CONDON-JOHNSON & ASSOCIATES, INC

# 6-16.3(2) Soldier Pile Shaft Installation

*For:*

**Porcupine Bay Landslide Road Repair – Lincoln County**

**Prepared by:**

**Condon-Johnson & Associates, Inc.**
**9012 S 208th St**
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**Soldier Piles:**

1. **Summary**

   200 soldier piles will be installed to retain both the east and west sides of Porcupine Bay Road repair. Pile installation will begin on the West Wall with W1 working north to W131. Following the completion of the West Wall, the East Wall piles will be installed beginning at E1 working north to E69.

2. **Equipment**
   1. IMT AF 250-Drill Rig or equivalent (see attachments)
   2. Linkbelt TCC 750- 75 ton track mounted rough terrain crane or equivalent (see attachments)
   3. Variable Reach Forklift – 12,000 lb. capacity
   4. Tools:
      a. 30" Shafts – dirt auger, rock auger, core barrel and digging bucket
      b. Larger tools may be used when telescoping casing is used.
   5. Casing:
      a. Top can to keep loose soils out of shaft (36")
      b. Temporary telescoping casing, as required. Depending on the length of the minimum OD" of casing will be 48", 42", 36" 30"

This crane and drill rig were selected for their abilities to maneuver around a jobsite and capacity to drill 30" shafts to the max depth of 72'. The tooling was chosen so that no matter what conditions are met in the subgrade CJA will have the capability to deal with it.

The soils expected to be encountered is a medium dense to dense gravelly, loamy sand, so an auger will be the main and expected tool of choice to drill the shafts.

Condon-Johnson & Associates have used this equipment on multiple projects a couple listed:

- N160 Northgate Light Rail Extension – Large shoring pit for a parking garage consisting of 2.5' and 3' shafts with a total lineal footage of 4673'.
- UW Animal Research and Care Facility – Shoring for a new research building, consisting of 5,337 linear feet with 30" diameter shafts for temporary shoring.
- Pike Place Market Entrance – Soldier pile wall with tiebacks and lagging consisting of 3' shafts with a total lineal footage of 3621'.

3. **Details of Shaft Excavation**

   A. **Survey:**

   Soldier pile locations will be marked with a center-point and a minimum of (2) off-set points (with elevations) at each shaft location. Offsets shall be placed 90 degrees from each other.

   B. **Site Prep:**

   The soldier pile locations will be accessed with a level and firm uniform pad capable of safely supporting CJA equipment. Pads at soldier piles will be graded with a 35' wide bench.

It is preferable to drill the pile with the track parallel to the wall alignment, with the rotary over the side of the tracks. Due to the active slide conditions present it may be necessary to vary the location of the drill. It is anticipated that the majority of the West Wall will be installed with the drill sitting on the roadway. At the portion of the wall nearest the slide, approximate RD STA 13+50 to 15+50, it may be necessary for the drill to work from behind the wall, requiring some temporary excavation. For the majority of the East Wall, the drill will sit behind the previously installed pile while drilling in front. This competency of the drill pad will be assessed by CJA to determine the safest and most productive location to drill from.

C. **Temporary Casing Installation:**

The need for temporary casing will be dictated by site conditions and the decision to use casing will be made by CJA. Shafts will be drilled open hole, If a top can is needed it will be used. If deemed necessary by CJA telescoping of casing will be utilized. Telescoping is using casing of decreasing diameters and increasing lengths installed as you progress in depth, the Kelly bar is used to twist the casing through the soil using a twister tool. To insure proper placement, the position of the casing will be verified using offset stakes. Plumbness of the casing will be verified using a 4' hand held level on both the drilling bar and the outside of the casing.

D. **Drilling:**

Drilling takes place through the casing, if used. The soil is excavated with an auger or digging bucket, and then a cleanout bucket if necessary. If the drill spoils can be retained on the auger flights, an auger will be used, otherwise shaft excavation will proceed with a digging bucket. Hole verticality will be confirmed by using 4' hand levels placed on the Kelly bar.

Drilling spoils will be deposited near the drill rig after each pass with the drilling tool. It will then be moved with a loader and disposed of to an off-site disposal site. Spoils will be removed in a manner that does not impede drilling production.

4. **Shaft Stability**

Surface casing (top cans) may be installed depending on site conditions. This casing will be removed after backfilling the shaft with lean concrete.

As described above the telescoping method will be used if shaft cannot be stabilized without lateral support. Heaving is not expected but if necessary the shafts will be flooded and then drilled under a water head with a digging bucket.

5. **Soldier Pile Placement**

Piles will be delivered full length with pre-fabricated tieback pockets and a picking eye cut in the pile top. Once the hole has been drilled to the elevation indicated the soldier pile may be set. The pile will hang plumb in the excavated shaft. Once set in its final position, the pile flanges will be clamped to steel angle iron supported on timber lagging adjacent to the excavated shaft, to assure placement while CDF cures. The soldier piles will remain approximately 12" above of existing grade.

