MINISTRY OF FORESTS

Design Vehicle Configuration Analysis and CSA-S6-00 Implication Evaluation Phase III

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Executive Summary

The Ministry of Forests (BCMoF) had previously commissioned Buckland & Taylor Ltd. to conduct a review of the Forest Service Bridge Design and Construction Manual and CAN/CSA-S6-00 (CHBDC) to determine if the existing BCMoF Design Vehicle Configurations are reasonably representative for the logging vehicles now being used in the British Columbia forest industry and if these configurations are appropriate for use with the load factors in CHBDC. This study indicated that for the current populations of trucks transiting forestry bridges the existing BCMoF Design Vehicle configurations produced rather inconsistent levels of design safety depending on the bridge span. In some cases the present configurations provide unconservative levels of design safety for shorter span bridges. Based on the results of Phase I and Phase II of this study, it was recommended that the existing BCMoF Design Vehicle configurations be modified for use with the design provisions of CHBDC.

The BCMoF extended Buckland & Taylor Ltd.'s original assignment to include the development of new design vehicle configurations that are appropriate for the current populations of logging trucks transiting the forestry bridge system and that are consistent for use with the design provisions of CHBDC.

In Phase III of the study, represented by this report, four types of design truck loadings were developed for use in the design of forestry bridges:

- On-Highway logging trucks, use CL-625 design loading in accordance with CHBDC.
- Off-Highway Interior design vehicle (73,400 kg).
- Off-Highway Light Coastal design vehicle (73,400 kg).
- Off-Highway Heavy Coastal design vehicle (114,200 kg).

The CL-625 design loading in CHBDC is considered to be appropriate for the design of forestry bridges that only carry logging trucks operating in accordance with the highway legal load limits.

The Off-Highway Interior design vehicle is intended to replace the existing L75 and L100 Design Vehicles. It was found that one Off-Highway design vehicle can suffice for both Interior and Light Coastal operations.

The Off Highway Heavy Coastal design vehicle is intended to replace the existing L150 and L165 Design Vehicles.

The proposed design vehicles were developed for the design of forestry bridge girders and it is possible that they are conservative for the design of forestry bridge decks. However, further study of the behaviour and performance of forestry bridge decks would be required to determine if any reduction in the design loadings are permissible.

Lane load models were developed for use with the Off Highway Interior and Off Highway Heavy Coastal design vehicles, to account for situations where more than one truck can be on a bridge.

The new design vehicle configurations being recommended apply only to logging trucks, not to the passage of heavy equipment used in the industry. The recommended design configurations do not provide an allowance for future increases in the weights of logging truck populations.

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1 Introduction

The Ministry of Forests (BCMoF) had previously commissioned Buckland & Taylor Ltd. to conduct a review of the Forest Service Bridge Design and Construction Manual [4] and CAN/CSA-S6-00 (CHBDC) [3] to determine if the existing BCMoF Design Vehicle Configurations are reasonably representative for the logging vehicles now being used in the British Columbia forest industry and if these configurations are appropriate for use with the load factors in CHBDC.

This study was conducted in two phases and the results are presented in reports to BCMoF entitled 'Design Vehicle Configuration Analysis and CSA-S6-00 Implication Evaluation' dated 2003 January 04 [1] and 'Design Vehicle Configuration Analysis and CSA-S6-00 Implication Evaluation Phase II' dated 2003 November 19 [2]. Phase I and Phase II of the study indicated that the existing BCMoF Design Vehicle configurations produced rather inconsistent levels of design safety for various bridge spans, and in some cases potentially unconservative levels of design safety for shorter span bridges. Several techniques for modifying the BCMoF bridge design requirements to provide appropriate and more consistent levels of safety were assessed including: the use of different design live load factors for the design of short or longer span bridges with the existing BCMoF Design Vehicle configurations; modifying the existing BCMoF Design Vehicle configurations to be appropriate for use with CHBDC and the use of a modified CHBDC CL-W type loading for the design of forestry bridges. Based on the results of this assessment, it was recommended that the existing BCMoF Design Vehicle configurations be modified for use with CHBDC.

Following consultation with personnel involved in the design, construction and operation of forestry bridges, the BCMoF has accepted this recommendation. Subsequently, the BCMoF extended Buckland & Taylor Ltd.'s original assignment to include the development of modified BCMoF Design Vehicle configurations that can be used directly with the design provisions of CHBDC.

