HOQUE & ASSOCIATES

Consulting Geotechnical, Materials and Environmental Engineers

April 10, 2019

Firm Overview with Relevant Experiences

Hoque and Associates, Inc. (HA) is a local consulting engineering firm specializing in geotechnical exploration and construction materials testing. The firm was established in 1997 to provide high quality, innovative, cost effective, and responsive services to its clients. HA employs a diversified staff of qualified and experienced professional and technical personnel including engineers, geologists, scientists, and laboratory and field testing technicians. HA specializes in a wide range of geotechnical engineering and material testing and inspection services. HA will perform all work and services out of our facility utilizing local personnel residing in the Phoenix metropolitan area.

HA has extensive experience in the following Crosshole sonic & Gamma Gamma Density logging services, listed below are Relevant Projects of Hoque & Associates, Inc.

- **ADOT (HB479 01C) I-10/Ina Road TI, Tucson, AZ** - Integrity testing on drilled shafts.
- **ADOT (T0021 01C) Oatman Highway at Sacramento Wash Crossing Topock, AZ** - Drilled shaft integrity testing and contractor quality control (CQC).
- **ADOT (H8827 01C) SR 202L South Mountain Freeway, Phoenix, AZ -** Integrity testing on drilled shafts.
- **Clark County (L-2048) I-215 Airport Connector Phase 2 Las Vegas, NV -** Integrity testing on drilled shafts.
- **ADOT (H8485 01C) US60 Bell Road TI, Surprise, AZ** - Integrity testing on drilled shafts.
- **PCDOT (4RTSUN) Sunset Road – Silverbell to I-10, Marana, AZ** - Integrity testing on drilled shafts.
- **Clark County (603740-15) Las Vegas Wash Pedestrian Bridges and Phase 2 Trail, Las Vegas, NV** - Integrity testing on drilled shafts.
- **ADOT (H8577 01C) I-10/SR303 TI PH II, Goodyear, AZ** - Integrity testing on drilled shafts.
- **ADOT (H8169 01C) L202 Red Mountain Freeway (L101 to Broadway Rd) Mesa, AZ** - Integrity testing on drilled shafts.
- **BIA (N36236) Navajo N31, Fort Defiance, AZ** - Integrity testing on drilled shafts.
- **ADOT (H8574 01C) Virgin River Bridge 6, Littlefield, AZ** - Integrity testing on drilled shafts.
- **ADOT (H7915 01C) US 89-SR 64 to Little Colorado River, Cameron, AZ** - Integrity Testing on 24 drilled shafts.
- **FHWA (AZ FLAP 64(3) 199(1), 288(3)) East Verde River Crossings, Houston Mesa Road, Payson, AZ -** Integrity testing of 15 drilled shafts.
- **ADOT (H6241 O2C0) I10 Prince Road Traffic Interchange, Tucson, AZ** - Integrity testing on over 250 drilled shafts.
- **ADOT (H7139 O1C) I10/303 Traffic Interchange, Goodyear AZ** - Integrity testing on 68 large diameter drilled shafts.
- **PSHIA (AV10000010) Sky Train Stage 1A Terminal 3/2** - Integrity testing & inspection on 40+ drilled shafts.

- **Pima County La Cholla Bridge: Magee Rd to Overton Road (4RTLTM)** – Drilled shaft integrity testing on 42 60-inch diameter drilled shafts.
- **Sahuarita Road Bridge, Town of Sahuarita (03P9B)** CSL & GDL shaft Integrity testing.
- **ADOT (H7473 O1C) Cienega Creek-Marsh Station, Phase III** - Integrity testing on 1(2) 60-inch to 84-inch diameter drilled shafts.
- **PCDOT (4MCFTL) Cortaro Farms & Magee Road Improvements, Tucson Arizona** - Integrity testing on (16) 60-diameter drilled shafts.
- **ADOT (H661401C) San Carlos River Bridge, Peridot AZ**. - Integrity testing on (16) 72-inch diameter shafts.
- **City of Tucson (S083) Cushing Street Bridge Improvements** - Integrity testing on 10 drilled shafts. Pier shafts extend to 155 feet below grade.
- **ADOT (H752801C) SR143/ Sky Harbor Blvd** - Integrity testing on 40 drilled shafts.
- **ADOT (H745701C) BRIDGE 3 202L-101L HOV BRIDGE** - Integrity testing on 15 large diameter (144-inch diameter, 130-diameter, 120-diameter) drilled shafts.
- **ADOT (H600501C) San Pedro Bridge #2944, Sierra Vista, Arizona -** Integrity testing on drilled shafts.
- **ADOT (H757101C) Laguna Creek Bridge #20001. Mexican Water, Arizona -** Integrity testing on drilled shafts.
- **PSHIA, Sky Train- Underpass on Taxiway "S&T" Phoenix Arizona -** Integrity testing on drilled shafts.
- **ADOT Bylas Test Shaft & Bylas Bridge #2945, Bylas Arizona -** Integrity testing on drilled shafts.
- **Obed Road Rehabilitation Bridge, Joseph City Arizona -** Integrity testing on drilled shafts.
- **SR70 San Carlos River Test Shaft, Peridot, Arizona -** Integrity testing on drilled shafts.
- **SRP-Pinal Central to Abel Transmission lines (113-116). Pinal County Arizona -** Integrity testing on drilled shafts.
- **ADOT (H687101C) SR 202/SR 51 TI to SR 101L EB/WB Widening Project, Phoenix/Tempe Arizona** - Integrity testing on approximately 215 drilled shafts. Bridges included the SR202 Salt River Bridge EB/WB, Indian Bend Wash EB/WB, Scottsdale Rd EB/WB, College Ave EB/WB, 32nd St EB /WB and 24th Street EB /WB.
- **City of Phoenix (AV10000001) PSHIA- PHX SKY TRAIN Stage 1 Design Project Phoenix, Arizona** - (Terminal 4, Guideway, EEL Station, 44th Street Station) Integrity testing on approximately 180 drilled shafts.
- **ADOT (H715601C) L303 Agua Fria River Bridge, Peoria Arizona** - Integrity testing on 34 drilled shafts.
- **ADOT (H583801C) TWIN PEAKS BRIDGE, Marana Arizona** - Integrity testing on 28 drilled shafts.
- **ADOT Mill Avenue Viaduct EB Widening (Loop 202 and Mill Avenue) Tempe Arizona** - Integrity testing on drilled shafts.
- **SR 202L South Mountain Freeway (H8827 O1C)** – Integrity testing on approximately 229 drilled shafts.
- **City of Phoenix PSHIA Sky Train Stage 2** - Integrity testing on drilled shafts.

