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AWARDS 2014: TRANSPORTATION

AECOM

HIGHWAY 63 PINCH POINT SECANT WALL



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SECTION 1

75 WORD SUMMARY

Alberta Transportation required upgrading of Highway 63 in Fort McMurray along an alignment with numerous geometric and geotechnical constraints, with no compromise on safety

standards. AECOM designed a 420m long, 9m high secant pile retaining wall to retain a steep, unstable hillside where the roadway alignment is tightly constrained at the base of the

hill by the Athabasca River. This slender wall design had to consider complex loading variables and multiple stages of wall construction.



Precast facing panel architectural treatment

PROJECT HIGHLIGHTS

PROJECT
HIGHLIGHTS



SECTION 2

PROJECT HIGHLIGHTS

2.1 INNOVATION

The design and construction challenges associated with retaining walls are often under-appreciated and receive far less public praise and attention than their bridge infrastructure counterparts. It is important to acknowledge the crucial role that the secant pile retaining wall has played in the Highway 63 upgrading project through Fort McMurray and to highlight the design process that required a collaborative approach between the Consultant and Contractor.

To the north of the Athabasca River, the widened Highway 63 with 6 mainline lanes and adjacent collector-distributor lanes is constrained between the river and a steep, slowly creeping, vegetated hillside with residential housing on top. The substantial increase in out-to-out width of the roadway corridor from 33 m to 68 m has been

achieved by the combination of roadway fill supported by a tangent pile wall adjacent to the river and a cut retained by a secant pile wall adjacent to the hillside. Although both walls are equally important to the success of the overall widening scheme, the secant pile wall is the focus

of this award submission and worthy of individual focus based on its sheer size, as well as the design and construction complexities. This wall is one of the longest of its type in Alberta. The secant pile wall was formed by constructing intersecting concrete piles. The unreinforced



Drilling structural piles after completion of infill piles

SECTION 2

PROJECT HIGHLIGHTS CONT'D

infill piles were constructed first with a pile tip approximately 1.5 m below the finished roadway grade in front of the wall. Subsequent construction of the structural reinforced piles involved boring the edges of the infill piles. The overlap between piles is 200 mm. The short portions of wall at each end were designed as free standing cantilevers. For taller portions of the wall, up to three ground anchors per structural pile were used as tie backs to resist loading from the hillside.

Excavation in front of the wall was undertaken in controlled stages after piling was

completed. It was necessary to limit the first stage of excavation to just below the top anchor position and to install these anchors before further excavation. Similar excavation restrictions were required for portions of the wall requiring two or three anchors.

This was a challenging project in terms of the significant geotechnical constraints, the requirement for construction staging and a large component of traffic accommodation. In addition, the project required in-depth Consultant involvement during construction to adapt the design based on field conditions.

2.2 COMPLEXITY

The most challenging aspect of the design was managing the large number of variable piles and therefore a logical and methodical design approach was essential. For design purposes, the wall was split into several zones based loosely on the wall height and the ultimate soil loading under a hillside failure condition.

As well as designing the wall for the completed condition, it was equally important to check the wall during all stages of construction. This increased the design effort



Pile cap concrete pour

SECTION 2

PROJECT HIGHLIGHTS CONT'D

many times over and furthered the importance of a methodical and well-documented design procedure. The wall models created were highly adaptable to different earth loading, anchor loading and soil resistance values.