6. **Concrete Placement**

Due to the absence of water in the geotechnical borings, it is anticipated the holes will be dry. For concrete placement in dry holes, concrete will be end dumped through the middle of the hole directed by a shovel to allow the mix to flow evenly on both sides of the soldier pile until CDF reaches top of shaft. The concrete will be evenly distributed to ensure the pile remains plumb.

For placing piles and CDF in wet holes a tremie method will be used. A tremie pipe will be placed into the bottom of the shaft and CDF lean mix will be pumped until the shaft is full. The pile will then be wet set into place using a crane, and held using clamps and angle iron.

7. **Unauthorized Shaft Entry**

A. **Exclusion Zone.**

This zone will be created around each open hole. Only qualified personnel will be allowed inside this zone (i.e.) the Drill Operator, Oiler, and Site Superintendent. The exclusion zone will be clearly marked.

B. **Fall Protection.**

Temporary casing may be left high enough above existing grade to be used as fall protection, a minimum of 42". If temporary casing is not high enough to be used as fall protection, personnel adjacent to the hole will wear a full-body harness attached to an engineered tie off point. After the shaft is drilled, prior to setting the pile, the hole will be covered with a piece of plywood marked "Danger: Hole Cover". Once the pile has been set, entry into the shaft is prevented and fall protection is no longer required.

8. **Construction Joint Elevation**

There are no construction joint elevations to control for this work. The top of soldier pile will be set using optical survey equipment, either a laser, a builders level, or a robotic total station.

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# 6-17.3(3) Tieback Installation

*For:*

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## Tiebacks:

### Summary

On the West wall there is only 1 tieback maximum per soldier pile, there will be a max of 4 tiebacks per pile on the East wall. This will vary depending on the exposed height of each soldier pile beam. There are a total of (272) tiebacks that are anchored with a 1" 150 KSI DCP threadbar. The factored design load ranges from 25 to 65 kips. The excavation will be no more than 3'-0" below the tieback elevation at time of installation. Excavation will resume following the tieback being locked off. The tiebacks will be drilled per specifications, at the plan locations, to the lengths shown in Attachment 3. The drill rig used to install tiebacks will be a Klemm 806, or equivalent.

### Equipment

1. Klemm 806 or similar
2. 900CFM-1000CFM High Pressure Air Compressor
3. High-Shear Colloidal Grout Plant
4. Cement Silo
5. Variable Reach Forklift – 12,000 lb. capacity
6. Generator (as required to run grout plant)
7. Casing – if required

### Materials

1. Williams Form Engineering Grade 150
2. Cement (grout for tiebacks), will either be bulk or sack cement
3. PVC centralizers
4. ½" or ¾" PVC tremie
5. ½" PVC post grout tubes.

### General Tieback Construction Methods:

I. The type of tools used for drilling the tieback holes will depend on the soil conditions encountered. If conditions allow for open hole drilling, a 6" nominal diameter drag bit will be used. Hard ground conditions may require the use of a 6" button bit attached to a 4" down-the-hole hammer. Caving ground conditions will require the use of drill casing. If required, 152mm (6" OD) casing will be used. If casing is used, the bit will be reduced to 4 ¾" to allow passage through the casing and the casing will be taken full depth to create a 6" diameter hole. The bit will be driven and rotated by a 2-3/8" API drill rod. The drill string is connected to an air swivel that allows air to be forced through the drill pipe and back out through the drilled hole to assist with drill cuttings removal.

II. CJA will drill through the pre-fabricated tieback pockets, and within plus or minus three-degrees of inclination from horizontal shown of approved working drawings.

III. CJA will place the DCP thread bar in drilled holes such that sheathing and grout tubes are not damaged during installation of the threadbar. Centralizers will be placed so that there is no more than 10' maximum spacing in between centralizers. The anchor will not be subject to sharp bends, and will not be driven or forced into the drill hole. If a hole blockage is encountered, the bar will be removed and the hole cleaned or re-drilled.

IV. CJA will use a neat cement grout mixed with a water/cement ratio of 0.45 and use a grout pump to inject the grout. Grout pumps will have pressure gages to monitor grout pressures and will

be sized to enable grout to be pumped in one continuous operation. The grout pump will also use a mixer capable of continuously agitating the grout.

V. For tieback grouting, the following procedures will be followed:
   - Inject grout starting from the lowest point of drill hole. Pump through PVC tremie pipe. Place grout after insertion of threadbar. Control grout pressures and grout take to prevent excessive heave or fracturing;
   - Post-grouting may be used at CJA's discretion to achieve required anchor pullout resistance.
   - Grout the entire drill hole at one time with structural grout.