An initial meeting for Phase III of this study was held at Buckland & Taylor Ltd. on 2004 February 19 including Brian Chow, P.Eng., of the BCMoF, Gary McClelland, P.Eng., of the BCMoF, Darrel Gagnon, P.Eng., of Buckland & Taylor Ltd., Julien Henley, P.Eng., of Associated Engineering and Paul King, P.Eng., of Rapid Span. At this meeting it was concluded that design vehicles appropriate for use with the design provisions of CHBDC were required for the following categories of traffic or operational regions:

- On-highway logging operations conducted throughout the Province (On Highway).

- Off-highway logging operations conducted in the Interior Region (Off Highway Interior).
- Off-highway logging operations conducted in the Coastal Region. (Off Highway Light Coastal and Off Highway Heavy Coastal).

In addition, it was requested that the possibility of developing a CHBDC style lane loading be investigated.

2 Additional Coastal Truck Weight Data

Following completion of the previous phases of this study, concerns were expressed by forestry industry personnel that the maximum surveyed truck weights for the coastal regions appeared to be lower than expected. This was considered to be a potentially serious issue since if unsurveyed populations of heavier trucks existed, the design provisions previously developed would be unconservative for use with these truck populations.

To further investigate the possible existence of heavier coastal truck populations, truck weights from a previously unsurveyed coastal operation, that was believed to be operating some of the heaviest logging trucks, were provided to Buckland & Taylor Ltd. This operation supplied a limited amount of weigh scale data for these trucks. The additional weigh scale data is provided in Appendix A.

A normal distribution was developed from the new weigh scale data and compared to the surveyed distribution of coastal truck weights previously obtained. As shown in Figure 1, the distribution for the additional coastal truck weight data compares closely with the distribution of heavy coastal trucks surveyed in Phase II of this study.

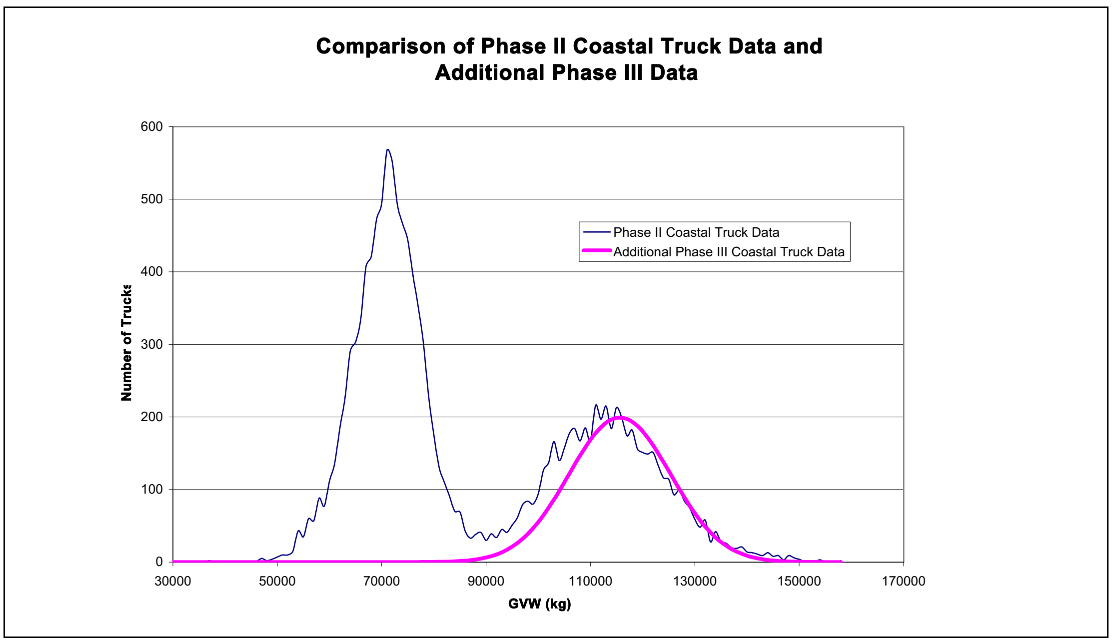

Figure 1: Comparison of Phase II and Phase III Coastal Truck Weight Data

Since the distribution of surveyed truck weights at this additional coastal operation do not differ significantly from the previously surveyed coastal truck weights, it does not represent evidence of a heavier population of trucks.

