

FAILURE ANALYSIS

CAUSE OF FAILURE — CORRECTIVE ACTION

TECHNIQUES AVAILABLE

- Scanning Electron Microscope w/EDS
- Chemical Analysis
- Microscopy/Metallography
- Mechanical Testing
- Nondestructive Testing
- Fractography

PERSONNEL

- Metallurgical & Materials Engineers
- Professional Registration
- Certified NDT Technicians
- Chemists

EXAMPLES

- Pressure Vessels
- Boilers
- Heat Exchangers
- Pipes, Valves, Pumps
- Fasteners
- Structural Steel
- Reinforced Concrete
- Lifting Equipment
- Tools
- Beverage Containers
- Medical Devices



MATERIALS

- Metals
- Composites
- Plastics
- Concrete
- Ceramics
- Coatings
- Elastomers
- Glass



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MATERIAL TESTING & ENGINEERING

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CONSTRUCTION SERVICES

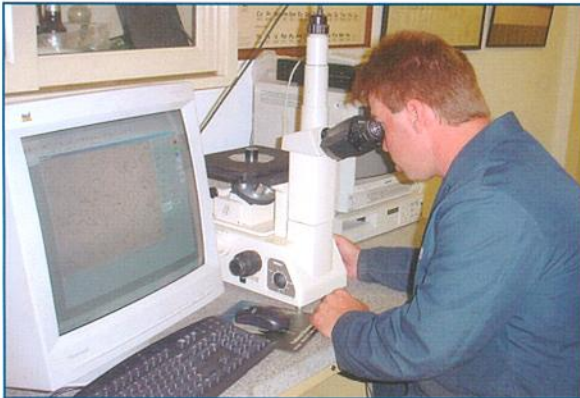
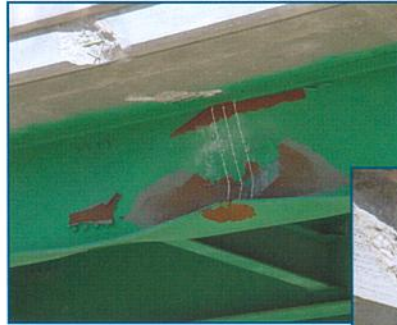
NEW BUILDINGS

EXISTING STRUCTURES

SEISMIC UPGRADE

STRUCTURE INSPECTIONS

- Visual
- Nondestructive Testing (NDT)
 - Ultrasonic
 - Liquid Penetrant
 - Magnetic Particle
- AWS Code and Weld Symbol Interpretation



BOLT EVALUATIONS

- Load Indicator, Calibrated Torque Wrench Testing Turn-of-the-Nut Methods
- Tensile and Yield Strength/Percent Elongation
- AISC Code Interpretation

ADDITIONAL SERVICES

- Reinforcing Steel Inspections
- Welder Certification Testing
- Written Welding Procedures & Prequalified Weld Geometry
- Crane Repair Certification per ANSI B30.15
- Onsite Chemical Analysis of Construction Materials
- Ground Penetrating Radar
- Concrete Level Evaluation



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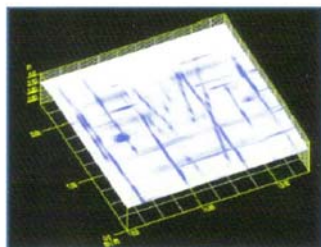
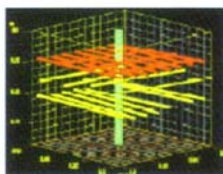
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GPR - GROUND PENETRATING RADAR

Ground Penetrating Radar (GPR) uses safe electromagnetic energy to detect and locate objects and voids beneath the surface of concrete, asphalt and soil. In the hands of our trained technicians, the Structure Scan Pro System™ is capable of determining the exact position of piping, utilities, rebar, post-tensioning cables, discontinuities and voids.

GPR ADVANTAGES

- In-field analysis with powerful, advanced data processing
- Immediate results in 2D or 3D
- Application integration, (CAD, GIS)
- Safer than X-Ray - structure and occupants are undisturbed
- No harmful emitted energy or radiation
- Accurate depth measurement and target locations
- Access to only one side of target area required



- Depths up to 24 inches in concrete and asphalt
- Depths of 30 feet for objects in earth

APPLICATIONS

INFRASTRUCTURE INSPECTION AND EVALUATION

• Utility Location

Gas Lines
Electrical Conduit
Water Lines
Sewer Lines

• Reinforcements

Post-Tensioning Cables
Rebar
Wire Mesh
Site Surveying/Mapping

CONCRETE AND ROADWAY INSPECTIONS

- QA/QC - New and Existing Structures
- Slab Thickness
- Air Pockets/Voids

CAPABILITIES

- Differentiation between metallic and non-metallic targets
- Ability to discern between types of reinforcing structures
- Able to locate targets on back side of concrete and asphalt slabs



