Canadian content

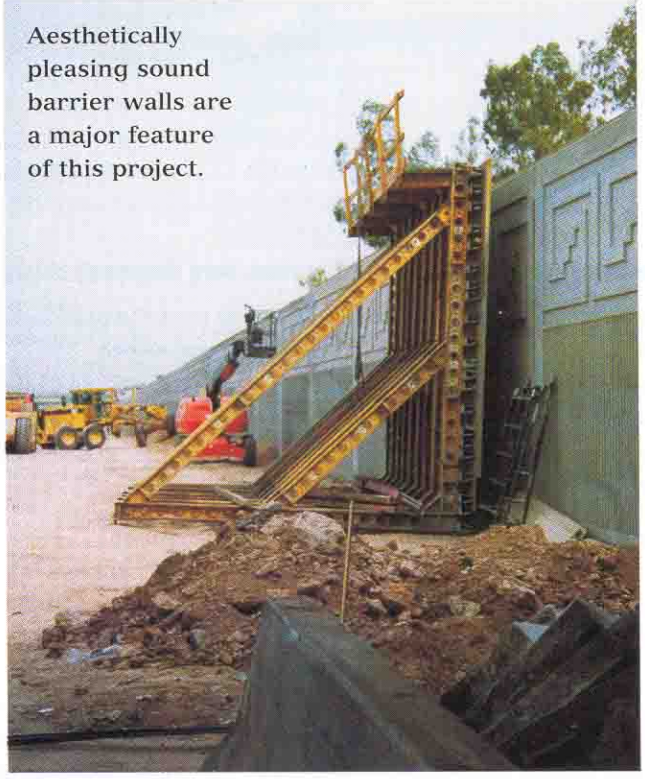
By Correspondent Tonia Jurbin

When it comes to roadbuilding, Canadian technology is second to none. From the frozen regions of the far north, to the often sweltering cities during the height of the summer, the diverse environments across Canada call for equally diverse designs and roadbuilding techniques.

Because of these capabilities, Canadian engineers and contractors are also being called upon by offshore clients to tackle projects in foreign lands.

The Cross-Israel Highway is one example. Another one, much closer to home, is the US$184-million widening of the Superstition Freeway in Phoenix, Arizona. It's the largest highway design-build contract ever awarded in the state and the Canadian consulting engineering firm of Golder Associates, of Vancouver, is in on the action for about US$1.2 million in geotechnical engineering fees.

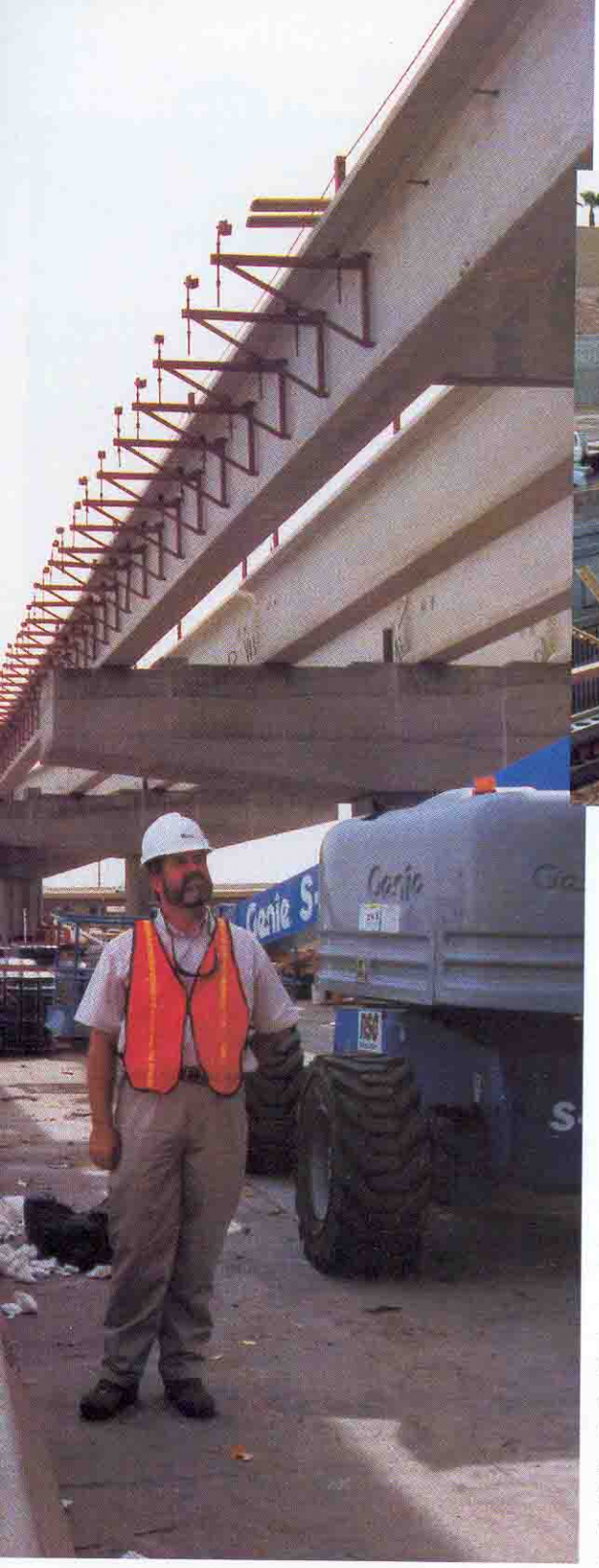
The project involves 21 km of freeway widening; major structures including extending four traffic bridges to accommodate the wider freeway, one new pedestrian bridge,



