale turbulence.

Human Factors Experimental Facilities

- ▶ Controlled facilities for visual experiments under special viewing conditions of fog, darkness, dust, etc.
- ▶ Driving simulators that are interactive, including kinematic cues to the subject and signing, lighting, or control devices, in-vehicle displays, or the presence of other vehicles or obstacles.

Traffic and Safety Test Facilities

- ▶ Test tracks capable of handling both passenger and heavy vehicles at high speeds and in critical maneuvers.
- ▶ Crash test facilities (with adequate instrumentation and data acquisition and reduction facilities).
- ▶ Instrumented and monitored highways for traffic control experiments.
- ▶ Intelligent vehicle highway test facilities.

Environmental Test Facilities

- ▶ Controlled facilities that permit the measurement of vehicle fuel consumption and emissions from single or multiple vehicles under various real or simulated traffic conditions.
- ▶ Facilities for air pollution and dispersion modeling by physical models (e.g., boundary layer wind tunnel; see above under Pavements and Structures).
- ▶ Anechoic chambers (10' by 10' or larger operation platform).
- ▶ Artificial rain chambers for modeling of soil erosion and runoff coefficients of selected surfaces.
- ▶ Large-capacity hydraulic facilities for studies of open channel flow, stream bed stability and sediment transport.
- ▶ Chambers for the evaluation of toxic hazards in the highway work environment and investigation of the removal, evacuation and disposal of toxic paints and other substances encountered in bridge and highway maintenance vessel.

Other Research Facilities

- ▶ All other facilities not meeting the above categories but having potential application in future highway research efforts.
-

satisfy the requirements stated above. In addition, the definition of highway research used to identify potential research facilities may not have included all subject areas that will be incorporated in highway research over the next 20 years. The users of this inventory should recognize the constraints under which this survey was conducted and factor this into any decisions made using this information.

METHODOLOGY

TRB formed a Steering Committee to work in a joint effort with the RAC to identify facilities, note their characteristics, and document their availability. The steering committee members represent a blend of individuals with scientific and technical expertise, such as pavement engineering, structural analysis, driver and vehicle performance, and materials testing. Based on general guidance provided by FHWA the committee identified the types of facilities to be inventoried, developed an inventory form, pilot tested the form in several states, summarized and analyzed the inventory results, and prepared this *Circular*, which documents the inventory. The RAC representatives in each state assisted in identifying specific research facilities, soliciting the owners' cooperation to complete the inventory forms, and processing the completed forms. A listing of the RAC members involved in this study can be found in Appendix A. Their positive contributions were critical to the development of this extensive listing of special highway research facilities.

A draft survey instrument, together with a statement of the project purpose and scope, was sent to three State Highway Research Directors, who were asked to have the form completed for a few installations in their states and to provide comments on how to improve the survey instrument. Comments from the pilot tests were used by the Steering Committee to revise the survey instrument. A copy of the final form is included in Appendix B.

With assistance from the Chairman and Vice Chairman of RAC, survey forms and packets of information were distributed to the RAC representatives in each state. The RAC representatives contacted the operators of state and private research organizations to determine the characteristics and availability of research facilities of interest. Based on the results of this contact, the RAC representatives sent inventory forms and a description of the purpose and scope of the inventory effort.

In parallel with RAC's efforts, several national research directories were used to identify federal agencies and national associations with special research facilities^{2,3,4,5}. While the research directories were

helpful in identifying potential resources for highway research, they do not provide the level of detail required to evaluate the adequacy of specialized facilities for specific highway research missions, nor do they indicate the degree to which these facilities are already saturated by the requirements of the owners, or what arrangements could be made for their use by outsiders. To obtain this level of detail, the individual laboratories were contacted and asked to complete the survey forms. The results of these efforts are contained in the following section.

FACILITY LISTING

The information in this section is arranged alphabetically by state and by zip code within each state. An index with facility owners, facility names, and key works follows this section. The index is keyed to a facility number consisting of the state abbreviation and a sequential number.

Owners of unlisted facilities who feel that their facilities should have been included, or owners of facilities that have errors in the listing, should complete a copy of the survey form in Appendix B and send it to Federal Highway Administration, ATTN: Research Facility Inventory, 6300 Georgetown Pike, McLean, VA 22101. If correcting a listing contained in this *Circular*, include a copy of the listing with the submission.

The reader is advised to communicate with the facility contact person listed to determine capacities, conditions of use, and availability. Availability may be limited to (1) government subcontractors, (2) research center contractors, (3) in-house researchers, (4) in-house researchers doing contract research, or (5) outside researchers on a contract basis.

Alabama

AL-1

Owner: National Aeronautics and Space Administration, George C. Marshall Space Flight Center

Facility: Vibro-Acoustic Facility, Marshall Space Flight Center, AL 35812

Contact: Clifton A. Kirby, Chief, Dynamics Test Branch

Telephone: 205-544-1119 **FAX:** 205-544-0236

General: Vibro-acoustic test facility including reverberation and anechoic chambers equipped with modulated air and voice coil generators and data acquisition and analysis hardware and software for sound pressure and

intensity, vibration, and dynamic transfer function measurements.
Unique: Sound pressure level and intensity for given volume.

Capacity: Reverberation chamber 15' by 18' by 14'; anechoic chamber 10' by 10' by 14'; 126 channel data processing; 155 dB overall SPL; 80,000 W acoustic power; low-frequency horn cutoff of 28 Hz.

Projects: Space Shuttle components and subsystems, Spacelab Experiment and Space Station prototype hardware.

Available for Outside Use: Yes

AL-2

Owner: National Aeronautics and Space Administration, George C. Marshall Space Flight Center

Facility: Dynamic Thruster Facility, Marshall Space Flight Center, AL 35812

Contact: Clifton A. Kirby, Chief, Dynamics Test Branch

Telephone: 205-544-1119 **FAX:** 205-544-0236

General: Cluster of four electrodynamic shakers with horizontal slip table equipped with sine, random and transient control test article response parameter measurement capability.

Unique: 9.0" displacement electrodynamic shaker capability.

Capacity: Test article interface surface 10' by 5'; 80,000 pound drive force; broad band random spectra tolerance; 126 channel data acquisition; conventional aerospace dynamic analysis and data processing.

Available for Outside Use: Yes

Comment: The Dynamic Thruster Facility has recently undergone major modification and refurbishment.

AL-3

Owner: National Aeronautics and Space Administration, George C. Marshall Space Flight Center

Facility: Load Test Annex, Building 4619, Marshall Space Flight Center, AL 35812

Contact: David E. Snoddy, Chief, Structural Test Branch

Telephone: 205-544-1104 **FAX:** 205-544-0236

General: The Load Test Annex provides the basic load reaction structure required for structural testing of large components, subassemblies, and assemblies. The facility features a 54' square movable cross-head which can be bolted off at any 5.5 inch increment between 40' and 115.' Numerous floor tie-downs, 2,356 - 2.75 inch ASTM 36 A36 anchor bolts on 18 inch centers, are provided under and adjacent to the cross-head. Massive walk platforms spanning two of the tower legs are provided at

20' intervals for reacting test article shear loads. The tower load capacity is 30 million pounds vertically upward, 2 million pounds vertically downward, and 2.4 million pounds lateral.

Projects: Structural test of ET/Orbiter Interface Hardware (Strut) and Space Station Freedom Module Model Survey Test.

Available for Outside Use: Yes

AL-4

Owner: National Aeronautics and Space Administration, George C. Marshall Space Flight Center

Facility: Gilmore Universal Testing Machine, Building 4619, Marshall Space Flight Center, AL 35812

Contact: David E. Snoddy, Chief, Structural Test Branch

Telephone: 205-544-1104 **FAX:** 205-544-0236

General: The Gilmore Universal Testing Machine is a tension or compression servo-controlled testing machine capable of static loading, cyclic loading, load rate control, and strain rate control. The non-shock capacity is 3 million pounds, tension or compression. The machine will accommodate a specimen 10' by 10' by 25' high, and is controlled from a console located in a control room adjacent to the machine.

Projects: Proof Load Testing and calibration of SRB Holddown Studs.

Available for Outside Use: Yes

AL-5

Owner: National Aeronautics and Space Administration, George C. Marshall Space Flight Center

Facility: Vibration Test Laboratory, Building 4619, Marshall Space Flight Center, AL 35812

Contact: James Wyckoff, Chief Planning and Requirements Office, Building 4250

Telephone: 205-544-7922 **FAX:** 205-544-4435

General: Vibration testing in the development of aerospace flight hardware.

Unique: Digital dynamic control systems. Transient and complex wave test techniques.

Capacity: 8-14,000 pounds force. Frequency 3,000 Hz. Maximum acceleration 150 g.

Projects: Space vehicle and payload design.

Available for Outside Use: Yes

AL-6

Owner: National Aeronautics and Space Administration, George C. Marshall Space Flight Center

Facility: Teleoperator and Robotics Facility, Building 4619, Marshall Space Flight Center, AL 35812
Contact: James Wyckoff, Chief Planning and Requirements, Building 4250
Telephone: 205-544-7922 **FAX:** 205-544-4435
General: Integrated test and simulation facility. 17,890 square feet. Precision flat floor. Development of manipulator systems.
Unique: Six degree of freedom mobility unit. Manipulator arm.
Capacity: Floor levelness ± 1 arc second. 68°F constant, 60' by 120' by 26' (height). 3,000 psi air.
Projects: Remotely controlled spacecraft studies. Remotely managed systems such as free flyer teleoperators.
Available for Outside Use: Yes
Comment: This facility suggested for consideration only. Science and Engineering Directorate's Laboratories (owner/users). Direct contact required with user for usage or availability.

AL-7

Owner: National Aeronautics and Space Administration, George C. Marshall Space Flight Center
Facility: Nondestructive Evaluation Facility, Marshall Space Flight Center, AL 35812
Contact: James Wyckoff, Chief Planning and Requirements, Building 4250
Telephone: 205-544-7922 **FAX:** 205-544-4435
General: Radiographic, ultrasonic, electromagnetic, optical, holographic, x-ray diffraction, and mechanical test facility.
Capacity: Radiographic equipment 300 keV.
Projects: Detection of flaws in engineering materials and in welded and bonded structures.
Available for Outside Use: Yes
Comment: This facility suggested for consideration only. Science and Engineering Directorate's Laboratories (owner/users). Direct contact required with user for usage or availability.

AL-8

Owner: National Aeronautics and Space Administration, George C. Marshall Space Flight Center
Facility: Engineering Analysis Data System, Building 4663, Marshall Space Flight Center, AL 35812
Contact: James Wyckoff, Chief Planning and Requirements, Building 4250
Telephone: 205-544-7922 **FAX:** 205-544-4435
General: Class VI Computer Facility.
Unique: Cray Vector Processor.

Capacity: 400 gigabytes - discs IBM. Mass storage - 385 billion bytes. 19.2 megabytes - Cray.
Projects: Processed large engineering programs for structural analysis.
Available for Outside Use: Yes
Comment: This facility suggested for consideration only. Science and Engineering Directorate's Laboratories (owner/users). Direct contact required with user for usage or availability.

AL-9

Owner: National Aeronautics and Space Administration, George C. Marshall Space Flight Center
Facility: Extension to Load Test Annex (ELTA), Building 4619, Marshall Space Flight Center, AL 35812
Contact: Gerald B. Waggoner, Chief, Structural Test Division
Telephone: 205-544-1101 **FAX:** 205-544-0236
General: The ELTA is a large high-bay building (80' to crane hook) with adjoining offices and equipment rooms. It is a facility where structural tests of very large structures have been performed. All the associated structural test equipment (hydraulic cylinders, load cells, servo load control systems, hydraulic supply, data systems) makes this a very formidable structural test facility.
Unique: A very thick (11') reinforced test floor, 70' by 160,' with tie-downs capable of 400K tension and 400K shear on 10' centers over entire floor.
Capacity: Depends on size of structure to be tested. Several million pounds if distributed over a large area of the test floor.
Projects: In the past two years mostly smaller component type tests were set up and run on this floor (100,000 pound loads or less). Previously, large tests such as a full-scale modal test of the Shuttle Lox Tank were performed with fill levels from empty to full. Total set-up more than 80' high, several million pounds weight, excited with electrodynamic shakers.
Available for Outside Use: Yes
Comment: This facility would be ideal for testing a bridge span in which multiple points of high-force cyclic loading and eventually loading to failure are required. The massive test floor with the special test equipment available (large hydraulic cylinders, load cells, servo load control systems, etc.) provides the main elements for loading such a structure.

AL-10

Owner: National Center for Asphalt Technology Education Foundation, Auburn University

Facility: National Center for Asphalt Technology (NCAT), Auburn University, AL 36849-5354

Contact: E.R. Brown, Director, 211 Ramsay Hall

Telephone: 205-844-6243 **FAX:** 205-844-6248

General: This laboratory has state-of-the-art equipment to evaluate Hot Mix Asphalt (HMA) and the various components of HMA. Qualified technicians are available to perform all tests related to HMA.

Unique: Equipment and personnel to perform most tests relating to HMA.

Projects: Many research projects have been performed for various sponsors. Some sponsors include SHRP, FHWA, State DOTs, and NAPA Education Foundation. Projects performed have included rutting causes and effects, asphalt-aggregate interface properties, use of crumb rubber in HMA, stripping of asphalt pavements, Stone Matrix Asphalt (SMA), and use of latex in HMA.
Available for Outside Use: Yes

Alaska**AK-1**

Owner: Department of the Army, Cold Regions Test Center

Facility: Bolio Cold Environmental Test Facility, Big Delta, Alaska

Contact: Jerold G. Barger, Technical Director, ATTN: STECR-CO Unit: 45818, APO AP, 96508-7850

Telephone: 907-873-4219 **FAX:** 907-873-1990

General: Shop Area and Natural Cold Exposure Area for Automotive Equipment. Includes instrumentation for temperatures, airflow, current, voltage, rpm, coolant flow and other critical automotive parameters. Used for testing of automotive systems starting ability, warm-up, cold starting aids, heaters, defrosters, and automotive component performance.

Unique: Natural Cold Environmental test site, experiencing temperatures down to -60°F.

Capacity: Starting current to 4,000 amperes available ambient wintertime temperatures. Winter use only.

Projects: Cold start, vehicle warm-up, heater performance on Army tracked and wheeled vehicles. The standard for cold weather vehicle startability and cold weather performance.

Available for Outside Use: Yes

Comment: Unique facility for cold weather testing of automotive systems and components. Employs synergistic effects of natural environment.

Arizona**AZ-1**

Owner: Arizona Department of Environmental Quality

Facility: Emission Research Laboratory, 600 North

40th Street, Phoenix, AZ 85008

Contact: Frank Cox, Program Manager

Telephone: 255-1146

FAX: 255-1232

General: Our laboratory is capable of performing the complete federal test procedure for new certification on emission. Using the three center bays of the vehicular emission building, we have a constant volume sampling system with both 300 & 600 cubic feet per second venturi, a ECE 50 class emission dynamometer and a sealed evaporative enclosure, also fuel cold storage and fuel chiller carts. Driving traces and analytic bench functions are computer controlled. We are capable of reading with an analytic bench carbon monoxide (0-1.0%), carbon dioxide (0-5%), total hydrocarbon (0 to 1,000 parts per million(ppm)), (as propane) methane (0 to 400 ppm), oxides of nitrogen (0 to 1,000 ppm).

Capacity: Minimum time for FTP is 19 hours, and we can do two vehicles at a time-maximum 10 tests per week.

Projects: Reduction of emission (tailpipe) by using oxygenated motor fuels. Reduction of emission both tail pipe and evaporative by lowering the Reid vapor pressure of motor fuel. Tail pipe emission of vehicles using compressed natural gas as a motor fuel.

Available for Outside Use: No

AZ-2

Owner: Heraeus Instruments

Facility: Heraeus DSET Laboratories, Inc., 1850 Black Canyon Stage I, Phoenix, AZ 85027

Contact: Lawrence A. Band, Sales Manager

Telephone: 602-465-7356 **FAX:** 602-465-9409

General: Well-equipped outdoor exposure test site in arid environment.

Unique: Full-service laboratory for outdoor natural, accelerated or artificial exposures for environmental conditions. Support services of optical, mechanical and thermal analysis. Civil engineers and mechanical engineers on staff.

Capacity: 40 acre site.

Projects: Testing all types of materials for arid environment conditions.

Available for Outside Use: Yes

AZ-3

Owner: Department of Agriculture, Agricultural Research Service

Facility: Water Conservation Laboratory, 4331 East Broadway Road, Phoenix, AZ 85040

Contact: John A. Replogle, Research Hydraulic Engineer

Telephone: 602-379-4356 **FAX:** 602-379-4355

General: Constant Head Water Flow System; weight tank calibration; tiltable glass-sided channel. Can calibrate or study flow meters, hydraulic structures, open channel flows, and pipe flows.

Unique: Large flows, 50,000 pound weigh (catch) tank.
Capacity: 15 cubic feet per second recirculating flow capacity. Calibration accuracy $\pm 0.1\%$. Repeatability approximately 0.06%.

Projects: Flow meter calibration (propeller meters) by SRP; critical-flow flume calibrations to check theory; special venturi calibrations (two basic styles).

Available for Outside Use: Yes

Comment: Several laboratories have weigh tank calibrators but with smaller capacities. Others have high flow rate, but not precision flow measurement. This facility combines high flow rates with precision measurement.

AZ-4

Owner: McDonnell Douglas Helicopter Company

Facility: MDHC Advanced Development Center (ADC), 5000 East McDowell Road, Mesa, AZ 85205

Contact: Andrew Logan, Vice President, Advanced Product Development & Technology (APDT), Building 530, Mail Stop B325

Telephone: 602-891-6100 **FAX:** 602-891-6003

General: This is a 14-laboratory, 340,000 square foot facility located in Mesa, Arizona. Major laboratories relevant to the Federal Highway Administration are: Instrumentation, Mass Properties, Materials and Processes, Metrology, Material Evaluation and Quality Evaluation, Manned Simulation, and Structures and Dynamics Test. Approximately 50,000 square feet of the ADC are equipped for the development and fabrication of composite components and full-scale articles. Intelligent Vehicle Highway System-related expertise is found in the Flight Controls Research & Development Laboratory, Avionic Computer Systems, Manned Simulation, Crew Systems, and Artificial Intelligence Laboratory Functions of the ADC.

Unique: The MDHC ADC represents a coordinated effort to house under one roof all major laboratories related to the development and test of advance vehicle and systems technologies, to include those technologies specifically involved in advanced manufacturing processes. The ADC is recognized as housing "state-of-the-art"

facilities for man-in-the-loop simulation and for advanced composites.

Capacity: Surge capability for second and third shift operations exist.

Projects: Fabrication and test of advanced vehicles including the LHX Helicopter, the MDX Helicopter, and the NOTAR Helicopter. Development and fabrication of composite assemblies for the C-17 aircraft have also been accomplished.

Available for Outside Use: Yes

Comment: The MDHC ADC was specifically designed to house the fabrication, test and development of advanced vehicle systems and subsystems. It has been in use for that purpose over the past five years.

AZ-5

Owner: McDonnell Douglas Helicopter Company

Facility: Simulation and Systems Evaluation, 5000 East McDowell Road, Mesa, AZ 85205

Contact: Lee Daniel, Manager, Building 531, M/S C240

Telephone: 602-891-6887 **FAX:** 602-891-8335

General: Three 50' high bay areas support five 20' diameter dome simulators used for real-time, man-in-the-loop simulation of advanced air vehicle designs. Principle use has been for engineering design, test and evaluation with emphasis on man-machine interface and system integration. All simulations use modern computer image generation and display equipment that provide a high degree of realism as well as experimental control over all relevant visual factors in the operator's task environment. Systems can be networked within the facility as well as via long-haul means to other geographical locations. An automated performance measurement system supports real-time data collection and off-line analysis.

Unique: A high level of visual fidelity provided through use of General Electric CompuScene IV, Evans and Sutherland ESIG-1000, and Sogitec GI-10k image generation systems. Systems have a large field of regard, head-tracked, area of interest display. The facility also contains a rapid prototyping laboratory for development of advanced controls and display system concepts.

Capacity: Facility has ability for simultaneous support of multiple programs including simultaneous conduct of classified/proprietary and unclassified projects. Limiting facility factors are number of domes and available image generation channels. Surge capability for second and third shift operation exist.

Projects: 1) Engineering and production simulation support of military (Apache, LHX) and commercial (MDX) rotorcraft systems. 2) Manned simulation support of Army Night Vision Laboratory evaluations of

helicopter obstacle avoidance system design parameters. 3) Simulation support of day/night adverse weather operations. 4) Night vision goggle evaluations. 5) Support of NASA-Houston for visual requirements for space station proximity operations. 6) USAF support to evaluate visual simulation requirements for effective low-level flight training.

Available for Outside Use: Yes

Comment: The SSI function at McDonnell Douglas Helicopter Company is an integral part of a 340,000 square foot Advanced Development Center that contains 14 laboratories. This simulation facility is currently available to the Arizona DOT and to the Arizona State University's Center for Advanced Transportation and Systems Research (CATSR) as well as to the five major vehicle manufacturers' test and evaluation activities located in the Phoenix area. ADOT/CATSR proposed use of this facility as an interim National Advanced Driving Simulator, and it has also been proposed for IVHS human factors work. Demographics of the Phoenix area make this facility ideal for the study of human factors issue of the elderly. Proximity to major industry and DOD users of simulation facilities promotes technology transfer and the potential for joint cooperative efforts.

AZ-6

Owner: Motorola Inc., Motorola Government Electronics Group

Facility: Temperature Chamber, 8201 East McDowell Road, Scottsdale, AZ 85252

Contact: John Perkins, Mechanical Engineer, M/S H-1416

Telephone: 602-441-2178 **FAX:** 602-441-5205

General: Temperature chamber, 3,000 cubic feet, -54° to +95°C.

Unique: Digitally programmable temperature cycling. Up to 5°C per minute transition rate.

Projects: Temperature qualification testing, burn-in and environmental stress screening, long-term reliability testing.

Available for Outside Use: Yes

AZ-7

Owner: Arizona State University, Department of Civil Engineering

Facility: Large-Scale Multi-Actuator Shake Table, Earthquake Laboratory, ECE 53061, Tempe, AZ 85287-5306

Contact: Dr. Avi Singhal, Professor

Telephone: 602-965-6901 **FAX:** 602-965-8296

General: 10'-1.5" x 10'-1.5" multishake tables with multi-actuators, with static load capacity of 250,000 pounds, 64

digital data collection and on-line data processing. Random or earthquake digital input capabilities.

Unique: Multi-actuator shake tables which can test bridges with phase difference at two ends.

Capacity: 64 channels, auto data recorder with 2.5 microsecond delay time between each channel

Projects: Shock isolators, bridge bearings, beam joint tests, connections, pipelines joints.

Available for Outside Use: Yes

AZ-8

Owner: Arizona State University

Facility: Center for Solid State Electronics Research, Tempe, AZ 85287-6206

Contact: Dr. Akers, Director, Stefan Myhajlenko, Research Scientist

Telephone: 602-965-3708 **FAX:** 602-965-8118

General: JEOL 840 Scanning Electron Microscope equipped with energy and wavelength dispersive x-ray analysis, cathodoluminescence, electron channeling, backscatter imaging, and electron beam induced current. Electronic fabrication clean room and electronic testing facility.

Unique: Low-temperature (liquid helium) stage for cathodoluminescence.

Capacity: X-ray micro-analysis

Projects: 1) Micro-analysis of high voltage insulators; 2) Monitoring of optical waveguide processing; 3) Characterization of high temperature super-alloys; 4) Analysis of OHMIC contacts to gallium arsenide, indium phosphide; 5) Cathodoluminescence investigations of gallium arsenide surfaces; 6) EBIC characterization of Si, Ge and poly-silicon structures.

Available for Outside Use: Yes

AZ-9

Owner: Arizona State University, Department of Mechanical and Aerospace Engineering

Facility: Unsteady Wind Tunnel, Tempe, AZ 85287-6106

Contact: William S. Saric, Professor

Telephone: 602-965-2822 **FAX:** 602-965-1384

General: Wind tunnel for low speed flows with gust velocity controls. Low turbulence. Extensive instrumentation for flow studies, including pressure sensors, laser-doppler anemometer, hot-wire on precision 3D traverse, and MASSCOMP 5600 and DEC 5000 data acquisition and computation facilities.

Unique: Unsteady, low-turbulence flow.

Capacity: 1.4 meter by 1.4 meter throat; 1 to 36 meters per second velocity ($\pm 0.1\%$) and provisions for gust simulation by shutters; 5 meter test section length.

Projects: "Transition Studies on a Swept-Wing Model," NASA Langley Research Center; "Transition Receptivity and Control," Air Force Office of Scientific Research; "Unsteady Low Reynolds Number Aerodynamics," Office of Naval Research.

Available for Outside Use: Yes

Comment: Facility is unique in capability to study aerodynamics of low-speed flow in boundary layers with unsteady flow conditions.

AZ-10

Owner: Arizona State University, Department of Electrical Engineering

Facility: Fog Chambers and High Voltage Laboratory, Tempe, AZ 85287-5706

Contact: Dr. Ravi S. Gorur, Assistant Professor

Telephone: 602-965-4894 **FAX:** 602-965-8296

General: A fog chamber and a high-voltage laboratory is being used to simulate pollution and test the integrity of insulation used for power transmission. The facility has been in operation for 4 years and has served the needs of basic and applied research, utilities and manufactures.

Unique: Has an on-line data acquisition system and state-of-the-art instrumentation. Equipped with diagnostic instruments for analysis of materials.

Capacity: Can handle 16 insulators at one time. Can perform ac, dc, and impulse tests on insulator.

Projects: Projects to SRP, BPA (DOE panel) for evaluation of insulation projects for manufacturers like 3M, GE for development of better materials.

Available for Outside Use: Yes

Comment: The facility has been instrumental in putting ASU on the forefront of insulation technology.

AZ-11

Owner: Arizona State University, Department of Aeronautical Technology

Facility: Technology Wind Tunnel, Tempe, AZ 85287-6406

Contact: Dr. Ben O. Latigo, Associate Professor

Telephone: 602-965-4381 **FAX:** 602-965-8296

General: Subsonic 4'x3' wind tunnel with a maximum test section velocity of 220' per second with 75 hp induction motor and Hertzell propeller fan. Operates in closed-cycle mode.

Unique: Flexibility in test-section rigging for both open and closed return operations.

Capacity: 386 PC, HP 3497DL data scanner/acquisition & control unit; scanivalve pressure system; thermal anemometry, strain gage systems.

Projects: Multi-screen turbulence reduction project; truck nose drag reduction project; screen pressure loss project; coanda airfoil project; and student projects.

Available for Outside Use: Yes

Comment: Tunnel was initially developed for instruction; however, it is now in a stage where it can support R&D in many areas, i.e., applied aerodynamics; highway vehicle aerodynamics; environmental studies. There is an effort to seek funding to support applied research.

AZ-12

Owner: Arizona State University

Facility: ElectroMagnetic Anechoic Chamber (EMAC), Telecommunications Research Center, Tempe, AZ 85287-7206

Contact: Dr. Constantine A. Balanis, Regents' Professor and Director

Telephone: 602-965-3909 **FAX:** 602-965-8325

General: EMAC is a 2,200 square foot facility that supports research of faculty and graduate students by providing precision antenna and radar cross section measurements. The inside dimensions are 51' by 26' by 18.'

Unique: Cylindrical compact range, HP 8510B network analyzer.

Projects: 1.) Advanced antenna research; 2.) Stealth technology

Available for Outside Use: No

AZ-13

Owner: Department of the Army

Facility: Climatic Test Chambers, Yuma Proving Ground, Yuma, AZ 85365

Contact: A. Kenneth Groff, Chief, Environmental Simulation Section

Telephone: 602-328-7467 **FAX:** 602-328-7024

General: 7 walk-in temperature/humidity chambers — 7' by 7' by 12' (long); 34 trailer mounted temperature conditioning chambers — 7' by 7' by 12' (long); 16 stationary temperature conditioning chambers — 7' by 7' by 12' (long); 1 large Multi-Purpose Environmental Chamber — 20' by 12' (high) by 34' (long). A Weapons Firing Environmental Chamber is being installed — 30' by 18' (high) by 45' (long) with several other smaller specialized chambers for altitude, salt fog and thermal exposure capabilities.

Unique: Temperature/humidity chambers have a temperature range of -100° to 200°F, humidity from 5% to 100% in a temperature range of 60° to 145°F.; temperature conditioning chambers (trailer mounted and stationary) have a temperature range of -100° to 200°F.; the large Multi-Purpose Environmental Chamber has a temperature range of -50° to 160°F. with humidity of 20 to 95% in a temperature range of 60° to 125°F.; the Weapons Firing Chamber has a temperature range of -65° to 160°F.

Capacity: Each chamber has a temperature/humidity recorder controller. All temperature/humidity chambers have digital programmable controllers. Data (temperature of items or air) can be acquired with various data loggers, analyzed and reduced to plots, listings or other presentations.

Projects: Conduct temperature humidity, long-term temperature storage and preconditioning (temperature) testing of artillery and tank munitions. Utilized large Multi-Purpose Environmental Chamber for cold start testing of Army tactical and non-tactical vehicles as well as temperature/humidity exposure testing of vehicles and shelter systems and components.

Available for Outside Use: Yes, utilization based on priority and mission.

AZ-14

Owner: Department of the Army

Facility: Mobile Dynamometer Testing, Yuma Proving Ground, Yuma, AZ 85365-9110

Contact: Jay Marchant, Chief, Automotive Systems Engineering Branch

Telephone: 602-328-6550 **FAX:** 602-328-6501

General: YPG has three Mobile Dynamometers capable of performing evaluations of tractive effort, drawbar pull, rolling resistance, towing capacity, of all types of light through heavy vehicles and mobile equipment. Testing conducted primarily on 2.5 mile paved dynamometer course, but all wheel drive dynamometers are capable of supporting tests on all types of terrain including soft sand. Dynamic testing capabilities supplemented by comprehensive automotive instrumentation including ability to acquire up to 132 channels of vehicle performance data (temperatures, pressures, events, interactions) including internal operating pressures and temperatures of engines, transmissions, final drives, and dynamic (moving) temperature profiles of tires throughout their performance (weights, pressures) envelopes. Available related support facilities include vehicle maintenance shop with 40-ton overhead crane, welding and machine shop, test vehicle scale (240,000 pound capacity) with ability to record separate axle and wheel loadings, 150 miles of automotive durability/mobility test courses; and climatic chamber.

Unique: Dynamometer power absorption capability more than 1,500 hp, all data can be recorded on-board dynamometer of telemetry to central test control point, the Multi-Purpose Environmental Chamber has a temperature range of -50° to 160°F with humidity of 20% to 95% in a temperature range of 60°F to 125°F.

Capacity: Each chamber has a temperature/humidity recorder controller. All temperature/humidity chambers have digital programmable controllers. Data (tempera-

ture of items or air) can be acquired with various data loggers, analyzed and reduced to plots, listing or other presentations.

Projects: All types of light to heavy wheeled and tracked vehicles from less than 3,000 pounds, Gross Vehicle Weight (GVW) to 230,000 pounds. (Tank Transporter with fully loaded M1AI Abrams Battle Tank and USAF Midget Man Missile Launcher.)

Available for Outside Use: Yes

AZ-15

Owner: Department of the Army

Facility: Vibration Test Facility, Yuma Proving Ground, Yuma, AZ 85365

Contact: A. Kenneth Groff, Chief, Environmental Simulation

Telephone: 602-328-7467 **FAX:** 602-328-7024

General: The Vibration Test Facility consists of three Electrodynamic Vibration Systems housed in three separate buildings. The systems are designed and equipped to simulate the effects of transportation (as cargo or vehicle installed equipment) upon components, units or systems utilized by the U.S. Army.

Unique: Vibration equipment can produce up to 30,000 pound force, up to 2" displacement, excitation of random, sinusoidal or complex (sine or random, random on random), shock impulse with data acquisition and reduction.

Capacity: Have capability to acquire vibration test as well as on vehicle vibration data. Capability to reduce/analyze vibration data to determine characteristic for performance parameters, descriptive or translate into test criteria.

Projects: Conduct logistic and tactical vibration test of artillery and tank munitions.

Available for Outside Use: Yes

AZ-16

Owner: Department of the Army

Facility: Blacktail Canyon EMI/TEMPEST Test Facility, Electronic Proving Ground, Ft. Huachuca, AZ 85613-7110

Contact: Robert Weeks, Chief EMI/Tempest Branch

Telephone: 602-533-2818 **FAX:** 602-533-1808

General: The USAEPG EMI/TEMPEST Facility mission is to plan, conduct, evaluate, and report on EMI, TEMPEST, and IEMC tests of sophisticated electronic equipment and systems. The mission also includes the responsibility to review and monitor tests conducted by contractors or other agencies; and to provide EMI/TEMPEST consultant services to Project Managers as requested. EMI testing is accomplished according to MIL-STD-461A, B, C/462/463; TEMPEST testing IAW

NACSIM 5100A, 5112, and KAG 30; IEMC testing IAW MIL-E-6051. The EMI/TEMPEST facility has a remote facility location, secure compound area, three shielded chambers, a unique hybrid Transverse Electromagnetic/Reverberation chamber (TEM/REV), extensive instrumentation suites, professional staffing, and active expansion efforts.

Unique: The three EMI/TEMPEST facility chambers include: 1) a 44 by 22 by 18' (high) anechoic chamber with door size of 14 by 12' (wide) which provides 120 dB of radio frequency (RF) isolation and will accommodate military gear ranging from manpack to vehicular equipments such as the HMMV, CUCV, LAV, and M113 families; 2) a 26 by 15 by 11.5' (high) EMI/TEMPEST shielded chamber providing 100 dB RF isolation; and 3) a 12 by 10 by 11.5' (high) shielded room for mission testing of compact military material.

Capacity: Facility instrumentation suites consist of the following: 1) Three Dynamic Sciences, Inc. TEMPEST test systems providing automated testing IAW NACSIM and KAG requirements. 2) Two automated AILTECH RFI/EMI data collection systems providing support to MIL-STD-461A, B, C/462/463 radiated and conducted emission testing from 20Hz to 40GHz. 3) One each HP EMI and HP OPEN-FIELD automated systems. 4) An integrated EMI susceptibility system allowing RF illumination of equipment under test from 10kHz to 40GHz at (or below) the field intensities (RMS) which follow: 10kHz to 30MHz - 100 V/M; 30MHz to 100MHz - 200 V/M; 100MHz to 1GHz - 200 V/M; 18GHz to 40GHz - 200 V/M.

Projects: Testing tracked vehicles, amphibious vehicles, and communications systems loaded on 2.5-ton trucks or mounted in semi-vans.

Available for Outside Use: Yes

AZ-17

Owner: Caterpillar Inc.

Facility: Tucson Proving Ground, 6000 West Caterpillar Trail, Green Valley, AZ 85614

Contact: Walter Harrison, Operations Superintendent

Telephone: 602-648-4621 **FAX:** 602-648-4625

General: The Tucson Proving Ground consists of two separate facilities. One is used for the test & development of Caterpillar equipment, the other is a demonstration & training center for Caterpillar equipment. The facilities are located 30 miles SW of Tucson, AZ, on 6,300 acres of private and state leased land. Both sites have vehicle repair facilities and state-of-the-art communication/computer systems.

Unique: Elevations range from 3,200' to 4,400'. The terrain is a combination of high desert and mountain

ranges. The soils include sand, several types of soil and rock.

Projects: Productivity studies on track-type tractors, wheel loaders, & hydraulic excavators. Acceleration and braking on off-highway trucks, wheel loaders on grades ranging from 0% to 20%, computer data acquisition and sound level measurement tests on various types vehicles. Demonstrations & training for Caterpillar customers & dealers from around the world.

Available for Outside Use: No

Comment: There are currently no plans to lease these facilities to outside companies, but future developments may prove it profitable.

AZ-18

Owner: Department of Agriculture, Agricultural Research Service (and Cooperators)

Facility: Walnut Gulch Experimental Watershed, Southwest Watershed Research Center, 2000 East Allen Road, Tucson, AZ 85719

Contact: Dr. L.J. Lane, Research Leader

Telephone: 602-670-6481 **FAX:** 602-670-6493

General: SW Watershed Research Center operates the 57 square mile Walnut Gulch Experimental Watershed and 8 small (2 to 10 acre) experimental watersheds on the Santa Rita Range.

Unique: Largest long-term gaged watersheds in semiarid regions.

Capacity: Rainfall (recording) data from approximately 90 gages and runoff from approximately 30 flumes and weirs. Also sediment data and runoff plots.

Projects: Basic hydrology: rainfall-runoff, flood frequency etc., global change, monsoon 90 and 91 experiments. Erosion: Wepp rainfall simulator plots. Transmission losses: infiltration and recharge from streams.

Available for Outside Use: Yes

AZ-19

Owner: University of Arizona

Facility: Microelectronics Laboratory, Center for Microcontamination Control, 1230 East Speedway, Tucson, AZ 85721

Contact: Dr. John O'Hanlon, Center Director

Telephone: 602-621-3380 **FAX:** 602-621-8881

General: Microelectronics/contamination control research/teaching laboratory.

Unique: 4' by 4' by 8' high class-1 test chamber for measuring contamination shed from people, gowns and equipment. Includes gown-up room and computer monitor and particle counter room.

Capacity: Clean air less than one 0.5 micrometer diameter particle per cubic foot.

Projects: Evaluation of dust shed by people, clean room gowns and equipment.

Available for Outside Use: Yes

Comment: Could be extremely useful for specialty measurements of dusting and wear of materials, tribological studies.

AZ-20

Owner: University of Arizona, Department of Civil Engineering and Engineering Mechanics

Facility: Constitutive Modelling Laboratory, Tucson, AZ 85721

Contact: Dr. Chandra S. Desai, Regents' Professor and Director

Telephone: 602-621-6569 **FAX:** 602-621-2550

General: Triaxial and multiaxial testing of materials (soils, concrete, asphalt) in pavements and interfaces and nondestructive testing. For constitutive modelling including entire stress-strain-strength response under static, quasistatic and cyclic (repetitive) loading. Models can allow for stresses, elastic, plastic and creep strains, damage, fracture and rutting, and anisotropic behavior under different stress paths.

Unique: Unique and new multiaxial, cyclic shear (for interfaces) and nondestructive (ultrasonic and acoustic) facility.

Capacity: Loading capacities include those occurring in pavement systems.

Projects: Testing of soils, rocks, concrete and interfaces and joints under three NSF grants and two AFOSR projects. Previous research projects include DOT-University Research on Testing and Computer Modelling for Multicomponent Track Support Systems.

Available for Outside Use: Yes

Comment: The testing facilities and constitutive modelling approaches available at U of A are unique and not readily available elsewhere. The unified modelling approach developed allows inclusion of factors such as plastic strains, volume change (dilation), creep, stress paths, fracture and damage and anisotropy in a single framework that is much simpler than conventional approaches. The FAA (DOT-TSC, Cambridge, MA) is considering the use of the facilities for material testing and modelling for Unified Pavement Design and Analysis for airport pavements.

AZ-21

Owner: University of Arizona, Department of Civil Engineering and Engineering Mechanics

Facility: Structural Engineering Laboratory, Building 72, Room 206, Tucson, AZ 85721

Contact: Hamid Saadatmenesh, Assistant Professor

Telephone: 602-621-2148 **FAX:** 602-621-2550

General: Laboratory is equipped with a 3' deep strong reaction floor covering an area of 42' by 32' with tie-down points at 3' on center. Modern testing facilities, which have been recently purchased through the support from the National Science Foundation and the University of Arizona, include: two hydraulic actuators each with a capacity of ± 110 kips, a hydraulic pump with a capacity of 23 gallons per minute, and a data acquisition and reduction system capable of reading 70 strain gages and 20 Linear Variable Differential Transducers (LVDTs).

Unique: In addition, portable data acquisition equipment with 20 data channels is available in the form of an HP-3421 unit with mass storage devices. Many mechanical and electronic measuring devices are also available in the laboratory, such as LVDTs and dial gages with ranges from 1 to 6."

Capacity: Load cells with capacities ranging from 50 to 200 kips, a variety of hand operated hydraulic pumps and jacks with capacities ranging from 50 to 200 kips, — single and double actions, etc. Test frames and hydraulic testing machines with capacities of up to 200 kips are also available in the laboratory.

Projects: Large-scale tests of bridge girders, building frame components, and bond tests of rebar in concrete.

Available for Outside Use: Yes

AZ-22

Owner: Ford Motor Company

Facility: Wet Traction Test Area, Arizona Proving Ground, Yucca, AZ 86438

Contact: F.G. Flesche, Manager, PO Box 428

Telephone: 602-753-7261 **FAX:** 602-753-7214

General: This "H" shaped facility, in one continuous plane, encompasses four different types of surfaces (burnished concrete, troweled concrete, broomed concrete and polished pebbles). The known and repeatable friction characteristics of these surfaces makes possible a comparison of friction characteristics of tires as a function of vehicle speed and tire design.

Unique: The surfaces can be watered continuously to simulate wet road tire contact conditions.

Projects: Automotive testing

Available for Outside Use: No, special contracts have been negotiated on occasion in support of FHWA and ADOT projects.

AZ-23

Owner: Ford Motor Company

Facility: Vehicle Dynamic Test Surface, Arizona Proving Ground, Yucca, AZ 86438

Contact: F.G. Flesche, Manager, PO Box 428

Telephone: 602-753-7261 **FAX:** 602-753-7214

General: Vehicle Dynamic Test Surface; Asphaltic concrete; for handling evaluation and steering maneuvers at high and low speeds.

Unique: Trapezoidal 17.2 acres of level asphalt.

Projects: Automotive testing.

Available for Outside Use: No. Special contracts have been negotiated on occasion in support of FHWA and ADOT projects.

AZ-24

Owner: Ford Motor Company

Facility: Corrosion Test Facility, Arizona Proving Ground, Yucca, AZ 86438

Contact: F.G. Flesche, Manager, PO Box 428

Telephone: 602-753-7261 **FAX:** 602-753-7214

General: Humidity/Drying chambers (ten passenger car/light truck and one heavy truck chamber) for acceleration salt corrosion testing.

Unique: Maintain test ambient temperatures at 120°F ±5°F and 95 to 100% relative humidity.

Projects: Automotive testing.

Available for Outside Use: No. Special contracts have been negotiated on occasion in support of FHWA and ADOT projects.

AZ-25

Owner: Ford Motor Company

Facility: Test Track, Arizona Proving Ground, Yucca, AZ 86438

Contact: F.G. Flesche, Manager, PO Box 428

Telephone: 602-753-7261 **FAX:** 602-753-7214

General: High Speed Test Track; asphaltic concrete; 3-lane/5-mile oval.

Unique: Maximum design (neutral) speed of 140 mph. Maximum grade in curves is 2.2%.

Projects: Automotive testing

Available for Outside Use: No. Special contracts have been negotiated on occasion in support of FHWA and ADOT projects.

Arkansas

AR-1

Owner: University of Arkansas at Little Rock, Department of Engineering Technology

Facility: Structures Laboratory, 2801 South University Avenue, Little Rock, AR 72204

Contact: Dr. James R. Blacklock, Professor

Telephone: 501-569-8223 **FAX:** 501-569-8020

General: Large component test laboratory for static and dynamic testing. Facility has 70 gallons per minute hydraulic pump. Floor mounted 200,000 pound electro-

hydraulic test machine with hydraulic chuck and articulating test load head.

Unique: Situated on 40' long load bed, six foot thick, for test stability and easy access.

Capacity: Total capacity is 200,000 pounds; hydraulic chuck is 100,000 pounds.

Projects: Multi-million cycle testing of concrete pavement shear dowels.

Available for Outside Use: Yes. This facility is currently available because it was purchased for future graduate level engineering technology testing and the state has not approved the program expansion. Therefore, the machine is available for outside testing.

AR-2

Owner: University of Arkansas at Fayetteville, College of Engineering

Facility: Environmental Chambers, 4183 Bell Engineering Center, Fayetteville, AR 72701

Contact: Jim Gattis, Associate Dean

Telephone: 501-575-6010 **FAX:** 501-575-4346

General: This environmental chamber allows controlled temperature experiments in the range of 0° to 100°F. The facility was designed to allow experiments to run continuously for several days to provide burn-in opportunities for newly designed electronic equipment.

Capacity: Chamber size is approximately 12' by 20' with a 4' entrance.

Projects: Provided burn-in testing under environmental extremes for newly designed and manufactured electronic equipment.

Available for Outside Use: Yes

California

CA-1

Owner: Systems Technology, Inc.

Facility: STI Full Scale Vehicle Measurement and Test System, 13766 South Hawthorne Boulevard, Hawthorne, CA 90250

Contact: Jim Nagy, Laboratory Manager

Telephone: 213-679-2281 **FAX:** 213-644-3887

General: The facility includes full automotive shop facilities, portable vehicle instrumentation packages including rate gyros, accelerometers, wheel tachs, steering wheel rate measurement, etc. Also ability to measure vehicles true center of gravity (CG) and roll moment of inertia.

Unique: Ability to measure CG and roll moment. Data acquisition is lap-top computer based.

Capacity: Instrumentation: MOPED through class 8 truck. CG and roll moment measurement up to 7,000 pounds on front axle.

Projects: NHTSA Project on rollover propensity, CPSC Project on 3-wheel ATV dynamics, power steering failure, large truck ride quality instrumentation.

Available for Outside Use: Yes

CA-2

Owner: Systems Technology, Inc.

Facility: STI Driving Simulation Laboratory, 13766 South Hawthorne Boulevard, Hawthorne, CA 90250

Contact: Anthony C. Stein, Principal Staff Psychologist

Telephone: 213-679-2281 **FAX:** 213-644-3887

General: The facility consists of both automobile and large truck cabs. The simulator is fixed-base, fully interactive, and has a force feel steering system. It can display numerous driving tasks including a timed signal light decision making task. Multiple screens can be linked to a common data base.

Unique: Force feel steering system. Ability to link data bases to multiple screens. Signal light decision making task.

Capacity: One subject can run at a time, up to six subjects per session, 100 MB data storage, unlimited driving distance.

Projects: Experiments on various human factors/driving issues, including alcohol, drugs, fatigue, dash layout, cellular phone use, signing, delineation, decision making, litigation reconstruction.

Available for Outside Use: Yes

CA-3

Owner: National Aeronautics and Space Administration

Facility: Autonomous Vehicle Research Testbed "Robby," Jet Propulsion Laboratory, M/S 107-102, 4800 Oak Grove Drive, Pasadena, CA 91109

Contact: Brian Wilcox, Group Supervisor

Telephone: 818-354-4625 **FAX:** 818-393-5007

General: This facility consists of a computer-controlled vehicular testbed RF-linked to an operator control station, with integrated system software. The articulated vehicle is fully instrumented with stereo cameras, gyrocompass, encoders on all degrees of freedom (11 mobility, 8 for manipulation), on-board computing, high bandwidth communications link, special purpose image processors. The control station allows mixing of stereo visual images with computer graphics, and real-time vehicle control.

Unique: Unique autonomous vehicle testbed: combination of off-road capability with necessary computing, sensing, and communications, integrated 3D/graphics

operator display to support intelligent vehicle and remote operations research.

Capacity: 1 Mbit per second communications from vehicle; 25 Mips of general purpose computing on-board; 1,000 Mips image processing capacity.

Projects: Development and demonstration of Semiautonomous Navigation: autonomous stereo-vision-based navigation through natural terrain without human guidance; Computer-Aided Remote Driving (CARD), in which a human operator designates 100-meter paths in the stereo display and these paths are executed by the vehicle.

Available for Outside Use: Yes

CA-4

Owner: Lockheed Aeronautical Systems Company

Facility: Temperature/Altitude Chamber, Kelly Johnson Research and Development Center, Valencia, CA 91385

Contact: Dave Carroll, Staff Engineer

Telephone: 805-295-2165 **FAX:** 805-295-2400

General: The chamber is 25' by 21' by 60' and can achieve altitudes to 120,000.' The temperature range is -100° to +400°F. The chamber is man-rated, allowing personnel in the chamber during temperature and altitude test conditions.

Unique: Man-rated 20 pounds per second, 600 psi air, 4 pounds per second, 300 psi air.

Projects: Aircraft Auxiliary Power Unit altitude tests.

Available for Outside Use: Yes

Comment: There is no other facility in the U.S. that has all the capabilities of this facility.

CA-5

Owner: University of California, San Diego

Facility: Charles Lee Powell Structural Systems Laboratory, UCSD Structural Systems Research Project, La Jolla, CA 92093-0411

Contact: Frieder Sieble, Ph.D., P.E., Professor

Telephone: 619-534-4640 **FAX:** 619-536-6373

General: The UCSD Charles Lee Powell Laboratory is a structural testing facility for full-or large-scale structural systems. Test floor space is 120' long, 50' wide with a 60' clearance to a 10-ton overhead crane. The test floor is a four (4) cell box girder with 13' structural depth.

Unique: The laboratory has a 50' high and 30' wide reaction strong wall with a structural depth of 15.5' and a lateral load capacity of over 1,000 tons.

Capacity: 600 kip UTM, 50-ton shake table 10' by 14', 15-servo control hydraulic actuators (4-220 kip, 6-165 kip, 2-110 kip, 3-500 kip).

Projects: Full-scale bridge test on structural concrete bridge deck overlays. Full-scale bridge tests on strength-

ening measures of RC bridges. Rolling load test simulations on prototype bridge. Three-story shear wall tests and simulated seismic loads. Proof-test of half-scale model of San Francisco double deck viaduct. Structural component tests on columns, walls, slabs, frames, joints, etc.

Available for Outside Use: Yes

Comment: UCSD is currently planning a second structural testing facility for structural component testing to supplement the structural systems laboratory research. The new laboratory will have a 4,000 square foot test floor and a 50' wide by 30' high reaction strong wall. These two facilities will be complemented by a 2000' high bay aerospace structural systems laboratory currently planned as part of a new Engineering Building at UCSD.

CA-6

Owner: Department of the Navy, Naval Air Systems Command

Facility: Anechoic Chamber, Naval Aviation Depot, North Island, San Diego, CA 92135-5112

Contact: Richard D. Anderson, Department Head, Code 06

Telephone: 619-545-9705 **FAX:** 619-545-9861

General: Facility is an 18' by 18' by 50' fully lined anechoic chamber with an automated positioning system for test and source units. Chamber was designed for use to simulate free-space conditions for generating RF-fields from 200 MHz to 40 GHz.

Unique: Facility is capable of characterizing response of test items through 6 axis of motion in a standard RF field environment.

Capacity: Positioner system is capable of handling 100 pound payload for test items and 500 pounds for source antennas.

CA-7

Owner: Department of the Navy, Naval Air Systems Command

Facility: Wind Tunnel, Naval Aviation Depot, North Island (Code 06), San Diego, CA 92135-5112

Contact: Richard D. Anderson, Department Head

Telephone: 619-545-9705 **FAX:** 619-545-9861

General: Wind tunnel has a 24" square test section. It is used to calibrate velocity type instrumentation.

