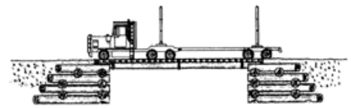
Ministry of Forests and Range

OPERATIONS DIVISION

ENGINEERING

ENGINEERING BULLETIN



Number #1 **September 24, 2009**

Clarification of GVW as Applicable to Bridge Load Rating

Gross Vehicle Weight (GVW) is the total weight of the vehicle including cargo. Load rating for a structure typically involves complex calculations and judgement and then distilling the results down to a simple number (a maximum GVW). Because of the simple communication it is possible for errors in interpretation in what it means. This bulletin is intended to provide clarity for the meaning of Gross Vehicle Weight, as applicable to bridge load rating.

Gross Vehicle Weight (GVW) load ratings for bridge structures are based on a specific logging truck vehicle configuration (specific axle spacing and axle loads). The BCFS L-series design vehicles are not "real" vehicles but are intended to be "envelope" logging truck vehicles which capture the force effects of the population of "normal" logging trucks. Force effects from load configurations consisting of other types of vehicles, such as yarders and excavators, are not typically captured by the design vehicles. Equipment crossings of this nature should be evaluated by a professional engineer on a bridge by bridge basis.

The L-series design configurations were founded on imperial ("short") tons (as opposed to "long" metric tonnes and kilograms). For example, a BCFS L-75 has a GVW of 75 imperial tons which is equal to 68 tonnes or 68,040 kilograms.

There are a number of design vehicle configurations which have been utilized over time. Some of these are no longer used to design new structures. There are, however, existing structures which were designed using these configurations that are still in service. Primary examples include the BCFS L-45 and BCFS L-60.

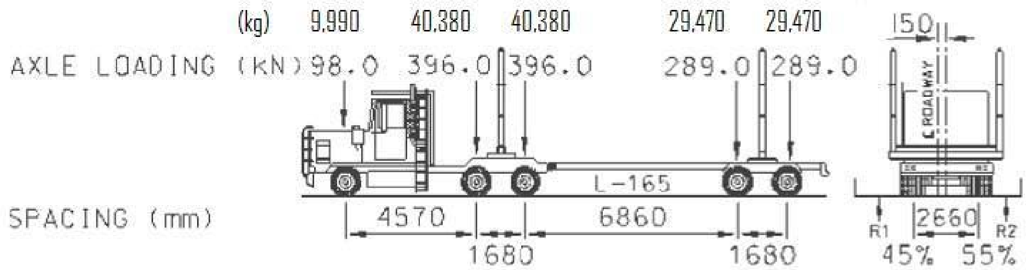
The CL 625 and BCL 625 highway vehicle design configurations are exceptions to typical logging truck configurations. These configurations are drawn from the Canadian Highway Bridge Design Code (CSA S6) and BC Ministry of Transportation and Infrastructure. These highway vehicle configurations were adopted by the Ministry of Forests and Range in order to be consistent with MoT design configurations for highway loads.

The following table provides a comparison of different design vehicle GVW force values for short (English) tons, kilonewtons, kilograms and long (metric) tonnes.

Design Vehicle Configuration	Gross Vehicle Weight			
	Tons (Imperial)	Kilonewtons (KN)	Kilograms (Kg)	Tonnes (metric)
BCFS				
L-45	45	408.2	40,820	41
L-60	60	533.8	54,430	54
L-75	75	667.2	68,040	68
L-100	100	889.6	90,680	91
L-150	150	1334.6	136,090	136
L-165	165	1468	149,700	150
CSA-S6 Canadian Highway Bridge Design Code				
CL-625	70	625	63,732	64
Ministry of Transportation – modified from CSA-S6				
BCL-625	70	625	63,732	64

