COASTRUCTURAL ENGINEERING LTD.
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November 17, 2016

Sunshine Coast Regional District
Field Road
Sechelt

Attn: Ken Robinson
Re: 5 Bridges Review

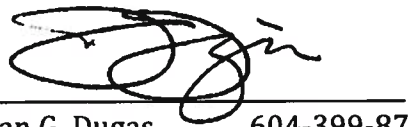
Dear Mr. Robinson,

Thank you for asking Coastructural Engineering Ltd to help you with this project. We have visited the sites of 5 bridges on October 19, 2016 accompanied by Charlie Hogg and Michel Frenette. Vine Brook Bridge, Lions Field Bridge, Coop Bridge, Soames Hill Park Bridge and Cliff Gilker –Blue Trail Roberts Creek Bridge were visited.

The objective of these reports is to identify any areas of concern with respect to the performance of each of the bridges so that appropriate repairs or alterations can be undertaken to prolong the usefulness of each bridge. When possible, safe loads and life expectancy will be identified and the interval until the next review shall be recommended. Our search efforts did not reveal any recommendations for minimum review periods.

We expect that these reports will satisfy your present requirements with respect to these bridges and remain at your service.

Yours truly.



Dean G. Dugas 604-399-8787
for
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Report to the SCRD on 5 Bridges November 17, 2016

Lions Field Bridge

Photo 1 Lions Field Bridge from the South

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LIONS FIELD BRIDGE

The Lions Field Bridge is a 48 foot long steel vehicle and pedestrian bridge which crosses a small creek on the property of the Lions Club in Kleindale. It is the conversion of a Freight Rail Car built by British Columbia Railway by removing the wheel trucks and perhaps the sides of the original bin. It was placed approximately 12 years ago by Don White and Indian Isle Construction. Two layers of wood members provide a driving surface and 6X6 wood rub rails have been installed at the edges for vehicles. Mr. Hogg has mentioned that guards are planned to be install atop the rub rails for the safety of pedestrians using the bridge.

Condition

The visible and exposed steel portions of the undercarriage are in very good condition.
Condition of the steel within the ground is undetermined.
Parts of the wood deck have recently been replaced but there are other punky areas which need replacement.
There are painted labels indicating its capacity and load limit (see Photo 6).

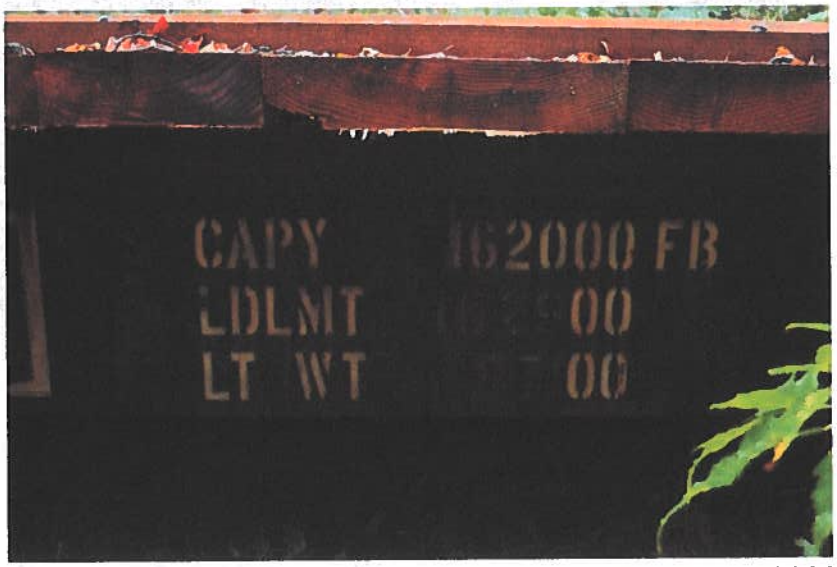

Photo 2 Lions Field Bridge - Freight Car Load Limit 162900

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A detailed survey of the bridge was not taken as it was raining and the banks of the stream were slippery and also for reasons listed below.

Load Limit:

Mr. Hogg related that the heaviest load that the bridge is expected to experience would be that of a dump truck and its pup trailer both full of sand or gravel crossing the bridge to carry out maintenance on the sports field. This load has already been experienced several times and the bridge has performed well.

