SECTION 310913

MONITORING OF ADJACENT STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Monitoring of existing structures shall be performed in accordance with the requirements of the Contract Documents and the 2014 NYC Building Code.

B. Work in this Section includes, but is not necessarily limited to the following:

1. All labor, materials, equipment, and services necessary to document conditions and protect existing structures (including but not limited to buildings, roadways, sidewalks and utilities) from damage during construction

2. All engineering, surveying, layout, monitoring, and submittals in connection with the work in this Section.

3. Photographic documentation of pre-construction conditions of adjacent structures and nearby historic landmark buildings.

4. Survey monitoring of adjacent structures and nearby historic landmark buildings for the duration of construction.

5. Crack propagation monitoring of adjacent structures and nearby historic landmark buildings for the duration of construction.

6. Vibration monitoring of adjacent structures and nearby historic landmark buildings during excavation, foundation installation and other below-grade construction for the duration of construction.

7. Review of existing relevant, subject building and structural drawings as needed to perform a structural stability assessment by a New York State licensed professional engineer.

8. Other labor and materials as may be reasonably inferred to be required to make the work under this Section complete.

1.02 RELATED SECTIONS

The contract drawings, other sections of these specifications, and the contract general provisions, including general and special conditions and related contract documents, apply to this section.

A. Section 022100 – Project Survey and Layout

B. Section 029000 – Site Preparation

C. Section 312300 – Earthwork

1.03 DEFINITIONS

A. Where “structure” is used herein, it shall include all buildings, tunnels, sheds,

roadways, sidewalks, utilities, poles, curbs, pavements, and other appurtenances which are to remain during construction.

B. "Review Level": The instrumentation value above which will trigger the evaluation of current construction methodology and, if necessary, implementation of mitigative action as shown in this specification to avoid detrimental effects on the surrounding facilities.

C. "Alert Level": The instrumentation value above which will halt the construction, require evaluation of subject, relevant structures affected, and necessitate mitigative action as shown in this specification to prevent damages to surrounding structures. The action must be such that the Alert Level is not exceeded in subsequent construction.

1.04 REFERENCES

A. All work shall comply with all applicable codes and regulations having jurisdiction, including but not limited to the requirements of the Building Code of the City of New York (Building Code), requirements of the New York State Department of Labor, requirements of Occupational Safety and Health Administration (OSHA), requirements of New York State Department of Health (NYSDOH), requirements of the New York State Department of Environmental Conservation (NYSDEC), requirements of the New York City Department of Environmental Protection (NYCDEP), requirements of the New York State Department of Transportation (NYSDOT), requirements of New York City Department of Transportation (NYCDOT), and with applicable requirements of all other authorities having jurisdiction.

B. New York City Department of Buildings (DOB) Technical Policy and Procedure Notice (TPPN) #10/88, published on 6 June 1988.

C. United States Bureau of Mines (USBM), Report of Investigations (RI) 8507, "Structure Response and Damage Produced by Ground Vibrations from Surface Blasting," by D. E. Siskind, M. S. Stagg, J. W. Kopp, and C. H. Dowding, dated 1980.

D. Deutsches Institut für Normung (DIN) 18723 – Field Procedure for Precision Testing of Surveying Instruments.

E. National Institute of Standards and Technology (NIST).

F. The following project-specific documents shall be referenced for the work of this Section:

1. Project Specifications and Contract Drawings

2. Geotechnical Engineering Memorandum prepared by Langan Engineering, Environmental Surveying, Landscape Architecture and Geology, D.P.C. and dated 22 May 2013.

3. Construction Protection Plan prepared by the Owner's Consultant outlining subject buildings, and structures to be monitored.

1.05 SUBMITTALS

Unless noted otherwise, the contractor shall prepare and submit the following items to the engineer for approval at least 30 days before the start of said work.

A. Submit the preconstruction conditions documentation report of the subject surrounding structures.

B. Submit documentation verifying that those performing the monitoring program have the required qualifications as specified herein.

C. The Contractor shall provide a monitoring plan prepared by a licensed professional land surveyor. The plan shall show the location vibration monitoring devices, crack monitoring gages, survey monitoring points and the survey benchmark(s) that will be used for vibration and optical survey monitoring. Monitoring plan and periodic elevation and lateral position control point monitoring data for the subject structures shall be submitted by the professional land surveyor.

