Structure #	Crossing Name	Forest Service Road	User km	CBR km		
SI-5635	Kennedy River	Sproat Lake FSR	0.5	0.5		

Figure 1-1: Upstream elevation.

Figure 1-2: Downstream elevation.

Figure 1-3: Looking towards woods end.

Figure 1-4: Looking towards camp end.

Figure 1-5: Looking upstream.

Figure 1-6: Looking downstream.

Structure #	Crossing Name	Forest Service Road	User km	CBR km		
SI-5635	Kennedy River	Sproat Lake FSR	0.5	0.5		

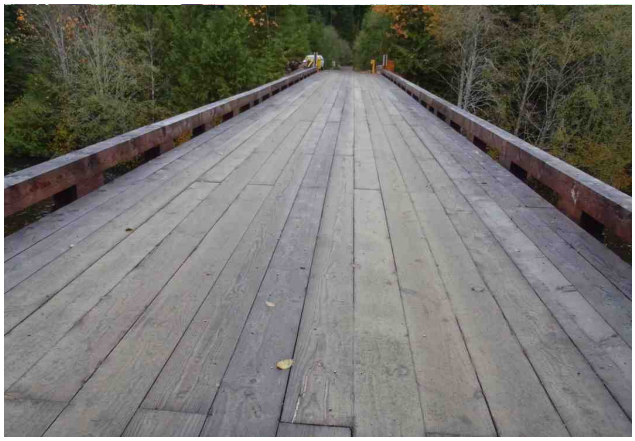

Figure 1-7: General deck condition.

Figure 1-8: Typical deck soffit condition.

Figure 1-9: Span 1 girder 1 upstream face.

Figure 1-10: Span 1 girder 1 upstream face; end check at camp end.

Figure 1-11: Span 1 girder 2 downstream face.

Figure 1-12: Span 1 girder 3 upstream face; check near bottom of girder.

Structure #	Crossing Name	Forest Service Road	User km	CBR km		
SI-5635	Kennedy River	Sproat Lake FSR	0.5	0.5		

Figure 1-13: Span 1 girder 4 downstream face.

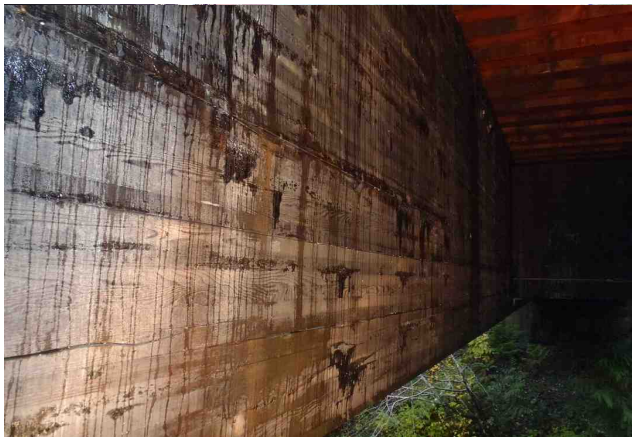

Figure 1-14: Span 2 girder 3 upstream face near pier. (AE2329, AE2341, AE2328)

Figure 1-15: Span 2 girder 3 upstream face near mid-span. (AE2301-AE2302)

Figure 1-16: Span 2 girder 3 upstream face near woods end.

Figure 1-17: Span 2 girder 4 downstream face.

Figure 1-18: Span 2 girder 4 downstream face; longitudinal checks along the top of girder.

Structure #	Crossing Name	Forest Service Road	User km	CBR km		
SI-5635	Kennedy River	Sproat Lake FSR	0.5	0.5		

Figure 1-19: Span 2 girder 4 downstream face; end check at woods end.

Figure 1-20: Camp end abutment.

Figure 1-21: Woods end abutment.

Figure 1-22: Pier camp end face.

Figure 1-23: Timber sills on pier.

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

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October 3, 2011
File: 20092501.05.E.05.00

Mr. Rick MacDonald, P.Eng.
CRM Engineering Ltd.
1280 Gilley Crescent
Parksville, BC
V9P 1W5

Re: CONDITION INSPECTION AND LOAD RATING OF THE KENNEDY RIVER BRIDGE

Dear Mr. MacDonald:

CRM Engineering Services Ltd. (CRM) retained **Associated Engineering (AE)** to complete a visual inspection and assessment of the Kennedy River Bridge. The purpose of the assessment is to determine whether it would be possible to facilitate the passage of highway legal trucks across the bridge.