An estimate of the bridge load limit is beyond the scope of normal hand calculation and our particular expertise. In order to estimate a reasonable load limit for this bridge it will be necessary to do a thorough survey of the different steel members comprising its complex structure. The resulting information can then be modelled in a computer finite element analysis program by a qualified technician and proper rolling loads applied. This procedure is time consuming and the cost unknown at this time.

Since the bridge performs well under its present maximum experienced load and there is no expectation for heavier loads we would recommending posting this weight as its Load Limit and maintaining the wood decking in good shape so that rolling point loads from vehicles can be properly shared by multiple members of the bridge structure. Heavier loads may only be expected from large fire trucks or concrete trucks so posting this limit will be of benefit if concrete installations are anticipated for the North side of the bridge and beyond.

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Cliff Gilker –Blue Trail, Roberts Creek Bridge

CLIFF GILKER PARK Blue Trail Roberts Creek Bridge from the South

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CLIFF GILKER PARK Blue Trail Roberts Creek Bridge was built in the summer of 1992 and is a double log stringer bridge.

Condition

The bridge is in poor condition with respect to all its parts.
Its stringers are being propped up by a log post near center which stands directly on the stream bed.
Guards and deck members are slippery and badly deteriorated in many areas.
Guards are unsafe and deflect excessively from a moderate sideways force.

Recommendation

The bridge is arguably a liability and should be closed now.
Plans for a new bridge should be developed for the nearby area.

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Coop Bridge

Coop Bridge from the South-East

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COOP BRIDGE

The Coop Bridge is a 34' wooden bridge built about 2006 south of Highway 101 on Clack Creek. The bridge is well shaded and has little chance at direct sun so the wood members are continuously wet. The main deck stringer beams (3-2x10 cedar) span the two gabions near the creek water level spaced at 16 feet and cantilever 4 feet at the west gabion to reach the bank and 5½' at the east gabion. Two more stringers (2-2x10 cedar) are supported on the east cantilever and on the east bank of the creek.

Coop Bridge from the North-East showing the main stringer beam cantilevering over the east gabion and its log cribbing. West gabion and cribbing are on the far side of the creek.

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Condition:

- The stringers, guards and most of the deck boards are in good shape.
- 3 stanchions require additional anchoring to reduce sideways deflection when pushed against.
- Several deck boards should be replaced.
- Cribbing logs are soaked and punky but provide a large bearing area so they will not require replacing for several years. This can be done easily as the rock area adjacent to the gabions will provide excellent bearing for temporary shoring of the stringers.
- Gabions are close to the water line but there is little chance for larger logs or debris to impact them as there is a culvert close by running under the highway limiting the size of wood coming downstream.

Recommendations:

- Additional horizontal rail to be added to the guards.
- Replace deteriorated deck boards.
- Stabilize 3 stanchions.
- Provide slip resistant screens as required.
- Monitor all bridge members and replace or repair as required.
- Replace cribbing when the bridge deck sags and creates uneven walking surface.
- Review with Engineer in 3 years.

Present Load Limit:

The bridge deck is currently able to support 100 pounds per square foot.

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Soames Hill Park Bridge

Soames Hill Park Bridge from the West

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SOAMES HILL PARK BRIDGE

This bridge was built in the summer of 1994 on 2 log stringers. The Fir logs are approximately 69' long and 8" & 20" in diameter with their butts reversed. Each stringer is propped at about the 30 foot and 45 foot mark by diagonal 8x8 pressure treated posts notched into the underside. The posts rest on concrete pads in the bank of the ravine. The area is heavily treed and sun exposure is rare. The moist environment will lead to accelerated deterioration of the stringers especially at the bearings on the ravine banks.

Condition:

Overall the bridge is very good condition with adequate guard rails.
We do suggest a cable attachment near the middle of the bridge to limit sideways movement. The bridge does have a long period natural frequency and it is quite easy to produce a large sway at the center of the bridge when rocked in timing with that frequency.
Aside from normal deck maintenance in the interim the bridge should be reviewed by an engineer in 3 years' time.

Load Limit:

The present capacity of the bridge is 225 pounds per lineal foot or about 70 pounds per square foot.

