VIBRATION AND NOISE MONITORING

Vibration and Noise Monitoring is a prudent measure when construction takes place in urban areas near historic buildings, sensitive bridge structures, medical facilities, homes, businesses or other. Construction activities are generally a nuisance to nearby homeowners and businesses. Measurements suggest that most construction induced vibrations are perceived to be larger by than they really are. But in today's society it is better to monitor actual levels and have the documented record.

The most common construction activities in which EDIFICA performs noise and vibration monitoring include:

- Pile Driving
- Sheet piles installed with Vibratory hammers
- Drilled shaft casing installation/extraction with Vibratory hammers
- Compaction efforts with Vibratory roller

EDIFICA Noise and Vibration Monitoring Services

- *Turn Key* Noise and Vibration Monitoring Services
- Highly Experienced Technicians and Registered Professional Engineers
- Equipment Rental and Training
- Data Analysis and Reporting of Results
- Assistance in Monitoring Program Planning and Specification Preparation

Equipment

EDIFICA uses a variety of noise and vibration equipment which we match to the project based on the specific needs and goals of the program.

Single or Multiple Geophones with high sensitivity Microphones with high sensitivity Automatic or Manual Data collection Paperless Electronic Reporting.

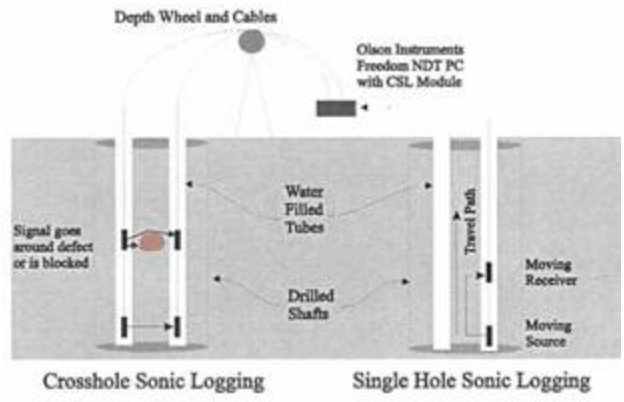
Drilled Shaft casing extraction with vibratory hammer.

Pile driving with impact hammer

CROSSHOLE SONIC LOGGING (CSL)
SINGLEHOLE SONIC LOGGING (SSL)

Crosshole Sonic Logging (CSL) is a nondestructive technique to assess the quality and integrity of drilled shaft foundations and other concrete structures after they have been cast. We perform this service on both routine and complex projects alike. This has provided us with a multitude of experience and an understanding of the limitations of these test methods. It is our ability to provide practical interpretation of the CSL data that has lead to us being among the most respected CSL testing firms.

The CSL test is conducted in small diameter water-filled access tubes, typically steel or PVC pipes 2.0 inches in diameter, installed in the drilled shaft prior to construction. The CSL test method utilizes the principles of sound wave prorogation traveling through concrete to verify the integrity of drilled shaft foundations. The CSL test method entails lowering an ultrasonic transmitter and receiver into individual water-filled access tubes. The transmitter and receiver are typically lowered to the bottom of the access tubes and are maintained at equal depths as they are raised to the top of the drilled shaft foundation. As the transmitter and receiver are raised in unison, the transmitter generates an ultrasonic pulse every 0.2 ft vertically that travels from the transmitter through concrete and is received by the receiver. Once the receiver receives the signal it is digitized and stored on a data acquisition system. The location of the transmitter and the receiver is measured and recorded using a depth wheel which provides the vertical axis for the first arrival times (FAT), velocity, and relative energy. The process is repeated for all the perimeter and opposing diagonal tube pair combinations to evaluate the concrete integrity around the inner perimeter and center of the drilled shaft.



A related technique to the popular CSL test method is the Singlehole Sonic Logging (SSL) test method. The SSL test method utilizes the same equipment and water-filled access tubes as the CSL method. However, in the SSL test method the transmitter and receiver is vertically offset by a predetermined distance, typically two feet, within a single water-filled access tube. The transmitter and receiver are lowered to the bottom of the water-filled access tube and subsequently retrieved simultaneously from the bottom up. The SSL test method allows for a quick and inexpensive method to evaluate the concrete integrity surrounding the water-filled access tube in a manner comparable to the Gamma-Gamma test method without the need for special provisions or precautions usually associated

