

SECTION 31 41 00

SHORING

PART 1 - GENERAL

1.01 SUMMARY

- A. Install shoring and bracing as indicated on the drawings to allow mass excavation of the site.
- B. Provide design and installation of all other shoring and bracing not specifically indicated on the drawings, to protect existing buildings, streets, walkways, utilities, improvements, workmen, the public, and excavations against loss of ground or caving of embankments.
- C. Maintenance of shoring and bracing.
- D. Removal or in place abandonment of shoring and bracing when no longer required.
- E. Related work:
 - 1. Section 31 00 00: Earthwork
 - 2. Section 05 12 00: Structural Steel

1.02 SUBMITTALS

- A. Comply with pertinent provisions of Division 1.
- B. Submit the following:
 - 1. Manufacturers' data and installation instructions for proprietary materials including tie back anchors, anchorage hardware, couplers, monitoring devices and other manufactured items if used.
 - 2. Shop drawings including complete details and schedules for fabrication and shop assembly of members for shoring as indicated on the drawings.
 - 3. Corrosion protection system for permanent ground anchors including the following.
 - a. Spacers and their location.
 - b. Centralizers and their location.
 - c. Unbonded length corrosion protection system.
 - d. Anchorage and trumpet.
 - e. Anchorage corrosion protection system.
 - 4. Mix designs for all grouts and concretes.
 - 5. Maintain and submit a complete and accurate record of all soldier pile locations, depths, concrete strengths, tieback locations and lengths, tieback grout strengths, quantity of concrete per pile, quantity of grout per tieback and applied tieback loads. Immediately report to Structural Engineer any unusual condition encountered during installation.

6. Submit calibration data for each test jack, pressure gauge and master pressure gauge to be used. The calibration tests shall have been performed by an independent testing laboratory and tests shall have been performed within 60 calendar days of the date submitted. Work shall not begin until the appropriate submittals have been reviewed by the Structural Engineer.
7. Complete design, plans and details for shoring, not shown on the drawings, to the Structural Engineer for review prior to submitting for approval of governmental agencies having jurisdiction.
 - a. The Structural Engineer's review will be for space coordination purposes only, and will not relieve the Contractor of his responsibilities under the Contract.
 - b. Should changes in the shoring design be required subsequent to the Structural Engineer's review, coordinate all such changes with the Structural Engineer and secure the Structural Engineer's approval of changes in space allocations.
8. Submit qualifications of the individuals responsible for the monitoring.
9. Submit monitoring reports on a weekly basis during excavation, and twice monthly during the remainder of the contract. Monitor tie-back anchor loading and any horizontal movement.

1.03 QUALITY ASSURANCE

- A. Conform to Division 1 of the specifications.
- B. Survey of Adjacent Structures and Levels by Registered Land Surveyor prior to excavation.
- C. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- D. Comply with pertinent requirements of governmental agencies having jurisdiction.
- E. Coordinate the construction and the required design of shoring.
 1. Soil investigation report prepared for this work;
 2. Structural system established for the work, including location of columns, pilasters, walls, and other features.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Division 1.
- B. Delivery and storage:
 1. Deliver materials to the job site properly marked to identify the location for which they are intended.
 2. Use markings corresponding to markings shown on the approved Shop Drawings.
 3. Store in a manner to maintain identification and to prevent damage.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Sand: Approved source, free from vegetation, rock and deteriorous matter, and from a source approved by the Structural Engineer.
- B. Pea Gravel Backfill Material: Provided in approved gradation from a source approved by the Structural Engineer.
- C. Steel:
 - 1. Structural steel from rolled shapes: ASTM A572, GR50.
 - 2. Connection material, embeds., misc. steel: ASTM A36.
 - 3. Structural tubing: ASTM A500, Grade B.
 - 4. Pipe: ASTM A53 Type S, Grade B.
 - 5. Bolts: ASTM A325 - N.
 - 6. Welding electrode: E70XX.
- D. Materials for concrete and grout.
 - 1. General Requirements: Concrete and grout shall consist of a mixture of cement, a pozzolanic material when approved, fluidifier, aggregate, and water proportioned and mixed so as to produce a concrete grout capable of being pumped without difficulty, with an ultimate compressive strength as indicated on the drawings. In addition, the mix shall have a slump such that the aggregates are uniformly dispersed vertically in the placement.
 - 2. Materials:
 - a. Portland Cement: Conform to requirements of ASTM C150.
 - b. Pozzolan: Pozzolan shall be a flyash or other approved pozzolanic material conforming to ASTM C618.
 - c. Grout Fluidifier: Grout fluidifier shall be a compound with characteristics which will increase the flow ability of the mixture, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the high strength cement mortar.
 - d. Water: Fresh, clean, free from sewage, oil, acid, alkali, salts, or organic matter.
 - e. Aggregate: Fine aggregate conforming to requirements of ASTM C33; coarse aggregate where required conforming to requirements of ASTM C33.

