Master thesis

Effect of simultaneous vehicle crossings on the North American fatigue correction factors

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Waterloo, 06/22/2012

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1. INTRODUCTION

The fatigue phenomena are part of the not well-understood phenomena in civil engineering. The fatigue phenomena are getting more and more popular in the research programs in civil engineering, given the fact that this is one of the most common cause of failure in the structures of any kind which have to withstand some dynamic loads, like bridges. Many research projects are leading to a better understanding of the fatigue phenomena. Most of them have studied the determination of the strength of different specimens of different sizes, configurations, and materials. Many researches talk about the influence of variable amplitude stress ranges during the same fatigue test. The research topics mainly study the fatigue strength definition, in order to increase the accuracy of the S-N curves, among others. Yet, a few works have tried to find a more proper way to define the stress acting on a civil engineering structure as a bridge. The main way to compute a fatigue stress (as it is done in the most of design codes) is to compute a stress range due to the passage of a fatigue truck load model and then to multiply this stress range by a fatigue correction factor in order to get a stress range which we can compare to a fatigue strength range. The definition of the fatigue truck load model varies from a design code to another, as well as the definition of the fatigue correction factor.

The purpose of this master thesis is to study the effect of simultaneous vehicle crossings on the fatigue correction factors. Indeed, most of the previous studies on the fatigue correction factors have considered a traffic with one-by-one vehicle crossing traffic configurations. Another point is that the North American codes do not have a factor like λ_4 (SIA code) to take into account the effect of the multiple presence of trucks on a structure.

A traffic simulation software developed at EPFL (WinQSIM) will be used in the framework of this master thesis. This traffic simulation software is able to simulate a traffic with the same characteristics of gross weight and geometry as a real traffic data. It is also possible to simulate simultaneous vehicle crossings traffic. Another software (FDA Bridge) developed by Nariman Maddah (PhD student at the Steel Structures Laboratory (ICOM) at EPFL) will be used to compute the fatigue correction factors.

The first step of this work was done in the pre-study of this master thesis. A summary about the fatigue phenomena and the different available fatigue design ways are described in this document. A mode of operation for the two different software is available as well. This pre-study is considered as a full part of this master thesis, but for evident reasons of convenience, it has not been considered necessary to sum up this work.

This master thesis will be divided into 3 different parts. The first one deals with the presentation of the three different codes (SIA, AASHTO, CAN/CSA-S6-06). The second part of this work is the presentation, treatment and analysis of the traffic database. Then, the different parameters of the simulations are presented and the hypothesis and choices about the performed and not-performed cases are discussed.

Finally, the different phenomena concerning the evolution of the fatigue correction factor with the effect of simultaneous vehicle crossing are analyzed and explained. In the last part of this master thesis, the results and conclusions are presented. Also, the future prospects concerning this research area are emphasized.

2. FATIGUE DESIGN CODES

In this first chapter, the different codes considered in this work will be presented. First of all, a review of the fatigue design code of the SIA (Swiss code) will be presented. Then, as the American and Canadian codes are very similar for the fatigue design, they will be presented together. Afterwards, a comparison between the codes will be performed, and the main differences emphasized. Finally, the conversion formula which was used to get a North American fatigue correction factor from an SIA fatigue correction factor value will be presented.

It is obvious that this chapter is mainly inspired by the different codes themselves. The main documents used are the three codes previously cited, i.e. the SIA code (SIA 260, 261, 263), the Eurocode 3, part 1-9:Fatigue EN 1993-1-9:2005 and also EN 1991-2, the AASHTO code section 3 and 6 and the Canadian Highway Bridge Design Code. The method used by the SIA code for the fatigue check is presented first.

2.1.Fatigue safety check by SIA

The presentation of the safety check for fatigue by the SIA code has already been presented in the pre-study of this work (Fischer 2012). As previously said, the pre-study has to be considered as a part of this work and is assumed like this. That is why only a summary will be done in this sub-chapter and the most important aspects will be emphasized. Please refer to the section 3.4 of Fischer (2012) for more details.

The concept on which is based the safety check for fatigue by the SIA is summarized in the figure below:

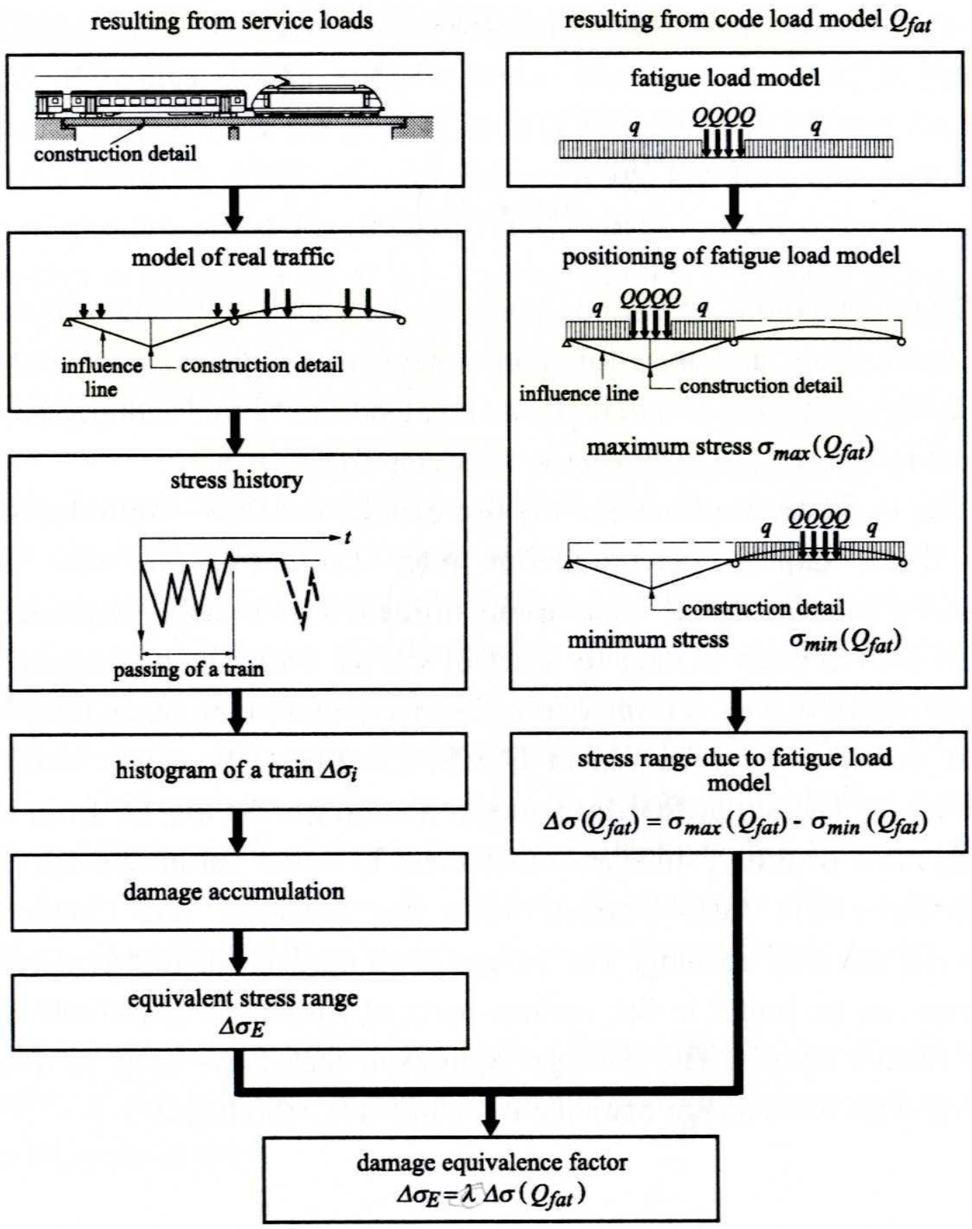


Figure 1: Damage equivalent factor by SIA (Hirt et al, 2006)

This figure shows the two different methods of doing a fatigue safety check. Indeed, the fatigue check of a given structural detail is given by the following formula:

$$\Delta\sigma_{E2} \leq \frac{\Delta\sigma_c}{\gamma_{Mf}}$$

Where

$\Delta\sigma_{E2}$	equivalent stress range, for 2 millions of cycles
$\Delta\sigma_c$	fatigue strength for the selected detail for 2 millions of cycles
γ_{Mf}	strength factor which takes into account the possibilities of watching a possible fatigue crack and the amount of damage this fatigue crack would cause (table 10, SIA 263).

