



## Post Tensioning

### Pulling it all together

Kiewit-General and WSDOT began post tensioning on Wednesday, August 23, 2006 tightening the first of approximately 2,500 steel cables and rods that run through pontoon PA walls, floor and top. Post tensioning is the largest portion of work left to be complete before the first cycle of pontoons are ready to be floated from Tacoma to Seattle. Accomplishing post tensioning within the allotted timeframe and projected cost is critical to the project's overall schedule and budget. Extensive planning was completed and training conducted prior to post tensioning to make sure this work would be done right.

Post tensioning, tightening up steel cables and rods that run through the pontoons in three directions, is used to increase the strength of these concrete structures. Concrete is strong when something pushes on it but weak when something pulls on it. This means that without the added strength of steel rebar and post tensioning, the forces from waves, wind, tides and heavy traffic would eventually pull the concrete apart.

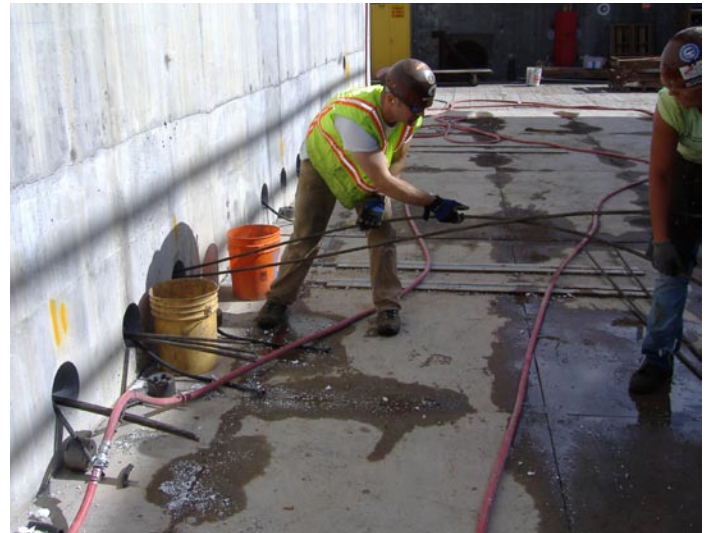
When a pontoon is post tensioned, the steel cables and rods within the pontoon walls pull inward. Three kinds of post tensioning are used on the Hood Canal Bridge pontoons: longitudinal (along the length of a structure), transverse (from side to side) and vertical (from top to bottom). Once the pontoons are all post tensioned together, they will stay in place and keep their shape.

### The post tensioning process

The crew post tensions small sections of the pontoons at a time, following a sequencing pattern that distributes the load, or pressure, on the concrete evenly throughout the post tensioning process.

The process is completed for each steel rod and cable starting with the vertical tendons, moving on to the transverse and finishing with the longitudinal.

1. Place hollow metal ducts in the pontoons. Keeping the ducts straight and round during installation is essential to be able to push the tendons through the ducts.
2. Pour concrete around and over the ducts. Inspectors carefully watch during concrete pours to make sure the ducts stay free from concrete. Once the concrete cures, or hardens, the ducts are firmly fixed in place.
3. Insert the tendons (steel ropes made up of steel cables) into the hollow tubes using a hydraulic pusher. This equipment looks like a baseball pitching machine. Its rubber tires spin, catch the cable and insert it into the ducts.



*Workers insert tendons (steel ropes made up of steel cables) into the hollow tubes that run from wall to wall through the pontoon PA floor, August 29, 2006.*

4. Attach an anchor plate to both ends of the metal ducts. These plates secure the tendons in place. Each plate must be level so equipment can sit on it during the operation.
5. Place wedges on each strand. Inside the wedges are small teeth-like objects which grab the strands. The wedges grab the steel tendons and hold them in place. As the tendon is stretched, it tries to pull back, securing itself in place.
6. Attach a hydraulic ram and pull the tendons tight. Crews must tighten the tendons slowly and carefully to stretch the tendons to the right length without damaging the tendon or the concrete pontoon. The pounds of pressure applied to each type of post tensioning are:
 

Longitudinal .....	835,000 lbs.
Transverse .....	176,000 lbs.
Vertical .....	178,000 lbs.
7. Cut off the excess tendon sections so the entire tendon will be covered by concrete and protected from the elements.
8. Install a grout cap on the anchor plates, mix cement grout and pump it inside the duct and around the tendons. This grout protects the steel strands from corroding. The grout cap is removed after 24 hours.

Once the post tensioning process is complete, workers can install rebar around the top of the post tensioning duct and pour concrete. Crews can then move forward to accomplish the final pontoon construction tasks that need to be completed before float-out.