D. Provide proposed method and locations of elevation and lateral position control points to be established to monitor any vertical and horizontal movements during excavation and shoring installation.

E. Provide results of monitoring point survey and crack monitoring within 24 hours of taking the readings. Provide via remote notification vibration monitoring results in real time.

F. Weekly monitoring reports shall be submitted by the contractor's professional land surveyor to the to the Owner's Engineers for review. The reports shall include incremental and cumulative deviation in vertical, longitudinal, and transverse axes; vertical and horizontal deviation at crack gauges; maximum daily peak particle velocity in vertical, longitudinal, and transverse axes; waveform recording of vibrations that exceed the threshold specified below.

1.06 QUALITY ASSURANCE

A. Optical monitoring shall be performed by a Professional Land Surveyor licensed in the state of New York with a minimum of three years of experience (or as approved by the Engineer) in deformation measurements of the types and accuracies specified herein.

B. Crack propagation and vibration monitoring shall be performed under the supervision of a Professional Engineer licensed in the State of New York with a minimum of three years of experience (or as approved by the Owner's Engineer) in monitoring of the types and accuracies specified herein.

C. The engineer responsible for Structural Stability of adjacent structures shall be a Professional Engineer licensed in the State of New York State with a minimum of five years of experience (or as approved by the Owner's Engineer) in performing structural stability assessment.

1.07 PROJECT CONDITIONS

A. The Contractor shall visit the site and shall review the above mentioned project documents and geotechnical engineering studies to familiarize themselves with the existing conditions of the surrounding historic buildings. All existing building elements and utilities shall be inspected by the Contractor prior to entering a bid.

B. There are sensitive buildings adjacent to and within the vicinity of the site. The work shall be executed so that no damage or injury will occur to the existing neighboring structures. Should any damage or injury occur that is caused by the Contractor, or by anyone in Contractor's employ, or by the work under this Contract, the Contractor shall repair such damage at his own expense and shall assume all responsibility for such injury.

C. The site is located within the Southpoint Open Space Park, Roosevelt Island, New York. The site is bound by South Loop Road to the north, East River to the east, Franklin D. Roosevelt Four Freedoms Park to the south and East River to the west.

D. Buildings/Structures of Interest for Preconstruction Documentation and Monitoring Purposes include the following**:**

1. Smallpox Memorial Hospital Ruins: The 3-story stone building is located southeast of the Southpoint Open Space Park adjacent to the East Road.

2. Strecker Memorial Laboratory: The 2-story building with 1-level basement is located east of the Southpoint Open Space Park adjacent to the East Road.

E. No guarantee is expressed or implied for the inferred information based on the subsurface logs and profiles provided in the geotechnical studies mentioned above. Boring logs are available for the Contractor's review. The Owner makes no predictions or representations regarding the character or extent of soil, rock, or other subsurface conditions to be encountered during the work. No information derived from such boring logs or plans will, in any way, relieve the Contractor from the responsibility of making his own evaluations, inspections and determinations in regards to the conditions at the site. The Contractor shall make his own assumptions of subsurface conditions that may affect methods of construction of the work hereunder, and he agrees that he will make no claims for damages or compensations, except as are provided under the agreement, should he find conditions during the progress of the work different from those as calculated and/or anticipated by him. Additional borings and other exploratory operations may be performed by the Contractor, at the Contractor's expense and following the Owner's approval. No change in the Contract Sum will be authorized for such additional exploration undertaken by the Contractor.

F. The Contractor shall be held to have visited the site and to have familiarized themselves with the existing conditions of site and the historic buildings.

G. Existing Utilities: Locate existing underground utilities in and beyond the areas of work. If utilities are indicated to remain in place, provide adequate means of support and protection during the work. The locations of utilities shall be verified in the field by the Contractor prior to work. Protection of all utilities located on the site is the sole responsibility of the Contractor.

1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with the Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

2. Do not interrupt existing utilities serving facilities occupied by the Owner or others, during occupied hours, except when permitted in writing by the Construction Manager and then only after acceptable temporary utility services have been provided. Provide minimum of 48 hour notice to the Construction Manager, and receive written notice to proceed before interrupting any utility.

3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

H. The Contractor, by careful examination, shall inform themselves of the nature and location of the work, the conformation of the ground, the nature of the subsurface conditions, the locations of the groundwater table, the character, quality and quantity of the materials to be encountered, the character of the equipment and facilities needed prior to and during the execution of the work, and all other matters which can in any way affect the work.