Aesthetically pleasing sound barrier walls are a major feature of this project.

and a new High Occupancy Vehicle (HOV) lane 'flyover' bridge. State-of-the-art traffic management including lighting and hi-tech sensors, cameras and message signs that monitor and report traffic conditions are also a part of the prime contract.

When the dust settles, an estimated 912 000 m^3 of material will have



Vancouver's Tony Rice keeps a close eye on bridge and wall construction along the route.

been excavated, and about 172 000 m^3 of concrete placed.

There have been many commuter and neighbourhood-friendly features designed into this modern freeway improvement during both the construction period and in-service use.

Contract specifications regulated the condition of exhaust systems and silencers on the heavy equipment as well as the locations of the stationary equipment. About 80 000 tonnes of rubberized asphalt in a 25.4 mm-thick layer over 330 mm of unreinforced concrete will provide a smoother ride for commuters and reduce vehicle noise by 2.5 to 4.5 decibels. About 111 600 m^2 of masonry sound wall barriers are included in the design which will reduce highway noise by an average of 5 decibels by just breaking the line of sight from the source, and another one decibel for each additional .6 m of height.

The landscaping, also designed to reduce noise and visual impact, will include replanting 300 mature trees and planting 10,000 new ones.

One of the key design features of the entire highway project is the use of "soil nail walls."

Although reasonably widespread in parts of Canada, soil nail walls have not been used extensively in the US.

The 24 645 m^2, maximum 6 m high soil nail walls were anchored with 4.5-m-long, 152 mm dia holes inclined at 15 degrees. The anchors were #8 (25.4 mm thick), 70 ksi steel Dywidag threaded bars on 1.9 m horizontal and vertical spacing. Most of the anchors were epoxy coated for corrosion protection except for under the bridge structures where double corrosion protection was used.

To maintain the integrity of the cut slopes, an elaborate surface drainage system was installed behind the shotcrete mesh. At the base of the wall, formed concrete pads were poured in place and were used as anchors for the aesthetic facing wall concrete forms.

When the anchors are fully loaded, the grout is expected to crack but will still hold the anchors because the bond to the soils has been

Bridge profile above with flash flood channel in foreground. Below photo shows formed concrete pads used to anchor walls.

demonstrated to be very strong.

The sedimentary and surficial geology around Phoenix is dominated by a number rivers and creeks in the Central Arizona area. Additionally, there are material fans that have been deposited in the lowlands resulting from flash flood events in the surrounding mountains.

In the arid climate, the flood transported material underwent cycles of drying and cementation resulting in highly variable layers of sand and gravel river deposits, interbedded with fine grain layers of clay, silt and sand.

This material, locally known as caliche (cal-ee-chee) is variable in strength as well as in grain size. The material is extremely friable, high strength when dry, but can deteriorate quickly if it gets wet.

Drilling (the soil nail anchor holes) through the caliche was one of the contractors biggest challenges, it's really tough to drill through and really dry and if the driller isn't careful, it will break up.

The HOV flyover structure is supported on 12 – 19-m-deep drilled shafts, two are double piered and 10 are singles.

Tony Rice, geotechnical manager for Golder Associates in Phoenix, and a Vancouver native, discusses the soil and groundwater conditions.

"Over the area of this site (which is considerable), a very deep groundwater table doesn't complicate our geotechnical work. We are able to drill 10 foot diameter shafts without casing and without caving. We are also able to use vertical zero-clearance excavations for the retaining walls because there is little chance of sloughing. This is different than anything I've worked on in Canada."

Because of the inherent strength of the material, the vertical zero clearance excavations allowed the contractor to advance quickly and significantly reduced the excavation volumes and therefore the construction traffic. Tight coordination and night work is necessary to keep the material and heavy equipment deliveries from causing more congestion on this heavily used freeway. Because it is such a major thoroughfare, it was important to keep commuter disruption to a minimum. The vertical excavations helped, but the excavation material still had to be hauled an average of 8 km where it was eventually spread over wider areas of the right-of-way.

There is a huge coordination effort during construction that includes daily scheduled meetings between the owners, designers, builders and other stake-holders that keep this project moving. ◆