$\Delta\sigma_{E2}$ represents the equivalent stress range, for 2 millions of cycles. This stress range can then be compared to the fatigue strength of the selected detail, which is defined for 2 millions of cycles as well.

The conversion of the equivalent stress range (over the whole service life of the structure) $\Delta\sigma_E$ to the equivalent stress range for 2 millions of cycles is presented below:

$$\Delta\sigma_{Ed2} = \Delta\sigma_{Ed}\left(\frac{N_{tot}}{2 * 10^6}\right)^{1/m}$$

The equivalent stress range can be computed by using the stress history over the bridge service life, or it can be calculated by using the concept of the fatigue correction factor.

The calculation of the equivalent stress range by using the stress history and calculating the damage accumulation is schematically represented on the left side of figure 1.

The following formula is then used to calculate the equivalent stress range by using the stress range histogram:

$$\Delta\sigma_E = \left(\sum_{i=1}^{k}\Delta\sigma_i^m\frac{n_i}{N_i}\right)^{1/m} = \left(\frac{1}{N_{tot}}\sum_{i=1}^{k}\Delta\sigma_i^m n_i\right)^{1/m}$$

Where

$\Delta\sigma_i$	stress range i of the stress histogram
n_i	number of cycles at an intensity of $\Delta\sigma_i$
N_i	number of cycles to failure, under an applied stress range equal to $\Delta\sigma_i$
m	slope of the S-N curve

Another method to calculate the equivalent stress range is to use the concept of the fatigue correction factor. It consists in calculating the highest stress range due to the passage of a fatigue truck model over a bridge (Q_{fat} load). This worst case is found by putting the fatigue truck model on the extreme values of the influence line. Then, the stress range due to the fatigue truck model is calculated by using the following formula:

$$\Delta\sigma(Q_{fat}) = \left|\sigma_{max}(Q_{fat}) - \sigma_{min}(Q_{fat})\right|$$

The equivalent stress range $\Delta\sigma_{E2}$ is then calculated by using the fatigue correction factor λ:

$$\Delta\sigma_{E2} = \lambda\Delta\sigma(Q_{fat})$$

Where

λ	global damage equivalent factor
Q_{fat}	characteristic value of the load model for fatigue given by the SIA 261 code

The fatigue correction factor concept was developed in order to avoid the tedious work of the damage accumulation computation.
The damage equivalent factor λ, as it is defined in the SIA code, depends on many parameters of the traffic and bridge characteristics. This is why the global factor λ is split into 4 different partial factors in order to allow for all the parameters to be accounted. The expression for λ is given in the equation below:

$$\lambda = \lambda_1 \lambda_2 \lambda_3 \lambda_4$$

$$\lambda \leq \lambda_{max}$$

Where

λ_1	factor accounting for the span length, function of the structure type
λ_2	factor accounting for the traffic volume
λ_3	factor accounting for the design work life of the structure
λ_4	factor accounting for the influence of more than one load on the structural member
λ_{max}	maximum damage equivalent factor value, taking into account the fatigue limit.

The explanation of the partial fatigue correction factors has been already done in the pre-study report, section 3.5 (Fischer 2012).

The fatigue correction factor cannot be higher than λ_{max}. Indeed, as it is explained in ECSS (2011), the limiting maximum damage equivalent factor is dictated by the fact that the multiplication of the individual partial factor may result in a value far exceeding the one obtained from a design using the fatigue limit.

As the fatigue safety check of the SIA code is based on the fatigue check of the Eurocode, the two versions are almost identical. Actually, the principle of verification is exactly the same. The main difference between the two codes concerns the definition of the critical influence line length. Thus, the definition of $\lambda_1$is also slightly different. Nevertheless, as it is not a critical point for the followings steps of this work, no more details about these small differences will be given in this section. For more information about this aspect, ECSS (2011) gives more details for the comparison between the SIA code and the Eurocode concerning the fatigue safety check. A summary of the comparison between the SIA code and the Eurocode can be found in Fischer (2012).

The fatigue safety check as it appears in the AASHTO code (American) and in the Canadian code is presented in details in the next section. Then, the main differences between the SIA code and the North American codes will be emphasized.

2.2. Fatigue safety check by the North American codes (AASHTO code and Canadian code)

In this section, the fatigue check procedure defined in the American design code (AASHTO code) and in the Canadian design code (CAN/CSA-S6-06) is presented. Afterwards, the fatigue correction factor procedure is developed, mainly based on Coughlin et al. (2011).

2.2.1. Fatigue safety check by the AASHTO code

In this sub-chapter, the fatigue design given by the AASHTO code used through the United States of America is reported. The most important articles of the code are copied in the following sections. The reference chapters of the AASHTO code are the section 6 (steel structures) and section 3 (loads and load factors).

The fatigue safety verification is given by the article 6.6.1.2.2 of the AASHTO code:

6.6.1.2.2 Design Criteria:

For load-induced fatigue considerations, each detail shall satisfy:

$$\gamma(\Delta f) \leq (\Delta F)_n$$

Where:

γ = load factor specified in Table 3.4.1-1 for the fatigue load combination
= 0.75

(Δf) = force effect, live load stress range due to the passage of the fatigue load as specified in Article 3.6.1.4 (ksi)

$(\Delta F)_n$ = nominal fatigue resistance as specified in Article 6.6.1.2.5 (ksi)

Thus, the design criteria equation is:

$$0.75\ (\Delta f) \leq (\Delta F)_n$$

As in every safety check in civil engineering, the stress is compared to the strength and the inequation has to be verified. Nevertheless, there are several methods to compute a fatigue safety check and the method used in the USA is slightly different from the one used in Switzerland (SIA code).

The main difference between the SIA code and the AASHTO code for the fatigue safety check concerns the load factor, or fatigue correction factor. Indeed, the fatigue correction factor defined in the SIA code, as seen previously, is divided in multiple factors. In the AASHTO code, the fatigue correction factor is defined by one single value only (0.75), as it can be seen in Table 3.4.1-1. A copy of this table is given in the figure below:

Load Combination Limit State	DC DD DW EH EV ES EL PS CR SH	LL IM CE BR PL LS	WA	WS	WL	FR	TU	TG	SE	Use One of These at a Time			
										EQ	IC	CT	CV
STRENGTH I (unless noted)	γ_p	1.75	1.00	—	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—
STRENGTH II	γ_p	1.35	1.00	—	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—
STRENGTH III	γ_p	—	1.00	1.40	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—
STRENGTH IV	γ_p	—	1.00	—	—	1.00	0.50/1.20	—	—	—	—	—	—
STRENGTH V	γ_p	1.35	1.00	0.40	1.0	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—
EXTREME EVENT I	γ_p	γEQ	1.00	—	—	1.00	—	—	—	1.00	—	—	—
EXTREME EVENT II	γ_p	0.50	1.00	—	—	1.00	—	—	—	—	1.00	1.00	1.00
SERVICE I	1.00	1.00	1.00	0.30	1.0	1.00	1.00/1.20	γ_{TG}	γ_{SE}	—	—	—	—
SERVICE II	1.00	1.30	1.00	—	—	1.00	1.00/1.20	—	—	—	—	—	—
SERVICE III	1.00	0.80	1.00	—	—	1.00	1.00/1.20	γ_{TG}	γ_{SE}	—	—	—	—
SERVICE IV	1.00	—	1.00	0.70	—	1.00	1.00/1.20	—	1.0	—	—	—	—
FATIGUE— *LL, IM & CE* ONLY	—	0.75	—	—	—	—	—	—	—	—	—	—	—

Tableau 1: table 3.4.1-1 Load Combinations and Load Factors

The force effect, as it is defined in article 6.6.1.2.2, corresponds to the live load stress range due to the passage of the fatigue load as specified in article 3.6.1.4.

Indeed, the article 3.6.1.4 defines the fatigue load, including the definition of the fatigue truck model and the amount of traffic which has to be considered.

Here is the reproduction of the article 3.6.1.4.1:

> **3.6.1.4.1 Magnitude and Configuration**
>
> The fatigue load shall be one design truck or axles thereof specified in Article 3.6.1.2.2, but with a constant spacing of 30.0 ft. between the 32.0-kip axles.
>
> The dynamic load allowance specified in article 3.6.2 shall be applied to the fatigue load.

