General Firm Information

**Firm name:** American Engineering Testing, Inc. (AET)
**Subsidiary of:** American Consulting Services, Inc. (ACS)
**Ownership:** Employee-owned
**Legal status:** S-Corp
**Leadership:** CEO/Chairman, Terry Swor, PG; President, Dan Larson, PE

**Locations**
American Engineering Testing (AET) is an employee-owned corporation providing geotechnical, environmental, materials and forensics consulting and testing services to public and private sector clients in a broad spectrum of industries. Our headquarters are in St. Paul and our service area is expanded by offices in Minnesota: Albertville, Duluth, International Falls, Mankato, Marshall, and Rochester; Wisconsin: Chippewa Falls, Menomonie, Wasau, and Green Bay; South Dakota: Rapid City, Pierre, Sioux Falls, and Beresford; Williston and Dickinson, North Dakota; Gary, Indiana; and Palatka, Florida.

**Working Philosophy**
We embrace hands-on participation of principals and senior-level personnel in daily project work. This experienced perspective enhances the quality and timeliness of our services and strengthens the overall ability of project team members to handle unforeseen conditions effectively. We feel it’s a key reason AET is a recognized leader in the geotechnical, environmental and materials fields.

AET is committed to assigning field personnel who can perform interdisciplinary tasks (both environmental and geotechnical), depending on site conditions and project schedules. Upon identification of the specific project schedules and final scope of work, we coordinate field personnel for specific services to minimize costs, such as providing a qualified, experienced field technician to conduct environmental, asbestos and geotechnical testing activities on a site.

**Honors and Awards**
2014 - ACEC/MN Honor Award
2012 - ASCE OPAL (Outstanding Projects & Leaders) Sustainability Award
2012 - MCA Award of Excellence for New Sustainable Concrete Mix Design
2012 - ACEC/MN Grand and People’s Choice Awards
2011 - MEI Award in Sustainable Communities category
2011 - ACEC National Recognition Award
2011 - ACEC/MN Grand Award
2011 - MnSPE Seven Wonders of Engineering Award
2010 - ACEC/MN Honor Award
2009 - ACEC/MN Honor Award
2009 - MSPE Merit Award
2008 - ACEC/MN Honor Award
2008 - MSPE Merit Award
2007 - Roads & Bridges #1 Road
TRUST DELIVERED. Founded in 1971, American Engineering Testing (AET) provides geotechnical, environmental, materials and forensic engineering, testing, and laboratory services in a broad range of market sectors including transportation, energy, government and vertical construction. Our services include:

AIR QUALITY SERVICES
- Air permit applications
- Ambient air monitoring
- Stack emissions monitoring
- New source review
- PSD applicability determinations
- Air contaminant monitoring
- Facility auditing

BUILDING FORENSICS
- Structural collapse/failure
- Fire and storm damage
- Condition assessments
- Ground penetrating radar (GPR)
- Mold/microbiological/bioaerosol
- Water leakage/infiltration
- Thermal surveys
- Cracking, deterioration, and corrosion
- Flooring problems

CHEMICAL ANALYSIS
- Wet chemistry
- X-ray Diffraction (XRD)
- X-ray Fluorescence (XRF)
- Fourier Transform Infrared (FTIR)

CONST. MATERIAL FORENSICS
- Alkali-silica reaction (ASR)
- Alkali-carbonate reaction (ACR)
- Coefficient of thermal expansion
- Delamination
- Freeze-thaw cycle

CONSTRUCTION SERVICES
- Excavation observations
- Piling and drilled pier observation
- Geopier observations
- Soil testing
- Concrete testing
- Masonry testing
- Aggregate testing
- Special Inspections
- Vibration monitoring
- Building condition surveys
- Floor flatness testing
- Bituminous testing
- DOT field/lab testing/observation

ENVIRONMENTAL SERVICES
- Phase I & Phase II ESAs
- Brownfield redevelopment, grants
- Storm/waste water infiltration
- Asbestos assessments
- Hazardous material assessments
- Remedial investigations
- Treatability/feasibility studies
- Wastewater discharge monitoring
- Subsurface soil borings, Geoprobe investigations
- Monitoring well installation
- Underground tank assessments
- Ground water modeling
- Dredge sediment testing/permitting
- Spill Prevention, Control, and Countermeasure (SPCC) planning