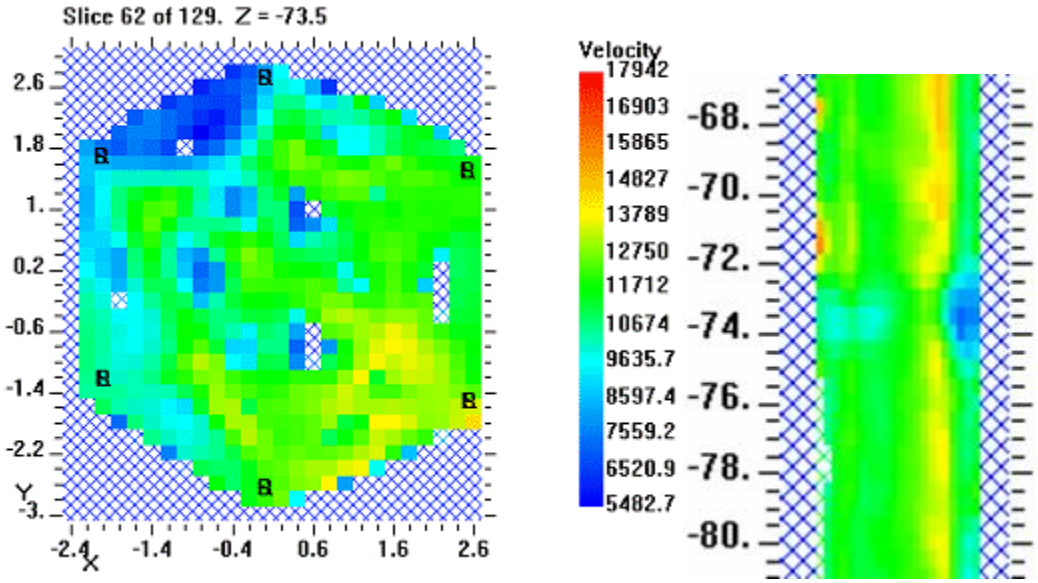
with the Gamma-Gamma test method. The SSL test method is typically employed to evaluate the concrete integrity for smaller diameter augured cast-in-place (ACIP) piles.

CSL Test in Progress

We utilize an Olson Instruments CSL system, model Freedom Data PC, to perform CSL and SSL logging. The CSL and SSL data is reviewed in the field and later post processed in the CSL2 software. The CSL2 software graphs the first arrival times (FAT), signal energy, velocity, and waterfall diagram as function of depth for all tested tube combinations. Relatively constant first arrival times with good signal energy and voltage amplitudes between parallel tubes indicate uniform, good quality concrete. In contrast, delays in first arrival times (slower velocities) and a reduction in energy at a given depth are generally interpreted as a potential anomaly. Examples of the CSL2 software output are shown below illustrating a defect detected by the Olson CSL logging system.

To investigate potential anomalies detected with the CSL method, we offer Crosshole Tomography (CT) imaging. Crosshole Tomography (CT) may minimize the need for time consuming and expensive coring of a drilled shaft in order to verify the concrete integrity within problematic areas. The CT method involves collecting data at predetermined offset angles (in degrees) in order to generate hundreds or even thousands of individual ray paths to accurately quantify the size, shape, severity, and location of the possible anomaly. All offset measurements are collected with an Olson Instruments CSL system, model Freedom Data PC. The offset measurements are then post processed in the office using the CSL2 software to determine the first arrival times (FAT) and then imported into the GeoTomCG® software. The GeoTomCG® software performs Crosshole Tomography (CT) analysis using an analytical technique which uses an inversion procedure referred to as simultaneous iterative reconstruction technique (SIRT). The analyzed data is displayed in 2-D and 3-D velocity models that more accurately quantify the size, shape, and severity of the possible anomaly than CSL testing alone.

The GEOTOMCG software features include user defined and display XY horizontal slices as well as XZ and YZ vertical slices in full color.



Sample Output for the GEOTOMCG Software. (Left) XY Horizontal Plane at an Elevation of –73.5 feet. (Right) YZ Vertical Plane at X = -1.4 Feet.

Mini-SID

The Miniature Shaft Inspection Device (Mini-SID) is a visual inspection system for evaluating bottom cleanliness of drilled shaft excavations.