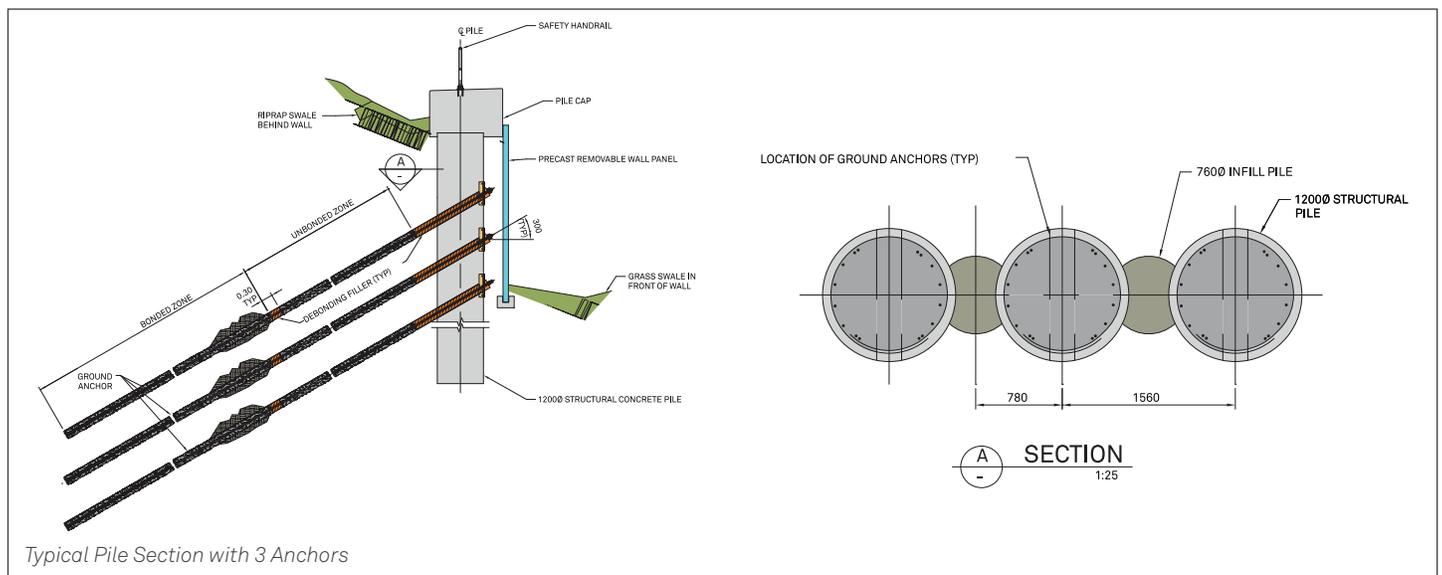
Constructability was a key consideration during the wall design whereby replication of details and procedures was maximized and constraints to the schedule were minimized. The Contractor was also encouraged to develop their own details. This took advantage of their past experience and helped

to improve construction efficiency. Two significant changes at the outset of construction impacted the design. Firstly,

the northernmost 100 m of the wall was realigned. The wall was shifted towards the hillside to avoid a potential conflict with a major power