GEOTECHNICAL ENGINEERING AND EXPLORATION
- Soil borings/rock coring
- Engineering analysis and reports
- Structural foundations
- Pavements and roadways
- Infrastructure
- Ground improvement
- Earth structures
- Forensic evaluations
- Piezocone/pressuremeter/vane shear
- Laboratory testing
- Dynamic pile testing

NONDESTRUCTIVE TESTING (NDT)
- NDT consulting services
- Fireproofing testing
- Welding consulting
- Welding monitoring

PETROGRAPHIC SERVICES
- Cracking
- Delayed Ettringite Formation (DEF)
- Fire damage
- Low strength
- Scaling or spalling
- Popouts

PRESERVATION SERVICES
- Document research
- Condition assessment
- Develop presentation/repair options
- Prepare construction documents

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**Office Locations**

<table>
<thead>
<tr>
<th>Location</th>
<th>Address</th>
<th>Office Phone</th>
<th>Contact(s)</th>
<th>Email Address</th>
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<tbody>
<tr>
<td><strong>Minnesota</strong></td>
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</tr>
<tr>
<td>Albertville</td>
<td>5548 Barthel Industrial Dr., Suite 500</td>
<td>763.428.5573</td>
<td>Brian Arman</td>
<td><a href="mailto:barman@amengtest.com">barman@amengtest.com</a></td>
</tr>
<tr>
<td></td>
<td>Albertville, MN 55301</td>
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<tr>
<td>Duluth</td>
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<tr>
<td></td>
<td>Duluth, MN 55807-2711</td>
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<tr>
<td>International Falls</td>
<td>1300 Riverside Drive, Lot No. 93</td>
<td>218.283.2958</td>
<td>Joe Kendzora</td>
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<tr>
<td></td>
<td>International Falls, MN 56649</td>
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<tr>
<td>Mankato</td>
<td>1730 First Avenue</td>
<td>507.387.2222</td>
<td>Greg Guyer, PE &amp; Steve Ruesink, PE</td>
<td><a href="mailto:mankato@amengtest.com">mankato@amengtest.com</a></td>
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<tr>
<td></td>
<td>Mankato, MN 56001-3021</td>
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<tr>
<td>Marshall</td>
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<td>507.532.0771</td>
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<td><a href="mailto:marshall@amengtest.com">marshall@amengtest.com</a></td>
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<td>Marshall, MN 56258-1673</td>
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<tr>
<td>Rochester</td>
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<td>Kyle Shubert, PE</td>
<td><a href="mailto:rochester@amengtest.com">rochester@amengtest.com</a></td>
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<td></td>
<td>Rochester, MN 55901-0269</td>
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<tr>
<td>Saint Paul (Headquarters)</td>
<td>550 Cleveland Avenue North</td>
<td>651.659.9001</td>
<td>Dan Larson, PE</td>
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<td>Saint Paul, MN 55114-1804</td>
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<td><strong>North Dakota</strong></td>
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<tr>
<td>Dickinson</td>
<td>99 26th Street East</td>
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<td>Al Hovick</td>
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<td>Dickinson, ND 58601</td>
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<tr>
<td>Williston</td>
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<td>Mike Bailey, PE</td>
<td><a href="mailto:mbailey@amengtest.com">mbailey@amengtest.com</a></td>
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<td>Williston, ND 58801</td>
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<td><strong>South Dakota</strong></td>
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<tr>
<td>Beresford</td>
<td>107 West Oak Street</td>
<td>605.763.8061</td>
<td>John Doorn, CWI &amp; Clair Christians, CWI</td>
<td><a href="mailto:jdoorn@amengtest.com">jdoorn@amengtest.com</a></td>
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<td>Beresford, SD 57004</td>
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<tr>
<td>Pierre</td>
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<td>605-224-9535</td>
<td>Robert Temme, PE</td>
<td><a href="mailto:pierre@amengtest.com">pierre@amengtest.com</a></td>
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<td>Pierre, SD 57501</td>
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<tr>
<td>Rapid City</td>
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<td>Rapid City, SD 57702</td>
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<td>Sioux Falls</td>
<td>601 E. 48th St. N.</td>
<td>605.332.5371</td>
<td>Bruce Card, PE</td>
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<td><strong>Wisconsin</strong></td>
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<tr>
<td>Chippewa Falls</td>
<td>1837 County Hwy. 00</td>
<td>715.861.5045</td>
<td>Joel Guanella &amp; Andrew Smith, PE</td>
<td><a href="mailto:asmith@amengtest.com">asmith@amengtest.com</a></td>
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<td>Chippewa Falls, WI 54729</td>
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<tr>
<td>Green Bay</td>
<td>3194 Market Street, Suite C</td>
<td>920.347.1286</td>
<td>Glenn Dionne, CWI</td>
<td><a href="mailto:gdionne@amengtest.com">gdionne@amengtest.com</a></td>
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<td>Green Bay, WI 54304</td>
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<tr>
<td>Menomonie</td>
<td>302 B West Wilson Avenue</td>
<td>715.235.8844</td>
<td>Ray Martinson</td>
<td><a href="mailto:rmartinson@amengtest.com">rmartinson@amengtest.com</a></td>
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<tr>
<td></td>
<td>Menomonie, WI 54751</td>
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<tr>
<td>Schofield (Wausau)</td>
<td>4203 Schofield Avenue</td>
<td>715.359.3534</td>
<td>Greg Owens, PG, Doug Ellingsen, CWI &amp; Ben Mattson, PE</td>
<td><a href="mailto:wausau@amengtest.com">wausau@amengtest.com</a></td>
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<tr>
<td></td>
<td>Schofield, WI 54476-2744</td>
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</tbody>
</table>