3 Recommended Design Vehicle Configurations

The design vehicle configurations developed for BCMoF bridges in the following are intended for use with the new bridge design requirements of CAN/CSA-S6-00 (CHBDC). These design vehicle configurations were developed based on the surveyed weights of logging trucks provided for use in this study. The recommended design vehicle configurations do not provide contingencies for possible future increases in the weights of logging trucks. Nor are these design vehicle configurations to be applied to trucks carrying heavy equipment, nor to the passage of the equipment itself (such as bulldozers, yarding equipment, etc.).

3.1 On-Highway Logging Trucks

This category applies to the design of forestry industry bridges on routes that are only intended to carry highway legal logging trucks.

The weights and configurations of logging trucks operating on-highway were surveyed and analyzed during Phase I of this study [1] and appropriate design live load factors were derived. In all cases, the factored design loadings required for the on-highway logging trucks are equivalent to or less than the factored loadings required by CHBDC for the CL-625 design vehicle. Therefore, the CL-625 design loading, applied in accordance with the provisions of CHBDC is suitable for the design of forestry bridges carrying highway legal logging trucks (On-Highway).

3.2 Off-Highway Interior Region

Although the bridge design standards previously and currently used by operators in the Interior Region can vary significantly, the BCMoF requested that a single design vehicle be developed for the design of off highway forestry bridges in the Interior Region. The Off-Highway Interior design vehicle being recommended is intended to provide appropriate bridge designs for all the interior logging truck populations identified in the surveys conducted during previous phases of this study.

During Phase II of this study [2], it was determined that for the existing BCMoF L100 Design Vehicle applied with a dynamic load allowance of 0.30 to properly represent the current population of Interior Region logging trucks, design live load factors of 1.83 and 1.36 were for required short and longer spans, respectively. In order to produce a design vehicle that can be applied with the provisions of CHBDC and be representative of the surveyed population of logging trucks, the axle weights of the L100 Design Vehicle were modified as follows to develop the

Off-Highway Interior design vehicle. The axle spacings and side to side unbalance of axle loadings for the Off-Highway Interior design vehicle remain the same as those specified for the L100 Design Vehicle.

- Step 1 - Increase the weight of the front tandem axle by a ratio of the short span live load factor to the long span live load factor (1.83/1.36 = 1.35) and decrease the weight of the rear tandem axle by an equivalent amount. This transfer of load allows the long span live load factor to be applicable for the design of all span lengths.
- Step 2 - Decrease the weight of the front tandem axle by a ratio of the Forestry Manual dynamic load allowance to the CHBDC dynamic load allowance for a single axle group (1.3/1.4 = 0.93) and increase the weight of the rear tandem axle by an equivalent amount. This accounts for the higher dynamic load allowance required by CHBDC for a single axle group.
- Step 3 - Decrease the weights of all axles by the ratio of the L100 longer span live load factor to the CHBDC design live load factor (1.36/1.7 = 0.80). This produces a design vehicle with loadings appropriate for application with the CHBDC design live load factor of 1.7.
- Step 4 - Round off resulting axle weights to produce the Off-Highway Interior design vehicle.

Table 1 shows the progressive transformation of the L100 Design Vehicle to the Off-Highway Interior design vehicle model through above steps.

Table 1: Development of Off-Highway Interior design vehicle from L100 Design Vehicle

	Steering Axle (kN)	Front Axle of Front Tandem (kN)	Second Axle of Front Tandem (kN)	Front Axle of Rear Tandem (kN)	Second Axle of Rear Tandem (kN)	Gross Vehicle Weight (kg)
L100 Design Vehicle	71.4	204.6	204.6	204.6	204.6	90,680
Step 1	71.4	276.2	276.2	133.3	133.3	90,680
Step 2	71.4	256.5	256.5	153.0	153.0	90,680
Step 3	57.1	205.2	205.2	122.4	122.4	72,544
Step 4 - Off-Highway Interior	**60**	**205**	**205**	**125**	**125**	**73,400 kg (720 kN)**

The Off-Highway Interior design vehicle model, modified as shown in Figure 2, has been developed based on the current weights of logging trucks operating in the Interior Region. If the weights of the truck population operating in this region increase in the future, the Off-Highway Interior design vehicle model will not provide the targeted level of safety.

