Stantec

# Memo

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| To: | Lindsey LeBlanc<br>MoTI - Kamloops | From: | Paul Dudzinski<br>Victoria |
| Project/File: | 115823098 | Date: | May 30, 2024 |

**Reference: Sackum O/H Replacement**

As part of the design work for the Sackum Overhead Replacement, feasible methods of erecting the structural steel for the new superstructure have been reviewed. This memo summarizes the results of the review made of the incremental launch method. The review was based on the bridge configuration as of the 100% detailed design submission.

## 1. Structure Description

The steel girder system to be erected consists of 5 lines of welded steel plate girders with a constant depth of 2000mm, continuous over two spans of 45.7m-53.9m. The 99.6m total length is currently divided into 4 segments, ranging from 14.2m to 32.5m, with bolted splices joining the segments. The girders are laid out on a radius of 1100m to the roadway control line, but each segment is straight with the accommodated by a small kink near each splice point. Plan bracing connects the outer pairs of girders and full depth diaphragms connect the girders at the kink points, supports and at intermediate locations in the spans. The bridge slopes longitudinally from south to north, increasing from -1.42% at the south abutment to -5.04% at the north abutment.

## 2. Incremental Launching

Techniques for incremental launching of steel plate girder bridges are fairly well established in BC. While launching girders to a curved plan is less common it has been accomplished recently, notably at Quartz Creek (kinked girders to a curved plan) and at Falls Creek (curved girders to a curved plan). Launches require a certain degree of erection engineering, which will likely result in the use of custom fabrications (launch nose) and possible localized girder strengthening (typically horizontal or vertical stiffeners).

### a) Launch System

The basic elements of an incremental launch system are:

- A launch ‘pit’: a level area behind an abutment where the initial assembly of girder segments and girder lines can take place on temporary supports before being launched into the bridge space. Launching is ideally performed in the uphill direction, which provides for more control during the launch. The preferred condition at Sackum would be to launch from north to south with the north approach fills acting as a staging and assembly area (and launch pit). The overall length of these fills is such that multiple girder segments could be preassembled with the final segment added after the launch has touched down on the middle pier. The number of segments to be assembled is typically governed by the need to

have adequate weight behind the abutment support to provide a counterbalance to the cantilever effect of the assembly before it touches down at the middle pier.

- A launch nose: a steel fabrication temporarily attached to each girder end, providing a light weight extension to the girder at a lower weight per unit length. This has the effect of reducing girder deflection due the cantilever effect and allowing for engagement of vertical and lateral support at the pier at an earlier stage of the launch, improving control of the launch and stability of the assembly (more points of support, ability to tie down a partially completed launch).

- Vertical roller supports: placed under each girder at the starting abutment (north at Sackum), the pier and at a location within the launch pit. Hillman Rollers are typically used for this purpose – they are widely available and come in a variety of capacities. To accommodate rotational deflection of the girders during launch the Hillman Roller is usually part of a fabrication that includes a rocker assembly.

- Lateral guidance: horizontal rollers or snubbers to keep the girders aligned over roller supports and provide resistance to lateral loads such as wind. Guidance is usually provided against the edge of the bottom flange and is provided at the abutment and pier installations. In addition, horizontally mounted hydraulic rams are installed at selected locations to allow for the girder assembly to be 'steered' during the launch.

- Motive power: the means of pushing (or pulling) the girder assembly across the spans, overcoming friction and the uphill gradient. The means can be heavy equipment (bulldozers, etc), winch assemblies or hydraulic rams. Customized assemblies and methods, providing a greater degree of control and redundancy, are preferred.

b) Launch Sequence

Sketch SK-1 shows an expected launch sequence for Sackum O/H. The schematic is meant to show braced assemblies of girders. With five girder lines the bridge could be launched as:

- All five at once, with all bracing installed (and a work platform supported on the bottom flanges);

- Two launches of two and three girder assemblies.