To assist, RM provided a load rating report completed by All-span Engineering & Construction Ltd. for StoneCroft Project Engineering Ltd. on July 28, 2011 (attached).

This letter presents a summary of the inspection and the results of our assessment.

1 THE CONDITION INSPECTION

Ryan Veitch, AScT, Jack Jiao, P.Eng., and **Rick MacDonald, P.Eng.** inspected the bridge on September 15, 201. The bridge crosses Kennedy River on a deactivated forest road near Kennedy Lake on Vancouver Island.

Photo 1 - Downstream Elevation

At the time of the inspection, access to the bridge was only available to the areas adjacent to the abutments (see **photo 1**).

October 3, 2011
Mr. Rick MacDonald, P.Eng.

The bridge comprises two 27.4 m simple spans and a14 ft timber deck. The Glulam girders are grouped in two pairs at 10-ft centres. The bridge deck, curbs and cross-ties are in very poor condition (see **photo 2**).

Two concrete abutments and one pier support the spans. The pier is supported by a group of steel pipe piles. Both abutments are in good condition and the pier appears to be in good condition although we were unable to access it at the time of the inspection.

Photo 2 - Typical Condition of Bridge Deck

The exterior faces of the upstream and downstream girders were weathered with the creosote leaching out (see **photo 3**). There is limited weathering and checking on the interior faces. We observed cracks and checks of various sizes near the abutments. We also observed a significant crack on the upstream exterior girder near the camp end abutment about 400 mm from the girder top (see **photo 4**). This crack measures 5 mm wide, 170 mm deep and approximately 8 m long. We cored the girder just below the crack and detected no rot.

Photo 3 - Typical Condition of Exterior Girder

Photo 4 - Girder Crack near the Camp End Abutment

CANADA'S 50 BEST MANAGED COMPANIES

2 THE BRIDGE LOAD RATING

We completed the live load evaluation in accordance with Section 14, CAN/CSA-S6-06 for the BCL-625 design vehicle.

To account for the crack, we did not include the top 400 mm of the girder (i.e., only assumed a 1700 mm deep girder). For the other girders, the whole section was considered effective (i.e., 2100 mm deep). Assuming all four girders share the live loads based on their stiffness, the 1700 mm deep girder carries 25% of the live load and the 2100 mm deep girder carries 46% of the live load.

We have assumed that the timber deck will be replaced with a 14 ft timber deck similar to the MFLNRO BCFS-L75 standard timber deck. We have also assumed that the Glulam girders were D. Fir grade 24f-E. The specific gravity of timber was taken as7 kN/m^3.

3 THE RATING RESULTS

Tables 1 and 2 summarize the Target Reliability Indices and the associated load factors.

Table 1
Target Reliability Indices

	Moment	Shear
System Behaviour	S2	S2
Element Behaviour	E1	E2
Inspection Level	INSP3	INSP3
Target Reliability Index	3.50	3.00

Table 2
Calculated Load Factors

Force Effect	Target Reliability Index	Load Category	Load Factor
Moment	3.50	α_{D1}	1.09
		α_{D2}	1.18
		α_{LL}	1.63
		DLA	17.5%
Shear	3.00	α_{D1}	1.07
		α_{D2}	1.14
		α_{LL}	1.49
		DLA	17.5%

Table 3 summarizes the results of the evaluation.

Table 3
Load Rating Results

Girder	Traffic Type	Force Effect	Factored Resistance	Factored Demand	LLCF[1]
1700 mm deep girder	Normal	Moment	3,350	2,346	1.79
		Shear	317	182	2.46
2100 mm deep girder	Normal	Moment	5,113	3,472	1.68
		Shear	377	263	1.65

Note: 1. LLCF≥1.0 indicates that the bridge has sufficient capacity to support the evaluation load.

October 3, 2011
Mr. Rick MacDonald, P.Eng.

Based on the analysis, the bridge has sufficient capacity to support the BCL-625 vehicle.

The pier and a large portion of the Glulam girders were not accessible at the time of our inspection and therefore not inspected. As such, we recommend that these components be visually inspected one year after the bridge is commissioned using a specialized bridge inspection truck to allow inspection of all critical components of the bridge.

Thank you for entrusting us with this interesting assignment. We trust that this letter satisfies your initial requirements; if you have any questions, please call me or Julien Henley.