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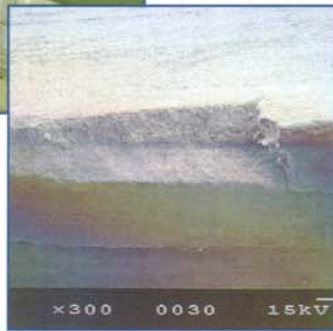
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Photos Courtesy of GSSI

MATERIAL TESTING-STRESS ANALYSIS

MATERIAL COMPOSITION

- Energy Dispersive X-Ray Spectroscopy (EDS Analysis)
- Chemical Analysis of Metals



STRENGTH TESTS

- Structurals - Load Testing
- Fatigue Testing of Assemblies
- Load Cell Applications
- Deflection Monitoring

METALLOGRAPHY - FRACTOGRAPHY

- Scanning Electron Microscopy
- Metallographic Analysis
- Photomacrography

VIBRATION - ACCELERATION



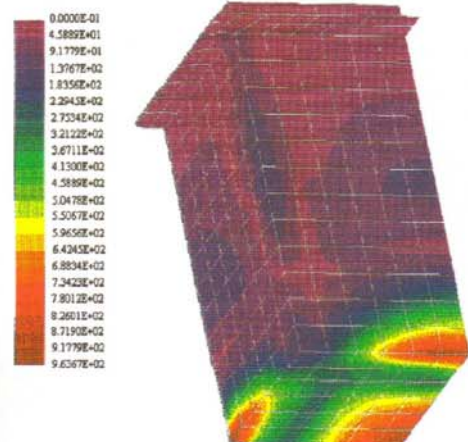
MECHANICAL TESTING

- Tensile - Compression
- Elongation - Modulus
- Impact Energy - Charpy Notch
- Rockwell and Microhardness
- Portable Hardness
- Surface Finish

STRESS ANALYSIS

- Multi-Channel Strain Gauge Testing Static and Dynamic
- Finite Element Analysis
- Photoelastic Stress Analysis
- Fracture Mechanics
- Matrix Analysis of Frame Structures

OVERALL STRESS DISTRIBUTION
OF 1/4 MODEL



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NONDESTRUCTIVE TESTING

PRESSURE VESSELS

HEAT EXCHANGERS

STORAGE TANKS

PIPELINES

FLAW DETECTION

- Eddy Current
- Remote Field Tube Evaluation
- Ultrasonics
- Articulating Borescope
- Microvideo to 100 feet
- Pinhole detector for coatings
- Magnetic Particle
- Dye Penetrant
- Vacuum Techniques

HARDNESS TESTS

- Rockwell
- Microhardness
- Portable
- Barcol



STAFF QUALIFICATIONS

- Certified NDT Inspectors
- API, 510, 570, 653
- Knowledge of applicable Codes, Standards and Regulations
- Field Inspections are Supported by a Complete Materials Testing laboratory and Registered Professional Engineers

THICKNESS MEASUREMENTS

- Ultrasonic - Metals
- Eddy Current - Coatings

SURFACE FINISH

- Profilometer



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POWERHOUSE EVALUATIONS

BOILERS

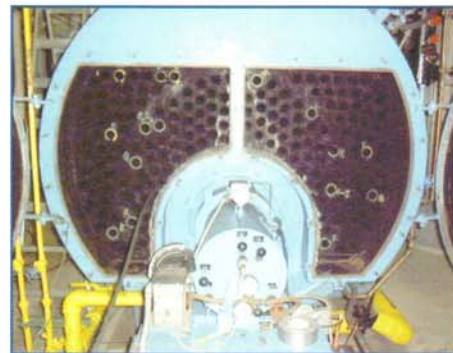
CHILLERS

DEAERATORS

HEAT EXCHANGERS

BOILER INSPECTIONS

- Tube inspection using Remote Field Eddy Current technique
- Ultrasonic thickness measurements of tubes and headers
- Articulating fiberoptic Borescope evaluation of tube and headers
- Microvideo Borescope inspection of tube interiors
- Ultrasonic flaw evaluations of major welds
- Drum ligament evaluations
- Water scale thickness measurement inside tubes using Turner Gauge
- Wet Fluorescent Magnetic Particle Testing



BOILER EVALUATION

- Boiler Condition and Useful Life Studies
- ASME Code calculations
- Boiler efficiency certification using the ASME short form
- Boiler flue gas analysis using Bachrach analyzer with NO meter
- Failure Analysis - Scanning Electron Microscope

DEAERATOR INSPECTIONS

- Wet Fluorescent Magnetic Particle Testing of welds for corrosion fatigue cracking
- Ultrasonic thickness measurements

CHILLER/HEAT EXCHANGER INSPECTION & CLEANING

- Eddy Current testing of heat exchanger tubes
- Remote Field testing of ferrous tubing
- Rotating brush cleaning to enable inspection



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