AET’s headquarters are in St. Paul, MN. We have regional offices in: Florida, Indiana, Minnesota, North Dakota, South Dakota and Wisconsin.
Locations Map

1. Williston, ND
2. Dickinson, ND
3. Rapid City, SD
4. Pierre, SD
5. Sioux Falls, SD
6. Beresford, SD
7. Marshall, MN
8. Mankato, MN
9. Albertville, MN
10. International Falls, MN
11. Saint Paul, MN
12. Duluth, MN
13. Rochester, MN
14. Menomonie, WI
15. Eau Claire, WI (NDT field)
16. Chippewa Falls, WI
17. Schofield (Wausau), WI
18. Green Bay, WI
19. Gary, IN (NDT field)
20. Palatka, FL (NDT field)

Nondestructive Field Offices
Eau Claire, WI; Gary, IN & Palatka, FL
Contact: Dave Fitterer, ASNT, III
Toll Free: 800-972-6364
dfitterer@amengtest.com
Transportation Experience in Minnesota

AET provides geotechnical services to the Minnesota Department of Transportation on many MnDOT projects, including geotechnical subsurface exploration programs for bridge, retaining wall and culvert projects throughout the state. Our personnel also conduct standard penetration testing, electronic piezocone penetrometer testing, rock coring and laboratory testing of soil samples in conjunction with many of these projects. We may also calibrate standard penetration hammers for ourselves and other consultants serving the state.

As a regular service, AET conducts geotechnical engineering services for numerous MnDOT projects by subcontracting with civil engineering consultants serving MnDOT. Additionally we may analyze and report roadway design, embankment/subgrade construction, slope stability and shallow/deep foundation designs including preparation of “Design Recommendations Reports,” as outlined in the MnDOT Geotechnical and Pavement Manual.

We deliver construction/bridge inspection and testing services for MnDOT design build projects (including ROC 52, TH 212 and the 35W Bridge) as well as pile analyses during construction using the Pile Driving Analyzer and/or load testing for various MnDOT bridge projects such as the Dresbach bridge, Penn Avenue bridge, Wakota bridge, I35W Crosstown and TH 212 bridges.

We cross-train engineers and technicians throughout our Minnesota offices in MnDOT testing and inspection procedures to maximize our efficiency of our personnel on project sites.

Contact:

David Rettner, P.E.,
Sr. Vice President
(651) 659-9001
drettner@amengtest.com

Jeffery Voyen, P.E.,
Sr. Vice President
(651) 659-1305
jvoyen@amengtest.com
Pavement and Infrastructure Group

AET’s pavement and infrastructure group specializes in the design, construction, maintenance and rehabilitation of roads, parking lots and other transportation-related structures.

