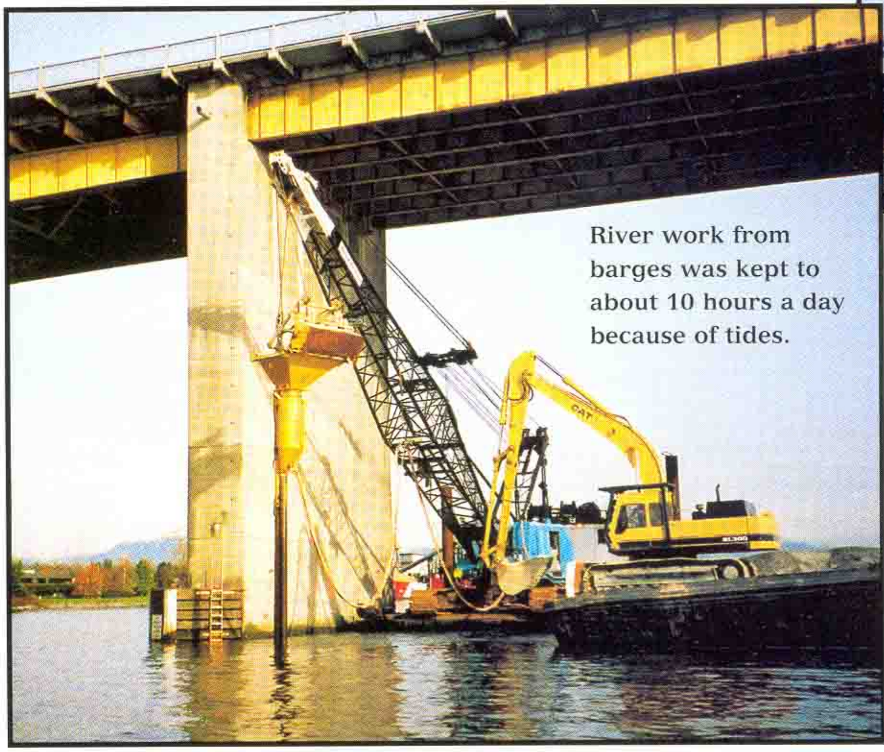
Preserving old Oak

By Correspondent Tonia Jurbin



River work from barges was kept to about 10 hours a day because of tides.

Vancouver's Oak Street bridge, built in 1957, is an integral part of Highway 99 connecting this major route to the United States' border. It's a relatively old bridge that spans the Fraser River and as a result, about $25 million has already been spent over the years rehabilitating the structure, most of which has been on structural seismic upgrades and restoration due to aging.

The bridge, in fact, is now on its 10th improvement contract... a four-month-long $1.2 million geotechnical upgrade to improve the performance of the loose saturated Fraser River sands in the event of an earthquake.

Soil around four of the in-river piers, one of the land piers, and a 93 m x 13 m swath of shoreline on the south side of the river is being densified. Vancouver Pile Driving Ltd. (VPD) is the prime contractor with Hayward Baker of Seattle the ground improvement sub-contractor and technical advisor. Dynamic Drilling Inc. installed the seismic drains.

Vibro-replacement methods were used to build stone columns that strengthened the soil mass, and seismic drains were installed to relieve the high pore pressures that can build up during an earthquake. If they work as predicted, small geysers will appear during the event.

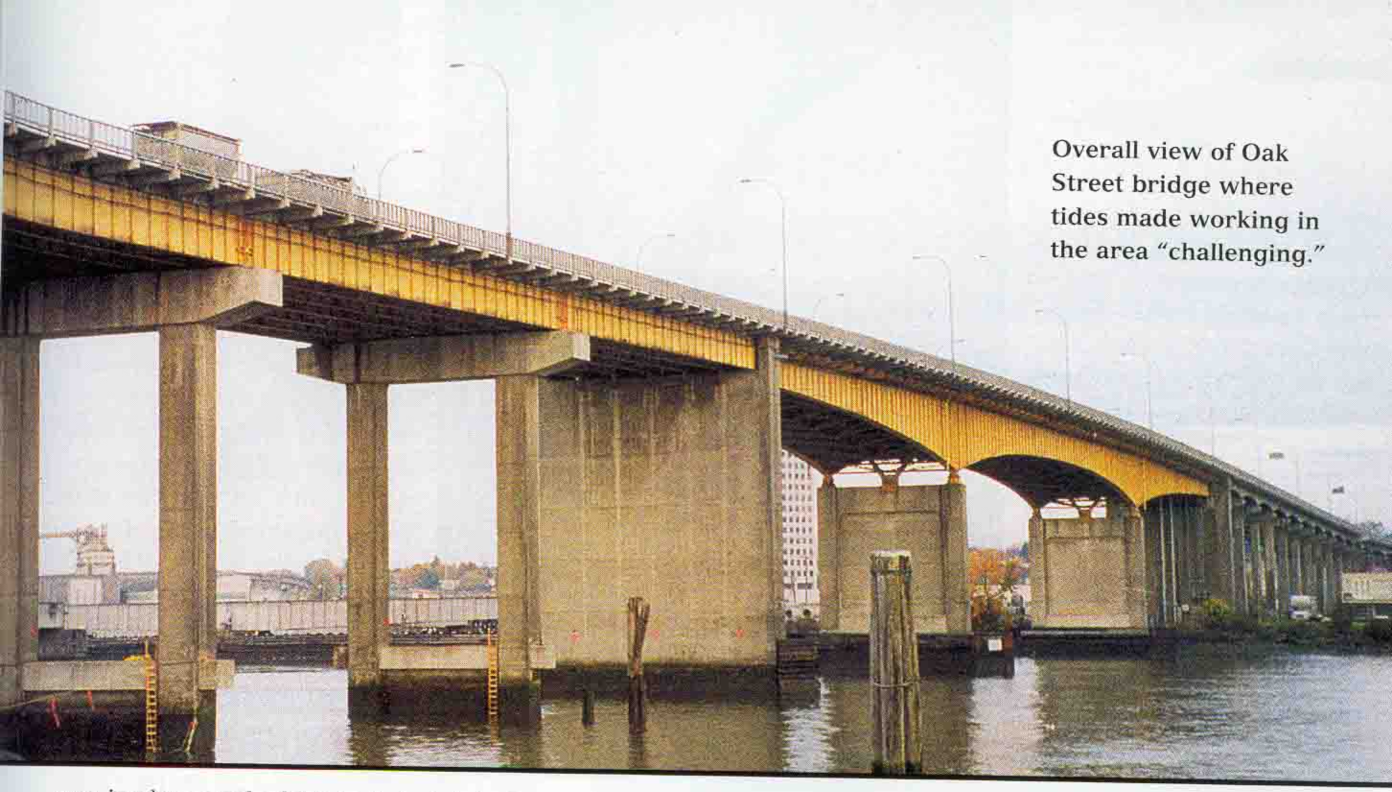
A total of 2500 linear metres of seismic drains were installed to depths ranging from 12 m to 20 m below mudline. Drains are 229 mm holes filled with rounded 'bird's eye' gravel. One thousand metres of the drains that were installed on the land portion of the site had full length perforated plastic pipe installed.