Mini-SID Services

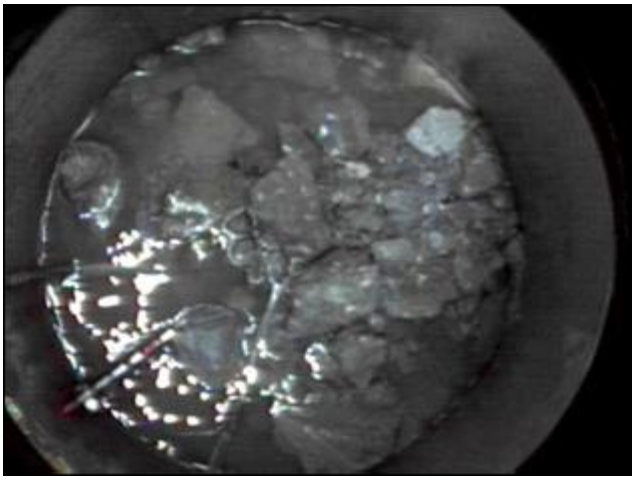
- *Turn Key* Mini-SID Testing Services
- Highly Experienced Operators
- Equipment Rental
- Training
- Repair and Maintenance
- Assistance in Job Planning and Specification Preparation

End Bearing Reliability – Bottom cleanliness of drilled shaft foundations has been proven, through load testing, to effect end bearing performance. Further research shows that displaced bottom sediment also reduces side shear in the bottom 1 to 2 shaft diameters. Good bottom cleaning methods such as airlifting and submersible pumps will significantly increase end bearing reliability. The Mini-SID allows the Owner, Engineer and Contractor to verify the effectiveness of these cleaning methods which ultimately provides increased end bearing confidence.

A special video camera contained within a bell housing is lowered into the shaft excavation and the bottom material and condition is safely viewed on a video monitor from the surface. The inspection of the shaft bottom is viewed on a color video monitor in real time and recorded with voice annotation on a standard VHS tape for permanent record. The bell housing is fitted with a graduated scale which provides a measure of the bottom sediment depth.

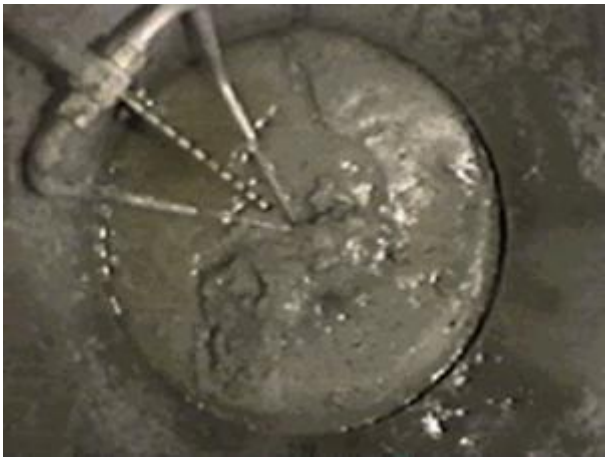
Mini-SID Capabilities

- Provides Confidence in End Bearing Reliability
- Dry Shafts
- Wet Shaft
- Slurry Shafts
- Water Shafts
- Depths of 250 feet



View of shaft bottom through Mini-SID camera with rock fragments only

View of shaft bottom through Mini-SID camera with 2.5 inches of sediment



View of clean shaft bottom through Mini-SID camera with ¼ inch of sediment

DYNAMIC PILE TESTING AND ANALYSIS SERVICES
PILE DRIVING ANALIZER (PDA)

Edifica USA LLC provides the full range of expert dynamic testing and analysis services. Edifica engineers have been involved in dynamic testing for nearly twenty years and have performed thousands upon thousands of dynamic tests. EDIFICA knows the merits and limitations of dynamic testing and uses the technology to make practical unbiased engineering decisions - independently.

Many of our Engineers possess the Foundation QA Dynamic Pile Testing Certification. With our staff of Qualified Pile Driving Installation Inspectors, we also provide production foundation certification.

EDIFICA's extensive experience, method of approach, and independent status has resulted in our being preferred by owners, engineers and contractors. We have also functioned in an oversight role performing independent verification testing and analysis of other dynamic testing consultants.

EDIFICA has offices in California and Colombia (S.A.) therefore can provide easy local coverage of North and South America.

We employ these techniques with engineering judgment to determine optimum pile lengths and driving criteria.