Our typical roadway, driveway & parking facility services include:

- Research program coordination
- Create/modify specifications and best practices manuals
- Develop/execute research/new-product implementation plans
- Falling-Weight Deflectometer (FWD) testing
- Maintenance activities/schedules
- Pavement design and optimization (including full-depth reclamation and cold-in-place recycling)
- Pavement management (including evaluation/condition surveys)
- QA/QC Management
- Rehabilitation alternatives
- Roadway Inspection and Testing

We offer services to address the needs of state and local government transportation units as well as private developers. Through professionally-managed client partnerships we address cost-effectiveness, construction/rehabilitation, project efficiency, public safety, forensic analysis and structure longevity & maintenance issues.

Our team is supported by other AET departments who lend their expertise in both laboratory and field construction testing, data collection and construction inspection so that we can deliver insightful management solutions for transportation-related materials, pavements and geotechnical engineering projects.

Contact:

David Rettner, P.E.,
Sr. Vice President
(651) 659-9001
drettner@amengtest.com

Joe Korzilius, P.E.,
Principal Engineer
(651) 659-1305
jkorzilius@amengtest.com
Geotechnical Engineering

Reducing uncertainty regarding soil properties can lead to lower construction costs. Working with AET’s sophisticated investigation and laboratory testing tools, along with our experienced geotechnical engineers, your design team gains accurate data and thoughtful recommendations to select appropriate foundation materials.

We work with structural engineers and architects, contractors, owner’s agents and government project managers to support the construction of roads, buildings, bridges, railways, oil and energy sites, levees and dams — projects in which soil/rock properties and geology must be considered in the design. We also have significant experience on complicated landslide and deep foundation projects.

AET offers geotechnical engineering and a suite of technical capabilities to test, observe and consult on the many aspects of your projects — from planning, design and construction to post-construction maintenance and forensics.

**Geotechnical engineering services include:**

- Structural foundations
- Infrastructure
- Earth structures
- Ground Improvement
- Pile Driving Analyzer® (PDA)
- Geotechnical surveying

**Exploration and laboratory services include:**

- Soil borings, including angle drilling
- Rock coring
- In-situ testing through Piezocone penetrometer, shear wave velocity testing, pressuremeter, vane shear, and Iowa borehole shear methods
- Laboratory testing
- Triaxial, permeability, and consolidation testing
- Geoprobe
- Instrumentation installation (including inclinometer, piezometer, extensometer, or strain gauges)
- Monitoring well installation, sampling, and abandonment

**Instrumentation installation for 35E MnPASS**

**Custom pile testing**

**Slope stability analysis**
### PARTIAL PROJECT LIST

- **ROC 52 through Rochester, Olmsted County, MN** ($232M)
- Roadway inspections on MNTH 10 Interchange with MNTH 32 near Hawley, in Clay County, MN ($8.6M)
- **Hwy 52 project through Oronoco, Olmsted County, MN** ($37M)
- **TH 212 from Eden Prairie to Carver/Hennepin/Carver Counties, MN** ($238M)
- **35W Saint Anthony Bridge Project, City of Minneapolis & Hennepin County, MN** ($234M)
- **Hwy 169 in St. Peter, Nicollet County** ($16.5M)
- **US 52 Elk Run Interchange, Pine Island, MN** ($30M)
- **TH 36 St. Croix Bridge Approach, Stillwater, MN** ($50M)
- **TH US 169/I-494 Interchange, Bloomington/Eden Prairie/Chaska, MN** ($125M)
- **TH US 169/I-494 Interchange, Bloomington/Eden Prairie/Chaska, MN** ($50M)

### Contact:

- **David Rettner, P.E., Sr. Vice President**
  - (651) 755-5795
drettner@amengtest.com
- **Joe Korzilius, P.E.**
  - (651) 603-632
  - jkorzilius@amengtest.com
Airport Project Experience

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Bituminous Testing

AET provides bituminous testing and mix design services. Members of our staff, across our midwest regional offices, are certified in Minnesota, Wisconsin, North and South Dakota. Our laboratory is AASHTO R-18 accredited and MnDOT & WisDOT Qualified. We offer the following bituminous services as well as a full compliment of additional assessment, analysis, and design services:

**Standard Testing**
- Mix Sampling for Asphaltic Mixtures – AASHTO T-168
- Bulk Specific Gravity – AASHTO T-166
- Rice Specific Gravity – AASHTO T-209
- Air Voids – AASHTO T-269
- Gyratory Compactor – AASHTO T-312
- Extraction/Gradation – AASHTO T-164 & T-308/T-30
- Tensile Strength Ratio – AASHTO T-283
- Extraction – WisDOT Test Method 1560
- Asphalt Mix Design – WisDOT Test Method 1559
- In-place Density Testing with the Nuclear or Drilled Core Method
- Mobile Bituminous Laboratory

**Specialty Testing**
- Cold In-Place Recycling (CIR) Mix Design and Testing
- Full-Depth Reclamation (FDR) Mix Design and Testing
- Seal Coat Compatibility and Design
- Disc-shape Compaction Testing (DCT)
- Hamburg Wheel Tracking (HWT) Test
- Dynamic Modulus Testing (SPT)
- Semi-Circular Bending Test (SCB)

**Contact:**

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**Wisconsin** - Greg Owens, P.E., Eastern Regional Manager 715.359.3534 gowens@amengtest.com

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**Partial Project List**

- Mn/DOT plant monitoring
  - SP 2510-47 Goodhue County
  - SP 2308-48 Fillmore County (We also did Cold-In-Place Recycling Density Tests)
  - SP 6780-101 I-90, Rock County
  - SP 8304-113 TH 15/60, Madelia
  - SP 8103-49 Hwy 14, Waseca
- QA Plant Monitoring for consultants (FAA and MnDOT specifications)
  - Fairmont Airport Runway Reconstruct (QA monitoring Density tests and gradations for Cold-in-Place Recycling)
  - Faribault Airport
  - Marshall Airport
- QC Testing (Bituminous mix design and field testing)
  - New Ulm Runway 15/33 Reconstruct
  - SAP 052-605-061 St. Peter
  - Street Improvements, Sleepy Eye
  - SP 8308-44 TH 60, near St. James

**SPT dynamic modulus testing.**

**Low temp cracking and resilience modulus testing.**

Al Hartleib operates a Wirtgen laboratory foamed bitumen plant.
Construction Materials Testing - Physical

Whether you are measuring the compressive strength of a concrete cylinder or conducting long-term creep and shrinkage tests, AET can evaluate and pre-qualify construction materials via our impressive range of laboratory testing and analysis services. We offer over 300 standards-based concrete and cementitious product tests, one of the largest lists of services in the industry.

We participate in the Concrete and Cement Reference Laboratory (CCRL) program. As part of this program, a comprehensive examination of AET’s laboratory procedures and equipment is conducted biannually. Also, AET is recognized and certified by AASHTO and validated by the Corps of Engineers. AET is active in technical organizations such as ASTM, ACI, and PCI, and participates in the development, adaptation and implementation of many test standards.

Test schedules are developed to meet your needs including rush services to minimize or eliminate your project downtime. Test results are reported promptly. For long-term tests such as creep and shrinkage, alkali-silica reactivity, and admixture evaluations, interim results are provided.

Our extensive list of tests include but aren’t limited to:

- ASTM C666 Resistance of Concrete to Rapid Freezing and Thawing
- ASTM C512 Creep of Concrete in Compression
- ASTM C1260 Potential Alkali Reactivity of Aggregates
- NT Build 492 Chloride Migration Coefficient
- AASHTO T336 Coefficient of Thermal Expansion of Concrete
- ASTM C465 Processing Additions for use in Cement
- ASTM C1293 Length Change of Concrete Due to Alkalai-Silica Reaction

10,000+ square feet of laboratory space includes:

- Numerous controlled environmental rooms (-10°F to 130°F, some with controlled humidity)
- Seven freeze-thaw chambers
- Compression testing machines with capacities from several pounds to 650,000 pounds
- 0°F walk-in-freezer
- Specialized facilities for mix design verification, casting, and curing of test specimens
- A full service cement/mortar laboratory
Mn/DOT Asbestos & Regulated Waste Survey

AET is a Pre-Qualified Minnesota Department of Transportation (Mn/DOT) approved contractor. Our team of experienced certified asbestos inspectors, asbestos supervisors, and Certified Hazardous Materials Manager (CHMM) can assist with your Mn/DOT project. Our team includes certified asbestos supervisors, CHMMs, asbestos inspectors, and lead inspector/risk-assessors. We process our samples through an NVLAP certified laboratory.