CA-8

Owner: Mobility Systems and Equipment Company

Facility: Automotive Research Center, San Bernardino, CA 92427

Contact: Dr. Anil V. Khadilkar, Executive Vice-president, 9920 La Cienega Boulevard, #708, Inglewood, CA 90301

Telephone: 213-641-3606 **FAX:** 213-641-1930

General: Complete engineering services for developmental and compliance certification of FMVSS 101 to 302 and regulation Part 581 bumper standard. Facility has barrier, vehicle to vehicle, laminar supports, median barrier and other crash test facilities for speeds up to 70 mph.

Unique: A pit with FHWA recommended S-1 and S-2 soils is a part of the crash test track facility.

Capacity: 1) tests up to 70 mph with vehicles weighing up to 5,000 pounds; 2) data acquisition for up to 100 channels of data.

Projects: 1) DOT/NHTSA projects for FMVSS compliances. 2) Caltrans/Industry projects for evaluation of roadside call boxes, and luminal supports. 3) Private industry projects on full vehicle certification. 4) Other R&D projects on data acquisition, cost studies, office automation, etc.

Available for Outside Use: No

CA-9

Owner: University of California at Riverside

Facility: Statewide Air Pollution Research Center, Riverside, CA 92521

Contact: J. Brian Mudd, Director

Telephone: 714-787-4584 **FAX:** 714-787-5004

General: The SAPRC Plant Sciences section currently has a large and flexible set of field chambers that are suitable for various types of pollutant exposures. The facilities include 28 dome-shaped, open-top chambers for trees; 22 Teflon-covered, closed-top chambers for air pollutant and pesticide-pollutant interaction research and interactive research with microbiological or insect organisms; and more than 84 open-top portable chambers of the National Crop Loss Assessment Network (NCLAN) design. These chambers are uniquely suitable for use in agricultural situations or for studies with small trees. The advantages of these chambers are their portability and adaptability to existing agricultural or native systems.

Unique: 1) Chambers for atmospheric chemistry. 2) Chambers for testing effects of air pollutants on plants.

Capacity: There are currently 4 environmental chambers, 2-6,400 liter, 1-3,600 liter and 1-5,800 liter. The 5,800 liter chamber is evacuable, Teflon-coated, and can be thermostated over the temperature range 270° to 340°K, ±1°K. This chamber is irradiated by a 24 kW xenon arc and has a multiple reflection optical system interfaced to a Nicolet 7100 FT-IR spectrometer. Sampling ports are provided to allow gas samples to be taken for GC-FID

and GC/MS analyses. The 2-6,400 liter all-Teflon chambers are each irradiated by 2 parallel banks of black lights (with the light intensity variable in 10% increments). These chambers are equipped with sampling ports for continuous NO-NO_x and O₃ analyzers, and for withdrawal of samples of volume 0.1 liter to 5,000 liters for GC-FID and GC/MS analysis.

Projects: 1) Mutagenic material produced by photolysis in the presence of NO_x. 2) Response of ponderosa pine to ozone and other stresses.

Available for Outside Use: Yes

CA-10

Owner: California Department of Transportation, City of Anaheim, City of Irvine, University of California, Irvine

Facility: Caltrans District 12 Advanced Testbed, Orange County, CA

Contact: W. Recker, Professor, Director, Institute of Transportation Studies, 330 Berkeley Place, Irvine, CA 92717

Telephone: 714-856-5989 **FAX:** 714-856-8385

General: The Advanced Testbed and associated Advanced Traffic Management Systems Laboratory are distinct from earlier corridor developments and will integrate network-wide traffic information (both surface street and freeway) in a real-time environment to provide "intelligent" computer-assisted decision support to District 12 and city traffic management personnel.

Projects: New facility.

Available for Outside Use: Yes

CA-11

Owner: University of California, Irvine, Department of Civil Engineering

Facility: Structural Test Hall, 146 Engineering Laboratory Facility (ELF), Irvine, CA 92717

Contact: Dr. Medhat A. Haroun, Professor and Chair, 103 ICEF

Telephone: 714-856-5016 **FAX:** 714-725-2117

General: The Engineering Laboratory Facility includes a Structural Test Hall, 28' high and equipped with a 5-ton capacity overhead traveling crane. The 24" thick reinforced concrete floor of the Hall is designed to act as a "strong floor" and one of the walls, 22' by 58.5' (long) by 36" (thick), is reinforced to act as a reaction wall. Both a 65 by 45' area of the strong floor and the total surface of the reaction wall have in-built sleeves, 2.5" in diameter at 20" centers both ways to facilitate connection of actuators or reaction frames. Each hole is rated at a design load of 20 kips in any orthogonal direction, with any four adjacent holes loaded simultaneously. A basement under the strong floor, "hollow

core" configuration, permits access to the underside of the test floor for equipment installation and storage. A separate computer room is provided adjacent to the test floor area for instrumentation and control equipment.

Unique: Extended Strong Reaction Wall and Strong Floor. Two small horizontal and vertical shaking tables are available for dynamic testing of small-scale models. A room adjacent to the Structural Test Hall houses other testing equipment including a Tinius Olsen 200 kip Universal Testing Machine and a concrete cylinder test rig.

Capacity: Two 220 kip actuators with servo valves, manifold, load cell, pin swivel head and pin swivel base. Two 55 kip actuators with servo valves, manifold, load cell, pin swivel head and pin swivel base. The excitation devices include two 5,000 pound harmonic shakers (1 Hz to 10 Hz) and a 300 pound impact device.

Projects: Testing of Bridge Pin Columns and Bridge Pier Walls for Seismic Design and Retrofit; Testing of Liquid Storage Tanks under Seismic Excitations; Testing of Concrete Panels under Cyclic Loads.

Available for Outside Use: Yes

CA-12

Owner: California State University, Bakersfield

Facility: Environmental Studies Area, 9001 Stockdale Highway, Bakersfield, CA 93311-1099

Contact: Dr. Ted D. Murphy, Director

Telephone: 805-664-3921 **FAX:** 805-664-3194

General: Environmental studies area consisting of 40 acres of formerly cultivated land. One half is a flat, fallow open field. Twenty acres are enclosed by a chain link fence and divided into areas of fallow field, dense woodland (irrigated), desert vegetation, freshwater pond. On site facilities include a small greenhouse, a laboratory-classroom building, and an animal rescue facility. Buildings are furnished with all utilities.

Unique: Open space, protected, occupied by unique animals, especially the San Joaquin Kit Fox.

Projects: Primarily field studies by CSUB students/faculty on kit Fox behavior, grass growth, desert plant adaptations, winter songbird populations. A major program at the site is a wildlife rescue/conservation program (FACT-Facility for Animal Care and Treatment).

Available for Outside Use: Yes

Comment: Facility was used for a study of air pollution by Caltrans several years ago; it was a site for mobile laboratory monitoring, air sampling, and meteorological balloon measurements.

CA-13**Owner:** SRI International**Facility:** Chemical and Chemical Engineering Laboratories, 333 Ravenswood Avenue, Menlo Park, CA 94025**Contact:** Thomas I. Dayharsh, Program Director**Telephone:** 415-859-4905 **FAX:** 415-859-4175

General: SRI maintains a number of fully equipped and instrumented chemistry laboratories and develops chemical processes for industry and government clients for physical separation, synthetic fuels production, material synthetics, and biochemical material development. SRI laboratories are equipped for feasibility evaluation of new processes, process scale-up and optimization, translation of processes from batch to continuous flow, and pilot plant designs. The high-temperature chemistry laboratory has facilities for mass spectrometry; vapor pressure characterization and measurement by Knudsen, Langmuir, torsion, and vapor transpiration methods; and thermogravimetric analysis. The vacuum laboratory includes equipment for sputtering, evaporation, and chemical vapor deposition of films. The ceramics laboratory has equipment for cutting and grinding hard materials to finished shapes, plasma spraying equipment, and furnaces capable of heating to 2000°C. The electrochemistry laboratory has high-speed potentiostats, battery evaluation equipment, and pulse-digital electrode transient data acquisition instrumentation.

Unique: Special analytical facilities include X-ray diffraction, warm rolling, scanning electron microscopy with EDAX, and transmission electron microscopy. Electron beam microprobe and STEM services are available. A high-bay area is used for process development units and small pilot plant processing.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-14**Owner:** SRI International**Facility:** Flying Laboratory, 333 Ravenswood Avenue, Menlo Park, CA 94025**Contact:** Thomas I. Dayharsh, Program Director**Telephone:** 415-859-4905 **FAX:** 415-859-4175

General: The SRI Beechcraft Queen Air, operated by the Geosciences and Engineering Center, provides a versatile flying laboratory with specialized capabilities for instrumentation installations.

Projects: Since its acquisition in 1978, funded by fees from client contracts, the aircraft has been used to map stratospheric ozone intrusions of the lower atmosphere,

survey air quality in various environmental studies, conduct radio propagation experiments, and support airborne laser radar (lidar) studies of power plant plume distributions, long-range tracking of fluorescent particle tracers, and remote detection of gas releases.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-15**Owner:** SRI International**Facility:** Materials Research Laboratories, 333 Ravenswood Avenue, Menlo Park, CA 94025**Contact:** Thomas I. Dayharsh, Program Director**Telephone:** 415-859-4905 **FAX:** 415-859-4175

General: SRI's materials research includes development, test, and evaluation of ceramics, polymers, fiber-reinforced, composite and semiconductor materials, and metal and mineral process technology. Facilities include a complete metallography laboratory; a mechanical properties laboratory with several uniaxial, biaxial, and hoop test machines capable of a very broad range of strain rates; a high-temperature crystal growing laboratory with several high-temperature programmed vacuum furnaces; a powder attrition and consolidation laboratory with conventional and isostatic compaction, sintering, and hot pressing; an ESR, NMR, and magnetic properties laboratory with Auger electron spectroscopy with ion sputtering, GC-MS, BET, IR spectroscopy, and pigment evaluation instruments.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-16**Owner:** SRI International**Facility:** Laser and Electro-Optical Laboratories, 333 Ravenswood Avenue, Menlo Park, CA 94025**Contact:** Thomas I. Dayharsh, Program Director**Telephone:** 415-859-4905 **FAX:** 415-859-4175

General: The facilities associated with electro-optical technology include laboratories dedicated to applications of active and passive remote sensing, high-sensitivity point detection, optical properties of aerosols, spectroscopy, imaging, infrared detector development, oil and gas exploration, holography, microprocessors, and fiber optics.

Unique: Large assortment of lasers, detectors, electron beam generators, spectrometers and spectrum analyzers, optical equipment, aerosol-generating equipment, and supporting computing equipment.

Projects: 1) The Infrared DIAL System--A completely self-sufficient mobile system designed for detection, discrimination, and mapping of gases, aerosols, and liquids that have spectral features in the infrared. 2) The 3-Color Lidar--Designed, constructed, and used to measure optical properties of dust formed by high explosives for the DNA.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-17

Owner: SRI International

Facility: Experimental Wideband Packet Communications Satellite Facility, 333 Ravenswood Avenue, Menlo Park, CA 94025

Contact: Thomas I. Dayharsh, Program Director

Telephone: 415-859-4905 **FAX:** 415-859-4175

General: The Wideband (packet satellite) network is an experimental 3-Mbit per second communications system developed under sponsorship of the DARPA and the Defense Communications Agency (DCA). This system is being used to evaluate the use of packet transmission for efficient voice communication, voice conferencing, and integration of voice and data over a satellite channel.

Unique: See below.

Projects: Each station in the wideband network consists of an earth terminal (dedicated 5-meter antenna plus associated IF/RF equipment), a burst-modem and codec unit, and a station controller. Station controllers provide interfaces to host computers (including packet speech sources) and manage the allocation of the satellite channel on a time-division multiplexing access (TDMA) demand-assigned basis. SRI is one of 10 network sites connected by the Wideband Satellite and is planning to use the network to demonstrate computer-based multimedia conferencing.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-18

Owner: SRI International

Facility: Structural Dynamics, Lethality, and Survivability Laboratories, 333 Ravenswood Avenue, Menlo Park, CA 94025

Contact: Thomas I. Dayharsh, Program Director

Telephone: 415-859-4905 **FAX:** 415-859-4175

General: SRI's Poulter Laboratory performs theoretical and experimental research of the response of materials

and structures under dynamic loads. In the 1950s, Poulter Laboratory pioneered in the use of specially designed explosive charges to simulate the effects of nuclear weapons on structures. The laboratory now specializes in determining failure mechanisms of the structures and materials of military systems exposed to nuclear and non-nuclear threats.

Unique: The laboratory maintains an extensive collection of analytical models of materials and structures, and maintains an explosive test site for experimental work.

Capacity: The Laboratory maintains a walk-in explosive vault capable of explosive experiments with up to 200-gram charges and two cylindrical chambers that can be used to perform experiments under vacuum. SRI's experimental facilities also include a shock tube and two gas guns capable of accelerating projectiles to 1 kilometer per second, two small-vehicle launchers, and an explosively driven missile launcher.

Projects: The laboratory has also applied its technologies and facilities to the study of the response of buildings subjected to earthquakes, failure mechanisms in industrial plants subjected to sabotage or to accidental explosions, and various types of vehicles involved in accidents. Poulter Laboratory also designs, builds, and tests specialized shaped charges.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-19

Owner: SRI International

Facility: Microwave Integrated Circuit Facilities, 333 Ravenswood Avenue, Menlo Park, CA 94025

Contact: Thomas I. Dayharsh, Program Director

Telephone: 415-859-4905 **FAX:** 415-859-4175

General: A wide variety of microwave integrated circuit (MIC) processing and testing facilities are available at SRI in a 1,000 square foot clean room. This installation provides control for dust, humidity, and temperature. It includes: an oil-free, high-vacuum station; chemical facilities; a microphoto-resist facility; a versatile RF sputtering system capable of sputter etching and of depositing thin films on refractory materials; and two multi-station evaporation systems for the deposition of thin metallic and insulating films.

Unique: Two oil-pumped dc triode sputtering systems and polishing and slicing equipment are available in adjoining controlled areas. This facility also contains an MIC assembly area that includes parallel gap welding, thermocompression, and ultrasonic bonding stations. SRI also has facilities for the probing and testing of hybrids.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-20

Owner: SRI International

Facility: Explosive Test Facility, 333 Ravenswood Avenue, Menlo Park, CA 94025

Contact: Thomas I. Dayharsh, Program Director

Telephone: 415-859-4905 **FAX:** 415-859-4175

General: SRI's Corral Hollow Experimental Site (CHES) is used primarily for both structural and materials response and failure tests. The site has experimental facilities including several instrumentation bunkers.

Unique: One bunker houses three EC 14-channel tape recorders with 250-MHz bandwidth, up to 20 Tektronix oscilloscopes, a Beckman and Whitney 189 framing camera, plus associated charge amplifiers, filters, and other electronic apparatus, including wide-bandwidth tape recorders.

Capacity: Also available are a large concrete test pad with an overhead crane for handling experiments and an underwater test facility 30' by 30' area with a depth of 15.' The latter is used for testing marine structures. The explosive testing bunker can be used with 1,000 pound charges above ground and large charges with an overburden. The site is also used to test new explosive, propellant, and pyrotechnic materials developed in SRI chemistry laboratories.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-21

Owner: SRI International

Facility: Robotics and Mechanical Research

Laboratory, 333 Ravenswood Avenue, Menlo Park, CA 94025

Contact: Thomas I. Dayharsh, Program Director

Telephone: 415-859-4905 **FAX:** 415-859-4175

General: SRI's Artificial Intelligence (AI) Center is one of the world's major centers for research on artificial intelligence. The AI Center's staff includes one of the largest and most highly trained groups of AI professionals in the world. SRI's AI Center has a program of basic research on intelligent mobile robots, including the design and construction of a mobile robot that will serve as a test bed for experimentation.

Projects: The robot is self-contained but capable of operating either autonomously or "tethered" to another computer. At present the mobile robot is equipped to

sense movement. A third level is being added to control and interpret visual input and to execute higher-level goals.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-22

Owner: SRI International

Facility: Intelligent Vehicle-Highway Systems

Laboratory, 333 Ravenswood Avenue, Menlo Park, CA 94025

Contact: Thomas I. Dayharsh, Program Director

Telephone: 415-859-4905 **FAX:** 415-859-4175

General: Laboratory will provide emulation of Automatic Traffic Management System (ATMS) and Automatic Driver Information System (ADIS) capabilities, plus emulation/simulation of Automatic Vehicle Control System (AVCS) capability. Laboratory will provide interfaces to major remote assets, such as sensors, controllers, vehicles, and video cameras.

Unique: Complete test bed for development of infrastructure capabilities.

Projects: Under development, operational in 1994.

Available for Outside Use: Yes

Comment: ATMS/ADIS Capability useful for: 1) developing architectures and standards; 2) supporting infrastructure providers; 3) developing system measures of effectiveness; 4) evaluating inter-operability requirements.

CA-23

Owner: SRI International

Facility: Microwave Anechoic Chamber and Analysis

Facility, 333 Ravenswood Avenue, Menlo Park, CA 94025

Contact: Thomas I. Dayharsh, Program Director

Telephone: 415-859-4905 **FAX:** 415-859-4175

General: Microwave anechoic chamber facilities and associated analysis equipment designed to conduct reflection-free measurements in the 0.4 to 18 GHz frequency range. Examples of objects measurable in the chambers are small antennas or scale models of large antenna systems (for antenna-pattern measurement), or scaled-down aircraft models for radar cross-section measurements. VHF measurements can be made on an outdoor roof-top range facility.

Unique: Support equipment includes automatic network analyzer (ANA) equipment, which facilitates the generation of design data and the verification of the performance of microwave passive and active components and systems. The HP 8510A (ANA) will tune up to 26.5

GHz, so the large chamber can be used to 26.5 GHz with additional RF hardware (antennas and waveguide).
Capacity: The 20' by 12' by 8' chamber is used for testing small antennas and scatterers from 2 to 18 GHz. The 40' by 20' by 20' chamber is used for larger objects from 0.4 to 18 GHz.

Available for Outside Use: Yes

Comment: Facilities support SRI contract research work. They are available to any organization at a cost that will be dependent on the work requirement.

CA-24

Owner: Department of the Army, Aviation Systems Command

Facility: Crew Station Research and Development Facility (CSRDF), NASA Ames Research Center, Moffett Field, CA 94035-1000

Contact: Terry Gossett, Chief, Simulation and Aircraft Systems Division, M/S 243-3

Telephone: 415-604-5905 **FAX:** 415-604-6475

General: Full mission simulator for performing a broad variety of studies to improve the pilot-vehicle system performance of Army aviators and rotorcraft. The CSRDF is centered around a pair of fixed-base, all digital "GLASS" cockpits with advanced visual imagery system displayed on a fiber-optic wide field-of-view helmet-mounted display.

Unique: Reconfigurable, multi-vehicle simulation capability

Capacity: Quantitative data available.

Projects: Helicopter evaluation pilot training, development of a cue augmentation device for the detection at night of obstacles in the helicopter's flight path.

Available for Outside Use: Yes, availability to outside users is evaluated on a case-by-case basis.

CA-25

Owner: Alliant Techsystems Inc.

Facility: Metrum Viking Laboratories, 440 Bernardo Avenue, Mountain View, CA 94043

Contact: Bill Dover, Region Manager

Telephone: 415-969-5500 **FAX:** 415-964-8673

General: 34,000 square feet of special floor space. Viking is a full service laboratory in that it provides a testing service for the Military Defense Aerospace and Electronics Industry Testing and Calibration Services.

Unique: Facilities for testing response to temperature, humidity, pressure, vibration, shock, fatigue.

Capacity: Full range of electronic reliability test

Projects: Calibration and repair of electron and mechanical test equipment for all major chip manufactures.

Available for Outside Use: Yes

CA-26

Owner: Department of Energy, Lawrence Livermore National Laboratory, University of California

Facility: Microfabrication Facility, Electronics Engineering, 7000 East Avenue, L-228 PO Box 808, Livermore, CA 94551

Contact: Stein Weissenberger, Transportation Program Leader

Telephone: 510-423-3336 **FAX:** 510-422-3694

General: LLNL microfabrication employs portions of integrated circuit (IC) technology to unorthodox, non-commercial applications and device parameters. The major emphasis is shared between 1) sensors and ICs for physics experiment diagnostics, and 2) a wide variety of silicon microstructure. Facility includes class 10 clean rooms and full process capabilities.

Unique: Low stress thin windows for sensor work. Anisotropic silicon etching capabilities. Lithium niobate technology and molecular beam epitaxy.

Capacity: Can work with silicon, gallium arsenide and lithium niobate substrates.

Projects: Silicon micromachining for heat sinks, sensors and x-ray windows. High power, short pulse laser diode arrays. GaAs IC sample-and-hold circuit. 20 GHz electro-optic modulator. Capillary-based chemical sensors.

Available for Outside Use: Yes

Comment: The LLNL Microfabrication Facility is unique from other IC facilities because of its ability to do prototype work using unorthodox technology. In addition, a wide variety of substrate materials can be used.

CA-27

Owner: Department of Energy, Lawrence Livermore National Laboratory, University of California

Facility: LLNL Emperor Test Facility/Microwave Anechoic Chamber, 7000 East Avenue, L-228 PO Box 808, Livermore, CA 94551

Contact: Stein Weissenberger, Transportation Program Leader

Telephone: 510-423-3336 **FAX:** 510-422-3694

General: Emperor is an LLNL broadband rf/microwave experimental test facility that operates from 100 MHz to 18 GHz. It consists of a well characterized, large cone and constant-gain antenna whose field drops off as 1/R. Emperor has been successfully used to investigate coupling of rf and microwave signals into high-valued electronic systems. The microwave anechoic chamber is a high-frequency facility that provides accurate measurements of microwave scattering and coupling into objects.

Unique: The Emperor facility was specially designed by LLNL engineers and provides unique capabilities for

characterizing systems in a known rf/microwave environment.

Available for Outside Use: Yes

Comment: The Emperor and microwave anechoic chambers potentially can be used to develop and test sensors and communications equipment for Intelligent Vehicle-Highway Systems (IVHS) research.

CA-28

Owner: Department of Energy, Lawrence Livermore National Laboratory, University of California

Facility: Engineering Measurements and Analysis, Engineering Sciences Division, Mechanical Engineering, 7000 East Avenue, L-228 PO Box 808, Livermore, CA 94551

Contact: Stein Weissenberger, Transportation Program Leader

Telephone: 510-423-3336 **FAX:** 510-422-3694

General: The Engineering Measurements and Analysis Section is committed to innovation and excellence in the application of measurement technologies. We have unique capabilities in the areas of: vibration, experimental modal analysis, sensor design, acoustic analysis, machine monitoring, strain gages, calibration of pressure vibration, displacement, force, mass, torque, flow, temperature and humidity sensors, and determination of thermo-physical properties.

Unique: Specialized instrumentation systems, impact measurements, modal analysis of large structures.

Projects: Large, multi-channel data acquisition systems, experimental modal analysis of large civil structures, rotating machinery, acoustic blast measurements, transportation and packaging studies, smart sensing systems, special application sensors.

Available for Outside Use: Yes

Comment: The Engineering Sciences Division is composed of three technology sections: Engineering Measurements and Analysis, Materials Test and Evaluation, and Nondestructive Evaluation.

CA-29

Owner: Department of Energy, Lawrence Livermore National Laboratory, University of California

Facility: Nondestructive Evaluation Facility, Livermore, CA 94551

Contact: Stein Weissenberger, Transportation Program Leader, Mechanical Engineering Department, 7000 East Avenue, L-228 PO Box 808

Telephone: 510-423-3336 **FAX:** 510-422-3694

General: Nondestructive evaluation facilities for radiography, ultrasonics, acoustic emission, eddy current, computer tomography (CT), dye penetrant, magnetic particle, infrared (IR) imaging, and signal and image

processing. NDE typically supports materials characterization, defect and flaw identification, and monitoring of in-service damage.

Unique: High-energy radiography (including portable 9-MeV linac for field work), ultrasonics, IR imaging, computer tomography, and signal and image processing. The NDE Section is a highly multi-disciplinary group comprising engineers (mechanical and electrical) physicists, chemists, computer scientists, and Level II/III certified technologists.

Capacity: 100 kHz-1 GHz ultrasonics, 10 keV-9MeV radiography, multiple energy (20 keV-9MeV) CT systems with resolutions ranging from millimeters to 100 μm , dual band IR system (3-5 mm and 8-12 μm).

Projects: Rebar Imaging in Concrete, Defect Characterization in Steel Bridge Pin, High Energy Radiography of Missiles, High Explosives Billet Characterization, Radiographic Film Digitization for Quantitative Analysis, IR Imaging of Buried Objects.

Available for Outside Use: Yes

Comment: The Engineering Sciences Division is composed of three technology sections: Engineering Measurements and Analysis, Materials Test and Evaluation, and Nondestructive Evaluation.

CA-30

Owner: Department of Energy, Lawrence Livermore National Laboratory, University of California

Facility: Site 300 Experimental Test Facilities, 7000 East Avenue, L-228 PO Box 808, Livermore, CA 94551

Contact: Stein Weissenberger, Transportation Program Leader

Telephone: 510-423-3336 **FAX:** 510-422-3694

General: Site 300 was initially developed by LLNL in 1955 as a remote experimental high-explosive test facility. It has evolved into a significant investment in land (6,893 acres or about 11 square miles) and specialized facilities capable of conducting sophisticated diagnostics on complex science and engineering experiments. On-site technology support includes modern destructive and nondestructive materials testing chemistry--for diagnosing chemical properties of materials in controlled environments (e.g., high explosives), materials fabrication for pressing machining, and assembly of components using remote processing, hydrodynamic testing--thermal and dynamic environments to provide data on material behavior.

Unique: Unique testing chambers and bunkers and an 18 MeV linear accelerator.

Available for Outside Use: Yes, by contractual arrangement.

CA-31

Owner: Department of Energy, Lawrence Livermore National Laboratory, University of California

Facility: Materials Test and Evaluation Section, Engineering Sciences Division, Mechanical Engineering, 7000 East Avenue, L-228 PO Box 808, Livermore, CA 94551

Contact: Stein Weissenberger, Transportation Program Leader

Telephone: 510-423-3336 **FAX:** 510-422-3694

General: The Materials Test and Evaluation (MTE) Section investigates the mechanical behavior materials, components, and assemblies under various conditions of load, deformation, temperature, and environment. Technical expertise is available in materials engineering, materials science, and the mechanical behavior of materials. A wide variety of mechanical tests can be carried out. They are: tension, compression, bending, torsion, biaxial, fracture, mechanics, impact, high strain rate, fatigue, creep, and hardness. The seven major technologies within MTE are: General Testing, Fracture Mechanics, High Rate Testing, Composite Materials, Material Modeling, Acoustic Emission, and Acoustic Properties of Materials.

Unique: 500,000 pound test machine, 4°K to 400°C fracture mechanics test apparatus, biaxial test system (tension/torsion), Hopkinson bar test unit for strain rates to 10⁴ per second, drop tower for impact testing at 100' per second, 50,000 pound extended frame test machine for oversized specimens, thermomechanical fatigue apparatus at 100 Hz, and up to 400°C. 2000°C vacuum test system.

Capacity: Loads up to 500,000 pounds strain rates 10⁻⁸ to 10⁴ per second temperatures from 4°K to 2000°C and environments of vacuum, gaseous, and aqueous.

Projects: All types of mechanical testing experiments.

Available for Outside Use: Yes

Comment: The Engineering Sciences Division is composed of three technology sections: Engineering Measurements and Analysis, Materials Test and Evaluation, and Nondestructive Evaluation.

CA-32

Owner: University of California, Lawrence Berkeley Laboratory

Facility: Mechanical Testing Laboratory, Center for Advanced Materials, Materials Sciences Division, MS 66-200, Berkeley, CA 94720

Contact: Professor Robert O. Ritchie, Director

Telephone: 510-486-5798 **FAX:** 510-486-4995

General: Mechanical testing facility specifically designed for the fracture toughness and cyclic fatigue testing of

very brittle materials (e.g., ceramics, intermetallics), at ambient and temperatures up to 1400°C.

Unique: Ability to determine cyclic fatigue-crack growth data in materials with toughness as low as K_{Ic} around 1 MPa/m.

Capacity: 5 x 10 kips electro-servo hydraulic testing machines, 1 x 40 kip electro-servo hydraulic machine.

Projects: Cyclic fatigue and fracture toughness of alumina, silicon, nitride, silicon carbide, zirconia, alumina/SiC composites, monolithic and composite TiAl intermetallics, Al-Li alloys, ceramic/metal interfaces. Cryogenic fracture toughness of Al-Li alloys.

Available for Outside Use: No

Comment: These are pure research facilities manned by post-docs and students engaged in University/National Laboratory research specifically for M.S. and Ph.D. degrees.

CA-33

Owner: University of California at Berkeley

Facility: Earthquake Simulator, Earthquake Engineering Research Center, 1301 South 46th Street, Richmond, CA 94804

Contact: Jack P. Moehle, Director

Telephone: 415-231-9554 **FAX:** 415-231-9471

General: 20' by 20' earthquake simulator (shake table) capable of subjecting structures (weighing up to 150 kips) to strong base motion in one horizontal and one vertical direction. The table is supported by extensive data acquisition and analysis facilities. Will be capable of second horizontal component in 1992.

Capacity: 128 conditioned channels plus 48 unconditioned channels. 300 k samples per second burst, 50 k samples per second throughput.

Projects: Tests of reinforced concrete and steel frames under dynamic base motions. Tests of base isolation and retrofitting strategies.

Available for Outside Use: Yes

CA-34

Owner: University of California at Berkeley

Facility: Large Isolation Bearing Tester, Earthquake Engineering Research Center, 1301 South 46th Street, Richmond, CA 94804

Contact: Jack P. Moehle, Director

Telephone: 415-231-9554 **FAX:** 415-231-9471

General: Facility capable of subjecting full-scale base isolation bearings to realistic axial and lateral load histories. The facility is supported by extensive data acquisition and analysis facilities.

Capacity: 64 channels; 250 k samples per second burst; 60 k samples per second throughput.

Projects: Tests of large-scale isolation bearings for building and bridge projects in regions of high seismic risk.

Available for Outside Use: Yes

CA-35

Owner: California Department of Transportation and University of California at Davis

Facility: California Automotive Research Test Site (CARTS), University of California, Davis, CA

Contact: Roger L. Stoughton, Senior Materials and Research Engineer, Caltrans, PO Box 19128, Sacramento CA 95819

Telephone: 916-739-2308 **FAX:** 916-739-4905

General: Proposed facility, design work over half complete. Phase I construction may start early 1992; Phase II in late 1992. Fourteen (14) acre, rectangular test site (500' by 1200'). Two test areas adjoining 300' diameter concrete pad. Small office and 3-bay test vehicle preparation shop on site.

Unique: Large steel flywheel planned for propelling vehicles up to 20,000 pounds at 65 mph into test barriers. Semi-circular, positive-slope gravel beds will surround the two test areas to stop test vehicles after impacts. Test bogies will be used for some tests. A device to measure the three rotational moments of inertia of test vehicles will be on site. A fixed rail guidance system will be used for both frontal and side impacts of test vehicles into safety barriers. Vehicle propulsion machinery will be computer controlled.

Available for Outside Use: Yes

CA-36

Owner: California Department of Transportation and University of California at Davis

Facility: California Dynamic Test Facility, 3500 Reed Avenue, West Sacramento, CA

Contact: Roger L. Stoughton, Senior Materials and Research Engineer, Caltrans, PO Box 19128, Sacramento CA 95819

Telephone: 916-739-2308 **FAX:** 916-739-4905

General: Test area paved with asphalt concrete, 62' by 1,100' rectangular area adjoining 350' by 1,100' triangular area. Shop building about 24' by 24'; storage building about 8' by 16.' Large concrete block with cantilevered slab simulating a bridge deck for bridge railing crash tests. Complete set of electronic and photographic equipment stored off site.

Unique: Two new bogies (one for 1,500 to 3,000 pound cars and one for 3,000 to 6,000 pound vehicles) and fixed rail guidance system just built.

Capacity: Test facility suitable for conducting all crash tests with 1,800 to 4,500 pound passenger cars according to crash test guidelines in NCHRP Report 230.

Projects: Crash tests conducted on concrete glare screen for median barriers, bridge rails for secondary highways, breakaway supports for call boxes, bogie strength tests, and wheel impact tests on median barriers and glare screen.

Available for Outside Use: No

Comment: Agreement to use test site which is on the grounds of the California Highway Patrol expires January 31, 1992. We hope to extend the agreement until a planned new test facility can be built.

Colorado

CO-1

Owner: Department of the Interior, Bureau of Reclamation

Facility: Concrete Laboratory, Research and Laboratory Services Division, PO Box 25007, Code D-3730, Denver, CO 80225

Contact: J.S. Pierce, Chief, Materials Engineering Branch

Telephone: 303-236-5989 **FAX:** 303-236-7664

General: 5 million pound load universal testing machine.

Unique: Loads to 5 million pounds in tension or compression, can test specimens up to 10' wide and 32' long. **Projects:** Primarily used to test large concrete specimens. Has also been used to test underground shoring systems (mine cribbing), and to test rock, rock bolt, and concrete system strengths.

Available for Outside Use: Yes

CO-2

Owner: Department of the Interior, Bureau of Reclamation

Facility: Triaxial Testing Machine, Research and Laboratory Services Division, PO Box 25007, Code D-3730, Denver, CO 80225

Contact: J.S. Pierce, Chief, Materials Engineering Branch

Telephone: 303-236-5989 **FAX:** 303-236-7664

General: Triaxial testing machine can test 6" by 12" concrete specimens.

Unique: Maximum axial load 7.5 million pounds. Maximum lateral pressure 125,000 psi.

Available for Outside Use: Yes

CO-3

Owner: Department of the Interior, Bureau of Reclamation

Facility: Hydraulics Laboratory, Denver, CO 80225

Contact: Philip H. Burgi, Chief, Hydraulics Branch, PO Box 25007

Telephone: 303-236-5985 **FAX:** 303-236-7664

General: Hydraulic Laboratory: Enclosed 5,000 square meters (53,820 square feet) floor space with 8.2 meters (27') high ceiling; 1,050 cubic meters (37,000 cubic feet) storage sump below floor level; 20 cubic meters (700 cubic feet) volumetric/weight tank; full complement of flow measurement equipment.

Unique: Large glass wall flume - 24 meters by 1.2 meters by 2.4 meters (depth); high-head pump - 183 meters head at shut-off, 122 meters at 127 liters per second discharge; low ambient test chamber - 16.7 cubic meters, vacuum to 10.1 KPa; tilting flume -0.5% to +8%, 91 centimeters by 18.2 meters by 61 centimeters (depth).

Capacity: Four large pumps (100 to 150 hp) with total recirculating capacity of 1 cubic meter per second (35 cubic feet per second (cfps)) and 45 meters (148'). Seven portable pumps: capacity range 60 to 140 liters per second (2 to 5 cfps).

Projects: Numerous studies of spillways, outlet works, overtopping dam embankment research, river models, water measurement research.

Available for Outside Use: Yes

CO-4

Owner: Department of the Interior, Bureau of Reclamation

Facility: Geotechnical Laboratory, Research and Laboratory Services Division, PO Box 25007, Code D-3730, Denver, CO 80225

Contact: J.S. Pierce, Chief, Materials Engineering Branch

Telephone: 303-236-5989 **FAX:** 303-236-7664

General: Drilling, sampling, in-situ testing. Field testing of soil, rock and concrete. Drilling capability with CME 75 drill rig using augers, rotary drills, rotary core barrels. In-situ testing, 20-ton cone penetrometer, flat dilatometer, soil and rock dilatometers, vane shear, soil/rock bore hole shear, rock hydraulic fracturing. Hazardous waste monitoring both conventional and direct push technologies.

Unique: CME 75 drill rig, Hogentogler 20-ton cone truck, soil gas sampling, portable sampling and in-situ testing equipment, large-scale rock testing.

Capacity: Ground investigations to depths of up to 1,000.' Large diameter sampling to 6-inch size. 20-ton direct push capacity.

Projects: FHWA - Scotts Bluff National Monument rock bolt testing, sentinel bridge site CPT and SPT. Corps of Engineers - Rocky Mountain Arsenal. Reclamation: Ridges Basin O'Neil, Steinaker Dams. BIA: Upper and Lower Dry For Dams.

Available for Outside Use: Yes

Comment: Research is performed to develop new sampling and testing technologies. Work done for other governmental agencies only.

CO-5

Owner: Department of the Interior, Bureau of Reclamation

Facility: Testing Machine, Research and Laboratory Services Division, PO Box 25007, Code D-3730, Denver, CO 80225

Contact: J.S. Pierce, Chief, Materials Engineering Branch

Telephone: 303-236-5989 **FAX:** 303-236-7664

General: 1-million pound stiff testing machine. Large scale structural testing facility capable of static loads using serve-hydraulic computerized controls.

Unique: Capable of multistage testing on a single specimen.

Capacity: Triaxial loading with 20,000 psi lateral load; 20,000 psi pore pressure; 400°F; 1 hertz dynamic; 4" diameter maximum specimen size.

Projects: Testing for various tunnel, foundations, and dam design engineers, parameters.

Available for Outside Use: Yes

CO-6

Owner: Department of the Interior, Bureau of Reclamation

Facility: Corrosion Laboratory, Research and Laboratory Services Division, PO Box 25007, Code D-3730, Denver, CO 80225

Contact: J.S. Pierce, Chief, Materials Engineering Branch

Telephone: 303-236-5989 **FAX:** 303-236-7664

General: Field corrosion testing equipment including polarization, resistivity, continuity, coating resistance, data loggers and recorders.

Unique: State-of-the-art equipment for conducting corrosion studies on all types of highway structures.

Capacity: Capable of tests on bridges, culverts, reinforced pavements.

Projects: Corrosion investigations of powerplants, pumping plants, pipelines reinforced concrete bridge decks, and culverts.

Available for Outside Use: Yes, with tests conducted by staff.

CO-7

Owner: Department of the Interior, Bureau of Reclamation

Facility: Materials Laboratory and Geosynthetic Testing, Research and Laboratory Services Division, PO Box 25007, Code D-3730, Denver, CO 80225

Contact: J.S. Pierce, Chief, Materials Engineering Branch

Telephone: 303-236-5989 **FAX:** 303-236-7664

General: Geosynthetic testing laboratory with: 1) 50,000 pound Tinius Olson and 5,000 pound Instron for determining tear and tensile properties, etc. of geosynthetics; 2) Computer automated hydrostatic pressure cells; 3) Direct shear testing capabilities; 4) Outdoor exposure environmental chambers for investigating durability of geosynthetics.

Unique: The hydrostatic test vessels can simulate varying hydrostatic heads over a geosynthetic placed on a variety of subgrade materials.

Projects: Hydrostatic tests were run on approximately six different types of materials over simulated Black Lake Dam subgrades. Other projects investigated include: Black Mountain Operating Reservoir, Mt. Elbert Forebay lining, Coachella Canal in-place lining prototype, and SanJusto HDPE lining.

Available for Outside Use: Yes

CO-8

Owner: Department of the Interior, Bureau of Reclamation

Facility: Vibration Laboratory, Research and Laboratory Services Division, PO Box 25007, Code D-3730, Denver, CO 80225

Contact: J.S. Pierce, Chief, Materials Engineering Branch

Telephone: 303-236-5989 **FAX:** 303-236-7664

General: Vibration Laboratory for structural dynamics investigations through use of hydraulic jacks and seismic mass.

Unique: Can test specimens up to 15' by 20' by 20.' Loads to 1,000,000 pounds vertically can be applied. Earthquake loads can be modeled.

Projects: Rapid load tests mass of concrete in tension flexure and compression.

Available for Outside Use: Yes

CO-9

Owner: Department of the Interior, Bureau of Reclamation

Facility: Soils Testing, Research and Laboratory Services Division, PO Box 25007, Code D-3730, Denver, CO 80225

Contact: J.S. Pierce, Chief, Materials Engineering Branch

Telephone: 303-236-5989 **FAX:** 303-236-7664

General: Radiographic inspection of soil or rock; vibratory compaction hammer; back pressure permeability; flow pump permeability apparatus; rotation shear test; direct shear; initial capillary pressure of soil by the exposed end plate method.

Unique: Fully automated triaxial shear testing capability: up to 9" diameter by 22.5" and confining pressure up to 1,000 pound-feet per square inch.

Projects: Reclamation's water resources construction projects.

Available for Outside Use: Yes

Comment: Ability to perform soil-cement/RCC proportions. Capability to teach soil-cement/RCC training courses: batch plant calibration; in-place unit weight and moisture content; cement content by heat of neutralization; compressive strength; and, coring and core evaluation.

CO-10

Owner: Department of Commerce, National Institute of Standards and Technology

Facility: Large-Scale Mechanical Testing Facility, Materials Science and Engineering Laboratory, 325 Broadway, Boulder, CO 80303

Contact: Dr. H.I. McHenry, Chief, Materials Reliability Division

Telephone: 303-497-3251 **FAX:** 303-497-5020

General: 10⁶ pound force capacity servo-hydraulic test machine with MTS electronic controls.

Unique: Top mounted load cell makes it convenient for environmental testing.

Capacity: ±10⁶ pound force approximately 5 Hz fatigue cycling rate.

Projects: Materials evaluation in cryogenic fluids.

Available for Outside Use: Yes

CO-11

Owner: University of Colorado at Boulder, Department of Civil Engineering

Facility: Structures and Materials Laboratory, Campus Box 428, Boulder, CO 80309

Contact: Benson Shing, Associate Professor

Telephone: 303-492-8026 **FAX:** 303-492-7317

General: Laboratory consists of state-of-the-art electro-hydraulic servo-controlled testing machines and equipment. It has a strong floor for testing structures and structural components.

Unique: 1 million pound universal testing machine; many hydraulic actuators for different configurations of

structural testing. 25' headroom. Modern data acquisition systems.

Projects: Seismic loading of reinforced masonry shear walls; concrete fracture mechanics studies; bridge deck fatigue studies; rock joint properties under cyclic loading; pseudo-dynamic testing of steel structures.

Available for Outside Use: Yes

Comment: Many structural configurations can be tested in the laboratory. Material characterization testing is also suitable.

CO-12

Owner: University of Colorado at Boulder, Department of Civil Engineering

Facility: Geotechnical Centrifuge Laboratory, Campus Box 428, Boulder, CO 80309

Contact: Hon-Yim Ko, Professor

Telephone: 303-492-6716 **FAX:** 303-492-7317

General: A 440 g-ton geotechnical centrifuge for testing scale models of structures to simulate effects of gravity body forces. Rotor arm is 18' (radius), and carries a 2 ton payload up to 4' by 4' by 3' in size. Also available is a smaller 15 g-ton centrifuge with earthquake simulation capabilities.

Unique: Large capacity (most powerful outside the Soviet Union); automatic balancing system; cooling system; data acquisition through remote programmable signal conditioning.

Capacity: 440 g-ton payload capacity; can model structures at 200th scale; maximum prototype size that can be simulated is 800' by 800' by 600.'

Projects: Model testing of drag anchors for offshore structures; pile driving simulation; stability of concrete dams, fracture of concrete dams; reinforced earth retaining wall systems; seismic stability of earth dams; simulation of lunar facility construction.

Available for Outside Use: Yes

Comment: A geotechnical centrifuge is an invaluable piece of equipment for testing models of soil and structures to simulate the effects of gravity loading. Its utilization in highway research can be identified in the following areas: bridge foundations (both shallow and deep); slope stability; soil reinforcing systems (retaining walls, foundations, etc.); buried culverts; tunnels; and underground openings. Centrifuge testing can be used to validate design, generate design charts, study failure and deformation mechanisms, and validate numerical procedures.

CO-13

Owner: Department of Agriculture, Agricultural Research Service

Facility: Outdoor Experimental Watershed, PO Box E, Fort Collins, CO 80522

Contact: Dr. Donn G. DeCoursey, Research Hydraulic Engineer

Telephone: 303-221-0578 **FAX:** 303-493-4347

General: The outdoor experimental rainfall facility was constructed in 1980 and is located at the Engineering Research Center, Foothills Campus, Colorado State University. This 230 square meter (2,800 square feet) facility can simulate 16 to 130 mm per hour (0.63 to 5.1 inch per hour) rainfall intensities, continuous measurement of surface water discharge, soil pore solution sampling, control and monitoring of a groundwater table (independent of rainfall infiltration) and continuous measurement of groundwater discharge.

Unique: The outdoor facility is a 33 meter by 9 meter (100' by 28') parallelogram with 46 cm (18") of loam soil separated from one meter (3') of crushed rock by fine mesh fabric. Butyl rubber prevents moisture from leaving the sides or bottom of the facility.

Capacity: The sprinkler system consists of 15 rows of sprinkler heads with five heads per row for a total of 73 heads. The sprinkler heads operate at an elevation of 3 to 4 meters (10' to 12') above the facility surface. Electrically controlled cut off switches operate four systems which may be used independently or in combinations to provide up to eight different rainfall intensities.

CO-14

Owner: Colorado State University

Facility: Hydraulics Laboratory, Engineering Research Center, Fort Collins, CO 80523

Contact: Dr. Steven R. Abt, Director, Hydraulics Laboratory

Telephone: 303-491-8203 **FAX:** 303-491-8671

General: 30,000 square feet floor space Hydraulics and Hydromachinery laboratories. Scour and sediment transport equipment, test facilities for turbines and pumps.

Unique: Large tilting flume, including sediment capabilities. Fixed flume 8' by 4' by 200.' 100 acres outdoor space. Outdoor flume 8' by 20' by 180.'

Capacity: Pump capacities to 120 cubic feet per second. Head limits 355.'

CO-15

Owner: Colorado State University

Facility: Fluid Dynamics and Diffusion Laboratory, Engineering Research Center, Fort Collins, CO 80523

Contact: Dr. Robert N. Meroney, Professor and Director

Telephone: 303-491-8574 **FAX:** 303-491-8671

General: The Fluid Dynamics and Diffusion Laboratory (FDDL) contains the largest set of wind-tunnel facilities in the world dedicated to the study of wind effects on man and his activities. The FDDL includes three large meteorological wind tunnels and 7 smaller facilities. The laboratory has a complete data acquisition instrumentation, computers, standards and visualization devices.

Unique: The Meteorological Wind Tunnel (MWT) is the only wind engineering tunnel in the country able to simulate the stable and unstable stratification of the atmosphere in simulated boundary layers 1 to 2 meters deep.

Capacity: The MWT is 2 meters by 2 meters cross-section by 30 meters long with thermal controls. The Environmental Wind Tunnel (EWT) is 4 meters by 3 meters cross-section by 20 meters long. The Industrial Aerodynamics Wind Tunnel (IWT) is 2 meters by 2 meters cross-section by 18 meters long.

Projects: Wind loading on buildings, roofs, and towers. Dispersion of pollutants and toxic materials from chimneys, incinerators, flues, toxic dump sites, etc. Pedestrian comfort studies near building complexes.

Available for Outside Use: Yes

Comment: Prior transportation related research in the FDDL at Colorado State includes: 1) Street canyon dispersion in generic urban building environments; 2) Bridge aerodynamics studies of suspension bridge sections; 3) Urban dispersion from ventilators for underground highway tunnels; 4) Snow and sand deposition over highway embankments and shelter belts; 5) Urban air pollution associated with heat-island effects, comparison with field experiments; and 6) Ship stack ventilator studies.

CO-16

Owner: Department of Transportation, Federal Railroad Administration

Facility: Transportation Test Center, Test Center Road, Pueblo, CO 81001

Contact: Jack B. Stauffer, Director, Test Engineering, PO Box 11130

Telephone: 719-584-0543 **FAX:** 719-584-0672

General: TTC is a 52 square mile remote facility of the U.S. DOT dedicated to testing full scale ground transportation systems, vehicles, and major components.

Location is in southern Colorado high semi-arid plains at a mean elevation of 5,000'.

Unique: Fifty plus miles of various railroad trackage representing the configurations found in U.S. and Canada. Very large hydraulic vibration test laboratory.

Capacity: Capable of simultaneous testing of 10 or more projects, any type of environment.

Projects: Development and certification to specification testing of rail vehicle (passenger, transit, and freight) and track structure under static and dynamic loadings.

Available for Outside Use: Yes

Comment: The facilities at TTC were constructed to test rail vehicles of all kinds. They have or can be adapted to test highway vehicles or aircraft components. The vibration test machines utilize one of the world's largest hydraulic power sources and are capable of testing structures up to 100' long, weighing up to 400,000 pounds. The TTC averages 320 weather working days per year. The facility is operated and under the direction of the Association of American Railroad's Research and Test Department on fully cost-reimbursement basis. It is also used to test and evaluate at other sites in the United States and several foreign countries.

Connecticut**CT-1**

Owner: University of Connecticut, Department of Civil Engineering

Facility: Structures Testing Strong Floor, Box U-37, Storrs, CT 06260

Contact: Dr. Erling Murtha-Smith, Professor

Telephone: 203-486-2245 **FAX:** 203-486-0318

General: A 40' wide by 6.5' long structures testing strong floor with 4' by 4' grid of anchors each rated at 200,000 pounds. Also includes data acquisition system and load control system. The facility is served by a 25' overhead crane and has 20' of head room.

Unique: Includes 400,000 pound universal testing machine.

Projects: Under construction; available in 1993.

Available for Outside Use: Yes

Comment: The facility is partially supported by a grant from the National Science Foundation. It is being constructed to encourage research and routine work with interaction of agencies, universities and industry in the New England region and beyond.

Delaware**DE-1**

Owner: University of Delaware

Facility: Center for Composite Materials, Newark, DE 19716

Contact: Roy McCullough

Telephone: 302-451-2310 **FAX:** 302-451-2657

General: Facility for research, testing and experimental manufacturing of composite materials. Includes resin transfer molding, injection molding and thermal forming equipment.

Unique: Robotic manufacturing equipment, textile forming equipment, NDE and acoustical emission laboratory.

Capacity: Autoclave 24"x 48"x 6."

Projects: Lightweight generator frame, lightweight vehicle (USA), new cure system.

Available for Outside Use: yes

DE-2

Owner: ENSCO, Inc.

Facility: Delaware Test Track Facility, 13 South Nanticoke Avenue, Georgetown, DE 19947

Contact: Dale Stout, Highway Program Manager, 5400 Port Royal Road, Springfield, VA 22151

Telephone: 703-321-4715 **FAX:** 703-321-7619

General: 5,000' long, 150' wide concrete runway capable of testing large vehicles (have conducted test of 50,000 pound vehicle). Grass area on both sides of runway and between end-of-runway taxiways available for guardrail and terminal installations, excavated pit at end of runway for bridge rail and median barriers. Site also has bogie testing capability.

Unique: 5,000' length; pit for bridge rails up to 150' long.

Capacity: Up to 24 channels of data, instrumented dummy testing capability.

Projects: Bridge rail, guardrail, median barrier, impact attenuator, terrorist barrier testing. 20-25 tests conducted per year.

Available for Outside Use: Yes

Florida**FL-1**

Owner: Department of the Air Force

Facility: McKinley Climatic Laboratory, Eglin Air Force Base, FL 32542-5000

Contact: Wayne Drake, Test Engineer, 3246

TESTW/TFOL

Telephone: 904-882-4619 **FAX:** 904-882-5531

General: The Climatic Laboratory consists of six test chambers ranging in size from 250' by 200' by 60' Main Chamber to 9' by 13' for the Altitude Chamber. Temperature control from -65°F to +160°F with rain and solar capability.

Unique: The Climatic Laboratory has the world's largest chamber (3.25 million cubic feet).