I. The Contractor shall investigate the conditions of public thoroughfares and roads as to availability, clearances, loads, limits, restrictions, and other limitations

affecting transportation to, and ingress and egress of the site of the work. The Contractor shall conform to all New York City and State, and Federal regulations in regard to the transportation of materials to and from and at the job site and shall secure in advance such permits as may be required.

J. Coordination: Examine drawings to determine sequence of operations, and relation to work of other trades. Start of work will signify acceptance of field conditions and will acknowledge coordination with other trades.

K. Comply with all federal, state and local environmental and health and safety regulators, including but not limited to Occupational Safety and Health Administration (OSHA).

L. The Contractor shall verify all dimensions, distances, and elevations of existing structures prior to start of work.

PART 2 - PRODUCTS

2.01 MONITORING EQUIPMENT

A. Optical Survey Monitoring Points and Equipment

1. Optical monitoring points on buildings for vertical and lateral displacement shall be mountable targets or prisms.

2. Settlement monitoring points may be set using pins or cross hatches in the structure to be monitored.

3. Accuracy of the survey monitoring readings shall be within 1/16 inch (0.005 ft) or better. Use appropriate calibrated survey equipment and procedures to achieve the specified accuracy level.

B. Crack Gauges

1. If allowed by the Property Owner, clear plastic crack gauges with reference line and measuring grid shall be used. Crack gauges shall be attached to structures using epoxy or bolts in accordance with manufacturer's recommendations. Photographic documentation should be used for monitoring.

2. If the Property Owner will not allow installation of crack gauges, reference lines may be used. A reference line should be drawn across and perpendicular to the crack. Two measurement points (one on either side of the crack) should be drawn and the initial distance between the two measurement points recorded for future comparison. Measurements should be taken in 1/32-inch increments.

C. Vibration Monitoring Equipment

1. Portable seismographs with the ability to record vibration events up to 10 inches per second (in/sec) with an accuracy of ±5% over a range of frequencies from 2 to 250 Hz.

2. Seismographs shall have the ability for remote monitoring and shall be set up to send recorded data at least twice daily and send out immediate, automatic alerts if threshold values are exceeded.

PART 3 - EXECUTION

3.01 PROTECTION OF ADJACENT STRUCTURES

A. The work shall be executed so that no damage or injury will occur to the subject landmark buildings. Should any damage or injury occur that is caused by the Contractor, or by anyone in Contractor's employ, or by the work under this Contract, the Contractor shall repair such damage at his own expense and shall assume all responsibility for such injury.

B. The above shall also include the protection of all existing utilities (including sewers, water lines, electrical lines and telecommunication lines) to remain in use within and adjacent to the area affected by the work of this project.

C. Prior to commencement of any work, consult the records for existing utilities, and note all conditions and limitations which might affect the work required under this Section. The Contractor shall not damage any utilities that are to remain and shall leave them accessible.

D. Monuments, benchmarks and other reference features on streets bounding this project, shall be protected. Should these be disturbed in any manner, the Contractor shall have them replaced at no cost to the Owner.

3.02 PRE-CONSTRUCTION CONDITIONS DOCUMENTATION

A. General: The contractor shall provide condition documentation of all the adjoining properties and structures of interest (or within 50 feet of the site, whichever is more stringent) prior to beginning of the work. The buildings of interest for this task are identified Part 1. Condition documentation shall include photographs, sketches, crack reference lines, elevation control points and measurements of ambient vibrations.

B. Photographs: Take photographs of the building walls of the adjoining properties and existing school (if applicable) so that the surfaces may be examined during construction and compared with the pre-work condition. If any cracks or other stress signs are exhibited by the buildings, halt operations until corrective action has been provided and is acceptable to the Owner.

C. Crack Reference Lines/Gauges: Install several crack monitoring gauges or lines on any nearby existing crack on adjacent properties. Monitor the lines/gauges during construction and compare with the pre-work condition. If increased stress signs are observed on the crack reference lines/gauges, halt operations until corrective action has been provided and is acceptable to the Owner.

D. A copy of the pre-construction conditions documentation of the subject structures will be made available to the Contractor upon contract award.

E. Before starting work, the Contractor and Land Surveyor shall check and verify governing dimensions and elevations, survey conditions of adjoining properties and historic landmark buildings, and record any prior settlement or cracking of structures, pavements, and other improvements.