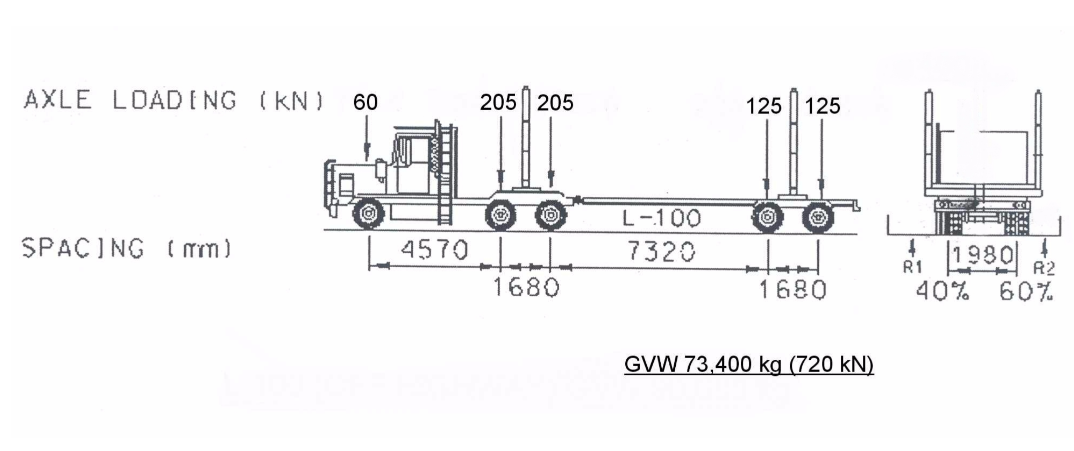

Figure 2: Off-Highway Interior design vehicle configuration.

3.3 Off-Highway Coastal Region

Survey results obtained during Phase II of this study for the Coastal Region indicated that the distribution of off highway logging truck weights was clearly bimodal. Such a result was expected since the truck population was known to consist of heavier wide bunk trucks that only operate off-highway and lighter trucks that could be configured for on-highway operations. Generally, Coastal Region operators were found to be specifying the L165 Design Vehicle configuration for the design of forestry bridges but some operators did specify lower design standards for routes that only carried trucks that could operate on-highway.

The BCMoF required that design vehicles be developed to accommodate the design of bridges for both of these truck populations. The new design vehicle configurations have been designated as Off-Highway Light Coastal and Off-Highway Heavy Coastal.

3.3.1 Off-Highway Light Coastal - Design Vehicle

Surveys conducted during Phase II of this study indicated a significant population of coastal logging trucks with gross vehicle weights between 50 tonnes and 90 tonnes. These trucks are substantially lighter than the wide bunk L150 or L165 truck configurations for which Coastal Region bridges are typically designed. However, a separate design category, Off-Highway Light Coastal, was required for these vehicles since several coastal operators indicated the existence of routes with L100 bridges, that presumably service only the lighter coastal truck configurations.

In general, the weights of the Off-Highway Light Coastal truck population are similar to those of the off highway logging trucks operating in the Interior Region. Although slightly lighter on average compared to the Interior Region truck population, the heaviest trucks from both populations have weights near 90 tonnes. Since no substantial differences were identified between the weights of the truck populations comprising the Off-Highway Light Coastal and Off-Highway Interior design vehicles, it was concluded that the Off-Highway Interior design loading should apply in both regions.

3.3.2 Off-Highway Heavy Coastal - Design Vehicle

The Off-Highway Heavy Coastal design vehicle model is intended to provide appropriate bridge designs for all the coastal logging truck populations identified in the surveys conducted during this and previous phases of this study. This design category includes the heavier wide bunk truck configurations in the coastal population, previously designated as L150 or L165.

During Phase II of this study [2], it was determined that for the existing BCMoF L165 Design Vehicle applied with a dynamic load allowance of 0.30 to properly represent the current population of Interior Region logging trucks, design live load factors of 1.47 and 1.29 were for required short and longer spans, respectively. In order to produce a design vehicle that can be applied with the provisions of CHBDC and be representative of the surveyed population of logging trucks, the axle weights of the L165 Design Vehicle were modified as follows to develop the Off-Highway Heavy Coastal design vehicle. The axle spacings and side to side unbalance of axle loadings for the Off-Highway Heavy Coastal design vehicle remain the same as those specified for the L165 Design Vehicle.