Projects: F-117A, MA1A Tank, Peace Cognac III, OH58 Helicopter, ARM Decoy, Chapparral, Base Recovery Vehicle, F-15E Aircraft, ACM, AC-130 Gunship, MERW Shelters, AN/ALO-166 Mine Sweep, and Aircraft Crash Crane.

Available for Outside Use: Yes, first come first serve.

Comment: The Climatic Laboratory is the world's largest environmental test facility to simulate any climatic condition encountered in the world. The facility has a complete engineering and fabrication branch which is capable of providing any test support necessary.

FL-2

Owner: University of Florida, Department of Civil Engineering

Facility: Structures and Materials Laboratory (planned), 345 Weil Hall, Gainesville, FL 32611-2083

Contact: Dr. Paul Y. Thompson, Professor and Chairman

Telephone: 904-392-9537 **FAX:** 904-392-3394

General: A 39,000 square foot Laboratory to replace existing laboratory space of approximately 12,000 square feet.

Unique: Large structural models (full scale) up to 42' by 100'; environmentally controlled pavement test pits; and other first class testing capability.

Capacity: 50' by 225' structural testing area with structural testing floor of 42' by 95'; environmental chambers for materials research.

Projects: This is a replacement facility. Typical projects in existing facility: punch and shear of thin reinforced concrete bridge decks both conventional and prestressed/post tensioned; concrete creep studies; concrete permeability; improved steel bridge ratings using LFD; strength gain and cementation of flexible pavement bases; and low-temperature pavement response testing for evaluation of thermal rippling.

Available for Outside Use: Yes

Comment: This replacement facility will be a world class Structures and Materials Laboratory. The laboratory will also support undergraduate and graduate academic programs.

FL-3

Owner: University of Florida, Department of Civil Engineering

Facility: Hydraulic Research Flume, Hydraulic Laboratory, 345 Weil Hall, Gainesville, FL 32611-2083

Contact: Dr. B.A. Christensen, Professor

Telephone: 904-392-0952 **FAX:** 904-392-3394

General: A fixed slope reinforced concrete flume with low head recirculation pump, towing carriage and observation windows. Length: 90'; width: 8'; maximum depth: 2.5'

Unique: 4' wide return flume of same length may also be used for flowing water research and towing of small to intermediate ship models. Uniquely suited for bridge scour research.

Capacity: Poncelet and Thomson Weirs. Maximum discharge: 18,000 gallons per minute, 100 hp pump, recirculation of sediment possible.

Projects: Development of Beam Trawl, Commercial Trawl Test, Calibration of Field Equipment, Friction Factors in Hurricane Flooding, Bridge Scour, flushing characteristics of marinas and residential canals.

Available for Outside Use: Yes

Comment: Excellent facility for scour studies and open moveable bed research.

FL-4

Owner: University of Central Florida, Department of Civil Engineering

Facility: Accelerated Bridge/Material Circular Test Track, Orlando, FL 32816

Contact: Dr. S.S. Kuo, Associate Professor

Telephone: 407-823-2280 **FAX:** 407-823-5483

General: The facility model is a 50' diameter circular test track. Total load varying between 30,000 and 80,000 pounds is evenly distributed to three dual wheels mounted on the ends of three I-beams arranged radially at the center of the track. The device powered by a 220 hp diesel engine with a hydraulic transmission, is capable of speed up to 25 mph. A computerized data acquisition system and software package have been developed to collect automatically, reduce, and store the test data from rosette strain gates and load cells mounted to the test specimens.

Unique: Simulated to traffic dynamic load with computer data acquisition system.

Capacity: The facility can operate the travel up to 25 mph speed and applying loading up to 20,000 pound wheel load.

Projects: Evaluation of large scale bridge expansion joint.

Available for Outside Use: Yes

Comment: The test track and loading device were purposely designed as simple as possible to make it versatile for future uses. It can be used for testing numerous other highway related projects with little or no modifications. The facility can be applied for pavement and material testing, fatigue of bridge testing, tire wear test, pothole repair technology, weight-in-motion research and system development.

FL-5

Owner: National Aeronautics and Space Administration, John F. Kennedy Space Center

Facility: 600-Ton Proof Test Fixture, Development Testing Laboratory, Kennedy Space Center, FL 32899

Contact: Garland Reichle, Chief

Telephone: 407-867-7286

General: The 600-ton Proof Test Fixture is a vertical unit, hydraulic powered, with 26'- 3" height and 18'- 6" width capability. It has outriggers on each side of the main structure such that up to 90' long wire ropes can be proof loaded up to 200 tons.

Capacity: 600 ton vertical (tension and compression), 400 ton out of plane, 200 ton tension at varying angles. 27.5' outriggers each side.

Projects: Testing of 250-ton hydrasets, 50-ton hydrasets, Gamma Ray Observatory payload processing beams, Shuttle solid rocket motor lifting beams, Titan solid rocket motor lifting beams, etc.

FL-6

Owner: Heraeus Instruments

Facility: Everglades Testing Laboratory, 16100 SW 216th Street, Miami, FL 33170

Contact: Jack L. Martin, Site Manager

Telephone: 305-245-3659 **FAX:** 305-245-9122

General: Well equipped outdoor exposure test site in subtropical environment.

Unique: Worldwide reference site for outdoor durability of materials. Support service in optical analysis.

Capacity: 9 acre site.

Projects: Testing all types of materials for subtropical environment conditions.

Available for Outside Use: Yes

Georgia

GA-1

Owner: Lockheed Aeronautical Systems Company
Facility: Universal Testing Machine, USAF Plant 6, 86 South Cobb Drive, Marietta, GA 30063
Contact: Dr. E.J. Coyne, Jr., Laboratory Department Manager, Materials Sciences and Testing
Telephone: 404-494-4837 **FAX:** 404-494-2555
General: 1.2 million pound capacity universal testing machine.
Unique: Test opening: tension - 22.5' plus 3' ram stroke, compression - 25.5,' between uprights - 10'
Capacity: Capable of loading large structures or components to 1.2 million pounds in tension or compression.
Projects: Calibration of 1 million pound capacity hydraulic cylinders for prestressing concrete. Compressive testing of aircraft wing panels.
Available for Outside Use: Yes

GA-2

Owner: Georgia Tech Research Institute
Facility: GTRI Electromagnetic Test Facility, 7220 Richardson Road, Smyrna, GA 30080
Contact: Howard Atkinson, Senior Research Engineer
Telephone: 404-528-7600 **FAX:** 404-528-7019
General: Georgia Tech Research Institute has developed a multi-purpose, wideband electromagnetic test and evaluation facility (EMTF) at the Georgia Tech Research Facility located in Cobb County. The facility includes a 1,300' antenna range, and instrumented rooftop radar laboratory and a turntable range capable of supporting multi-ton radar targets.
Unique: For antenna measurements on vehicles in support of programs like intelligent vehicle-highway systems (IVHS), two heavy positioners are available: 1) a three-axis positioner that can support vehicles up to 20-tons, and 2) a 22.5' diameter turntable that can support vehicles up to 100-tons.
Capacity: Automated antenna measurements of antennas mounted on vehicles or of the antennas alone can be made in the frequency range of 20 MHz to 107 GHz.
Projects: Antenna measurements of antennas used in various defense-related work including reflector, phased arrays and microstrip patch antennas.
Available for Outside Use: Yes
Comment: This facility is suitable to measure any vehicle-mounted antenna and can support testing of intelligent vehicle-highway systems studies. Measuring radiation characteristics of vehicle-mounted antennas is important to prevent unsatisfactory antenna performance. The pattern coverage of a vehicle-mounted antenna can be significantly different from the pattern

coverage of the antenna alone. Therefore, the EMTF can provide measurement support for the development of antennas for use on vehicles.

GA-3

Owner: Georgia Tech Research Institute
Facility: Aerospace Laboratory - Aeroacoustics, 7220 Richardson Road, Smyrna, GA 30080
Contact: R.A. Cassanova, Director, AST
Telephone: 404-528-7826 **FAX:** 404-528-3271
General: The aeroacoustics laboratory consists of 6 unique facilities, including 3 anechoic facilities (the flight simulation facility and the static acoustic test facility), a high-temperature jet facility and a sonic boom facility. These facilities can accommodate scale model tests of rotor and airframe acoustic signatures, experiments for jet noise research and tests of automobile scale models or full scale automobile components. The anechoic flight simulation facility is also an acoustic-lined low-speed wind tunnel. Complete instrumentation, diagnostics systems and computerized data acquisition systems for sound, velocity (laser velocimeter and hot wire) and pressure are available. A unique facility for simulating sonic booms down to a frequency of 2 kHz has been added recently. A range of optical equipment is available with a self-contained optics facility that has been used to develop state-of-the-art diagnostic methods such as acoustic holography and phase-locked laser schlieren photographs to visualize sound fields and unsteady flows.
Unique: The flight simulation facility, the static acoustic test facility and the sonic boom facility are unique due to the combination of acoustic anechoic capabilities, flow-through design for hot jet experiments, low-speed wind tunnel integration and sonic boom simulation.
Capacity: Test section size of 30" by 43" by 90"; maximum speed of 200 feet per second.
Projects: High-temperature jet noise reduction concepts, scale model turboprop acoustic signatures, rotorcraft noise signatures, concept development for reducing acoustic noise in jet engine test facilities, and evaluation of human response to sonic booms.
Available for Outside Use: Yes, availability is based on sponsored contract requirements.

GA-4

Owner: Georgia Tech Research Institute
Facility: Aerospace Laboratory - Experimental Research Facility, 7220 Richardson Road, Smyrna, GA 30080
Contact: R.A. Cassanova, Director, AST
Telephone: 404-528-7826 **FAX:** 404-528-3271
General: The experimental facility (ERF) is a low-speed wind tunnel with an easily modified test section whose

size can be changed from 30" by 10" by 56" to 30" by 30" by 100" with air speeds up to 180 feet per second (fps). Two separate test sections with sound-absorbing linings are also available to make simultaneous flow and acoustic measurements. Instrumentation includes scanivalve pressure system, 6-component balance, 2 or 3-dimensional laser velocimeter and hot film/hot wire system. This facility is especially useful where unusual shapes such as sections of automobile exteriors must be aerodynamically tested. It is also well-suited for 2-D airfoils and 3-D advanced aircraft configuration development.

Unique: The ERF can be operated by one person and inexpensively produces high-quality aerodynamic performance data. Test sections can be easily modified for special aerodynamics and acoustic tests.

Capacity: Test section sizes range from 30" by 1" by 56" to 30" by 30" by 100"; maximum speed of 180 fps.

Projects: Acoustic evaluation of flows over full-scale, front quarter panels of a Ford Taurus and tests of acoustic emissions from automotive radio antennas.

Available for Outside Use: Yes, availability is based on sponsored contract requirements.

GA-5

Owner: Lockheed Aeronautical Systems Company
Facility: Low Speed Wind Tunnel, 1055 Richardson Road, Smyrna, GA 30080

Contact: Gerald Pounds, Staff Engineer

Telephone: 404-494-4158 **FAX:** 404-494-4790

General: Large random test section, single return low-speed wind tunnel. External balance to measure model forces and moments. Aerospace, automotive, structural proof testing under wind loads are major areas of test. More than 54,000 test hours during 24 years of operation.

Unique: Size, velocity, data productivity.

Capacity: Large test section: 26' by 30' - 100 mph. Small test section: 16.25' by 23.25' - 200 mph.

Projects: Automotive drag, handling, wind noise, under hood airflows including radiator and air conditioner condenser performance, brake cooling, for manufacturers. Aerospace including performance, stability and control, propulsion integration, and safety of flight.

Available for Outside Use: Yes

GA-6

Owner: Georgia Tech Research Institute
Facility: Vehicle Radar Cross Section Measurement Facility, 7220 Richardson Road, Smyrna, GA 30080

Contact: W. Evan Chastain, Director,

GTRI/RIDL/CCRF, Atlanta, GA 30332-0800

Telephone: 404-528-7741 **FAX:** 404-528-7749

General: The Vehicle Radar Cross Section Measurement Facility consists of a turntable at ground level and a tower 90' high and 150' from the turntable. Radar backscatter measurements can be made at angles up to 32 degrees above the turntable by radars operating at 5, 10, 16, 35, 94, and 140 GHz. All systems are polarization agile.

Unique: Multiple frequencies, dual polarization, any angle between 0 degrees and 32 degrees, 200,000 pound loading.

Capacity: Cross section data is digitally recorded and can be processed to provide numerous data formats for analysis.

Projects: Measurement of military vehicles to determine their radar cross section at various frequencies.

Available for Outside Use: Yes

Comment: This facility can collect radar cross section data for vehicle anti-collision radar development. Its use will allow the quick assessment of radar cross section as a function of elevation and azimuthal angles. Also, developed sensors can be tested and evaluated.

GA-7

Owner: Georgia Tech Research Institute

Facility: Aerospace Laboratory - Model Test Facility, 7220 Richardson Road, Smyrna, GA 30080

Contact: R.A. Cassanova, Director, AST

Telephone: 404-528-7826 **FAX:** 404-528-3271

General: The model test facility (MTF) is a low-speed wind tunnel with a top speed of 200 feet per second (fps) which is routinely used for experimental evaluation of aircraft and other moderate-speed vehicle concepts. The wind tunnel has a complete range of instrumentation including: pressure scanning system, 6-component balance, wake traverse system, 2-dimensional laser velocimeter, hot film-hot wire system, flow visualization and two high-pressure air supply systems for powered lift propulsion simulation. The tunnel can be configured with a moving ground plane and boundary layer modification system for accurate simulation of vehicles in ground effect such as STOL aircraft, automobiles and racing hydroplanes.

Unique: The MTF can be operated by one person and inexpensively produces high-quality aerodynamic performance data, including on-line data reduction and full-color displays. The flow has been modified to simulate vehicles in ground effect. The design of the force balance mounting system allows variable aspect ratio testing.

Capacity: Test section size of 30" by 43" by 90"; maximum speed of 200 fps.

Projects: Aerodynamic scale model evaluation of a racing hydroplane, tilt-wing aircraft, cruise missile,

advanced air superiority fighter and the national aerospace plane.

Available for Outside Use: Yes, availability is based on sponsored contract requirements.

GA-8

Owner: Georgia Tech Research Institute

Facility: Anechoic Chamber, EEE Laboratory, 225 North Avenue, Atlanta, GA 30332

Contact: Hugh Denny, Director

Telephone: 404-894-3522 **FAX:** 404-894-3906

General: 40' by 60' by 30' anechoic chamber.

Unique: Electromagnetic emission and susceptibility testing of vehicles from VHF to MMW.

Available for Outside Use: Yes

Comment: This facility was donated to GTRI by the Bendix Corporation. It is in storage. Estimated time to erect and achieve operational capability in 9-12 months.

GA-9

Owner: Georgia Institute of Technology

Facility: Automated Guided Vehicle Laboratory, Material Handling Research Center, Atlanta, GA 30332

Contact: Wiley Holcombe, Sr., Research Engineer

Telephone: 404-894-6144 **FAX:** 404-894-8051

General: In response to the needs of the AGV hardware projects, the Laboratory is equipped with: 1) two Litton S-800 stripe-following AGVs and one Prontow Mini-cart wire-guided AGV (three of the four AGVs donated by IBM in 1985), 2) an area simulating the inside of a semi-trailer, 3) supporting computer controls and radio communications, 4) supporting design and mechanical facilities, 5) a theodolite-based coordinate measuring system.

Unique: Prototype vehicle that does not depend on a physical guide path for navigation.

Capacity: One of the Litton S-800 AGVs has been extensively modified into a test-bed vehicle for off-wire navigation research. This vehicle is operating successfully with off-wire navigation based on odometry and a vision system that measures vehicle position relative to landmarks mounted on the ceiling.

Projects: Develop navigation schemes for industrial, driverless vehicle; develop learning and adaptive control algorithms to augment navigation algorithms; develop off-line programming. The AGV Laboratory is the site of the MHRC prototype AGV System currently under development. The system will consist of an AGVS Engineering Workstation, an AGV System Controller with radio communications to the vehicle, the MHRC prototype off-wire vehicle, and the Litton stripe-guided vehicle.

Available for Outside Use: Yes

Comment: Laboratory also houses additional hardware used by the college of computing for autonomous mobile robot research.

Idaho

ID-1

Owner: University of Idaho, Department of Civil Engineering

Facility: Structural Testing Frames, Moscow, ID 83843

Contact: Robert Linderman, Assistant Professor

Telephone: 208-885-7326 **FAX:** 208-885-6645

General: One 20' by 25' planar reaction frame housed outdoors and two orthogonal rectangular reaction frames indoors. The larger indoor frame is approximately 10' by 35,' and the smaller indoor frame is approximately 10' by 20.'

Capacity: The outdoor frame is designed to resist reactions up to 115 kips at reaction points. Larger indoor frame is designed for 600,000 pound load.

Available for Outside Use: Yes

Illinois

IL-1

Owner: Portland Cement Association, Construction Technology Laboratories, Inc.

Facility: Structural Laboratory, 5420 Old Orchard Road, Skokie, IL 60077

Contact: Henry G. Russell, Vice President Construction

Telephone: 708-965-7500 **FAX:** 708-965-6541

General: Structural testing laboratory 56' by 176' in plan and 40' high with a 12' deep reinforced concrete box girder reaction floor. Two 20-ton cranes. Fully equipped for static and dynamic testing of large structural components including data acquisitions systems.

Unique: Constant temperature and humidity (73°F, 50%).

Capacity: ±100 kips at 3' centers throughout the test floor area of 56' by 120.'

Projects: Testing of 8' diameter pipes under internal pressures up to 700 psi. Testing of railroad car components with complex dynamic loadings. Testing of 24" square prestressed concrete piles.

Available for Outside Use: Yes

IL-2

Owner: Basic Industry Research Laboratory (BIRL), Northwestern University

Facility: Thermal Spray Coating Laboratory, 1801 Maple Avenue, Evanston, IL 60201-3135

Contact: Dr. Thomas F. Bernecki, Research Scientist

Telephone: 708-491-2448 **FAX:** 708-491-4486

General: Part of a \$30 million applied R&D laboratory focusing on the development of materials, processes, and process controls, the thermal spray facility contains two acoustically isolated thermal spray cells, several plasma and combustion spray guns and support facilities that can be used for developing coatings for bridges, rebar, and other metal structures.

Unique: 6-axis, computer-controlled robot; production scale equipment.

Capacity: 60- and 80-kW plasma gun systems.

Projects: Development of coating materials and coating processes for corrosion protection, wear prevention, and thermal insulation.

Available for Outside Use: Yes, BIRL conducts applied R&D on a contract basis for industrial firms and governmental agencies. Its facilities are used by the BIRL staff for those projects.

Comment: In addition to thermal spray coating facilities, BIRL has modern facilities for physical vapor deposition, chemical vapor deposition, electroplating, laser processing, powder processing, polymer processing, corrosion studies, automation and controls, image processing, software engineering, and materials analysis.

IL-3

Owner: Deere and Company

Facility: Vehicle Motion Simulator, Technical Center, 3300 River Drive, Moline, IL 61265

Contact: Ed Wegscheid, Manager, Product Dynamics

Telephone: 309-765-3778 **FAX:** 309-765-3807

General: Six (6) degree -of freedom motion base for the simulation of vehicle motion, especially for off-road operation. Hydraulically powered, computer controlled.

Unique: 6 DOF, high payload, relatively high frequency response, multi-channel data acquisition.

Capacity: Designed to accelerate 1 ton up to 1.5 g, frequency response approximately DC to 12 Hz; programmable with simulation and field data.

Projects: 1) Test and evaluation of operator seat and seat suspension for Ag tractor during field operation. 2) Acquisition of objective and subjective data during evaluation of seat and seat suspension for 4WD loader during road transport and construction site operations.

Available for Outside Use: No

Comment: Current applications are mainly seat and seat-suspension evaluations. Have conducted man-in-the-

loop studies to evaluate operator control interfaces on lawn and garden tractors, harvesting machines, etc. Sound and visual cue systems have been used in some studies. Internally approved for manned operation.

IL-4

Owner: Caterpillar Inc.

Facility: Structural Cells, Technical Center, PO Box 1865, Peoria, IL 61656-1875

Contact: C.E. Grawey, Director of Research

Telephone: 309-578-6777 **FAX:** 309-578-6733

General: To determine operating stresses and fatigue life of entire vehicle structures, as well as smaller vehicle components, a broad range of test beds are utilized. From a basic 7' by 9' plate with a few servo valves to a 35' by 40' plate with multiple loading systems simulating or exceeding recorded in-use vehicle stresses. 20 bed plates span the range of capability.

Unique: Some of the unique test systems included are a spin pit for increasing burst speeds of flywheels and turbochargers, bearing fatigue test machines, cab roll-over structure test which includes up to 600,000 pound push loads and 500 pound object drop test, torsional load capability to 80,000 foot-pounds.

Capacity: The seven bed plate systems in this area are all aimed at vehicle structure systems like main frames or excavator "boom and stick." Up to 1,000 hp can be applied to bed plates that range from 20' by 25' to 30' by 40' in size.

Available for Outside Use: No

IL-5

Owner: Caterpillar Inc.

Facility: Emission Cells, Technical Center, PO Box 1875, Peoria, IL 61656-1875

Contact: C.E. Grawey, Director of Research

Telephone: 309-578-6777 **FAX:** 309-578-6733

General: The ten transient test cells (20' by 26' engine area) were constructed in 1980-1981 to develop and certify highway truck engines meeting the U.S. EPA transient emission laws. Basic test cell capability includes a 600 hp electric dynamometer for power absorption and motoring, engine fuel, coolant and inlet air temp control throttle position control, exhaust dilution tunnel for constant volume gas emissions sampling, double dilution tunnel for particulate, and cell computers for automatic control and measurement. Steady state emissions are measured in standard engine development cells originally for combustion development and truck engine emissions certification (late 1960s to early 1980s).

Unique: Actual operating conditions are automatically compared to specifications and must be within legal limits.

Capacity: Emissions measurement include CO, CO₂, HC, NO_x, smoke, and particulate (new micro-dilution tunnel). The equipment can be installed at any of the 64 standard or 12 single-cylinder performance test cells from 50 to 8,000 hp (20' by 26' to 20' by 40' respective engine area).

Available for Outside Use: No

IL-6

Owner: Caterpillar Inc.

Facility: Engine Laboratory, Technical Center, PO Box 1875, Peoria, IL 61656-1875

Contact: C.E. Grawey, Director of Research

Telephone: 309-578-6777 **FAX:** 309-578-6733

General: One engine laboratory test cell has controlled porosity foam wedges on the ceiling and walls (semi-anechoic). The facilities (instruments, dyno, water and air supplies) are foam wrapped or buffered by additional wedges. Engines can be evaluated up to 750 hp. Full engine foam and lead foil wrapping is included in many component tests so that a window can be peeled back identifying individual component noise contribution.

Unique: The separate building for hydraulic system and power train sound measurement (108' by 84') is equipped similar to the engine laboratory cell. This includes semi-anechoic foam wedges, component or system isolation capability, high speed data acquisition and analysis. However, the large all weather facility further allows evaluation of the complete vehicle sound suppression systems.

Available for Outside Use: No

IL-7

Owner: University of Illinois at Urbana-Champaign, Department of Civil Engineering

Facility: Circular Test Track (CTT), 1007 West Western Avenue, Urbana, IL 61801

Contact: E.J. Barenberg, Professor, 205 North Mathews Avenue

Telephone: 217-333-6252 **FAX:** 217-333-9464

General: The CTT is an "inside" facility. The CTT has an inside radius of 4' and an outside radius of 13' (pavement width of 9'). The test pit is 48" deep. A rotating load frame (single wheel at each end) applies wheel loads up to 3,200 pounds over a wheel path of 30 inches at a maximum speed of 15 mph.

Unique: Water table depth can be controlled. Various "wheel types" can be attached to the rotating load frame.

Capacity: Typically, four pavements can be tested simultaneously. Maximum wheel load is 3,200 pounds. At 15 mph, 48 load repetitions per minute can be applied.

Projects: Rutting resistance of open-graded aggregate bases.

Available for Outside Use: Yes

Comment: 1) Facility has been successfully used for a variety of "comparative" type tests. 2) tie-downs are available to facilitate "static" or "repeated" loads (non-moving). 3) The temperature in the CTT Building can be varied from ambient to ambient plus. 4) Adjacent laboratory testing facilities are available.

IL-8

Owner: University of Illinois at Urbana-Champaign, Department of Civil Engineering

Facility: Earthquake Simulator, Newmark Laboratory, 205 North Mathews Avenue, Urbana, IL 61801

Contact: Mete A. Sozen, Professor

Telephone: 217-333-3929 **FAX:** 217-333-9464

General: The University of Illinois Earthquake Simulator, which has been in continual use since 1967, comprises a 12' by 12' test platform, a 75,000 pound electrohydraulic ram, a 110 gallons per minute pump, and state-of-the-art (1989) control electronics. The system has data acquisition and conditioning facilities (64 channels for continuous recording) based on MVAXII and a VAX750.

Capacity: The maximum ranges of operation are defined by an acceleration of 7g, a velocity of 18 inches per second, and a double-amplitude displacement of 5 inches. Maximum specimen weight is 12,000 pound and the frequency range is 0.1 to 50 Hz.

Projects: Evaluation of torsional response of reinforced concrete structures.

Available for Outside Use: Yes

IL-9

Owner: University of Illinois at Urbana-Champaign, Department of Civil Engineering

Facility: Large-Scale Model Test Facility for Soil and Soil-Structure Interaction, Hydrosystems Laboratory, 301 North Mathews Avenue, Urbana, IL 61801

Contact: James H. Long, Associate Professor, 2230 Newmark Laboratory, 205 North Mathews Avenue

Telephone: 217-333-2543 **FAX:** 217-333-9464

General: The test facility consists of a test chamber, material storage area, and materials handling transportation. The test chamber can contain a volume of soil (or soil/structure model) up to 10' by 14' by 16' (HxLxW). Chamber walls are movable and removable to allow a variety of configurations for testing. Storage facility and materials handling/transportation are designed to minimize labor required to move the 120 tons of soil required to fill test chamber.

Unique: Large size of test chamber (10' by 14' by 16', HxLxW).

Capacity: 10' by 14' by 16' to 4' by 4' by 1', 200 channel data acquisition system, full complement of instrumentation.

Projects: Soil nailing study and model tie-back system study.

Available for Outside Use: Yes, by arrangement.

IL-10

Owner: University of Illinois, Urbana-Champaign, Department of Theoretical and Applied Mechanics

Facility: 3,000,000 Pound Southwark-Emery Tension/Compression Machine, Talbot Laboratory, 104 South Wright Street, Urbana, IL 61820

Contact: James W. Phillips, Professor

Telephone: 217-333-2322

General: A high capacity universal tension and compression testing machine with a capacity of 3 million pounds. Manufactured by Southwark-Emery, this machine was originally installed in 1929-30, has been maintained in accurate calibration. It is served by a full range of machine shop services and modern, state-of-the-art instrumentation.

Capacity: 3 million pounds capacity; axial specimen length of 30'; a 12' by 12' base platform; 20' long beams with test bed extension.

Projects: Testing of high capacity cables. Calibration of load cell.

Available for Outside Use: Yes

IL-11

Owner: Department of the Army, Construction Engineering Research Laboratory

Facility: Biaxial Shock Test Machine, Champaign, IL 61826-9005

Contact: James Gambill, Electronics Engineer, ATTN: CECER-EME, PO Box 9005

Telephone: 217-373-6760 **FAX:** 217-373-7222

General: Large capacity biaxial (one horizontal axis, vertical axis) shaking table. One of three large U.S. public sector shaking tables. Suitable for seismic, shock, and vibration testing.

Unique: Largest known U.S. shaking table, with high payload capacity and high frequency and acceleration.

Capacity: 12' by 12' platform; frequency 0 to 600 Hz; 12,000 pound payloads: 30 g vertical, 20 g horizontal; and 60,000 pound payloads: 10 g vertical, 6.7 g horizontal.

Projects: In-structure shock testing for shock isolation systems. Seismic structural testing: base isolation systems beam-column sub-assemblages, masonry in-fill walls. Seismic qualification of mechanical equipment.

Available for Outside Use: Yes

Comment: Shaking Table is complemented by other in-house testing facilities: structural load floor, manual

jacks, dynamic hydraulic actuators, MTS load frames (50 kip, 1,000 kip), and Unholtz-Dickie electrodynamic shaker. Shaking table is further complemented by available laboratory and staff at University of Illinois at Urbana-Champaign.

IL-12

Owner: Southern Illinois University at Carbondale

Facility: Driving Range, Safety Center, Carbondale, IL 62901

Contact: Dan V. Shannon, Project Coordinator

Telephone: 618-453-2080

General: 1,000' long x 200-250' wide. The facility was built to highway specifications during the early 1970s. A storage/training building is also on site. This building houses motorcycles, training vehicles, and other equipment.

Unique: Skid pad area; off-road recovery area.

Projects: Motorcycle Rider Program (Beginning and Advanced), Advanced Driver Education Programs (Emergency Driving), Defensive and Protective Driving (Anti Terrorists Driving), Beginning Driver Education.

Available for Outside Use: Yes

Comment: The storage/training building is unheated, however, classrooms are located nearby.

Indiana

IN-1

Owner: Indiana Department of Transportation

Facility: Accelerated Pavement Testing Facility, 1205 Montgomery Street, PO Box 2279, West Lafayette, IN 47906

Contact: David Ward, Research Section Engineer

Telephone: 317-463-1521 **FAX:** 317-497-1665

General: A 40' by 50' building housing a 20' by 20' by 6' test pit and linear accelerated loading mechanism.

Unique: Test pit and linear accelerated loading mechanism.

Capacity: 4 test lanes with a maximum of 3 different materials.

Projects: First project commencing fall 1991 deals with determining the percent crushed aggregate requirements in bituminous pavements.

Comment: It is estimated that the load effects of 35 million ESALs can be compressed into 405 - 8 hour work days for an SN of 5. It is further estimated that the rutting effects of 5 million ESALs can be compressed into 13 - 8 hour work days, at a pavement temperature of 100°F.

IN-2

Owner: Purdue University, Department of Civil Engineering

Facility: Civil Engineering Materials Chemistry Laboratory West Lafayette, IN 47907-1662

Contact: Janet Lovell, 1662 Civil Engineering Building, Room B173

Telephone: 317-494-6371

General: Materials Chemistry Laboratory in Civil Engineering Building.

Unique: Ion Chromatography, Thermal Analysis, LTD Calorimeter, Atomic Absorption Spectrophotometer, UV-Visible Spectrophotometer, X-ray Diffractometer, Scanning Electron Microscope.

Projects: Studies on cement chemistry, pore size distribution and absorption of aggregates. Freeze/thaw studies in concrete.

Comment: 85% of the work done by this laboratory is funded by the Indiana Department of Transportation.

Iowa**IA-1**

Owner: Iowa State University, Department of Civil and Construction Engineering

Facility: Materials Analysis and Research Laboratory, Ames, IA 50011

Contact: Jerry Amenson, Manager, 23 Town Engineering Building

Telephone: 515-294-8752 **FAX:** 515-294-8216

General: The Materials Analysis and Research Laboratory (MARL) houses a wide variety of scientific equipment that can be utilized to study the fundamental properties of nearly any material. The major equipment items available at the MARL cover the broad areas of microscopy and image analysis, x-ray analysis, porosimetry and thermal analysis. These major pieces of equipment include: JEOL JSM-840A Scanning Electron Microscope; KEVEX Delta V Microanalyzer with a Quantum Detector; Microspec WDX-2A Wavelength Dispersive Spectrometer; Siemens D500 X-ray Diffractometer; Siemens SRS200 X-ray Spectrometer; LeMont OASYS Image Analyzer; Quantachrome SP-200 Scanning Porosimeter; TA-2000 Thermal Analysis System. The MARL is also equipped with the appropriate supportive equipment needed for sample preparation.

Unique: The JEOL JSM-840A scanning electron microscope will accommodate samples up to eight inches in diameter, and includes the following accessories; electron beam blanking device, digital image video acquisition system, motorized stage driver and annular split ring backscattered electron detector.

Projects: The Materials Analysis and Research Laboratory is an "open" laboratory that allows access for a wide range of university and industrial researchers. Hence, the equipment has been utilized to characterize a wide variety of different materials. Recent studies include materials that range from high technology areas (high-temperature superconductors, catalysts and thin film specimens) to more conventional low technology applications (portland cements, aggregates and waste by-products from the energy industry).

Available for Outside Use: Yes

IA-2

Owner: Iowa State University, Department of Civil and Construction Engineering

Facility: Structures Laboratory, Ames, IA 50011

Contact: Dr. Terry Wipf, Associate Professor, 164 Town Engineering Building

Telephone: 515-294-6979 **FAX:** 515-294-8216

General: The main laboratory is 80' by 50' including a 80' by 25' structural tie-down floor with a capacity of 1,000,000 pounds. The ceiling height is 25' and has a 20-ton overhead crane. Another facility off campus has 7,000 square feet and uses self-contained formes for testing. Major equipment includes a 400,000 pound universal testing machine, two MTS servo-controlled closed loop fatigue systems having load capacities of 50,000 and 110,000 pounds, numerous hydraulic cylinders with capacities ranging from 2,000 to 400,000 pounds. Three data acquisition systems are available. A 150-channel system for static testing, a 54-channel system for static or dynamic testing, and a 30-channel system.

Unique: Another MTS closed-loop system is based around a DEC microvax computer controlling two 55,000 pound actuators. The system features the following load capabilities: static, fatigue, pseudo-dynamic, real-time dynamic and sequential dynamic.

Capacity: The University environment provides support facilities including a machine shop for high tolerance fabrication, electronics shop for maintenance and special circuitry services.

Projects: Bridge strengthening procedures, full scale masonry wall and hollow core plank diaphragm interaction, full scale composite steel deck strength evaluations, development in thermoset composite concrete reinforcement (involving strength, ductility, bonding, and aging characteristics), icing induced vibrations of high voltage power cables, full scale precast prestressed concrete panel subdecking in skewed bridges, investigation of shell structures utilized as bridges, full scale diaphragm action in prestressed concrete bridges, soil-pipe interaction study using full scale culvert sections, fatigue on interlocking mechanism used in breakwater structures.

Available for Outside Use: No

Comment: Other topics of experimental and theoretical research done by the Structural Engineering faculty include the following: weldments; sandwich walls; joints; concrete materials and additives; composite steel deck diaphragm slabs; nuclear containments; sheet piles; integral abutments; framed stairways; cold-formed steel members; tornado documentation of structural damage; stiffened shells; reliability studies; long-term structural movement; timber columns and joints; glued laminated bridges; fatigue studies on aluminum, timber, concrete materials, and composite slabs; and load distribution in bridges.

IA-3

Owner: University of Iowa, Iowa Institute of Hydraulic Research

Facility: Tilting Laboratory Flumes, Iowa City, IA 52242

Contact: Tatsuaki Nakato, Research Scientist

Telephone: 319-335-5228 **FAX:** 319-335-5238

General: Various flumes in different configurations 1' to 2' by 30' to 100' by 1' to 2' (depth) are available.

Unique: Slope of the flume can be changed.

Capacity: Discharges up to 4 cubic feet per second.

Projects: 1) River-bed armoring. 2) Effect of ice cover on sediment transport. 3) Flow around Iowa Vanes. 4) Dam-break problems. 5) Calibration of small flow meters, etc.

Available for Outside Use: Yes

IA-4

Owner: University of Iowa, Iowa Institute of Hydraulic Research

Facility: Environmental Flow Facility (EFF), Iowa City, IA 52242

Contact: Tatsuaki Nakato, Research Scientist

Telephone: 319-335-5228 **FAX:** 319-335-5238

General: The EFF is a recirculating laboratory flume having a test section 65' by 10' by 8' (depth). The test section is fitted with 1.5" thick glass windows for visual observation of the flow.

Unique: The size of this facility makes model studies possible at scales that minimize blockage effects which normally impose severe limitations.

Capacity: Water discharges up to 120 cubic feet per second can be recirculated.

Projects: 1) Near-bank flow characteristics of the Ohio River at East Kentucky Power Coop's Spurlock Power Plant to reduce siltation in barge unloading areas. 2) Biophysical characteristics of swimmers to improve their swimming skills. 3) Design of screens to prevent fish from impingement.

Available for Outside Use: Yes**IA-5**

Owner: University of Iowa

Facility: Iowa Driving Simulator, Iowa City, IA 52242

Contact: Professor Jim Stoner, Associate Director, Room 208 ERF

Telephone: 319-335-6048 **FAX:** 319-335-6061

General: The Iowa Driving Simulator (IDS), supports high-fidelity, operator-in-the-loop driving simulation. IDS equipment consists of a Harris Nighthawk 4404 real-time computer and an Evans and Sutherland CT6 Image Generation system projecting four channels of display onto a 12' radius partial dome which encloses an actual car. Currently operational in a fixed-base environment, the entire dome/car subsystem will eventually be placed on a 6 degrees of freedom motion platform to provide coordinated, realistic vehicle motion along with the computer generated visual images. An Ensonig EPS-16 digital sampling workstation provides audio cues. Dynamics for the simulation are generated on an Alliant FX/2800 Supercomputer.

Unique: High Fidelity Multibody Dynamics, Textured High Resolution Graphics, Digital Audio System, Control Loading with Dynamics Feedback, 6 degrees of freedom Motion Base.

Capacity: 4 Channel CT6 IG 1000 Textured Polygons per Channel at 60 Hz 2 Gflop FX 2800 Dynamics Computer, 85 ms visual delay and 30 ms fixed motion delay.

Projects: Human factors studies (older drivers), highway design studies (IVHS, traffic control devices), and vehicle design (advanced cruise control).

Available for Outside Use: Yes

IA-6

Owner: University of Iowa

Facility: Computer Graphics Facility, Iowa City, IA 52242

Contact: Dr. Edward J. Haug, Director, Room #208 ERF

Telephone: 319-335-5726 **FAX:** 319-335-6061

General: The Computer Graphics Facility, housed within the Center for Computer Aided Design, provides a variety of workstation platforms for the display of computer graphics, fully integrated with other Center facilities, including the Iowa Driving Simulator. Connections also exist to other on and off campus computer resources via the campus network and its connection to NSFNet.

Unique: 2 Silicon Graphics Iris/3XX VGX series workstations for real-time animation of complex mechanical systems; 29 HP/Apollo workstations; 2 personal

Irises; DEC VS3140; 2 DEC DS5000/200 PX; DEC DS5000/200 PXG.

Capacity: Iris VGX display greater than 1,000,000 polygons per second.

Projects: Support visualization of dynamics research such as cars, trucks, and tanks, in on and off road evaluations.

Available for Outside Use: Yes

Kansas

KS-1

Owner: University of Kansas, Department of Civil Engineering

Facility: Engineering Microanalysis Laboratory, Lawrence, Kansas 66045

Contact: David Darwin, Professor & Director, 2006 Learned Hall

Telephone: 913-864-3826 **FAX:** 913-864-3199

General: The Engineering Microanalysis Laboratory performs microscopic structural and material analysis of engineering materials using an integrated scanning electron microscope, energy dispersive spectrometer, and image analysis system. Systems are tied in with high performance work stations for supplemental analysis.

Unique: The facility can carry out manual, semi-automated, and fully automated image acquisition, as well a morphological and elemental analysis of specimens. Specimens containing water can be prepared and viewed using a quick-freeze system and cold stage on the scanning electron microscope. The image analysis system can be used to analyze the data in real time, including simultaneous morphological and elemental characterization. The system is also tied in with a TV camera that will allow analysis to be performed on optical images.

Projects: Microscopic cracking in cement paste and mortar. Quantitative backscattered electron analysis of cement paste. Fracture of steel. Erosion damage of steel. Morphological analysis of cement particles. Microstructural analysis of rock. Chemical analysis of deposits in pipelines.

Available for Outside Use: Yes

KS-2

Owner: University of Kansas, Department of Civil Engineering

Facility: Structural Testing Laboratory, Lawrence, KS 66045

Contact: David Darwin, Professor & Director, 2006 Learned Hall

Telephone: 913-864-3826 **FAX:** 913-864-3199

General: The Structural Testing Laboratory has both static and servo-hydraulic testing equipment. The

structural test bay has 4,000 square feet of open laboratory area built on a series of parallel reinforced concrete box girders. The lab floor is 30" thick with a clear height of 28' for large-scale structural testing.

Unique: The laboratory can be used to apply static loads on 3' centers over a 50' by 80' area using static jack systems. Cyclic and dynamic tests of full-scale structural components can be carried out within the test bay.

Projects: Tests of 40', two-span reinforced concrete T-beams and joists to determine the shear strength of lightly reinforced members. Bond strength of reinforcing steel to concrete using beam-end specimens and full-scale beam and slab specimens. Bond strength of drilled and grouted reinforcement to concrete. Cyclic load capacity of reinforced concrete beams. Strength of steel trusses with eccentric joints. Cyclic loading of structural steel joints.

Available for Outside Use: Yes, but must be done by University of Kansas researchers.

KS-3

Owner: Department of Agriculture, Agricultural Research Service, Kansas State University

Facility: Wind Erosion Research Laboratory, Manhattan, KS 66505

Contact: Lawrence J. Hagen, Research Leader, Room 105 Waters Hall

Telephone: 913-532-6785 **FAX:** 913-776-0962

General: Two boundary layer wind tunnels with feeders for abrader and downwind samplers. One portable wind tunnel for field use with samplers.

Capacity: Working sections tunnel 15 - 30" by 36" by 20'; tunnel 23 - 5' by 6' by 50'; tunnel 33 - 36" by 36" by 38."

Projects: Measurement of boundary layers, turbulence parameters, erosion thresholds, abrasion rates and soil trappings of various simulators and real soil erosion and plant canopies.

Available for Outside Use: Yes

KS-4

Owner: Wichita State University, National Institute for Aviation Research

Facility: Walter H. Beech Memorial Wind Tunnel, Wichita, KS 67208

Contact: Bonnie Johnson, Director

Telephone: 316-689-3404 **FAX:** 316-689-3175

General: Subsonic wind tunnel, 7' by 10' test section, closed return, 0 to 180 mph. Full range of force balances, pressure instrumentation and flow measurement equipment.

Unique: Auxiliary blowing air systems.

Capacity: New data acquisition and processing system, 48 channels, dynamic data logging.

Projects: Aircraft development for Boeing, Learjet, Cessna, Beech and others. Non-aeronautical uses include wind turbines, automobiles and components, buildings, etc.

Available for Outside Use: Yes

KS-5

Owner: Wichita State University, National Institute for Aviation Research

Facility: Aviation Research Laboratories, Wichita, KS 67208

Contact: William H. Wentz, Jr., Executive Director, Joe Mitchell, Laboratory Manager

Telephone: 316-689-3678 **FAX:** 316-689-3175

General: Combined laboratories in one facility: aerodynamics, propulsion, flight simulation, CAD/CAM, computer integrated-manufacturing, composites, human factors, avionics, materials, structures, icing, cryogenics, computers/software, aviation management. The Crash Dynamics Laboratory consists of a track, sled, propulsion system, deceleration system, and data acquisition system. The systems are designed to accelerate up to 3,000 pounds to 55 mph and decelerate this load at up to 25 g. The principal activity will be to test aircraft seats under crash conditions.

Unique: Large payload, high speed video, university environment.

Capacity: 2,500 pound payload, 77 foot track, 25 g maximum deceleration.

Projects: Aerodynamics, composites producibility, delamination of composites, erosion, crash analysis and testing, software reliability, human factors in cockpit, aging aircraft. Crash Dynamics Laboratory is a new facility.

Available for Outside Use: Yes

Comment: This facility will be available soon for aircraft seat certification test. It will be the largest sled suitable for aircraft crash testing.

Kentucky

KY-1

Owner: Heraeus Instruments

Facility: Heraeus DSET Laboratories, Inc., Louisville Site, 14201 Bohannon Lane, Valley Station, KY 40272

Contact: Jack L. Martin, Site Manager, 16100 SW 216th Street, Miami, FL 33170

Telephone: 305-245-3659 **FAX:** 305-245-9122

General: Outdoor exposure test site — temperate northern environment, industrial pollution site.

Unique: Acid rain for material testing

Capacity: 1/2 acre site.

Projects: Testing all types of materials for temperate northern environment conditions with industrial pollution.

Available for Outside Use: Yes

KY-2

Owner: Asphalt Institute

Facility: Asphalt Institute Research Center, Research Park Drive, Lexington, KY 40512-4052

Contact: Dr. Scott Shuler, Director of Research

Telephone: 606-288-4960 **FAX:** 606-288-4999

General: Full service asphalt and asphalt concrete research laboratory. Standard ASTM/AASHTO and special testing capabilities for asphalt cements, cutbacks, and emulsions, asphalt concrete mixture design and analysis.

Unique: 22 kip servo-hydraulic closed loop universal test system dynamic mechanical analysis of asphalts and asphalt mixes, gyratory compaction, vibratory compaction, rolling wheel permanent deformation.

Projects: SHRP A001 Tasks B & F, NCHRP, 14-8A, improved mixture design development for using large stone in asphalt mixtures, vibratory compaction for laboratory preparation of mixes, and analysis of well-performing pavements.

Available for Outside Use: Yes

Louisiana

LA-1

Owner: Tulane University, Department of Civil Engineering

Facility: Experimental Research Frame, New Orleans, LA 70115

Contact: Dr. Robert N. Bruce, Jr., Professor of Civil Engineering

Telephone: 504-865-5778 **FAX:** 504-865-6740

General: 200-ton capacity loading frame capable of testing 60' flexural specimens and 50' columns; specimens up to width of 7.' Frame can be used for static, cyclic or long-term loads.

Unique: Accessible to truck or crane transportation.

Available for Outside Use: Yes

Comment: The experimental research frame is used almost exclusively for experimental research projects. Between projects, the frame is not in use. Its use has been offered to the State of Louisiana in connection with highway research and testing.

LA-2

Owner: Department of the Interior, Fish and Wildlife Service

Facility: National Wetlands Research Center, 700 Cajun Dome Boulevard (will move to location in mid 1992), Lafayette, LA 70506

Contact: Dr. Robert E. Stewart, Jr., Director, 1010 Gause, Slidell, LA 70458

Telephone: 504-646-7564 **FAX:** 504-646-7288

General: Center dedicated to national wetlands research emphasizing 1) wetlands ecology (plant stress, modeling, global climate change), 2) birds (migratory waterfowl, neotropical migrants, shorebirds, colonial-nesting birds), 3) technology development (geographic information systems, remote sensing, cartography, electronics).

Unique: 1) Geographic Information System (GIS) data base (habitat maps for all of Gulf Coast and selected other areas, e.g., San Francisco Bay, CA Central Valley, DE, NC, SC); 2) electronics laboratory, e.g., radio-telemetry, remotecontrol vehicles, geographic positioning systems; 3) remote sensing e.g., satellite methodologies; 4) modeling e.g., landscape and forest succession; 5) environmental chambers for plant and animal studies.

Projects: 1) GIS — Computer analysis and cartographic generation for wetland loss and change; 2) GIS — risk assessment of contaminants in Mobile Bay; 3) Landscape modeling applications — predict environmental change in coastal LA; 4) Forest succession modeling applications — effects of hydrologic changes from proposed levees in LA, water-control structures on wildlife refuges.

Available for Outside Use: Available for cooperative projects with other agencies for issues related to Center's mission.

LA-3

Owner: Louisiana State University

Facility: Remote Sensing and Image Processing Laboratory, 3221 CEBA, Baton Rouge, LA 70803

Contact: Robert J. Polge, Director

Telephone: 504-388-6826 **FAX:** 504-388-5263

General: This facility consists of comprehensive equipment involving computers, servers, workstations, global positioning systems, image processing peripherals, geographic information systems and image processing software.

Unique: The facilities are broad in scope including Sun Microsystems and Intergraph Workstations. Software includes a comprehensive set of Intergraph Modular GIS Environment (MGE) software, Oracle database systems, and ESRI ARC/INFO GIS systems.

Capacity: Ten Sun workstations, three Intergraph workstations, and three Trimble GPS systems are available.

Projects: Spatial Information Systems for Transportation; Geographic Information Systems for Nonpoint Source Pollution; Geographic Information Systems for Wellhead Protection; Louisiana Reference Station for Global Positioning Systems.

Available for Outside Use: Yes

LA-4

Owner: Louisiana Department of Transportation

Facility: Geosynthetic Engineering Research Laboratory (GERL), Louisiana Transportation Research Center, 4101 Gourrier Avenue, Baton Rouge, LA 70808

Contact: Paul M. Griffin, Jr., Geophysical Systems Research Administrator

Telephone: 504-767-9109 **FAX:** 504-767-9108

General: Complete physical testing facility for geosynthetics.

Unique: Two large pullout boxes, full scale instrumented embankment (available 1993), large scale direct shear testing.

Capacity: 1) Pullout boxes 3' by 5' by 2' (deep), Zotow hydraulic capacityload or strain control. Boxes are modular for size increase. 2) Embankment 120' long by 20' high, granular and cohesive soil. Vertical wall and sloped wall. 3) Large scale direct shear 27.5" by 27.5" shear plane up to 30 psi normal stress.

Projects: Boxes only: confined and unconfined geogrid testing in granular materials, large scale direct shear testing.

Available for Outside Use: Yes

Comment: GERL is a new facility.

LA-5

Owner: Louisiana Department of Transportation

Facility: Pavement Research Facility, Louisiana Transportation Research Center, 4101 Gourrier Avenue, Baton Rouge, LA 70808

Contact: Steven L. Cumbaa, Research Administrator

Telephone: 504-767-9106 **FAX:** 504-767-9108

General: Pavement Research Facility will feature an Accelerated Loading Device (ALD) for accelerated loading of test pavements; associated test equipment, 3 acre site, 3,400 square feet instrumentation building.

Projects: Anticipated "Start Date" August 1992.

Available for Outside Use: Yes

Comment: Facility is expected to serve the needs of LDOTD, other regional DOTs and FHWA. Consideration will be given to facility use by other federal agencies and private industry. Wherever possible, experiments will be designed to be of mutual benefit to many governmental agencies.

Maine

ME-1

Owner: University of Maine, Department of Civil Engineering

Facility: Structures Laboratories, Boardman Hall, Orono, ME 04469

Contact: Dr. M. Elgaaly, Professor

Telephone: 207-581-2137 **FAX:** 207-581-2202

General: The Laboratory has 13' by 10' by 20' reaction frame with 200,000 pound capacity, 10' by 20' by 15' reaction frame with 100,000 pound capacity, a Baldwin testing machine with 400,000 pound capacity, MTS system with three actuators, 165,000 pound, 55,000 pound and 22,000 pound capacity. State-of-the-art data acquisition system with 64 channels, state-of-the-art measurement devices and instruments and a machine shop with welding equipment.

Unique: Static, cyclic and dynamic testing state-of-the-art software to process test results, hooked up to an IBM 3090 main frame.

Capacity: Capability to test bridge decks 10' by 20' in plan.

Projects: Behavior of steel plate shear walls under cyclic loading (NSF). Behavior of beams and girders webs under patch loading (NSF). Behavior of beams and girders with corrugated webs (NSF). Behavior of skewed slab rigid frame bridges (MDOT). Cyclic behavior of timber connections (FPL). Behavior of prestressed timber bridges (USDA & MRCD).