E. Anchors:

1. Prestressing Steel: Threaded bars shall be DYWIDAG THREADBAR anchors. Uncoated threaded bars for prestressed concrete with ultimate tensile strength of 150 ksi conforming to ASTM A722.
2. Bearing and Anchor Plates: The bearing and anchor plates shall be fabricated from steel conforming to ASTM A36 and sized in accordance with ACI 318.
3. Anchorage Hardware: Anchorage Hardware shall be capable of developing at least 125% of the guaranteed yield strength of the prestressing steel.
4. Couplers: Couplers shall be DYWIDAG couplers. Couplers for prestressing steel shall be capable of developing at least 125% of the guaranteed yield strength of the prestressing steel and shall be used only where indicated.
5. Spacers and Centralizers: Spacers and centralizers shall be fabricated from plastic, steel or material which is non-detrimental to the prestressing steel. Wood shall not be used. Centralizers should be fabricated, placed and located such that they shall not impede the flow of grout.
6. Bondbreaker: The bondbreaker shall be fabricated from a smooth plastic tube of pipe having the following properties:
 - a. Resistant to chemical attack from aggressive environments, grout or grease.
 - b. Resistant to aging by ultra-violet light.
 - c. Fabricated from material non-detrimental to the threaded bars.
 - d. Capable of withstanding abrasion, impact and bending during handling and installation.
 - e. Enable the threaded bars to elongate during testing and stressing.
 - f. Allow the threaded bars to remain unbonded after lock-off.

F. Lagging

1. Wood lagging shall be rough sawn from species and sizes shown on the drawings. Lagging shall be pressure-treated with waterborne preservative in accordance with AWPB LP-22 to a minimum retention of .4 lbs/cu. ft. Wood lagging shall be new.

2.02 COATING SYSTEM

- A. Coat tar epoxy paint: Prepare surface to near white blast finish in accordance with AISC/Structural Steel Painting Council SP.10 Publication, and apply two coats of coal tar epoxy paint to 8 mil thickness each.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General Requirement

1. Hole drilling for piles and ground anchors shall be done without loss of ground and without endangering previously installed shoring members.
2. Casing or other methods shall be used where necessary to prevent loss of ground and collapse of the hole.
3. Remove all water from the holes prior to installing piles and ground anchors.
4. After lagging installation, immediately backfill voids between lagging and soil to the full height of lagging.

B. Piles:

1. The steel soldier pile shall be plumb and true in the augured hole and braced against displacement during grouting. The exposed face of the steel soldier pile shall be clean and dry immediately prior to field welding of studs, walers or other structural members. A continuous "Styrofoam" strip or other approved bond breaker may be fastened to the face of the soldier pile to facilitate concrete removal.
2. After the steel pile is centered in the hole and all loose material at the proper depth is removed, the concrete shall be placed. See the drawings for appropriate type of concrete to be placed at the embedded part. Lean concrete may be used from the bottom of the excavation to the top of the pile.
3. Place concrete in a manner that will not cause segregation of the particles or permit infiltration of water or permit any other occurrence which would tend to decrease the strength of the concrete or the capacity of the finished drill pile.
4. At the Contractor's option, and with the approval of the structural engineer and geotechnical engineer, drilled piles with diameters larger than those shown may be constructed at the Contractor's own expense.
5. Lean concrete shall be removed from the piles in such a manner that the pile coating is not damaged.

C. Ground Anchors:

1. Installation:
 - a. Anchor holes shall be drilled without loss of ground and without endangering previously installed anchors or existing utilities.
 - b. The method of installing the anchor shall insure that the tendon is located in the middle third of the grout anchor section.
 - c. The anchor shall be inserted without difficulty into the drill hole to the desired depth as shown on the Drawings.
 - 1) When the anchor cannot be completely inserted, the Contractor shall remove the anchor from the drill hole and clean or redrill the hole to permit insertion.

