

CONSTRUCTION VIBRATION AND CRACK MONITORING

**\*\*From Burke BRF 0269(13)**

- xx. DESCRIPTION. This work shall consist of conducting pre-construction building surveys, developing appropriate vibration trigger levels, and installing vibration and crack monitoring devices to record conditions prior to and during construction activities at the project site.
- xx. GENERAL. Vibration producing activities such as blasting, pile driving, vibratory compaction, pavement breaking, or operation of heavy construction equipment required for the construction of this project have the potential for creating damage to surrounding infrastructure and buildings. The Contractor is advised that structures are located in very close proximity to the proposed work and that construction activities shall be conducted so as to preclude damage to these structures. The Contractor is responsible for all damage caused by the Contractor's activities.

Structures immediately to the east of the project work area have been identified as historical and will require extra care to avoid damage.

- xx. MATERIALS. The Contractor shall provide InstanTel Blastmate III, or equivalent amplitude/frequency vibration monitors ([www.instanTel.com](http://www.instanTel.com)). These instruments shall be capable of measuring, recording, and producing a hard copy of the frequency and peak particle velocity in three mutually perpendicular axes (Instruments that record "Vector sum" only measurements are not acceptable). These instruments shall be capable of measuring Linear Scale (dB-L) sound levels.

The Contractor shall provide crack monitoring equipment from the following, or an approved equal:

Tell-Tale Crack monitors  
RST Instruments Ltd.  
Tel.: (800)665-5599  
[www.rstinstruments.com](http://www.rstinstruments.com)

Crack monitoring Equipment  
Geotest Instrument Corp.  
Tel.: (866)430-7645  
[www.crackgauge.com](http://www.crackgauge.com)

Avongard Crack Monitor  
Avongard Products U.S.A.  
Tel.: (800)244-7241  
[www.avongard.com](http://www.avongard.com)

- xx. MONITORING CRITERIA.

(a) The Contractor shall provide the services of an independent qualified Engineering Consultant to perform pre-construction surveys of nearby buildings, develop site specific vibration limits that are protective of nearby structures, especially historical structures, and monitor the vibrations along active work zones and any crack monitoring identified as necessary during pre-construction building inspections or created by

current construction activities. The Engineering Consultant shall have at minimum a two year associate's college degree in science or engineering and at least 10 years of experience in seismic monitoring. The Engineering Consultant shall interpret the seismograph records to ensure that the seismograph data will be effectively utilized in the control of the construction activities with respect to the existing structures. The Engineering Consultant used shall be subject to the approval of the Engineer. The Engineering Consultant shall supervise the placement and operation of the seismographs.

The Contractor and Engineering Consultant shall be mindful of the historic nature of the Bed & Breakfast structure located within 15 feet of Abutment 2 of the proposed bridge and shall set appropriate vibration limits in the Vibration Monitoring Plan so that the Contractor does not damage existing above and/or below ground features of this structure during construction.

- (b) The Contractor shall provide a description of proposed construction methods, including amplitude descriptions of each vibration producing activity, and a vibration monitoring plan for each activity, including the format for reporting the vibration readings. A minimum of two construction vibration monitoring devices shall be placed within or along the construction zone. These devices shall be placed at locations nearest buildings or structures closest to active construction to optimize evaluation and assessment of potential damage to surrounding features. Additional devices may be required as directed by the Engineer.
- (c) In order to establish background conditions, vibration monitoring equipment should be set to record data for at least one full week prior to construction activities. A full report of this information will be provided to the Engineer prior to any construction activities beginning. If the Contractor's construction means and methods create ground vibrations that result in damage to surrounding buildings or structures, the Engineer will direct that all activities related to those causing the vibration be stopped. The Engineer may also, at any time, halt construction activities if vibration levels exceed those developed by the Engineering Consultant or if there are signs of damage to surrounding buildings and structures. In the event of work being stopped as a result of ground vibrations, the Contractor shall submit to the Engineer a report giving the construction parameter data and include the proposed corrective action for future construction events. In order to proceed with any further vibration producing activities, written permission must be obtained from the Engineer.
- (d) Vibration monitoring equipment shall be capable of continuously recording the peak particle velocity and providing a permanent record of the entire vibration event. Copies of all vibration records and associated construction activity (blasting, pile driving, pavement breaking, compaction, etc.) data shall be provided to the Engineer in a format approved by the Engineer.
- (e) The Engineering Consultant shall measure the magnitude of each vibration event with at least two vibration instruments,

generally located adjacent to the closest or most critical structures. The vibration monitors shall be amplitude and frequency sensitive and shall be operated during vibration producing activities that produce measurable ground vibrations. In the event that the Contractor chooses to have concurrent vibration producing activities at more than one location adjacent to buildings, the Contractor shall notify the Engineer prior to the commencement of such activities. The Engineer may require additional vibration monitoring instruments at each location depending on site parameters. No vibration producing activities may be started until the appropriate instrumentation is provided by the Contractor and approved by the Engineer.