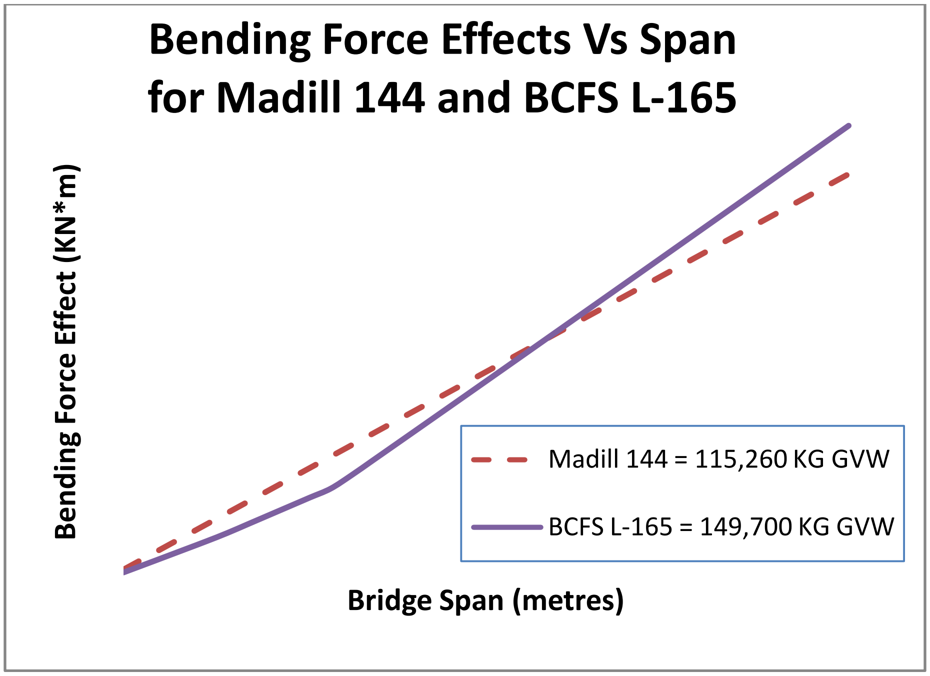
A bridge structure that is load rated to a specified GVW does not mean that the structure can safely pass any vehicle with a weight equal to or lesser than the GVW. The design vehicles on which the GVWs are based have their load distributed over a number of axles over the length of the vehicle. A bridge that is shorter than the design vehicle would not have all of the axles of the vehicle on the bridge simultaneously and thus the full vehicle GVW would not be on the bridge. The bridge is not designed for a concentrated load of the total vehicle GVW but for the worst case vehicle axle loading possible for the bridge length - this could be an axle group (eg. tandem, tridem), axle groups or even a single axle.

Example Design Vehicle Loading Diagram - BCFS L-165 (GVW 149,700 KGs)

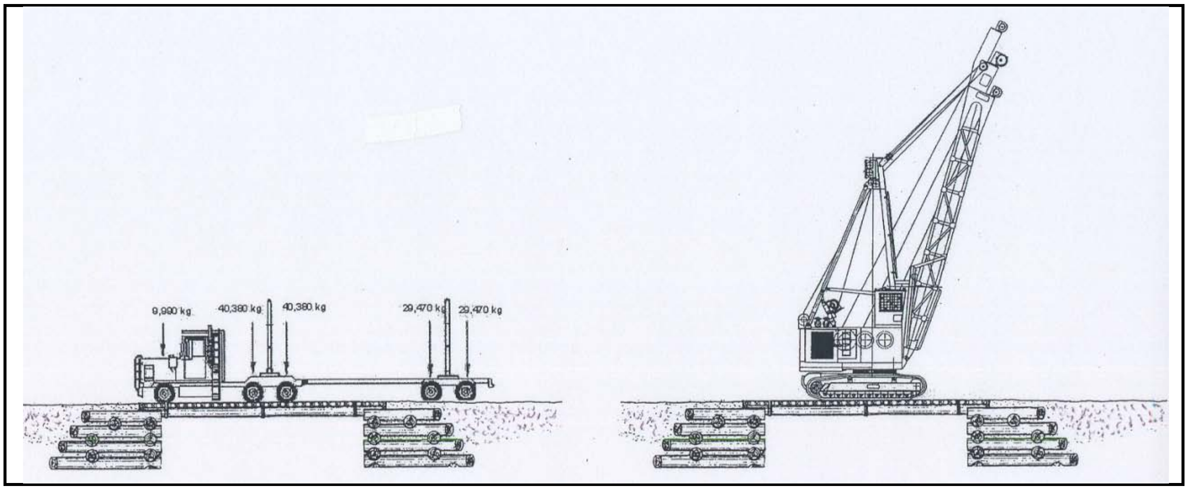


FORCE EFFECTS OF DESIGN VEHICLES VERSUS CONCENTRATED EQUIPMENT LOADS

The following graph of bending force effects verses bridge span is provided for illustrative purposes only and is <u>not to be used to interpret allowable loads</u> for application to any actual structure.