- 2) Partially inserted anchors shall not be driven or forced into the hole.
2. Pressure Grouting Procedure:
 - a. Grout shall conform to the Post Tension Institute Manual, Latest Edition.
 - b. Grout mix is to be batched on site, discharged into a holding tank, or directly into the grout pump. The grout shall be pumped by a piston pump with pressures monitored by a pressure gauge at the outlet of the pump.
 - c. The grout equipment shall produce grout free of lumps and indispersed cement. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer shall be capable of continuously agitating the grout.
 - d. The quantity of the grout and the grout pressures shall be recorded. The grout pressures shall be controlled to prevent excessive heave in soils or fracturing rock formations.
 - e. Batching Procedure:
 - 1) Fill mixing unit with 4½ to 5 gallons of potable water.
 - 2) Add one sack, 94 lbs. of cement to mixer.
 - 3) Agitate thoroughly until a homogenous mix is achieved.
 - 4) Discharge grout into tank or directly into shaft, agitate slowly to prevent segregation when pumped into tank, pump grout into shafts as noted above.
3. Installation of Pressure Grouted Anchors
 - a. Provide continuous inspection by Inspector of Record during installation of pressure-grouted anchors.
 - b. Machine drill the tie-back shaft with temporary casing as required to prevent sloughing or caving of material.
 - c. Inject air and/or water under pressure through the drill stem to remove the drill cuttings from the drill shaft.
 - d. Install tie-back anchor rod with attached centralizing devices into the shaft or through the drill casing. Centralizing devices shall not restrict movement of the grout.
 - e. The anchor shall be inserted without difficulty into the drill hole to the desired depth as shown on the drawings.
 - 1) When the anchor cannot be completely inserted, the Contractor shall remove the anchor from the drill hole and clean or redrill the hole to permit insertion.
 - 2) Partially inserted anchors shall not be driven or forced into the hole.

- f. Fill the shaft through a 3/8" diameter polyethylene grout tube with neat cement grout. Tube may remain or be removed after grouting. If left in place, tube must be full of grout.
 - g. Terminate grouting when the shaft is completely filled.
 - h. After the initial grouting has attained its set, perform post grouting of the anchor bond zone through the attached post grout line and valves. Post grout line shall be 1/2" diameter schedule 40 PVC pipe with rubber valves at 4 feet on center in the post grout zone.
 - i. Fracture the initially set grout in the bond zone with water and repeat grouting until a confinement back-pressure of approximately 300 psi is recorded. Actual injection pressures and grout volumes will vary depending on grouting conditions and holding capacities of anchors.
 - j. Flush post grout line with water for reuse.
 - k. The anchor rod/strands shall remain undisturbed until grout has cured a minimum of 3 days.
 - l. Test anchors in accordance with the procedures described in the "Testing & Inspection" section of the notes.
 - m. Should the anchor fail the acceptance criteria, unload the rod/strands and perform additional post grouting and retest anchor until it passes the prescribed test.
 - n. After a successful load test, the rod/strands shall be locked off at the design load.
 - o. Repeat the above procedure for all tie-backs.
 - p. An alternative grouting procedure may be submitted to the shoring engineer and OSHPD for review and approval prior to the installation of the tie-back anchors.
- 4. The grout at the top of the drill hole shall not contact the back of the pile. Only non structural compressive filler can be placed above the bonded anchor length grout prior to testing and acceptance of the anchor.
 - 5. Anchor installation and stressing shall be completed prior to excavation more than one (1) foot below the anchor level at the top row of tie-back, and prior to excavating more than two (2) feet below the anchor level at lower tie-back rows.

D. Paint:

- 1. Apply paint in accordance with SSPC Paint-1:
- 2. Fabricated items shall be shop painted to the greatest extent possible, leaving exposed metal where field welding is to occur. These joints shall be field painted in accordance with SSPC Paint-1 after welding is completed.
- 3. All coatings which are damaged during shipping, handling, installation, or due to the Contractor's activities, shall be repaired.