Available for Outside Use: No

Maryland

MD-1

Owner: Department of the Navy, Naval Air Test Center

Facility: Aircraft RF Anechoic Test Facility, Systems Engineering Test Directorate, Patuxent River, MD 20670-5304

Contact: John L. Dawson, Department Head (SY80)

Telephone: 301-863-4797 **FAX:** 301-737-0305

General: 100' by 60' by 35' (Main Door 40'W x 20'H) greater than 100 dB RF isolation (15 kHz - 18 GHz). Anechoic Chamber, primarily used in the T&E of aircraft.

Unique: 30-ton hoist, 1301 Halon fire extinguisher system, wide range of standard and unique support capabilities, linked with simulation/stimulation laboratories.

Projects: 21 aircraft (including USA, USAF and foreign government's) satellites, jammers/communication equipment.
Available for Outside Use: Yes

Comment: The chamber can be used for quiet, secure testing and has support capabilities to provide test articles simulation/stimulation in generated RF environments (10 kHz-40 GHz). This facility has been in operation since July 1983. We have tested more than 100 aircraft including 3 satellites that are now in orbit. We can and have tested automotive vehicles including jeeps, trucks and tanks. All tests, military, commercial, non-DoD are handled on a DoD priority system.

MD-2

Owner: Department of the Navy, Naval Air Test Center

Facility: Electromagnetic Environmental Generating Systems (EMEGS), Systems Engineering Test Directorate, Patuxent River, MD 20670-5304

Contact: John L. Dawson, Department Head (SY80)

Telephone: 301-863-4797 **FAX:** 301-737-0305

General: A facility capable of providing RF generation from 10 kHz-40 GHz at extremely high power levels. Environments can be generated outdoors and indoors in a shielded hangar (300' by 150' by 65') or in an anechoic chamber (100' by 60' by 35').

Unique: Capable of reproducing the man made RF environment anywhere in the world, including complex modulation schemes-radars, communications etc.

Projects: 16 various aircraft including commercial aircraft MD-11 and 747-400.

Available for Outside Use: Yes

Comment: EMEGS can easily simulate any RF environment, military or civilian. We have successfully recreated city environments within the U.S. and overseas. We have also replicated space environments.

MD-3

Owner: Department of the Navy, Naval Air Test Center

Facility: Electrical/Environmental Test Facility, Systems Engineering Test Directorate, Patuxent River, MD 20670-5304

Contact: Edwin E. Taylor, Department Head (SY60)

Telephone: 301-863-4701 **FAX:** 301-737-4781

General: Numerous environmental simulation capabilities under one roof. Complete electrical system test laboratory, environmental test chambers, vibration and shock equipment, small wind tunnel and electromagnetic interference and susceptibility chambers.

Unique: Combined environmental testing, temperature -73° to +176°C, humidity 20% to 95%, vibration 4,500

pound force sine or random, electromagnetic interference and susceptibility.

Capacity: Temperature, temperature altitude, humidity, salt fog and dust chambers ranging in size to 343 cubic feet, capable of temperatures from -73° to 177°C, altitude to 150,000,' humidity of 20% to 100%. Vibration 5 to 2,000 Hz, 24,000 pounds force, shock up to 100 g for 200 pound specimens.

Projects: Primarily DoD related electrical power systems, electronic components specification compliance testing.

Available for Outside Use: Yes

Comment: Although environmental test facilities are not large scale in size, the range of capabilities is difficult to find in a single location. These facilities could be particularly useful for scale model or component testing.

MD-4

Owner: Department of the Navy, Naval Air Test Center

Facility: Navy Lightning Test Facility, Systems Engineering Test Directorate, Patuxent River, MD 20670-5304

Contact: John L. Dawson, Department Head (SY80)

Telephone: 301-863-4797 **FAX:** 301-737-0305

General: Various lightning/p-static generators capable of reproducing all natural electrostatic effects for testing on full scale vehicles.

Unique: The only 3MV/200kA lightning generator in the world. Capability to construct ESD/lightning wave forms to your specifications. Automated data collection system.

Projects: A-6E Composite Wing, MK-50 Torpedo, P-Static tests of 26 Aircraft

Available for Outside Use: Yes

Comment: This is the only DoD facility for testing full scale vehicles. We've been in operation since 1974.

MD-5

Owner: Department of Agriculture, Agricultural Research Service

Facility: Nuclear Magnetic Research Unit, Natural Resources Institute, Environmental Chemistry Laboratory, 10300 Baltimore Avenue, Building 001, BARC-West, Beltsville, MD 20705

Contact: George Gassner, Research Scientist

Telephone: 301-344-3511 **FAX:** 301-344-1048

General: Nuclear magnetic resonancy research for imaging, and broadband solutions and solids spectroscopy, in vivo ³¹p, ¹H imaging and spectroscopy.

Unique: Superconducting magnets, cryogenes, cross polarization magic angle spectroscopy.

Capacity: Molecular structure.

Projects: Structure of Agricultural related chemicals, plant and animal imaging, cross polarization and magic angle spinning.

Available for Outside Use: Yes

MD-6

Owner: National Aeronautics and Space Administration, Goddard Space Flight Center

Facility: High Capacity Centrifuge (HCC), Engineering Services Division, Greenbelt, MD 20771

Contact: Alda Simpson, Head, Environmental Test Engineering Branch, Code 750

Telephone: 301-286-5072 **FAX:** 301-286-6916

General: The High Capacity Centrifuge is used for simulating launch and landing loads on spacecraft hardware. Payloads can be installed either in a cylindrical test chamber (nominal test radius 60') or on a test platform (nominal test radius 51'). It is powered by two 1250 hp dc motors operated with a motor generator set. Controlled deceleration is possible by using the drive motors in a regenerative mode.

Unique: A 3-ton hoist is utilized to position the test article on the platform. Tilt fixtures are available for orienting the test article in the proper attitude at either test location.

Capacity: Nominal test radius: 60'(chamber), 51'(platform); maximum test weight: 5,000 pounds (chamber and platform); maximum test acceleration: 30 g (chamber), 25.5 g (platform); maximum speed: 38.3 rpm (chamber and platform); maximum specimen size: 10' diameter x 15' length (chamber) and 10' by 10' by 10' (platform).

Projects: Testing of spaceflight hardware for Extreme Ultraviolet Explorer (EUVE), Explorer Platform, and Topography Experiment for Ocean Circulation (TOPEX).

Available for Outside Use: Yes, only on a non-interfering basis.

MD-7

Owner: Department of the Navy, David Taylor Research Center

Facility: Anechoic Flow Facility, Bethesda, MD 20841-5000

Contact: J. Spina, Head, Subsonic Acoustics Research, Code 195

Telephone: 301-227-1308

General: 8' by 8' subsonic wind tunnel with special acoustic quieting features and an open jet test section in an anechoic room (20' by 10' by 20').

Unique: Low noise, low turbulence anechoic room.

Capacity: 0 to 200' per second flow rate.

Projects: Research into trailing edge flow excitation.

Available for Outside Use: Yes

MD-8

Owner: Department of the Navy, David Taylor Research Center

Facility: Uni-Axial Servo-Hydraulic Fatigue Testing Machines, Bethesda, MD 20841-5000

Contact: David Kihl, Structural Engineer, Code 1730.3

Telephone: 301-227-1956 **FAX:** 301-227-1230

General: Four machines with adjustable ranges having overall capabilities of $\pm 1,000,000$ pounds, $\pm 200,000$ pounds, and $\pm 100,000$ pounds. Grillage test fixture is planned which will be capable of applying in-plane and lateral loads.

Unique: Fatigue testing machines are computer controlled and capable of running spectrum loads. Three of the four machines have hydraulic grips ($\pm 600K$ does not).

Capacity: Fatigue test machines $\pm 1,000,000$ pounds, $\pm 600,000$ pounds, $\pm 200,000$ pounds, $\pm 100,000$ pounds.

Projects: Fatigue characterization of welded structural details under constant amplitude and variable amplitude loadings.

Available for Outside Use: Yes

MD-9

Owner: Department of the Navy, David Taylor Research Center

Facility: Structures Evaluation Laboratory, Bethesda, MD 20841-5000

Contact: Franklin I. Siegrist, Head, Engineering and Facilities Office, Code 1706

Telephone: 301-227-1830 **FAX:** 301-227-1230

General: A general purpose structural test facility consisting of a strong floor 40' by 100' by 7' with tie downs rated 250 kip per point on 5' centers. Individual hydraulic jacks and load cells available from 1 to 250 kip, all suitable for closed-loop control. Load control by computer based 16 channel system. Data collection available under computer control for more than 1,000 sensors. All components designed for fatigue and static testing.

Unique: Highest load carrying capacity of "strong-floor" structural test facilities.

Capacity: See above. Hydraulic system consists of 8 pumps, each rated 50 gallons per minute and 3500 psi.

Projects: Full-scale U.S. Navy propeller static and fatigue tests. Full-scale and model-scale sonar dome tests. Full-scale submarine dive plane fatigue and static tests.

Available for Outside Use: Yes

Comment: The facility is capable of multiple test operations. Time available is only limited by the available

work force which is drawn from a large pool of technicians working other U.S. Navy facilities at DTRC.

MD-10

Owner: Department of the Navy, David Taylor Research Center

Facility: Acoustic Materials Laboratory, Bethesda MD 20841-5000

Contact: Dr. James J. Dlubac, Mechanical Engineer, Code 1945.1

Telephone: 301-227-1470

General: Measure the dynamic and static response of viscoelastic materials.

Unique: Custom-built apparatus.

Projects: Ship Applications.

Available for Outside Use: Yes

MD-11

Owner: Department of the Navy, David Taylor Research Center

Facility: Subsonic Wind Tunnels, Bethesda, MD 20841-5000

Contact: Arthur E. Johnson, Subsonic Facilities Coordinator, Code 1270

Telephone: 301-227-1181 **FAX:** 301-227-3197

General: Two subsonic general purpose wind tunnels. Six-component force and moment balances. Removable ground planes for both tunnels available. Corporate experience includes testing vehicles and bridges. Numerous hydraulic and variable frequency electric motors from 10 to 150 hp. No current capability to reproduce scaled turbulence.

Unique: Laser sheet illumination for flow visualization is under development. Inserts available to convert one tunnel to 2-dimensional (3' wide, 8' high) test section.

Capacity: Test sections size: 8' by 10' by 14' (HxWxL). Maximum velocity approximately 190 mph.

Projects: Aircraft and aircraft components, ships (those portions above water surface) and ship components, underwater vehicles and components; all of above both in entire test section and in test section with ground plane; and bobsleds.

Available for Outside Use: Yes

MD-12

Owner: Department of the Navy, David Taylor Research Center

Facility: Circulating Water Channel, Bethesda, MD 20841-5000

Contact: Dr. William B. Morgan, Head, Ship Hydromechanics Department, Code 15

Telephone: 301-227-1578 **FAX:** 301-227-3679

General: The Circulating Water Channel is a 670,000 gallon vertical plane, closed recirculating water circuit, variable speed channel with an open to the atmosphere test section with a free surface. The Channel possesses a rectangular cross-sectional shape with a constant inside width of 6.7 meters (22') (except at the pumps).

Unique: The Circulating Water Channel possesses ten large viewing windows at different elevations on either side of the test section, and nine viewing windows in the bottom of the test section. A moveable bridge spans the test section for ease and versatility in mounting models. Filters keep the water photographically clear.

Capacity: Working section maximum velocity: 5.1 meters per second (10 knots). Working section dimensions: 18.3 meters (60') by 6.7 meters (22'), maximum water depth of 2.7 meters (9'). **Instrumentation:** dye injection system for flow visualization experiments, pressure sensors, force measuring dynamometers, high speed photographic system, model motor power supplies.

Projects: Flow visualization experiments on ship hulls, rudders, fairings, bilge keels, appendages, submerged bodies, etc.; stack gas flow studies over ship superstructures at various headings; towed body experiments; diver and diving suit performance evaluations when operating in a current, and development and testing program aimed at enhancing the performance of commercial fishing trawl nets.

Available for Outside Use: Yes

Comment: These facilities are used primarily to conduct fundamental, applied, and developmental hydrodynamic research for the U.S. Navy and are often used by others for a wide variety of unusual experimental projects.

MD-13

Owner: Department of the Navy, David Taylor Research Center

Facility: Model Basin Facility, Bethesda, MD 20841-5000

Contact: Dr. William B. Morgan, Head, Ship Hydromechanics Department, Code 15

Telephone: 301-227-1578 **FAX:** 301-227-3679

General: The basin building is 3,200' long and houses the Shallow Water Turning Basin, the Deep Water Basin, and the High Speed Basin. These model towing basins are among the largest and the best in the world. The seakeeping qualities and propulsion characteristics of models in head and following seas are determined in the Deep Water and High Speed Basins with wave makers that are capable of producing either uniform or irregular waves. The water level in the Shallow Water Basin can be varied to simulate rivers, canals, and restricted channels.

Unique: The Towing Carriages are powered by either electric or electro-hydraulic drive systems with regenerative braking action. Each has a model motor power supplies, minicomputer data acquisition systems, photographic lights, and thrust, torque, and force measuring dynamometry. Recently microwave communication systems have been installed on each of the Towing Carriages to provide a capability for transmitting real time digital data, voice, and video signals between shore and the Carriages during test runs.

Capacity: 1) Shallow Water Turning Basin: This 8,870,000 gallon rectangular concrete fresh water basin is 363 meters (1192') by 15.5 meters (51'). Towing Carriage 1 operates towing models at speeds up to 9.3 meters per second (18 knots). The Carriage can maintain test speeds in either direction within a few hundredths of a knot. 2) Deep Water Basin: This 15,820,000 gallon rectangular concrete fresh water basin is 575 meters (1886') by 15.5 meters (51') and a constant depth of 6.7 meters (22'). Towing Carriage 2 operates towing models at speeds up to 10.3 meters per second (20 knots). 3) High Speed Basin: This 6,310,000 gallon rectangular concrete fresh water basin is 904 meters (2968') by 6.4 meters (21'). Towing Carriages 3 and 5 have maximum speeds of 16.5 meters per second (32 knots) and 25.7 meters per second (50 knots), respectively.

Projects: Resistance, self-propulsion, and static stability in calm water; open water propeller characterizations; self-propelled model steering maneuvers; unsteady propeller blade force measurements; wake surveys; knot-meter calibrations under simulated dynamic conditions; vertical planar motion experiments; hydrodynamic forces on submerged bodies, foils, etc.; towed body experiments; longitudinal wave cut experiments; seakeeping & propulsion evaluations in head or following waves; planar motion experiments; hydrodynamic forces on hydrofoils, planing boats, & other high speed craft operating in calm water & in waves.

Available for Outside Use: Yes

Comment: These facilities are used primarily to conduct fundamental, applied, and developmental hydrodynamic research for the U.S. Navy and are often used by others for a wide variety of unusual experimental projects.

MD-14

Owner: Department of the Navy, David Taylor Research Center

Facility: Anechoic Facility, Bethesda, MD 20841-5000

Contact: Dr. Y.F. Wang, Head, Machinery Silencing Division, Code 274, Annapolis, MD 21402-5067

Telephone: 301-267-2649 **FAX:** 301-267-2561

General: The Anechoic Facility is a sub-facility of the Machinery Acoustic Silencing Laboratory. The facility consists of an anechoic platform 25' by 25' within an anechoic chamber measuring 40' by 60'. The large chamber dimensions provide adequate space for installation of sound absorbing material on the floor. Walls and ceilings are covered. Instrumentation is available to measure, record, analyze airborne sound and structure borne noise and vibration.

Unique: The test floor measuring 30' by 50' is designed to carry very heavy loads and is supported on its own foundation isolated from the building itself.

Capacity: This chamber may be used for acoustic measurements down to approximately 50 Hz.

Projects: The anechoic chamber currently houses a fan test facility. Several Quiet Fan development projects for the SSN 21 and other submarine and ship applications have been carried out using this chamber.

Available for Outside Use: Yes

MD-15

Owner: Department of the Navy, David Taylor Research Center

Facility: Acoustic Data Analysis Center, Bethesda, MD 20087

Contact: William Niner, Supervisor Electrical Engineer

Telephone: 301-227-4345 **FAX:** 301-227-4712

General: Collection of systems for signal and data processing. Includes one of a kind signal system, general purpose VAX data processing, VAX/Array processor system, HP based special purpose signal processing system. Configured/protected for classified processing and handling.

Unique: Very high volume signal processing capability plus capability for signal processing R&D.

Projects: Processing of acoustical trial data. Modeling/processing of structural acoustic problems.

Available for Outside Use: Yes

MD-16

Owner: Department of the Navy, David Taylor Research Center

Facility: Water Tunnel, 36-inch Variable Pressure, Bethesda, MD 20841-5000

Contact: Dr. William B. Morgan, Head, Ship Hydromechanics Department, Code 15

Telephone: 301-227-1578 **FAX:** 301-227-3679

General: The 36" Water Tunnel is one of the largest and best U.S. Navy test facilities for determining the propulsive and acoustic performance and cavitation characteristics of propellers and ship appendages. It is used primarily to determine the performance and cavitation

characteristics of propellers and ship appendages. It also is used extensively for acoustic evaluations of propellers and propeller cavitation.

Unique: The 36" Water Tunnel is one of the largest of its kind. It is a 334,000 gallon, vertical plane, closed recirculating tunnel with variable-speed and variable-pressure capability, and with a resorber, deaerator, and 5-micron filter system. The Tunnel possesses two interchangeable circular test sections (an open-jet and a closed-jet) with 36" diameter throat entrance nozzles.

Capacity: Total motor power: 2610 kW (3500 British hp), 300 rpm. Working section maximum velocity: 25.7 meters per second (50 knots). Maximum and minimum absolute pressures: 414 kPa (60 psia), 14 kPa (2 psia). Minimum cavitation number: $\sigma = 0.034$ (at 2 psia and 50 knots). Instrumentation: propeller dynamometers on up and downstream shafts, right angle drive dynamometer, inclined shaft dynameter, transverse bearing force dynamometer, six-component force balance, pressure sensors, hydrophones, computerized data collection system, high speed photographic system.

Projects: Propeller evaluations including: single shaft upstream and downstream, counter-rotation, inclined shaft, erosion, super cavitation, ventilation, transverse bearing forces, and wake simulations. Force, pressure distribution and cavitation inception studies on: hydrofoils (super cavitating & ventilated), fairings, ship appendages, waterjet inlets, etc.

Available for Outside Use: Yes

Comment: Although this facility is used primarily to conduct fundamental, applied, and developmental hydrodynamic research for the U.S. Navy, it has been used by other government agencies and private companies for a variety of unusual experimental projects.

MD-17

Owner: Department of the Navy, David Taylor Research Center

Facility: Acoustical Holography System, Bethesda, MD 20841

Contact: Joseph Clark

Telephone: 301-227-1761

General: An array of sound sensors deployed to detect the sound radiated from a structure and connected to signal acquisition and processing electronics, computers, and software.

Unique: Measures sound radiated from structures in high noise environment. Provides far-field sound levels, and gives frequency wave number data of radiating structure.

Capacity: With flexible reconfiguring capability can measure sound from 1' in diameter to 10' and 10' long. Has 32 data channels.

Projects: Sound measurements from full-scale ships, large scale models, and small models of ship and ship components.

Available for Outside Use: Yes

MD-18

Owner: Department of the Navy, David Taylor Research Center

Facility: Rotating Arm Basin, Bethesda, MD 20841-5000

Contact: Dr. William B. Morgan, Head, Ship Hydromechanics Department, Code 15

Telephone: 301-227-1578 **FAX:** 301-227-3679

General: The Rotating Arm Basin is unique within the U.S. Navy, and is used primarily for submarine and surface ship propulsion evaluations in turns, and for captive model stability and control experiments. It is also used for towed body evaluations in a turn and hydrofoil performance studies.

Unique: 1) Basin: Circular 7,940,000 gallon basin 79.2 meters (260') in diameter and 6.1 meters (20') deep. Models are towed in circular paths through still water by a rotating arm. Large underwater viewing windows are located in the Basin wall at different elevations, filters keep water photographically clear, overhead traveling cranes are located in the fitting room areas and over the path of the moveable dry dock. 2) Carriage: model towing struts and model positioning apparatus is attached to a carriage, which can be moved radially on tracks located beneath the arm structure. Strut spacing can be varied to accommodate different length models.

Capacity: Maximum arm speed: steady-state speeds up to 15.4 meters per second (30 knots) can be obtained in one-half revolution at a radius of 36.6 meters (120'), speeds up to 25.7 meters per second (50 knots) at the same radius can be obtained in about two revolutions.

Projects: Captive model stability and control experiments with submarines and surface ships; propulsion evaluations in a turn; hydrofoil performance studies; towed body evaluations in a turn.

Available for Outside Use: Yes

Comment: Although this facility is to be used primarily to conduct fundamental, applied, and developmental hydrodynamic research for the U.S. Navy, it can be used by other government agencies and private companies for a variety of experimental projects.

MD-19

Owner: Department of the Navy, David Taylor Research Center

Facility: Submarine Simulator, Bethesda, MD 20841-5000

Contact: Dr. William B. Morgan, Head, Ship Hydromechanics Department, Code 15

Telephone: 301-227-1578 **FAX:** 301-227-3679

General: The Submarine Simulator can simulate submarine motions and controls. This facility is unique within the U.S. Navy, and is used to evaluate new display concepts and overall maneuvering performance. The simulator is in an enclosure containing the usual submarine controls, instrumentation, and displays arranged as they would be on a submarine. The motions of the Simulator are controlled by computers that solve equations of submarine motion. Motion responses and signals from the computers also serve as inputs to the display instrumentation.

Unique: The enclosure is mounted on gimbals to allow pitch and roll movements. Duplicate sets of controls inside the simulator allow two-person use of the facility.

Capacity: The controls and computer responses can be programmed for any submarine for which the appropriate data are available.

Projects: Simulation of submarine motions and controls.

Available for Outside Use: Yes

Comment: Although this facility is to be used primarily to conduct fundamental, applied, and developmental hydrodynamic research for the U.S. Navy, it can be used by other government agencies and private companies for a variety of experimental projects. Perhaps this human factors Submarine Simulator could be adapted to highway driving simulation projects.

MD-20

Owner: Department of the Navy, David Taylor Research Center

Facility: Maneuvering and Seakeeping Basin, Bethesda, MD 20841-5000

Contact: Dr. William B. Morgan, Head, Ship Hydromechanics Department, Code 15

Telephone: 301-227-1578 **FAX:** 301-227-3679

General: The Maneuvering and Seakeeping Basin is unique within the U.S. Navy, and is used to model the full scale motions of ships, platforms, and mooring systems in waves. In this facility, engineers evaluate the maneuverability, propulsion, dynamic stability, and control of surface ships and submarines in waves and smooth water at various headings. The facility is also used for capsizing tests and slamming studies.

Unique: 1) Basin volume of 12,210,000 gallons, 110 meters (360') by 73 meters (240') by 6.1 meters (20'), except a 10.7 meters (35') deep by 15.2 meters (50') wide trench which is parallel to the long side of the basin. Large underwater viewing windows are located in the basin wall at different elevations; filters keep water photographically clear.

Capacity: Maximum carriage speed of 7.7 meters per second (15 knots). Ship models can be towed in head or following seas at any angle from 0 to 90 degrees. Description of towing carriage: rectangular shape 6.1 meters (20') wide by 6.6 meters (21.75') long by 2 meters (6.7') high, weight of 147 kN (16.5 tons) including equipment. Wave generation capability: regular waves from 0.9 to 12.2 meters (3 to 40') in length and up to 0.6 meters (2') in height. Irregular waves simulating the ocean up to sea state 9.

Projects: Maneuvering experiments; seakeeping and propulsion evaluations at various headings in waves; motions and loads on moored ships, floating structures and buoys; dynamic stability and capsizing tests; slamming studies.

Available for Outside Use: Yes

Comment: Although this facility is to be used primarily to conduct fundamental, applied, and developmental hydrodynamic research for the U.S. Navy, it can be used by other government agencies and private companies for a variety of experimental projects.

MD-21

Owner: Department of Commerce, National Institute of Standards and Technology

Facility: Cold Neutron Research Facility, Materials Science and Engineering Laboratory, Building 235, Gaithersburg, MD 20899

Contact: Dr. H. Prask, Scientific Assistant to Division Chief

Telephone: 301-975-6226 **FAX:** 301-921-9847

General: When fully completed in the mid-1990s, the CNRF will provide fifteen new experimental stations for use by U.S. researchers, with capabilities currently unavailable in this country. The instruments can be conveniently grouped into four categories: Materials Structure (three small angle neutron scattering [SANS] instruments, reflectometer, grazing-incidence diffractometer), Materials Dynamics (triple-axis spectrometer, spin-polarized inelastic neutron spectrometer, time-of-flight spectrometer, back-reflection spectrometer, spin-echo spectrometer), Chemical Analysis (depth-profiling facility, prompt-gamma facility), and Neutron Physics (neutron interferometer fundamental physics station).

Unique: The CNRF is based on the use of total reflection inside neutron "guides" that transport intense beams of neutrons from the cold source inside the reactor core up to 100 meters out into a new experimental hall. The longer neutron wavelengths of cold neutrons allow determination of larger scale structures such as polymers, precipitates, biological molecules, and colloids, and

allow easier study of optical effects, including interference, refraction and nuclear properties.

Capacity: Greater than 10^9 N/cm²/sec in the guides; comparable to the best in the world.

Projects: CNRF began operations in October 1990 with three (of fifteen) instruments now operating. Chemical analysis and small-angle neutron scattering (polymers, biological systems, metallurgy) employed so far.

Available for Outside Use: Yes

Comment: The CNRF is a unique facility in the U.S. No cold neutron source will compare until the Advanced Neutron Source (Oak Ridge) is completed in the year 2000.

MD-22

Owner: Department of Commerce, National Institute of Standards and Technology

Facility: NIST Research Reactor, Materials Science and Engineering Laboratory, Building 235, Gaithersburg, MD 20899

Contact: Dr. H. Prask, Scientific Assistant to Division Chief

Telephone: 301-975-6226 **FAX:** 301-921-9847

General: The NIST Reactor (NBSR) is a 20 MW reactor located at the Gaithersburg, MD, site and contains 25 experimental facilities used for materials science, chemical analysis, nondestructive evaluation, neutron standards, and irradiations. The experimental facilities in the reactor hall are involved in the following activities: neutron scattering and diffraction, neutron radiography, chemical trace analysis by neutron activation and depth profiling, fundamental neutron physics, long-term irradiations, and isotope production.

Capacity: Approximately 25 thermal beam facilities; 4×10^{14} N/cm²/sec maximum thermal flux.

Projects: Crystallography, metallurgy, reflectometry, neutron spectroscopy chemical analysis.

Available for Outside Use: Yes

Comment: The NBSR is a world-class reactor facility, with the most diverse range of instrumentation of any neutron source in this country.

MD-23

Owner: Department of Commerce, National Institute of Standards and Technology

Facility: Large-Scale Structural Testing Facility, Gaithersburg, MD 20899

Contact: Dr. H.S. Lew, Chief, Structures Division, Building 226, Room B168

Telephone: 301-975-6061 **FAX:** 301-975-4032

General: Large-scale structural testing facility consists of a universal testing machine equipped with a horizontal hydraulic ram of 4.5 MN capability used with a 13.7

meter high reaction buttress. Facility capable of testing large-scale structural components up to 17.7 meters in height.

Unique: Large capacity combined with lateral loading capability.

Capacity: Capacity 53.4 MN in compression; 27 MN in tension; reaction load shear capacity 1.3 MN; and wall bending capacity 5.7 MN-meter.

Projects: Evaluate seismic performance of concrete columns 1.5 meters in diameter up to 9.1 meters in height. Performed puncture propagation in steel plates 1 meter wide x 150 millimeters thick.

Available for Outside Use: Yes

MD-24

Owner: Department of Commerce, National Institute of Standards and Technology

Facility: Tri-Directional Structural Testing Facility, Gaithersburg, MD 20899

Contact: Dr. H.S. Lew, Chief, Structures Division, Building 226, Room B168

Telephone: 301-975-6061 **FAX:** 301-975-4032

General: Computer-controlled apparatus capable of applying forces or displacements in three directions simultaneously to full-scale structural components and systems. Specimens up to 3.4 meters high and 3.1 meters in length or width can be subjected to 6 degrees of freedom.

Unique: Computer-controlled apparatus with moveable cross head.

Capacity: 2 MN in vertical direction; about 890 kN in each horizontal direction.

Projects: Study masonry shear walls, precast concrete connections and steel-frame connections for their cyclic inelastic lateral load resistance.

Available for Outside Use: Yes

MD-25

Owner: Department of the Navy, Naval Surface Warfare Center

Facility: Vibration Analysis and Structural Modeling Facility, White Oak Laboratory, 10901 New Hampshire Avenue, Silver Spring, MD 20903-5000

Contact: Stanley M. Wojnar, Head, Vibration Section

Telephone: 301-394-1306 **FAX:** 301-394-3009

General: High capacity electrodynamic shaker, slip table, and extensive data acquisition, analysis, and structural modeling computers, hardware, software, and expertise.

Unique: Combination of facilities with expertise on related test/analysis fields.

Capacity: 35,000 pounds force output, 5' by 5' slip table, fast graphical modeling and analysis workstation, greater than 100 channels data acquisition, automatic analysis.

Projects: Facility less than one year old. All projects related to U.S. Navy weapon systems and subsystems.

Available for Outside Use: Yes

MD-26

Owner: Department of the Navy, Naval Surface Warfare Center

Facility: Shock Facilities, White Oak Laboratory, 10901 New Hampshire Avenue, Silver Spring, MD 20903-5000

Contact: Martin T. Walchak, Head, Shock Section

Telephone: 301-394-4459 **FAX:** 301-394-3009

General: High energy air launcher impact facilities; precision drop test machines; centrifuges 12," 36," 10' diameter; air guns 15," 21," 26" diameter.

Unique: Produce inertial simulation of various impact, launch, and operational environments.

Projects: 1) Centrifuges: transducer calcs, fuzing systems. 2) Launchers: warhead impact studies; air guns. 3) Water-entry ground impact studies on components.

Available for Outside Use: Yes

MD-27

Owner: Department of the Army, Combat Systems Test Activity

Facility: Suspension Properties Tester, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: Suspension Properties Tester is used to measure the suspension properties of heavy vehicles and determine parameters such as wheel rates, roll stiffness, spring lash, hysteresis, and various compliances. This facility allows for a complete vehicle suspension to be tested, thus measuring the cumulative effect of the suspension kinematics.

Projects: This is a new facility for testing all wheeled vehicles.

Available for Outside Use: Yes

MD-28

Owner: Department of the Army, Combat Systems Test Activity

Facility: Automotive Tilt Table, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The Automotive Tilt Table is used to determine the roll stability of heavy vehicles such as combat tanks and tractor/trailer combinations. By tilting a test vehicle about its roll axis, the Tilt Table can be used to determine the vehicle's maximum side slope capability and its maximum cornering capability before rollover.

The effect of lateral acceleration on suspension deflections can also be charted throughout the vehicle's range of lateral acceleration capability.

Unique: The tilt table has a continuous flat surface measuring 14' by 101,' has a total test item weight capability of 140 tons, and an axle weight capability of 35,000 pounds. Maximum angle of tilt is 40 degrees, with greater angles achieved by canting the vehicle on the platform before testing. The table also features a 25' wide section at its midpoint to allow testing vehicles such as forklifts and cranes in their pitch axis.

Projects: This is a new facility testing all types of wheeled and tracked vehicles.

Available for Outside Use: Yes

MD-29

Owner: Department of the Army, Combat Systems Test Activity

Facility: Mobile Field Dynamometers, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: These vehicles (M16, M18, and M11) are highly specialized units used in determining full power draw-bar effort and cooling characteristics of military wheeled and tracked vehicles. They are also utilized to determine resistance-to-towing characteristics of the same type vehicles. The vehicles contain a complete complement of instrumentation required for measurement of pertinent performance parameters, and has a maximum absorption of 55,000 pounds.

Projects: M1, M60 tanks, Heavy Expanded Mobility Tactical Truck (HEMTT), Palletized Loading System (PLS), and the Family of Medium Tactical Vehicles (FMTV).

Available for Outside Use: Yes

MD-30

Owner: Department of the Army, Combat Systems Test Activity

Facility: Climatic Simulation Chamber, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: This test facility is designed to meet Military Standard 810D. It features a 40' by 75' by 24' (high) chamber capable of temperatures ranging from -70° to +170°F. plus humidity control in the elevated temperature range. Additionally, the chamber can be divided into two chambers, 40' by 37,' which can be operated at two different sets of conditions simultaneously.

Projects: M1 tank, M2/M3 Bradley Fighting Vehicles, Heavy Expanded Mobility Tactical Truck (HEMTT),

High Mobility Multi-purpose Wheeled Vehicle (HMMWV), various shelters and generator sets.

Available for Outside Use: Yes

MD-31

Owner: Department of the Army, Combat Systems Test Activity

Facility: Toxic Fumes Instrumentation Trailer, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: A 40' semitrailer equipped with instrumentation to measure toxic gas concentrations produced by vehicles, fuel burning equipment or weapons firing. Up to 24 channels of data plus on-site meteorological data is recorded and processed. Analyzers for Ammonia, CO, CO₂, nitrogen oxides, sulfur dioxide, and halons. Computer controlled vacuum sampling collection system for off-line analysis of lead fumes, particulate, etc. Has an HP-9000 computer and HP-3852 data acquisition and control system.

Projects: Toxic fumes tests on all types of wheeled and tracked vehicles (M1, M2/M3 Bradley Fighting Vehicle, Palletized Loading System (PLS), Family of Medium Tactical Vehicles (FMTV)).

Available for Outside Use: Yes

MD-32

Owner: Department of the Army, Combat Systems Test Activity

Facility: Mile Loop Automotive Test Area, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The Mile Loop is a level, concrete course of oval shape for continuous high speed operating tests of vehicles. The course consists of two straight sections, each 0.25 mile long, joined at each end by 0.25 mile sections of regular curvature to form an oval of 1 mile total circumference. The course is covered with hot mixed bituminous concrete and has a parallel outside oval of gravel.

Unique: The Mile Loop also contains a 100,000 pound pull (deadman) for winch testing, a pothole course, 1" spaced bump course, and 6" cross-tie.

Projects: Road shock and vibration studies of all types of tracked and wheeled vehicles.

Available for Outside Use: Yes

MD-33

Owner: Department of the Army, Combat Systems Test Activity

Facility: Munson Test Area, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE
Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The Munson Test Area contains an array of fixed obstacles and special courses used for making specific measurements of the field performance of automotive material. Testing includes determination wheeled and tracked vehicle performance parameters using laboratory type instrumentation to make specific measurements of vehicle performance in field environment plus endurance testing on test courses which duplicate road surfaces found in many parts of the world. The courses and network of connecting roads total 9 miles and cover 150 acres of land.

Unique: Facilities include a paved road, improved gravel road, rolling hill course, sand course, clay soil bin, abrasive mud course, fording basin, underwater fording facility, frame twister, Belgian Block course, imbedded rock course, side slopes, gradeability slopes, simulated loading ramp, 2" washboard, wave course, 5" to 12" staggered bump, vertical walls, bridging device, ditch profile, turning circle, load vibration course, and winch test device.

Projects: M1, M1A1, M1A2 and other main battle tanks, M2/M3 Bradley Fighting Vehicles, Heavy Expanded Mobility Tactical Truck (HEMTT), High Mobility Multi-purpose Wheeled Vehicle (HMMWV), and other various tracked and wheeled vehicles including trailers, dolly sets.

Available for Outside Use: Yes

MD-34

Owner: Department of the Army, Combat Systems Test Activity

Facility: Dynamometer Course, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE
Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The Dynamometer Automotive Test course is a level and straight course constructed of reinforced concrete covered with bituminous concrete. The course has a total gradient of less than 0.1% in its 1 mile length, is one traffic lane in width, and has a turnaround located at each end. Closely controlled engineering tests are performed over the course such as drawbar pull, tractive resistance, acceleration, braking and fuel consumption measurements.

Unique: The mobile field dynamometers M16, M9 and M18 and the Automatic Data Acquisition System are

extensively used to support tests conducted on this course. Vehicle maintenance services are available at the nearby Perryman Test Area.

Projects: M1 tank, M2/M3 Bradley Fighting Vehicles, various trucks, trailers, and dolly sets.

Available for Outside Use: Yes

MD-35

Owner: Department of the Army, Combat Systems Test Activity

Facility: Perryman Test Area, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE
Telephone: 301-278-4277 **FAX:** 301-278-3089

General: Perryman Test Area is a complex of 11 test facilities contained within approximately 2,000 acres. It is used primarily for the level cross-country, secondary road, and paved portions of vehicle endurance tests. The four cross-country courses are especially suited for endurance testing of suspension systems, frames, bodies, and hulls. These 4 courses consist of: a moderate course with a road bed of quarry spall and bank gravel; a 2-mile loop maintained as a moderately irregular terrain with a surface of native soil; a course of native soil similar to course 2, but more severe; and an area of extremely rough terrain including marshy areas with swamp-type vegetation. These courses are inspected monthly to assure that specified standards of roughness are maintained.

Unique: Additional facilities consist of a secondary road of native soil and another surface with crushed stone and bank gravel; a high speed 3-mile paved straightaway with banked turnaround loops at either end; mud and swamp courses for mobility testing in soft soil and natural vegetation.

Projects: M1, M1A1, M1A2 and all other main battle tanks, M2/M3 Bradley Fighting Vehicles, Heavy Expanded Mobility Tactical Truck (HEMTT), High Mobility Multi-purpose Wheeled Vehicle (HMMWV), and other various tracked and wheeled vehicles including trailers and dolly sets.

Available for Outside Use: Yes

MD-36

Owner: Department of the Army, Combat Systems Test Activity

Facility: Churchville Test Area, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE
Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The entire Churchville Test Area is characterized by a series of steep hills with slopes up to 29%. The test area is used for hilly cross-country endurance tests

of tracked and wheeled vehicles and emphasizes durability characteristics of brakes, engines and power trains. The most frequently used course in the CTA is course B. It consists of grades up to 29% and is composed of moderate to rough native soil and stone, ranging from muddy to dusty, depending on the weather conditions. Course C is a 1.5 mile secondary road test course with controlling grades of 10% and turnarounds at each end. This course is used for trailers and semitrailers which are not intended to have full cross-country capability. **Unique:** Prepared mud slopes up to 20% on a nearby test area are used for evaluating the performance of vehicles in mud.

Projects: M1, M1A1, M1A2 and all other main battle tanks, M2/M3 Bradley Fighting Vehicles, Heavy Expanded Mobility Tactical Truck (HEMTT), High Mobility Multi-purpose Wheeled Vehicle (HMMWV), and other various tracked and wheeled vehicles including trailers and dolly sets.

Available for Outside Use: Yes

MD-37

Owner: Department of the Army, Combat Systems Test Activity

Facility: Vehicle Dynamics Area, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE
Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The Vehicle Dynamics Area (VDA) is a large, flat rectangular pad of bituminous concrete (asphalt), upon which provides a safe area to conduct automotive performance and safety testing to include braking, steering and handling, traction and stability tests.

Unique: VDA includes: 1) a soaking pit sufficiently deep to allow wetting of brake components; 2) a shallow water trough to allow assessments of limited tire wetting and road splash; 3) a concrete pad with a finished surface located in one corner of the VDA, and other small sections with different paving materials and coatings to provide surfaces with different coefficients of friction; and 4) a sprinkler system or similar capability to wet the entire VDA surface.

Projects: This is a new facility for testing medium tactical vehicles, palletized loading systems, high mobility multi-purpose wheeled vehicles, and heavy equipment transporters.

Available for Outside Use: Yes

MD-38

Owner: Department of the Army, Combat Systems Test Activity

Facility: Sustained Speed Test Track, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: A 2 to 2.5 mile banked oval test track to accommodate testing of current and future higher performance military vehicles.

Unique: This test track allows heavier systems to maintain highway speeds for a long period.

Capacity: This test track allows sustained speed operation in a safe, controlled area.

Projects: This is a new facility for testing all classes of wheeled vehicles.

Available for Outside Use: Yes

MD-39

Owner: Department of the Army, Combat Systems Test Activity

Facility: Human Factors Laboratory, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE
Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The laboratory is fully equipped to conduct complete human factors test and evaluation which includes measurements of the working environment (light, sound, whole-body vibration, and anthropometric studies) and human performance. Instrumentation includes photometers, sound level meters, frequency analyzers, microphones, anemometers, and anthropometric measurement kits.

Projects: Wheeled and tracked vehicles, generators, engines, guns and mortars, and general equipment.

Available for Outside Use: Yes

MD-40

Owner: Department of the Army, Combat Systems Test Activity

Facility: Automotive Performance Test Laboratory, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE
Telephone: 301-278-4277 **FAX:** 301-278-3089

General: Consists of a 2-floor concrete building with its own heating and air conditioning facilities. It houses instrumentation and electronic laboratories, data collecting and reducing equipment, office space and facilities for the engineering staff, and a shop area 150' by 68,' with a 36' ceiling. All four sides of the shop have roll-up doors that are 20' high and 16' wide. In the shop is a 10-ton overhead crane that can move over the entire length of the shop area.

Unique: Roof installation facilities are provided for radar and systems test operations, including direct electrical connections with the electronic laboratories below.

Projects: Test Measurement and Diagnostic Equipment (TMDE) performance tests; weight distribution and

center of gravity test of all commodities; turret response tests of tanks and ground-vehicle-mounted air defense systems; instrumentation application for all vehicle performance tests and for road shock and vibration tests of all commodities.

Available for Outside Use: Yes

MD-41

Owner: Department of the Army, Combat Systems Test Activity

Facility: Communications-Electronics Road, Shock, and Vibration Course, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The road, shock, and vibration course is available for communications related systems and comprises 3.2 km of the Munson Test Area. The course was arranged to accommodate the standard load vibration test and includes the following surfaces: 6" washboard, 2" washboard, Belgian Block, radial washboard, 3" spaced bump, and inter-connecting gravel roads. This unique course mix is designed to determine the ability of electronic units to withstand shock and vibration experienced in specific vehicles.

Projects: All types of wheeled and tracked vehicles which carry electronic equipment.

Available for Outside Use: Yes

MD-42

Owner: Department of the Army, Combat Systems Test Activity

Facility: Pooles Island Automotive Test Area, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: This test area has a wide, clear, sandy beach about 1 mile long suitable for sand mobility and amphibious testing. A firm smooth area slopes from the sandy beach to a 15' water depth and a stable hard bottom for deep water fording tests. Water transportation to the test area is provided by landing craft capable of transporting the heaviest current production vehicles.

Projects: M88A1 recovery vehicle and the M60A1 tank deep water fording tests.

Available for Outside Use: Yes

MD-43

Owner: Department of the Army, Combat Systems Test Activity

Facility: Test Vehicle Measurement System, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: This system will be used to support automotive testing at three USACSTA test areas. The system will provide continuous, bi-directional data communication coverage to all points on the test courses. All data will be stored at a test area control station where an operator can monitor vehicle status and reconfigure the system. The test areas use a microwave link to transfer test data to a central data communication center collocated with the Munson Test Area control station.

Unique: Andrew Corp. Radiax ("leaky coax") cable is installed along the test courses to establish the system communication link. RF transmissions are modulated by unique spread spectrum codes for each course within a test area to eliminate interference from adjacent test courses.

Capacity: Each test area has two continuous PCM links at 2 Mbit per second as well as 9600-baud bi-directional data links. All are operating simultaneously.

Projects: This is a new facility for collecting test data on all automotive tests at USACSTA's automotive test areas.

Available for Outside Use: Yes

MD-44

Owner: Department of the Army, Combat Systems Test Activity

Facility: Engine Dynamometer Test Cell, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The dynamometer is a water brake type capable of measuring engine horsepower of medium size engines up to 500 hp.

Unique: The engine dynamometer is capable of developing engine torque and engine horsepower versus engine speed curves of new, rebuilt and broken-in engines. The dynamometer could also be used for engine durability testing.

Projects: This is a new facility for testing engines up to 500 hp.

Available for Outside Use: Yes

MD-45

Owner: Department of the Army, Combat Systems Test Activity

Facility: Mobile Tire Dynamometer, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: The Mobile Tire Dynamometer (MTD) consists of a trailer that incorporates a fixture on which a test tire is mounted, whereby the vertical load and slip

angle of the tire can be varied. The trailer is towed over a range of road speeds and road surfaces to determine the effects of velocity and road friction on cornering stiffness.

Projects: This is a new facility for testing all wheeled vehicles.

Available for Outside Use: Yes

MD-46

Owner: Department of the Army, Combat Systems Test Activity

Facility: Robotics Test Facility, Aberdeen Proving Ground, MD 21005-5059

Contact: Jerold L. Nook, Director, STECS-AE

Telephone: 301-278-4277 **FAX:** 301-278-3089

General: Used to analyze performance characteristics and examine the influence of human factors variables on unmanned ground vehicles. The facility consists of 35,000 square feet indoor research laboratory and a 14 acre contained outdoor driving course with dedicated instrumentation. Optimal performance, in the indoor facility, is measured using an optical contrast tracker that provides a video image which is analyzed using a computer program algorithm.

Unique: Measurements are recorded when the test vehicle passes over pressure sensitive switches located every 16'. The outdoor course uses a radio frequency navigation grid system to provide a position location system of similar accuracy to indoor capability. A centralized real time data collection and analysis facility is planned.

Projects: Human Factors Vision Study and the High Mobility Multi-purpose Wheeled Vehicle (HMMWV).

Available for Outside Use: Yes

MD-47

Owner: Department of the Navy, David Taylor Research Center

Facility: Acoustic Prototype Laboratory/Pulse Tubes, Annapolis, MD 21402

Contact: W.P. Kenney, Branch Head, Code 2842

Telephone: 301-267-2862 **FAX:** 301-267-2640

General: This facility is used to develop, test and evaluate materials and designs for vibration and noise control. It consists of two laboratory areas for processing and physical testing of rubber and polyurethane materials inclusive of prototype manufacturing. A separate pulse tube facility is utilized to characterize acoustic performance in water.

Unique: Complete turn-key design and manufacturing for elastomeric materials/assemblies. Acoustic testing at pressures up to 700 psi and frequencies to 10 kHz.

Capacity: Processing of 150 gallons of polyurethane compounds per day; acoustic testing of 16 samples per pulse tube per day.

Projects: Development of acoustic reflectors, absorbers and decouplers, as well as transition coatings, machinery isolation mounts and cast/sprayed damping materials.

Available for Outside Use: Yes

MD-48

Owner: Department of the Navy, David Taylor Research Center

Facility: Welding, Fabrication and Nondestructive Evaluation Facility, Annapolis, MD 21402-5067

Contact: Robert DeNale, Supervisory Metallurgist, Code 2815

Telephone: 301-267-2662 **FAX:** 301-267-2640

General: This facility, with its full time staff of 20, is by far the largest in the DOD devoted to welding and nondestructive evaluation research and development. It supports work in the areas of arc welding, concentrated energy beam welding, weld automation, weldability testing, NDE (ultrasonics, electromagnetic testing, and radiography) and thermal spray coating technology.

Unique: Weld sensing capabilities include a laser vision system that allows enhanced real time visualization of the welding arc, molten weld pool, droplet transfer, and surface effects of the welding process. The weld acoustic monitor which senses the airborne acoustics of the welding arc and automatically assesses the quality of the weld being produced. A 2000 ampere buried gas tungsten arc welding system capable of welding thick section steel in two passes.

Capacity: Approximately 17,000 square feet of laboratory and engineering space acquired in 1989 (8,000 square feet), 1974 (6,000 square feet), and 1958 (3,000 square feet) containing: laser welding equipment, electron beam welding equipment, gas tungsten arc welding, gas metal arc welding, shielded metal arc welding, submerged arc welding, plasma arc welding, buried gas tungsten arc welding, weld simulation via the Gleebe 1500, weldability testing using implant, vareststraint and transvareststraint test equipment, radiographic inspection laboratory, ultrasonic inspection equipment, eddy current and magnetic particle inspection equipment, holographic interferometric inspection system, thermal spray, plasma spray, and High Velocity Oxy-Fuel spray coating techniques, and unique features previously cited.

Projects: More than forty research and development tasks in the areas of: nondestructive evaluation of welded structures, weld automation and control, high strength steel welding consumable (wire and flux) development, weld process development, and thermal spray technology for repair and refurbishment have been performed in

this facility within the past two years. Typical examples include: defect detection and sizing capabilities of ultrasonic techniques in highly attenuative materials; evaluation of state-of-the-art ultrasonic instrumentation; development of eddy current techniques to detect surface breaking cracks in steels; electric potential methods to measure crack depths in steels; monitoring and control of the welding process and weld quality using airborne acoustic during the welding process; development of high quality, high production welding processes such as buried gas tungsten arc welding technique.

Available for Outside Use: Yes

MD-49

Owner: Department of the Navy, David Taylor Research Center

Facility: Marine Corrosion and Electrochemistry Laboratory (MCEL), Annapolis, MD 21402-5067

Contact: Robert Ferrara, Branch Head, Code 2813

Telephone: 301-267-2843 **FAX:** 301-267-4885

General: Facility consists of a field site located at Wrightsville Beach, NC, with free access to natural seawater and atmospheric corrosion testing facilities. Also is a modern fully equipped and stocked bench-top electrochemical testing laboratory.

Unique: Can carry out all forms of marine corrosion testing under the direct control of a team of experienced and qualified corrosion engineers and scientists.

Capacity: Consists of twelve professional and 4 technicians at Annapolis site plus an additional 4 professional and 6 technicians at field site.

Projects: More than 30 years of work on marine corrosion problems related to ships and submarines of the U.S. Navy. Projects ranging from fundamental and applied research to corrosion engineering and failure analyses have been conducted.

Available for Outside Use: Yes

Comment: The Marine Corrosion and Electrochemistry Laboratory (MCEL) at DTRC provides equipment and experience for dealing with ship hulls, machinery and electrical equipment marine corrosion research and development requirements as well as shipboard related maintenance and repair problems in an integrated facility with first-rate equipment. The MCEL is in the forefront of the development of Electrochemical Impedance Spectroscopy (EIS) techniques that could be used for predicting the life of anti-corrosion and anti-fouling coating systems. The MCEL also provides corrosion research and corrosion control for seawater piping systems, shipboard machinery, ship hulls and electrical components.

MD-50

Owner: Department of the Navy, David Taylor Research Center

Facility: Paint Analytical Formulation, Application and Testing Facility, Annapolis, MD 21402

Contact: Jean A. Montemarano, Head, Paints and Processes Branch, Code 2841

Telephone: 301-267-2337 **FAX:** 301-267-2839

General: This facility is used in conducting comprehensive RDT&E in paints materials and components, chemical resins and coatings for protection against corrosion, erosion, cavitation and fouling.

Unique: Equipment is available to conduct a wide range of comprehensive T&E. Assets include temperature controlled immersion tanks for corrosion testing, aerated tanks for cathodic protection testing, a salt spray apparatus for testing panels according to ASTM standards, devices for exposing specimens to condensation and ultraviolet light, a potential adhesion cabinet for environmental simulation, a color spectrophotometer, light sectioning microscope, reflectometer, centrifuge, and physical testing apparatus. Analytical spectrophotometers include infrared, fluorimeter for spectral analysis; low and high pressure liquid chromatography, and image analysis equipment interfaced with a computer are available. Paint and substrate roughnesses are analyzed using precision electronic digital profilometers. A full range of formulating and small scale manufacturing equipment is available for paint application and production. Small scale powder coating unit is utilized for electrostatic spray application of 100% solids coatings. Included is the capability to thermal spray using the latest techniques (powder, hypervelocity spray) metal/ceramic coatings.