The graph shows the bending force effects arising for a 144 Madill yarder with a GVW of 115, 260 kilograms as compared to a BCFS L-165 logging truck configuration with a GVW of 149,700 kilograms. Although the yarder has a significantly lower GVW, the resulting bending force effects are significantly greater than that of the heavier L-165 logging truck for shorter span bridges. This result is due to the concentration of the weight of the yarder over a shorter length. In contrast, the logging truck does not have all of its axles on the shorter span bridges. As the bridge length increases, more truck axles come into play on the bridge, resulting in the bending force effects of the logging truck surpassing those of the yarder.



The graphic above shows a 10 metre span bridge with an L-165 truck on the left and a 144 Madill Yarder on the right. The vehicles are positioned where the maximum bending force effect would occur on the bridge. As you can see, the truck only has the front three axles (with a combined weight of 90,680 kilograms) on the bridge, whereas the full yarder (GVW 115,620 kilograms) is on the bridge at its centre. The yarder generates a force effect of 2,168 KN*m while the truck only generates 1,670 KN*m. The yarder bending force effect is 130% of the logging truck. A 10 metre bridge designed for L-165 loading would not have adequate capacity for a Madill 144 yarder.

ROAD NETWORK DESIGN VEHICLE LOAD RATING

Typically, road networks have a specified design vehicle load configuration identified. All bridge structures would be designed for the specified design vehicle load. There have been incidents where a bridge with a lower design load has been installed at the beginning of the road network. This can effectively result in the lower design load restricting access on the full road network.

The design vehicle load configuration for Forest Service Roads would ideally be posted at the commencement and other entrances to the road. Only bridges which were not capable of meeting that design vehicle load would be posted with a sign specifying an allowable safe GVW which has been determined by a Professional Engineer. New guidance is being developed for road signage and will be available in the foreseeable future.

SAFE VEHICLE PASSAGE

Any concerns for safe capacity of bridge structures should be brought to the attention of a professional engineer. Where it is uncertain whether a particular vehicle can safely cross a bridge, a professional engineer should be consulted to assess the structure for the specific vehicle. For any structure that has been down rated, professional engineering advice is critical to avoid errors in interpretation. Failure to assess the carrying capacity of a bridge can have disastrous results as exemplified in the picture below.

Further Information

If there are any questions about the content of this bulletin, please contact:

Brian Chow	Chief Engineer	(250) 387-8615	Brian.Chow@gov.bc.ca
Mike Penner	Bridge Engineer	(250) 387-6566	Mike.Penner@gov.bc.ca

Ministry Bridge Engineers

Southern Group

Drew Alway	Reg. Bridge Engineer	(604) 702-5799	Drew.Alway@gov.bc.ca
Paul Blueschke	Engineer	(250) 828-4565	Paul.Blueschke@gov.bc.ca
Gary McClelland	Reg. Bridge Engineer, Kamloops	(250) 371-3709	Gary.McClelland@gov.bc.ca
Jeff Townsend	Reg. Bridge Engineer, Nelson Centre	(250) 365-8631	Jeff.Townsend@gov.bc.ca
Barry Trenholm	Field Eng, Geotechnical, Williams Lake Centre	(250) 398-4794	Barry.Trenholm@gov.bc.ca

Northern Group

Howard Debeck	Road Engineer	(250) 847-6397	Howard.DeBeck@gov.bc.ca
Ray Getzlaf	Reg. Bridge Engineer	(250) 565-7089	Ray.Getzlaf@gov.bc.ca

Coastal Group

Greg Dohm	Reg. Bridge Engineer	(250) 751-3144	Greg.Dohm@gov.bc.ca
Gino Fournier	Field Engineer	(250) 751-7185	Gino.Fournier@gov.bc.ca
Richard Mills	Reg. Field Engineer	(250) 751-7170	Richard.Mills@gov.bc.ca
Ljubomir Stevanovic	Reg. Bridge Engineer	(250) 751-3140	Ljubomir.Stevanovic@gov.bc.ca