AET’s Asbestos and Regulated Waste Inspections comply with Mn/DOT requirements as well as Minnesota Pollution Control Agency (MPCA), Minnesota Department of Health (MDH) and US Environmental Protection Agency (US EPA) requirements. These inspections include the following scope of services:

- Observe the bridge/building and review available plans (as-built plans) to obtain information indicating the existence of ACM and regulated wastes
- Locate and sample, thermal system insulation, surfacing material, and miscellaneous material identified as suspect ACM
- Analyze the suspect ACM samples for asbestos content by polarized light microscopy (PLM) or appropriate
- Assess the condition and estimate the quantities of any confirmed ACM
- Test for lead-based paint, through use of an x-ray fluorescence (XRF) analyzer or laboratory analysis
- Test for polychlorinated biphenyls (PCBs) in sealants and coatings
- Identify regulated/hazardous waste to include but not limited to asbestos, lead, mercury, PCBs, and treated wood/timbers

ARE YOU PREPARED?
All MnDOT funded projects, that involve demolition of bridges and/or buildings, require identification, abatement and removal of all asbestos and regulated materials. An Asbestos and Regulated Waste Inspection is performed to identify and document any asbestos containing materials (ACM) and regulated materials. Contractors that perform the Asbestos and Regulated Waste Inspections for Mn/DOT funded projects must be selected from the Mn/DOT pre-qualified contractor list.

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Highway bridges require close scrutiny.

Waterways are especially sensitive sites.

North-region bridges are at high risk for exposure.
Ground Penetrating Radar for Highways

Ground Penetrating Radar (GPR) offers a non-destructive means of material analysis without coring or probing. GPR uses high frequency electromagnetic (radio) waves to measure material depths and determine where material types change. As the antenna moves continuously across the test surface it transmits short pulses into the substrate which is reflected back to the receiver and interpreted into a linear scan profile. The arrival time and strength of reflections determine and boundaries of dissimilar materials are profiled as the radio waves reflect back, identifying depth, extent, and locations of materials.

In pavements, GPR continuously collects data and measures layer thicknesses by identifying depths at which bituminous, concrete and aggregate base materials change. For most applications, data is collected at highway speeds without inconveniencing and compromising the safety of the traveling public with road closures. GPR data collected for pavement thickness is performed at a rate of one vertical scan per foot at 55 mph, with only a few cores recommended to be taken for confirmation of material types. Analysis of the data identifies the variability of pavement and base layer thicknesses allowing the planning and design of roadway rehabilitation projects. Typical projects include identifying where pavement rehabilitation approaches, such as reclaiming depths for pavements and bases and mill and overlay depths, are most appropriate to avoid construction delays and claims.

GPR can also be used to identify depths to utilities and determine the trending direction of the utility by scanning in multiple locations within the area of interest using a hand-held or walk-behind cart.

We collect GPR data at 1-foot intervals with GPS.

Alaska highway pavement thickness profile.

GPR FOR STRUCTURES

Did you know that AET’s Building Technology Group can also use handheld GPR in concrete walls and floor slabs to identify the thickness of the walls, the location and orientation of reinforcement and voids or inconsistencies including depth and continuity of cracks in the material.

We can provide 3D imaging of the data and a pictorial interpretation on projects that include identification of thickness/voids beneath floor slabs or behind walls and identification of the placement of structural reinforcement where cracks are developing.

We can also use GPR to identify the severity and extent of cracking for concerns of structural integrity and safety.

We can provide 3D views of concrete data.

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Falling Weight Deflectometer

AET uses the Dynatest Falling Weight Deflectometer (FWD) nondestructive pavement testing device to quickly and economically evaluate pavement structures. Pavement structure design procedures are typically calibrated to pavement performance using data from existing roadways. The pavement, base and subgrade response data obtained is utilized in AASHTO’s Mechanistic-Empirical Pavement Design procedures to design new or rehabilitate existing pavement structures.

