SECTION 01 35 51

VIBRATION CONTROL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes minimum provisions for compliance with City, state, and federal laws and regulations for vibration control, and notes to which Standard Construction Measure (SCM) the section refers.

1. Vibration Control (SCM-5).

B. Related Sections:

1. Section 00 41 00 Bid Form
2. Section 01 35 49 Minimum Environmental Procedures
3. Section 01 31 19 Project Meetings

1.2 REFERENCES

A. Refer to the following references:

1. Andrews, Jim, et al. Transportation and Construction Vibration Guidance Manual. California Department of Transportation Report No. CT-HWANP-RT-13-069.25.3, September 2013.

1.3 DEFINITIONS

A. For the purposes of this Section, the following definitions apply:

1. Historic buildings or historic structures: Buildings or structures labeled as historic structures on project plans.

1.4 SUBMITTALS

A. Contractor shall submit the following prior to the start of construction and prior to performing any vibration monitoring:

1. A record of laboratory calibration shall be provided for all vibration-monitoring instruments to be used on site. Certification shall be provided to indicate that the instruments are calibrated and maintained in accordance with the equipment manufacturer's calibration requirements and that calibrations are traceable to the U. S. National Institute of Standards and Technology (NIST). The record shall certify that all seismographs shall have been calibrated by the manufacturer or certified calibration laboratory within one year of their use on site.
2. Manufacturer's product data for all vibration-monitoring instruments to be used on site describing all specified vibration-monitoring instruments, together with product data and instruction manuals.
3. Documentation and photography of the properties that are the subject of the Vibration Monitoring Plan, as specified below in 3.4.G.
4. A written Vibration Monitoring Plan detailing the procedures for vibration monitoring. Such plan shall include:

(a) The name of the Firm providing the vibration monitoring services.

(b) Description of the instrumentation and equipment to be used.

(c) Measurement locations and methods for mounting the vibration sensors.

(d) Procedures for data collection and analysis.

(e) A limiting value as applied in 3.4, below.

(f) Means and methods of providing warning when a limiting value is reached.

(g) Generalized plans of action to be implemented in the event the limiting values is reached. The generalized plans of action shall be positive measures by the Contractor to control vibrations (e.g. using alternative construction methods).

(h) Procedures for post-construction assessment of any damage due to vibration during construction to historic buildings or structures susceptible to vibration in or adjacent to the project, and reporting requirements and procedures if such damage occurs.

5. Within 10 working days after the completion of the background vibration monitoring as described in 3.4.G, Contractor shall submit a hard copy report documenting the results of background vibration monitoring at each monitoring location.

B. Qualification Data: For firms and persons specified in subsection 1.5 "Quality Assurance" of this Section to demonstrate their capabilities and experience.

1.5 QUALITY ASSURANCE

A. Qualifications

1. Qualified Vibration Instrumentation Engineer: a registered Professional Engineer in the State of California, who has a minimum of a Bachelor of Science degree in civil engineering, and who has at least 4 years of experience in the installation and use of vibration-monitoring instrumentation and in interpreting instrumentation data.

B. Regulatory Requirements

1. All work shall comply with the following:
   (a) San Francisco Police Code, Article 29, Ordinance #274-72 ("Noise Ordinance")
   (b) San Francisco Public Works Code, Article 2.4 (“Excavation in the Public Right-of-Way”)
   (c) San Francisco Public Works Code Ordinance #175-91,Sections 1100-1107

C. The City will inspect and monitor Contractor's adherence to the requirements specified herein and will report on Contractor's compliance.

1. Said inspection, monitoring, and reporting activities may include, but are not limited to, qualitative, quantitative and photographic observations and data collection on the impacts of vibration.

2. Contractor shall cooperate with such inspection and monitoring activities, provide access to the Work site to establish and secure monitoring stations, and make its facilities and records available to the City for performing such monitoring.

3. The City will issue a Non-Compliance Notice to Contractor for any detected non-compliance with the provisions herein or of any environmentally objectionable acts and the corrective action to be taken.

1.6 SEQUENCING

A. Contractor shall submit a Vibration Control Plan to the City for review and approval at least 30 days prior to commencing construction.

B. Contractor shall notify the City Representative at least 24 hours prior to starting a new construction task potentially capable of exceeding the project's vibration Threshold Value.

1.7 DAMAGES FOR FAILURE TO MEET ENVIRONMENTAL REQUIREMENTS

A. The Contractor shall be liable for all fines, penalties, liquidated damages and costs arising from any failure to implement mitigation measures to control vibration impacts that are subject to Federal, State, and local regulatory fines.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials necessary for compliance with the Vibration Monitoring Program:

1. The seismograph(s) used as part of the program shall have the following minimum features:

(a) Seismic range: 0.01 to 4 inches per second with an accuracy of +5 percent of the measured peak particle velocity or better at frequencies between 10 Hertz and 100 Hertz, and with a resolution of 0.01 inches per second or less.

(b) Frequency response (+3 dB points): 2 to 200 Hertz.

(c) Three channels for simultaneous time-domain monitoring of vibration velocities in digital format on three perpendicular axes.