- Pile Driving Analyzer (PDA) - PAK Models
- Foundation Pile Diagnostic System – TNO Model
- Sonic Integrity Tester (SIT) - TNO model
- Sonic Echo Tester (SE) - Olson model

- GRLWEAP Wave Equation Software
- TNOWAVE Wave Equation Software
- CAPWAP Software
- TNO Signal Matching Software

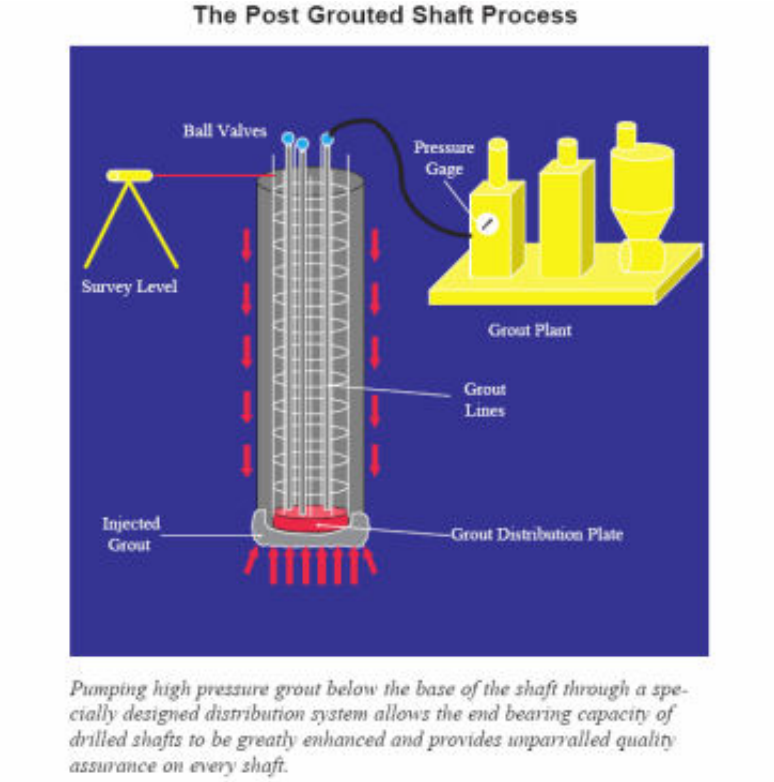
From Bridges to Port Facilities to Commercial Building Structures dynamic testing programs performed by EDIFICA have resulted in foundation cost savings and problem solving.

Dynamic Testing Services Offered

- Driveability Studies
  - Pre-Bid
  - Pre-construction
- Wave Equation Analysis
- Dynamic Pile Testing PDATM
- Signal Matching Analysis CAPWAPTM
- Practical Engineering Interpretation
- Engineering Recommendations
  - Pile Lengths
  - Driving Criteria
- Independent Verification Testing

DRILLED SHAFTS POST-GROUTING

Drilled shaft post-grouting is a technology to significantly increase (50% or more) the end bearing capacity of drilled shafts. End bearing capacity of drilled shafts is typically significantly reduced or even discounted altogether due to the large displacement required to mobilize ultimate capacity. Consequently, a large portion of the ultimate capacity necessarily goes unused. To regain some of this unusable capacity, mechanistic procedures to integrate its contribution have been developed by pressure grouting beneath the shaft tip. The process is known as Post Grouting. The post-grouting process entails: (1) installation of a grout distribution system during cage preparation that provides grout tube-access to the bottom of the shaft, and (2) after the shaft concrete has cured, injection of high pressure grout beneath the tip of the shaft which both preloads the in-situ soil and compresses any debris left by the drilling process.



Pumping high pressure grout below the base of the shaft through a specially designed distribution system allows the end bearing capacity of drilled shafts to be greatly enhanced and provides unparralled quality assurance on every shaft.

By essentially preloading the soil beneath the tip, higher end bearing capacities can be realized within service displacement limits. Not only will post grouting significantly increase the tip capacity, it will decrease foundation settlement and bring a higher level of quality assurance to the drilled shafts.

A design approach for post grouted drilled shafts was developed by The University of South Florida under a research grant from the Florida Department of Transportation. The method makes use of common parameters for a conventional drilled shaft design, where the available side shear is used to determine the achievable grout pressure. The grouted end bearing capacity is strongly dependent on available side shear. However, it is relatively independent of the ungrouted end bearing capacity when in sandy soils. As such, the end bearing in loose sands can be greatly improved in both stiffness and ultimate capacity. In silts and clays significant improvement in stiffness can be realized resulting in greater usable end bearing capacity. In rock, post grouted shafts have the potential to engage both the side shear and end bearing simultaneously.

High Pressure Grout Plant

Post Grouting of Production Shafts

By design, the grout distribution system provides a known pressurizing surface area, therefore by monitoring grout pressure, the end bearing and upward skin friction load is determined to a level proportional to the applied grout pressure. Quantitative data about the load carrying capability of every production shaft is obtained thereby increasing confidence in the performance of the structure.