- Step 1 - Increase the weight of the front tandem axle by a ratio of the short span live load factor to the long span live load factor (1.47/1.29 = 1.14) and decrease the weight of the rear tandem axle by an equivalent amount. This transfer of load allows the long span live load factor to be applicable for the design of all span lengths.
- Step 2 - Decrease the weight of the front tandem axle by a ratio of the Forestry Manual dynamic load allowance to the CHBDC dynamic load allowance for a single axle group (1.3/1.4 = 0.93) and increase the weight of the rear tandem axle by an equivalent amount. This accounts for the higher dynamic load allowance required by CHBDC for a single axle group.
- Step 3 - Decrease the weights of all axles by the ratio of the longer span L165 live load factor to the CHBDC design live load factor (1.29/1.7 = 0.76). This produces a design vehicle with loadings appropriate for application with the CHBDC design live load factor of 1.7.
- Step 4 - Round off resulting axle weights to produce the Off-Highway Heavy Coastal design vehicle.

Table 2 shows the progressive transformation of the L165 Design Vehicle to the Off-Highway Heavy Coastal design vehicle through above steps.

Table 2: Development of Off-Highway Heavy Coastal design vehicle from L165 Design Vehicle

	Steering Axle (kN)	Front Axle of Front Tandem (kN)	Second Axle of Front Tandem (kN)	Front Axle of Rear Tandem (kN)	Second Axle of Rear Tandem (kN)	Gross Vehicle Weight (kg)
L165 Design Vehicle	98	396	396	289	289	149,700
Step 1	98	451.4	451.4	233.6	233.6	149,700
Step 2	98	419.8	419.8	265.2	265.2	149,700
Step 3	74.5	319.0	319.0	201.6	201.6	113,772
Step 4 - Off-Highway Heavy Coastal	**80**	**320**	**320**	**200**	**200**	**114,200 kg (1120 kN)**

The Off-Highway Heavy Coastal design vehicle load model, modified as shown in Figure 3, has been developed based on the current weights of logging trucks operating in the Coastal Region. If the weights of the truck population operating in this region increase in the future, the Off-Highway Heavy Coastal design vehicle load model will not provide the targeted level of safety.

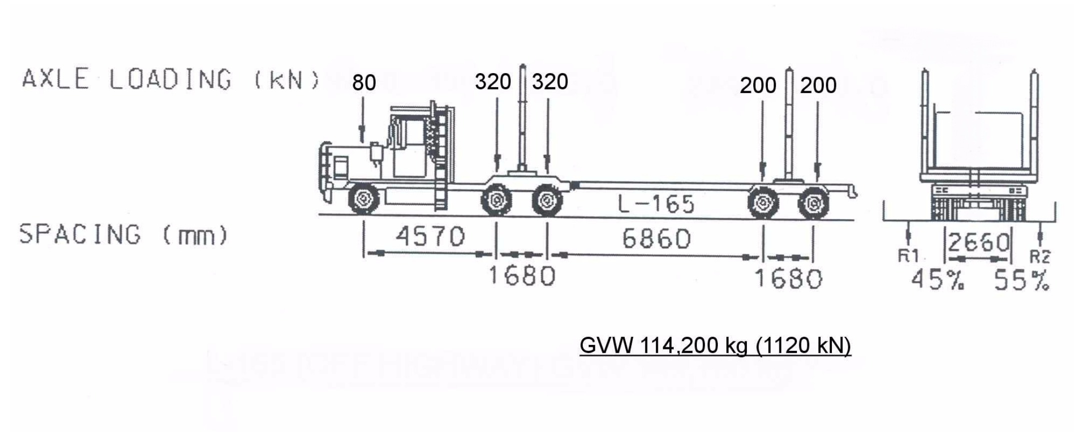

Figure 3: Off-Highway Heavy Coastal design vehicle configuration.

3.4 Placement of Design Vehicle on Bridge

For the design or evaluation of bridge components, the Design Vehicles are to be placed on the bridge deck in accordance with the requirements of CHBDC.