The characteristics of the design truck (loads and exact spacings between axles) are reproduced in figure 2.

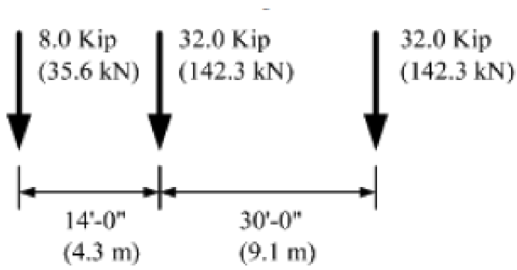


Figure 2: configuration of the AASHTO truck model (Caughlin et al., 2011)

The frequency of the fatigue truck model load is defined in the article 3.6.1.4.2. Indeed, the fatigue check is not computed at 2 millions of cycles like in the SIA code. The fatigue check is computed considering the exact (or expected) number of cycles over the service life of the bridge. This point will be emphasized, explained and discussed later in this work.

The article 3.6.1.4.2 of the AASHTO code defines the number of trucks of the fatigue model which has to be considered.

3.6.1.4.2 Frequency

The frequency of the fatigue load shall be taken as the single-lane average daily truck traffic ($ASTT_{SL}$). This frequency shall be applied to all components of the bridge, even to those located under lanes that carry a lesser number of trucks.

In the absence of better information, the single-lane average daily truck traffic shall be taken as:

$$ADTT_{SL} = p * ADTT$$

Where:

$ADTT$ = the number of trucks per day in one direction averaged over the design life

$ADTT_{SL}$ = the number of trucks per day in a single-lane averaged over the design life

p = taken as specified in Table 3.6.1.4.2-1

Number of Lanes Available to Trucks	p
1	1.00
2	0.85
3 or more	0.80

Tableau 2: table 3.6.1.4.2-1 Fraction of Truck Traffic in a Single Lane, p

Some additional specifications about the frequency are given in the article C3.6.1.4.2:

> Since the fatigue and fracture limit state is defined in terms of accumulated stress-range cycles, specification of load alone is not adequate. Load should be specified along with the frequency of load occurrence.
>
> For the purpose of this article, a truck is defined as any vehicle with more than either two axles or four wheels.
>
> The single-lane ASTT is that for the traffic lane in which the majority of the truck traffic crosses the bridge. On a typical bridge with no nearby entrance/exit ramps, the shoulder lane carries most of the truck traffic.
>
> Since future traffic patterns on the bridge are uncertain, the frequency of the fatigue load of a single lane is assumed to apply to all lanes.
>
> Research has shown that the average daily traffic (ADT), including all vehicles, i.e., cars and trucks, is physically limited to about 20,000 vehicles per lane per day under normal conditions. This limiting value of traffic should be considered when estimating the ADTT. The ADTT can be determined by multiplying the ADT by the fraction of trucks in the traffic. In lieu of site-specific fraction of truck traffic data, the values of table may be applied for routine bridges.

Class of Highway	Fraction of Trucks in Traffic
Rural Interstate	0.20
Urban Interstate	0.15
Other Rural	0.15
Other Urban	0.10

Tableau 3: table C3.6.1.4.2-1 Fraction of Trucks in Traffic (AASHTO code)

Moreover, as it is specified in article 3.6.1.4.1, a dynamic load allowance factor (IM) has to be applied to the fatigue truck model load in order to take into account the dynamic effects. The definition of the dynamic load allowance as defined in the AASHTO code is even simpler than the definition of the dynamic factor which is considered in the SIA code. Indeed, the dynamic load allowance factor is defined by a single fixed value.

Here is a part of article 3.6.2 of the AASHTO code talking about the definition of the dynamic load allowance:

> The factor to be applied to the static load shall be taken as: $(1 + IM/100)$.
>
> The dynamic load allowance shall not be applied to pedestrian loads or to the design lane load.

Component	IM
Deck Joints—All Limit States	75%
All Other Components • Fatigue and Fracture Limit State • All Other Limit States	 15% 33%

Tableau 4: table 3.6.2.1-1 Dynamic Load Allowance

Nevertheless, no dynamic load allowance factors will be applied in the computations of the fatigue correction factors. Indeed, if the same DLA is assumed in both real traffic and code truck damage calculations (as it will be done and presented in the next steps of this work), the choice for the DLA has no influence on the results of the calculation (Caughlin et al. 2011).

The fatigue resistance equation can be found in the article 6.6.1.2.5 of the AASHTO code:

Except as specified below, nominal fatigue resistance shall be taken as:

$$(\Delta F)_n = \left(\frac{A}{N}\right)^{\frac{1}{3}} \geq \frac{1}{2}(\Delta F)_{TH}$$

In which:

$$N = (365)(75)n(ADTT)_{SL}$$

Where:

A = constant taken from Table 6.6.1.2.5-1 (ksi^3)

n = number of stress range cycles per truck passage taken from table 6.6.1.2.5-2

$(ADTT)_{SL}$ = single-lane ADTT as specified in article 3.6.1.4

$(\Delta F)_{TH}$ = constant-amplitude fatigue threshold taken from table 6.6.1.2.5-3 (ksi)

DETAIL CATEGORY	CONSTANT, A TIMES 10^8 (ksi^3)
A	250.0
B	120.0
B'	61.0
C	44.0
C'	44.0
D	22.0
E	11.0
E'	3.9
M 164 (A 325) Bolts in Axial Tension	17.1
M 253 (A 490) Bolts in Axial Tension	31.5

Tableau 5: table 6.6.1.2.5-1 Detail Category Constant, A

Longitudinal Members	Span Length	
	> 40.0 ft.	≤40.0 ft.
Simple Span Girders	1.0	2.0
Continuous Girders		
1) near interior support	1.5	2.0
2) elsewhere	1.0	2.0
Cantilever Girders	5.0	
Trusses	1.0	
Transverse Members	Spacing	
	> 20.0 ft.	≤20.0 ft.
	1.0	2.0

Tableau 6: table 6.6.1.2.5-2 Cycles per Truck Passage, n

Detail Category	Threshold (ksi)
A	24.0
B	16.0
B′	12.0
C	10.0
C′	12.0
D	7.0
E	4.5
E′	2.6
M 164 (A 325) Bolts in Axial Tension	31.0
M 253 (A 490) Bolts in Axial Tension	38.0

Tableau 7: table 6.6.1.2.5-3 Constant-Amplitude Fatigue Thresholds

The detail category concept of the AASHTO code is very similar to the one of the SIA code.

2.2.2. Fatigue safety check by the Canadian code

The fatigue safety check by the Canadian code is very similar to the AASHTO code. The chapter of the Canadian code (CAN/CSA-S6-06) which deals with the fatigue safety check is the chapter 10.17: “Structural fatigue”.

The design criteria in the Canadian code is given by the article 10.17.2.2:

> For load-induced fatigue, except in bridge decks, each detail shall satisfy the requirements that
>
> $$0.52 f_{sr} < F_{sr}$$
>
> Where
>
> f_{sr} = calculated fatigue stress range at the detail due to passage of a tandem set of 125kN axles spaced 1.2m apart and with a transverse wheel spacing of 1.8m.

For the fatigue safety check in bridge decks, the fatigue correction factor is modified, as it can be noticed in the article 10.17.2.2 as well:

> For load-induced fatigue in bridge decks, each detail shall satisfy the requirement that:
>
> $$0.62 f_{sr} < F_{sr}$$

f_{sr} corresponds to the stress range, or bending moment range, due to the passage of the fatigue truck model over the bridge. The principle of calculation is the same as the principle presented in the SIA code section. The truck model is placed on the two extreme and worse positions along the bridge and the stress (or bending moment) range is then calculated.