3.03 MONITORING OF EXISTING STRUCTURES

For this project, the buildings, structures, elements of interest for monitoring purposes are identified in the Part 1 of these specifications**.**

A. Vertical and Lateral Displacements -

1. Monitor each building/structure/element of interest or within 50 feet of the site laterally.

2. Install a minimum of 10 optical survey monitoring points on each façade of the buildings/structures of interest (minimum of 5 sets of 2 points each – each set consisting of one point within the lower level (street level) and one point at the roof line, at a minimum) for monitoring vertical and lateral displacement. Monitoring locations shall not be spaced at intervals exceeding 25 feet laterally. Install additional sets of monitoring points as necessary to maintain this spacing.

3. All monitoring locations shall be subject to review by the Owner's Engineers.

4. The monitoring points shall be established and monitored by the Contractor's Professional Land Surveyor licensed in the State of New York, and referenced to a fixed, off-site benchmark.

B. Crack Gauge Monitoring

1. Install crack gauges at large visible cracks in the foundation walls on the buildings/structures of interest identified in Part 1 to monitor changes in crack width during construction. Initial conditions of the crack gauges shall be measured and/or documented photographically.

2. Location of crack gauges shall be selected by agreement between the building owner, Contractor, the engineer responsible for Structural Stability and the Owner's Engineer.

C. Vibration Monitoring

1. Install at least 1 seismograph in each adjacent/neighboring building. Seismographs are to be installed at the lowest level of each building at a point closest to the construction anticipated to cause maximum vibrations (e.g. demolition, heavy equipment, earthwork etc).

2. Alerts shall be sent out automatically to designated recipients (Owner's Engineer, Owner's Representative, Contractor, and engineer responsible for Structural Stability) if threshold levels specified below are exceeded.

3. Waveform recording of vibrations shall be provided for vibration events exceeding a peak particle velocity of 0.250 inches per second as measured along any axis.

3.04 FREQUENCY AND REPORTING

A. Optical Survey Monitoring

1. Monitoring shall be performed by the Professional Land Surveyor once weekly during construction. The accuracy (margin of error) of the survey readings shall be 0.005 feet or better. All monitoring data shall be transmitted to the Owner on a weekly basis.

B. Crack gauges shall be monitored once a week during construction activities. Monitoring shall consist of measuring the distance between the points established during installation or by documenting the crack gauge photographically.

C. Vibration monitoring shall be performed on a continual basis during construction activities.

D. Should movements or vibrations exceed the specified thresholds, monitoring intervals shall be increased to daily unless otherwise instructed by the Owner's Engineer.

E. Owner's engineer shall decide when to terminate monitoring based on the construction operations.

3.05 ALERTING

A. Alerts shall be generated when data collected are determined by those responsible for that aspect of monitoring to have reached or exceeded the Review and Alert Level thresholds as defined herein.

B. Alerts for Review and Alert Level thresholds shall be promptly forwarded to the Construction Manager, Owner, and Owner's Engineer. The alert shall contain the monitoring point that has exceeded its Review and Alert Level threshold, the data, the date and time of the reading, the reading value and the Review or Alert Level. For vibrations exceeding the Review or Alert Level thresholds, the alert should include the waveform recording of the vibrations.

C. The alert system shall include a means for the recipient of the alert to acknowledge that the alert has been received and to disable repeated alarming on that sensor.

D. The Contractor shall make every effort to work with those responsible for monitoring to provide timely readings for review of data and sending of alerts.

3.06 THRESHOLD LIMITING VALUES

A. The Contractor shall take every precaution to guard against excessive movement, settlement, groundwater drawdown, vibration, or damage of adjacent buildings and structures. The Contractor is solely and entirely responsible for the safety and support of such structures, and liable for any damage and injury caused thereby or resulting therefrom.

B. The following Review Level Thresholds shall require that the Contractor cease construction, review their means and methods of construction and suggest revised means and methods to limit movements and vibrations in adjacent structures. A written description of revised means and methods must be submitted by the Contractor before work can proceed.

1. Vertical or Horizontal Movement

a. Buildings or other Structures: Two consecutive readings of 1/8-inch of movement, or one confirmed reading of 1/4-inch.

b. Excavation Support Systems: Three consecutive readings of 1/4-inch of movement, or one confirmed reading of 1/4-inch.