3.02 STORAGE AND HANDLING

A. Tendons:

1. Tendons shall be handled and stored in such a manner as to avoid damage or corrosion. Damage to the prestressing steel as a result of abrasions, cuts, nicks, welds and weld splatter will be cause for rejection.
2. The prestressing steel shall be protected if welding is to be performed in the vicinity. Grounding of welding leads to the prestressing steel is forbidden. Prestressing steel shall be protected from dirt, rust and deleterious substances. A light coating of rust on the steel is acceptable. Heavy corrosion or pitting is not permitted.
3. The Contractor shall use care in handling and shoring the tendons at the site. Prior to inserting a tendon in the drill hole, the contractor shall examine the tendon for damage to the encapsulation and the sheathing. If the encapsulation is damaged, the Contractor shall repair the encapsulations in accordance with the tendon supplier's recommendations.

3.03 TOLERANCES

A. Soldier Piles

1. Tops of soldier piles shall be within $3'' \pm$ horizontally of the location shown on the plans, except that piles shall not extend more than 1-1/2" into excavation.
2. Soldier piles shall be within 1% of plumb.

B. Anchors

1. Deviation of anchor projected angle shall be not more than 2 degrees vertically and horizontally.
2. Anchor clearance to the existing utilities shall be not less than 3 feet.

3.04 SHORING REMOVAL

A. Removal of Shoring:

1. All shoring unless indicated on the drawings shall be removed as follows:
 - a. Destress tieback anchors following construction.
 - b. Cut off soldier piles four feet below final adjacent grades.

3.05 INSPECTION AND TESTING

A. Tie Back Anchors:

1. Inspection and testing will be performed under provisions of applicable SECTION of Division -1 – General Provisions.
2. The Owner will provide testing laboratories to furnish inspection and material testing services.
3. The Owner will retain the services of a Geo Technical Engineer to observe the shoring installation, including observation and recording of tests for verification and production anchors.

4. The Testing Laboratory shall test concrete in accordance with Section 03 30 00.
5. The Testing Laboratory shall test tieback anchor grout in accordance with ASTM C109 prior to tieback stressing.
6. The Testing Laboratory shall inspect welds in accordance with Section 05 12 00.
7. 200% Anchor Performance Tests:
 - a. During anchor installation, performance tests shall be conducted on anchors pre-selected by the Geotechnical Engineer at the site in concurrence with the OSHPD District Structural Engineer (DSE) for the project.
 - 1) As a minimum, three of the initial anchors shall be selected for a 200% 24-hour test, and eight additional anchors shall be selected for the 200% quick test.
 - 2) If tie-back installation methods are changed, the anchors installed using the new method shall be performance tested per items 1 and 2 in this section.
 - 3) Successful performance test anchors may be utilized as production tiebacks. The lock-off procedure for these anchors shall be the same as for production anchors.
 - 4) The purpose of the 200% test is to verify the friction value assumed in design.
 - b. For post-grouted anchors, the 200% test load shall be computed as that required to develop the appropriate friction along the entire bonded length of the anchor. The test load should be computed as provided on page 25 of the "Report of Geotechnical Investigation" from MACTEC, dated February 20, 2006, and as follows:

$$P_{\text{test}} = P_{\text{design}} * L_b/L_a * M$$

Where: L_a = Length of anchor beyond the active wedge;
 L_b = Bonded length of anchor;
 M = 200%.

- c. The maximum stress of prestressing steel shall not exceed 80 percent of the ultimate tensile strength during performance testing.
- d. The 200% 24-hour performance test shall measure anchor stress and displacement incrementally to 200 percent of the design tie-back load.
 - 1) Prior to performance testing, an alignment load (AL) shall be applied to the tie-back anchor to stabilize the anchor and seat the load frame and jacking equipment. The deflection of the anchor under AL load will serve as a reference for movement that occurs during testing.
 - 2) The total deflection during the 24-hour 200% tests should not exceed 12 inches during loading; the anchor deflection should not exceed $\frac{3}{4}$ " during the 24-hour period, measured after the 200% test load is applied. If the anchor movement after the

200% load has been applied for 12 hours is less than ½ inch, and the movement over the previous 4 hours has been less than 0.1 inch, the test may be terminated.