The fatigue truck model as defined in the Canadian code, section 3.8.3.2 is represented in the figure below:

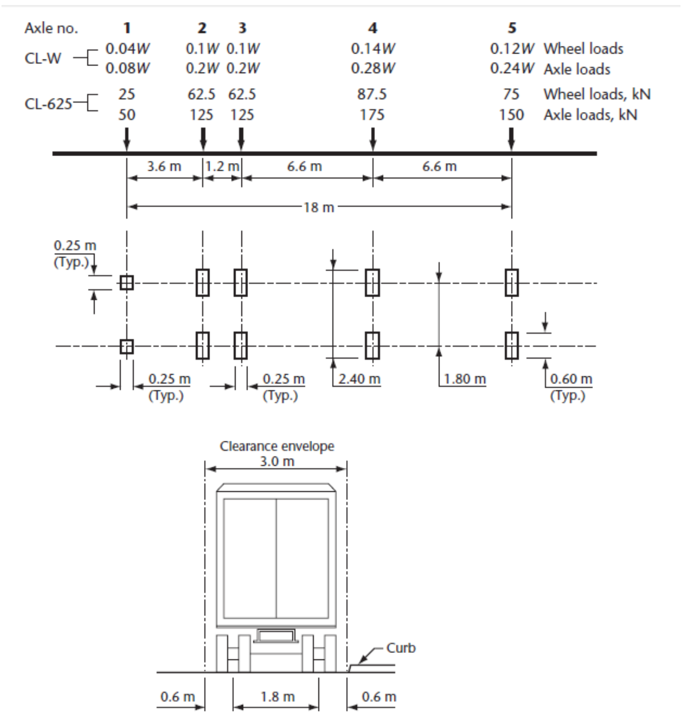


Figure 3: configuration of the Canadian truck model (CL-W Truck) (CAN/CSA-S6-06)

The schematic drawing of the fatigue truck model loads can be found in Coughlin et al. (2011):

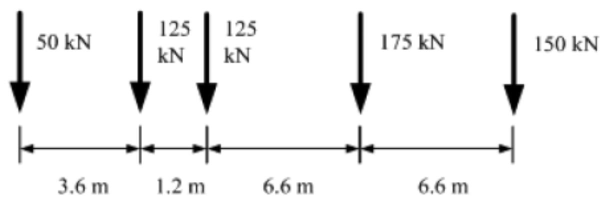


Figure 4: axles loads of the Canadian truck model (Caughlin et al., 2011)

Like in the fatigue safety check by the AASHTO code, the fatigue check as defined in the Canadian code is not computed at 2 millions of cycles like in the SIA code. The fatigue check is computed considering the exact (or expected) number of cycles over the service life of the bridge.

The fatigue stress range resistance is defined in article 10.17.2.3 of the Canadian code:

> The fatigue stress range resistance of a member or a detail, F_{sr}, other than for shear studs or cables, shall be calculated as follows:
>
> $$F_{sr} = \left({}^{\gamma}/_{N_c}\right)^{1/3} \geq F_{srt}/2$$
>
> Where
>
> γ = fatigue life constant pertaining to the detail category established in accordance with Clause 10.17.2.4 and specified in Table 10.4
>
> N_c = $365yN_d\left(ADTT_f\right)$
>
> Where
>
> y = design life (equal to 75 years unless otherwise specified by the Owner or Engineer)
>
> N_d = number of design stress cycles experienced for each passage of the design truck, as specified in Table 10.5
>
> $ADTT_f$ = single-lane average daily truck traffic, as obtained from site-specific traffic forecasts. In lieu of such data, ADTT, shall be estimated as $p(ADTT)$, where p is 1.0, 0.85, or 0.80 for the cases of one, two, or three or more lanes available to trucks, respectively, and ADTT is as specified in Table 10.6.

The constant amplitude threshold stress range can be found in the following table:

Detail category	Fatigue life constant, γ	Constant amplitude threshold stress range, F_{srt}, MPa
A	8190×10^9	165
B	3930×10^9	110
B1	2000×10^9	83
C	1440×10^9	69
C1	1440×10^9	83
D	721×10^9	48
E	361×10^9	31
E1	128×10^9	18
M164	561×10^9	214
M253	1030×10^9	262

Tableau 8: fatigue life constants and constant amplitude threshold stress range (CAN/CSA-S6-06)

Longitudinal members	Span length, L, $\geq$ 12 m	Span length, L, < 12 m
Simple-span girders	1.0	2.0
Continuous girders		
Near interior support (within 0.1L on either side)	1.5	2.0
All other locations	1.0	2.0
Cantilever girders	5.0	5.0
Trusses	1.0	1.0
Transverse members	**Spacing $\geq$ 6 m**	**Spacing < 6 m**
All cases	1	2

Tableau 9:number of design stress cycles experienced for each passage of the design truck

Class of highway	*ADTT*
A	4000
B	1000
C	250
D	50

Tableau 10: average daily truck traffic (ADTT)

Other equations are defined in the Canadian code for the resistance of fillet welds transversely loaded, for stud shear connectors and for cables, but these particular cases of fatigue resistance will not be presented in this section because they will not be used in this work.

A comparison between the AASHTO code and the Canadian code is presented in the table below:

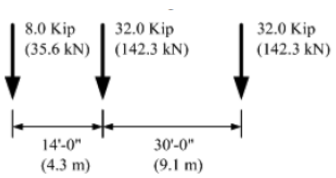
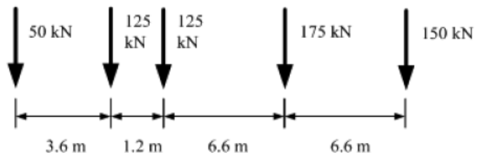
	AASHTO code	**Canadian code**
Design criteria	$0.75\ (\Delta f) \leq (\Delta F)_n$	$0.52 f_{sr} < F_{sr}$
Fatigue correction factor	0.75	0.52
Fatigue truck model		
Fatigue truck model total gross weight	320.2 kN	625 kN
Strength equation	$(\Delta F)_n = \left(\frac{A}{N}\right)^{\frac{1}{3}} \geq \frac{1}{2}(\Delta F)_{TH}$	$F_{sr} = \left(\gamma / N_c\right)^{1/3} \geq F_{srt}/2$
Number of cycles	$N = (365)(75)n(ADTT)_{SL}$	$N_c = 365 y N_d \left(ADTT_f\right)$
Number of cycles per truck	n	N_d

Tableau 11:comparison between the AASHTO code and the Canadian code

2.3.Comments on the comparison between the SIA, AASHTO and Canadian codes

As it has been presented in the previous sections, it can be noticed that the fatigue check method used in the North American codes is slightly different from the one used in the SIA code. Indeed, any equivalent stress range is calculated in the North American code, like it is done in the SIA code. In the SIA code, the equivalent stress range is computed at 2 millions of cycles and then compared to the strength of the considered detail, which depends on the geometry of the construction detail.

This difference between the SIA code and the North American codes means that the computation of the fatigue correction factor by comparing the damage accumulation due to the real traffic to the stress range due to the truck model is also different.

In the SIA code, and as it is explained in figure in section 2.1, the fatigue correction factor λ is the ratio between the equivalent stress range at 2 millions of cycles and the stress range due to the fatigue truck model. The calculation of the equivalent stress range has already been explained in section 2.1.

As said before, the computation of the fatigue correction factor for the North American codes is slightly different. Thus, the procedure is explained in detail in the following section. It has to be noted that it is mostly based on what has been presented in Caughlin et al. (2011).

2.4. Calculation of the North American fatigue correction factor

The fatigue correction factor calculation procedure for the North American codes can be summarized with the next figure:

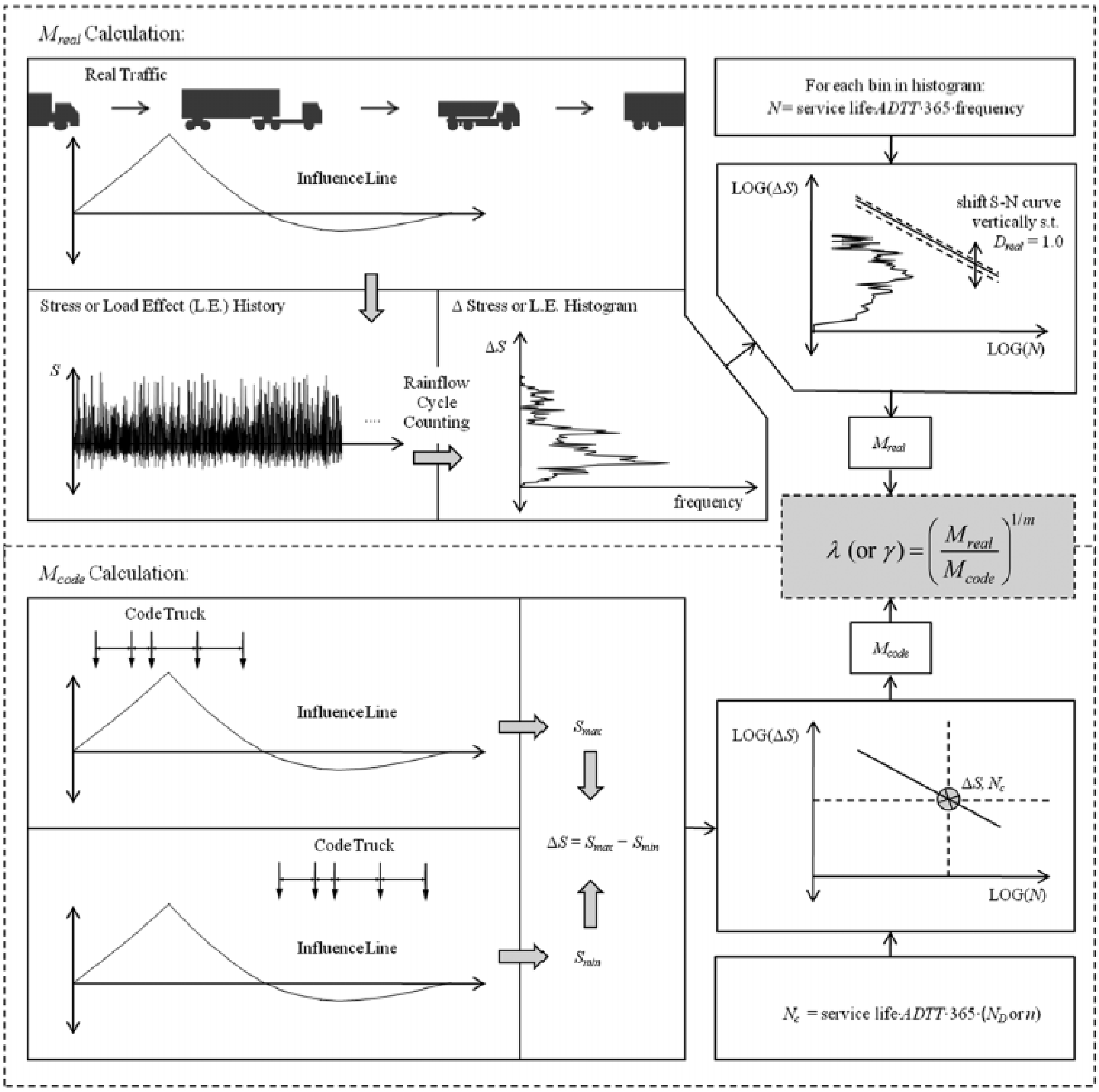


Figure 5: fatigue correction factor procedure (Caughlin et al. 2011)

Several types of information are required in order to compute the fatigue correction factor as schematically described in the figure above (Caughlin et al. 2011):

- a code truck model
- real traffic data
- an influence line for the bridge configuration and critical location of interest
- a design service life and expected traffic volume (not required if the S-N curve has only one single slope)
- the shape (i.e., slope or slopes) of the S-N curve for which the correction factor is to apply

The fatigue correction factor computation procedure for the North American codes is described as follows:

1) The trucks in the real traffic database are each passed over the influence line in succession (simultaneously or not)
2) The load effect due to the axle loads is determined for each vehicle position along the influence line. Whenever a peak value is observed, it is recorded in a "load effect history".
3) Once the load effect history for all the trucks is generated, the rainflow method is used to count cycles. These counted cycles are then collected into an histogram.
4) Next, the code truck model is passed over the same influence line and the maximum load effect range, ΔS, is recorded.
5) Following this, the S-N curve is compared to the histogram, scaled to the expected total truck volume (=service life x ADTT x 365), like it can also be seen in figure 1.9 of ECCS (2011). Specifically, the S-N curve is assigned an arbitrary vertical position, and then the damage ratio, D_{real}, is calculated using Miner's sum. An algorithm is then implemented wherein the S-N curve is shifted vertically until $D_{real} = 1.0$ is achieved. The resulting value of the parameter used to describe the curve's vertical position, M, is termed M_{real}, where:

$$log_{10}(N) = log_{10}(M) - mlog_{10}(\Delta S)$$

It has to be noted that M corresponds to the constant C defined in TGC 10. Indeed, the S-N curve in TGC 10 (figure 13.23) is defined as follows:

$$N = C\Delta\sigma^{-m}$$

Which gives, in logarithm scale:

$$\log(N) = \log(C) - mlog(\Delta\sigma)$$

Then, the total damage is calculated using the following equation:

$$D = \frac{\sum n_i}{\sum N_i}$$

N_i is the number of cycles that would cause failure due to constant amplitude loading under nominal stress range ΔS_i and n_i is the actual number of cycles under this stress range.

6) Next, the S-N curve is again shifted vertically to the value of M that results in $D = 1.0$ under constant amplitude loading at the load effect range imposed by the code truck, for a number of cycles, N_c, equal to the total truck traffic volume multiplied by $N_d$in the Canadian code or n in the AASHTO code, which are factors reflecting the average number of cycles per truck passage. The resulting value of M is termed M_{code}.
7) Finally, it can be shown (Coughlin et al. 2011) that the fatigue correction factor is given by the following equation:

$$\lambda = \left(\frac{M_{real}}{M_{code}}\right)^{1/m}$$

By using this procedure and this final equation, the fatigue correction factor can be obtained without knowing the nominal stress influence line (which depends on the bridge cross-section). If a 1-slope curve is used, then the result is also independent of the traffic volume. If a multi-slope S-N curve is used, however, then the correction factor will depend on the assumed truck traffic volume and service life.

2.5.Comparison between the Swiss and the North-American procedure for the fatigue correction factor computation

Finally, the different equations for the calculation of the fatigue correction factor are given below:

By the SIA code:

$$\lambda_{SIA} = \frac{\Delta\sigma_{E2}}{\Delta\sigma(Q_{fat})}$$

By the North American codes (AASHTO and CAN/CSA-S6-06):

$$\lambda_{AASHTO-CAN} = \left(\frac{M_{real}}{M_{code}}\right)^{1/m}$$

It is obvious that the North American and the Swiss fatigue correction factors cannot be directly compared. It means that the fatigue correction factor computed by FDA Bridge gives a “Swiss” value and cannot be applied as a “North American” value. This is why the value computed by FDA Bridge has to be modified in order to get a North American fatigue correction factor, corresponding to the constant values 0.52 and 0.75 admitted in the Canadian and US code respectively. In the following section, a conversion formula is developed to convert the fatigue correction factor value given by FDA Bridge to a North American value.

2.6.Development of a conversion formula

The procedure to compute the North American fatigue correction factor has been shown in the previous section. In other words, it can be said that the North American fatigue correction factor is equal to the ratio between the equivalent stress range due to the passage of the real traffic over the bridge during the whole service life and the equivalent stress range due to the passage of the fatigue truck model over the bridge, considering the same number of repetitions than the total number of trucks which has been considered in the real traffic.

On the other side, the fatigue correction factor considered by the SIA code is equal to the ratio of the equivalent stress range for 2 millions of cycles. This is why the value given as an output by FDA Bridge has to be modified in order to get the fatigue correction factor for the AASHTO or the Canadian code.

In order to find this conversion formula, let's first consider the equivalent stress range of the real traffic:

$$\Delta\sigma_{E,real} = \left(\frac{1}{N_{tot\ cycles\ real}} \sum_{i=1}^{k} \Delta\sigma_i^m n_i \right)^{1/m}$$

Now, let's define the stress range due to the passage of the fatigue truck model as $\Delta\sigma(Q_{fat\ AASHTO-CAN})$.