VI. Post Grout. All holes will be installed with a post grout tube. The tube will be solid ½" PVC pipe from the face of the tieback through the no load zone. In the bond zone, there are break out

**Tieback Grout Mix Design**

The tieback grout mix design will conform to the following quantities:

One 94 lb. (42.6 kg) bags of Type I/II cement are mixed with approximately 5 gallons of potable water in a grout plant to make a 0.45 w/c ratio grout. Potable water/cement grout only.

**Details of the Jacking Frame**

Testing will be performed after grout has reached 50% of 28-day required compressive strength (3,000 psi) requirements or a minimum of 3 days. A center hole jack, capable of achieving the specified load, will be placed onto the tieback. One dial gauge will be mounted on an independent frame during testing that will be capable of measuring to within 0.001 inches. Piles will be braced as necessary to restrain soldier piles from twisting during stressing operations. Calibration for the jack will be provided in a later submittal.

**Proof Testing Tiebacks**

All tiebacks shall be proof tested. These tests shall be incrementally loaded and unloaded in accordance with the schedule provided in Temporary Excavation Shoring General Notes SH-1 up to a maximum load of 1.00 FDL (Factored Design Load). Testing of the tieback will be performed by using a jack resisted by the soldier pile. The test works by pushing against the pile, which in turn pulls up on the tieback. Movement will be monitored via dial gauges. Dial gauges will be isolated so as not to be affected by the load application.

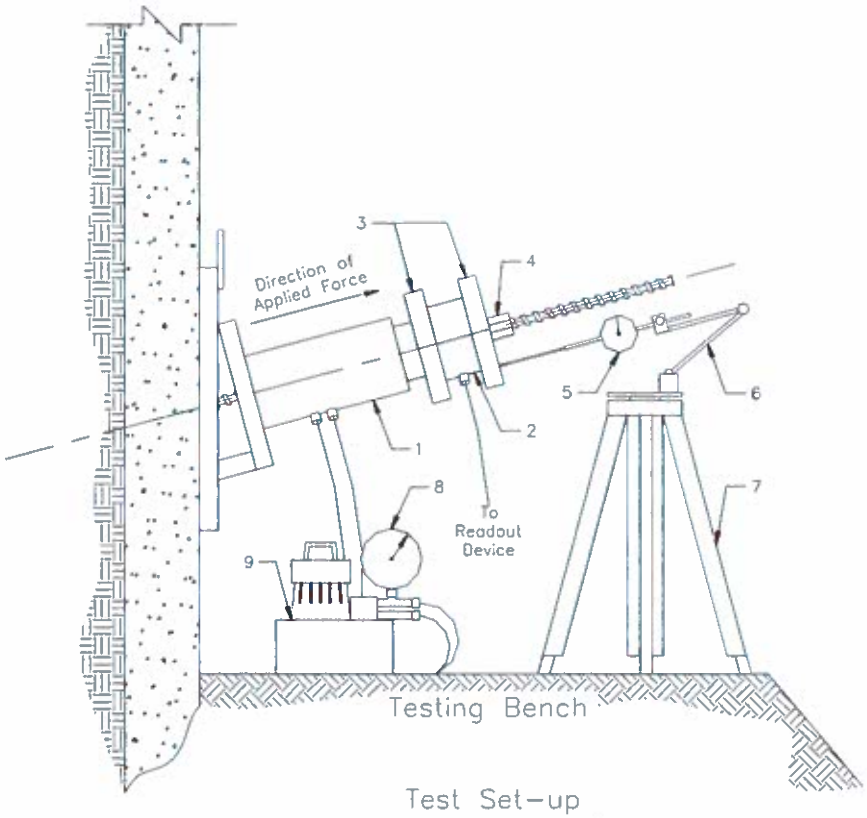
**Equipment List**

I. A dial gauge capable of measuring to the nearest 0.001 inch.

II. Hydraulic jack and pump used to apply the test load. Stressing equipment will be accurate within plus/minus 2%. Jack calibrations will be submitted separately.

III. Two pressure gauges: one as the primary pressure gauge and a reference pressure to ensure the primary gauge is accurate. Both gauges accurate enough to read 100 psi changes in pressure.

IV. All stressing equipment will be placed over the ground anchor tendon in such a manner that the jack, bearing plates, and stressing anchorage are axially aligned with the tendon and the tendon is centered within the equipment.




Test Set–up
Ready for Stressing

**(1) Hydraulic hollow core stressing ram**
**(2) Load cell**
**(3) Bearing plate**
**(4) Hex nut**
**(5) Dial gauge x 1**
**(6) Magnetic gauge base**
**(7) Isolated gauge stand**
**(8) Pressure Gauge**
**(9) Hydraulic Pump**