- 3) The anchors shall be loaded and measurements recorded per the following increments: AL, 0.25P, 0.75P, 1.00P, 1.25P, 1.75P, 2.0P.
AL = Alignment Load: 2 to 10 percent of P;
P = Design load of anchor.
 - 4) An unload-reload cycle shall be performed at each test load increment which consists of incrementally unloading the anchor to the AL, and then re-loading the anchor in the same sequence to the next test load. During unloading, the applied load should not fall below the AL.
 - 5) All performance anchors shall be creep tested. Refer to anchor creep testing section.
 - 6) Measurements of movements shall be accurate to 0.01 inch.
 - 7) Measurement of load shall be accurate to 5 kips. An electrical strain gauge shall be used to monitor the loads.
- e. The 200% quick performance test shall measure anchor stress and displacement incrementally to 200 percent of the design tie-back load.
- 1) Prior to performance testing, an alignment load (AL) shall be applied to the tie-back anchors to stabilize the anchor and seat the load frame and jacking equipment. The deflection of the anchor under AL load will serve as reference for movement that occurs during testing.
 - 2) The 200% quick test shall be maintained for 30 minutes. The 200% quick test shall be maintained for 30 minutes. The anchor deflection shall not exceed ¼ inch measured after the 200% test load is applied during the 30 minutes. The total deflection during the 200% quick test should not exceed 12".
 - 3) The anchors shall be loaded and measurements recorded per the following increments: AL, 0.25P, 0.75P, 1.00P, 1.25P, 1.75P, 2.0P.
AL = Alignment Load: 2 to 10 percent of P;
P = Design load of anchor.
 - 4) An unload-reload cycle shall be performed at each test load increment which consists of incrementally unloading the anchor to the AL, and then re-loading the anchor in the same sequence to the next test load. During unloading, the applied load should not fall below the AL.
 - 5) Each load increment shall be held for 1 minute. The load time shall begin when the test load reaches the load for the increment being applied.
 - 6) Axial movement readings shall be taken at 6 sec., 15 sec., 30 sec., and 1 minute for each load increment. The residual movement shall be measured 1 minute after the final load and/or each load increment has been removed to the AL.

- 7) All performance anchors shall be creep tested. Refer to anchor creep testing section.
 - 8) Measurements of movements shall be accurate to 0.01 inch.
 - 9) Measurement of load shall be accurate to 5 kips. An electrical strain gauge shall be used to monitor the loads.
- f. A successful anchor test shall be one in which all creep testing requirements were satisfied.
8. Production Anchors:
- a. Each production anchor shall be proof-loaded to 150 percent of the design load.
 - 1) For post-grouted anchors, the 200% test load shall be computed as that required to develop the appropriate friction along the entire bonded length of the anchor. The test load should be computed as provided on page 25 of the "Report of Geotechnical Investigation" from MACTEC, dated February 20, 2006, and as follows:

$$P_{\text{test}} = P_{\text{design}} * L_b/L_a * M$$
 Where: L_a = Length of anchor beyond the active wedge;
 L_b = Bonded length of anchor;
 M = 150%.
 - 2) Prior to production anchor testing, an alignment load (AL) shall be applied to the tie-back anchor to stabilize the anchor and seat the load frame and jacking equipment. The deflection of the anchor under AL load will serve as a reference for movement that occurs during testing.
 - 3) The total deflection during the tests should not exceed 12 inches.
 - 4) The anchors shall be loaded and measurements recorded per the following increments: AL, 0.25P, 0.75P, 1.00P, 1.25P, 1.75P, 2.0P.
 AL = Alignment Load: 2 to 10 percent of P;
 P = Design load of anchor.
 - 5) Each load increment shall be held for 1 minute. The load time shall begin when the test load reaches the load for the increment being applied.
 - 6) Axial movement readings shall be taken at 6 sec., 15 sec., 30 sec., and 1 minute for each load increment. The residual movement shall be measured 1 minute after the final load and/or each load increment has been removed to the AL.
 - 7) All production anchors shall be creep tested. Refer to anchor creep testing section.
 - 8) Measurements of movements shall be accurate to 0.01 inch.

- 9) Measurement of load shall be accurate to 5 kips. An electrical strain gauge shall be used to monitor the loads.
- b. A successful anchor test shall be one in which all creep testing requirements were satisfied and either 150% or 200% test is successful.