FWD data enhances the design procedure which can have significant economic impact on rehabilitation projects. This data can be used during structural design to calculate pavement bearing capacity, estimate expected life, and suggest required overlay thickness to achieve a desired design life.

Pavement rehabilitation techniques include determining optimal mill and overlay thickness based upon desired load carrying capacity, traffic volumes and condition. Mechanistic–empirical analysis is also useful in determining the structural value of recycled asphalt pavements as well as treated and stabilized base and sub-base materials. This allows the choice of an appropriate rehabilitation technique.

The FWD applies a load impulse to the roadway surface by a specially designed loading system which simulates the dynamic short term loading of a moving wheel load. The deflection basin response of the pavement is measured with a set of 9 precision geophones at varying distances from the loading plate. AET evaluates the deflection response of the pavement and can calculate the pavement strength as well as the “in-situ” resilient E-moduli of each layer in a pavement structure. The resilient E-moduli of each layer of material are important factors for new pavement design as well as estimating the performance of rehabilitation options.

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SOIL-CEMENT

Soil-cement (also called cement-stabilized base, or cement-treated aggregate base) is a highly compacted mix of virgin or reclaimed soil/aggregate/bituminous pavements, cement, and water. It is an often used pavement base for roads, streets, parking, airports, shoulders, and materials-handling and storage areas.

Soil cement combines strength, durability, and low first cost to provide value. A thin bituminous surface is usually applied to the surface to complete the pavement.

Portland Cement Stabilization

AET has extensive experience applying portland cement stabilization in soil embankment grading for use as a working platform and as a designed structural layer in roadways, parking lots, and under buildings.

Cement Stabilization of Subgrade Soils
- Typical cement content for plastic soils (clay) – 6-12% by weight
- Very effective method of improving the subgrade under an aggregate surfaced roadway – leaving an aggregate surfaced roadway that can support heavy truck traffic
- Can improve material with a CBR of 2 into a CBR of 30 - 60
- Reduces shrink/swell potential in silty-clay soils
- Typical unconfined compressive strength of 200-400 psi at 7 days (controlled strength material) resulting in a freeze/thaw durable material
- Material can be stabilized in layers 10-15 inches thick in one pass
- Typically is used as a designed structural pavement layer – provides equivalent strength to aggregate base. AASHTO layer coefficient of 0.12 - 0.15
- Can provide almost immediate improvement in the stability of wet soils so that work can progress. Generally requires 4-6% cement to improve wet/unstable soils to serve as a working platform (not intended as a structural layer)

Cement Stabilization of Reclaimed Aggregate Base/Bituminous Pavement
- Typical cement content 3-5% by weight
- Can improve material with a CBR of 10-20 into a CBR of 40-80
- Works well with base material contaminated with subgrade soils
- Layers of 6-12 inches can be stabilized and compacted in one pass
- Typical unconfined compressive strength of 250-400 psi at 7 days that has long term durability – but not too much strength (controlled strength material)
- Typically is used as a designed structural pavement layer – provides equivalent strength to crushed stone base. AASHTO layer coefficient of 0.15 - 0.25
- Can be directly paved over, or used as a stabilized subbase layer
American Engineering Testing, Inc. (AET) offers testing services to our clients to confirm the quality of aggregate used in their projects. Wisconsin Department of Transportation specifications require quality testing of aggregate to be performed every three years for quarries and five years for pits.

**TESTING CAPABILITIES**
AET staff can assist clients in ensuring quality aggregates by providing the following services:

- Sodium Sulfate Soundness
- Los Angeles Abrasion
- Gradation
- Specific Gravity and Absorption
- Flat and Elongated Particles
- Freeze / Thaw Soundness
- Lightweight Pieces
- Atterberg Limits

**LABORATORY QUALIFICATIONS**

- Certified Wisconsin Department of Transportation Laboratory
- AASHTO R-18 for aggregate

**AET STAFF IS CERTIFIED IN:**

- Aggregate Sampling
- Aggregate Tech I
- Aggregate Testing for Transportation Systems (ATTS)

For more information, please contact us at one of the following local office locations:

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