3.5 Implications for the Design of Bridge Decks

The increased maximum wheel or axle loadings being proposed for the new Design Vehicles imply higher design requirements for forestry bridge decks. However, the Design Vehicle axle/wheel loadings were calibrated for the design of bridge girders/stringers and may not be representative of the loadings required for the design of bridge decks. Existing concrete decks on forestry bridges are reported to be performing well, which suggests that an increase in the design loadings for bridge decks may be unwarranted.

Instead of a direct calibration, the CHBDC provisions for the design of highway bridge decks are based on the results of numerous analytical studies, laboratory tests and a history of generally satisfactory performance. Use of a similar approach may be reasonable for determining the appropriate design loading requirements for forestry bridge decks.

4 Design Lane Loading

Longer bridges or bridge spans are more likely to be subject to loadings produced by the presence of multiple trucks. The current Forest Service Bridge Design and Construction Manual attempts to address this issue by requiring that bridges with a total length over 40 m between abutments be designed for the loadings produced by two design vehicles with a distance between them equal to half the vehicle length. Bridges with a total length not exceeding 40 m can be designed for loads produced by a single design vehicle.

This provision results in an abrupt increase in the live load force effects required for design when effective span lengths exceed 40 m. However, in reality, the force effects produced by two trucks on a span should increase gradually with increasing span length.

Participants of this study, involved in the design and construction of forest bridges, indicated that bridges with spans somewhat greater than 40 m were sometimes avoided due to the abrupt increases in girder sizes and corresponding costs. In some cases, this could lead to a shorter than preferred bridge crossing or an increased number of piers being used in a bridge crossing.

Development of a design lane loading, similar to those used in the highway design standards, was desired to provide a more rational and consistent design of bridges that could be subjected to loadings by multiple trucks.

4.1 Development of Design Lane Loadings

The previously developed design vehicle load models and corresponding live load factors are intended to provide an appropriate level of safety for the heaviest single truck loading expected to be annually carried by the bridge. However, most of the annual population of trucks carried by a bridge would be substantially lighter than the heaviest annual truck. This is true for both highway and forestry bridges.

Except in exceptional circumstances, the probability of having two of the heaviest trucks from the annual population on the bridge simultaneously would be very small. Therefore, when multiple trucks are producing the loadings, reduction factors are applied to the design vehicle loadings to provide a suitable combined loading. For two side by side trucks on a heavily travelled highway bridge this reduction factor is typically specified as 0.9.

This reduction factor may be even lower for forestry bridges due to the following:

- The number of trucks annually crossing a forestry bridge is typically much lower than the number of trucks crossing a heavily travelled highway bridge. This results in fewer opportunities for multiple truck events to occur on a bridge. With fewer such events, it is less likely that the event will include two of the heavier trucks.
- Vehicles travelling side by side in adjacent lanes are more likely to be generating dynamic forces (impact) in the bridge that are correlated. The dynamic forces generated in a bridge by vehicles travelling in a single lane are less likely to be correlated since the vehicles are at different locations along the span and would have experienced any abrupt excitations (bumps) at different times.
- The current design provision require that the two design vehicles be applied with a half vehicle length separation, approximately 7.5 m, between the trucks. Although such tight following distances can occur, typically vehicles travelling at normal operating speeds would maintain significantly larger separations. Less separation between vehicles could be expected for slower moving traffic, but slower vehicles generally produce lower dynamic load effects in the bridge.

Based on the above information, a minimum multiple presence reduction factor of 0.8 was considered to be reasonable for two forestry trucks travelling in the same lane.

Therefore, a lane load model needs to produce 80% of the force effects generated by two design vehicles separated by half a design vehicle length. However, the lane load model should not produce abrupt changes in the design force effects for bridge spans around 40 m.

Since most bridge designers are familiar with the CHBDC lane load model, a similar lane load model was developed for the design of forestry bridges. This model consists of a portion of the design vehicle applied with a uniformly distributed loading and the same live load factors as applied to the design vehicle load model. Dynamic load allowances are not applied to any portion of the lane loading.

