Having connections

New structure takes shape while existing Morey Channel Swing Bridge (background) continues to provide service to the airport.

Since 1992, the Vancouver International Airport has been undergoing a variety of major improvements, expansions and renovations including a third runway, a new air control tower, a new international terminal and a parkade.

The major infrastructure improvement currently under construction is Phase II of the $40 million dollar Airport Connector Project... a roadway designed to improve the traffic flow to the airport from Highway 99, the major route into Canada from the U.S. border.

Phase I, a new interchange for Highway 99 east of the airport, has been completed. Phase II, the construction of a three-lane westbound bridge to the airport, is a design/build contract now being carried out by a Walter/SNC Lavalin joint venture.

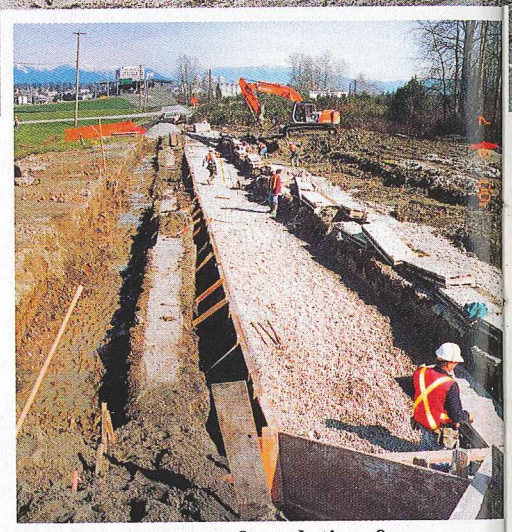
The existing 45-year-old, two-lane Morey Channel Swing Bridge currently serves the crossing between Sea Island where the airport is located to the west, and Lulu Island in Richmond to the east where the new interchange was built.

The Morey Channel Bridge is old and will eventually be replaced, but at the end of this project it will still be used as a two-lane eastbound bridge away from the airport. Both bridges will have dedicated bicycle lanes.

"Most of the on/off ramps that we are building here on Sea Island don't impact the existing traffic flow at all because they are new. Phase I of this project was much more disruptive and involved a lot of night work," says Gary Ogston, project manager for the Walter/SNC Lavalin joint venture.

"Our biggest challenge on this job was trying to maintain the schedule for a fast-track job that is a design/build contract. The difficulty is in coordinating our designers, design consultants, sub contractors and keeping the utility companies, the client and the City of Richmond happy. It's been a good project for us, we'll make some money on this job."

Most infrastructure that crosses the Fraser River in the Southwest corner of British Columbia, whether it's a buried pipeline, a bridge, or a high-voltage overhead transmission line, is subject to the threat of liquefaction of the loose saturated soils during an earthquake.



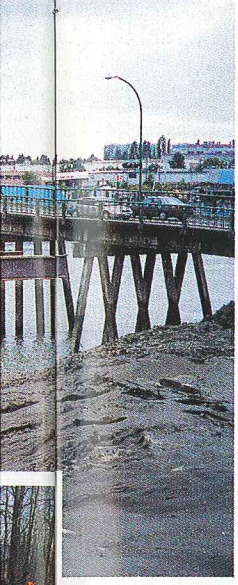
Workers prepare foundation for service tunnel.

This location is no different. The second obstacle to construction along parts of the Fraser River is the large post construction settlements that can occur if the soft underlying soils are not improved. An estimated 130 000 m^3 of Fraser River sand is being used to preload the site in places with preload heights of up to 16 m. About 700 mm of settlement is expected at some locations.

A couple of interesting features

s really count

By Correspondent Tonia Jurbin



about Phase II of the Airport Connector Project is the way the designers handled the liquefaction threat, and how the existing underground services were either protected from the expected settlements or relocated.

The depth of water at this crossing site is about 5 m depending on the tides and time of year. A very dense four to six metre layer of soil underlies three metres of soft riverbed mud. Liquefiable soils underlie the dense layer.

A conventional design might be to densify the soil and then drive piles. In this case, however, because of the consistent layer of very dense soil (about 110 blows/foot), the designers opted to use end bearing piles. A pile had to be designed that could punch into the dense layer of material without causing excessive disturbance.

The geotechnical information has to be reliable for this kind of design because if a pile punches all the way through the dense layer it is useless. About a dozen mostly land-based boreholes were used to map out the dense layer.

Before any pile driving could begin, an existing 610 mm City of Richmond steel watermain had to be relocated because parts of it were either under a pile location or under the preload. There were early discussions to hang the service under the new bridge, but that would have meant interrupting the water supply to the airport.

To ensure a reliable water supply, a new line had to be installed and in service before the pile driving could be completed. A new, high-density polyethylene (HDPE) .66 m dia pipe was pulled through a .93 m dia directionally drilled 310 m hole. A local company, Directional Mining & Drilling Ltd., installed the pipeline in about one month.

The first attempt had to be abandoned because the positioning system lost track of the pilot bit which created more risk of damaging other utilities (underground transmission cables, the existing watermain and the road) than the subcontractor was willing to accept. The second hole surfaced within a metre of the surveyed exit location.

Arch culvert takes shape to protect vital services connecting to the airport.

Two, 30-year-old BC Hydro 69 kV underground cables provide the airport's only connection to the BC Hydro grid. BC Hydro's estimate for relocating the cables was $1.2 million. To avoid those costs, the designers instead proposed building two arch culvert protection tunnels over the existing concrete encased ducts. The tunnels would allow the ground to settle with the preload and provide short-term access for monitoring and long-term access for maintenance. It also allowed for the option to maintain the duct elevation if the settlement was causing too much stress on the cables.

Concrete around the cables cracked in at least two locations during the early stages of the preloading. Cracks in the duct have not damaged the cables, but have to be dealt with. The concrete was excavated and removed from around the cables so that they could settle without the risk being sheared. The cable ducting will be reinstalled when the maximum 6 m of preload over them are removed.

The price of the protection tunnel alternative was $600,000, or half of the relocation estimate.

The piles themselves are interesting because the bottom 7 m of the piles are cruciforms (crosses) that range in size from 500 mm at the tip, to 1250 mm at the top where it meets the 1220 mm dia, three-metre-long end bearing barrel. The rest of the approximately 17 m to 30 m pile length is 760 mm. The cruciforms act as an anchor for the pile driving and also create a sort of a pilot hole for the pile.

A total of 60 piles, all at a 5:1 batter, were driven by Fraser River Pile & Dredge using their fixed mounted A-Frame pile driver. Fifteen fender piles were also driven. The pile driving took about two months.

The airport connector is just one of many multi-million dollar projects at the Vancouver International Airport in the last eight years. ◆