Life Expectancy

Minimum 10 to 15 years with regular maintenance of deck and guards.

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Vine Brook Bridge

Photo 1 Vine Brook Bridge from the East

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1 VINE BROOK BRIDGE

The Vine Brook Bridge was built approximately 15 years ago and is part of the Suncoaster Trail and can be accessed from Malaspina Substation Road. It is in a well exposed to sun and air. Its support structure is made up of two parallel Douglas Fir stringer logs approximately 59 feet long and 17"-18" in diameter. The two logs are arranged with one butt at each end of the bridge and use large gabions as bearing blocks. The bridge deck is wide at 52" and guards are in generally good shape. A posted sign advises of a 500 pound weight limit with no horses allowed and only one ATV at a time.

Construction:

The stringer logs do not actually clear-span the 59 foot length as they are supported near mid-span by a vertical steel frame which is in turn supported on two tension cables (see Photo 2) made of ¾" diameter steel braided cable. The cables attach to steel rods which penetrate the underside of the stringers at a shallow angle near their bearing and are anchored within the logs by a steel rod crossing both logs near their center lines (see Photo 4). All steel hardware is in good condition.

Theory:

If the bridge was just a double stringer wood log bridge without the cables the dead and live loads would be taken by the logs and they would have to have been chosen based on the full span for strength and deflection. The performance of the bridge could then be assessed on the basis of the remaining integrity of the logs all along their lengths.
With this long span the cables help out by "propping" up the center of the stringers. However that induces large tension forces in the cables and therefore great pressure on the wood fibres at the anchor rods and cross bar. A great deal of the performance of the bridge is now dependent on the condition of the log just local to the cross bars. The north ends of the stringers in particular are surrounded by the bridge deck above, the gabion below and soil and leaves covering the sides. This constantly moist condition has led to accelerated deterioration of the stringers.

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Photo 2 Vine Brook Bridge showing stringers supported at mid-span on steel frame and tension cables.

Deterioration:

Mr. Frenette used a boring tool near the north end of the west stringer to extract a ¼" diameter core of wood from near the heartwood of the log. This sample site was near the area shown in Photo3 with the rotting and missing fibres. On examination of the small core it could be seen that the interior fibres had also lost integrity as they were soft and crumbly.

Deflection:

The West stringer has deflected downward about 2 to three inches more than the east stringer at the midpoint support of the bridge and this puts a sideways slope on the deck board. This differential again indicates that most likely the bearing area of wood next to the cross bar which anchors the tension cables has compressed and that this would be due to the deterioration.

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Photo3 Vine Brook Bridge. North end of West stringer log showing much deterioration.

There is no danger of sudden collapse of this bridge because the failure mode is expected to be the anchor rods pulling the cross bar through the softening stringers. An advance of the anchor rods by 1" in the end of the stringer would show up as a 5" downward deflection at the center of the bridge. We expect the bridge will be retired when the downward deflection reaches this range.

We expect that the bridge will continue to support the 500 pound load limit safely for the period of 5 to 10 years as this is only a fraction of the estimated weight of the present bridge (10,000 pounds). Deflection monitoring (see recommendations) could revise this number.

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Photo 4 Vine Brook Bridge. South end of East stringer showing the end of the cross bar between the logs.

The deck suffers a cross fall slope as mentioned above. This is a serviceability issue and will affect slippage on the deck in the wet season and with leaf coverings. The SCRD should consider whether to continue to allow ATVs on the bridge due to the momentum which they can gather (depending on the speed). Should the driver need to stop suddenly the machine could damage or break through the guard. The distance into the creek ravine is appreciable and potential for injury or worse is always present. The weight of a driver and the ATV is typically in the range of 600 to 700 pounds which exceeds the posted limit. Of course the weight of only three average adults could exceed this limit.

Recommendations:

- The logistics of replacing the bridge should be planned now for the near future as the stringers have lost much of their original integrity.
- In order to exclude ATV traffic from the bridge, bollards or staggered gates should be placed at each end of the bridge.
- Staff should monitor the deflection on the bridge once a year beginning this fall by using a builders level or transit to document the deck elevations at each end of the bridge and at the mid-point of each stringer.

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- An Engineer should reassess the bridge in 3 years unless staff monitoring raises concern earlier than that.