Capacity: Paint formulation capability for 1 gallon quantities. Accelerated testing simultaneously for fifty paint coupons.

Projects: Evaluation of paints for replacement of machinery enamel using water based and high solids coatings. Development of microencapsulation technology for paint additives. Investigation of radiation cured coatings for corrosion control applications where the use of solvent based paints must be eliminated. Testing and identification of alternative coatings for resolution of paint discoloration and delamination on fuel storage tanks. Development of hypervelocity spray for corrosion resistant coatings.

Available for Outside Use: Yes

Comment: The DTRC facility provides a full range of formulation, application, analytical and testing capabilities focused on paint and coatings for corrosion control applications. This facility allows the U.S. Navy to meet ever stringent environmental demands (e.g., VOC

compliant coatings) with high solids and water based coating technology. Additionally this facility allows for rapid resolution of field problems due to its testing and analytical capabilities.

MD-51

Owner: Department of the Navy, David Taylor Research Center

Facility: Semiconductor Research Facility (27-14), Annapolis Laboratory, Annapolis, MD 21402-5067

Contact: Stephen G. Smith, Electrical Engineer, Code 2713

Telephone: 301-267-3123 **FAX:** 301-267-2571

General: This facility provides the measurement and diagnostic capability to develop application, reliability and selection criterion for power semiconductors.

Unique: The Thyristor Automated Measurement and Simulation System (TAMS) is an automated, computer controlled, multi-device (load) static and dynamic measurement and analysis system.

Capacity: Used to meet control, common-stress, monitor, measurement, data-storage and data-display requirements of experiments involving power solid-state devices such as thyristors, transistors, gate-turn-off switches, SCRs and diodes.

Projects: Electrical characterizations of MOS Controlled Thyristors (MCT), Insulated Gate Bi-polar Transistors (IGBT) and Silicon Controlled Rectifiers (SCR).

Available for Outside Use: Yes

Comment: Approximately \$500,000 of new power semiconductor test equipment (LEM TR 6015 and LEM 3015 GTO Tester) expected to be operational in 1992. MCT developments expected to yield one of the necessary enabling technologies needed for cost effective electric car.

MD-52

Owner: Department of the Navy, David Taylor Research Center

Facility: Survivability and Fire Research Laboratory, Annapolis, MD 21402-5067

Contact: A.J. Marchand, Branch Head, PO Box 418, Arnold MD 21012

Telephone: 301-267-3050 **FAX:** 301-261-1845

General: Laboratory is physically located on 23 acres of land remote from the facilities at Annapolis and Carderock. Equipment and people acquired in last 8 years in response to U.S. Navy's desire for improved fire testing. Much of work is verifying material meets fire specifications and developing new specifications.

Unique: For testing small material quantities, rate of heat release calorimeters, ASTM fire and smoke tests,

GC mass spec and FTIR spectrometers and system unique tests, 20' by 20' burn chamber.

Capacity: Complete small scale fire and smoke testing 20' by 20' and cable burn chamber provide capability for corner and 1/4 scale burns.

Projects: Passive Fire Protection, Fire Hardened Ship-board Cable and Resolution of Composite Fire Issues.

Available for Outside Use: Yes

Comment: The fire testing capability of the survivability and fire research laboratory is unique in the U.S. Navy as to quick turnaround and extent capability of evaluating the fire performance of materials of construction and outfitting. U.S. Navy's principal laboratory for fire related cable problem. Fire performance of interior coatings. A principal laboratory for identifying and resolving fire issues associated with composites.

MD-53

Owner: Department of the Navy, David Taylor Research Center

Facility: Fatigue and Fracture Research Facility, Annapolis, MD 21402

Contact: E.M. Hackett, Senior Materials Engineer, Code 2814

Telephone: 301-267-2614 **FAX:** 301-267-4885

General: Facilities for mechanical testing, fracture, fatigue testing and materials processing research. Extensive capabilities in dynamic loading of materials and testing of structural elements.

Unique: 550,000 pounds capacity Servo-Hydraulic Test Machine with high rate capability to 220,000 pounds. Second high rate test frame to 300 inches per second. Steel processing simulator with induction heater.

Capacity: Drop tower for dynamic testing (6,000 foot-pounds). Fatigue and environmental testing to 550,000 pounds.

Projects: Dynamic Fracture Behavior of Navy Steels; Constraint Effects in Fracture for USNRC; Certification Mechanical Testing for New Navy Steels; Environmental Testing of Bolting Materials.

Available for Outside Use: Yes

Comment: While other laboratories exist with somewhat comparable facilities, no facility is available with the unique combination of capabilities at DTRC in the fatigue and fracture behavior of metals area. This is especially true in the areas of high rate loading and large-scale structural element testing for fatigue and fracture and deformation behavior of materials.

Massachusetts**MA-1**

Owner: Department of the Army, Natick Research Development and Engineering Center

Facility: Climatic Chambers Building, Natick, MA 01760

Contact: Lynn Finneran, Facility Manager

Telephone: 508-651-5295 **FAX:** 508-651-5103

General: The climatic chambers consisting of the Arctic and Tropic wind tunnels and the Arctic and Tropic conditioning rooms are designed to study human physiology, clothing, individual equipment, parachutes, shelters, and the other equipment under worldwide environmental conditions in the laboratory. Both wind tunnels are 60' long, 11' high, and 15' wide. They each have two treadmills. Four soldiers can walk or run on each treadmill, so eight soldiers at a time can be tested on the mills. The chambers are large enough to accommodate up to 25 soldiers on tests not involving the treadmills. Both wind tunnels have a relative humidity range of 10 to 90%. Wind speeds up to 40 mph can be achieved in each tunnel. It can rain up to four inches per hour in each chamber. There is no capability for sleet or snow in the Arctic chamber, only a cold rain down to 30°F. The temperature range for the Tropic chamber is 0° to 165°F. The temperature range for the Arctic chamber is -70° to 70°F.

Unique: There are two smaller conditioning rooms available for studies involving fewer soldiers or smaller equipment. Each conditioning room is 16' by 27'. Only temperature and relative humidity can be controlled in the conditioning rooms. The temperature range in the Tropic conditioning room is 40° to 120°F. The temperature range for the Arctic conditioning room is -40° to 70°F. There are no treadmills in the conditioning rooms, but portable treadmills and ergometers can be moved into the rooms for studies.

Comment: This is the largest U.S. Army facility used for human research. Because of the large size of the chambers, equipment can also be tested in the chambers.

MA-2

Owner: Massachusetts Institute of Technology

Facility: Remergence Laboratory, 77 Massachusetts Avenue, Building 1, Room 330, Cambridge, MA 02139

Contact: Herbert Einstein, Professor

Telephone: 617-253-3598 **FAX:** 617-253-6044

General: The Remergence Laboratory provides an intellectual environment for research on geomaterials and artificial materials incorporated in large structures and structural elements. It is interdisciplinary and involves the Departments of Civil Engineering, Mechan-

ical Engineering, Ocean Engineering, Material Sciences and Engineering and Earth, Atmospheric and Planetary Sciences.

Unique: Centrifuge 15 g per ton; High Pressure triax (maximum 60,000 psi axial); Triaxial apparatus for swelling rock. Direct shear testing for rock joints. SEM and X-Ray diffraction.

Projects: Jointed Rock, Dynamic Stability of earth retaining structures and rock structures. Projects on embankments of soft ground, deep excavation, and tunnels.

Available for Outside Use: Yes

Comment: The high pressure triax and swelling rock triax are one-of-a-kind.

MA-3

Owner: Massachusetts Institute of Technology, Department of Aeronautics and Astronautics

Facility: Wright Brothers Facility, 77 Massachusetts Avenue, Building 17-110, Cambridge, MA 02139

Contact: Eugene E. Covert, Professor, Director, Building 33-215

Telephone: 617-253-2604 **FAX:** 617-253-0051

General: Low speed (up to 170 mph) subsonic wind tunnel.

Unique: Entire wind tunnel can be pressurized (2 atmospheres) or evacuated 0.25 atmosphere.

Capacity: 6 component mechanical force; balance; 300 pressures; flow visualization, etc.

Projects: 1) Pedestrian level wind studies of several cities; 2) studies of galloping of ice coated poles; 3) wing pressure and force measurements; 4) various other aerodynamic research projects.

Available for Outside Use: Yes

Comment: Tunnel is ideally suited for static force and aeroelastic test of models of lights and road signs. It can also be used for aerodynamic studies of vehicles and can obtain full scale Reynolds numbers for 1/4 and 3/8 scale model. Has capability of simulating natural approach flows for studies of buildings and other structures.

MA-4

Owner: Tufts University

Facility: Soil Mechanics and Materials Testing Laboratories, Anderson Hall, Medford, MA 02155

Contact: Lewis Edgers, Professor

Telephone: 617-627-3211 **FAX:** 617-381-3819

General: Fully modernized soil mechanics and materials testing facilities (Fall 1991). The Soil Mechanics Laboratory has modern soil mechanics test equipment, electric, pressure, vacuum and water supplies, and data acquisition systems for the performance of both simple and complex soil mechanics tests. The Materials Testing

Laboratory has 1) 22 kip, 10 gallons per minute servo-hydraulic load frame for repeated loading (Instron); 2) 300 kip screw thread static loader (Riehle); and 3) pressurized soil test chamber, 1 meter diameter by 2 meter high.

Capacity: 1) Cyclic loading, 22 kip, $\pm 1''$ at cps.; 2) static loading, 300 kip capacity.

Projects: Cyclic loader (September 1991 delivery) is capable of resilient modulus testing. Other facilities have been used for teaching and research projects on the engineering properties of soil cement, the engineering properties of silt and model pressure meter tests in the 1 meter diameter test chamber.

Available for Outside Use: Yes

MA-5

Owner: Massachusetts Institute of Technology

Facility: Lincoln Laboratory, 244 Wood Street, Lexington, MA 02173

Contact: Carl H. Much, Group Leader

Telephone: 617-981-7763 **FAX:** 617-981-0156

General: Seven large anechoic chambers for measurement of antenna radiation patterns and RF field strengths. Two outdoor antenna test ranges for realistic far field antenna radiation patterns.

Unique: The chambers have rotating pedestals for varying the aspect angle of the test device. The outdoor ranges are built on flat, grassy areas with minimal multi-path reflection.

Capacity: The chambers vary in size from 60' by 50' by 25' to 27' by 12' by 12.' The outdoor ranges are 2,000' and 700' long.

Projects: Numerous measurements of the radiation pattern of special antennas. Also measurement of the radar cross section of several target devices.

Available for Outside Use: Yes

MA-6

Owner: Massachusetts Institute of Technology, Lincoln Laboratory

Facility: Environmental Test Laboratory, 244 Wood Street, Lexington, MA 02173

Contact: Carl H. Much, Group Leader

Telephone: 617-981-7763 **FAX:** 617-981-0156

General: Two 10,000 pound of force shakers capable of random and sine vibration in the frequency range of 5 to 3,000 Hz. Complete spectrum control system and instrumentation.

Capacity: Up to 1,000 pound test specimen can be accommodated.

Projects: Variety of spacecraft packages have been tested to insure rocket launch survival.

Available for Outside Use: Yes

Michigan

MI-1

Owner: University of Michigan, Department of Civil Engineering

Facility: Structures Research Laboratory, 2340 G.G. Brown Building, Ann Arbor, MI 48109-2125

Contact: James K. Wight, Professor

Telephone: 313-763-3046 **FAX:** 313-764-4292

General: Testing facility for large scale structures. Consists of 5' thick concrete floor and 2' thick by 20' high reaction walls. Tie-down locations are spaced at 4' centers on both the floor and walls. Scaled structural models or full scale members are subjected to lateral loads intended to simulate earthquake motions.

Unique: Ability to apply bi-directional lateral loads. 600,000 pound servo-controlled testing machine.

Capacity: Various hydraulic servo-controlled actuators, testing machines and data acquisition systems.

Projects: 1) Simulated seismic testing of half-scale reinforced concrete beam to column connections. 2) Behavior of long span steel truss beams subjected to large lateral deformations. 3) Cyclic and static compression behavior of high strength fiber reinforced concrete cylinders.

Available for Outside Use: Yes

MI-2

Owner: Motorola Inc.

Facility: Detroit Applications and Systems Engineering Center, 15201 Mercantile Drive, Dearborn, MI 48120

Contact: Michael Cops, Chief Engineer

Telephone: 313-441-5530 **FAX:** 313-271-2620

General: The equipment installed at the Center is state-of-the-art engine and vehicle test equipment purchased from suppliers that are recognized as centers of excellence around the world. Of particular interest is the dynamic engine dynamometer and an environmental chamber equipped with a chassis dynamometer and emission measurement system.

Unique: Vehicle emissions testing at various ambient conditions. The dynamic engine dynamometer is capable of electronically simulating the complete vehicle drive train including clutch operating, gear changing and the characteristics of the drive shaft, tire, etc.

Capacity: Chassis dynamometers, 150 HP (105 mph and 80 mph), ambient temperature control from -40° to 120° F; engine dynamometers, 440 HP (dynamic) and 200 HP (static).

Projects: 1) 20" Roll Electric Dynamometer, Emissions Evaluation for MVMA (Motor Vehicle Manufacturers Association). 2) Cold CO ($20 \pm F$) Emission Testing. 3)

Forward Model Year Vehicle Development Testing. 4) Wide Open Throttle Power Testing, Engine Mapping, Air Fuel Ratio, Distributions, Engine Component Friction, and Idle Quality.

Available for Outside Use: No

MI-3

Owner: Department of the Army, Tank Automotive Command

Facility: Physical Simulation Laboratory, Warren, MI 48397-5000

Contact: Harry J. Zywiol, Electrical Engineer, M/S AMSTA-RY

Telephone: 313-574-5032 **FAX:** 313-574-8667

General: The facility includes several re-configurable motion base simulators capable of exciting Army vehicles or systems simulating specific operating environment. They are used to determine component and system performance and durability.

Unique: Roll, pitch, and vertical motions, driver and power train not required, controlled, repeatable test conditions, not man-rated.

Capacity: Payloads up to 25-ton, accelerations up to 15 g, 12 Hz bandwidth, 64 channel A/D conversion.

Projects: Comparison and initial production testing of various trailers and dolly sets. Accelerated service life of a vehicle was used as inputs to hydraulic actuators to determine durability of vehicle system.

Available for Outside Use: Yes

Comment: A single crew member payload ride motion simulator also exists. It can be used for ride quality and man/machine interaction studies.

MI-4

Owner: Department of the Army, Tank Automotive Command

Facility: Crew Station/Turret Motion Base Simulator (CS/TMBS), Warren, MI 48397-5000

Contact: Dr. Ronald R. Beck, Chief, Systems Simulator and Technology Division

Telephone: 313-574-6228 **FAX:** 313-574-8667

General: The CS/TMBS is a six-degree-of-freedom high performance motion base simulator. The CS/TMBS is driven by an Applied Dynamics Int. AD-100 real time computer which allows man-in-the-loop testing. It can accommodate payloads up to 25 tons with 6 g of vertical acceleration. The CS/TMBS provides ± 30 inches of translational movement and $\pm 18^\circ$ of angular movement. The CS/TMBS has a bandwidth of 5 Hz for a 20-ton load.

Unique: Safety man-rated to provide rider safety; delivers 6 g force to 25 tons or 14 g to 5 tons; man-in-

-the-loop capability; full complement of data collection, output and analysis tools.

Capacity: Maximum of 25-ton payload; ± 30 inches translational motion; ± 18 degrees angular motion, 14 g acceleration with 5-ton load; 6 g acceleration with 25-ton load.

Projects: Newly constructed simulator with no previous projects.

Available for Outside Use: Yes

Minnesota

MN-1

Owner: Minnesota Department of Transportation

Facility: Minnesota Road Research Project, 1400 Gervais Avenue, Maplewood, MN 55109

Contact: Robert J. Benke, Manager Research Administration

Telephone: 612-779-5510 **FAX:** 612-779-5616

General: MN/ROAD is a pavement engineering research facility being constructed with a complete network of sensors tied directly to an automated data base to accommodate cold climate moisture/freeze-thaw effects research. The University of Minnesota Civil Engineering Department is a partner in this venture.

Unique: Mainline test road 17-500' sections on low volume loop. Automatic weather station and weigh-in-motion seals.

Capacity: Unlimited research opportunity. Oracle data base compatible with SHRP.

Projects: Currently under construction; pilot studies completed 1990 on instrumentation installation. Current study design includes 75 separate projects. Anticipate completion fall 1992, preliminary tests through spring 1993 and open to traffic summer 1993.

Available for Outside Use: Yes

Comment: MN/DOT anticipates collaborative partnerships with states, FHWA, U.S. Army, CRREL, Finnish National Road Administration and others.

MN-2

Owner: Department of the Interior, Bureau of Mines

Facility: Twin Cities Research Center, 5629 Minnesota Avenue South, Minneapolis, MN 55417

Contact: Robert L. Schmidt, Research Supervisor

Telephone: 612-725-4597 **FAX:** 612-725-4526

General: Research facilities to study novel methods of rock fragmentation for the mining industry; included are hard-rock mechanical rock cutting; abrasive water jets; drill-split fragmentation; microwave fragmentation.

Unique: Believed to be one-of-a-kind facilities, although similar facilities may exist elsewhere.

Capacity: All are still in the research stage.
Available for Outside Use: Yes
Comment: Recent legislation has facilitated cooperative efforts with outside parties through Cooperative Research and Development Agreements.

Mississippi

MS-1

Owner: Department of Agriculture, Agricultural Research Service
Facility: 100-ft and 250-ft Hydraulic Flumes, National Sedimentation Laboratory, PO Box 1157, Oxford, MS 38655
Contact: Joe C. Willis, Research Leader
Telephone: 601-232-2926 **FAX:** 601-232-2915
General: 100' recirculating flume — 4' by 2' channel, variable slope (0% to 1%) and flow capacity at 16 cubic feet per second (cfps). 250' flume — 9' by 8' channel, fixed slope, flow capacity at 150 cfps (presently deactivated but could be reactivated when need arises).
Unique: Both flumes will recirculate water and sand in transport.
Projects: Study of transport of sand-sized sediments. Model study of grade-control structures for stream channels.
Available for Outside Use: Yes

MS-2

Owner: Department of the Army, Engineer Waterways Experiment Station
Facility: Concrete Testing Facility, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199
Contact: Dr. Robert W. Whalin, Technical Director
Telephone: 601-634-2664 **FAX:** 601-634-4180
General: Special testing facility for determining the physical, chemical and mineralogical properties on the concrete quality for concrete, mass concrete, special concretes, grouts and other construction materials. Cyclic load testing, durability, triaxial testing, ultimate strain and permeability.
Unique: Load capacity of 2.5 million pounds, confinement pressures of 200,000 psi, large walk-in storage from -15° to 150°F and humidity 20 to 100%
Capacity: 20,000 square feet of testing in controlled conditions.
Projects: Repair, evaluation, maintenance and rehabilitation of concrete dams, pavements, locks, building, permeability, structural analysis, hydrostatic testing.
Available for Outside Use: Yes

MS-3

Owner: Department of the Army, Engineer Waterways Experiment Station
Facility: Materials Research Center, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199
Contact: Dr. Robert W. Whalin, Technical Director
Telephone: 601-634-2664 **FAX:** 601-634-4180
General: A facility for testing of highway and airfield pavement materials. Laboratory research is conducted on bituminous materials, modified binders, joint sealants, pavement sealers, recycling of deteriorated pavement materials, aggregates, epoxies, polymers, and potential binders such as sulfur-asphalt, tar rubbers and epoxy resins.
Unique: Research gyratory compactor, gel-permeation, infrared spectrometry, dynamic mechanical analyzer, fatigue testing.
Capacity: 20,000 square feet of unique transportation testing capability, 2 large mobile laboratories and 1 small mobile laboratory.
Projects: Pavement binders, joint sealers, forensic analysis, mix design, extractions, chemical analysis of bitumens, foamed-asphalt, sand asphalt, marginal material evaluation, aggregate testing, asphaltic concrete evaluations.
Available for Outside Use: Yes

MS-4

Owner: Department of the Army, Engineer Waterways Experiment Station
Facility: Tire Inflation Test Facility, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199
Contact: Dr. Robert W. Whalin, Technical Director
Telephone: 601-634-2664 **FAX:** 601-634-4180
General: This facility is a 0.7 mile, two-lane road divided into 15 sections including curves and grades. Various surfaces are constructed of native soil, crushed aggregate, or asphalt concrete capable of loading up to 200,000 pounds for highway trucks.
Unique: Preconstructed test bed allowing different surfacings and actual truck traffic with different curvatures, slopes, and speed conditions.
Capacity: 0.7 mile full-scale test facility.
Projects: Forest Service Road net capacity, maintenance studies, surface aggregate loss studies, variable base course thickness evaluation, soil stabilization studies, dust control, curvature effect on pavement performance.
Available for Outside Use: Yes

MS-5

Owner: Department of the Army, Engineer Waterways Experiment Station

Facility: Circular Test Track Facility, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Contact: Dr. Robert W. Whalin, Technical Director

Telephone: 601-634-2664 **FAX:** 601-634-4180

General: The Circular Test Track Facility consists of a 49' diameter test track bound on the outer edge by a 7' wide portland cement concrete and the inner edge of 3' wide pavement. This facility can test different surfacing materials at 10,000 load applications of a 10,000 pound dual wheel in a 24 hour period. The load can be increased to 50,000 pounds.

Unique: Large numbers of full-scale load applications in a short period.

Capacity: Dual wheel load assemble remote operation, transverse speed control, 10,000 applications per day.

Projects: Asphalt surfaces tested under traffic data.

Available for Outside Use: Yes

MS-6

Owner: Department of the Army, Engineer Waterways Experiment Station

Facility: Soils Testing Facility, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Contact: Dr. Robert W. Whalin, Technical Director

Telephone: 601-634-2664 **FAX:** 601-634-4180

General: A facility to evaluate soils, rocks and other construction materials. 42 controlled strain direct shear machines, 64 triaxial machines, 29 consolidometers, cyclic triaxial apparatus creep testing, physical property testing, 1,500 square feet constant temperature/humidity storage.

Unique: Soil histories accumulated more than 60 years.

Capacity: 8,300 square feet

Projects: Consolidation studies, shear strength, constitutive soil properties, permeability cyclic loading, heat transfer, liquefaction, gradations, Atterberg limits, density, moisture content, direct shear, triaxial shear.

Available for Outside Use: Yes

MS-7

Owner: Department of the Army, Engineer Waterways Experiment Station

Facility: Soils Research Facility, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Contact: Dr. Robert W. Whalin, Technical Director

Telephone: 601-634-2664 **FAX:** 601-634-4180

General: A facility used to conduct complex studies and analysis of soil responses observed from tests such as resonant column, resilient modulus, annular shear, large triaxial compression, triaxial compression/torsion

controlled stress or strain loading, tensile, hollow cylinder tensile, biaxial consolidation of 18 inch specimens.

Unique: Specialized research testing.

Capacity: 9,700 square feet, capacities of 250 kips and triaxial specimens up to 15" diameter.

Projects: All research soil mechanics, five closed station loop electrohydraulic system subgrade and foundation shear strength highway materials cyclic loading.

Available for Outside Use: Yes

MS-8

Owner: Department of the Army, Engineer Waterways Experiment Station

Facility: Analytical Capabilities for Transportation Facilities, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Contact: Dr. Robert W. Whalin, Technical Director

Telephone: 601-634-2664 **FAX:** 601-634-4180

General: The analytical capabilities in transportation systems include a Cray Y-MP supercomputer, several mainframes (IBM, VAX, CYBER), several graphics work stations (Silicon Graphics, Intergraph), and UNIX and MS DOS compatible 386 and 486 PC's.

Unique: The Cray Y-MP supercomputer performs 2 billion calculations per second (to be upgraded to 2.7 billion calculations) and operates in a high electromagnetic pulse and Tempest-approved facility.

Projects: Analytical studies on research projects in pavement design and evaluation. These include development of an elastic-layered design method for airfield pavements; finite element analysis of pavement structural systems; computer analysis for design and evaluation of air fields, highways, railroads, and culverts. Computer codes have been developed by WES for design and evaluation of these transportation systems.

Available for Outside Use: Yes

Comment: The analytical capabilities include a wealth of programs developed by WES to perform routine design and evaluation of pavement structures for both highways and airfield. These include designs based on the Westergaard method, CBR method, and elastic-layered theory. Methods for back-calculation of pavement layer moduli which use deflection basins as input are available. Codes for structural analysis of box culverts have been developed. These codes are performed on personal computers such as the 386 or 486. More complex 3-D finite element codes are run on the Cray for detailed analysis of pavement response to moving wheel loads.

MS-9

Owner: Department of the Army, Engineer Waterways Experiment Station

Facility: Geochemistry Facility, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Contact: Dr. Robert W. Whalin, Technical Director

Telephone: 601-634-2664 **FAX:** 601-634-4180

General: This facility consists of analytical tools of forensic petrography including polarized and ultra-violet-light microscopy, scanning electron microscopy with image and energy-dispersive analysis, automated x-ray diffraction and many physical, mechanical and nondestructive tests used by materials scientists.

Unique: Hitachi 2500 electron microscope, Phillips PW 1800 XRD.

Projects: Determining causes of deterioration of building foundations, lockwalls, solidified oily hazardous wastes, materials for underground disposal of radioactive wastes, permeability of solids, pavement material analysis, rapid setting repair materials.

Available for Outside Use: Yes

MS-10

Owner: Department of the Army, Engineer Waterways Experiment Station

Facility: Instrumentation Facility, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Contact: Dr. Robert W. Whalin, Technical Director

Telephone: 601-634-2664 **FAX:** 601-634-4180

General: Laboratory comprising design and fabrication for instrumentation systems. In-house capability to provide state-of-the-art and beyond instrumentation for numerous applications.

Unique: The expertise of the associated personnel.

Capacity: 400 data channels recorded and analyzed per year.

Projects: Measurement of velocity, displacement, temperature, soil stress, and load in pavement test sections and the analysis of the data using software specifically written for these projects.

Available for Outside Use: Yes

Comment: This facility is manned by 17 technicians and 8 engineers--of whom 2 hold PhD degrees and 2 hold Master's degrees. This team has extensive experience in the design, fabrication, and application of instrumentation for the measurement of soil and pavement parameters achieved during the past 30 years. The professional staff has proven expertise in the development of specific application software for data acquisition and analysis attained during the past 10 years.

MS-11

Owner: Department of the Army, Engineer Waterways Experiment Station

Facility: Indoor Test Track Facility, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Contact: Dr. Robert W. Whalin, Technical Director

Telephone: 601-634-2664 **FAX:** 601-634-4180

General: The Indoor Test Track is a 60,000 square feet, 70' high facility used to shelter and conduct pavement test items for trafficking with actual loading conditions. The facility also contains a laboratory for monitoring quality control during testing, simulating controlled rainfall, and continuous 24 hour per day full-scale traffic applications.

Unique: Full-scale loading up to 60,000 pounds per wheel, under roof testing facility, controlled moisture, continuous monitoring in trafficking, 400' long.

Capacity: 16-ton vibrator capable of 25 to 50 kip dynamic loads, variability of wheel spacing, distributive traffic.

Projects: Asphalt test items, fiber reinforced polyester tests, geogrids, sand grids, anchoring capabilities in concrete pavements, concrete test items, radial versus bias tire comparative study, nondestructive testing, surface wave analysis.

Available for Outside Use: Yes

Comment: This loading capability is the only one in existence.

MS-12

Owner: Department of the Army, Engineer Waterways Experiment Station

Facility: Outdoor Test Facility and Soil Processing Area, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Contact: Dr. Robert W. Whalin, Technical Director

Telephone: 601-634-2664 **FAX:** 601-634-4180

General: The outdoor test facility consists of a heavy duty test bed 275' by 65' with controlled foundation strength and properties. The soil processing area is a 1,200' by 400' heavy duty flexible pavement used to contain construction materials for preparation of moisture content and strength.

Unique: The very large paved areas with known foundation properties of 278-tons of full-scale loading capability.

Capacity: 500,000 square feet of heavy duty paved testing and processing area.

Projects: Single wheel aircraft loadings, aircraft anchor studies, bituminous mix design, porous friction courses, epoxy resin asphalt studies, polymer studies.

Available for Outside Use: Yes

Comment: 16 kip vibrator in a semitrailer allows a vibratory load varying from up to 15,000 pounds with

frequency of 5 to 100 Hz. Elastic deflection measured through velocity transducers. This device is the only one of its kind.

Missouri

MO-1

Owner: Central Missouri State University, Missouri Safety Center

Facility: Highway Safety Instructional Park, 1200 South Holden Street, Warrensburg, MO 64093

Contact: Glenn A. Carriker, Coordinator of Instruction, Humphreys, Suite 201, CMSU, Warrensburg, MO 64093-5117

Telephone: 816-543-4830 **FAX:** 816-543-4830

General: The Highway Safety Instructional Park sits on 11+ acres of land on the campus of CMSU. The facility is made up of a test/training track set-up to correspond to a type of city street setting with a short interstate highway section. Also included is a large skid pan which can be used year round. The operations building has a sixteen place computer controlled driver simulator system, as well as general meeting facilities.

Unique: Facility also houses a state-of-the-art Breath Alcohol Testing/Training Laboratory for all approved breath testing devices.

Capacity: The existing driving surface is set up for car and light trucks at the present time. An addition for high speed and heavy vehicles is planned for completion by the mid 1990s.

Projects: Technology transfer programming in highway safety. Examples: Law Enforcement — training in traffic supervision Police Tactical Driving, Accident Investigation, etc., Industry — CDL Training (Primary and Third Party), Accident Investigation, Substance & Drug Abuse; Motor carriers training; Government — specialized training in vehicle dynamics and special vehicle usage.

Available for Outside Use: Yes

Comment: The Missouri Safety Center, Central Missouri State University, has in the Capital Expansion Plans established a design for the addition of a large fleet range to be constructed on the adjoining property to the existing 11 acre facility. This new facility will be used for commercial, as well as higher speed law enforcement training. The Missouri Safety Center was established in 1969 as a part of Missouri's preparation for the implementation of the Highway Safety Act. The Center's role as the state's technology transfer operation for 402 Funding has been closely maintained while expanding the Center's direction in assisting industry and business.

MO-2

Owner: University of Missouri

Facility: Hydrology Laboratory, Agricultural Engineering Building, Columbia, MO 65211

Contact: James C. Frisby, Room 138

Telephone: 314-882-2350 **FAX:** 314-882-1115

General: The laboratory is intended for research and teaching on hydrologic subjects. It is used by Agricultural Engineering Department faculty and students, and by USDA-ARS scientists.

Unique: Raindrop tower to evaluate erosion of rain on various surfaces. A 30' flume to simulate open channel flow. A rain simulator to simulate rainfall over a watershed. Facilities are not completely constructed.

Projects: Raindrop tower has been used jointly by Agronomy and Agricultural Engineering faculty to evaluate effectiveness of various mulches.

Available for Outside Use: Yes

MO-3

Owner: University of Missouri, Columbia, Department of Civil Engineering

Facility: Civil Engineering Structural Test Facility, Columbia, MO 65211

Contact: James W. Baldwin, Professor and Chairman

Telephone: 314-882-3285 **FAX:** 314-882-4784

General: The Civil Engineering Structural Test Facility is a general purpose facility for large-scale structural testing. The building was completed in 1989. Since that time it has been extensively equipped with an array of instrumentation and closed-loop electro-hydraulic loading equipment. Also includes equipment for measuring inertia properties of highway vehicles.

Unique: 20' by 100' structural test floor capable of sustaining either vertical or horizontal loads in excess of 1 million pounds.

Capacity: 50' by 100' high bay with 10-ton overhead crane. Seventy gallons per minute hydraulic capacity.

Available for Outside Use: Yes, available for use on outside projects by University of Missouri staff.

MO-4

Owner: University of Missouri, Columbia, Department of Civil Engineering

Facility: Portable Electro-Hydraulic Shaker, Columbia, MO 65211

Contact: James W. Baldwin, Professor and Chairman

Telephone: 314-882-3285 **FAX:** 314-882-4784

General: Portable electro-hydraulic shaker for application of dynamic loads in the field.

Unique: Capability of full-scale bridge or pavement, fatigue or dynamic testing in the field.

Capacity: Seventy (70) gallons per minute hydraulic capacity; 10,000 pound shaker capable of applying very high dynamic forces at resonant frequency.

Projects: Bridge fatigue tests.

Available for Outside Use: Yes, available for use on outside projects by University of Missouri staff.

MO-5

Owner: University of Missouri, Columbia, Department of Civil Engineering

Facility: Full Scale Highway Bridge, Columbia, MO 65211

Contact: James W. Baldwin, Professor and Chairman

Telephone: 314-882-3285 **FAX:** 314-882-4784

General: 100' by 44' full-scale interstate highway bridge which has been extensively instrumented and is set up for dynamic or failure testing.

Unique: Full-scale soil-structure-interaction or structural behavior tests.

Capacity: Tapered steel girders are six to seven feet deep.

Projects: Out-of-plane web bending.

Available for Outside Use: On outside projects by University of Missouri staff.

MO-6

Owner: University of Missouri

Facility: High Pressure Waterjet Laboratory, Rock Mechanics Facility, Rolla, MO 65401

Contact: Dr. David A. Summers, Director

Telephone: 314-341-4311 **FAX:** 314-341-4368

General: A facility using high pressure waterjets for research on cutting; removing concrete, paint and coatings; cleaning surfaces; and excavation of rock and geotechnical material including abrasive waterjet use.

Unique: A full range of jet pressures can be developed (50 to 5,000,000 psi) and specialized use equipment.

Projects: Developed equipment to cut straight slots 15' deep in concrete and rock; operated remote equipment to remove explosive from bombs; removed paint from surfaces; removed damaged concrete; built remotely operated submarine with enclosed TVs to survey blocked cave.

Available for Outside Use: Yes

Comment: The High Pressure Waterjet Laboratory has a broad range of equipment which can be used to study waterjet applications to highway problems.

MO-7

Owner: University of Missouri

Facility: Rock Mechanics and Explosives Research Center (RMERC), 1006 Kings Highway, Rolla, MO 65401

Contact: Dr. David A. Summers, Interim Director

Telephone: 314-341-4314 **FAX:** 314-341-4368

General: Facilities and equipment for work on rock mechanics and applied explosives engineering.

Unique: Large blast chamber, underground facilities for blasting and rock mechanics research.

Projects: Abrasive Jet Drilling of Long, Accurately Aligned Blastholes; Abrasive Cutting System; Water Jet Entrained Explosives Stream for Controlled Excavation; Titanium Alloys Milling Assisted Jet; Mineral Comminution With High Pressure Water Jet Assistance; Water Jet Sensitivity Testing Class 1.1 MII, Stage III CYH Propellant; Automated Explosives Handling.

Available for Outside Use: Yes

Nebraska

NE-1

Owner: University of Nebraska, Walter Scott Engineering Center

Facility: Structures Laboratory, 17th and Vine Streets, Lincoln, NE

Contact: Dr. Atorad Azizinamini, W348 Nebraska, University of Nebraska, Lincoln NE 68588-0531

Telephone: 402-472-5106 **FAX:** 402-472-2410

General: Laboratory is 40' wide, 130' long, 40' high served by 15-ton crane. Equipment includes hydraulic loading cylinders with 5,000 to 2,000,000 pound capacity, hydraulic pumps and control systems. Laboratory equipment: 200,000 pound test frame, 120,000 pound Timius Olsen universal testing machine, 200,000 pound Ametex machine, 200,000 pound soil test concrete compression tester, 264 foot-pound Timius Olsen impact tester, and 10,000 inch-pound Timius Olsen torsion machine.

Projects: Testing of wood poles, reinforced concrete beams and columns and reinforced masonry elements.

NE-2

Owner: University of Nebraska

Facility: Midwest Roadside Safety Facility, Walter Scott Engineering Center, 17th and Vine Streets, Lincoln, NE (Test Site-Lincoln Municipal Airport - apron)

Contact: Dr. Samy E.G. Elias, Assistant Dean, Engineering Research, W150 Nebraska Hall, Lincoln NE 68588-0501

Telephone: 402-472-3810

General: Test site is 400' wide and 3,000' long on a concrete apron, plus a 230' wide and 750' long soil area off apron. Site is enclosed with an 8' high chain link security fence. Have three large rectangular cutouts in

concrete for constructing full-scale bridge and rail installation, and guard rail installations. Large area can accommodate accident reconstruction testing and automobile performance handling. Has two soil pits for safety performance evaluations of sign posts or support, mail boxes, telephone or utility poles.

Projects: Concrete bridge rails, laminar supports, median barriers, wooden bridge rail.

Comment: The availability of high-tech instrumentation equipment combined with the expertise and experience, provide for a top notch facility available for the research and development of roadside safety appurtenances.

NE-3

Owner: University of Nebraska

Facility: Hydraulic Laboratory, Walter Scott Engineering Center, 17th and Vine Streets, Lincoln, NE

Contact: Dr. Rollin Hotchkiss, W348 Nebraska Hall, Lincoln NE 68588-0531

Telephone: 402-472-5501 **FAX:** 402-472-2410

General: Glass-walled flume: 40' by 1.25' by 1.5' (depth) tilting device. Fed by recirculating pump system, capable of flow rates up to 3 cubic feet per second (cfps) (1,350 gallons per minute). Entrance can receive physical models of culverts, wing walls, etc. Tilt can be adverse, horizontal or positive (downhill). Flow metering and computer assisted data collections are possible. Modeling basin: 110' by 25' with 2' wall for perimeter. Recirculating pump capable of 5 cfps (2,250 gallon per minute). Measuring devices available to determine velocity, depth, flow direction, pressure, bottom profiles, and flow rates.

Projects: Flume: research on how to alleviate dangerous recirculating currents associated with low dams, demonstrations on how different culvert inlets save energy and increase discharge. Local company used flume to calibrate a flow measuring device. Modeling basin: constructed full-scale roadway and modeled several different inlets and configurations to test for efficiency and ability to reduce spread of water on highways in NE.

Available for Outside Use: Yes

Nevada

NV-1

Owner: Department of Energy, Lawrence Livermore National Laboratory, University of California

Facility: LGF Spill Test Facility, Nevada Test Site, Mercury, NV 89023

Contact: Stein Weissenberger, Transportation Program Leader

Telephone: 510-423-3336 **FAX:** 510-422-3694

General: A chemical process-type facility designed to release, by remote control, large quantities of hazardous chemicals. Measurements can be made on behavior of hazardous material up to five miles downwind.

Unique: Only such facility in the world.

Capacity: Up to 90 cubic meters cryogenic and high pressure vessels available. Rates of 100 cubic meters per minute possible.

Projects: Small tests involving 50-gallon drum releases and foam mitigation.

Available for Outside Use: Yes

NV-2

Owner: Department of Energy, Lawrence Livermore National Laboratory, University of California

Facility: Nevada Test Site

Contact: Stein Weissenberger, Transportation Program Leader, 7000 East Avenue, L-228 PO Box 808, Livermore, CA 94551

Telephone: 510-423-3336 **FAX:** 510-422-3694

General: The Nevada Test Site (NTS) is a physically large remote test facility owned by the Department of Energy and operated by several of its nuclear weapons contractors, including LLNL. Physically, it consists of 1,350 square miles (larger than the State of Rhode Island). Many unique and special test facilities and capabilities exist on-site that potentially could be used to support federal highway research. It is a remote area where experiments can be conducted that require large ground area. Also, large underground tunnels exist that could provide a unique test environment. NTS contains many miles of both paved and unpaved highways.

Unique: One of a kind test facility.

Available for Outside Use: Yes

NV-3

Owner: University of Nevada, Las Vegas

Facility: Acoustics and Vibration Laboratory, 4505 Maryland Parkway, Las Vegas, NV 89154

Contact: Douglas D. Reynolds, Director

Telephone: 702-739-3807 **FAX:** 702-739-0962

General: The acoustics facilities consist of the following test chambers: a 9,400 cubic foot reverberation chamber, a 4,300 cubic foot reverberation chamber, an anechoic chamber, and an in-duct sound testing facility. The large reverberation chamber has three openings plus the door in the front wall of the chamber. Two openings that are near the top of the chamber can accommodate ducts with maximum dimensions of 5' by 5' of 5' diameter. The anechoic chamber has a work area of 12' by 14' by 10'. The three chambers are separate rooms within the Tiberti Multi-Function Laboratory. Each chamber is mounted on a grid or rubber isolators that are designed

to prevent vibration energy from entering the chambers as sound. There is a 6' by 6' opening between the anechoic chamber and the large reverberation chamber. There is a 9' by 8' opening between the two reverberation chambers.

Unique: Anechoic and reverberation sound chambers, experimental modal analysis measurement instrumentation, sound measuring instrumentation.

Capacity: Can obtain and process any type of sound and vibration data.

Projects: Environmental noise studies, propeller fan vibration studies, studies and research projects associated with heating, ventilating, and air conditioning noise.

Available for Outside Use: Yes

NV-4

Owner: University of Nevada, Las Vegas

Facility: National Supercomputing Center for Energy and the Environment, 4505 Maryland Parkway, Las Vegas, NV 89154

Contact: Dr. William Culbreth, Interim Director

Telephone: 702-597-4153 **FAX:** 702-597-4156

General: The NSCEE began in 1989 to develop a supercomputing resource for the State of Nevada and UNLV. The Center operates a Cray Y-MP 2/216 supercomputer, a Sun 4/490 file server, and numerous Sun SparcStation 1+ and Silicon Graphics 4D workstations. Connection to the Internet allows networking access, nationwide.

Unique: Cray supercomputer, high-speed graphics workstations, GIS (geographic information system) on SUN workstations.

Capacity: Cray Y-MP 2 processor supercomputer, UNICOS 6.0 operating system, 128 megabyte central memory, 256 megabyte SSD, 8 gigabyte hard disk (combined capacity).

Projects: Computing time has been allocated for projects in transportation engineering (ESRI ARC/INFO on Sun computers), nuclear waste management (through DOE funding), fossil energy (DOE), astrophysics, health science, and groundwater hydrology.

Available for Outside Use: Yes

Comment: The NSCEE is involved in a wide variety of projects with an emphasis on projects with the State of Nevada, the U.S. DOE, and the EPA. In the transportation area, the Center has provided computing time to the UNLV Transportation Research Center. The UNLV TRC uses the NSCEE Sun file server and workstations to create data files and plots using ARC/INFO, a GIS software package. The NSCEE can offer time on these machines or the Cray Y-MP for transportation research.

NV-5

Owner: University of Nevada, Reno, Civil Engineering Department

Facility: Bridge Structures Laboratory, Center for Civil Engineering Earthquake Research, Reno, NV 89557

Contact: Bruce Douglas, Director

Telephone: 702-784-1519 **FAX:** 702-784-4466

General: There is a 3' thick main test hall slab of reinforced concrete measures 101' by 56'. The main floor has a 2' by 2' grid work of tie down or socket holes formed by 2.5" standard pipe sleeves perforating the test hall slab. The main 3' thick slab was designed as a one-way slab supported by the two north-south walls of the basement and three intermediate bearing walls. A 20' by 19' (high) by 2' (thick) post-tensioned strong wall is located in the center of the east wall. The purpose of the strong wall is to allow for relatively rapid test setups without the use of the modular reaction blocks. Nonetheless, the wall may be used with the blocks to form L shaped reaction systems.

Unique: Planning to develop earthquake simulation capabilities within the laboratory with at least two shake tables of reasonably large capacity.

Capacity: 1) Uniform loads and patch loads of any size in balanced or unbalanced configurations and in any direction up or down: 3.4 ksf. 2) North-south line loads in any single slab span in any direction up or down: capacity varies linearly from 35 kips per lineal foot applied at mid span to 23 kips per lineal foot at 3' from the supports. 3) Single point loads with no other load applied within 12' of the point load which are not adjacent to the basement stair openings: 300 kips upward or 240 kips downward.

Comment: No comparable facility in U.S.

New Hampshire

NH-1

Owner: Department of the Army, Cold Regions Research and Engineering Laboratory

Facility: Soils (Material Testing) Laboratory, 72 Lyme Road, Hanover, NH 03755-1290

Contact: William Quinn, Chief, Civil and Geotechnical
Telephone: 603-646-4471 **FAX:** 603-646-4640

General: The Soils Laboratory can do all major soil, concrete and asphalt testing, in addition to specialty testing such as frost susceptibility, thermal conductivity, and hydraulic properties. Additional testing equipment consists of a dual gamma nondestructive scanning system, a 20 kip MTS universal (tension/compression) electro-hydraulic testing machine and a 20 kip Tinius-Olsen universal testing machine. Most equipment has a

refrigerated environmental chamber or is located in a cold room. The Soils Laboratory also has 10 cold rooms that can go to -25°F to conduct cold regions testing.

Unique: Cold room complex, specialized soil tests — frost susceptibility, thaw consolidation, MTS testing machine with environmental chamber, thermal stress device for pavement materials.

Projects: Study on thermal cracking of asphalt pavements at low temperatures, study of changes in permeability and void ratio of fine-grained soils subjected to freeze/thaw cycles, characterize changes in resilient modulus of soils in pavement structure when frozen, thawing and during thaw recovery.

Available for Outside Use: Yes

NH-2

Owner: Department of the Army, Cold Regions Research and Engineering Laboratory

Facility: Ice Engineering Facility, 72 Lyme Road, Hanover, NH 03755-1290

Contact: Dr. J.C. Tatinclaux, Chief, Ice Engineering Research Branch

Telephone: 603-646-4361 **FAX:** 603-646-4477

General: The Ice Engineering Facility, the largest and most modern of its kind, was designed to conduct large-scale engineering studies of ice and its effects on structures, waterways, and similar engineering activities in northern climates. The 210' x 160,' two-story facility, contains three major refrigerated areas, Hydraulic Model Area, Flume, and Test Basin.

Unique: 1) The Hydraulic Model Area is an 80' x 160' clear span and has a temperature range of $+65^{\circ}$ to -10° F. Piping capable of providing a flow of 1, 2, 4 or 8 cubic feet per second (cfps) is located on one side of the room and a large drain trough on the other. The floor is designed for loads up to 400 pounds per square feet. 2) The Flume is situated in a room where the temperature can be regulated between $+65^{\circ}$ and -20° F. The flume is 2' by 4' by 120' long. It tilts from $+2^{\circ}$ to -1° slope, has a flow capacity of nearly 14 cfps and has a refrigerated bottom. 3) The test basin was designed for large scale work on ice forces on structures, such as drill platforms and bridge piers, and for tests using model ice breakers. It is 30' by 120' by 8' (deep). At one end there is a set-up pool that can be shut off from the rest of the basin and either drained or kept at a different temperature.

Projects: Modeling of ice control structures in rivers; modeling of ice passage at locks and dams; icing of water intake trash racks, ice accretion and deicing; tests on thermosyphons; ice action on riprap/ice forces on structures (e.g., bridge piers); evaluation of ice sensors for FAA; and tests of ships in ice.

Available for Outside Use: Yes

Comment: The combination of an ice towing tank, ice flume and ice hydraulic modeling area makes the Ice Engineering Facility of CRREL unique in the world.

NH-3

Owner: Department of the Army, Cold Regions Research and Engineering Laboratory

Facility: Frost Effects Research Facility, 72 Lyme Road, Hanover, NH 03755-1290

Contact: Robert Eaton, Research Civil Engineer

Telephone: 603-646-4209 **FAX:** 603-646-4640

General: This 29,000 square foot building houses an instrumentation and operation room, a mechanical and electrical equipment room, a test mobilization area (storage and staging area), and 12 test basins. The test basins will allow seasonal or perennial (permafrost) frozen soil conditions to be artificially created and maintained. This facility provides the capability to assess, under controlled conditions, the influence of winter conditions on the performance of engineering structures such as foundations, pavements and underground utility lines. This capability improves the reliability of the test data by eliminating the dependence of the research projects on the vagaries of weather. This facility offers the unique opportunity to run numerous winter cycles in a single year.

Unique: This facility is a controlled environment for conducting large-scale tests on pavements, soils, structures, vehicles, and equipment that are affected by low temperatures and freeze/thaw cycles. The building is 182' by 102' and includes 12 test basins.

Capacity: The building's heating/cooling equipment uses a brine mixture of ethylene glycol and water; temperatures can be controlled from -35° to 120°F . The ambient air temperature can be changed at an average rate of 12°F per hour, and soil can be frozen or thawed at or about 1" a day depending on moisture content and soil composition.

Projects: Pavement studies (evaluating seasonal load bearing changes), utilities (evaluating heat loss in soils), and mobility (traction in thawing soils).

Available for Outside Use: Yes

New Jersey**NJ-1**

Owner: Department of Transportation, Federal Aviation Administration

Facility: Airflow Facility, FAA Technical Center, Fire Safety Branch, ACD-240, Building 204, Atlantic City International Airport, Atlantic City, NJ 08405

Contact: Dr. Thor Eklund, Program Manager, Fire Management

Telephone: 609-484-5322 **FAX:** 609-484-4005

General: Multi-purpose facility consists of the following: 1) ejector wind tunnel with 5' diameter throat; 2) environmental chamber; 3) laminar flow wind tunnel; 4) high pressure compressor; and 5) high pressure fire test vessel.

Capacity: 1) Throat Mach number equal to 0.85, 10' diameter inlet section (for larger articles); 2) -100° to +250°F., 100,000' pressure altitude; 3) 0-160 mph, 20" by 28" test section; 4) 1000 psi.

Projects: Cargo compartment Halon replacement agent tests; Halon dissipation inside small airplanes; structured integrity tests of smoke venting valves.

Available for Outside Use: To Be Determined

NJ-2

Owner: Department of Transportation, Federal Aviation Administration

Facility: Full-Scale Fire Test Facility, FAA Technical Center, Fire Safety Branch, ACD-240, Building 275, Atlantic City International Airport, Atlantic City, NJ 08405

Contact: Richard Hill, Program Manager, Materials Fire Safety

Telephone: 609-484-5997 **FAX:** 609-484-4005

General: U.S. Government's largest enclosed fire test facility. Devoted to the development of improved fire safety design standards for commercial airliners. Post-crash fuel-fed fires and in-flight fires are simulated. Computerized data acquisition for temperature, smoke, and various toxic gases plus photographic/video coverage.

Unique: Designed to withstand 20 square feet fuel fire for 2 minutes and accommodate aircraft fuselage test articles.

Capacity: 180' by 70' by 45' (high) test bay. Currently houses wide body (130' long) DC-10 and narrow body (B-707) test articles.

Projects: Cabin on-board water spray fire suppression system; "combi" cargo compartment fire protection; hydraulic fluid spray flammability; hidden fire protection.