The equivalent stress range due to the passage of $N_{tot\ cycles\ code}$ fatigue model trucks can be written as follows:

$$\Delta\sigma_{E,code} = \left(\frac{1}{N_{tot\ cycles\ code}} \sum_{i=1}^{k} \Delta\sigma(Q_{fat\ AASHTO-CAN})^m n_i \right)^{1/m}$$

As $\Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right) = \Delta\sigma_i$ for all values of i, it can be simplified:

$$\Delta\sigma_{E,code} = \Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right)$$

By comparison of the two equivalent stress range definitions, we have:

$$\Delta\sigma_{E,real} = \left(\frac{1}{N_{tot\ cycles\ real}} \sum_{i=1}^{k} \Delta\sigma_i^m n_i \right)^{1/m} = \lambda_{AASHTO-CAN}\ \Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right)$$

We can switch the expression in order to isolate $\Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right)$. It gives:

$$\Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right) = \frac{\left(\frac{1}{N_{tot\ cycles\ real}} \sum_{i=1}^{k} \Delta\sigma_i^m n_i \right)^{1/m}}{\lambda_{AASHTO-CAN}}$$

The result for the fatigue correction factor given by FDA Bridge is consistent with the equation assumed in the SIA code, which is a comparison at 2 millions of cycles:

$$\left(\frac{N_{tot\ cycles\ real}}{2*10^6}\right)^{1/m} \Delta\sigma_{E,real} = \lambda_{FDA}\ \Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right)$$

By combination of the 2 last equations, we have:

$$\left(\frac{N_{tot\ cycles\ real}}{2*10^6}\right)^{1/m} \Delta\sigma_{E,real} = \lambda_{FDA} \frac{\left(\frac{1}{N_{tot\ cycles\ real}}\sum_{i=1}^{k}\Delta\sigma_i^m n_i\right)^{1/m}}{\lambda_{AASHTO-CAN}}$$

By developing the expression for $\Delta\sigma_{E,real}$, we have:

$$\left(\frac{N_{tot\ cycles\ real}}{2*10^6}\right)^{1/m}\left(\frac{1}{N_{tot\ cycles\ real}}\sum_{i=1}^{k}\Delta\sigma_i^m n_i\right)^{1/m} = \lambda_{FDA} \frac{\left(\frac{1}{N_{tot\ cycles\ real}}\sum_{i=1}^{k}\Delta\sigma_i^m n_i\right)^{1/m}}{\lambda_{AASHTO-CAN}}$$

By isolating $\lambda_{AASHTO-CAN}$, we finally get the conversion formula:

$$\lambda_{AASHTO-CAN} = \frac{\lambda_{FDA}}{\left(\frac{N_{tot\ cycles\ real}}{2*10^6}\right)^{1/m}}$$

Another way is possible for the development of this expression. Indeed, it is possible to find an algebraic expression for the North American fatigue correction factor, and then modify this equation to link it with the Swiss fatigue correction factor definition.

First of all, we find an expression for the C_{code} parameter:

$$N_{code} = C_{code}\Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right)^{-m}$$

Thus, we have:

$$C_{code} = \frac{N_{code}}{\Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right)^{-m}} = N_{code}\Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right)^{m}$$

Then we develop the same expression for the real traffic:

$$N_{real} = C_{real}\Delta\sigma_{E\ real}^{-m}$$

So, we have:

$$C_{real} = N_{real}\Delta\sigma_{E\ real}^{m}$$

As we have an expression for C_{code} and C_{real}, it is possible to calculate the North American fatigue correction factor:

$$\lambda_{AASHTO-CAN} = \left(\frac{C_{real}}{C_{code}}\right)^{1/m} = \left(\frac{N_{real}\Delta\sigma_{E\ real}^{m}}{N_{code}\Delta\sigma\left(Q_{fat\ AASHTO-CAN}\right)^{m}}\right)^{1/m}$$

Moreover, we have: $N_{code} = N_{real}$

Then, the expression of the North American fatigue correction factor becomes:

$$\lambda_{AASHTO-CAN} = \left(\frac{\Delta\sigma_{E\,real}^{m}}{\Delta\sigma\left(Q_{fat\;AASHTO-CAN}\right)^{m}} \right)^{1/m} = \frac{\Delta\sigma_{E\,real}}{\Delta\sigma\left(Q_{fat\;AASHTO-CAN}\right)}$$

The expression considered by the SIA code, and the fatigue correction factor computed by FDA Bridge, is:

$$\left(\frac{N_{tot\;cycles\;real}}{2*10^6}\right)^{1/m} \Delta\sigma_{E,real} = \lambda_{FDA}\Delta\sigma\left(Q_{fat\;AASHTO-CAN}\right)$$

By combination of the two last expressions, we replace $\Delta\sigma_{E,real}$ in the last equation and we get:

$$\left(\frac{N_{tot\;cycles\;real}}{2*10^6}\right)^{1/m} \Delta\sigma\left(Q_{fat\;AASHTO-CAN}\right)\lambda_{AASHTO-CAN} = \lambda_{FDA}\Delta\sigma\left(Q_{fat\;AASHTO-CAN}\right)$$

Finally, we obtain the same expression as before:

$$\lambda_{AASHTO-CAN} = \frac{\lambda_{FDA}}{\left(\frac{N_{tot\;cycles\;real}}{2*10^6}\right)^{1/m}}$$

It has to be noted that the total number of cycles depends on the assumed definition of a cycle. Indeed, we can consider one big cycle instead of many smaller ones which their addition gives the full big single cycle. It means that the term $N_{tot\;cycles\;real}$ refers to the expected number of cycles. It means we have:

$$N_{tot\;cycles\;real} = n\,N_{tot\;trucks\;FDA}$$

Where:

$n\ (or\ N_d)$ = the expected number of cycles per truck

$N_{tot\;trucks\;FDA}$ = the number of simulated trucks considered in the FDA Bridge computation

Thus, the final expression for the conversion formula is:

$$\lambda_{AASHTO-CAN} = \frac{\lambda_{FDA}}{\left(\frac{n\,N_{tot\;trucks\;FDA}}{2*10^6}\right)^{1/m}}$$

This conversion formula shows that the Swiss fatigue correction factor depends on the number of simulated trucks, but not the North American one. In the simulations performed in the framework of this master thesis, the number of trucks simulated by WinQSIM was always equal to 2 millions and then increased to 50 millions of trucks in FDA Bridge.

It also has to be noticed that this conversion formula is valid only for some single slope S-N curves.

3. TRAFFIC DATABASE

The purpose of this master project is to study the effect of simultaneous vehicle crossings on the fatigue correction factors. Some computations of fatigue correction factor will be performed and the obtained results will be compared to the design value of the corresponding code (American or Canadian code). The goal of this work is to check if the code design procedure is safe enough concerning fatigue and if the safety margin concerning the fatigue correction factor is high enough to be able to avoid considering the probability of simultaneous vehicle crossing. The computed value of the fatigue correction factor considering some real traffic data depends on the characteristics of the considered traffic. Some traffic data are more aggressive than another on a fatigue solicitation point of view, depending on the average total weight, the axle spacing, among others. The traffic condition characteristics (percentage of light vehicles, traffic speed, traffic flow, etc) have also a significant influence on the fatigue damage as well.

This is for these reasons that it has been chosen to consider the same traffic data as the traffic data considered for the development of the design codes in order to get some comparable fatigue correction factor values, without the influence of the traffic data (as it would have been the case if some real traffic WIM databases have been considered). The advantage of this process is that the effect of simultaneous vehicle crossing is isolated from the other parameters.

3.1.American traffic database

3.1.1. American traffic database treatment

As the goal of this work is to study the effect of the simultaneous vehicle crossing on the North American fatigue correction factors, the study of the American and Canadian traffic data is required. Concerning the fatigue correction factors computations for the American traffic, the traffic data used in this work are the same as the data on which was calibrated the fatigue correction factor of 0.75. The article “Fatigue correction factors for welded aluminium highway structures” written by Reid Coughlin and Scott Walbridge (Coughlin et al. 2011) mentioned the fact that the origin of the AASHTO fatigue correction factor’s value is understood to be NCHRP Report 299 (Moses et al. 1987): “In this report, a fatigue design truck is proposed with a gross vehicle weight (GVW) that is 75% of the GVW of the code truck for static design. This truck weight was calculated by taking the GVW histogram from a 27 513 truck survey (Snyder et al. 1985)”. This truck survey was the same as the one used by Chotickai et al. (2006) in the article in which they define a new three-axle fatigue truck model in order to avoid the overestimation of the current fatigue correction factor value used in the AASHTO code, especially for short-span girders.

The same survey data will be employed in this study. Coughlin et al. (2011) give a precise description of this traffic data: “The truck weight survey data in Snyder et al. (1985) was collected in a nationwide survey conducted in the 1980s, encompassing truck data from several states across the United States. Weigh-in-motion (WIM) data was recorded for 27513 trucks from 30 sites in California, Georgia, Arkansas, Texas, Illinois, New York, and Ohio. […]. In Moses et al. (1987), idealized axle weight distribution and spacings for six truck categories are defined, including 11 different truck types. Of the 27 513 trucks surveyed in Snyder et al. (1985), 25 901 of the trucks conformed to one of the 11 truck types described in Moses et al. (1987)". Unfortunately, the axle weights and spacings for each truck were not available in the traffic database. GVW histograms only were provided in Snyder et al. (1985) for all 11 truck categories. For this master project, these histograms were used. Afterwards, the idealized axle weights and spacings have been defined, accordingly to Moses et al (1987).