2. Crack Gauges: three consecutive readings of 1-millimeter, or one confirmed reading of 3-millimeters.

3. Vibrations

a. Buildings of Interest and Other Structures: Peak Particle Velocity exceeding 0.500 inches per second measured along any axis.

C. The following Alert Level Threshold (maximum allowable limits) values shall require the Contractor to cease construction activities and notify the construction manager, Owner, Owner's Engineer, and Department of Buildings (DOB) Excavation Unit immediately. The engineer for Structural Stability engaged by the Contractor will make an inspection of the affected building within 24 hours of the reported exceedances.

The contractor's engineer will prepare a report assessing the condition of the affected building and any required remediation. The report will be submitted to the construction manager, the design team, and the DOB Excavation Unit within 48 hours of the incident. If the building is judged to be in an unstable condition, the DOB will be notified immediately. Construction activities shall not continue until adequate measures are in place to achieve stability of adjacent structures or excavation support systems. Where significant movements are detected the frequency of data collection shall be increased to once daily or as directed by the Owner's Engineer.

1. Alert Level Vertical and Horizontal Movements

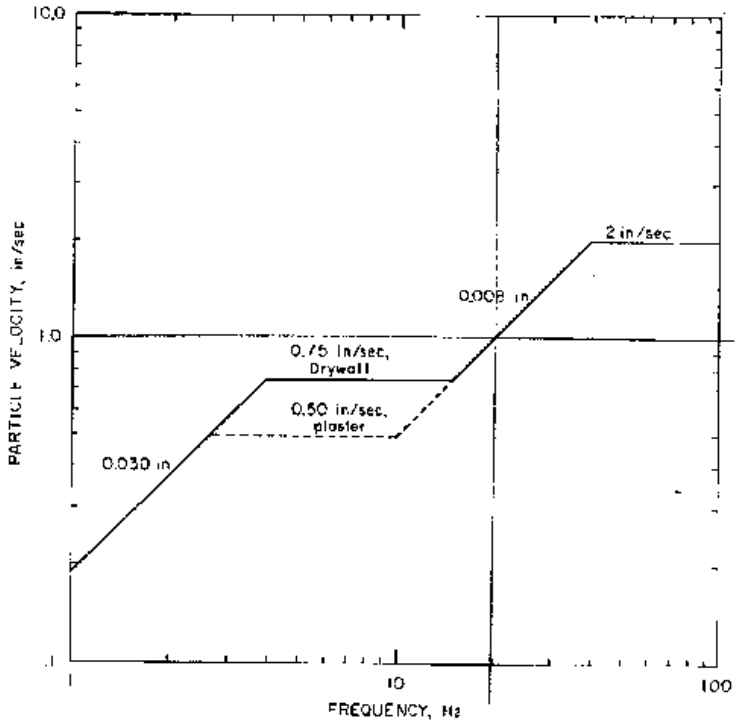
    a. Buildings or other Structures: 0.35-inch total vertical or 0.35-inch total horizontal.

    b. Excavation Support Systems: 0.5-inch total movement.

2. Crack Gauges: 4 millimeter increase in crack width.

3. Vibrations:

    a. Buildings: Peak particle velocities (PPV) exceeding the USBM plot of allowable PPV versus frequency as published in RI 8507 (graphically shown below).



    b. Buildings/Structures of Interest: For landmark buildings, such as the surrounding structures identified in part 1, PPV shall not exceed 0.5 inch per second for all frequencies.

D. Any movement or vibration levels exceeding the above criteria shall be reported immediately to the Owner. If the above thresholds are exceeded:

    1. The Contractor will immediately stop work in the vicinity of the exceedance.

2. The engineer for Structural Stability engaged by the Contractor will make an inspection of the affected building or structure within 24 hours of the reported exceedances. The Contractor's engineer will prepare a report assessing the condition of the affected building and any required remediation. The report will be submitted to the construction manager, the design team, and the DOB Excavation Unit within 48 hours of the incident.

3. The Contractor shall develop alternate methods and procedures, subject to the review and approval of the Owner's Engineers and the affected building's engineers.

4. Resume work using the agreed upon alternative method.

5. Corrective measures to achieve stability of adjacent structures shall be the responsibility of the Contractor. The Contractor shall restore, to the satisfaction of the Property Owner, by repair or otherwise, the portions of buildings, or their contents, altered by the Contractor's work. Restoration shall be completed to the conditions which existed prior to the start of work.

END OF SECTION