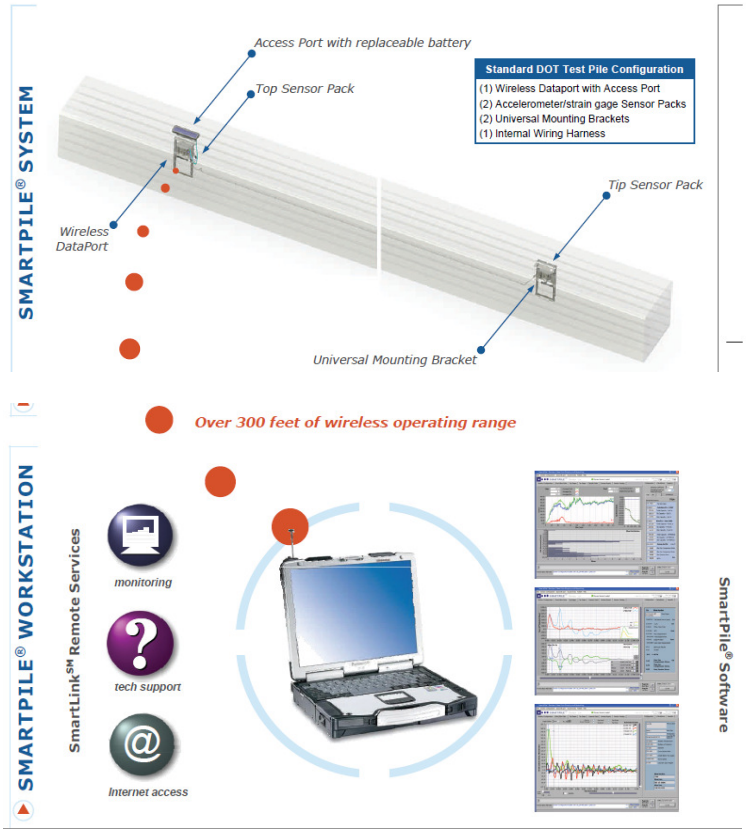
Our team has developed a proven systematic approach to post grouted shaft design and implementation. We have post grouted more drilled shafts in the United States than any other company. In most cases, the method was used as a cost saving alternate to conventional drilled shafts or to replace competing foundation systems.

We can give your drilled shafts a renewed competitive edge in the foundation construction industry.

SMARTPILE ™ WIRELESS EMBEDDED PILE SENSOR SYSTEM

BREAKTHROUGH PILE TESTING & MONITORING SYSTEM

Through a powerful combination of wireless technology, industry expertise, and rugged design comes a breakthrough technology that collects, transmits, and processes vital information from concrete piles—during casting, during transportation, during driving, during restrikes, and beyond. The SmartPile™ system provides engineers, transportation officials and contractors with an immediate cost-saving solution to the challenge of dynamic testing and structural monitoring. It offers a safe, reliable, and low-cost way to decrease construction time, decrease testing costs, and improve testing accuracy.



STATIC LOAD TESTING SERVICES

Edifica USA LLC provides unrivalled expertise in load testing equipment, instrumentation, monitoring and analysis services. We own and operate a full inventory of engineered static load test systems with capability up to 3,000 tons. Our full digital monitoring systems which have been applied in well over 1,000 load tests provide the highest high degree of precision and reliability. With so much importance hinging on your load test, EDIFICA will give you the confidence in knowing your test was performed to the highest possible standards.

A Wide Range of Static Testing Services Offered by EDIFICA from independent monitoring to complete turnkey packages where we provide the entire reaction system.