Available for Outside Use: No

New Mexico**NM-1**

Owner: Department of the Army, White Sands Missile Range

Facility: Temperature Test Facility, New Mexico 88002-5178

Contact: Mr. Richard O. Martinez, Supervisory General Engineer, ARMTE, STEWS-TE-AE

Telephone: 505-678-4000 **FAX:** 505-678-3787

General: 1) Large Temperature Chamber: Inside dimensions 105' long by 40' wide by 50' high, Temperature Range -80° to 160°F; 2) Small Temperature Chamber: Inside dimensions 35'L x 30'W x 25'H, Temperature Range -80° to 160°F; 3) Salt Fog/Humidity Chamber: Inside dimensions 20'L x 15'W x 10'H, Temperature Range +50°F to 200°F, RH 35°F Dewpoint to 100%; 4) Altitude Chamber: Inside dimensions 6'x6'x6', Range -500' to 200,000'; 5) Rain Facility: Dimensions 54'L x 46'W x 24'H, 5" to 24" per hr; and 6) Sand/Dust chamber: Inside dimensions 8' x 8' x 8', Temperature range +70°F to 170°F.

Unique: Capability to test large items under extreme climatic conditions found throughout the world.

Projects: Army material including shelters, vans, and tactical weapons; commercial medical vans/equipment.

Available for Outside Use: Yes

NM-2

Owner: Department of the Army, White Sands Missile Range

Facility: Metallurgy Laboratory, New Mexico 88002-5178

Contact: Dr. Howard W. Bennett, Jr., Materials Engineer, STEWS-TE-AE

Telephone: 505-678-5632

General: Unique application of nondestructive inspection (NDI) techniques, failure analysis, metallography, hardness testing to metallic and non-metallic engineering materials.

Unique: Portable x-ray machines of various potentials, 0.3-4 MeV, with portable darkroom.

Capacity: Varies with mission requirements.

Projects: NDI of various material including welds and explosives. Ballistic effects on material. Failure analysis of helicopter components.

Available for Outside Use: Yes

New York

NY-1

Owner: Rensselaer Polytechnic Institute, Civil and Environmental Engineering Department
Facility: Geotechnical Environmental Chambers, Troy, NY 12180

Contact: Thomas F. Zimmie, Professor
Telephone: 518-276-6939 **FAX:** 518-276-4833

General: Two environmentally controlled rooms in the Geotechnical Engineering Laboratories. Walk-in rooms, controlled temperature and humidity, temperature range about 0° - 95°F.

Capacity: Two separate rooms, total capacity about 3,000 cubic feet.

Projects: Freeze/thaw effects on clay soils, effect of freezing and thawing on permeability of clay, effect of freezing and thawing on landfill covers and liners, frost heave in soils.

Available for Outside Use: Yes

NY-2

Owner: Rensselaer Polytechnic Institute, Department of Civil and Environmental Engineering
Facility: Hydraulic Flume and Towing Tank, Troy, NY 12180

Contact: Thomas F. Zimmie, Professor
Telephone: 518-276-6939 **FAX:** 518-276-4833

General: Hydraulic flume: approximately 30' long x 30" wide, powered by two centrifugal pumps to recirculate the water, water velocities of about 5' per second maximum can be achieved. Towing tank: approximately 100' x 4' wide x 4' deep, instrumented.

Projects: Sediment transport and erosion in rivers, bridge foundation scour, snow loads on buildings (walnut shells in water, simulate snow), bed load sediment transport in rivers, current meter calibration, erosion of cohesive sediments.

Available for Outside Use: Yes

NY-3

Owner: Rensselaer Polytechnic Institute, Department of Civil Engineering

Facility: Geotechnical Centrifuge Research Center, JEC Building, Troy, NY 12180

Contact: Ricardo Dobry, Professor, and Ahmed W. Elgamal, Assistant Professor

Telephone: 518-276-2842 **FAX:** 518-276-4833

General: 100 g-ton Geotechnical Centrifuge. 30 meter radius, 1-ton payload at 100 g or 0.5-ton at 200 g. Complete with 64 channels of data acquisition and dynamic loading capabilities.

Unique: Only medium size centrifuge in United States; third in size and capacity. Large centrifuge shaker or earthquake simulator is available.

Capacity: Can carry 1-ton payload at 100 g. Can carry 0.4-ton payload and subject to earthquake excitation at 50 g.

Projects: Testing of mechanically stabilized (Reinforced Earth) structures (static and earthquake loading). Investigation of liquefaction-induced large deformations.

Available for Outside Use: Yes

Comment: The centrifuge facility is an integral part of the Class of 1933 Soil Dynamics and Earthquake Engineering Laboratory. The laboratory contains soil sample cyclic loading capabilities and a full-scale in-situ dynamic testing equipment.

NY-4

Owner: New York State Department of Transportation
Facility: Universal Testing Machine, 1220 Washington Avenue, Albany, NY 12232

Contact: Wayne J. Brule, Director, Materials Bureau

Telephone: 518-457-3240 **FAX:** 518-457-8171

General: Tinius Olsen Universal Testing Machine

Unique: Large loading frame

Capacity: 600,000 pounds compression and tension

Projects: Bridge Bearings, #14 rebar coupling tests, rock anchor devices, concrete pavement load transfer devices, concrete blocks, concrete pavers.

Available for Outside Use: No

NY-5

Owner: New York State Department of Transportation
Facility: Structural Testing Laboratory, State Campus Building 7A-600, 1220 Washington Avenue, Albany, NY 12232

Contact: Dr. Robert J. Perry, Director, Engineering R&D Bureau

Telephone: 518-457-5826 **FAX:** 518-457-6513

General: Strong floor is 25' by 66' (8' thick 3 cell box) with 2 loading frames (50,000 pound and 25,000 pound) and 33 rows of tie-downs spaced 2' apart. Floor to ceiling height is 17' and has a 5-ton overhead crane. Facility is capable of large-scale testing of structural systems under static and dynamic loads or displacement control with computer integrated data acquisition system.

Unique: Only facility of this type owned by State Government in Northeastern United States.

Capacity: 396 tie-downs with capacity 30 kips each (or 4 kips per foot line load). Hydraulic ram with load capacities up to 60 tons with 10" stroke. 50,000 pound loading frame and 100,000 pound hydraulic jack.

Projects: 1) Embedment depths for reinforcement bars; 2) Testing of a 1/6 scaled model of a simple span bridge.

Available for Outside Use: No

Comment: Testing facility has capabilities to conduct tests on structural systems, i.e., single or multiple span bridges under static and dynamic loads. Supported by an electronics laboratory with a design engineer and a technician. Equipped with computer-integrated static and dynamic data acquisition systems, and variety of transducers. A steel model table (15' by 6') is also available.

NY-6

Owner: Clarkson University, Department of Civil and Environmental Engineering

Facility: Strong Floor and Reaction Walls, Potsdam, NY 13699-5710

Contact: Dr. John Wallace, Professor

Telephone: 315-268-6501 **FAX:** 315-268-7985

General: Strong floor is 24' by 45' by 4' (thick) with a L-shaped reaction wall 40' by 15' by 5' (thick). Floor to ceiling height is 30' and the laboratory has a 5-ton overhead crane. Facility is capable of large scale testing of structural systems under load or displacement control with computer integrated data acquisition.

Unique: Only facility of this type in NY State and New England. Only ten to fifteen comparable (or larger) facilities in the U.S..

Capacity: Floor tie-downs are spaced 4' on center with capacity of 400,000 pounds each. Reaction walls are capable of resisting 1,500^{lk} (115,000 pounds at a height of 13') per 4' width of wall.

Projects: This is a new facility for 1) testing of full-scale reinforced concrete beams; 2) testing of 2/3 scale beam-column joints; 3) testing of reinforced concrete pier walls.

Available for Outside Use: Yes

Comment: Testing facility has adequate capacity to conduct tests on large-scale single span bridges or smaller-scale multi-span bridges. Bridges could be tested under static or dynamic loads, or vibration studies could be conducted using rotating mass exciters.

NY-7

Owner: Calspan Corporation

Facility: Vehicle Experimental Research Facility (VERF), Advanced Technology Center, 4455 Genesee Street, Buffalo, NY 14225

Contact: S.M. Pugliese, Director, Transportation Sciences Center

Telephone: 716-631-6839 **FAX:** 716-631-6843

General: 33 acre site, full-scale crash barrier, ability to evaluate vehicle crash worthiness, occupant protection,

roadside appurtenances. Calspan has accumulated considerable experience and developed specialized test techniques over the past two decades in the crash testing of vehicles and roadside structures. These tests have involved structural crash worthiness, occupant crash protection and accident reconstruction. Full-scale crash tests are performed at Calspan's VERF. VERF is typically used to aid in the design to and conformance with Federal Motor Vehicle Safety Standards (FMVSS) 204, 208, 212, 219, and 301. In addition to the FMVSS type tests, Calspan performs a wide variety of tests ranging from vehicle side impacts to full-scale tractor trailer testing.

Unique: Ability to test car-to-car, both moving at any angle.

Capacity: Greater than 100 electronic data channels, 20 high-speed cameras.

Projects: 1) Federal Motor Vehicle Safety Standards testing (Nos. 208, 212, 219, 301); 2) Structural crash worthiness evaluations (car-to-car).

Available for Outside Use: Yes

NY-8

Owner: Calspan Corporation

Facility: HYGESled Facility, Advanced Technology Center, 4455 Genesee Street, Buffalo, NY 14225

Contact: S.M. Pugliese, Director, Transportation Sciences Center

Telephone: 716-631-6839 **FAX:** 716-631-6843

General: 12" HYGESled acceleration sled used to evaluate restraint system performance under dynamic loading.

Unique: Ability to design metering pins to match desired crash pulses.

Capacity: 108 electronic data channels; 12 high-speed cameras, up to 22,000 feet per second; payload 5,000 pound; max stroke 8'; 90' track; maximum thrust 295,000 pounds.

Projects: 1) Child restraint performance; 2) Air bag system development; 3) Aircraft seat evaluations.

Available for Outside Use: Yes

NY-9

Owner: Calspan Corporation

Facility: Tire Research Facility (TIRF), Advanced Technology Center, 4455 Genesee Street, Buffalo, NY 14225

Contact: G.A. Tapia, Head, Tire Research Section

Telephone: 716-631-6782 **FAX:** 716-631-6843

General: World's largest indoor flat belt tire test facility. TIRF is a unique indoor facility for obtaining the most comprehensive and consistent data on tire performance characteristics. TIRF, developed and built by Calspan, fills a long-standing need for a flat-roadway test machine

that completely defines and measures the forces and moments transmitted between the roadway and the tire over a wide range of operating conditions, including high speed, and wet or flooded roadways.

Unique: Speed capability of greater than 200 mph, measurement capability and accuracy. A coated, stainless-steel belt moving at speeds up to 180 mph provides a "simulated roadway" that remains flat (± 0.001 inch) under automobile, all-terrain vehicle, motorcycle, and truck tire loads over an area 14" long and 24" wide — sufficient to accommodate the footprint of the largest car, truck, or racing tire. Tires up to 47" in diameter can be tested at TIRF. Strain gage balance systems are used to measure the forces and moments produced by the tire.

Capacity: High speed drum testing at more than 200 mph is accomplished by removing the roadway and reconfiguring the machine to run on the 67" drum. This is used primarily for high-speed aircraft, racing, and high-performance passenger-car tires. The TIRF control room has a dedicated computer system that controls the testing operation and processes the test data for visual display, magnetic tape storage, and printout.

Projects: Evaluation of tire designs for industry.

Available for Outside Use: Yes

NY-10

Owner: Calspan Corporation

Facility: Ashford Environmental Test Chamber, Advanced Technology Center, 4455 Genesee Street, Buffalo, NY 14225

Contact: C. William Rogers, Principal Meteorologist

Telephone: 716-631-6808 **FAX:** 716-631-6815

General: Calspan's Ashford test chamber is a unique facility for atmospheric simulation, air pollution, cloud physics, and aerosol research studies. The heart of the test facility is a cylindrical chamber of 9 meter diameter and 9 meter height. The total volume is 600 cubic meters (20,000 cubic feet), making it one of the largest available test chambers in the United States, especially valuable in minimizing wall effects and closely simulating actual atmospheric conditions. The chamber wall is constructed of 0.5" plate steel designed for pressure differentials up to 9 psig.

Unique: The inner chamber surface is covered with a special coating. The very high fluorine content provides, in analogy to fluorocarbon polymers, both high chemical stability and low surface energy. Such favorable physical and chemical characteristics add further to the capability of the chamber in minimizing possible wall effects during photochemical aerosol studies.

Capacity: Absolute filters are incorporated to permit virtually total removal of particulates (less than 200

Aitken nuclei per cubic centimeter). Impregnated charcoal filter panels are installed to enable the removal of gaseous contaminants. Some of the most difficult to remove contaminants, such as CO and CH₄, are present only at minimum concentrations in the unpurified ambient air due to the rural location of the test facility. The air purification system is thus capable of preconditioning the chamber for studies of pollutant effects even at minute concentrations. Humidistatically controlled cooling coils serve to dehumidify the chamber air. Humidity increases are achieved by nebulizing distilled water from a nozzle. Purified water with or without addition of a detergent can be introduced through a rotating jet sprayer. This flush system reaches all areas of the chamber wall, and may also be utilized on some occasions for gross adjustment of humidity. Photolysis lamps simulating the near UV portion of the earth's ground level solar radiation spectrum are located around the chamber wall to permit near uniform intensity distribution within the chamber.

Projects: 1) Cloud cycling experiments; 2) Dimethyl sulfide photolysis experiments.

Available for Outside Use: Yes

Comment: This facility has been used in photochemical smog experiments, obscurant evaluations, fog generation and clearing characteristics. It is equipped to operate above and below atmospheric pressure. Samples of its atmosphere may be drawn for analysis. It has visible and IR transmissometers. Special non-reactive interior coating enhances its surface area to volume ratio benefit.

NY-11

Owner: Calspan Corporation

Facility: Piper Aztec Airplane, Advanced Technology Center, 4455 Genesee Street, Buffalo, NY 14225

Contact: Ronald W. Huber, Section Head

Telephone: 716-631-6753 **FAX:** 716-631-6990

General: Twin engine airplane suitable for measuring temperatures, taking photographs.

Unique: 22" diameter camera hole cut in floor of cabin for photo and small project work.

Projects: 1) Infrared Photograph to measure heat loss for Rochester, NY Power Company; 2) Test bed to test new Kodak Camera.

Available for Outside Use: Yes

Comment: Available as test bed, experimentally licensed for project use.

NY-12

Owner: State University of New York at Buffalo

Facility: Earthquake Simulator, 103 Ketter Hall, Buffalo, NY 14260

Contact: J.A. Neal, Engineer/Associate Professor

Telephone: 716-636-3633 **FAX:** 716-636-3733

General: Table 3.6 meters x 3.6 meters (12' by 12'); maximum model weight 20 metric tons (44,000 pound); maximum model size 3.6 meters x 3.6 meters x 7 meters (12' by 12' by 23'); maximum overturning moment 46 meter-metric ton (330,000 foot-pound); Horizontal (x), vertical (z) and roll (β) controllable; lateral (y), pitch (α) and yaw (γ) compensated at zero.

Unique: Horizontal ± 15 centimeters (6") 1.15 g fully loaded; vertical ± 7.6 centimeters (3") 1.15 g fully loaded.

Capacity: 120 channel (100 Hz sampling) for acceleration, strain and displacement of table or model.

Projects: Active control of building structures; base isolation of structures; progressive damage in reinforced concrete structures; structural diaphragms; response of computer systems to earthquakes.

Available for Outside Use: Yes

Comment: Table motion controlled in displacement or acceleration. Inputs include white noise, analytical functions, and actual earthquake motion histories.

NY-13

Owner: State University of New York at Buffalo, Department of Civil Engineering

Facility: Environmental Fluid Dynamics Laboratory, Buffalo, NY 14260

Contact: Dr. Dale D. Meredith, Chairman

Telephone: 716-636-2157 **FAX:** 716-636-3733

General: The laboratory contains a rotating laboratory for geophysical fluid mechanics experiments, a sediment transport tilting flume, a wave tank, a recirculating water tunnel, and supporting instrumentation for measuring fluid velocities, pressures, water levels, and flow visualization.

Unique: The rotating laboratory enables studies of circulation patterns and flow dynamics at a synoptic level in large water bodies such as the Great Lakes.

Capacity: 7' by 12' floor space in rotating laboratory, 60' sediment-water tilting flume, 60' wave tank.

Projects: Studies of river plume entering Lake Ontario, effects of turbulence levels on sediment entrainment, sediment transport by surface runoff, flow visualization studies in automatic radiators, ice transport by waves.

Available for Outside Use: Yes

NY-14

Owner: Rochester Institute of Technology, College of Engineering

Facility: Center for Microelectronic and Computer Engineering, PO Box 9887, Rochester, NY 14623

Contact: Dr. Lynn Fuller, Head, Microelectronic Engineering

Telephone: 475-6065 **FAX:** 475-6879

General: Complete facility for manufacturing silicon integrated circuits.

Unique: Electron beam mask making.

Capacity: 0.5 micron lithography.

Projects: Electron beam lithography, examer laser lithography, silicon micro-machines, silicon sensors.

Available for Outside Use: Yes

NY-15

Owner: Cornell University

Facility: Beam-Column Cyclic Loading System, George Winter Structural Laboratory, Ithaca, NY 14853

Contact: Peter Gergely, Professor

Telephone: 607-255-4217 **FAX:** 607-255-3760

General: A full scale beam-column cyclic loading system, including: 1) A large, stiff testing frame in which 400 kip forces may be applied to columns while up to 100 kip forces may be applied to beams, moving them vertically up to 6". 2) Independent control of system's 2-100 kip and 1-400 kip actuators by a multi-channel servocontrol system acting as an inner loop. 3) Independent load measurement for all three actuators and force in the top column shear restraint element. 4) A computer controlled data acquisition and control system allows test control on any combination of actuator displacements, measured forces, measured beam-column relative displacements or measured or computed joint rotations. 5) Test frame design that allows varying specimen height, column and beam sizes and beam length.

Projects: Full size lightly reinforced concrete frame components subjected to various seismic forces.

NY-16

Owner: Cornell University

Facility: Shake Table, George Winter Structural Laboratory, Ithaca, NY 14853

Contact: Peter Gergely, Professor

Telephone: 607-255-4217 **FAX:** 607-255-3760

General: A shake table facility designed for seismic testing of building components and models. Table specifications include: 1) 5' by 7' by 4" (thick), solid aluminum upper plate (with a 4" square bolt grid) which slides on an oil film over a large granite block and is guided by hydrostatic bearings; 2) 20 kip hydraulic actuator with 6" of stroke; 3) a single degree of freedom control system capable of faithfully reproducing ground acceleration profiles from specific earthquakes or providing constant acceleration over a broad frequency range (from 1 to 150 Hz at 0.3 g for a 200 pound specimen to 1.8 to 100 Hz at 1 g for a 6,000 pound specimen); 4) a high speed, computer controlled, 36 channel

data acquisition and control system for gathering data and providing table control.

Projects: Reinforced concrete building frames for seismic loadings.

NY-17

Owner: Cornell University

Facility: Rock Mechanics Tester, George Winter Structural Laboratory, Ithaca, NY 14853

Contact: Peter Gergely, Professor

Telephone: 607-255-4217 **FAX:** 607-255-3760

General: Structural materials testing facility with an ultra-stiff MTS rock mechanics testing system; a large working space, inverted actuator (allowing large beam tests), fatigue machines, and a large, distributed, multiple actuator and closed loop controller, test facility in a high bay. The ultra-stiff test machine (from MTS) includes: -600 kip compression, 300 kip tension loading capacity; system servocontrol on actuator displacement, force, axial or diametral strain; built in repetitive signal generation (including sine, haversine, ramp and square) and counting; separate 10 gpm hydraulic system. The large working space machine (from MTS) includes: a cross-head mounted, four column, 200 kip capacity, 6' stroke actuator with hydraulic crosshead lifts and locks. Test frame height of 12.'

Projects: Fracture mechanics studies; bending of very thick steel plates.

Available for Outside Use: Yes

North Carolina

NC-1

Owner: North Carolina State University, Department of Civil Engineering

Facility: Pavement Test Track, Box 7908, Raleigh, NC 27695-7908

Contact: Dr. N. Paul Khosla, Professor

Telephone: 919-515-7835 **FAX:** 919-515-7908

General: Inside circular pavement test track with a moving wheel load.

Unique: The test track is capable of being instrumented for measuring pavement response and performance.

Available for Outside Use: No

Comment: The pavement test track is proposed to be constructed during the next two years (1992-1993) in the Engineering Graduate Research Center at NC State University. When completed, this facility will be used for pavement research projects.

NC-2

Owner: Duke University, School of Engineering

Facility: Transportation and Infrastructure Research Center, Durham, NC 27706

Contact: Dr. Mrinmay Biswas, PE, Director

Telephone: 919-660-5201 **FAX:** 919-660-5219

General: 1) The center performs non-destructive evaluation of bridge structures by global vibration testing. 2) Evaluation of transportation facilities construction materials. 3) Use of expert systems and artificial intelligence for transportation facilities design.

Unique: Vibration testing and dynamic load testing facilities.

Capacity: 4-channel spectrum analyzers, 220 kip MTS load frame.

Projects: 1) FHWA-Penn DOT project on detection of incident failure in bridges. 2) Evaluation of aggregates for concrete for FHWA-NCDOT project. 3) Development of expert system for bridge design.

Available for Outside Use: No, used for sponsored research.

Comment: Also include 1 cubic yard environmental chamber with temperature range of -100° to +350°F., including humidity control. The chamber control is programmable. This unique equipment is not readily available. Also: 17 specimen freeze-thaw chamber and several dynamic/seismic load actuators.

NC-3

Owner: Charlotte Motor Speedway, Inc.

Facility: High Speed Test Track, PO Box 600, Concord, NC 28026-0600

Contact: Wes Harris, Vice President, Development and Operations

Telephone: 704-455-3200 **FAX:** 704-455-3249

General: A controlled, high-speed test track facility. Major features related to IVHS testing include a 1.5-mile long banked oval track with 45' wide (minimum) pavement capable of sustained speeds of greater than 150 mph, a 2.25-mile road circuit with 40' wide pavement, and a closed system of more than four miles of streets (24' wide two-lane pavements) with intersections.

Unique: The oval is already signalized. Detectors and other equipment may be installed as needed.

Projects: 1) Auto equipment manufacturers testing new products. 2) Auto manufacturers demonstrating new vehicle models for dealers.

Available for Outside Use: Yes

NC-4**Owner:** Inco United States, Inc.**Facility:** LaQue Center for Corrosion Technology, Inc., Corner Highway 76 and Auditorium Circle, Wrightsville Beach, NC 28480**Contact:** W. Tim Raines, Manager, Finance and Administrator, PO Box 656**Telephone:** 919-256-2271 **FAX:** 919-256-9816**General:** Facilities for aqueous corrosion evaluations at Wrightsville Beach, NC, and facilities for atmospheric exposure testing and evaluations in Kure Beach, NC.**Unique:** Atmospheric test sites: testing under aggressive atmospheric conditions; can accommodate test panels, working components, coatings evaluations. Aqueous facility: located on tidal channel, monitoring of seasonal variations control of environmental parameters.**Capacity:** Seawater pumping capability of up to 9 million gallons per day; 27.5 acres of atmospheric exposure site.**Projects:** Sheathed piling study on piling and concrete structures, galvanic corrosion studies for outdoor materials, coatings evaluations for outdoor light fixtures, corrosion behavior of various metals and alloys, corrosion training courses for engineers and maintenance personnel, survey of corrosion of culvert piping and materials, marine atmospheric evaluation of painted test panels (road signs), rebar in concrete corrosion evaluations, cathodic protection evaluations for offshore steel structures (bridges over water).**Available for Outside Use:** Yes**Comment:** The LaQue Center began in the 1930s with testing at its Kure Beach atmospheric test sites. The Wrightsville Beach facility was added for seawater testing in 1950. The Center is operated as an independent laboratory and has served a broad cross-section of industries with testing from materials evaluations to materials performance in all types of corrosive environments.**NC-5****Owner:** Department of Commerce, National Oceanic and Atmospheric Administration**Facility:** National Climatic Data Center, Federal Building, 37 Battery Park Avenue, Asheville, NC 28801-2696**Contact:** Sam McCown, Chief, Climate Services Branch**Telephone:** 704-259-0682 **FAX:** 704-259-0876**General:** The National Climatic Data Center (NCDC) acquires, processes, archives, analyzes, and disseminates global climatological data; develops analytical and descriptive products to meet user requirements; and provides facilities for the World Data Center-A (Meteorology).**Unique:** As the world's largest climatic data center, NCDC collects wind, temperature, and precipitation data as well as all other meteorological/climatological parameters from U.S. and world-wide locations.**Capacity:** NCDC has more than six hundred gigabytes of in-situ data added to the archive since 1985 and is growing at a rate of more than 20 terrabytes a year.**Projects:** The Historical Climate Network (HCN), a 1219 station climate network, with data spanning the nineteenth and twentieth centuries, recognized as the highest quality historical data set available. Scientists throughout the world have used this product as a standard. NCDC is best known for its climate census work. NCDC produces the climatic normals used by virtually every media outlet for weather information, e.g., "the high temperature for today was 10 degrees above normal and for June precipitation is running 1.2 inches below normal."**Available for Outside Use:** Yes**North Dakota**

ND-1**Owner:** University of North Dakota**Facility:** Energy and Environmental Research Center (EERC), 15 North 23rd Street, Grand Forks, ND 58204**Contact:** Charles J. Moretti, Research Supervisor**Telephone:** 701-777-5150**General:** The EERC is a coal utilization research facility. It has the equipment and personnel to study the process from the coal preparation to the waste disposal operations.**Unique:** The EERC has an extensive materials characterization capability.**Projects:** Studies have been conducted on fluidized bed coal combustion, coal liquidation and coal combustion solid waste utilizations.**Available for Outside Use:** Yes**Ohio**

OH-1**Owner:** Transportation Research Center, Inc.**Facility:** Transportation Research Center of Ohio, East Liberty, OH 43319**Contact:** Phyllis Radlinski, Director of Marketing**Telephone:** 513-666-2011 **FAX:** 513-666-5066**General:** A complex of test facilities for vehicular R&D and testing programs. Current programs test for safety, energy, fuel economy, emissions, durability, performance,

noise, crash simulation. Vehicles and their components for passenger, recreational, truck, motorcycle, transit and electric can be studied.

Unique: Complex test facilities for wide range of test conditions, vehicles.

Capacity: Operates 24 hours per day, 7 days per week on 7,500 acre facility. Video tape description available.

Projects: EPA fuel economy testing, NHTSA crash tests, wide variety of proprietary tests run by manufacturers, crash dummy calibration.

Available for Outside Use: Yes

OH-2

Owner: National Aeronautics and Space Administration, Lewis Research Center

Facility: Icing Research Tunnel, 21000 Brookpark Road, Cleveland, OH 44135

Contact: David Vincent, Facility Manager, M/S 6-8

Telephone: 216-433-5719 **FAX:** 216-433-8551

General: Wind tunnel capable of producing icing conditions at speeds of 50 to 300 mph for several hours. Test section measures 6' high x 9' wide x 20' long. Total air temperature can be varied from - 25° to 32°F. Air water content can be varied from about 0.2 to 2.5 gallons per cubic meter. 200 channels of analog instrumentation are available for test articles.

Unique: Capability to control temperature within 1°F and vary water droplet size from 15 to 40 μ m. Altitude exhaust rates of 3 to 80 pounds per second via computer control. Data acquisition system can be linked in real time to mainframe computers.

Capacity: 0 to 300 mph. Temperature to -40°C.

Projects: Helicopter rotor blade icing studies, aircraft engine inlet de-icer system performance tests, Ice Physics Research.

Available for Outside Use: Yes

Comment: Test section is supported by supercomputers and other equipment (housed in a separate facility) capable of performing complex and high speed flow analysis.

OH-3

Owner: National Aeronautics and Space Administration, Lewis Research Center

Facility: Subsonic Wind Tunnel, 21000 Brookpark Road, Cleveland, OH 44135

Contact: Osvaldo Rivera, Facility Manager, M/S 6-8

Telephone: 216-433-5699 **FAX:** 216-433-8551

General: Wind tunnel capable of producing uniform wind velocities to 175 mph. Test section measures 9' high by 15' wide by 28' long and has been specially treated to support acoustic testing of propulsion system components down to 250 Hz. Sophisticated data acquisi-

tion system can be tied to mainframe computer to provide near real-time analysis and display of data.

Unique: 4 degree of freedom model support system, high temperature/pressure air source, laser doppler velocimetry system, and sheet laser flow visualization system.

Capacity: 0 to 224 feet per second; 0 to 72 psf. Temperature to 550°R.

Projects: Noise research of propulsion systems/components, F-15 STOL hot gas reingestion performance, aeroelastic and acoustic testing of counter-rotating turboprops, hot gas reingestion testing of ASTOVL aircraft, NASA advanced concepts.

Available for Outside Use: Yes

Comment: The 9' by 15' Subsonic Wind Tunnel is one of two test sections contained within a single tunnel loop facility. Duration and scheduling of the 9' by 15' test section are therefore dependent on activities in the other test section. Both test sections are supported by supercomputers and other equipment (housed in a separate facility) capable of performing complex and high speed flow analysis.

OH-4

Owner: Department of the Air Force, Armstrong Laboratory

Facility: Vertical Deceleration Tower, AL/CFBE Wright-Patterson Air Force Base, OH 45433-6573

Contact: Dr. Francis S. Knox III, Branch Chief

Telephone: 513-255-3931 **FAX:** 513-255-2019

General: A 4' by 6' carriage is accelerated by gravity from a predetermined drop height guided by 40' long vertical rails. A plunger mounted on the rear of the carriage is guided into a cylinder filled with water. Accelerations approximating upward ejections or landing impacts are produced by displacing the water from the cylinder through opening between the plunger and orifice plate.

Capacity: 40' drop, 56 feet per second at impact, 80 g acceleration with 500 pound payload, 40 to 180 msec pulse duration, 750,000 pound force, deceleration stroke = 4.'

Projects: The VDT is used to produce +Gz impacts. Evaluation of structural integrity and the protective effectiveness of operational and developmental personnel restraint systems during impacts. Kinematic and inertial response of human and manikin subjects are measured during impact for development of design criteria for personnel restraint systems.

Available for Outside Use: Yes

OH-5

Owner: Department of the Air Force, Armstrong Laboratory

Facility: Six Degree of Motion Simulator (SIXMODE), AL/CFBE Wright-Patterson Air Force Base, OH 45433-6573

Contact: Dr. Francis S. Knox III, Branch Chief
Telephone: 513-255-3931 **FAX:** 513-255-2019

General: A 59" square table is driven by six electrohydraulic actuators. The table is vibrated with a random, sinusoidal motion in six degrees of freedom. Any combination of X, Y, Z translation, roll, pitch, or yaw motion can be generated. Power for the SIXMODE is provided by a 1,000 gallons per minute, 3,000 psi hydraulic power supply.

Unique: Six simultaneous motions, X, Y, and Z translation with roll, pitch, and yaw.

Capacity: 2,000 pound payload, DC-30 Hz frequency range, 20,000 pounds force/actuator maximum, 10 inch²D.A./actuator, 1.5 g-peak linear, 15 rad/sec² angular. Data collection is provided by an on site PDP computer.

Available for Outside Use: Yes

Comment: The SIXMODE has not been used in the past two years due to funding. However, past usage has been at a rate of 2 months per year. Current efforts are underway to return system to "man-rated" status.

OH-6

Owner: Department of the Air Force, Armstrong Laboratory

Facility: Anechoic Chamber, AL/CFBA Wright-Patterson Air Force Base, OH 45433-6573

Contact: Dr. Charles W. Nixon, Chief, Bioacoustics
Telephone: 513-255-3607 **FAX:** 513-255-2781

General: The anechoic chamber, with all six walls covered with 4' acoustical wedges, has dimensions inside the wedges of 20' by 20' by 20.' The chamber has a suspended wire floor. The room characteristics are such that a B-52 bomber flying at 500' overhead cannot be heard inside. It is also sufficiently quiet that the ambient noise level is as much as 10 decibels below the lowest sounds detected by the human ear. The room is used for human experimentation, acoustical measurements, and instrumentation calibration.

Unique: Acoustical isolation, large interior space, suspended floor, exceptionally low ambient noise levels, 7' by 7' access door.

Capacity: Background noise 10dB below human hearing threshold.

Projects: Precision microphone calibration, psychoacoustic studies of human reaction to aircraft flyover noises, basic research in human auditory localization, measure-

ments of human head-related transfer functions of sound from a source to the ears of human observers.

Available for Outside Use: Yes

Comment: The anechoic chamber is currently housing a 14' diameter geodesic sphere which contains 272 individual loudspeakers. This facility is being used in a research program on human auditory localization. The experimental subject is positioned in the center of the sphere and test signals can be presented from many different sources at the same time. This sphere is used to collect human auditory localization performance data that is being used to develop a sound localization cue synthesizer which will provide 3-D auditory displays for personnel in aircraft, air traffic control, and other high workload tasks.

OH-7

Owner: Department of the Air Force, Armstrong Laboratory

Facility: Horizontal Impulse Accelerator (Bendix 24" HYGE), AL/CFBE Wright-Patterson Air Force Base, OH 45433-6573

Contact: Dr. Francis S. Knox III, Branch Chief
Telephone: 513-255-3931 **FAX:** 513-255-2019

General: A 4' by 6' test sled is propelled along a 250' track by a thrust column. The column is accelerated by the principle of differential gas pressure on a 24-inch thrust piston. The acceleration is controlled by metering the high pressure gas entering the thrust chamber with a metering pin.

Unique: 2,000 pound payload, 150 g peak acceleration, 4% repeatability, 170 feet per second (fps) velocity.

Capacity: 750,000 pounds force, 150 g acceleration for 500 pound payload, 2,000 pounds payload maximum, 170 fps velocity, 20 to 260 msec duration sine, triangular, square pulses.

Projects: The HIA is used to produce $\pm G_x$, $\pm G_y$, $\pm G_z$ impacts. Evaluation of structural integrity and the protective effectiveness of operational and developmental personnel restraint systems during impacts. Kinematic and inertial response of human and mannequin subjects are measured during impact for development of design criteria for personnel restraint systems.

Available for Outside Use: Yes, both our use and use by others dependent upon availability of data acquisition instrumentation. Also depends on collocation of U.S. Army and Navy biodynamics research programs.

OH-8

Owner: Department of the Air Force, Armstrong Laboratory

Facility: Horizontal Decelerator, AL/CFBE Wright-Patterson Air Force Base, OH 45433-6573

Contact: Dr. Francis S. Knox III, Branch Chief

Telephone: 513-255-3931 **FAX:** 513-255-2019

General: A 4' by 6' test sled is propelled along a 250' track by a shuttle accelerated with a tape reeled in by the energy stored in a rotating flywheel. After 75' of low level launch acceleration, the sled coasts freely along the track for 125' to the test site. The impact event occurs when the plunger mounted on the front of the sled enters the hydraulic decelerator with a controlled acceleration pulse.

Unique: 2,000 pound payload, 100 g impact, 56 inch deceleration stroke.

Capacity: 400,000 pound force, 100 g acceleration with 2,000 pound payload, 56 inch stroke. 125 feet per second velocity change.

Projects: The HD is used to produce $\pm G_x$, $\pm G_y$, $\pm G_z$ impacts. Evaluation of structural integrity and the protective effectiveness of operational and developmental personnel restraint systems during impacts. Kinematic and inertial response of human and manikin subjects are measured during impact for development of design criteria for personnel restraint systems. The HD is used to evaluate the performance of operational and developmental ejection seat catapults in an accelerated environment.

Available for Outside Use: Yes

Comment: HD uses same facility as HIA above so use is mutually exclusive.

OH-9

Owner: Ohio University

Facility: Center for Geotechnical and Groundwater Research, Stocker Center, Athens, OH 45701-2979

Contact: Shad M. Sargand, Professor

Telephone: 614-593-1467 **FAX:** 614-593-4684

General: Materials and Geotechnical: 1) large-scale centrifuge equipment. 2) high-capacity multi-axial cubical testing system.

Unique: 1) Unbalance detector, B&W monitoring camera installed internally to provide pictures on TV. 2) Multi-channel digital data acquisition of deformations.

Capacity: Variable 1 to 200 g at 42" nominal radius. Accuracy more than 99.9%.

Projects: 1) Modeling of spread footing highway bridge performance. 2) Tests of backfill material, rubber.

Available for Outside Use: Yes

OH-10

Owner: Ohio University, Avionics Engineering Center

Facility: Avionics Hangar/Laboratory Facility, 231 Stocker Center, Athens, OH 45701

Contact: Dr. Robert Lilley, Director

Telephone: 614-593-1514 **FAX:** 614-593-1604

General: This facility and the Avionics flight program it supports have been supportive of ODOT Division of Aviation projects over the past five years. A DC-3 aircraft and four light, single-engine flying laboratories are available for applications requiring them. Complete maintenance facilities are available, as are electronics laboratories and personnel for creating, operating, and maintaining data collection equipment.

Unique: Aircraft instrumented for precise position location and with available space for experimental or developmental systems and equipment. Could be adapted for aerial photography with precise position and time recording. Ground test beds for navigation aids.

Capacity: Five aircraft available for use. All current and developmental FAA navigational aids can be evaluated. Other applications possible.

Projects: Flight evaluation of Loran-C instrument approach at Galion, OH. Transportation and technical support of NASA/FAA Loran-C Planning Work Group (Ohio holds the chairmanship of this group). Support for ODOT Aviation All-Weather Access Program.

Available for Outside Use: Yes, by contract arrangement.

Comment: This flight facility is supported by the full staff and management of the Avionics Engineering Center, which carries out a continuing research and engineering function for FAA, NASA, various military capabilities of the College of Engineering and Technology at Ohio University.

Oklahoma

OK-1

Owner: University of Oklahoma, School of Aerospace and Mechanical Engineering

Facility: The L.A. Comp Subsonic Wind Tunnel, 865 Asp Avenue, Norman, OK 73019-0601

Contact: Dr. Charles W. Bert, Professor and Director

Telephone: 405-325-5011 **FAX:** 405-325-1088

General: Subsonic wind tunnel with electric motor drive, 4' by 6' test section, and strain-gage type force and moment balance. Tunnel was renovated in 1985.

Unique: Provided with a modern digital data acquisition system.

Capacity: 200 mph maximum speed; 4' by 6' test section.

Projects: Testing of various wind tunnel models of new designs for aircraft, i.e., testing the landing approach performance for a generic design for the National Aerospace Plane.

Available for Outside Use: Yes

Comment: This facility is an example of one which has not been used for highway-related research but could be used to test the aerodynamic effects on vehicle-roadway interaction.

OK-2

Owner: University of Oklahoma, Department of Civil Engineering

Facility: High Capacity Cubical Device, 202 West Boyd Street, Room 334, Norman, OK 73019

Contact: Dr. Musharraf Zaman, Associate Professor

Telephone: 405-325-5911 **FAX:** 405-325-7508

General: The High Capacity Cubical Device (HCCD) can be used to study load deformation response of materials under general three-dimensional loading. Both static and cyclic tests can be conducted. Loads up to 30,000 psig can be applied along a given axis of a cubical specimen.

Unique: Servo-controlled three-dimensional loading; computerized data acquisition; load/deformation monitoring capability for selected channels; static/cyclic loading.

Capacity: 4" cubical specimen; 0.5" maximum deformation; 30,000 psig load.

Projects: Three-dimensional testing of plain and fiber reinforced concrete; testing of an Oklahoma coal for effective design of underground mines.

Available for Outside Use: Yes

Comment: The High Capacity Cubical Device was constructed by funds from the National Science Foundation and Oklahoma Department of Commerce.

OK-3

Owner: Department of Transportation, Federal Aviation Administration

Facility: Impact Test Facility, Civil Aeromedical Institute, 6500 South MacArthur Boulevard, Oklahoma City, OK 73125

Contact: Dr. Jerry R. Hordinsky, Manager, Aeromedical Research Division, AAM-600

Telephone: 405-680-4808 **FAX:** 405-680-4813

General: A sled/track facility operating in the deceleration mode.

Unique: 150' long horizontal track; acceleration system consists of a mass attached to the sled through a cable/pulley system providing a 4:1 mechanical advantage; impact pulse is shaped by striking 3-gage steel wire in as many as four layers high along a 5' displacement parallel to the line of motion of the sled.

Capacity: Maximum energy available with this system is 184,500 foot-pounds.

Projects: Development and assessment of seats and restraint systems for use in the civilian and military aircraft.

Available for Outside Use: Yes

Comment: Priority applications at the Oklahoma City site include those addressing FAA and NTSB regulatory interests. This developmental work typically integrates staff and equipment from all U.S. manufacturers (and many foreign manufacturers) of aircraft seat and restraint systems.

OK-4

Owner: Department of Agriculture, Agricultural Research Service

Facility: Hydraulic Engineering Research Unit, 1301 North Western Street, Stillwater, OK 74075

Contact: Charles E. Rice, Research Leader

Telephone: 405-624-4135

General: The mission of the facility is to develop criteria for the analysis and design of structures and channels for the control, conveyance, storage, and measurement of runoff waters. The facility has 100 acres of clear land available for research studies immediately below the dam of a reservoir with 3,400 acres of surface area at spillway elevation.

Unique: The facility can conduct hydraulic studies on small-scale models or full-size structures and channels. Gravity flows are available for most studies.

Capacity: Flow rates from a trickle flow to 150 cubic feet per second are available. Full-size studies of structures and channels can be conducted.

Projects: Research studies include: Riprap size and placement downstream of stilling basins; Hydraulic stress and pressure distribution at an overfall; Gully head advance and submergence; Development and analysis of a submerged jet for soil erodibility; Conceptual and mathematical model of vegetated earth spillway failure.

Available for Outside Use: No

Oregon

OR-1

Owner: Oregon Department of Transportation

Facility: Traffic Signal Services Unit, 2445 Liberty Street, NE, Salem, OR 97310

Contact: Melvin Makin, Signal Unit Manager

Telephone: 503-378-2645 **FAX:** 503-378-5834

General: The facility is housed in a converted warehouse of approximately 12,000 square feet floor space. The unit is divided into four sections: warehouse, repair room, environmental testing laboratory, and administrative offices.

Unique: Traffic controller environmental testing laboratory with complete remote instrumentation for testing the function of controllers under extreme temperature conditions.

Capacity: Testing of 416, 8-phase signal units per year.

Projects: Test traffic signal control units.

Available for Outside Use: No

OR-2

Owner: Oregon State University

Facility: O.H. Hinsdale Wave Research Laboratory, Grat Hall 205, Corvallis, OR 97331

Contact: C.K. Sollitt, Director

Telephone: 503-737-3631

General: Wave Channel: 342' by 12' by 15' (deep) - largest university-owned channel in the world. Rectangular Wave Basin: 87' by 60' by 5' (depth). Circular Wave Basin: 50' in diameter, 5' deep. Both basins and channel are contained in an environmentally controlled building.

Unique: Collectively, the two basins and channel represent unique capability for evaluating the effect of waves on structures, both ocean and shoreline.

Projects: "Wave Interaction with Rubble Toe Protection" and "Response of Armor Units to Impact Loads," National Oceanographic and Atmospheric Administration; "Coastal Erosion Evaluation," U.S. Army Coastal Research Center; and "Dynamics of Offshore Structures," Office of Naval Research.

Available for Outside Use: Yes

Comment: This facility can be used to evaluate any element of a transportation facility that is exposed to wave or tidal forces, e.g., bridges, jetties, embankments, etc.

Pennsylvania

PA-1

Owner: Alcoa Research Laboratories

Facility: 3.5% NaCl Alternate Immersion Test ASTM G44, Alcoa Technical Center, 100 Technical Drive, Alcoa Center, PA 15069

Contact: W.G. Truckner, Division Manager

Telephone: 412-337-2751 **FAX:** 412-337-2044

General: Large (2' by 8' by 10') tanks with either lift or ferris wheel-type alternate immersion capabilities. Solution 3.5% NaCl (CiPi), weekly solution change. 1 hour cycle - 10 minute immersion with 50 minute drying. 45% humidity $\pm 6\%$, 80°F $\pm 2^\circ$ temperature. Specific gravity and pH of solution, temperature and humidity monitored and recorded daily by technician.

Unique: Largest ASTM G44 test facility in the world.

Projects: Quality control (lot release and surveillance) of plant production materials. Primarily used for stress and corrosion evaluations.

Available for Outside Use: Yes, most 3.5% alternate immersion testing conducted by others on small scale using bench top apparatus.

PA-2

Owner: Alcoa Research Laboratories

Facility: Fog/Spray Test Cabinets, Alcoa Technical Center, 100 Technical Drive, Alcoa Center, PA 15069

Contact: W.G. Truckner, Division Manager

Telephone: 412-337-2751 **FAX:** 412-337-2044

General: Nine automatic fog/spray test cabinets manufactured by Harshaw.

Unique: Variety of fog/spray testing conducted at same time and location. Special exhaust and flushing system.

Capacity: Testing limited to average size test specimens and small assemblies. Timers and counters for automatic programming.

Projects: Many research investigations evaluating aluminum products and various coatings. Specific research investigation evaluating simulated bridge assemblies including dissimilar metals.

Available for Outside Use: Yes

Comment: Alcoa has the largest number of fog/spray cabinets in one place in the world. Most companies and universities have only one or possibly two test cabinets. Various types of fog/spray testing should be segregated with certain fog/spray tests confined to certain cabinets.

PA-3

Owner: Alcoa Research Laboratories

Facility: Biaxial Load Frame, Alcoa Technical Center, 100 Technical Drive, Alcoa Center, PA 15069

Contact: Ron Wygonik, Senior Technical Supervisor

Telephone: 412-337-5714 **FAX:** 412-337-5436

General: The biaxial load frame is an integrated structural testing system consisting of the load frame, computer controls, data acquisition, hydraulic actuators, and power supply. The frame will accommodate 12' clearance under the cross head, and 10' between the upright stanchions. Adjustments in the cross head position are possible. It is mounted on a large dynamic test bed and is capable of reacting dynamic loads in two axes simultaneously.

Unique: Two axis reaction capability, large capacity hydraulic power supply, adjustable positions, integrated computer controls and data acquisition, ability to program random block loadings.

Capacity: 110,000 pounds in the vertical, and 35,000 pounds in the horizontal direction. The horizontal loads

may be applied up to 6' above the test bed. Actuators are driven by a 140 gallons per minute pumping unit.

Projects: Fatigue evaluation of various welded connections in ground vehicle area. General static and fatigue testing of welded and mechanically fastened joints.

Available for Outside Use: Yes

PA-4

Owner: University of Pittsburgh, Department of Civil Engineering

Facility: Large Capacity Open Channel, Fluid Mechanics and Hydraulic Laboratory, Pittsburgh, PA 15261

Contact: Chao-Lin Chiu, Professor

Telephone: 412-624-9872 **FAX:** 412-624-0135

General: 4' by 2' by 75' long open channel, adjustable slope, recirculating with wave generator.

Unique: The flow can be mixed with sediment to study stream bed stability, sediment transport, scour and erosion.

Capacity: Discharge rate can go up above 50 cubic feet per second.

Projects: Open channel flow study, demonstration for spillway capacity. Teaching purposes.

Available for Outside Use: Yes

PA-5

Owner: Pennsylvania Turnpike Commission

Facility: Safety Testing and Research Facility (STAR), Near Breezewood, PA

Contact: Neal E. Wood, Research and Programming Manager, PO Box 8531, Harrisburg PA 17105

Telephone: 717-939-9551 **FAX:** 717-986-9645

General: 11.7 miles of four (4) lane divided highway including two 2 lane tunnels. This is an abandoned section of the original Turnpike resulting from the Ray-Sideling Hill bypass alignment. This section was closed in 1968.

Unique: Two 2 lane vehicular tunnels, one more than one mile in length.

Projects: "Developing the Trade-offs between sign size and retro-reflectivity for traffic signs" (FHWA), SNAP (Sonic Nap Alert Pattern) testing of various groove patterns on the shoulder area to prevent "drift off the road" type accidents, Recessed Reflective Pavement Marking Tests.

Available for Outside Use: Yes

Comment: Section of 4 lane divided highway with a 200' minimum width right-of-way. Usable roadway is approximately 10.3 miles. Roadway width is 24' in both east and west directions with a 10' median. Roadway is 10" RCP with a 3.5" bituminous overlay. At the tunnels, both lanes and the median narrow to one lane in each direction.

Maximum roadway grade is 3% with most less than 1%. Tunnel lengths are 3512' and 6791' and no lighting. Since this area has not been used for more than 20 years, some upgrading must be done to restore it for full use.

PA-6

Owner: Altoona Vo-Tech, leased to Pennsylvania State University

Facility: Altoona Bus Testing Center, 6th Avenue, Altoona, PA

Contact: Dr. James C. Wambold, Professor, Pennsylvania Transportation Institute, 201 Research Office Building, University Park, PA 16802

Telephone: 814-863-1889 **FAX:** 814-865-3039

General: The Altoona Center building has 13,000 square feet of garage bay area and 4,000 square feet of workshop and classroom area. Building includes conference and seminar rooms as well as a dark room and video/audio studio. The building is mainly used for Bus Testing and Research, but is also used for seminars like State Police School Bus Inspection.

Unique: 20-ton overhead crane and will have a large environmental room to hold a tractor trailer on a dual chassis dynamometer to perform exhaust gas analysis on trucks and buses. CG and moment of inertia measurement equipment for buses and trucks.

Projects: Bus testing, CDL license testing, school bus inspection classes for state police.

Available for Outside Use: Yes

PA-7

Owner: Pennsylvania State University, Department of Civil Engineering

Facility: Pavement Rainfall-Runoff Area, Hydraulics Laboratory, 212 Sackett Building, University Park, PA 16802

Contact: Dr. Joseph R. Reed, Professor of Civil Engineering

Telephone: 814-863-0512 **FAX:** 814-863-7304

General: A laboratory area of 1,000 square feet in Room 3, Sackett Building houses the test facilities for pavement runoff studies. The area was formerly used for a stream model study associated with a highway problem. It could be converted easily for that use again. Artificial rainfall generating equipment is part of a recirculating water supply from an under-floor sump.

Unique: The artificial rainfall equipment utilizes "spray-up" nozzles in the 20' high laboratory. Rained-on pavements are laid on an aggregate-sand bed above the sump.

Capacity: Rainfall rates have been studied up to 3" per hour on a spatial average basis. Higher rates are possible.

Projects: A grooved pavement runoff study was completed for the FAA in 1989. It was conducted on a 25' by 25' PC concrete slab with variable groove spacing and wind velocities. Water depths were measured as they affect hydro-planing. A present study is nearing completion on a cost sharing basis with FHWA. It is aimed at defining a fundamental hydraulic resistance variable for pavements of varying slopes and textures.

Available for Outside Use: Yes

Comment: The facility is primarily for use of research faculty in hydraulics at Penn State. It is available to outside users through contractual arrangements with the University. A rainfall-runoff study may not be restricted to pavements in the facility, although it has been used only for pavements.

PA-8

Owner: Pennsylvania State University, Pennsylvania Transportation Institute

Facility: Test Track and Bus Research and Testing Center

Contact: Dr. James C. Wambold, Professor, 201 Research Office Building, University Park, PA 16802

Telephone: 814-863-1889 **FAX:** 814-865-3039

General: The Pennsylvania Transportation Institute maintains a research and test track facility for use in bus testing, crash testing, pavement durability, roughness research, and truck escape ramps.