(d) Two power sources: internal rechargeable battery and charger and 115 volts AC. Battery must be capable of supplying power to monitor vibrations continuously for up to 24 hours.

(e) Capable of internal, dynamic calibration.

(f) Direct writing to printer and capability to transfer data from memory to a secure digital memory card and/or USB mass storage device. Instruments must be capable of producing strip chart recordings of readings on site within one hour of obtaining the readings. Provide computer software to perform analysis and produce reports of continuous monitoring.

(g) Continuous monitoring mode must be capable of recording single-component peak particle velocities, and frequency of peaks with an interval of one minute or less.

PART 3 - EXECUTION

3.1 VIBRATION CONTROL

A. This subsection applies when trees, rock outcroppings, historic buildings, historic structures, or other resources or landscape features are shown on the project plans and are labeled as requiring a vibration-monitoring program.

B. Where the project includes or is directly adjacent to a resource susceptible to vibration, as shown on project plans, the Contractor shall institute a vibration-monitoring program to

protect such properties from excess vibration during demolition and construction activities associated with the project.

C. The Contractor shall submit a Vibration Control Plan to the City for review and approval, to be fully implemented upon approval.

1. For purposes of this subsection, “limiting value” shall be:

   (a) For Vibration Control Plans for historic buildings or historic structures, 0.12 inches per second peak particle velocity (in/sec PPV) for sustained vibration (e.g. impact pile drivers, vibratory equipment) in any direction, unless a greater value is approved in writing by the City Representative.

   (b) For Vibration Control Plans for all other resources, 0.2 inches per second peak particle velocity (in/sec PPV) for sustained vibration (e.g. impact pile drivers, vibratory equipment) in any direction, unless a greater value is approved in writing by the City Representative.

2. The Contractor’s vibration-monitoring personnel shall include a Qualified Vibration Instrumentation Engineer approved by the City’s Representative. The Qualified Vibration Instrumentation Engineer shall:

   (a) Be on site and supervise the initial installation of each vibration-monitoring instrument.

   (b) Supervise interpretations of vibration-monitoring data.

3. Contractor shall collect seismograph data prior to any vibration-producing demolition or construction activities to document background vibrations at each monitoring location. The background monitoring shall be performed for a minimum of two non-consecutive workdays, spanning the hours during which demolition and construction activities will take place. Monitoring shall consist of a continuous recording of the maximum single-component peak particle velocities for one-minute intervals, which shall be printed on a strip chart.

4. Contractor shall have seismographs in place and functioning at least 24 hours prior to any such activity within 200 feet of the monitoring locations. No significant vibration-producing activity shall occur within this zone unless the monitoring equipment is functioning properly, as determined by the City Representative.

5. Contractor shall monitor vibration during demolition and other significant vibration-producing construction activities as determined by the City Representative. This monitoring shall consist of a continuous recording of the maximum single-component peak particle velocities for one-minute intervals, which shall be printed on a strip chart. During the monitoring, Contractor shall document all events that are responsible for the measured vibration levels, and submit the documentation to the City Representative with the data.

6. All vibration monitoring data shall be recorded contemporaneously and plotted continuously on a graph by the data acquisition equipment. Each graph shall show time-domain wave traces (particle velocity versus time) for each transducer with the same vertical and horizontal axes scale

7. The Contractor shall interpret the data collected, including making correlations between seismograph data and specific construction activities. The data shall be evaluated to determine whether the measured vibrations can be reasonably attributed to construction activities

8. The equipment shall be set up in a manner such that an immediate warning is given when the peak particle velocity in any direction exceeds the Threshold Value in the previously submitted Vibration Monitoring Plan. The warning emitted by the vibration-monitoring equipment shall be instantaneously transmitted to the

responsible person designated by Contractor by means of warning lights, audible sounds or electronic transmission.

9. If a Limiting Value is reached, the Contractor shall:

   (a) Immediately notify the City Representative and suspend activities in the affected area, with the exception of those actions necessary to avoid exceeding the Limiting Value.

   (b) Meet with the City Representative to discuss the need for response action(s).

   (c) If directed by the City Representative during the above meeting that a response action is needed, submit within 24 hours a detailed specific plan of action based as appropriate on the generalized plan of action submitted previously as part of the vibration-monitoring plan.

   (d) If directed by the City Representative, implement response action(s) within 24 hours of submitting a detailed specific plan of action, so that the Limiting Value is not exceeded.

10. Where the subject of the Vibration Monitoring Plan is a historic building or structure, Contractor shall engage a Qualified Historic Architect or Historic Preservation Professional to document and photograph the properties that are the subject of the Vibration Monitoring Plan to ensure structural damage does not result from construction activities that could cause ground vibration.

    (a) The post-construction survey and monitoring results will be evaluated to determine whether the new structural and/or architectural damage was caused by vibration due to Contractor's performance of this Work.

    (b) If, following completion of construction, changes in the architectural or structural conditions the properties that are the subject of the Vibration Monitoring Plan have occurred, Contractor shall restore the buildings to pre-construction conditions, and to the satisfaction of the City Representative.

END OF SECTION