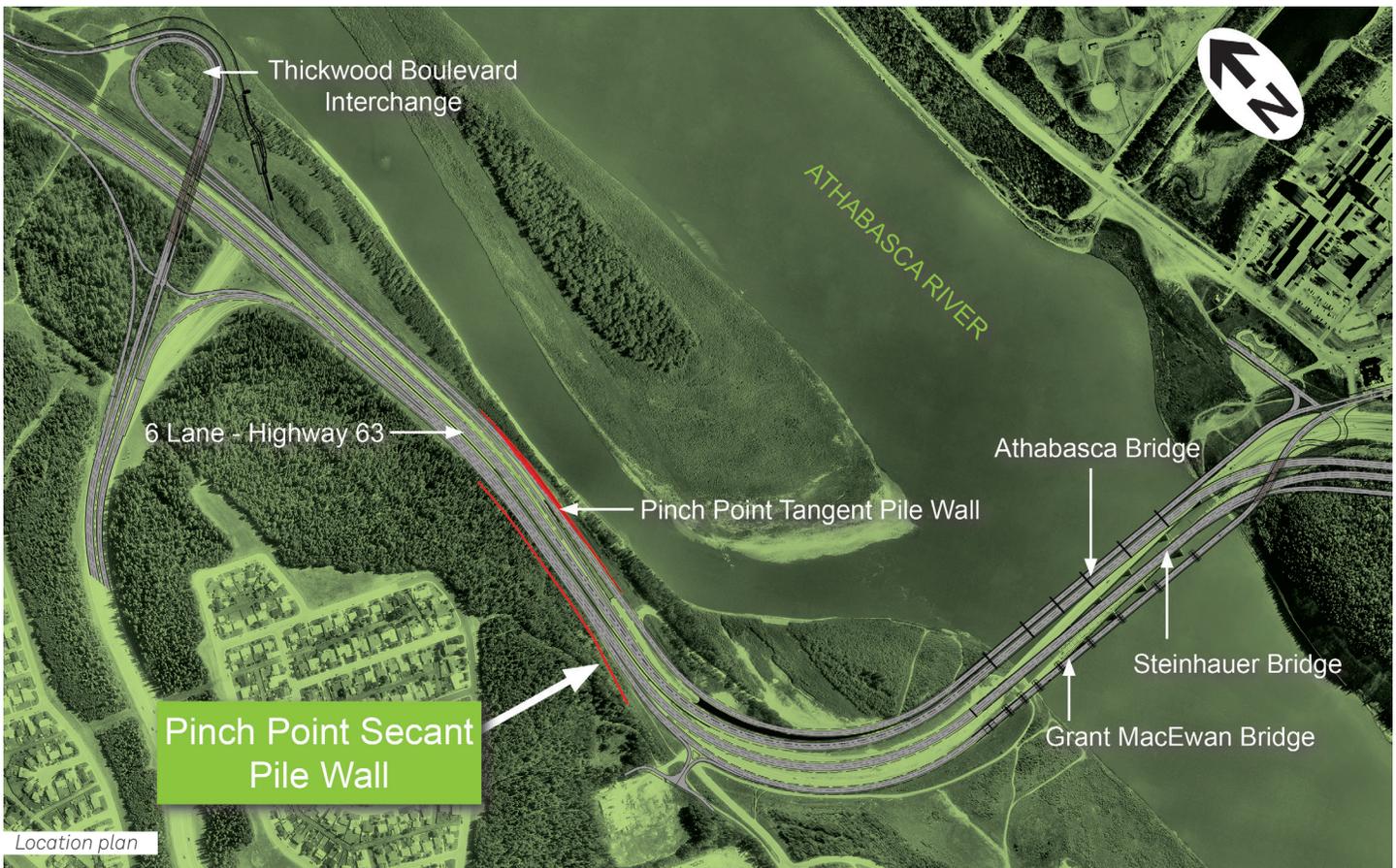


Drilling through a structural pile prior to anchor installation



SECTION 2

PROJECT HIGHLIGHTS CONT'D



line serving a large population in Fort McMurray. The second change required much more thought about the behaviour of the wall. The Contractor requested a substitution of the bar anchors to strand anchors which represented a cost saving to the construction but significantly altered the flexibility of the wall under lateral loading.

2.3 SOCIAL AND/OR ECONOMIC BENEFITS

Highway 63 is the major transportation corridor in Fort McMurray and serves as a route for local traffic across the Athabasca River between many of the residential neighborhoods and the town's

retail and commercial center. Highway 63 also serves as the main transportation route for people, goods and services to the large Oil Sands developments to the north of Fort McMurray, including many specialized over-dimensioned loads. The secant pile wall performs an important role in improving transportation access through

SECTION 2

PROJECT HIGHLIGHTS CONT'D

Fort McMurray along Highway 63 from the perspective of reduced traffic congestion and improved user safety. The retaining wall is a key component in the overall scheme to accommodate local traffic in discrete lanes that are physically separated from the higher-speed highway traffic. Segregation of local and highway traffic will greatly

enhance the local community. Reduced commuter travel times to the Oil Sands developments, which were significant particularly at peak hours, and improved flow of resources to these developments which rely on truck transport will have immediate and long term economic benefits at a local, regional and national level. The retaining wall is a

prominent feature for the local community with architectural treatment consistent with adjacent structures and aesthetics that are sympathetic to the local surroundings. The retaining wall is one of the largest and most strategically important structures of its type in Alberta Transportation's inventory.