- (f) All vibration instruments shall be powered with rechargeable batteries, and the Contractor shall supply extension geophone and microphone cables so that the instruments can be placed within structures if outside temperatures drop below 32°F.
  - (g) All vibration instruments shall be supplied with current calibration documents and shall be recalibrated on approximately a six-month use interval. All geophones shall be securely coupled to the ground.
  - (h) The Contractor shall be responsible for instrument maintenance. If the Contractor does not maintain a sufficient number of instruments to monitor the buildings/structures adjacent to the vibration producing activity, the Engineer may direct that all vibration activities cease until a sufficient number are working. The Contractor's consultant will be responsible for placing the instruments at measuring locations designated in the monitoring plan, and reading and recording the pertinent vibration levels during pile driving and other construction activities designated by the engineer.
  - (i) Crack displacement monitoring gages will be installed as appropriate across any significant existing cracks in buildings or structures identified and deemed necessary by the Contractor and Engineer during the Pre-Construction Building Inspections and agreed to by the Property Owner. Readings from the crack monitoring devices should be taken at the time of installation (at least one week prior to construction activities), again, just prior to construction start-up and at intervals during construction established by the Engineering Consultant. The consultant shall take and record readings of all instrumentation during the performance of the work and a report shall be provided to the Engineer within 24 hours of completing the readings.
  - (j) The Contractor shall also be required to install additional crack monitoring devices as necessary and directed by the Engineer as a result of cracks that are identified or develop during construction.
- xx. Pre-Construction Condition Survey. The Contractor shall conduct a pre-construction condition survey of any buildings, structures, or utilities within a 150 foot radius of the construction operations creating vibrations. The survey method used shall be acceptable to the Contractor's insurance company, the Agency, and local authorities. The

Contractor shall be responsible for any damage resulting from construction activities. The pre-construction condition survey records shall be made available to the Engineer for review. Occupants of local buildings shall be notified by the Contractor prior to the commencement of activities which may generate excessive vibrations.

xx. SUBMITTALS. The Contractor shall submit their proposed construction vibration monitoring plan for the structural health of nearby buildings and structures to the Engineer for review and approval a minimum of 14 days prior to the start of construction. The submittals shall include the following:

- (a) The qualifications of the Engineering Consultant. Include a list of three projects (with references) in the past five years where the Consultant has successfully developed vibration criteria and monitored construction activities on projects similar to the scope of the current project.
- (b) A description of the monitoring equipment and current calibration documentation.
- (c) Plan view showing number and locations of seismographs and crack gages being monitored.
- (d) Proposed vibration limits for the particular construction activities under consideration.
- (e) A list of structures, utilities and all other facilities which in the judgment of the Engineering Consultant require a pre and post construction condition survey. Particular attention shall be given to historic structures, structures in poor condition, structures supported by vibration sensitive materials which could cause settlement or loss of support, and structures which contain sensitive equipment or processes.
- (f) Procedures to be implemented if it is determined that the proposed construction activity cannot be reasonably implemented without exceeding vibration limits that are necessary to protect adjacent facilities.

xx. PUBLIC RELATIONS. The Contractor is required to contact residents and owners or operators of the buildings along within 150 feet of active construction work zones. This contact will be made prior to the beginning of any vibration producing activity. The Contractor shall furnish to the Engineer a list of those contacted.

The Contractor shall maintain a log of all vibration related complaints, contacts, and actions, and shall furnish copy(ies) to the Engineer upon request.

xx. METHOD OF MEASUREMENT. The quantity of Special Provision (Construction Vibration and Crack Monitoring) to be measured for payment will be on a lump sum basis in the complete and accepted work.

xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (Construction Vibration and Crack Monitoring) will be paid for at the Contract lump sum price. Payment will be full compensation for developing safe vibration limits, installing the monitors, recording the vibrations and crack movement, making all necessary submittals, and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.645 Special Provision (Construction Vibration and Crack Monitoring)	Lump Sum