HA provides the above services in-house with the exception of drilling. HA's in-house resources include a fully equipped construction materials testing laboratory and offices for professional and support personnel who provide engineering, management, and administrative services. Managers have state-of-the-art computer systems dedicated to their exclusive use. Software proven effective in project management is utilized to assist our project managers with efficient budget development and tracking, schedule development and tracking, database development and maintenance, and documentation and report generation.

Our laboratory is accredited by appropriate state and federal agencies. All of HA's laboratory and field testing equipment is calibrated on a routine basis per our accreditation criteria, and calibration documentation is kept on file in our offices. All equipment is routinely inspected and repaired or replaced as appropriate. Nuclear gauges used for field density testing of soil and asphalt are licensed by the Arizona Radiation Regulatory Agency (License number 7-431).

HA has been in business for more than 22 years. As a premier geotechnical and construction materials testing engineering firm, HA follows a strict quality control process. Our project management and schedule control philosophy are based on the following elements:

- The most qualified, trained and experienced personnel are assigned to each project to assure that the project work is completed on time and project deliverables meet the client's requirements.
- Daily communication occurs between the project manager and the key project personnel.
- Periodic project meetings (monthly, weekly, or daily as appropriate) are conducted to discuss the project status, accomplishments, budget, and any current or future issue. Meeting minutes and project status reports can be provided to the client if necessary or requested.
- To assure that an individual with authority to commit resources of the company is involved, firm principals serve as project directors and oversee the project. The project directors work closely with the project manager and serve as the key contact for the client.
- Project reports form the basis of our billing and include work and tasks completed, work and tasks to be completed with an updated schedule, and the actual man-hours that have been completed.

Brief descriptions of key team members including their company title, project role, and relevant experience are provided below.

Enamul Hoque, PE, President
Project Role: Project Director/Principal-in-Charge
State of Arizona Registered Professional Engineer (Civil) No. 20920
Mr. Enamul Hoque has more than 41 years of experience as a geotechnical, solid waste, and construction materials testing engineer. Mr. Hoque posses a masters degree in Civil Engineering and is currently registered as a professional engineer in Arizona, Nevada and Washington state. Mr. Hoque is an ASCE Fellow and the Founder and President of

HA. He is a highly qualified, experienced, and respected engineer with strong scope of work, budget development, and cost control skills who has completed more than 1,000 geotechnical investigation projects involving field exploration, field and laboratory testing, engineering analysis, engineering design, and/or construction quality assurance and construction quality control. His experience includes: foundations and slopes in seismic zones, analysis for liquefaction, and identification and mitigation of geologic hazards such as earthquakes and wind to engineered structures; providing innovative solutions to the design of containment systems and the control of subsurface flow related to slope failures and landslides; and, foundation inspection and foundation retrofit for transient loads such as seismic and vortex shedding due to wind. Mr. Hoque is well versed with more than 24 years of hands-on experience providing laboratory and field work and he regularly supervises and performs field testing and inspection services associated with HA's project work. He has been with Hoque & Associates since February 1997.

Cory McElprang, PE, Project Manager:
Project Role: Project Manager/Principal
State of Arizona Registered Professional Engineer (Civil) No. 61839
Mr. Cory McElprang has more than 14 years of experience in the field of geotechnical engineering including instrumentation, monitoring, material testing, and field exploration. Mr. McElprang has a BSE in Civil Engineering and is a registered professional engineer in Arizona. Mr. McElprang has performed shaft Integrity testing of 3500+ drilled shafts. Mr. McElprang has experience managing projects for construction materials testing, geotechnical exploration and specialized geotechnical engineering projects. He has worked with Hoque and Associates since July 2008.