Unique: Bus durability testing, handling and skid pad for vehicle testing, crash testing, up to 18,000 pounds up to 60 mph, roughness and profilometer calibration, truck escape ramp testing.

Projects: Bus testing and research, police pursuit testing, sports car rallies, crash testing of plastic medium barriers, crash testing of bridge parapets, accident investigation classes, vehicle dynamics classes.

Available for Outside Use: Yes

Comment: Several other comparable facilities for parts but none with the same combination of facilities.

PA-9

Owner: Lehigh University, Center for Advanced Technology for Large Structural Systems (ATLSS)

Facility: ATLSS Multidirectional Experimental Laboratory, 117 ATLSS Drive, H Building, Bethlehem, PA 18015-4729

Contact: Frank E. Stokes, Manager of Structural Testing Laboratory

Telephone: 215-758-5498 **FAX:** 215-758-5553

General: The ATLSS Multidirectional Experimental Laboratory provides a unique, world-class facility for three-dimensional static and fatigue testing of large structures and complex assemblies. In addition to a large test floor measuring 102' by 40,' the laboratory has a massive fixed reaction wall 50' high that encircles two sides and three corners of the floor. This unique wall allows three-dimensional loads and motions to be applied at any elevation by a wide-ranging spectrum of fatigue-rated computer-controlled hydraulic actuators.

Unique: 1) Reaction Wall, and the capabilities it offers for multi-directional testing of very large structures. 2) Complete computer-controlled operation for static, fatigue, and pseudodynamic loadings.

Capacity: Individual jack capacities up to 460 kips, jack strokes up to 38," testing speeds up to 5 Hz. Total hydraulic system capacity is 720 gallons per minute. Up to 6 independent, but simultaneous test setups on large test floor.

Projects: 1) Fatigue tests of full-size highway and railroad bridge girders, of steel and aluminum. 2) Ultimate strength tests of heavy-reinforced concrete beam-column sections. 3) Strength of new design beam-to-column steel connections.

Available for Outside Use: Yes

Comment: The Laboratory is part of the ATLSS Center (Center for Advanced Technology for Large Structural Systems), a National Engineering Research Center established with a grant from the National Science Foundation. The Commonwealth of Pennsylvania has made a major financial commitment to the Laboratory.

PA-10

Owner: Lehigh University, Center for Advanced Technology for Large Structural Systems (ATLSS)

Facility: Fritz Engineering Laboratory, Bethlehem, PA 18015-3176

Contact: Frank E. Stokes, Manager of Structural Testing Laboratory

Telephone: 215-758-3532 **FAX:** 215-758-4522

General: Fritz Engineering Laboratory houses a 5-million-pound-capacity hydraulic universal testing machine and an 800-kip-capacity mechanical universal testing machine. It also houses a dynamic test bed for fatigue testing full-scale girders and other structural assemblies. Moreover, it houses various alternating-stress fatigue testing machines.

Unique: The 5-million-pound capacity machine not only has the tremendous capacity, but can accommodate a specimen height up to 40,' depending on required end fixtures, and a specimen width of up to 10.'

Capacity: 5 million pounds, 36" hydraulic stroke, 40' testing height, 10' clear width, test bed 20' long.

Projects: 1) Compression testing 35' tall steel tubular legs from offshore structures. 2) Tensile tests of bridge suspender cables up to 6" diameter. 3) Tests of winch assemblies used in positioning and anchoring oil platforms. 4) Tests of 20" diameter, 12' tall reinforced concrete columns.

Available for Outside Use: Yes

Comment: The 5 million pound testing machine has been used for outstanding steel research since the mid-1950s. It is calibrated regularly. It has been updated with digital electronics.

PA-11

Owner: Department of the Navy, Naval Air Development Center

Facility: Human Centrifuge/Dynamic Flight Simulator, Code 6035, Warminster, PA 18974-5000

Contact: Jack Eyth, Facility Manager

Telephone: 215-441-2891 **FAX:** 215-441-3758

General: The Centrifuge complex is a sustained acceleration device capable of dynamic orientation of the acceleration vector with respect to the occupant. The device is man-rated, and is used in physiologic studies, safety of flight concerns, operational training, and advanced crew station work.

Unique: The centrifuge consists of a 50' arm, vertical DC motor, and dual axis gimbaling systems. All are unique.

Capacity: 40 g maximum acceleration, onset rates to 10 g per second (payload weight dependent).

Projects: Typical projects include hazardous flight regime studies, high acceleration physiology, and operational training.

Available for Outside Use: Yes

PA-12

Owner: Department of the Navy, Naval Air Development Center

Facility: Ejection Tower Facility, Code 6035, Warminster, PA 18974-5000

Contact: John Swan, Site Engineer

Telephone: 215-441-2053 **FAX:** 215-441-3758

General: The Ejection Tower is a pyrotechnically actuated device used in development and evaluation of ejection related systems for military aircraft.

Unique: This facility is unique in the United States. The facility is rated for manned testing. The facility is photographic coverage, and digital data acquisition systems.

Capacity: Pyrotechnic actuation using MK 18 cartridges, which may be uploaded to approximately 130 gms., accelerations up to 30 g.

Projects: Typical projects include physiologic studies and qualifications of ejection systems, including manned qualification of the NACES Ejection Seat, safety of flight certification support of the Advanced Tactical Life Support System, and various other programs

Available for Outside Use: Yes

PA-13

Owner: Department of the Navy, Naval Air Development Center

Facility: Environmental Physiology Laboratory, Code 6035, Warminster, PA 18974-5000

Contact: Jon Kaufman, Project Investigator

Telephone: 215-441-2565 **FAX:** 215-441-3758

General: The Environmental Chamber is a thermal device used to evaluate heat and cold stress associated with crew systems, including human factors experiments. The chamber is a climate controlled chamber, capable of either wet or dry operation. Wet operation involves use of water pool for immersion studies.

Unique: The facility is manned operation rated, and includes immersion, wind chill, sea spray, and ocean state capabilities.

Capacity: Air Temperature of -30° to 160°F., water temperature as low as 35°F.

Projects: Typical projects include physiologic studies and qualifications of survival suits, pressure suits and other crew system equipment which is thermally affected. Projects have included pressure suits for the Space Shuttle.

Available for Outside Use: Yes

PA-14

Owner: Department of the Navy, Naval Air Development Center

Facility: Horizontal Accelerator Facility, Warminster, PA 18974-5000

Contact: Carl Pierce, Site Engineer, Code 6035

Telephone: 215-441-2666 **FAX:** 215-441-3758

General: The Horizontal Accelerator is a crash pulse test facility using a pneumatic actuator to provide high acceleration pulses to test articles. These accelerations represent impact decelerations. The facility is primarily used in the evaluation of crew stations, including seating, restraining, and physiologic concerns.

Unique: The facility includes a 12" Hyge Actuator, 115' rails, 1 megawatt high intensity lighting, indoor facility, organic instrumentation, data acquisition, and photographic systems, and other support equipment including mannequins and fixture fabrication capabilities.

Capacity: 50 g peak acceleration, 2,100 pound payload capacity, 8' to 10' stroke length.

Projects: Typical projects include crashworthiness studies of ejection, troop, and passenger seats, head and neck loads evaluations, restraint and inertia reel development and evaluation.

Available for Outside Use: Yes

PA-15

Owner: Department of the Navy, Naval Air Development Center

Facility: Fuel Fire Test Facility, Code 6035, Warminster, PA 18974-5000

Contact: John Yannaccone, Site Engineer

Telephone: 215-441-8723 **FAX:** 215-441-3758

General: The Fuel Fire Test Facility is a device used in the evaluation of fire protection of flight deck clothing. The facility provides a JP-4 fuel fire with exposures from 2 to 10 seconds. Data is generated on thermal flux, skin temperature, and self extinguishing characteristics.

Unique: The Fire Pit consists of a 20' by 25' water pit which contains a fuel distribution manifold. A propane igniter system is used to initiate the test burn. A jib crane is used to swing the test article through the flames. **Capacity:** Use of JP-4 fuel as combustible material, providing temperature and specific heat associated with jet fuel.

Projects: Typical projects include flight suits, pressure suits, and man mounted equipment exposures to 2 second duration JP-4 fuel fires.

Available for Outside Use: Yes

Rhode Island

RI-1

Owner: Alcoa Research Laboratories

Facility: Atmospheric Seacost Test Site, Ocean Road, Point Judith, Rhode Island

Contact: W.G. Trucker, Division Manager

Telephone: 412-337-2751 **FAX:** 412-337-2044

General: Large atmospheric seacost test station located immediately adjacent to the Atlantic Ocean. Capabilities to expose 45 degrees and vertically. No restrictions or barriers between ocean and test site.

Unique: Probably the most severe atmospheric test facility available. Samples actually receive some spray from the ocean.

Capacity: Test materials checked daily by part-time custodian. Atmospheric weathering data available from Block Island, close by.

Projects: Exposure of various Alcoa building products (painted soffit, gutters, siding, and shingles). Anodized and chrome-plated auto bumpers. Stressed and unstressed test specimens from standard mill products.

Available for Outside Use: Yes

Comment: Comparative test data with other atmospheric seacoast sites indicate that Alcoa's Point Judith site is the most severe and comparable only to samples exposed on aircraft carriers.

South Carolina

SC-1

Owner: University of South Carolina

Facility: Faculty Testing Laboratory, Swearingen Engineering Complex, Columbia, S.C. 29208

Contact: Dr. James B. Radzinski, Associate Dean of Engineering

Telephone: 803-777-7505 **FAX:** 803-777-9597

General: Structural Testing Laboratory: 13,000 square feet overall, with 7,500 square feet two-story (22' clear height) crane bay area. Crane bay contains a 44' x 32' rectangular reaction floor with tie-downs located 4' on center in a square grid pattern. The capacity of each tie-down is 100 kips, compression or tension. Separate from the rectangular reaction floor is a square reaction "donut" also containing 100 kip capacity tie-downs at 4' on center. Orientation of reaction floor and reaction donut are such that a girder with a clear span of 80' can be tested.

Unique: Laboratory contains 16' by 16' by 10' (deep) pit with perimeter reaction "donut." Pit may be filled with various soil strata, subgrade materials, and topped with pavement. Load frame mounted on a donut can be used to apply cyclic loads to pavement.

Capacity: Current testing equipment consists of 1-110 kip and 1-55 kip hydraulic load actuator supplied by a 140 gallons per minute pump. Actuators are capable of both static and cyclic testing facility.

Projects: New facility

Available for Outside Use: Yes

Comment: Reaction floor common to all laboratories. Reaction "donut" and open pit may be a unique.

SC-2

Owner: Clemson University, Department of Civil Engineering

Facility: Wind Load Test Facility (Spring 1992)

Contact: Ben L. Sill, Professor, 135 Lowry Hall, Clemson, SC 29634-0911

Telephone: 803-656-3325 **FAX:** 803-656-2670

General: Upon completion, will contain a 100' long boundary layer wind tunnel with 6.5' by 10' test section. Installation complete in Spring 1992. Will also contain equipment for testing wind loads on prototype roof structures.

Unique: Is one of the five best boundary layer wind tunnel facilities in the U.S.; speed and turbulence levels are accurately controlled.

Capacity: Working section is 70' long with maximum wind speed of 60 feet per second.

Projects: Numerous studies of wind structure loads, cladding, pressures, pedestrian wind environment, bridge aerodynamics, and air pollution.

Available for Outside Use: Yes

South Dakota

SD-1

Owner: Department of the Interior, U.S. Geological Survey

Facility: EROS Data Center, Sioux Falls, SD 57198

Contact: Dr. Donald T. Lauer, Acting Chief

Telephone: 605-594-6123 **FAX:** 605-594-6589

General: The EROS Data Center is a data archive, management and research field center for the U.S. Geological Survey's National Mapping Division. The Center holds the world's largest collection of space and aircraft acquired imagery of the Earth.

Unique: The EROS Data Center is a source of aerial photography for all areas in the United States.

Capacity: The 8 million plus photographs in the Center archives are primarily high resolution black and white and color infrared photographs. Aerial photos can be used for preliminary site selection for highway planners.

Projects: Extensive national and international research and applications projects in several disciplines.

Available for Outside Use: Yes

SD-2

Owner: South Dakota School of Mines and Technology

Facility: Engineering and Mining Experiment Station, 501 East St. Joseph Street, Rapid City, SD 57701-3995

Contact: Dr. Briant Davis, Director

Telephone: 605-394-2496 **FAX:** 605-394-5360

General: A wide variety of the most advanced instrumental techniques are used. Analyses available include gold and silver assays; chemical analyses of minerals, ores, raw materials and manufactured products; analysis of water (environmental monitoring, exploration); environmental and occupation-related analyses; analyses of fluid inclusions; and custom analytical services for exploration and industrial research and development.

Unique: Wet chemistry, electron microbeam, scanning electron microscope, transmission electron microscope, X-ray diffraction, optical microscope, core analysis and storage laboratories.

Capacity: SEM-Jeol JSM-840A; TEM Hitachi H7000 FA.

Projects: Asbestos analysis, gold analysis, X-ray diffraction of materials, cyanide concentration studies, fluid inclusion studies.

Available for Outside Use: Yes

SD-3

Owner: RE/SPEC Inc.

Facility: Calibration Services, PO Box 725, Rapid City, SD 57709

Contact: Nancy S. Brodsky, Acting Manager, Materials Test

Telephone: 605-394-6400 **FAX:** 605-394-6456

General: This facility consists of a dead weight system for calibrations of pressure, load cells for calibration of force, gage blocks and micrometers for calibration of displacements, and an ice point, furnace, and platinum RTDs for calibration of thermocouples.

Unique: All testing activities can be performed under a Quality Assurance Program that fully complies with NQA-1. All standards used in calibration are directly traceable to NIST and recertified annually by NIST. All in-house calibrations are performed in a testing laboratory with a controlled environment (temperature controlled at 20°C ±1°C). The laboratory facility is protected by 24-hour security system.

Capacity: Pressure calibrations up to 85 MPa (12,325 psi), force calibrations up to 4.5 MN (1,000,000 pounds), and temperature calibrations up to 200°C (392°F).

Projects: Continuous calibrations of all force, temperature, pressure, and displacement sensing elements used in the laboratory.

Available for Outside Use: Yes

SD-4

Owner: RE/SPEC Inc.

Facility: Materials Test Facilities, PO Box 725, Rapid City, SD 57709

Contact: Nancy S. Brodsky, Acting Manager, Materials Testing

Telephone: 605-394-6400 **FAX:** 605-394-6456

General: Comprehensive laboratory for measurement of strength, stiffness creep, thermal and other properties of materials such as rock, concrete and metals, and conducting petrographic analysis.

Unique: 10 station creep frame; colorimeter and thermal property measurement system; hollow cylinder triaxial apparatus.

Capacity: 4.5 MN (1 million pounds) loads, pressures to 70 MPa.

Projects: Triaxial tests on WIPP salt, creep rates of rock.

Available for Outside Use: Yes

Tennessee

TN-1

Owner: Department of Energy, Oak Ridge National Laboratory

Facility: Advanced Composites Laboratory, Applied Technology Division, PO Box 2003 Building K-1225, MS 7294, Oak Ridge, TN 37831-7294

Contact: R.E. Ziegler, Manager, Program Development

Telephone: 615-574-0285 **FAX:** 615-574-8481

General: This facility consists of a material environmental exposure chamber supported by various composite winding machinery and inspection equipment. ORNL/ATD can make specimens of unique material combinations and geometrical design for environmental testing. **Unique:** Capability of stress and creep rupture tests of high performance composites over a wide range of mechanical and environmental conditions.

Capacity: Temperatures ranges: 25° to 100°C ($\pm 2^\circ\text{C}$); relative humidity ranges: 15% to 95% ($\pm 1\%\text{RH}$); maximum winding dimensions: diameters to 48," lengths to 45.'

Projects: Hollow clay tile wall testing program for earthquake response prediction.

Available for Outside Use: Yes

Comment: May be used for highway structure testing of actual components, or scaled models of entire design. May also be used for vehicle body or framework life testing.

TN-2

Owner: Department of Energy, Oak Ridge National Laboratory

Facility: Seismic Test Facility, Applied Technology Division, PO Box 2003, Building K-1225, MS 7294, Oak Ridge, TN 37831-7294

Contact: R.E. Ziegler, Manager, Program Development Department

Telephone: 615-576-0285 **FAX:** 615-574-8481

General: This facility consists of a bi-directional shaker table utilizing electrohydraulic servo systems to apply vertical and horizontal combined or independent displacements or forces to simulate seismic activity.

Unique: Low frequency range of accelerations to 0.1 Hz, large displacements, tilt control, precise waveform replication.

Capacity: Acceleration: 0 to 0.25 g (bi-directional); Frequencies: 0.1 to 20 Hz; Table area: 6' by 6'; Maximum sample weight: 8 tons; Stroke capability: 15.2"; Maximum velocity: 12" per second; Maximum sample size: 15' by 20' by 75.'

Projects: High-g testing of electronic components, evaluation of materials for rotational stresses, creep fatigue, and failure modes. Prior applications included; flywheel design evaluation, precision component balancing, high-energy burst testing, aerodynamic studies, gas separation experiments, and determination rotor fragment containment requirements.

Available for Outside Use: Yes

Comment: This facility can support geotechnical model verification through exaggerated gravitational simulation.

TN-3

Owner: Department of Energy, Oak Ridge National Laboratory

Facility: Environmental Test Chamber, PO Box 2008, Building 7601, M/S-6304, Oak Ridge, TN 37831-6304

Contact: C.T. Kring, Group Leader

Telephone: 615-574-7122 **FAX:** 615-574-2081

General: A 15' by 15' enclosed chamber for exposing process equipment and other hardware to atmospheres containing various concentrations of acid vapors. Original construction was to support testing in environments typical of nuclear fuel reprocessing cells.

Unique: Corrosive vapor testing with low oxygen concentrations possible.

Capacity: Temperature, pressure, humidity, O₂, NO, NO₂, and HNO₃ concentrations.

Projects: Material corrosive testing.

Available for Outside Use: Yes

TN-4

Owner: Department of Energy, Oak Ridge National Laboratory

Facility: Center for Engineering Systems Advanced Research (CESAR), PO Box 2008, Building 6025, MS-6364, Oak Ridge, TN 37831-6364

Contact: Francois G. Pin, Group Leader

Telephone: 615-574-6130 **FAX:** 615-574-7860

General: Experimental facility for autonomous mobile robots and intelligent systems. Includes a series of mobile platforms named HERMIES (HERMIES-IIB, III, and IV currently available) equipped with on-board sensors and computers, and autonomous path-planning algorithms for navigation in a wide variety of environments.

Unique: HERMIES autonomous robots, path- and route-planning algorithm, 3D simulation systems, user interfaces, "easy integration system" for addition of new modules.

Capacity: Capacity for 30+ researchers; 3 operational platforms.

Projects: Demonstration of novel path-planning algorithm for "car-like" robots under U.S. Army project.

Integration of autonomous mobility and manipulation for DOE-NE project. Proof of principle demonstration of basic research in environment perception, navigation in a-priori unknown environments, autonomous navigation using fuzzy logic, path-planning for omni-directional platforms for DOE-BES.

Available for Outside Use: Yes

Comment: User facility which has hosted, as an average, 20+ users, mainly from universities, per year.

TN-5

Owner: Department of Energy, Oak Ridge National Laboratory

Facility: Engineering Physics Laboratory, Applied Technology Division, PO Box 2003 Building K-1225, MS 7294, Oak Ridge, TN 37831-7294

Contact: R.E. Ziegler, Manager, Program Development

Telephone: 615-574-0285 **FAX:** 615-574-8481

General: Fiber optics laboratory for transportation research and development applications.

Unique: Resident capability in wide range of transportation applications including hardware and software for: weigh-in-motion, traffic trend analysis, and vehicle identification.

Capacity: Weight: 0.1 to 30 metric tons; certified for speeds under 5 mph; development in progress for speeds up to highway speed limits.

Projects: Development test methods for screening of materials. Materials quality control.

Available for Outside Use: Yes

Comment: Additional capabilities, including those exercised in prior work include examination of fabrication effects, chemical structure, and mechanical properties such as visco-elasticity. These capabilities may be applied in programs, such as composites inclusion in lightweight, crashworthy vehicles, or in research of new road and infrastructure materials.

TN-6

Owner: Department of Energy, Oak Ridge National Laboratory

Facility: High-Speed Rotational Testing Facility, Applied Technology Division, PO Box 2003 Building K-1225, MS 7294, Oak Ridge, TN 37831-7294

Contact: R.E. Ziegler, Manager, Program Development

Telephone: 615-574-0285 **FAX:** 615-574-8481

General: High-speed air turbines contained in energy-absorbing liners and concrete revetment. High gravitational stress fields are used to test rotor, component and material structural integrity, durability, fatigue and failure modes. High-speed aerodynamic testing under

variable test conditions is available, as well as various test monitors, including high-speed photography, are available.

Unique: High speeds, vacuums, and weights available at this facility; 5 to 10 gm masses have been accelerated at rotational speeds to 100,000 rpm.

Capacity: 3 Vacuum chambers: to 30,000 rpm (extendable to 100,000 rpm), to 1E-5 torr vacuums, parts to 30" by 30" and 200 pounds. Instrumentation in place: remote TV and thermal video systems and standard test condition monitoring. Expansion of monitor capability includes: high speed photograph (to 35,000 feet per second) and video, telemetry systems, slip ring systems. **Projects:** Weigh-in-motion; fiber optic vehicle identification system, landfill portal monitoring, smart skins, and embedded sensors.

Available for Outside Use: Yes

Comment: ORNL/ATD has a wide range of capabilities in fiber optic R&D with increasing emphasis in recent years on transportation development. A Major DOE-sponsored fiber-optic weigh-in-motion instrumentation development project is currently in progress at this facility.

TN-7

Owner: Department of the Navy, David Taylor Research Center

Facility: Large Cavitation Channel, Memphis Detachment, 2700 Channel Avenue, Presidents Island, Memphis, TN 38113-0428

Contact: Dr. William B. Morgan, Head, Ship Hydromechanics Department, DTRC, Bethesda MD 20841-5000

Telephone: 301-227-1578 **FAX:** 301-227-3679

General: The Large Cavitation Channel (LCC) is the world's largest and quietest high-speed, variable-pressure water channel. Its design permits the U.S. Navy to measure submarine and surface ship power, efficiency, and propeller noise by using models in a controlled but realistic environment. As a model is held stationary, water flow at speeds up to 35 knots combines with variable pressure to allow simultaneous measurements of propeller cavitation and acoustics from the model's propulsor.

Unique: The Large Cavitation Channel is a vertical plane, closed recirculating 1.4 million gallon, variable speed, variable pressure, channel with lower half submerged in 2.5 million gallon water filled trench, plus numerous other acoustic treatment features, 6:1 contraction ratio. High speed capability up to 50 feet per second. Large test chamber with 10' by 10' cross-section.

Capacity: Working section maximum velocity: 15.4 meters per second (30 knots). Working section dimen-

sions: 13.1 meters (43') by 3 meters (10') by 3 meters (10') (depth). Maximum and minimum absolute pressures: 414 kPa (60 psia), 3.5 kPa (0.5 psia). Minimum cavitation number: $\text{Sigma}=0.02$ (0.5 psia and 30 knots). **Projects:** This is a new facility. First test was scheduled for August 1991. This facility is capable of tests involving cavitation, force measurement, flow visualization and noise on complete hull-appendage-propulsor models, bodies of revolution, surface ships, submarines, and torpedoes; open water propeller tests; basic and applied research requiring low background noise levels, large Reynold's numbers, variable pressure and low turbulence levels.

Available for Outside Use: Yes

Comment: Although this Facility is to be used primarily to conduct fundamental, applied, and developmental hydrodynamic research for the U.S. Navy, it can be used by other government agencies and private companies for a variety of experimental projects.

Texas

TX-1

Owner: Southwestern Laboratories, Inc.

Facility: Full-Size Environmental Chambers, Houston, TX 77008

Contact: D. Fred Martinez, Vice President, 222 Cavalcade Street, P.O. Box 8768

Telephone: 713-696-6288 **FAX:** 713-696-6307

General: Walk-in chambers with controlled temperature and moisture cycling. Data collected includes temperature and moisture.

Projects: 1) Material conditioning, 2) weather cycling, and 3) controlled temperatures for full-size structure test.

Available for Outside Use: Yes

Comment: These huge chambers are used to simulated variances environmental conditions.

TX-2

Owner: Southwestern Laboratories, Inc.

Facility: Dynamic Testing Facility for Vehicle-Pavement and Vehicle-Structure Interaction, Houston, TX 77008

Contact: D. Fred Martinez, Vice President, 222 Cavalcade Street, P.O. Box 8768

Telephone: 713-696-6288 **FAX:** 713-696-6307

General: Dynamic testing facility with two axles up to 50,000 pounds capacity each, capable for load and deformation control, equipped with environmental chambers. Data collected includes Load, Deformation, Temperature.

Projects: 1) Evaluate construction material responses to various loading conditions, and 2) simulate traffic loads to structures.

Available for Outside Use: Yes

Comment: Part of this facility has been used to perform SHRP resilient modulus testing.

TX-3

Owner: Southwestern Laboratories, Inc.

Facility: Wheel Tracking Device, Houston, TX 77008

Contact: D. Fred Martinez, Vice President, 222 Cavalcade Street, P.O. Box 8768

Telephone: 713-696-6288 **FAX:** 713-696-6307

General: Full-size wheel tracking device used to determine pavement susceptibility to permanent deformations. Data collected includes deformations.

Available for Outside Use: Yes

Comment: This device is used to measure pavement deformation and makes use of a actual wheel.

TX-4

Owner: University of Houston

Facility: Soil Pressure Chamber, Houston, TX 77204-4791

Contact: Michael W. O'Neill, Professor and Chairman, 4800 Calhoun Road

Telephone: 713-749-1361 **FAX:** 713-749-2559

General: This is a reusable soil pressure chamber, cylindrical in shape and capable of accommodating approximately 40 cubic feet of soil. The soil can be saturated. Boundary condition include either controlled stress or zero displacement. Ports are available to accommodate driving of piles, thrusting of penetrometers, etc. Impact and vibratory pile drivers and service gantry are a part of the facility. All necessary pumps, pressure supplies and data acquisition devices are also available.

Unique: Gantry and adjustable pile hammers make the facility uniquely suited to the study of pile driving phenomena.

Capacity: Loading system will support load test up to 60,000 pounds. Pressures of up to 60 psi can be applied to the soil. Soil pressures can be varied vertically and ratio of horizontal to vertical pressure can be varied freely.

Projects: 1) Study of the behavior of piles driven by vibrators. 2) Study of the effects of pile geometry on capacity. 3) Study of the effects of pile toe geometry on driveability and capacity. 4) Calibration of mini-pentrometers.

Available for Outside Use: Yes

Comment: The chamber has been in almost continuous use since it was constructed in 1985. Numerous devices

have been added since that time, making it adaptable to the fundamental study of many geotechnical engineering problems.

TX-5

Owner: University of Houston

Facility: Universal Panel Tester, Houston, TX 77204

Contact: Thomas T.C. Hsu, Professor, 4800 Calhoun Road

Telephone: 713-749-2491 **FAX:** 713-749-2559

General: A high-capacity and versatile facility for testing panels 53" by 53" and up to 16" thick. Each panel can be subjected to tension, compression, bending, shear and/or torsion and, therefore, could represent any element isolated from a structure such as a shearwall, a bridge, a nuclear containment structure or an offshore structure. The facility consists of forty 100-ton in-plane jacks housed in a 16' x 16' steel frame and twenty 60-ton jacks in a horizontal frame.

Unique: 1) Can test full-size reinforced concrete panels. 2) The panel can be subjected to any imaginable stresses from axial load, bending, shear and torsion.

Capacity: Capable of applying 1,000-ton of force in each of the two directions of the panel. The panel can be reinforced with 1" diameter bars.

Projects: Two projects sponsored by National Science Foundation (NSF) were completed in the past 2 years resulting in two research reports entitled 1) "Constitutive Laws of Reinforced Concrete in Biaxial Tension-Compression" and 2) "Constitutive Laws of Reinforced Concrete in Shear". A new NSF project currently underway is entitled "High-Strength Reinforced Concrete Panels in Shear."

Available for Outside Use: Yes

TX-6

Owner: University of Houston

Facility: Field Foundation Test Facility, Houston, TX 77204-4791

Contact: Michael W. O'Neill, Professor and Chairman, 4800 Calhoun Road

Telephone: 713-749-1361 **FAX:** 713-749-2559

General: This is a field test facility at which geotechnical conditions have been thoroughly characterized over the past 13 years. Test piles, piers and footings have been installed at the site and subjected to static, cyclic and dynamic loadings. The site consists of layers of over-consolidated clay and silt. It has been proposed to NSF as a national geotechnical experimentation site.

Unique: An extraordinary large number of loading tests have been performed on piles, piers and footings at the site, and the site has been characterized by numerous in situ and laboratory testing methods.

Capacity: The site is available for users. Utilities are provided and the data acquired concerning the soil are also available against which other test methods and geotechnical characterization methods can be tested. The site occupies approximately one acre.

Projects: 1) Evaluation of the capacity of eccentrically loaded pin piles. 2) Uplift behavior of shallow piers under cyclic and long-term loading. 3) Statistical studies of the variability of soil as indicated by QCPT tests.

Available for Outside Use: Yes

TX-7

Owner: Texas A&M University, Texas Transportation Institute (TTI)

Facility: Metropolitan Transportation Systems Operations and Management Center Simulator/Laboratory, College Station, TX 77843-3135

Contact: Conrad L. Dudek, Professor/Research Engineer, TTI/CE Building

Telephone: 409-845-1727 **FAX:** 409-845-6254

General: The facility is being developed. The highly realistic, multipurpose transportation demonstration, training, teaching, and research facility will emulate the most technologically advanced transportation management centers being developed in the U.S. Using portable software and hardware system design, it will create a "operating environment" that can model typical daily and incident operations of real-world control centers. It will be equipped with the latest computers, high resolution graphics, real-life video, large screen projection systems, traffic simulation models, video detection, satellite communication systems technologies and will be updated as advances in technology are introduced.

Available for Outside Use: Yes

TX-8

Owner: Texas A&M University, Texas Transportation Institute (TTI), and Texas Department of Transportation

Facility: Hydraulics and Erosion Control Field Laboratory, College Station, TX 77843-3137

Contact: Harlow C. Landphair, Manager, TTI Environmental Management Program

Telephone: 409-845-0133 **FAX:** 409-845-4491

General: This is an outdoor laboratory facility for full-scale testing and experimentation related to erosion control materials and techniques, open channel hydraulics slope mechanics. The site is divided into two parcels totaling 23.7 acres. The facility is currently 60% complete and includes: two reservoirs, 950' of embankment with a vertical rise of 22' at 2:1 and 3:1 slopes, silt collection boxes, full weather station, ten test channels, head water control structure, pumping station, rainfall

simulators and instrumentation. The second phase of the project, covering approximately 16 acres, will be devoted to highway runoff and wetlands process research.

Unique: This outdoor laboratory facility will support full-scale testing of erosion control and channel lining materials under controlled conditions of soil type, simulated rainfall or flow rates.

Capacity: The embankment has thirty-six sets of research plots (20' wide by 60' long) that provide two different soil types (erosive sands and high PI clays) and two different slopes (2:1 and 3:1) with control plots. Four rainfall simulators are provided to cover a full 20' wide plot and are calibrated to produce variable rainfall intensities of 1" to 7" per hour. The pump station consists of a 10 hp electric pump to support the rainfall simulators and a diesel driven 20" pump that will produce flows up to 60 cfs. A headwater control structure provides distribution and flow rate control to the test channels. Flow rates can be varied from 20 cfs to 60 cfs. Instrumentation is provided to measure depth, velocity, and flow rates.

Projects: The first test cycle, testing of erosion control blankets and mats, began in March 1991. The second cycle testing of erosion control mats, wood and cellulose mulches and temporary flexible channel lining materials began in March 1992. These tests are currently projected to continue through FY 1995.

Available for Outside Use: Yes

Comment: Similar capabilities to those being developed are located at Utah State University, Colorado State University and at the USGS Hydraulics Laboratory, Bay St. Louis, MS. However, to our knowledge no facility exists that offers the level of scale, pumping capacity and control available in this facility.

TX-9

Owner: Texas A&M University, Texas Transportation Institute (TTI)

Facility: Proving Ground Research Facility, Riverside Campus, College Station, TX 77843

Contact: Richard Zimmer, Manager

Telephone: 409-845-6385 **FAX:** 409-845-6107

General: The Proving Ground utilizes 9 million square feet of existing concrete runways, two 7,000' long, three 5,000' long, and a 4,000' by 450' parking apron to conduct full scale tests. The runways provide areas for concurrent crash testing of roadside appurtenance using automobiles, trucks and buses. Test speeds up to 60 mph and up to 80,000 pound tractor trailer are easily accommodated. In places the concrete surfaces are overlaid to produce various road friction levels. These test pads are then used to evaluate and develop road friction measurement devices traveling up to 60 mph. The runways

intersect in a way that allows for configuration of a driving course for research into vehicle handling and performance. The driving course also may be configured for human factors experiments. A wetted, 72,000 square foot, low friction, handling pad is provided for tire research and driver training. In addition, two high mast roadway lighting towers are located on the Proving Ground. These two 150' towers with mounting rings that may be lowered, provide for evaluation and research of highway lighting fixtures and aiming patterns. A 32,000 square foot, high bay building provides for the fabrication and assembly of full scale, highway research test articles. Machine tools, overhead cranes as well as a wide assortment of heavy equipment are available in this facility. The building also provides space for large static and dynamic test devices used in highway safety research. Two such devices are a hydraulic shaker for endurance testing of truck mounted crash attenuators and a device for determining the moments of inertia of vehicles up to 10,000 pounds.

Capacity: To conduct certain types of impact tests, a pendulum facility is provided. Up to a 2,000 pound pendulum head is suspended by cables from 50' towers. The facility is very flexible in that various sizes and types of heads may be used. Impact speeds up to 25 mph be used and practically any type of appurtenance may be installed and impacted.

Projects: Full scale automobile, truck and bus crash tests, testing of guard rails, bridge deck rails, break away signs and luminair supports, pavement friction research, pavement durability research, static and dynamic testing on highway safety hardware.

Available for Outside Use: Yes

TX-10

Owner: Texas A&M University

Facility: Walk-In Environmental Chambers, College Station, TX 77843-3135

Contact: Joe Button, Research Engineer

Telephone: 409-845-9386 **FAX:** 409-845-0278

General: Twelve environmental exposure chambers (walk-in type, each is 1,600 cubic feet or larger) with controlled temperature and humidity and/or temperature cycling and/or ramping; corrosive agent exposure chambers; ultraviolet or similar capabilities.

Unique: Large enough to accommodate test equipment and/or large size test specimens. Facilitates long-term undisturbed tests.

Capacity: Temperature ranges from -30° to 160°F. Humidity from 10 to 100%.

Projects: Flexural and tensile fatigue testing of asphalt concrete. Conditioning of asphalt and portland cement concrete specimens before or during testing.

Available for Outside Use: Yes

TX-11

Owner: Texas A&M University, Texas Transportation Institute (TTI)

Facility: Concrete Laboratory Facility, College Station, TX 77843-3135

Contact: Joe Button, Research Engineer

Telephone: 409-845-9386 **FAX:** 409-845-0278

General: The Concrete Laboratory tests and evaluates aggregates, cements, and fresh and hardened concrete. It contains three compression tests machines, with maximum capacities ranging from 120,000 to 250,000 pounds. A cylinder compressometer enables the determination of Poisson's ratio and modulus of elasticity for concrete compressive cylinders. This information establishes creep curves for high-strength concrete. Multi-position strain gauges and test frames assess concrete creep and shrinkage. The laboratory has a full range of standard equipment to evaluate properties of separate concrete ingredients or batch concrete mixes.

Capacity: Capable of loads up to 250,000 pounds.

Projects: Evaluation of concrete paving mixtures containing various size aggregates. Study of special lightweight concrete for vehicle crash barriers.

Available for Outside Use: Yes

TX-12

Owner: Texas A&M University, Texas Transportation Institute (TTI)

Facility: McNew Materials Laboratory, College Station, TX 77843-3135

Contact: Joe Button, Research Engineer

Telephone: 409-845-9386 **FAX:** 409-845-0278

General: The McNew Materials Laboratory is a versatile facility for sample preparation and materials testing. Among its facilities are a complete asphalt testing laboratory, loading systems, two types of creep tests, Gilmore electro-hydraulic closed-loop testing systems, three types of automated data acquisition systems, two integrated electro-hydraulic closed-loop testing systems, and several environmentally controlled test facilities. Includes equipment for in situ pavement testing accredited by AASHTO.

Unique: Includes both foreign and domestic sample preparation/test equipment. One-of-a-kind test equipment to simulate in situ pavement stresses.

Projects: Development of state-of-the-art test equipment and protocols. Evaluation of asphalt rheology, durability, chemical properties and relationship to performance. Evaluations of various mixture design and materials regarding resistance to aging, rutting, cracking, and water using standard as well as specialized techniques.

Available for Outside Use: Yes

TX-13

Owner: Texas A&M University, Texas Transportation Institute (TTI)

Facility: Spectrum Analysis Laboratory, College Station, TX 77843-3135

Contact: Joe Button, Research Engineer

Telephone: 409-845-9386 **FAX:** 409-845-0278

General: The liquid/gel permeation chromatograph determines molecular size distributions of complex materials such as asphalt cement. For FT-IR the Nicolet Thermal Analyzer System includes a differential scanning calorimeter and a thermal gravimetric scanner. Developed at TTI, the Duomorph Sensor monitors physical or structural changes occurring in a material after it has been in service. Also includes atomic absorption, electron spin resonance, mass spectrometer, and gas chromatography.

Unique: Specialized equipment and techniques for analysis of asphalt products using FT-IR.

Projects: Determination essential chemical components of superior asphalts. Determine chemical changes in asphalts exposed to heat, oxygen and/or solvents. Development of new test protocols.

Available for Outside Use: Yes

TX-14

Owner: Texas A&M University, Texas Engineering Experiment Station

Facility: Materials & Structures Laboratory, College Station, TX 77843-3135

Contact: Toby Selcer

Telephone: 409-845-8660 **FAX:** 409-845-6156

General: The lab offers expertise in mechanical systems (designing the test, selecting the appropriate test system and constructing fixtures) and in instrumentation (computer adaptation, electronic support and strain gauge expertise). In operation since 1984, the laboratory is a single, air-conditioned complex that features a high-bay structural testing facility and a one-story materials testing area. In the high bay, structures such as bridge supports and steel beams can be bolted to the 40' by 75', 24" thick, concrete floor. In the materials area, specimens such as graphite composites can be subjected to a variety of tension, compression and twisting forces. Components are positioned in the structures test area with the aid of a 20-ton overhead bridge crane. Holes through the floor on 3' centers provide attachment points for fixtures and reaction frames.

Capacity: Closed-loop servo-hydraulic structural test systems, servo-controlled actuators and electro-mechanical screw-driven material test systems offer up to 500,000 pounds of load for compression and tension testing. Equipment includes the following: MTS High Axial

Capacity Test System — Fatigue rated to a full capacity of 500,000 pounds, tests controlled from stroke, strain and load feedback signals. MTS Axial-Torsional Test System — Fatigue rated to 20,000 pound axial capacity, 12,000 in-pound torque capacity. MTS Axial-Precision Test System — Precisely aligned crosshead and grips produce superior results in compression testing. MTS High Rate Material Test System — Operated as open-loop or closed-loop servo hydraulic test system. MTS Axial Test System — Applies axial loads to a test specimen, fatigue rated to 20,000 pounds. MTS Structural Actuators — 22 kip, 55 kip, 110 kip capacities, capability to push or pull in any direction using any combination of actuators and the strong lab floor. Instron 1125 Axial Materials Test System — Electro-mechanical screw-driven material test system with 20,000 pound axial capacity.

Projects: Static and dynamic load testing of bridge structures, offshore structures, roadside safety structures. Damage characterization of composite materials. Low-temperature fracture toughness testing.

Available for Outside Use: Yes

TX-15

Owner: Southwest Research Institute (SwRI)

Facility: Anechoic Chambers, San Antonio, TX 78228-0510

Contact: Merle Converse, Assistant Director, P.O. Drawer 28510

Telephone: 512-522-2716 **FAX:** 512-522-5499

General: SwRI owns and operates three (3) anechoic chambers. One chamber is an acoustic chamber 12' x 17' x 9' with a range from 125 Hz. Another chamber is an RF-type chamber with a range of 30 MHz to 46 GHz measuring 10' x 10' x 16'. The third measures 12' x 8' x 6' and has a dynamic range from 2 GHz to millimeter wave.

Projects: The RF chambers are utilized in the TEM-PEST and antenna design and development work done at the Institute. The acoustic chamber is used by the electronics division for a variety of noise suppression work.

Available for Outside Use: Yes

TX-16

Owner: Southwest Research Institute (SwRI)

Facility: Crash Track, San Antonio, TX 78228-0510

Contact: Glenn W. Deel, Senior Engineering Technologist, 6220 Culebra Road, P.O. Drawer 28510

Telephone: 512-522-2427 **FAX:** 512-522-3042

General: Guardrail crash facilities at Brooks AFB runway and within the acceleration test track at SwRI Facility.

Unique: SwRI Facility is a slotted facility approximately three quarters (3/4) of a mile long.

Capacity: Self-contained digital acquisition system, high speed photography, instrumented dummies.

Projects: Testing of median guardrails, bridge rails, anti-terrorist security barriers, light standards, and other highway appurtenances.

Available for Outside Use: Yes

TX-17

Owner: Southwest Research Institute (SwRI)

Facility: High Capacity Tensile Facility, San Antonio, TX 78228-0510

Contact: George K. Wolfe, Manager, P.O. Drawer 28510

Telephone: 512-522-2428 **FAX:** 512-522-3042

General: The high capacity tensile facility is capable of 6.5 million pound tension and 1.75 million foot-pound bending on a specimen 5' in diameter and 17' long (active stroke 3.5").

Projects: Testing risers and other structural members for offshore oil platforms.

Available for Outside Use: Yes

Comment: This facility is supported by an intermediate load capacity, high elongation facility; a combined external pressure and tension facility; and an intermediate load capability.

TX-18

Owner: U.S. Department of Energy, Southwest Research Institute (SwRI)

Facility: Energy Alternative Fuel Center, San Antonio, TX 78228-0510

Contact: Thomas W. Ryan, P.O. Drawer 28510

Telephone: 512-522-3192 **FAX:** 512-522-2019

General: The Alternative Fuel Center can provide 5- to 500-gallon quantities of special fuels to support the research efforts of the nation's Alternative Fuels Research Program. Established in 1982 for DOE programs, the services of the center are also available to other organizations on a non-interference basis.

Unique: A hydrotreater pilot plant converts a variety of different materials to fuel-quality products through hydrogenation.

Capacity: Records are maintained of all fuels received and shipped, inventories, blending, and fuel properties. Data management system can generate periodic reports of fuel movements, construct tabulations of fuel analyses and locate and list fuels with specific properties.

Projects: In its most active three years of operation, the Center provided 26 fuels totaling 2,490 gallons to 11 alternative fuels research programs. More recently,

about 2,010 gallons of fuel have been produced involving 26 different fuels for 10 projects.

Available for Outside Use: Yes

TX-19

Owner: Southwest Research Institute (SwRI)

Facility: Seismic Simulator, San Antonio, TX 78228-0510

Contact: Roger L. Bessey, Manager, P.O. Drawer 28510

Telephone: 512-522-2345 **FAX:** 512-522-5122

General: The SwRI designed electrohydraulic biaxial shaker system rides on orthogonal bearing sets to provide simultaneous, uncorrelated motion in both vertical and horizontal planes. Test run include: independent biaxial excitation; resonance frequency search; sine dwell, sine beat, and random earthquake simulation; follow taped earthquake signals; envelope required response spectra; and electrical and mechanical functional checks.

Unique: The table can accommodate test objects up to 6,000 pounds dead weight.

Capacity: High-speed magnetic recorders of real-time computer analysis of the imposed seismic event.

Projects: Used frequently to test components intended for installation in nuclear energy plants as well as conventional power production plants. Significant test work is done for the communications industry and for many aerospace manufacturers as well as for NASA.

Available for Outside Use: Yes

TX-20

Owner: Southwest Research Institute (SwRI)

Facility: Pendulum Impact Facility, San Antonio, TX 78228-0510

Contact: Kirk A. Marchand, Manager, P.O. Drawer 28510

Telephone: 512-522-3695 **FAX:** 512-522-3042

General: The pendulum impact facility is used primarily to evaluate materials, structures, and vehicular components at impact velocities to 40' per second. The impacting medium is a steel-reinforced, concrete mass with either a hard, unyielding impact face or a staged, crushable aluminum honeycomb nose to simulate vehicle deformation.

Unique: The first Federal Highway Administration-qualified facility where an 1,800-pound mass utilizing the recently designed crushable nose is commercially available for developmental and experimental work.

Capacity: Test data are recorded by both electronic and photographic equipment. Signals from accelerometers mounted on the rear of the mass are monitored continuously on high speed magnetic recorders.

Projects: Used to impact guardrails, bridge rails, light standards and other roadside appurtenances.

Available for Outside Use: Yes

Comment: Many types of impact events can be modeled with the pendulum facility, which offers a method to explore the performance of structural systems before utilizing more costly full-scale simulations.

TX-21

Owner: Southwest Research Institute (SwRI)

Facility: Test Track, San Antonio, TX 78228-0510

Contact: Johnny M. Kitchens, Manager, P.O. Drawer 28510

Telephone: 512-522-2821 **FAX:** 512-684-2375

General: A 1.2 mile oval asphalt track which is fenced, secured, lighted for evening work and features a warning light of operations.

Capacity: Data acquisition for the test track is all portable and is not left at the track unattended.

Projects: Transmission testing, transmission fluid testing, acceleration testing, suspension system testing, engine coolant testing, air conditioning coolant testing, tire testing.

Available for Outside Use: Yes

TX-22

Owner: The University of Texas at Austin

Facility: Center for Research in Water Resources, Balcones Research Center, Austin, TX 78712

Contact: Randall J. Charbeneau, Director and Professor of Civil Engineering

Telephone: 512-471-3131 **FAX:** 512-471-0072

General: Administrative building houses offices, conference areas, computer equipment and classrooms. Adjacent laboratory building houses all equipment, instrumentation and data acquisition systems necessary for major laboratory and field studies. In addition, there is substantial outdoor area for models and experimentation.

Unique: Hydraulic and Environmental Laboratory for large-scale hydraulic studies and field investigations. Current models include a 75' recirculatory flume, a 70' scale model of a side-weir, and a 100' meandering channel.

Projects: "Hydraulic Studies of Side-Channel Weirs and Related Problems for Regional Detention Ponds," and "Hydraulic Characteristics of Recessed Curb Inlets and Bridge Drains"

Available for Outside Use: No

TX-23

Owner: The University of Texas at Austin
Facility: Ferguson Structural Engineering Laboratory-Expansion, 10100 Burnet Road, Building 24; Austin, TX 78758

Contact: Karl H. Frank, Director

Telephone: 512-471-4590 **FAX:** 512-471-1944

General: 20,000 square foot high rise extension to existing laboratory. The six-story extension will house a 6 million pound universal test machine and 7,000 square foot test floor with a companion test wall.

Unique: Full size static and dynamic testing of structures.

Capacity: 5 million pound test capacity up to approximately 30' length. Flexural test specimens over 100' in length.

Projects: Anticipated use will be seismic tests of components and full scale structural tests.

Available for Outside Use: Yes

Comment: This new addition in conjunction with the existing Ferguson Lab facility, will be the largest structural test facility in the U.S.

TX-24

Owner: The University of Texas at Austin

Facility: Ferguson Structural Engineering Laboratory-Large Force Tension Test Facility, 10100 Burnet Road, Building 24, Austin, TX 78758

Contact: Karl H. Frank, Director

Telephone: 512-471-4590 **FAX:** 512-471-4590

General: Large force tension test facility, static capacity 4 million pounds, fatigue capacity 1.6 million pounds. Designed to test cables and other large tension specimens.

Unique: Large test forces and rapid test setup.

Capacity: 1.6 million pound fatigue, 4 million pound static. Maximum specimen diameter 14," specimen length 14 to 18.'

Projects: Fatigue tests of stay cable anchorages. Full size fatigue tests of pipe riser welds.

Available for Outside Use: Yes

Comment: Unique test facility; when built, most cable stays in the U.S. were tested in facility. Able to do random fatigue testing as well as sinusoidal loading.

TX-25

Owner: The University of Texas at Austin

Facility: Ferguson Structural Engineering Laboratory-Structural Test Facility, 10100 Burnet Road, Building 24, Austin, TX 78758

Contact: Karl H. Frank, Director

Telephone: 512-471-4590 **FAX:** 512-471-1944

General: 9,000 square foot structural test floor and reaction wall, capable of testing full size as well as

prototype structures. Forces over 1 million pounds, both static and dynamic loading.

Unique: Large floor with complete access by overhead crane and truck with closed and open loop hydraulic loading equipment. 600,000 pound university test machine incorporated into test floor.

Capacity: 9,000 square foot test floor and 1,300 square foot reaction wall with large variety of loading rams to over 2 million pounds.

Projects: Tests of bridge components 2/3 to full scale. Tests of anchor bolts, seismic retrofits, high strength concrete, and new steel and concrete girder designs.

Available for Outside Use: Yes

Comment: Large general purpose structural laboratory with supporting equipment such as computerized data acquisition systems, variety of hydraulic power supplies, test frames, and trained technical staff.

TX-26

Owner: Texas Tech University, Department of Civil Engineering

Facility: Wind Engineering Field Research Laboratory, Lubbock, TX 79409

Contact: Dr. Kishor C. Mehta, Professor, Department of Mechanical Engineering, Mail Stop 1023

Telephone: 806-742-3475 **FAX:** 806-742-3540

General: Wind Engineering Field Research Laboratory consists of three main components: a 30' x 45' x 13' prefabricated metal test building that can be rotated; a 160' tall guyed tower carrying meteorological instrumentation; and a concrete block building housing the data acquisition system.

Unique: Test building which has the ability to be rotated thus providing researchers with the control of wind angle-of-attack. Ability to measure wind speed at four different elevations.

Capacity: Wind speed measurements at 13, 33, 70 and 160.' Wind direction at 33 and 160.' Temperature at 0 and 160.' Barometric pressure and relative humidity at 13.'

Projects: Studies of wind induced pressures on low rise buildings, building internal pressures, atmospheric stability, performance of loose-laid roof paving systems, flow visualization.

Available for Outside Use: No

TX-27

Owner: Texas Tech University, Department of Civil Engineering

Facility: Thin Section Concrete Pavement Test Site, Reese Air Force Base, Lubbock, TX 79409

Contact: Dr. Warren K. Wray, Professor and Chairman, Box 41023

Telephone: 806-742-3524 **FAX:** 806-742-3488

General: Thin (6") full scale concrete test pavement with different types of reinforcements: 1) Polypropylene Geogrid (Tensar SS-2), 2) Conventional mild steel rebar, and 3) conventional welded wire fabric reinforcement. The test pavement sections are instrumented with concrete strain gages near the top and bottom of the pavement, pressure sensors located near the base of the concrete pavement, geophones to measure deflection under the load, temperature sensors to measure temperature gradients through the depth of the pavement, and thermocouple psychrometers to measure changes in soil moisture conditions and soil temperature. Data acquisition is through a 386-20 MHz PC located in a skid mounted portable shelter at the test location.