The force effects produced by various combinations of reduced design vehicles and uniformly applied loading intensities were compared against the force effects produced by single design vehicle with impact and those produced by two design vehicles with impact separated by half a design vehicle length. It was concluded that the lane load model that produced the most suitable force effects over a variety of bridge spans consisted of the design vehicle, with each axle loading reduced to 65% of the full design vehicle axle loading, superimposed within a uniformly distributed load of 2.8% times the original design vehicle weight per metre.

For the Off Highway Interior design vehicle a comparison of the force effects produced on bridges of varying span length for a single design vehicle with impact, two design vehicles separated by half a vehicle length with impact and the lane loading are shown on Figures 4 and 5, for moments and shears respectively.

Figure 4: Comparison of moments generated on varying bridge span lengths by a Single Truck, Two Trucks on spans over 40 m and the proposed lane loading.

The lane load model produces moments and shears that are less than those produced by a single design vehicle for effective bridge spans of less than 35 m. This means that spans less than about 35 m will be governed by the design vehicle and spans longer than about 35 m will be governed by the design lane load, with a smooth transition.

For an effective bridge span of 40 m the lane loading produces force effects that 7% and 6% higher than those produced by a single design vehicle for moment and shear respectively. For spans effectively exceeding 40 m in length the lane load produces force effects that are higher than those for a single design vehicle but less than those produced by two design vehicles. Maximum moments and shears produced by the lane load were at least 0.91 and 0.80, respectively, of the maximum moments and shears produced by the two design vehicles.

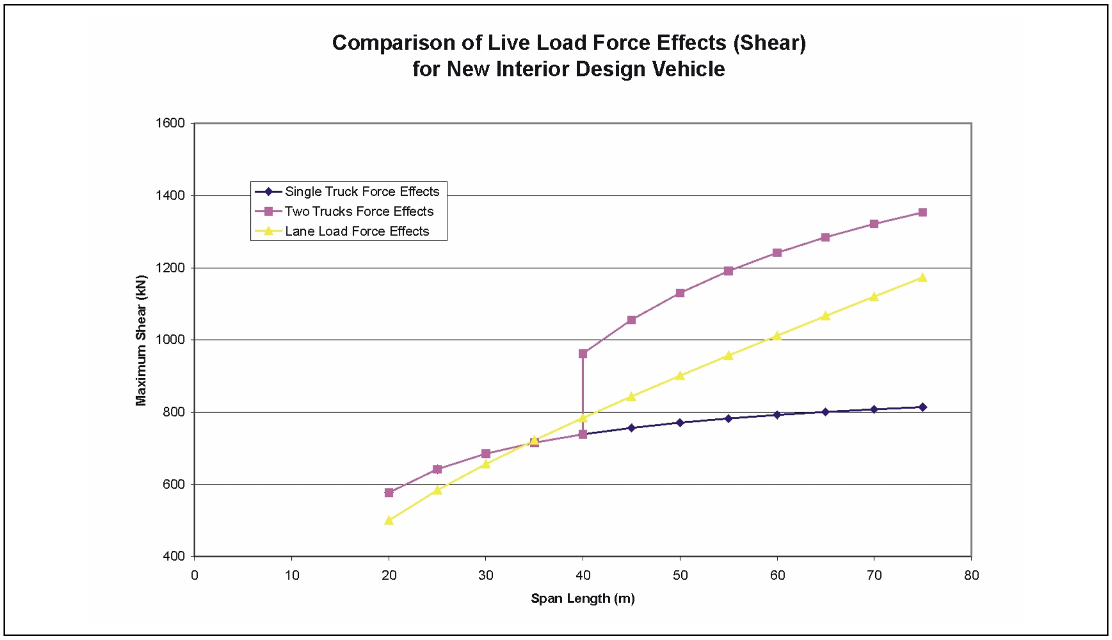

Figure 5: Comparison of shears generated on varying bridge span lengths by a Single Truck, Two Trucks on spans over 40 m and the proposed lane loading.

Very similar results were obtained for the Off Highway Heavy Coastal design vehicle.

4.2 Discussion of Lane Loading

The lane loading model developed for the design of forestry bridges produces force effects that smoothly increase with increasing effective bridge span lengths. This avoids any abrupt increases in the required design forces that may have caused avoidance of bridges with particular span lengths in the past.

