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MUFFORD CRESCENT RAILWAY OVERHEAD

LANGLEY, BC



AWARDS SUBMISSION
2015



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Project Title

MUFFORD CRESCENT RAILWAY OVERHEAD

Location of Project

LANGLEY, BC

Category of Entry

TRANSPORTATION

Project Owner

BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

Project Client

BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

75-word Summary

URBAN SYSTEMS AND KLOHN CRIPPEN BERGER PROVIDED DESIGN SERVICES TO THE BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE FOR THE NEW MUFFORD CRESCENT INTERCHANGE IN LANGLEY, BC. THE PROJECT INCLUDED WIDENING OF MUFFORD CRESCENT, REALIGNMENT AND WIDENING OF HIGHWAY 10 (GLOVER ROAD), UPGRADES TO 64TH AVENUE BETWEEN HIGHWAY 10 AND 216TH, AND A NEW BRIDGE OVER THE CP RAILWAY TO ELIMINATE AN AT-GRADE CROSSING.

Name of Contractor involved

LAFARGE CANADA

Innovation

Urban Systems and Klohn Crippen Berger provided design services to the BC Ministry of Transportation and Infrastructure for the new Mufford Crescent Interchange in Langley, BC. The project included widening of Mufford Crescent, realignment and widening of Highway 10 (Glover Road), upgrades to 64th Avenue between Highway 10 and 216th, and a new bridge over the CP Railway to eliminate an at-grade crossing.

Requirements to minimize impact to agricultural land severely constrained the geometry of the road and bridge structure. The project is located in an area with very difficult soil conditions. The site is underlain by deep deposits of soft silt and clay to greater than 100 m depth, which are very sensitive and prone to both short term and long term settlements.

THE FIVE PRIMARY OBJECTIVES WERE:

- Eliminate at-grade rail crossing to reduce delays and improve safety and network reliability
- Address agricultural and environmental concerns
- Improve arterial road network connectivity
- Align with Official Community Plans, Transportation Master Plans and Strategic Network Plans
- No net negative impacts on existing Highway 10 operations

Three design concepts were considered during the preliminary design phase of the project including curved trapezoidal steel box girders, a single span bridge using concrete box girders, and a highly unusual bridge design known as a “trellis” structure. One of the keys to the design was to minimize the depth of the superstructure in order to keep the road and approach profiles as low as possible, both to get the roadway to grade quickly at the intersection on the south end, and to reduce the height and weight of the approaches. The “trellis” design with the main girders placed perpendicular to the railway had the shortest spans and therefore the shallowest superstructure.

To reduce post-construction settlements, the approach embankments were preloaded with a preload-surcharge prior to construction. Limit state stability analysis indicated that temporary preload fills could not be placed higher than 2.5 m above the existing grade without risk of foundation bearing failure.

The preliminary foundation design showed that open-ended, driven steel pipe piles were the most effective means by which to support the foundations and limit future settlement of the bridge structure. Computer programs, LPILE and GROUP, were used to assess the individual and pile group lateral performance and to predict lateral displacements in a seismic event. Pile spacing was optimized, reducing pile spacing on areas of the piers and abutments that were more heavily loaded. The seismic analysis of foundation demands resulted in the pile size increasing from 610mm to 915mm in some areas. As constructed, the project used only 915mm diameter steel pipe piles, driving them to an increased depth of 60m up from 40m in areas where the foundations were more heavily loaded or had increased seismic demands.

Complexity

The project is located within the Agricultural Land Reserve. Strict requirements on the impact to agricultural capacity severely constrained the geometry of the road and bridge structure design, requiring a very short radius curve on a high skew over the railway. The project is also located in an area with very poor settlement prone soils. The designers dealt with congested utilities, a challenging schedule and difficult property issues.

The “trellis” structure was designed utilizing precast concrete girders placed perpendicular to the railway to minimize the span of the girders, thereby minimizing superstructure depth. This lowered the road profile allowing the roadway to get to grade for the intersection, and reduced the height and weight of the approaches. Deep piles for the bridge foundations along with preloads and lightweight EPS fills were used to deal with the challenging soil conditions.

The new roadway crossed a high-pressure transmission gas main owned by Fortis BC, along with a series of distribution lines. To alleviate concerns over settlement of the line, a design was prepared utilizing a combination of lightweight EPS fill and steel sleeves for the gas mains. Extensive analysis was undertaken to demonstrate the system would not impose loading due to differential settlement onto the gas main.

The curved bridge approaches were constructed using expanded polystyrene (EPS) blocks, an effective but costly lightweight fill. Monitoring data from the preload-surcharge settlements allowed refinement of future settlement estimates, thereby reducing the quantity of costly EPS, along with reducing the volume of preload fill removal.

Social and/or Economic Benefits

The Mufford Interchange Project is an important component of the Roberts Bank Rail Corridor Program (RBRC). The RBRC is an important 70 km railway link connecting Canada’s largest container facility and a major coal terminal at Roberts Bank (Deltaport) with the North American rail network, and carries increasing volumes of international freight through communities in the Lower Mainland. A comprehensive corridor study was completed in February 2007 to prioritize road-rail grade separations in preparation for the planned expansion of Deltaport to accommodate consumer and business-driven demand for increased Canadian trade through the west coast of Canada. The program will improve safety and road network reliability, and reduce delays and traffic congestion.

The opening of Mufford Crescent marked the completion of all nine RBRC improvement projects enhancing the province’s transportation and trade links. Currently, rail tracks carry up to 18 trains per day, many of them more than two kilometres long. Rail traffic is expected to increase to 28 to 38 trains a day by 2021, as the port’s capacity expands.