Unique: Pavement test site with complete instrumentation to monitor effects of loading as well as environment. Test site is located on Reese Air Force Base in Lubbock and has complete information on axle loadings and climatic data is available.

Capacity: 24 ft, 2 lane pavement section: 6 in. concrete slab over 6 in. chalice base. 3 separate sections each approximately 85 ft in length. Portable data acquisition system collecting data from 219 sensors.

Projects: Comparison of the serviceability of a polypropylene geogrid reinforced section with conventionally reinforced concrete pavement section.

Available for Outside Use: Yes

Comment: Site is located on Reese AFB. Outside users are able to access the site subject to prior approval by Reese AFB.

TX-28

Owner: Texas Tech University, Department of Civil Engineering

Facility: Water Tow Tank Facility, Lubbock, TX 79409

Contact: Dr. Walt Oler, Professor, Department of Mechanical Engineering

Telephone: 806-742-3563

General: 60,000 gallon capacity water tow tank facility is 80' long, 35' wide and 10' deep. It contains a towing carriage capable of moving up to 10 fps velocity. When objects are connected to the carriage and are pulled through the water, a flow past the object is represented 15 times as fast because of the difference in kinematics viscosity. Thus the 10 fps speed in water corresponds to 150 fps (or 100 mph) in air.

Unique: Only underwater tow tank dedicated to aerodynamics.

Capacity: 80' long x 35' wide x 10' deep.

Projects: Studying drag coefficients for octagonal shaped light posts (for TxDOT); Automotive Aerodynamics (Ford Motor Co.); Parachute Dynamics (Sandia Labs);

Wake Interaction of Jet Aircraft Wings (Sandia Labs); Wind Generating Turbines (Sandia Labs).

Available for Outside Use: No

Utah

UT-1

Owner: Thiokol Corporation

Facility: Environmental Conditioning Chambers, Space Operations, PO Box 707, Brigham City, UT 84302-0707

Contact: Paul Peterson, Supervisor, Facilities Planning, M/S 556

Telephone: 801-863-6916 **FAX:** 801-863-4198

General: Walk-in environmental exposure chambers designated as T-15 (6 chambers), T-51 (3 chambers), and T-3 (3 chambers) ranging from 4,400 cubic feet to 5,760 cubic feet. Electronically controlled for temperature cycling from -100° to 200°F. Equipped with failure and out-of-specification warning devices.

Unique: One chamber (4,000 cubic feet) capable of performing salt, fog and rain test. Three chambers capable of combined temperature and humidity testing.

Capacity: -100° to 200°F constant temperature or temperature cycling.

Projects: Long term aging, combined temperature/humidity tests and pre-firing temperature conditioning of solid rocket motors and components.

Available for Outside Use: Yes

Comment: Chambers are walk-in and include rails for storage carts to move test specimen in and out of chambers. Occasionally used to test commercial vehicles such as snowmobiles.

UT-2

Owner: Thiokol Corporation

Facility: T-53 Vibration Test, Space Operations, PO Box 707, Brigham City, UT 84302-0707

Contact: Paul Peterson, Supervisor, Facilities Planning, M/S 556

Telephone: 801-863-6916 **FAX:** 801-863-4198

General: T-53 vibration facility including electrodynamic shakers and electrohydraulic shakers capable of up to 160,000 force pounds. Types of testing include vibration, shock, and handling. The facility can test specimens measuring 20' by 35' by 20' high. Equipment includes digital control system, FM instrumentation system and 50-ton bridge crane.

Unique: 5 million pound reaction mass. Control room located remotely for safe testing of hazardous specimens.

Capacity: Hydraulic vibration system capable of forces up to 160,000 pounds force at low frequencies and

electro-dynamic system capable of 64,000 pounds from 5 to 2000 Hz.

Projects: Vibration testing of solid propellant rocket motors and components.

Available for Outside Use: Yes

UT-3

Owner: Thiokol Corporation

Facility: T-18 Structural/Hydrotest, Space Operations, PO Box 707, Brigham City, UT 84302-0707

Contact: Paul Peterson, Supervisor, Facilities Planning, M/S 556

Telephone: 801-863-6916 **FAX:** 801-863-4198

General: Bay is 39' high, 20' wide and 40' long. Contains a 50-ton overhead bridge crane.

Unique: Instrumentation recording capacity of 510 digital channels and 20 FM channels.

Capacity: More than 1 million pounds of load capacity that can be combined with up to 5,000 psi hydrostatic pressure for pressure vessel tests.

Projects: Structural test of solid propellant rocket motor cases.

Available for Outside Use: Yes

UT-4

Owner: Utah State University

Facility: Open Channel Flumes, Utah Water Research Laboratory, Logan, UT 84322-8200

Contact: L. Douglas James, Director

Telephone: 801-750-3168 **FAX:** 801-750-3663

General: Variety of open channel flumes: 1, 2, and 3' wide tilting flumes, plus stationary one 6' by 8' by 500'. Water supplied from reservoir through 4' diameter concrete pipe, and distributed throughout the laboratory through steel pipes beneath the floor. Large capacity weigh tanks and volumetric tanks. Open space for physical models.

Unique: Large capacity indoor hydraulic test facilities in open area with supply and drains throughout. Experienced faculty. 6' by 8' by 500' good for large scale models such as for bridge piers.

Capacity: Flows greater than 150 cubic feet per second, static head of water supply of 35' with pumping capacity to 550'. Flow measurement with accuracy of 1.25%.

Projects: Model studies of hydropower plant intake structures, spillway, stilling basin, pump pits, as well as numerous tests of hydraulic equipment. Erosion and sediment studies of diversion structures, road crossing, energy dissipators, etc.

Available for Outside Use: Yes, available for outside work but only under the supervision of UWRL professionals.

UT-5

Owner: Utah State University

Facility: Environmental Quality, Utah Water Research Laboratory, Logan, UT 84322-8200

Contact: William Doucette, Associate Professor and Laboratory Manager

Telephone: 801-750-3178 **FAX:** 801-750-3663

General: Research laboratory for evaluation of fate and transport of hazardous organic and inorganic chemicals in air, water, and soil environments.

Unique: Certified for handling radiolabelled chemicals.

Capacity: Analytical instrumentation for organic and inorganic chemicals; treatability facilities.

Projects: 1) Soil treatability studies; 2) Underground storage tank leakage and remediation; 3) Chemical analysis of soil and water.

Available for Outside Use: No

UT-6

Owner: Utah State University

Facility: Rainfall Simulator, Utah Water Research Laboratory, Logan, UT 84322-8200

Contact: L. Douglas James, Director

Telephone: 801-750-3168 **FAX:** 801-750-3663

General: A 400 square foot indoor drip-type rainfall simulator; a 400 square foot tilting test flume containing soil; a 400 square foot sunlight simulator; and a uni-directional wind generator. Also, two 4' by 50' soil-filled high-velocity test channels.

Unique: Provides control of soil, slope, sunlight, wind, and rainfall rate and duration for erosion studies. Can also control quantity and velocity of flow for channelized studies.

Capacity: Produces rainfall from 1" to 30" per hour; sunlight is suitable for plant growth; flume tilts from horizontal to 1.5:1 slope; wind velocity to 60 mph; and high-velocity water flows in channels more than 20 feet per second and 75 to 100 cubic feet per second.

Projects: Determining the effectiveness of various erosion control products in reducing soil erosion on highway cuts and fills, and in minimizing erosion of channels caused by high-velocity stream flows.

Available for Outside Use: Yes, available for outside work but only under the supervision of UWRL professionals.

Virginia**VA-1**

Owner: Department of the Army, Belvoir Research, Development and Engineering Center (BRDEC)

Facility: Rail Impact Facility, Fort Belvoir, VA 22060-5606

Contact: Carl Hasle, Chief, Test Operations Branch

Telephone: 703-664-5719

General: Rail impact at 5 to 12 mph. **Limitation:** rail car cannot be turned end for end. Test item must be removed and itself turned for impact in opposite direction.

Projects: Rail impact of generators (skid and trailer mounted).

Available for Outside Use: Yes

VA-2

Owner: Department of the Army, Belvoir Research and Engineering Center

Facility: Center for Night Vision and Electro Optics, Ft. Belvoir, VA 22060

Contact: Walter Morrow, ODS Coordinator, AMSEL-RD-NV-VMD-LET

Telephone: 703-664-5104 **FAX:** 703-354-0100

General: The U.S. Army CECOM Center for Night Vision and Electro Optics maintains a Terrain Board for testing and evaluating Automatic Target Recognizers (ATRs). This is a technique for Ground/Image Truthing using a digital map.

Unique: A combination of ground truth and image truth procedures has been devised that minimizes the number of location measurements made, thus reducing set-up time.

Projects: Army Automatic Target Recognizers, Human Aided Search, Sensor Evaluation.

Available for Outside Use: Yes

VA-3

Owner: Department of the Army, Belvoir Research, Development and Engineering Center (BRDEC)

Facility: Digital Load Control System, Fort Belvoir, VA 22060-5606

Contact: William Mitchell, Project Engineer, ATTN: STRBE-JBA

Telephone: 703-664-5594 **FAX:** 703-781-8262

General: Four channel Digital Load Control System (DLCS) designed for static, dynamic and fatigue testing of Army Bridging Systems. The hardware can apply a static load of up to 100,000 pounds at each actuator (total of 400,000 pounds) and a dynamic load of up to 70,000 pounds at each actuator (total of 280,000 pounds). Under cyclic loads a rate of up to 4 cycles per minute

for a 24" displacement with a total working stroke length of 36."

Unique: A complete turn-key, multi-channel, digital load control system with auxiliary data acquisition capabilities. Each of the actuators can be operated independently.

Capacity: The Data Acquisition System has a total of 128 data channels.

Projects: The DLCS has been upgraded recently for dynamic testing. The last two years, the typical projects have been static loads for military bridges.

Available for Outside Use: Yes

VA-4

Owner: Department of the Army, Belvoir Research, Development and Engineering Center (BRDEC)

Facility: Climatic Chamber, Fort Belvoir, VA 22060-5606

Contact: Mr. Covington, Lead Engineering Technician

Telephone: 703-664-5870

General: Chamber facility is being rebuilt as a result of a fire that occurred in 1988.

Unique: High Temperature up to 160°F.; Low Temperature down to -60°F; Humidity up to 100%; and Altitude up to 32,000.' Personnel can enter and exit chamber during altitude testing by a small entrance chamber.

Projects: Climatic testing of generators, air compressors, fuel distribution system, and engine.

Available for Outside Use: Yes

VA-5

Owner: Department of Transportation, Federal Highway Administration

Facility: Hydraulics Laboratory, Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101

Contact: J. Sterling Jones, Research Hydraulics Engineer

Telephone: 703-285-2474 **FAX:** 703-285-2379

General: Hydraulics Laboratory has a recirculating pumping system to pump up to 6,000 gallons per minute (gpm) through a 6' wide x 70' long tilting flume.

Unique: Flume tilts longitudinally and transversely has a sediment recess for bridge scour studies. A catch box below the flume has a "v" notch weir for measuring intercepted flow from inlets.

Capacity: 6,000 gpm pumping capacity; tilt slopes up to 15%.

Projects: Developed procedures for sizing riprap to protect bridge piers and abutments from scour. Grote inlet capacity (hydraulic) tests.

Available for Outside Use: Yes

VA-6

Owner: Department of Transportation, Federal Highway Administration

Facility: Highway Safety Information System (HSIS), Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101-2296

Contact: Jeffrey F. Paniati, Manager HSIS

Telephone: 703-285-2568 **FAX:** 703-285-2379

General: The HSIS Laboratory provides the facility for the operation of the Highway Safety Information System. The HSIS contains information from five States (Illinois, Maine, Michigan, Minnesota, and Utah) on all police reported accidents on the State-maintained highway system for 1985 through 1989. It also contains the latest roadway inventory and traffic volume data for these roads.

Unique: Two powerful microcomputer systems (with rewritable optical disk storage) for data analysis. Video-disc-based photo log viewing system for collection of roadway data.

Capacity: Since the HSIS is composed of data from various data files within five different States, and because these files can be merged with each other for a specific analysis question, the HSIS provides the flexibility to analyze many safety problems. These will range from the more basic "problem identification" issues in which the analyst is attempting to study accident or roadway factors leading to a high accident rate to multivariate modeling efforts in which the analyst is attempting to predict future accidents from roadway characteristics and traffic factors.

Projects: Current topics include: Median and crossover accident rates; Older driver accident characteristics; Freeway lighting effectiveness; Truck accident characteristics; Roadside hazard severity; Pedestrian accident traits.

VA-7

Owner: Department of Transportation, Federal Highway Administration

Facility: Federal Outdoor Impact Laboratory (FOIL), Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101-2296

Contact: Richard King, COTR

Telephone: 703-285-2468 **FAX:** 703-285-2379

General: Impact testing of roadside safety hardware through full-scale crash tests using small cars or surrogate vehicles. The facility has a single track with a universal sign mount and two soil pits for testing signs. Pendulum testing is available for certain types of hardware or components.

Unique: Reusable test vehicle (bogie) representing a small car. Crash test vehicles in frontal and side impacts.

1,850 pound pendulum for pendulum testing up to 20 mph.

Capacity: One bogie test every 1 to 2 days. Vehicle crash test every 2 to 3 days. Able to test 1,850 pound vehicle at speeds up to 60 mph, 2,700 pound cars at 58 mph, and 3,000 pound cars at 55 mph.

Projects: Investigated the effect on small vehicles of side impact with roadside hardware. Investigated problems of slip-base luminaries not activating. Conducted testing of large and small signs system, currently in use by the States, using 1,850-pound small vehicles of modified end terminals for guardrail systems.

Available for Outside Use: No

Comment: This is the only facility in the U.S. that can test small car side impact crashes into roadside hardware.

VA-8

Owner: Department of Transportation, Federal Highway Administration

Facility: Pavement Isothermal Test System (PITS), Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101

Contact: James A. Sherwood, Highway Research Engineer

Telephone: 703-285-2619 **FAX:** 703-285-2791

General: The Pavement Isothermal Test System is a temperature controlled room, about 20' by 30'. Two 10' by 10' asphalt concrete pavements were constructed on 7' of clay subgrade. The pavement sections have an 8" crushed stone base, a thin 2.6" and a thick 6.6" asphalt concrete surface.

Unique: Controlled temperature and moisture/instrumented pavements.

Capacity: 0° to 100°F., 11,000 pound load.

Projects: The Pavement Isothermal Test System was last used to test prototype pavements in about 1977. This was to test a Portland Cement Concrete overlay of the original asphalt concrete pavement. In 1976, an extensive test series was completed on the two asphalt concrete pavements, at four temperatures and three loads. This data has been reduced, and is still being analyzed.

Available for Outside Use: No

Comment: Plans have been made to perform an analysis of the data collected under the Phase 2 testing in 1976. Plans have been made to perform a test series with the objective of quantifying the difference between moving and stationary pulsed loads. The PITS have been used to house the FHWA Multiple Fatigue Testing Apparatus, for temperature control.

VA-9

Owner: Department of Transportation, Federal Highway Administration

Facility: Highway Driving Simulator Laboratory (HYSIM), Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101-2296

Contact: King M. Roberts, Manager, HSR-30

Telephone: 703-285-2008 **FAX:** 703-285-2379

General: The central feature of HYSIM is the car cab. Except for engine and drive train, the car is complete with drivers participating in an experiment actually "driving" the car. All primary controls (the accelerator, brake and steering wheel) are functional and the "feel" of the controls has been carefully maintained. Secondary controls (lights, horn, shift selector, switches, etc.) also function. As the driver operates the car, a roadway scene is projected on a wide screen located near the front of the car. The displayed roadway scene elements come from two sources. Roadway delineations and a few other scene elements are computer generated by special graphics hardware; overhead and shoulder mounted signs and traffic signals are projected by four 35 mm slide units equipped with computer controlled zoom lenses and mirrors.

Unique: All projection equipment is computer controlled. Thus, the displayed scene responds to the driver's manipulations of the car controls. Signs, moving in registry with the roadway, increase in size and brightness as the driver approaches. As the driver speeds up, elements in the roadway scene appear to move by more quickly; and as the steering wheel is turned, the scene shifts in azimuth to simulate a heading change.

Capacity: Other HYSIM capabilities include simulation of 1) head and cross wind(s); 2) wet or icy road surfaces; 3) different sets of vehicle dynamics; 4) fog; 5) wind, engine/drive train, and road noises, and a siren sound when drivers exceed specified speed; 6) presentation of an approaching or passing vehicle; and 7) simulation of on-board audio and visual navigation and information devices.

Projects: "Driver Responses to Active Advance Warning Signs at High Speed Signalized Intersections," "Effects of Supplemental Interchange Signing on Driver Control Behavior," "Construction Zone Vertical Sequential Sign Display Evaluation," "Comparison of Flagger Symbols," "Variable Speed Limit System: System Design," and "Noticeability Requirements for Delineation on Non-Illuminated Highways."

Available for Outside Use: No, except FHWA contractors.

VA-10

Owner: Department of Transportation, Federal Highway Administration

Facility: Human Factors Laboratory and Graphics Center, Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101-2296

Contact: King M. Roberts, Manager, HSR-30

Telephone: 703-285-2008 **FAX:** 703-285-2379

General: Human Factors Laboratory (HFL) provides a working environment for study of drivers' capabilities and limitations. Historically, the facility has been used to conduct applied studies evaluating the potential effectiveness of either new or modified traffic control devices through improvements in conspicuity, legibility, detection, and message content. More fundamental, theoretical studies concerning basic issues of human perception, cognition, and motor functions involved in driving tasks are also performed.

Unique: The laboratory recently acquired equipment to present stimuli on 35 mm slides. The images can be "moved" toward subjects such that the image expands at a preset rate to simulate the usual angle expansion of real-world roadway signs or other roadway features.

Capacity: Work area 1 is approximately 12' by 40' and provides rear-projection capabilities for slide presentation sequences. This area is painted flat black and is carpeted for noise control. The room has copper screening installed in the walls, ceiling, and floor to exclude radio frequencies and allow collection of very low level physiological signals (heart and respiration rates, galvanic skin response, and electroencephalograms). The area has slide projectors, tachistoscope, stimulus control apparatus, timing devices, psychophysiological measuring modules, and other ancillary electronics. Area 2 contains apparatus to study drivers' behavior at intersections, bifurcations, and entry/exit ramps. A modified Aetna Driv-O-Trainer is used with three wide screen projection televisions and synchronized video cassette recorders. This arrangement allows highly detailed, 120-degree field-of-view scenes, similar to motion pictures, to be presented to drivers.

Projects: "The Legibility of Features on Interstate Guide Signs," "Legibility and Driver Response to Selected Lane and Road Closure Barricades," "Driver Perception of Risk and Its Relationship to Highway Geometry," "Driver Behavior Analysis of the Highway Guidance System," "Driver Response to Intersections: Analysis of Workload-Related Variables," and "The Performance of Drivers with Physical Limitations at T-Intersections."

Available for Outside Use: No, except FHWA contractors.

VA-11

Owner: Department of Transportation, Federal Highway Administration
Facility: Roadside Safety Library (RSL), Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101-2296
Contact: Leonard C. Meczkowski, RSL Manager
Telephone: 703-285-2420 **FAX:** 703-285-2379

General: The RSL contains a library of analytical tools, crash test films, and computer simulation models specifically designed for the investigation of vehicles impacting roadside hardware. Computer simulation of vehicle/barrier crashes is an essential element in the process of designing roadside hardware. The cost of computer simulation is considerably less than the alternate — full-scale tests.

Capacity: Computer programs GUARD and Numerical Analysis of Roadside Design (NARD) have been developed to simulate crashes into roadside hardware. Improvements have been made to the programs to provide a terrain model, to improve the input and output formats, and to provide an easy method to interpret the results. Also the NARD program has been installed in the PC environment.

Projects: The library programs have been used to help a State in litigation involving a truck skidding into a concrete median barrier. The computer simulation had a significant impact in reducing the million dollar law suit to a low cost out-of-court settlement. The programs were used to help the Office of Highway Safety develop guidance for States in the placement of cable guardrail on slopes. They were used to provided guidance for reducing the post spacing for less deflection in Georgia, and for increasing post spacing in Michigan over culvert inlets.

Available for Outside Use: Yes, films only.

VA-12

Owner: Department of Transportation, Federal Highway Administration
Facility: Petrographic Laboratory, Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101
Contact: Dr. Stephen W. Forster, Research Geologist, Pavements Division - HNR-20
Telephone: 703-285-2073 **FAX:** 703-285-2379

General: The Petrographic Laboratory performs examination, identification and analysis of aggregate, bituminous mixtures, and concrete samples. Analyses are performed on the entrained air void systems in portland cement concrete.

Unique: Image analysis system for examining voids, in concrete, and surface texture of aggregate and pavement samples.

Projects: 1) Distress analysis of portland cement concrete. 2) Staff study on microtexture and pavement friction.

Available for Outside Use: No

VA-13

Owner: Department of Transportation, Federal Highway Administration
Facility: Pavement Testing Facility, Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101
Contact: Ramon Bonaquist, Highway Research Engineer
Telephone: 703-285-2629 **FAX:** 703-285-2791

General: The Pavement Testing Facility is an outdoor, full scale pavement testing laboratory. It includes the Accelerated Loading Facility Pavement Testing Machine, 12 instrumented test sections, and a computer data acquisition system. The facility provides the capability to study pavement response and performance under simulated axle loading conditions.

Unique: Accelerated Loading Facility Machine, instrumented test sections.

Capacity: Accelerated Loading Facility applies 8,500 load repetitions per day. Facility operated 24 hours per day, 7 days per week. Loads to 22,500 pound per dual axle.

Projects: Effect of tire pressure on flexible pavement damage. Assessment of the damage potential of wide base single tires.

Available for Outside Use: No

VA-14

Owner: Department of Transportation, Federal Highway Administration
Facility: Photometric and Visibility Laboratory, Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101-2296
Contact: John B. Arens, Manager
Telephone: 703-285-2427 **FAX:** 703-285-2379

General: Basic Laboratory is 120' by 14' by 8' high. All interior surfaces are painted flat black. Two continuous rows of florescent 4-lamp luminaries providing 6 lighting levels. Full heating and AC available. A central room 14' by 24' by 8' high is integrated with the laboratory. One end wall of laboratory is removable to extend visual range. Laboratory can accommodate full sized vehicle.

Unique: A longitudinal curtain plus 2-4' by 4' optical mirrors provide for a 240' visibility range. A "people mover" is planned to allow dynamic studies using subjects in evaluating new Traffic Control Devices.

Projects: Facility has just been completed. Retroreflective measurements, solar evaluations, spectro-radiometric work.

VA-15

Owner: Department of Transportation, Federal Highway Administration

Facility: Structures Laboratory, Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101

Contact: Lloyd R. Cayes, Laboratory Manager

Telephone: 703-285-2471 **FAX:** 703-285-2379

General: Open laboratory with strong floor 50' by 160' by 31' high with two 20-ton cranes, heated and air conditioned. Laboratory test control center is 18' by 36,' shop 15' by 24' and office 16' by 20.' Digital data acquisition system, 300 channels, for recording strains, loads, rotations, deflections, etc.

Unique: The entire laboratory structural floor system is instrumented with weldable strain gages, Carlson strain gages, soil interface pressure meters, and thermocouples. This provides the unique capability to monitor the response of the floor during testing.

Capacity: The 573 tie down holes are in a grid at 3' centers. Each hole is capable of handling a 1,000 kip load, or greater, if a base plate is used to distribute the load to prevent punching. The loads may be applied horizontally or vertically when using either the MTS servo-hydraulic loading system with jacks for fatigue testing or the Enerpac hydraulic system with loading cylinders for static testing. Both static and fatigue testing can be done independent of each other. MTS includes 140 gallons per minute (gpm), 40 gpm, and 10 gpm pumps. MTS servo-hydraulic actuators include 4-220 kip, 3-110 kip, 2-70 kip, and 2-20 kip capacity.

Projects: Full bridge model of 0.4 scale, two span, 3 girder continuous, 113' long, 19' wide. 15 welded plated girders being tested under variable amplitude fatigue. 50 rectangular prestressed concrete specimens being tested for bond transfer and development length. 16 concrete deck panels with fiber composite reinforcement.

Available for Outside Use: No

VA-16

Owner: Department of Transportation, Federal Highway Administration

Facility: G.S. Vincent Aerodynamics Laboratory, Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, McLean, VA 22101

Contact: Harold R. Bosch, Laboratory Manager

Telephone: 703-285-2753 **FAX:** 703-285-2379

General: A large room (40' by 75' by 18' high) containing an open circuit wind tunnel for evaluating the

aerodynamic stability of long span bridges and other highway structures. Room is heated and air conditioned. Model design and fabrication facilities are available. A laboratory office (20' by 40') adjacent to the laboratory contains various computer facilities for analysis and evaluation of test data.

Unique: Two D.O.F. large scale, active turbulence generators. Three D.O.F. motor driven sensor traverse systems (8' by 8'). Three component high-frequency, dual force-balance systems. Three high speed data acquisition systems (200 channels).

Capacity: During normal operation, air enters through the double inlet section of the tunnel, passes through a diffusing section containing a series of screens, and exits through a 6' by 6' nozzle into the test area. The air then recirculates down the sides of the room on its return to the inlet section. This wind tunnel, with its capacity of 110,000 cubic feet per minute, can generate extremely smooth flows at speeds up to 50 feet per second. For experiments where turbulent flow is desired, an active turbulence generator is inserted into the circuit. The vertical angle of the wind can change.

Projects: Evaluation of various structural modifications for improving the aerodynamic performance of a 50-year-old suspension bridge. Measurement of wind conditions and bridge response at two long span bridge sites. Measurement and cataloging of wind force coefficients on general structural shapes.

Available for Outside Use: No

VA-17

Owner: The MITRE Corporation

Facility: Vehicular Traffic Analysis Capability (VTAC), 7525 Colshire Drive, McLean, VA 22102

Contact: Michael F. McGurrin, Associate Department Head

Telephone: 202-863-2974 **FAX:** 202-863-2988

General: Traffic modeling laboratory, including both standard and unique traffic engineering models. Hardware platforms include Sun stations, large Sun server, CD-ROM, color printing and plotting. Software includes VTAC model, NETSIM, FRESIM, CORFIO, and model development languages including MODSIM, SIMGRAPHICS, SIMSCRIPT, D, FORTRAN, etc. TRANPLAN transportation planning tool, GIS tools and processing of TIGER files available. Silicon graphics workstations available.

Unique: VTAC, an object-oriented traffic model designed to assess ATIS and ATMS systems. VTAC is an event-driven, microscopic (individual vehicle) simulation model.

Capacity: VTAC tested on traffic networks on the order of hundreds of nodes, hundreds of links, and several thousand vehicle trips.

Projects: Research and development of object-oriented traffic model for evaluation of Advanced Traveler Information Systems (ATIS) and Advanced Traffic Management Systems (ATMS). Development of model of Troy, MI and analysis of performance of an ATIS system in Troy.

Available for Outside Use: Yes, use by government agencies or academic institutions might be possible.

VA-18

Owner: Insurance Institute for Highway Safety

Facility: Vehicle Safety Research Center, Greene County, Virginia

Contact: Brian O'Neill, President, 1005 North Glebe Road, Arlington, VA 22201

Telephone: 703-247-1500 **FAX:** 703-247-1678

General: The research center will initiate test programs in Fall 1992. It will contain 3 enclosed test tracks to permit barrier and vehicle-to-vehicle crash in a specially equipped laboratory. There will also be an outdoor skid pad for handling and braking tests.

Unique: There will be a strong linkage between real-world crashes and laboratory testing.

Projects: New facility, Fall 1992.

Comment: The staff at the center will be regularly investigating real-world crashes and these investigations will set the direction for much of the laboratory testing.

VA-19

Owner: Old Dominion University

Facility: Dynamic Material Testing, Norfolk, VA 23529-0241

Contact: Dr. Isao Ishibashi, Professor, 147 KDH

Telephone: 804-683-3753 **FAX:** 804-683-5354

General: Various types of repeated or dynamic testing for materials or structural components can be done by the system. The system includes dynamic actuator (2,000 to 100,000 pounds) with electro-servo hydraulic (MTS) unit. Automatic high-speed digital data acquisition system is also available.

Unique: Variety of configuration for material or structural element testings.

Capacity: High speed automatic digital data acquisition system.

Projects: Dynamic response of flexible pipe joints.

Available for Outside Use: Yes

VA-20

Owner: Virginia Polytechnic Institute and State University, Department of Industrial and Systems Engineering

Facility: Human Factors Engineering Center, Blacksburg, VA 24061-0118

Contact: Dennis L. Price, Professor of ISE;

Coordinator, Human Factors, Engineering Center

Telephone: 703-231-6656 **FAX:** 703-231-3322

General: The Human Factors Engineering Center consists of the following laboratories: Rehabilitation Engineering, Vehicle Analysis and Simulation, Auditory Systems, Human-Computer, Environmental and Safety, Displays and Controls, and Industrial Ergonomics. While a given faculty member might devote considerable time to the activities in one or more of these laboratories, that faculty member's interests and activities will almost certainly extend beyond those represented by any one facility. Changing interests of existing faculty or the addition of new faculty can result in changes in a laboratory's direction or use.

Unique: Vital components of the laboratory include the Available Motions Inventory (AMI) apparatus, which is a testing and evaluation device capable of measuring residual abilities of disabled persons through a battery of 71 common occupational tasks. These tasks include switch settings and rates, tests of strength, simple reaction times, and selected line assembly tasks. The Vehicle Analysis and Simulation Lab in the Human Factors Engineering Center contains three major facilities: a moving-base driving simulator, a moving-base aircraft simulator, and a supporting computational system. The driving simulator provides a six degree-of-freedom computer-generated display. Alternatively, videotape scenes can be used. The apparent movements of the roadway images are coordinated with a hydraulically actuated motion platform designed to simulate vehicular movements in yaw, roll, lateral translation, and longitudinal translation. Four channels of sound and vibration are used to enhance realism of the simulation. The Auditory Systems Lab is uniquely equipped for a variety of psychoacoustic research on auditory means of information display. The laboratory also provides an environment for evaluation of hearing protection devices, including Noise Reduction Rating (NRR) determination according to ANSI S12.6-1984. Audiometric testing capability is provided by a stationary Beltone clinical audiometer, affording air and bone conduction test modes as well as a variety of noise masking configurations.

Available for Outside Use: Yes, as contracted or funded by research grants under the direction of faculty.

Washington**WA-1**

Owner: University of Washington, Materials Science
Facility: Scanning Transmission Electron Microscope, Wilcox Hall, Seattle, WA 98195
Contact: Mehmet Sarikaya, Associate Professor, Room 327
Telephone: 206-543-0724
General: Aid in materials research; specialize in advanced ceramic materials.
Unique: Capable of atomic resolution.
Projects: Biomimicking.
Available for Outside Use: Yes

WA-2

Owner: University of Washington
Facility: JEOL Superprobe, Microprobe Laboratory, Geological Sciences, Seattle, WA 98195
Contact: Scott Kuehner, Research Scientist
Telephone: 206-543-8698
General: Analyzes the chemical composition of materials: minerals and metals from boron to samarium.
Capacity: Up to 2,000 magnification; EDS spectra.
Projects: Mantle pressure and temperature tests; What happens to pre-historic materials (flint, etc.) when heat treated; Diffusion profiles in glass and minerals.
Available for Outside Use: Yes

WA-3

Owner: University of Washington
Facility: Superconducting Booster, Nuclear Physics Laboratory, Seattle, WA 98195
Contact: Derek Storm, Research Professor
Telephone: 206-543-4085
General: Accelerates particles to high velocities.
Unique: 1/4 wave resonance, unique design.
Capacity: 80 MeV oxygen, 33 MeV hydrogen.
Projects: Beams for heavy ion physics research; Giant dipole resonance decay width: tin isotopes and oxygen reactions.
Available for Outside Use: Yes

WA-4

Owner: University of Washington
Facility: Water Tunnel, Guggenheim Hall, Seattle, WA 98195
Contact: Robert Briedenthal, Professor
Telephone: 206-685-1098
General: 14,000 gallon tunnel: open-air, free surface, recirculating. Full visualization of flow & turbulence; test section: 60 cm square & 1.5 meter long. No data gathering equipment included. Laser flow study possible.

Projects: Telescope study/keep; dirt out; Air foils; Turbulent mixing.
Available for Outside Use: Yes

WA-5

Owner: University of Washington
Facility: Cyclotrons (Vandergraf), Nuclear Physics Laboratory, Seattle, WA 98195
Contact: William Weitkamp, Research Professor/Director
Telephone: 206-543-4080
General: Provides accelerated beams of particles; functions by itself or with the super booster.
Unique: Has high degree of energy regulations, ion sources for polarized and heavy ions.
Capacity: 18 MeV protons, 8 MeV oxygen.
Projects: Nuclear reactions, astrophysics, mass spectrometry; Measure cross-section composition emission scanning; Single event upset of electron circuits (Boeing).
Available for Outside Use: Yes

WA-6

Owner: University of Washington, Department of Aeronautics and Astronautics
Facility: F.K. Kirsten Wind Tunnel, Seattle, WA 98195
Contact: William Rae, Jr., Associate Director
Telephone: 206-543-0439 **FAX:** 206-543-0217
General: Low speed tunnel for aerodynamic testing.
Unique: As far as low speed tunnels go, it has one of the highest degrees of repeatability. Relatively low cost.
Capacity: Test section is 8' by 12' by 12'.
Projects: Good percentage of take off and landing configurations for Boeing and other aircraft companies; Several truck companies check out their new models; Olympic bobsleds, speed skis (very small percentage).
Available for Outside Use: Yes

WA-7

Owner: University of Washington
Facility: Research & Development Platform/Vessel, Applied Physics Laboratory, Seattle, WA 98195
Contact: Eric Boggett, Captain
Telephone: 206-543-1257
General: Testing and calibrating underwater equipment; underwater acoustics research; 3 tier vessel.
Capacity: Up to 12 knots.
Available for Outside Use: No

WA-8

Owner: University of Washington

Facility: Spectrometer ESCA System, Benson Hall, Seattle, WA 98195

Contact: Buddy Ratner, Director/Professor

Telephone: 206-685-1005

General: Have (2) of them. Surface analysis. Put samples into high vacuum environment, then examine the type of atoms, and arrangement of the atoms in the outer atomic layers. Surface analysis of a wide range of materials. Primarily biomedical research. Can do ceramics and any vacuum compatible material.

Unique: Information on type and concentration of atoms. Identify elements and provide inside arrangements between 10-20 atomic layers of a material.

Projects: Polymeric biomaterials.

Comment: It is a national/international facility. Most of the outside work is limited. If it is another University of Washington publish oriented research, there is no charge.

WA-9

Owner: PACCAR Inc.

Facility: PACCAR Technical Center, 1261 Highway 237, Mount Vernon, WA 98273

Contact: David R. Rudkin, Manager, Technical and Administration Services

Telephone: 206-757-5229 **FAX:** 206-757-5370

General: Multi-disciplined testing/development facility focuses on internal work for PACCAR Inc. product line. Primary emphasis on class 7-8 vehicles.

Unique: Facility has approximately 100,000 square feet of laboratory space and both high-speed and durability tracks.

Projects: Conduct a variety of cab shake and full-truck durability test programs; cab shake area and full road simulator computer controlled to provide controlled "road" inputs. Able to use road simulator for vehicle-pavement interaction study. Have done SAE fuel consumption testing. Capable of cab crashworthiness testing in laboratory.

Available for Outside Use: No

Comment: Currently instrumenting track for dynamic wheel loads work in cooperative effort with Washington State Department of Transportation, University of Washington, and University of California. Adding corrosion test capability to vehicle durability cycle. Program to evaluate full-vehicle splash and spray characteristics.

WA-10

Owner: Washington State University, Department of Civil and Environmental Engineering

Facility: Environmental Engineering Laboratories, Pullman, WA 99164-2910

Contact: Richard Watts, Associate Professor

Telephone: 509-335-5999 **FAX:** 509-335-7632

General: The Environmental Engineering Laboratories have state-of-the-art equipment for the measurement of physical, chemical, and biological components of water, air, and soils. The equipment and facilities provide excellent research capabilities for bench-scale, pilot, and laboratory studies.

Unique: 12 gas chromatographs (e.g., Hewlett Packard 5890), 3 atomic absorptive spectro-photometers (e.g., Varian Spectra 300), Packard 2000 LL scintillation counter, Alp Kem Autoanalyzet environmental chambers, etc.

Capacity: Data acquisition systems and microcomputers are linked to many of the laboratory and field instruments.

Projects: Acid deposition, global change, measurement of oxidants in the atmosphere, biodegradation of pollutants, catalyzed peroxide treatment of soils, characterization of hydrocarbons in sludge, lake restoration.

Available for Outside Use: No

Comment: More than 8,000 square feet of laboratory space is available in six separate laboratories. The facilities and equipment are constantly being upgraded to provide the necessary support for state-of-the-art research.

WA-11

Owner: Washington State University, Department Civil and Environmental Engineering

Facility: Wood Materials and Engineering Laboratory, Pullman, WA 99164-2920

Contact: Rafik Y. Itani, Chairman

Telephone: 509-335-9578 **FAX:** 509-335-7632

General: Structural testing laboratory consisting of 70' by 30' strong back floor; 15-ton overhead crane; reaction frames; loading actuators; test supports; column testing facility; electronic strain, displacement, and load instruments; electronic data acquisition system and hydraulic pumps.

Unique: Capability to test full scale bridge and structure components.

Capacity: 4-300 kip, 1-200 kip, 2-100 kip, 1-55 kip, 1-22 kip hydraulic actuators; 80 channel data acquisition system.

Projects: 1) Bridge column testing under simulated earthquake loading. 2) Testing of retrofitted bridge substructure sections. 3) Testing of bridge anchor bolt

connections. 4) Shear testing of full-scale prestressed bridge girders.

Available for Outside Use: No

WA-12

Owner: Washington State University, Department of Civil and Environmental Engineering

Facility: Albrook Hydraulic Laboratory, Pullman, WA 99164-2910

Contact: Howard D. Coop, Professor

Telephone: 509-335-2576 **FAX:** 509-335-7632

General: 20,000 square feet of space and facilities to assemble experimental apparatus for tests on physical characteristics of various engineering works. While this laboratory has emphasized hydraulic engineering and fluid mechanics, other interests could be explored.

Unique: Long-term experience in laboratory work by faculty and staff; significant inventory of experimental apparatus and facilities; excellent support by major library, fabrication staff, and photographic facilities.

Capacity: Large capacity water supply for experiments or erosion, for example: 10,000 square feet of useable, open space; operating technicians available; excellent observation capability; long term experience.

Projects: Hydraulic model studies of hydroelectric power projects; experimental investigations of vortex formation; studies of open channel water flow characteristics; support, via demonstrations, of fluid mechanics class work.

Available for Outside Use: Yes

Wisconsin

WI-1

Owner: University of Wisconsin-Milwaukee, Department of Civil Engineering

Facility: Structural Engineering Laboratories, PO Box 784, Milwaukee, WI 53201

Contact: Donald Sherman, Director

Telephone: 414-229-5201 **FAX:** 414-229-6958

General: The Civil Engineering and Mechanics Department has an excellent capability for mechanical testing of materials and structural assemblages. A major facility in the Department is the Structural Test Floor. This 60' by 40' floor has a pattern of tie-downs that permits the erection of a variety of reaction frames for testing large and unique structural systems. The Department also has extensive facilities for concrete testing including humidity and moisture control runs, cement laboratories and general concrete laboratories. Loads are applied monotonically by hydraulic rams that have capacities up to 120 kips. Higher total loads have been achieved by using

rams in parallel. The test floor also has hydraulic outlets to operate closed loop servo-controlled actuators. The actuator has a 55 kip capacity with stroke and frequency ranges to duplicate earthquake motions.

Unique: Design of building and placement of equipment permits high test loadings on large pieces and a variety in load patterns.

Capacity: Major testing machines available in the laboratory are: 1) 400 kip compression machine with 24" clearance; 2) 60 kip universal tension-compression machine with 50" clearance; 3) Electro-hydraulic shaker with 10 kip capacity and DC to 3,000 Hz frequency range; and, 4) 110 kip servo controlled MTS machine with 70" clearance. A variety of instrumentation is available for data collection.

Projects: Full scale acoustic testing of bridge beams. Test of a composite stud girder floor system. The deck in this system was 55' long and 8' wide. Beam and beam-column tests of tubular members as used in offshore towers. Load distribution and strength tests in precast concrete floor systems covering areas as large as 30' x 20.' Shear tests of metal wall and roof diaphragms. Numerous tests of joints, connections and individual members in many sizes. These include steel, concrete and composite construction. Three by four bay double layer space frame roof system. Machinery equipment such as truck components and backhoes.

Available for Outside Use: Yes

WI-2

Owner: Milwaukee School of Engineering

Facility: Fluid Power Institute, PO Box 644, Milwaukee, WI 53201

Contact: Rick Ottman, Associate Director

Telephone: 414-277-7196 **FAX:** 414-277-7470

General: An applied research facility that deals with the design, prototyping, evaluation, and endurance testing of hydraulic components and/or systems. A special emphasis has been given to: hydraulic pumps and motors, electro-hydraulic valves, filtration, and contamination found in oil.

Unique: Modular laboratory facilities designed for quick turnaround time of projects. All data is collected using state of the art flow, pressure, speed torque and force transducers of various ranges.

Capacity: Hydraulic supply capabilities, 125 gallons per minute (gpm) at 5,000 pounds per square inch (psi), 180 gpm at 3,500 psi, 450 gpm at 500 psi, 96 gpm at 10,000 psi, 50,000 psi maximum steady state pressure.

Projects: Ford Motor Co., hydraulic component modeling and simulation. Sundstrand Aviation Corp., military qual tests of components. J.I. Case, hydraulic cylinder seal analysis on leakage. FMC, qualification of off

highway hydraulic systems, engines, filter performance evaluations.

Available for Outside Use: Yes

Comment: The Fluid Power Institute has been in existence for more than 30 years. We typically do about 100 industrial or governmental sponsored projects each year. Most projects commence upon receipt of a purchase order. Many projects are completed on site, where we travel with our equipment, collect data, make recommendations or changes and follow up with an engineering report. Projects are completed by various faculty, staff and students of the Milwaukee School of Engineering.

WI-3

Owner: Department of Agriculture, Forest Products Laboratory

Facility: Engineering Mechanics Laboratory, One Gifford Pinchot Drive, Madison, WI 53705-2398

Contact: Robert J. Ross, Supervisory Research Engineer

Telephone: 608-231-9221 **FAX:** 608-231-9592

General: Physical and mechanical testing facility capable of handling small coupon size specimens up to full-size structural components.

Unique: Equipment for full-size testing in bending, tension and compression.

Capacity: Bending compression capacity to 1 million pounds, tension to 210 kips. Long span tests up to 40' in tension and 55' in bending.

Projects: Long span tests of glue laminated timbers (bridges), full-size tests of glue laminated material (mine sweepers). Tension tests as full-size nail laminated posts.

Available for Outside Use: Yes, in general, we make our services available to users as a part of research programs in the Forest Products Laboratory. Outside contract type testing is not conducted for non-governmental agencies.

WI-4

Owner: University of Wisconsin-Madison

Facility: Biotron, Engineering and Experiment Station, 2115 Observatory Drive, Madison, WI 53706

Contact: T.T. Kozlowski, Director

Telephone:

General: The Biotron provides precise control of temperature, light intensity, day length, humidity, wind, atmospheric pressure, pollution, and sound. Because of the precise control of the environment in the Biotron the data obtained are characterized by low variability and high reproducibility.

Unique: More than 100 environmental chambers from cabinet size to "walk in."

Available for Outside Use: Yes

Comment: The Biotron is especially useful in the following types of research: 1) Growing uniform organisms for biochemical studies. 2) Effects of environmental factors, diseases, and insects on physiological processes and growth. 3) Exposure of organisms to stress at different stages of development. 4) Acclimation and adaptation of plants and animals to environmental stress. 5) Effects of pollutants and agricultural chemicals on plants and animals. 6) Selecting climatic regimes for field-testing plants.

WI-5

Owner: University of Wisconsin-Madison, College of Engineering

Facility: Laboratory for Structures and Materials Testing, 2266 Engineering Building, 1415 Johnson Drive, Madison, WI 53706

Contact: Steven M. Cramer, Director

Telephone: 608-262-7711 **FAX:** 608-262-5199

General: Materials and structures laboratory for loads on structures and components, fatigue, and vibration. Materials research on concrete, steel and timber, and non-destructive tests.

Unique: Thermographic stress analysis, vibrational pattern imagery.

Capacity: 1 million pound forces, fatigue loads to 100,000 pounds, vibration to 1,200 pound-force.

Projects: Tests of timber bridge sections; thermographic analysis of welds.

Available for Outside Use: Yes

WI-6

Owner: University of Wisconsin-Madison, College of Engineering

Facility: Engine Research Center, Engineering and Experiment Station, 1500 Johnson Drive, Madison, WI 53706

Contact: Dr. Arthur S. Lodge, Professor

General: Comprehensive facility for research on internal combustion engines, including combustion, fuel effects, heat transfer, spray dynamics, lubrication and materials.

Unique: Various laboratory research engines, gas chromatography, LDV laser-doppler velocity measurement system, particle dynamic analyzer.

Projects: Combustion studies; flow and heat transfer, volatile-composition interaction effects on diesel combustion, lubrication.

Available for Outside Use: Yes

Comment: Affiliation with U.S. Army.

WI-7

Owner: University of Wisconsin-Platteville,
Department of Civil Engineering

Facility: Materials Test Floor, One University Plaza,
Platteville, WI 53818

Contact: Max Anderson, Chair, Civil Engineering

Telephone: 608-342-1543 **FAX:** 608-342-1566

General: Materials test floor with 30' by 40' by 30' (height) area with 3' grid of openings through the floor for hydraulic rams to be attached to test specimens.

Capacity: Two 50,000 pound hydraulic rams and associated data recording/reduction facilities.

Projects: Prefabricated steel/concrete wall panels analysis, modular retaining wall block analysis, plywood wall shear strength analysis.

Available for Outside Use: Yes

Wyoming

WY-1

Owner: University of Wyoming Research Corporation

Facility: Western Research Institute, Box 3395
University Station, 365 North 9th Street, Laramie, WY
82070

Contact: J.G. Speight, Chief Executive Officer

Telephone: 307-721-2208 **FAX:** 307-721-2345

General: Mechanical spectrometer (M.SP.); solid state nuclear magnetic resonance spectrometer (NMR); scanning electron microscope X-ray diffraction (SEM-XRD).

Unique: M.SP. — Viscoelastic Properties of Binder vs. Temp, load and shear frequency. NMR — Asphalt binder microstructural information and viscoelastic properties. SEM-XRD — Aggregate surface composition and texture.

Projects: Mechanical spectrometer: Viscoelastic property of binders (SHRP Project A002A). NMR: Coal structure similar solid state NMR (another lab) for asphalt microstructure (SHRP Project A002C). SEM-XRD: Current use is for analysis of aggregate surfaces of roads.

Available for Outside Use: Yes

Comment: We have 28 years experience in the study of asphalt chemistry with the major emphasis on correlation of chemical properties with field performance. This group is the prime contractor for SHRP Project A002A and a subcontractor for SHRP Project A003B.

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APPENDIX A - MEMBERSHIP OF AASHTO RESEARCH ADVISORY COMMITTEE

The following is a list of the members of the AASHTO Research Advisory Committee involved in the identification and collection of information of special highway research facilities.

Richard D. Albertin
Director, Management Systems Bureau
New York Department of Transportation

David Albright
Chief, Research Bureau
Planning and Research Division
New Mexico Highways & Transportation Department

Gary Allen
Director, Virginia Transportation Research Council
Virginia Department of Transportation

Miguel A. Barrera
Puerto Rico Department of Transportation & Public
Works

Dennis O. Barry
Assistant Director, Planning
Nevada Department of Transportation

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Research Administration and Development
Minnesota Department of Transportation

Bernie Brown
Materials Engineer
Iowa Department of Transportation

Robert F. Cauley
Materials and Research Engineer
Vermont Agency of Transportation

Thomas A. Conboy
Supervising Planner, Planning Division
Rhode Island Department of Transportation

Denis E. Donnelly
Research Coordination Engineer
Colorado Department of Transportation

Al Donofrio
Chief, Materials and Research
Delaware Department of Transportation

William F. Edwards
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Georgia Department of Transportation

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Chief, Regional Planning
Alaska Department of Transportation

Bill McCall
Director, Office of Transportation Research
Iowa Department of Transportation

Richard L. McReynolds
Engineer of Research
Kansas Department of Transportation

Virginia Mok
Chief, Office of Materials, Development, and
Research
District of Columbia Department of Public Works

Barry K. Partridge
Chief, Division of Research
Indiana Department of Transportation

Robert T. Peterson
Materials and Research Engineer
North Dakota State Highway Department

Martin Pietz
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William J. Quinn
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Oregon Department of Transportation

T. V. Ramakrishna
Head, Research and Special Studies
West Virginia Department of Highways

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Harry A. Reed
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Arizona Department of Transportation

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Gerald J. Rourke
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Stephen F. Shober
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Robert M. Smith
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Richard L. Stewart
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Transportation

Peter R. Stopher
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Louisiana Transportation Research Center

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Robert A. Welke
Assistant Deputy Director for Highway Operations
Michigan Department of Transportation

John West
Chief, Research and Development
California Department of Transportation

APPENDIX B - INVENTORY FORM FOR SPECIAL FACILITIES

This inventory is being conducted for the Federal Highway Administration by the Transportation Research Board and American Association of State Highway and Transportation Officials.

INSTRUCTIONS: Complete a separate form for each special facility, as defined in the inventory description. Use additional sheets as necessary, and attach any brochures or other information describing the facility. If you have no facilities to report, please complete Items 1 and 2 (indicating None in Item 2) and return the form.

GENERAL INFORMATION

Date: _____

- 1. Owner: _____
- 2. Facility Name: _____
- 3. Address: _____

- 4. Contact Person: _____
Title: _____ Tel: _____ FAX _____
Address, if different from above: _____

- 5. Person completing this form: _____ Tel: _____

FACILITY DESCRIPTION

- 6. General: _____

- 7. Unique Features: _____

- 8. Quantitative Data on Capacity or Capability: _____

- 9. Approximate Replacement Cost \$ _____
- 10. Staff (Number of full-time equivalents required to support this single facility): Professional _____ Support (non-clerical) _____

USAGE INFORMATION

11. Typical projects and uses in past 2 years: _____

12. Average Number of Hours Used per Week _____

13. Available for outside users? _____ Yes _____ No
If yes, percent of time available for use by others: _____
Approximate rate of charge for use: _____

14. Estimated number of Comparable Facilities in the:
United States _____ Foreign _____
Where?: _____

COMMENTS

Please return completed forms to:

Federal Highway Administration
ATTN: *Special Facilities for Highway Research*
6300 Georgetown Pike
McLean, VA 22101