9. Anchor Creep Tests

- a. A creep test shall be performed at the maximum test load for all performance and production anchors.
- b. The creep test consists of the following:
 - 1) Maintain the maximum load on the anchor for at least 15 minutes.
 - 2) Movement readings shall be recorded at 6 sec., 30 sec., 1 min., 3 min., 5 min., 10 min., and 15 min.
 - 3) A successful creep test is one in which the difference in the movement between 1 and 15 minute readings is less than or equal to 0.1 inches.
 - 4) If the difference between the 1 and 15 minute readings is greater than 0.10 inches, the creep test shall be continued for an additional 50 minutes.
 - i) Movement readings shall be taken at 5 minute intervals for the extended creep test period.
 - ii) If the difference in the movement between the 5 minute and the 50 minute readings is less than 0.08 inches, the testing can be stopped. The movements shall be plotted vs. time and the Geotechnical Engineer shall evaluate if the anchor is acceptable.
 - iii) If the difference in movement between the 5 minute and 50 minute readings is greater than 0.08 inches, the testing shall be stopped and the Contractor shall follow the procedure outlined below.
 - 5) If a tie-back anchor initially fails the testing requirements noted above, re-grout the anchor and re-test. If the anchor continues to fail, the following procedure shall be taken:
 - 6) The Contractor shall determine the cause of the failure, i.e. variation of the soil conditions, installation method, or materials.
 - 7) The Contractor shall propose a solution to remedy the problem. The proposed solution will need to be reviewed and approved by the Geotechnical Engineer, the Shoring Engineer, and SSHPD.
 - 8) A successful anchor test shall be one in which all creep testing requirements were satisfied.
 - 9) Following proof loading, each anchor shall be locked off at 100 percent of the design load.

- 10) After transferring the load and prior to removing the jack, a lift-off reading shall be made. The lift-off reading shall be within ten percent of the specified lock-off load. If the lift-off load is not within ten percent of the lock-off load, the anchorage shall be reset and another lift-off load reading shall be taken. This process shall be repeated until the desired lock-off load is obtained.
- 11) The maximum stress in prestressing steel at the design load shall not exceed 60 percent of its ultimate tensile strength.

3.06 MONITORING

A. Monitor the existing structures and shoring as follows:

1. The contractor shall complete a written and photographic log of all existing structures within 100 feet of the site prior to construction. A licensed surveyor shall document all existing substantial cracks in adjacent streets, sidewalks and existing structures.
2. Monitoring of the shoring system, conducted by the Contractor, shall include measurements of vertical and horizontal movements at the top and at the anchor head of each soldier pile and at intermittent intervals as considered appropriate by the Geotechnical Engineer and OSHPD field staff. Pile deflections shall be measured relative to the pile position after tie-back anchors have been installed and tested and the excavation has been completed. If pile tip horizontal deflection exceeds 2 inches or if anchor head horizontal deflection exceeds 1 inch, the Contractor shall stop work and shore/reinforce the excavation and contact the Shoring Engineer.
 - a. Additional monitoring points may be established at the direction of the Geotechnical Engineer.
 - b. Reference points for horizontal movement should also be selectively placed at various tie-back levels as the excavation progresses.
3. The measuring system used for shoring monitoring should have an accuracy of at least 0.01 ft.
 - a. All reference points on the existing ground surface shall be installed and read prior to commencing the excavation.
 - b. Subsequent points at depth along the shoring wall should be installed and read as soon as possible during excavation.
 - c. All reference points should be read prior to and during critical stages of construction.
 - d. Surveying shall be performed by a licensed surveyor.
4. The frequency of readings will depend on the results of previous readings and the rate of construction.
 - a. As a minimum, readings shall be taken about once a week throughout construction until the shoring walls are completed. Readings shall be taken twice monthly during the remainder of construction.

- b. More frequent readings may be required at critical times during construction or if significant movement occurs.
- c. All readings shall be reviewed by the Geotechnical Engineer.

B. Monitoring of Existing Structures

1. Monitoring of the existing structures shall take place once a day (in the morning, prior to starting work) during the installation of the shoring,
2. Monitoring shall be performed by a licensed surveyor and shall consist of measuring the vertical and horizontal movement of the existing structure.
3. Prior to starting shoring installation, a pre-construction meeting shall take place between the Contractor, Shoring Engineer and OSHPD to identify monitoring locations on the existing buildings.
4. The Contractor shall document existing conditions of walls including size and location of cracks prior to the installation of the shoring adjacent to the existing buildings.
5. The Contractor shall monitor existing walls for movement or cracking that may result from the adjacent shoring.
6. If excessive movement or visible cracking of the wall occurs, the Contractor shall stop work and shore/reinforce the excavation and contact the Shoring Engineer.
7. After the shoring is installed, the frequency of the monitoring can be reduced to once a week until foundations, basement walls, and first floor slab have been installed.
8. All readings and measurements shall be submitted to OSHPD and the Shoring Engineer.

END OF SECTION