“Separating trains from traffic at Mufford Crescent to enhance safety and reduce congestion has been Langley Township’s main transportation priority for years,” said Mayor Froese. “The completion of this overpass and the other RBRC projects will provide great relief for both residents and businesses. We appreciate the funding and cooperation that this partnership generated and extend our thanks to our funding partners. The resulting overpasses will improve travel in our region for years to come.”

Source: Railresource.com

Environmental Benefits

The Township's original proposal for the Mufford Overpass was rejected in 2010 by the Agricultural Land commission, because it intruded too much on farmland. The new design reduced agricultural land requirement by approximately one half. The new overpass has a direct connection to Glover Road, which was not part of the original proposal improving traffic flow.

A stormwater detention pond was constructed to improve runoff water quality and provide peak flow attenuation. The contributing area primarily pavement surface from the new Mufford Crescent / Highway 10 intersection and is an area for automobile pollutants given the significant traffic volumes, braking and accelerating, and risk of collisions. This facility is designed as an ephemeral marsh and extended detention pond which is designed to allow suspended sediments to settle during the design storm, with smaller particles continuing to settle between storms. This is particularly important as the project corridor is adjacent to an extensive Nicomekl River lowland flood area and provides significant value to salmon habitat.

Meeting Client's Needs

The bridge structure was designed to minimize impact on rail operations, highway traffic, and the environment. The superstructure consisted of 23 – 21.3 m long precast prestressed concrete box girders spanning perpendicular to the railway. Partial depth precast deck panels, supported by the precast girders, acted both as forms for the deck and as part of the final deck slab structure, thus eliminating formwork over the railway and resulting in fast erection. This minimized disruptions to railway operations, traffic and the environment.

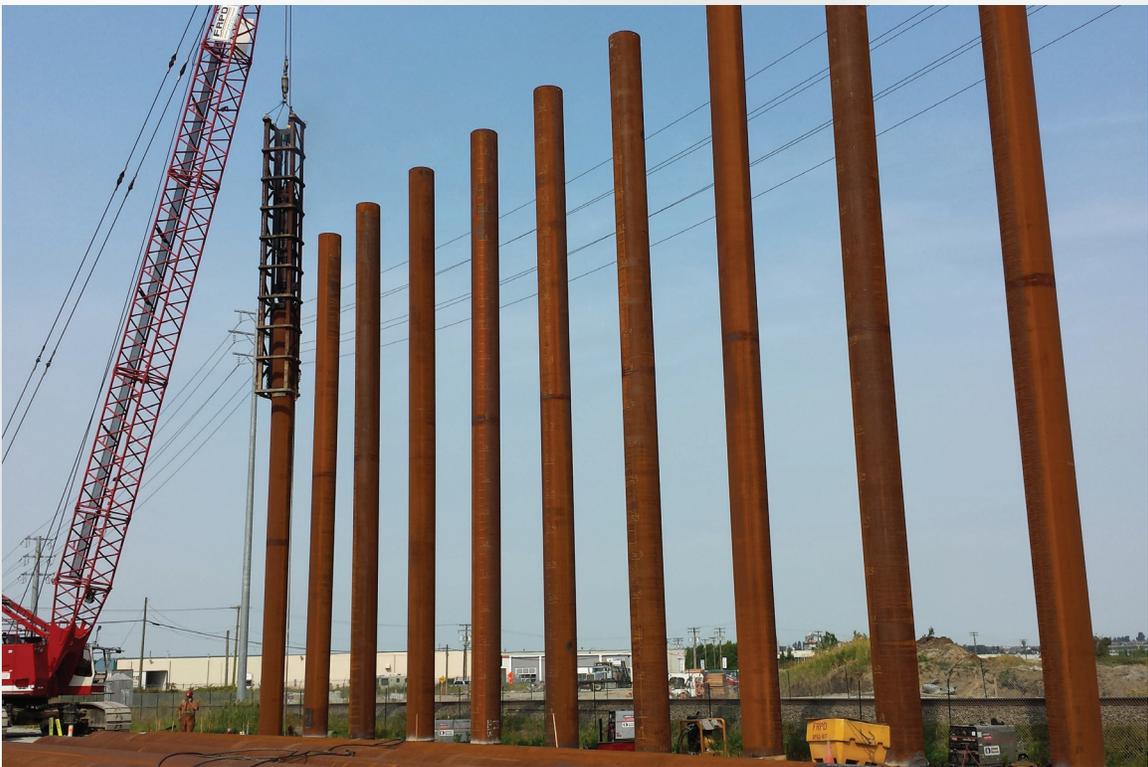
It was made clear to the design team at the outset of the project that there was no additional funding possible. The design absolutely could not exceed this budget limit, and given the initial cost estimates were higher than funding allowed, the designers faced a major challenge indeed. Continual optimization of the innovative structural and geotechnical design were major factors in bringing the project in just under the budget limit.

Total funding for the project contributed by the Roberts Bank Rail Corridor (RBRC) partners was \$51M and included:

- \$12.5M from the province
- \$3.1M from federal government
- \$24M from TransLink
- \$9.3M from the Township of Langley
- \$2.1M from Port Metro Vancouver



LIGHTWEIGHT EXPANDED POLYSTYRENE (EPS) CONSTRUCTION



DEEP FOUNDATION PILES FOR PIERS



REINFORCING STEEL IN BRIDGE PIERS



BRIDGE DECK READY FOR CONCRETE POUR



BRIDGE "TRELLIS" BEAMS



MUFFORD INTERCHANGE FROM SOUTH WEST