Early stages of excavation in front of the retaining wall



Pile anchor bearing plates



Placing the concrete footing to support the precast facing panels

SECTION 2

PROJECT HIGHLIGHTS CONT'D

2.4 ENVIRONMENTAL BENEFITS

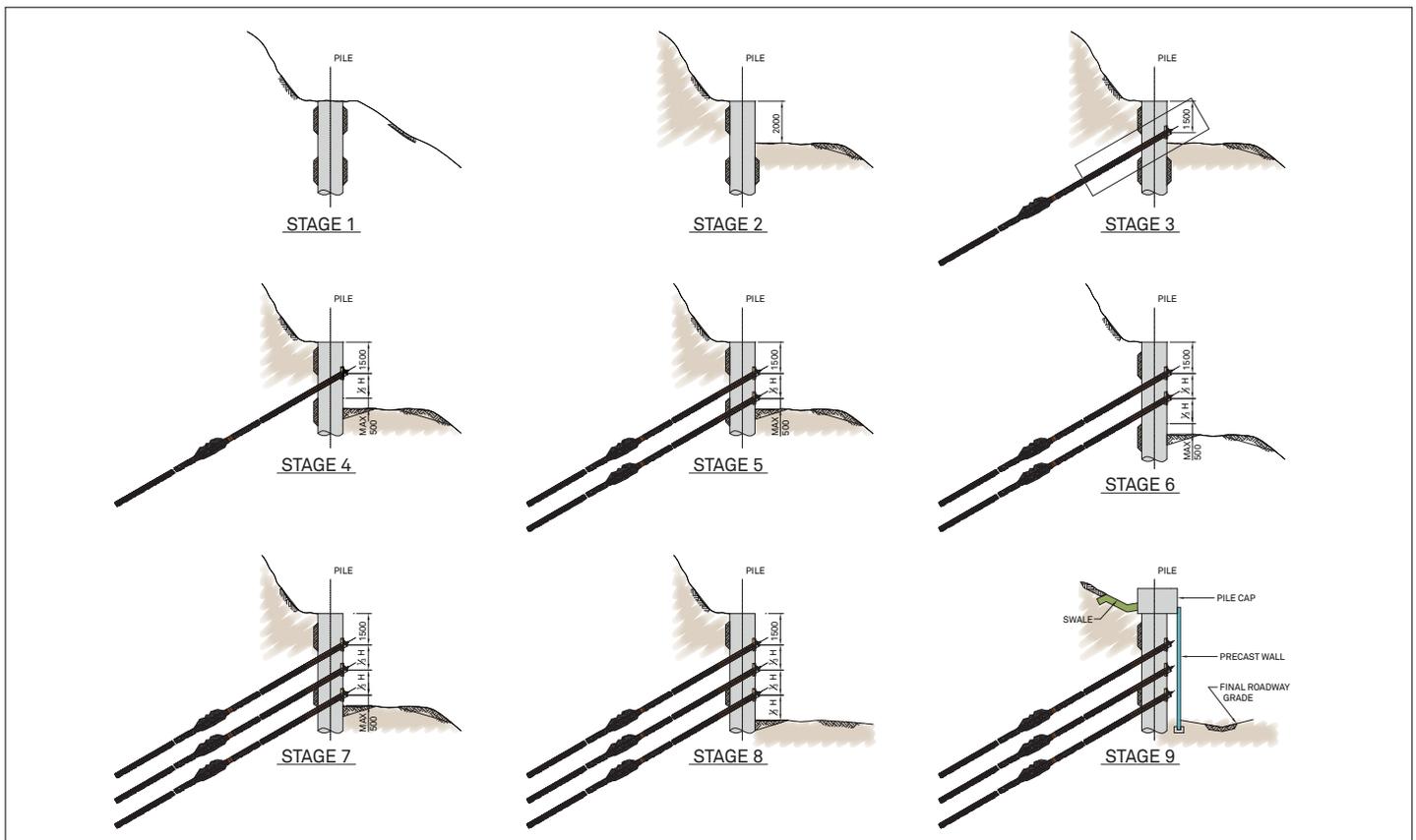
The design concept and development through to detailed design was done in an environmentally responsible manner whereby tree removal on the hillside above the wall was minimized and building out into the river was avoided

thus eliminating impact to fisheries and habitat in the Athabasca River at this location.

The design solution at the pinch point location specifically, and along the widened Highway 63 in general, is a sustainable solution for local and regional transportation of people, goods and services. The increased

road capacity is significant and will accommodate future projected traffic growth which is significant as the oil sands are developed.

Improved traffic flow on this section of Highway 63 will reduce congestion, particularly during peak hours, creating fewer green house gas emissions.



SECTION 2

PROJECT HIGHLIGHTS CONT'D

2.5 MEETING CLIENT'S NEEDS

The secant pile retaining wall is an integral part of the widening scheme to ease traffic congestion and improve user safety along the Highway 63 corridor within Fort McMurray. The existing four lane highway has been upgraded to six new mainline lanes in addition to four new C-D lanes. The wall has allowed roadway design standards to be maintained along the entire length of the project rather than introducing hazards within the Clear Recovery Zone for errant vehicles or requiring speed limit restrictions.

The open cross section also accommodates the frequent over-dimensioned loads travelling to the oil sands developments north of Fort McMurray along this corridor.

All parties advanced local knowledge about secant pile walls with tie back strand anchors. This experience will likely be of future benefit to widening projects as Alberta's road infrastructure continues to expand, particularly where space behind a given wall is limited. The project demonstrated numerous examples of the Consulting team being proactive and reactive, and working with

the Client and Contractor in an efficient and collaborative manner to deliver a high quality project.

“Widening of Highway 63 at the pinch point location and managing the required number of lanes without creating environmental or geotechnical issues was a challenge and required critical/ innovative thinking.”

- Rizwan Hussain,
Construction Manager,
Alberta Transportation.



The AECOM logo is centered on a dark gray background with wavy, horizontal lines. The logo consists of the letters 'AECOM' in a bold, white, sans-serif font. The letter 'E' is stylized with three horizontal bars, giving it a unique, geometric appearance.

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