Yours truly,

Prepared by:

Jack Jiao, M.Eng., P.Eng.
Project Engineer

Reviewed by:

Julien Henley, M.A.Sc., P.Eng.
Manager – Resource Infrastructure

JJ/JH/skn

Attachment:
- Kennedy River Bridge Glulam Girder Analysis

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email: All-Span@telus.net

StoneCroft Project Engineering Ltd.
2165 Kelland Road
Black Creek, BC
V9J 1G4

July 28, 2011 Our File No.: 11-055

Attention: Mr. Lee Deslauriers, P.Eng., RPF

Regarding: Kennedy River Bridge Glulam Girder Analysis

Dear Mr. Deslauriers:

As requested, we have completed our evaluation of the Kennedy River Bridge glulam girders. The girders were analyzed for the Ministry of Transportation and Infrastructure (MoTI) BCL625 design highway truck load (representing legal highway truck load) as well as various Ministry of Forests (MoF) standard logging truck configurations.

The analysis was completed using Section 14 of the Canadian Highway Design Code CAN/CSA-S6-10 (modified for logging truck loadings as required) and "Procedures for Inspection and Evaluation of Glued-Laminated Bridges, Ministry of Forests", November 1993.

An assessment of the abutments and piers was not included in our scope of work.

The results of the analysis indicate that the girders do not have sufficient capacity to carry the BCL625 highway truck load. It was also determined that the girders do not have enough capacity to carry MoF standard L75, L60 or L45 logging truck loads.

In these cases, the governing load effect was bending and shear of the girders for the L75 truck load and bending for the remainder of the vehicle loads.

The results are summarized below:

Truck	% Overstressed
L75	44% in Bending 13% in Shear
L60	20% in Bending
L45	8% in Bending
BCL625	30% in Bending

In addition, the girders were analyzed for a CAT excavator and Volvo articulated truck load.
It was determined that the girders did have sufficient capacity for a CAT 215 series Excavator or equal (vehicle only) with maximum operating weight of 20140 kg, and an unloaded Volvo A30E articulated truck or equal with maximum empty unloaded operating weight of 23060 kg.

Please note the following:

- The CAT excavator and/or Volvo truck must travel down the center of the bridge.
- New deck components must be installed prior to use of the bridge.
- A close proximity inspection of the girders, abutments and piers should be carried out prior to use of the bridge to confirm the condition of the bridge components.

Our assumptions used in the analysis were as follows:

- Girder properties and configuration (provided by StoneCroft Project Engineering) are as per attached sketch. 2 simple spans of 27.43m each.
- Vehicle configurations are as per attached sheet. Maximum 400mm eccentricity between the center of the bridge and the center of the truck was assumed (excluding excavator and Volvo articulated truck).
- The two interior girders carry all of the dead and live load, based on the inspection observations stating there were significant longitudinal cracks in both of the exterior girders. (Ref: "Statement of Works Proposed for Deflection Test of Kennedy River Bridge", dated May 12, 2011 by StoneCroft Project Engineering)
  It was assumed that repair of the exterior girders will be very difficult with little or no guarantee the repair will last for the long term.
- The two interior girders are in good condition with minor checks and cracks
- The tops of the girders were assumed to be sufficiently braced with diaphragms - four diaphragms at equal spacing, with one at each bearing to restrain torsional rotation

I trust this meets your requirements at this time. Please contact us should you have any questions or comments.

Sincerely,

Shaheeda Mawani, M.Eng., P.Eng.

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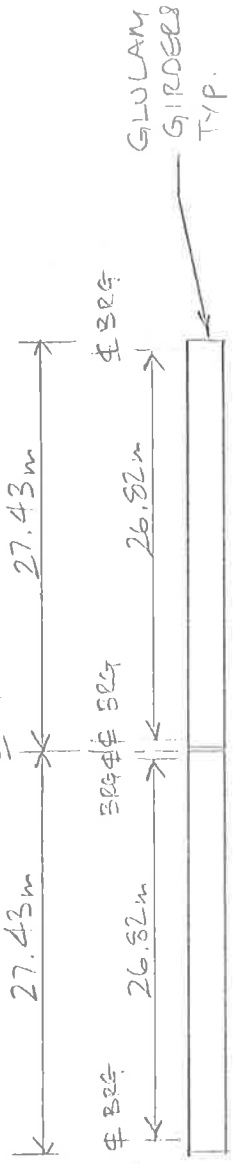
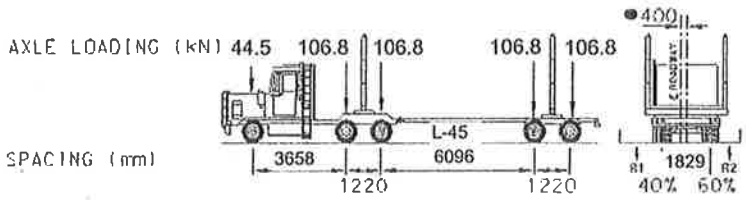
(604) 940-2212 Fax (604) 940-1516