For the Off Highway Interior and Off Highway Heavy Coastal design vehicles the truck portions of the loading have total weights of 468 kN and 725 kN, respectively and uniformly applied portions of the lane loadings are 20 kN/m and 31 kN/m, respectively. The truck portion of the lane loading is to be located to maximize the particular force effect being considered. No impact is applied to either component of the lane loading.

These lane loadings do not change the design requirements for bridges with an effective span of less than 35 m. Increases in the required design live loadings of up to 7% occur as the effective span of a bridge increases from 35 m to 40 m. For effective bridge spans in excess of 40 m the lane load reduces the required design forces by up to 9% for moments and 20% for shear forces.

5 Conclusions

The additional truck weight data provided by a previously unsurveyed coastal operation thought to contain heavier trucks is very similar to the previously surveyed coastal truck weight data. Therefore, no evidence has been supplied to date that indicates the existence of logging truck populations that are significantly heavier than those used in this study to develop new design vehicle configurations.

The design provision of CHBDC, including the CL-625 design loading, are appropriate for the design of forestry bridges carrying logging trucks operating under highway legal loading conditions (On-Highway).

The existing L100 Design Vehicle configuration was modified to produce the Off-Highway Interior design vehicle which is appropriate for use with the design provisions of CHBDC for the design of Interior Region forestry bridges. The Off-Highway Interior design vehicle is intended to replace the existing L75 and L100 design vehicles.

The existing L165 Design Vehicle configuration was modified to produce the Off-Highway Heavy Coastal design vehicle which is appropriate for use with the design provisions of CHBDC for the design of Coastal Region forestry bridges. The Off-Highway Heavy Coastal design vehicle is intended to replace the existing L150 and L165 design vehicles.

The Off-Highway Interior design vehicle configuration was also found to appropriately represent the lighter off-highway logging trucks operating in the Coastal Region. Therefore, there is no difference between the Off-Highway Interior design vehicle and the Off-Highway Light Coastal design vehicle.

For design, the proposed design vehicles are to be placed on a structure in accordance with the provisions of CHBDC.

The proposed design vehicles were developed for the design of forestry bridge girders and it is possible that they are conservative for the design of forestry bridge decks. However, further study of the behaviour and performance of forestry bridge decks would be required to determine if any reduction in the design loadings are permissible.

Lane loadings were developed for use with the Off-Highway Interior and Off-Highway Heavy Coastal design vehicles. The lane loadings consist of 65% of the design vehicle applied with a uniform lane loading equal to 2.8% of the unreduced total design vehicle weight. No impact is applied to either component of the lane loading. These lane loading models are intended to replace the two design truck requirement previously applied to bridges over 40 m in length.

The new design vehicle configurations being recommended as a result of this study apply only to logging trucks, not to logging equipment or trucks hauling equipment. The recommended design configurations do not provide an allowance for future increases in the weights of logging trucks.

6 References

[1] Buckland & Taylor Ltd. report to Ministry of Forests, Design Vehicle Configuration Analysis and CSA-S6-00 Implication Evaluation, dated 2003 January 04.

[2] Buckland & Taylor Ltd. report to Ministry of Forests, Design Vehicle Configuration Analysis and CSA-S6-00 Implication Evaluation - Phase II, dated 2003 November 19.

[3] Canadian Standards Association, CAN/CSA-S6-00 Canadian Highway Bridge Design Code. (Canadian Standards Association, Toronto, 2000).

[4] Ministry of Forests, 'Forest Service Bridge Design and Construction Manual', Resource Tenures and Engineering Branch, 1999 July 30.

Appendix A
Additional Coastal Truck Weight Data

BCMoF Design Truck Development
B&T Project Number: 1579
Engineer: DPG
Date last Modified: 2004 May 10

Additional Coastal Logging Truck GVWs (Data received 2004 May 05 in file qcd-99.xls)

Sample Number	GVW (kg)
1	126670
2	118350
3	114450
4	107910
5	126270
6	127430
7	120960
8	111420
9	103830
10	102990
11	122940
12	134800
13	113230
14	103570
15	133200
16	129570
17	122640
18	110570
19	125380
20	97700
21	123920
22	103020
23	110420
24	111610
25	122710
26	119500
27	116650
28	106540
29	99180
30	123340
31	109410
32	109640
33	111310
34	109310
35	116890

Average	115638	kg
Std Dev.	9760	kg
COV	8.44	%
Max	134800	kg
Min	97700	kg