		Axle load (%)				Axle spacing (ft [m])		
Truck category	Truck type	1	2	3	4	1	2	3
Two axle singles	SU2	40	60	—	—	16 [4.88]	—	—
Three axle singles	SU3	30	70	—	—	18 [5.49]	—	—
	SU4							
Two axle semi-trailers	2-S1	27	40	33	—	12 [3.66]	32 [9.76]	—
Three axle semi-trailers	2-S2	23	35	42	—	12 [3.66]	28 [8.54]	—
	3-S1							
Four axle semi-trailers	3-S2	18	45	37	—	14 [4.27]	32 [9.76]	—
	2-S3							
	3-S3							
Five axle semi-trailers	2-S1-2	17	29	42	12	10 [3.05]	25 [7.62]	25 [7.62]
	3-S1-2							

Tableau 12: characteristics (fixed values) of the American truck categories (Moses et al., 1987)

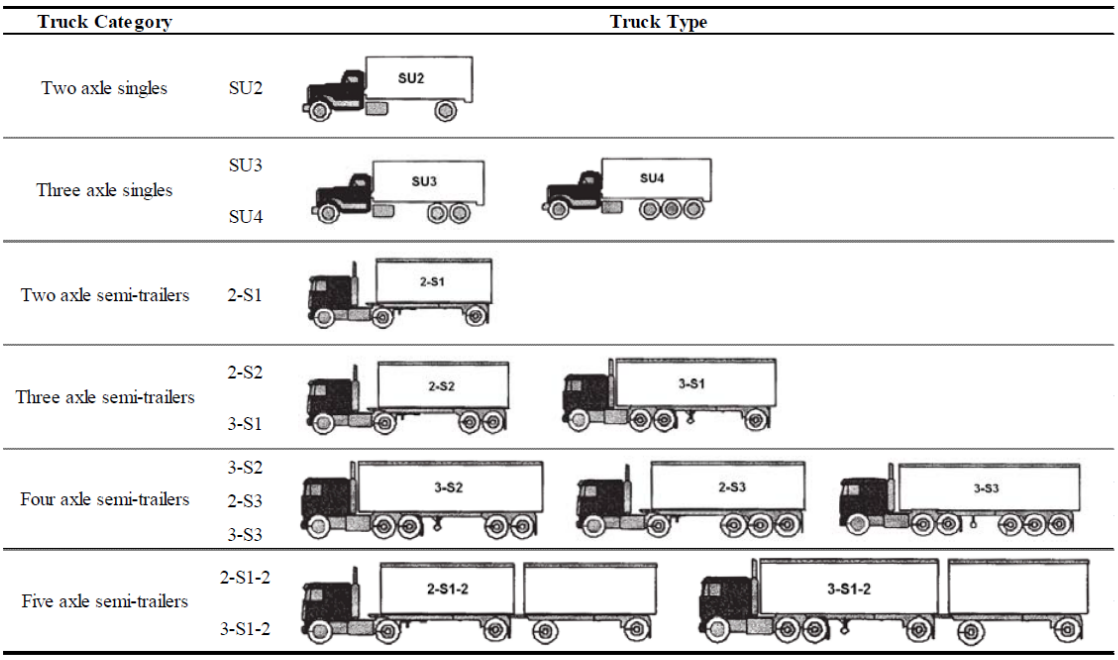


Figure 6: United States truck categories and types (Moses et al. 1987, Harwood et al. 2003)

A database of truck traffic was then defined using these deterministic characteristics. The database represents the entire truck fleet. Coughlin et al. (2011) give a certification about the negligible effect of the omitted trucks in the database due to the classification: "To assess the significance of the 1612 trucks omitted from the database for not conforming to any of the 11 truck types, a check was performed, which confirmed that the GVW histogram for the omitted trucks had a shape and upper limit very similar to the total GVW histogram in figure 7. On this basis, it was concluded that the effect of omitting theses trucks should be minimal."

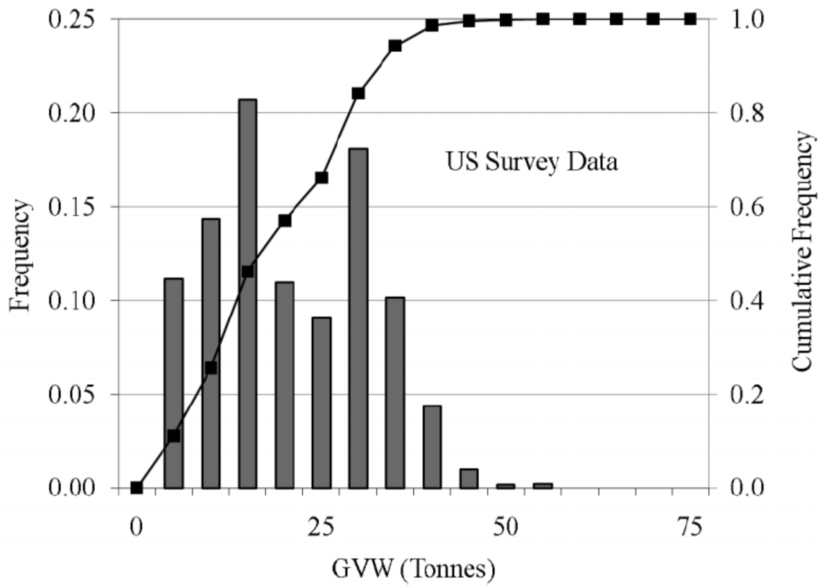


Figure 7: histogram for an American survey of 27513 trucks (Snyder et al. 1985)

As the axle weights and spacings for the US survey data are deterministic, it is not required to sort the traffic data, as there won't be any "crazy" values. Indeed, every truck of the traffic survey can be taken into account in the traffic simulations.

Nevertheless, the sorting of the US traffic data is required to get the characteristics of the traffic database. The traffic data should be categorized into the different vehicle types defined in Moses et al. (1987). The sorting conditions have to be defined in order to get the same vehicle categories as defined in table 12. Afterwards, it is possible to check if the characteristics of the sorted vehicles (axle weights and spacings) correspond to the deterministic values discussed previously. There shouldn't be any unclassified vehicles. It also should be noted that the available axle weights data correspond to the recording of the weight of the group of axles, and not of every single axle. This is why, for instance, a "four-axle semi-trailer" can have 5 or 6 axles, even though they are classified in the same category. The reason is that the distance between axles and the axle weights correspond actually to the distance between groups of axles and axle group weights. It has been decided to simulate the traffic as close as the given data. It means that the axles were not simulated, but only the groups of axles. Actually, the total weight of each axle group is concentrated in a local single load.

First of all, it is important to remind the type of recorded data for the US traffic. The available data for the US traffic data are the following ones:

- Total gross weight [kg]
- Total truck length [cm]
- Axle weight [kg]
- Axle spacings [cm]

It has to be noted that the total truck length doesn't give any information on the front or back or total cantilever length. This recorded value in the traffic data file corresponds to the addition of the total axle spacings. This comment can be verified by looking at the computed total cantilever length for the US traffic data. Indeed, this value is equal to zero for every single truck of the traffic survey.

As there is no distorted data concerning the US traffic data, the amount of unclassified vehicles should be equal to zero. The conditions of the sorting file (.trc file) are only based on the goal of categorization of the trucks into the previously defined categories.