PROJECT KENNEDY RIVER FILE # 11-055
DESIGN _____ CHECK _____
ITEM BRIDGE ELEVATION & SECTION REVISION _____
DATE 28 JULY 2011 PAGE # SK1 OF _____

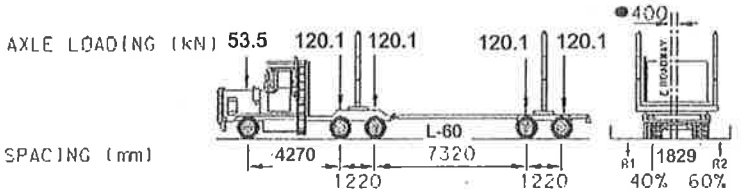


KENNEDY RIVER BRIDGE GLULAM GIRDER ANALYSIS

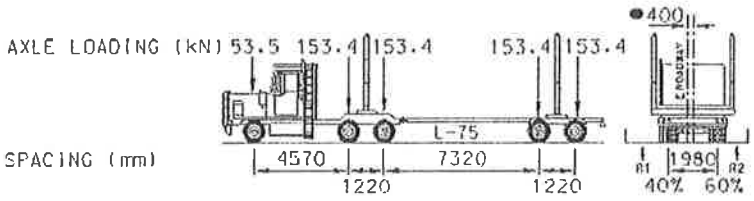
VEHICLE CONFIGURATIONS



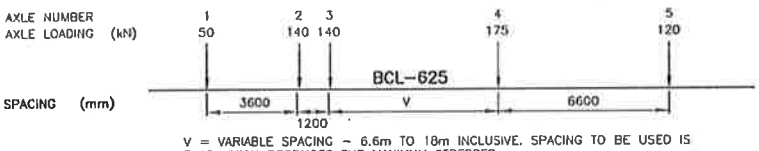
L-45 (OFF HIGHWAY) GVW 40824 kg



L-60 (OFF HIGHWAY) GVW 54430 kg

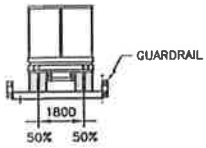


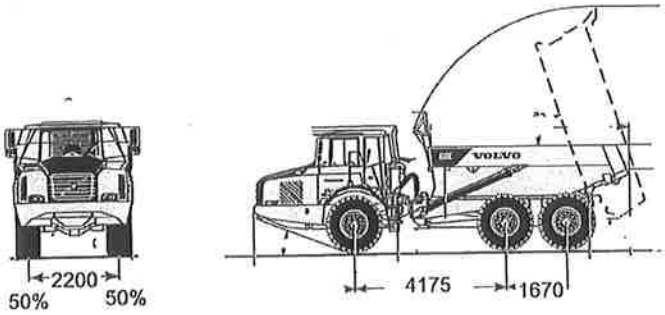
L-75 (OFF HIGHWAY) GVW 68,040 kg



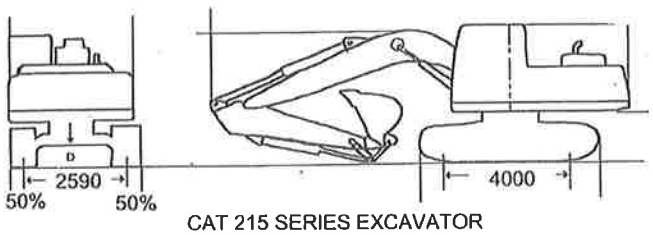
V = VARIABLE SPACING ~ 6.6m TO 18m INCLUSIVE. SPACING TO BE USED IS THAT WHICH PRODUCES THE MAXIMUM STRESSES

BCL-625 DESIGN TRUCK





VOLVO A30E ARTICULATED TRUCK
EMPTY OPERATING WEIGHT 23060 kg



CAT 215 SERIES EXCAVATOR
OPERATING WEIGHT 20140 kg