The ground improvement methods, in conjunction with the seismic drains, will mitigate the chance of liquefaction during an earthquake.

The contract dictated a performance specification rather than an installation method, so Hayward Baker determined the layout and spacing of the stone columns. Based on their equipment and experience, they went with 3 m centres on a square grid.

A square grid is easier to layout than a triangular grid (especially underwater), and it also leaves the option to come back over the grid and install additional columns if the densification specification is not met during the confirmation testing. A 0.6 m dia vibrofloat (complete with fins) build stone columns that range in size from 1.0 to 1.2 m.

Before work could begin, an environmental program



Overall view of Oak Street bridge where tides made working in the area "challenging."

was implemented which included stripping and stockpiling all of the native sedgegrass along the existing dyke. It was stored in the intertidal zone so that it could be kept wet and the fines were contained with silt fences. These native grasses will be used during site reclamation.

A workpad was also placed over the shoreline area to improve driveability for the track-mounted equipment and to keep it out of the river. The workpad was constructed with the 76 mm minus topfeed material which was constantly being moved around the site using a loader.

A vibrofloat probe was used to build stone columns to strengthen soil mass under bridge.

Land-based work was done using the top feed method, with the vibrofloat probe advanced using mostly water. In this case, the water is more environmentally friendly because it makes it easier to keep the fines that rise to the top of the hole contained at the work site.

About 5200 linear metres of 12 m to 17-m land-based stone columns were built with the probe suspended from a 70 ton track-mounted crane. An excavator was used to shove the 76 mm minus limestone workpad material into the hole created by the probe.

There was about 18 m of headroom under the bridge deck at the lower elevations of the land-based work.

In early November, when the tides finally allowed VPD to start the marine work, a diving inspection was carried out. During the riverbed soundings (using a lead

Stone being placed in new column near bridge pier.

line at slack tide), suspicions of woodwaste along the river bottom were raised. In fact, so much woodwaste was discovered because of a wood storage lot less than a kilometre upstream, a proposal had to be prepared to remove it.

Wood can throw the probe tip off making the densification pattern uncertain. It took about four days to remove the wood using a five-yard clamshell. Although it didn't quite fill 2200 ton (52 m by 16 m) barge, "there wasn't much deck room left," says Clancy Lannon, VPD's project superintendent for this job.

The river-based work was done using the bottom feed method where granite is fed to the bottom of the probe which is advanced using mostly air. About 3500 linear metres of 17 m to 20 m stone columns were built using the bottom feed method with the probe suspended from a 150 ton barge-mounted crane.

A long-reach excavator worked off of the stone scow, feeding the material into a skip near the water level, which is raised up to the hopper and fed to the bottom of the probe using gravity and air pressure. About 40% of the columns were subjected to headroom restrictions.

"On land, this job wouldn't be nearly as interesting, we have to really work the tides here, unfortunately sometimes the tides are best at night," says Clancy.

Tides at this site fluctuate from 1.3 m to 4.3 m a day during the early fall to early winter. "We are constantly having to move equipment around and change our shifts to take advantage of the tides, and even then we can get chased out of an area up to two hours before we expect to. Even though the charts are accurate, other things can effect the tide that are not reflected on the charts, like wind direction, for example."

At the farthest pier from shore, work could be done anytime because of the lower mudline and the higher bridge deck, so those crews were able to work regular 10-hour shifts. The original shifts were to be daytime only, but by late fall, early winter, the tides are too high to work the land site during the day.

As you approach the shore, the crews are limited to a 1.5 m to 3 m tide so their shifts and work locations are dictated by the tide. When you're working with cranes under a bridge, headroom is already a challenge, but when your work windows have to meet several criteria, including not hitting the bridge, not submerging the stone hopper, and making sure you don't bottom out, it becomes really important to have flexible crews. ◆