The choice of how many launches to undertake is a decision balanced between how much launch equipment is available, availability and timing of rail closures, how quickly steel erection is desired and how much of the steel assembly is to be completed while on the ground instead of in the air.

c) Girder Strength

During the launch, as the girders move over the points of support, the shear and bending moments within the girder will vary when compared with the permanent condition. Depending on span lengths, support points and the girder design some sections of the girder could be overstressed, if not specifically designed to be launched. A Contractor choosing an incremental launch scheme for erection would be responsible determining extra material

required for the girders and incorporating it into the shop drawings. The engineer of record would then need to recalculate the required camber for modified sections.

d) Girder Detailing for Launch

Several aspects of girder detailing can help facilitate a launch. These include:

- Bottom flange is detailed flush along the launch length (web height varies with flange thickness, out-to-out girder depth remains constant.)
- Bottom flange width is detailed to the same width (if possible) along the launch length, to allow for continual guidance by the horizontal rollers and eliminate the requirement to reset the rollers.
- Bottom flange splice plates are split to allow for passage over the Hillman Rollers. Minimum clear width would be per Hillman requirements.

e) Effect of Kinks

The girders are detailed as a series of straight segments (4), spliced with a small angular deviation at the joint to follow the overall curvature. The segments currently range in length from 14.2m to 32.5m. With a curve radius of 1100m the maximum chord offset within a straight segment would therefore range from 23mm to 120mm. Therefore, with vertical rollers set on a girder centre line the deviation from roller centre line during launch could be as much as 120mm. The effect of the offset on girder web and flange capacity would have to be reviewed.

The girder length being launched will always be under the control of two sets of lateral guide rollers. As the launch leaves the north abutment it will be guided by rollers placed at the north abutment and by tail rollers placed within the launch pit (longitudinal spacing to be determined by the erection engineer). As the girders are advanced the lateral rollers will be manipulated so that the launch nose arrives at the center line of the bearings at the middle pier. When the lateral guide rollers are engaged at the middle pier the rollers in the launch pit are disengaged and guidance for the remaining launch would be provided by the lateral rollers at the north abutment and middle pier.

As the launch proceeds, the nose and tail of the girder assembly will wander laterally proportionate to the length of free cantilever relative to the spacing of the guide rollers (to be determined regarding roller placement within the launch pit). The second phase of the launch would result in a free cantilever of 46m with guide rollers spaced at 58m, proportionately reducing the maximum amount of wander at the nose and tail. Guide rollers in the launch pit should be set as far back as reasonable for launch phase one in order to gain the same beneficial effect.

f) Launch Timings

A key element of the Sackum launch will be complete the phase one launch and tie-off at the middle pier within the track possession available from CPKC (Canadian Pacific Kansas City). Recently, at Falls Creek, a 77m span was launched during a procedure that was scheduled to

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start at 8 AM and finish at 4:45 PM. This was achieved but a breakdown of the actual timings indicates that approximately 90 minutes was spent actually advancing the girders. 4 hours were spent placing counterweights and having a lunch break and a lesser amount of time was spent replacing a broken Hillman roller.

At Sackum there is enough assembly area on the north approach to allow for pre-assembly and rehersal of the launch procedure which will help to identify and eliminate any unforseen glitches that may occur. The contractor should develop a robust launch procedure and have an adequate supply of spare parts and redundancy in available equipment to account for any eventuality.

With a reasonable plan (and pre-rehersal) launch phase one, to the middle pier, should be achievable within a single track possession. Launch phase two could conceivably be performed without a track possession (subject to approval), but if required the second launch would be of a lesser length (and closure) than the first.