HA's field personnel have been through Competent Person Training (OSHA 29 CFR Part 1926.650-652 Subpart P) that includes both trench safety and confined space entry issues. HA commits the above referenced personnel to provide its clients with quality and responsive services. HA has additional personnel to commit to projects and will do so as needed with approval from the client.

Crosshole Sonic Logging (CSL) and Gamma Density Logging (GDL) Test Procedure

The CSL testing is performed in general compliance with ASTM D 6760 and project specifications by utilizing the Cross Hole Analyzer (CHAmp) CSL device manufactured by Pile Dynamics, Inc (PDI). The equipment consists of a transmitter capable of producing ultrasonic frequencies (more than 40,000 Hertz) and a receiver compatible to the transmitter. In addition, cross-hole analyzer developed by PDI will be for data acquisition and data analysis. Down-hole logging consists of lowering two 5.25 inch long probes to full depth of the shaft within the access tubes. One of the probes acts as the receiver and the other one as the transmitter. Prior to inserting the receiver and transmitter into the access tubes, the depth of each tube and spacing of tubes combinations will be measured by lowering a measuring device and a tape, respectively. The depth and spacing of tube combination measurements will be saved into a dedicated PC computer containing the hardware and software for CSL. After that, testing starts by simultaneously lowering the receiver and transmitter to the bottom of the tube and CSL test data will be acquired by moving them "Up" the access tubes. The receiver and transmitter will be kept

at the same horizontal elevation (zero offset) during this testing so that the direct waves travel (compressional wave) time is recorded.

The moment the signals or ultrasonic pulse from the transmitter start generating, data acquisition is started at the receiver probe and the receiver records the first arrival time (FAT) of the primary or fastest wave and the energy of the pulses as they travel to the receiver. At each time or depth the receiver records the data, it assigns the depth of the data as provided by the testing personnel based on the measurement of the unobstructed tube length. An on-site dedicated portable yet rugged computer displays the data acquired during testing to confirm the data quality or any abnormal data. The data display includes ultrasonic profile including FAT and energy of transmitted pulse at the receiver probe at each depth interval. The data collected from the field will be saved into the dedicated computer and transferred to the HA office for processing.

The acquired data processing includes calculating wave velocity within the travel path of the pulses and energy level based on FAT and distances between these tubes. The recorded travel time between two tubes is used to calculate velocity of the wave as the distance of the tube is known. The velocity is plotted with depth of the tubes. The velocity is related to the elastic properties of concrete (modulus, density and Poisson's ratio). Elastic modulus of concrete also has an indirect relationship with unconfined compressive strength of concrete via an empirical equation. For acceptance or qualitatively evaluate the uniformity or consistency of concrete, the actual velocity of compressional wave velocity recorded from the CSL results are compared with theoretical compressional wave velocity calculated from the elastic properties of the concrete (based on information on mix design and amount of reinforcement) and is expressed in terms of velocity reduction, VR.

$$VR = \left(1 - \frac{V}{V_b}\right)100\% \approx \left(1 - \frac{V}{13{,}000}\right)100\%$$

(Brown, D. A., Turner, J. P., & Castelli, R. J. (2010). *Drilled shafts: construction procedures and LRFD design methods*. McLean, VA: U.S. Dept. of Transportation, Federal Highway Administration.)

A qualitative value of VR is assigned by the engineer to the placed concrete as below:

VR= 0-10%	Good or Acceptable Concrete
VR= 10-20%	Minor Contamination, Intrusion, or Questionable Concrete
VR= >20%	Contamination, Intrusion, and/or Poor Concrete

In addition, soft or poor quality concrete absorbs energy of the sonic wave and this phenomenon is reflected in lower signal amplitudes. It is therefore, generally accepted that if the CSL data indicate lower velocity (in this case VR>10%) and lower pulse energy (lower than -9 dB) then the anomalous zone caused by soil intrusions or poor quality concrete or non-uniform concrete or non-uniform maturity of concrete or combination thereof.

The GDL will be completed using a Mount Sopris MGX II Portable Digital logger. This device has a 100 miliCurie Cesium (Cs) 137 source and reads Compton-scattered gamma-ray from the medium at a rate of 1 per 0.1 feet. The reflected photons are counted at a scintillation crystal package at a distance from the source. The density of concrete is inversely proportional to gamma count rate and is calculated as the average weighted density of the medium within an omni-directional distance of a 5 inch radius. The media within this distance includes different materials (densities) such as PVC pipe, PVC pipe couplings with irregular glues, concrete, steel rebar and possible air and or water, any combinations of these materials. Therefore within the Omni-directional distance of 5 inches would affect the average calculated density and would be reflected in the density data. The test will conducted at an ascend speed of 10 feet per minute.

Company References

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HA appreciates the opportunity to work on your project. If you have any questions, or if we can be of any further assistance, please contact us at (480) 921-1368.

Sincerely
Hoque & Associates, Inc.

Cory McElprang, PE
Project Manager