Compression - ASTM D1143

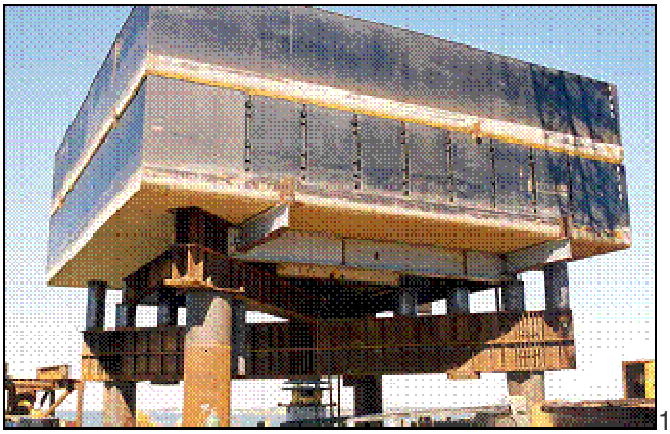
Tension - ASTM D 3689

Lateral - ASTM D 3966

Plate Load Tests

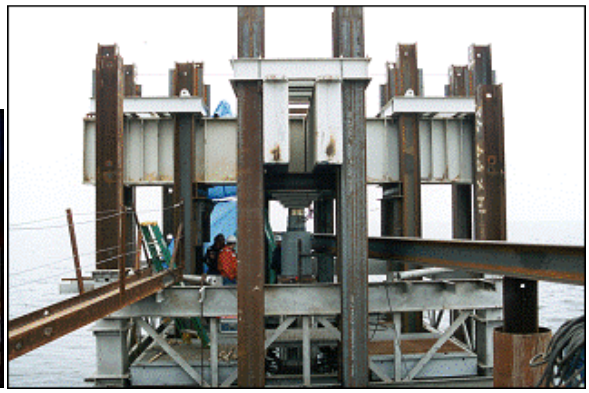
Shallow Foundation Load Tests

- ***Turn Key* Package - Reaction System, Jack, Instrumentation, Monitoring and Report.**
- **Highly Experienced Registered Professional Engineers and Technicians.**
- **Reaction Systemsup to 1500 tons.**
- **Hydraulic Jacks.**
- **Precision Instrumentation and Monitoring.**
- **Data Analysis and Reporting of Results**
- **Equipment Rental Only.**
- **Assistance in Monitoring Program Planning and Specification Preparation**


1600 Ton Compression Load Test

16675 Slate Dr. Unit 1411, Chino Hills, CA, 91709 – Phone 1 909 3428301 – info@edificausa.com
Carrera 48 No. 98-57, Bogota, Colombia. – Phone 57 12362121





1200 Ton Compression Load Test

Lateral Load Test Concrete Cylinder Pile and voided square concrete Pile Cape Fear River Bridge - Instrumentation and Data Acquisition

Our specialized data acquisition equipment and instrumentation can be fully interfaced and sampled at virtually any rate. All the data is readily available in ASCII format allowing efficient data regression.

- Hydraulic jacks.
- Hemispherical bearings.
- Load Cells.
- Pressure transducers.
- Displacement transducers (LVDT's).
- Strain gage instrumentation.
- Data acquisition systems.

We can also custom design instrumentation and monitoring schemes to fit your needs.

Static Load Test Reaction Systems

We own several reaction systems which are adaptable from the smallest tests up to 1500 tons. Our systems are fully engineered and designed for simple and efficient set-up. They are available for rental or we can provide a full testing service or anything in between.

STATNAMIC LOAD TESTING

Statnamic load testing has been used extensively all over the world on bridges, high rise condominium structures, office towers, military facilities, Corps of Engineers flood control structures, water and wastewater facilities and various other commercial structures. Statnamic Load Testing is a recognized test method by the American Society for Testing and Materials designation number ASTM D7383-08. Statnamic load testing is routinely used as an alternate to ASTM D1143 (Compression), ASTM D3689 (tension), ASTM D3966 (lateral) and ASTM D 1194 (plate load test). It can also be a higher quality alternate to ASTM D4945 (high strain dynamic). In the realm of load testing an assortment of test methods are available for foundations. Each methodology has is merits as such many issues play into the selection of the most appropriate method. These methods have historically been divided into two categories: static or dynamic. Recently a new classification of testing denoted as rapid load testing has emerged, which combines many of the benefits of the previous methods. Static load tests are thought to provide the most reliable results and the analysis is straightforward. However, the tests are costly and time consuming. Additionally, they are not immune to side effects such as influence from reaction piles, maintaining independent displacement measurements and precision of load measurement (e.g. indirect load measurement via pressure). Dynamic testing, which was developed for driven piles, is considered less reliable (AASHTO, design codes) and is used only as an estimate of capacity. Mainly, because the analysis is complex and relies heavily on user dependent modeling and parametric estimates to which there is no unique solution. Its requirements for capacity analysis are only satisfied for uniform piles reducing its reliability for use on cast-in-place foundations. For driven piles, however, it is a very efficient and economical means of testing. It also provides a wide variety of other important data during pile driving, i.e. hammer energy, driving stresses, pile integrity and driving resistance. Statnamic load testing, a rapid load test, combines the simplicity of static analysis with the efficiency and cost effectiveness of dynamic testing.