Regards,

**STANTEC CONSULTING LTD.**

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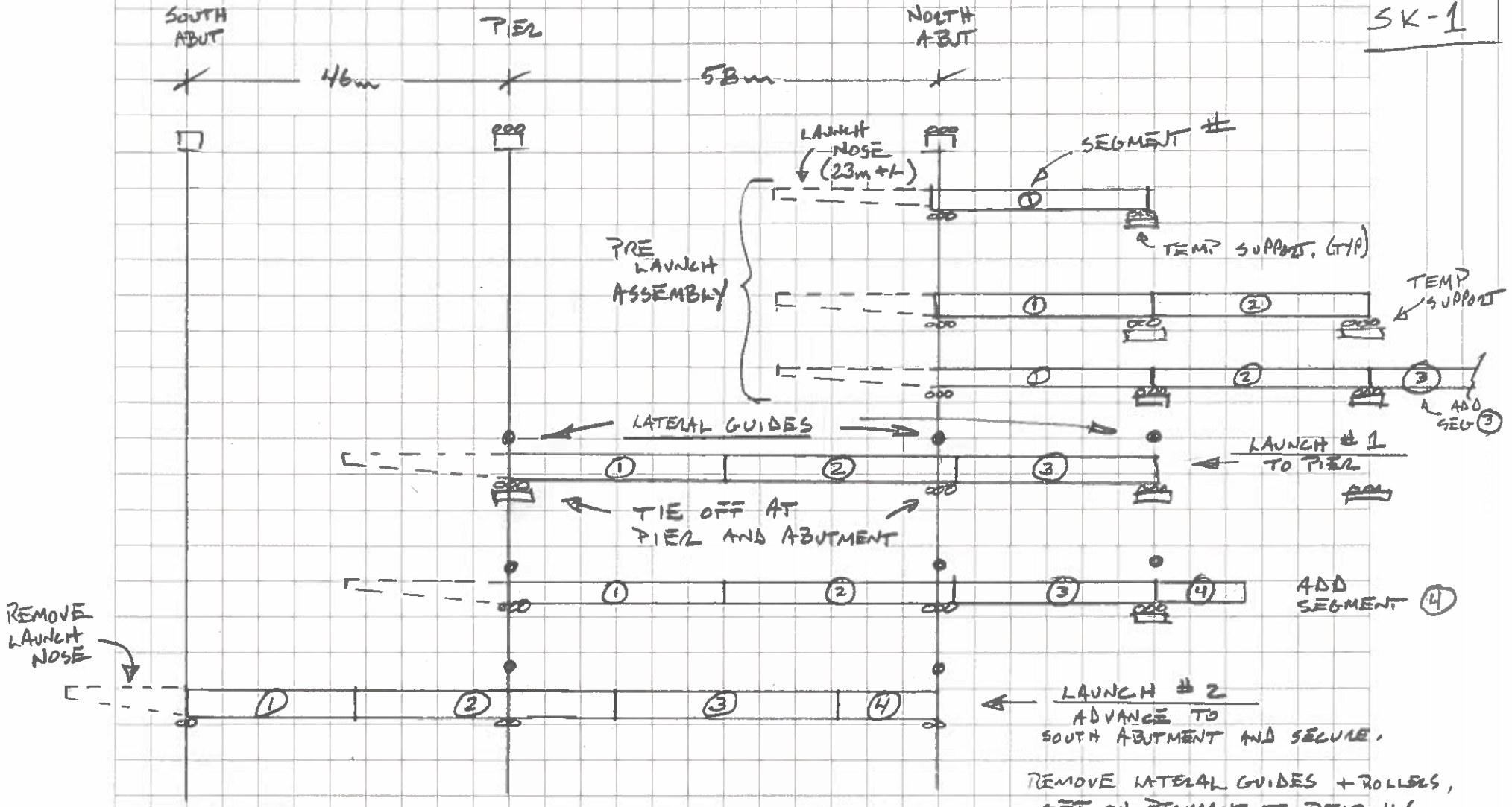
Attachment: [Attachment]

**Reference: Sackum O/H Replacement**

SK-1




SALKUM O/H
PROPOSED LAUNCH SEQUENCE

17 APR 2024
TSD
Designed by:

Stantec