The conditions defined in the .trc file are shown in the following table:

vehicleID	parameterID	description	minvalue	maxvalue
21	100	2 axles	2	2
31	100	3 axles	3	3
41	100	4 axles	4	4
121	100	2 axles	2	2
121	201	Distance between axles 1 and 2	**487**	**489**
121	300	Total gross weight	0	60000
131	100	2 axles	2	2
131	201	Distance between axles 1 and 2	**548**	**550**
131	300	Total gross weight	0	60000
141	100	3 axles	3	3
141	201	Distance between axles 1 and 2	**365**	**367**
141	202	Distance between axles 2 and 3	**974**	**976**
141	300	Total gross weight	0	60000
151	100	3 axles	3	3
151	201	Distance between axles 1 and 2	**365**	**367**
151	202	Distance between axles 2 and 3	**852**	**854**
151	300	Total gross weight	0	60000
161	100	3 axles	3	3
161	201	Distance between axles 1 and 2	**426**	**428**
161	202	Distance between axles 2 and 3	**974**	**976**
161	300	Total gross weight	0	60000
171	100	4 axles	4	4
171	201	Distance between axles 1 and 2	**304**	**306**
171	202	Distance between axles 2 and 3	**761**	**763**
171	203	Distance between axles 3 and 4	**761**	**763**
171	300	Total gross weight	0	60000

Tableau 13 criteria of the American truck categories

The vehicleIDS are defined in table 14:

ID	name (as defined by Moses et al. (1987))	description	combination
11	All vehicles		no
12	Unclassified vehicles		NOT[121] AND NOT[131] AND NOT[141] AND NOT[151] AND NOT [161] AND NOT [171]
21	2 axles		no
22	2 axles unclassified		[21] AND NOT[121] AND NOT [131]
31	3 axles		no
32	3 axles unclassified		[31] AND NOT[141] AND NOT [151] AND NOT [161]
41	4 axles		no
42	4 axles unclassified		[41] AND NOT [171]
121	Two axle singles	o-o	no
131	Three axle singles	o-o	no
141	Two axle semi-trailers	o-o-o	no
151	Three axle semi-trailers	o-o-o	no
161	Four axle semi-trailers	o-o-o	no
171	Five axle semi-trailers	o-o-o-o	no

Tableau 14: categories for the American trucks

It can be noticed that there is no condition on the different recorded weights (axle or total weights). Indeed, geometrical conditions only are enough to sort every truck. Moreover, it is not required to unclassify some distorted data.

The results file for the US traffic data is obtained by sorting the rawdata with the ".trc" file. The output file is a ".trr" file which is readable by using the ResultViewer (.xls file) (Fischer, 2012).

The histogram of the total gross weight of the classified heavy vehicles is shown below:

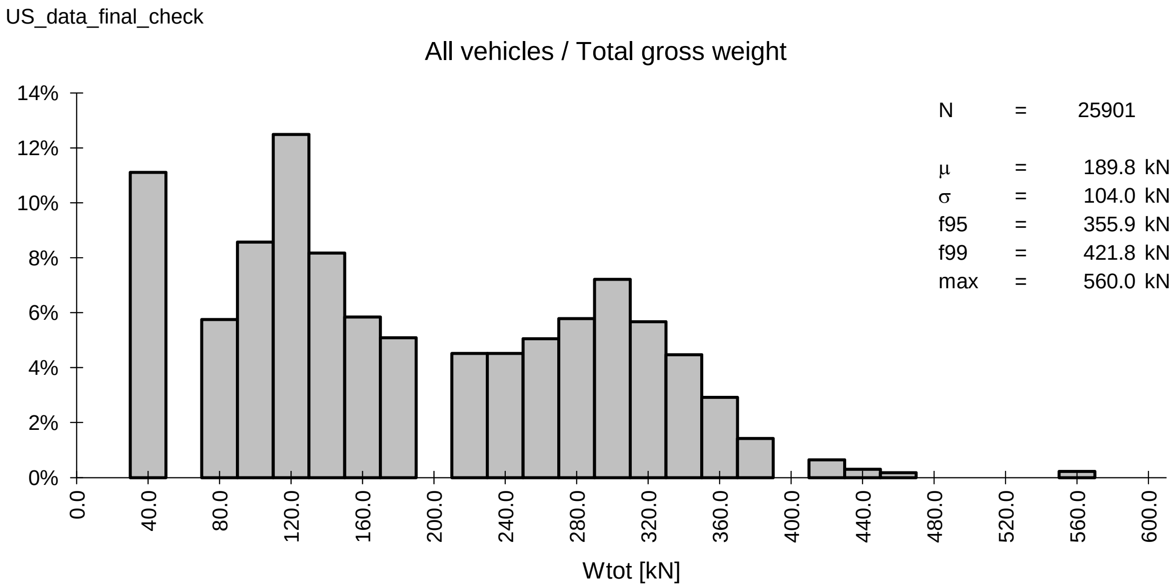


Figure 8: American traffic database: total gross weight histogram

We can notice that the total number of classified trucks is equal to 25'901. It confirms the fact that there is no unclassified truck, as previously expected. Every truck is categorized into one of the 6 different categories (121, 131, 141, 151, 161, and 171).

The definition of the distance between axles and the weights of the groups of axles has to be studied in order to be able to define the characteristics of the simulated traffic in the .qst file.

An example of an American truck is given with the characteristics of a truck of the category 171 (4 groups of axles).

First of all, the total gross weight histogram is computed and is shown in figure 11:

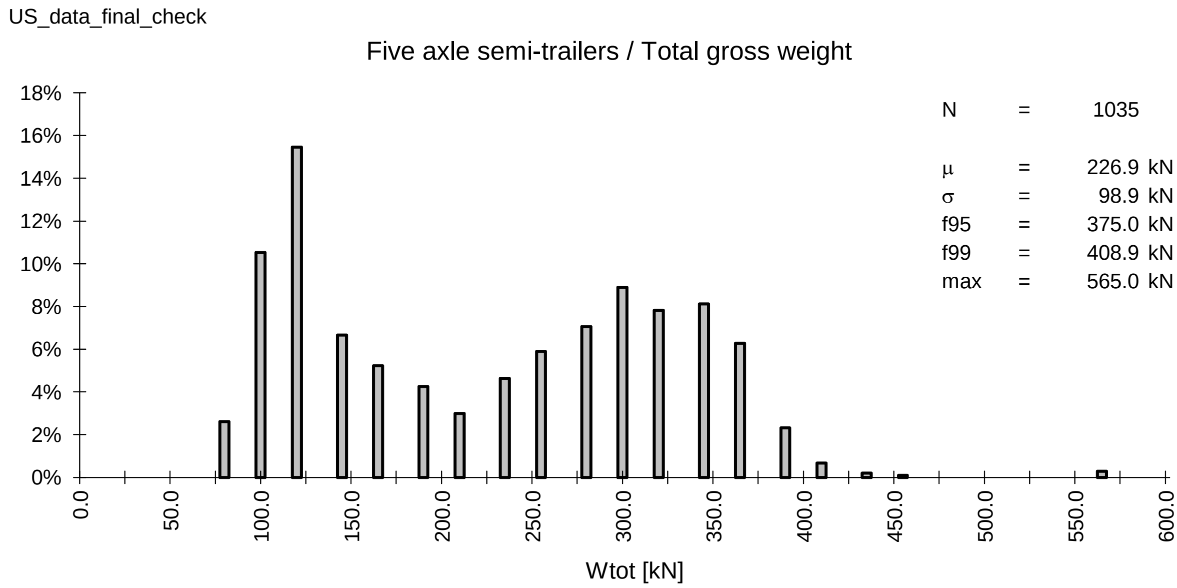
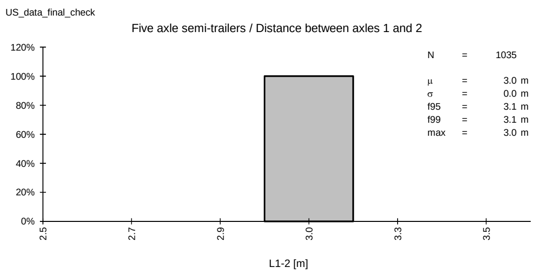
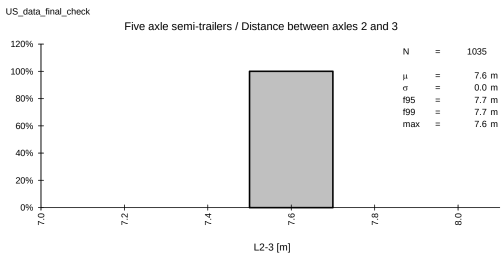
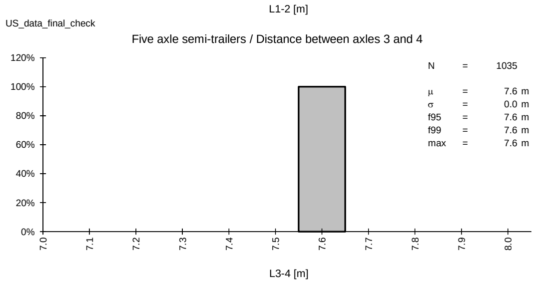


Figure 9: American traffic database: total gross weight histogram of the "five axle semi-trailers" category

The geometrical characteristics (spacings between groups of axles) are displayed in the figures below:



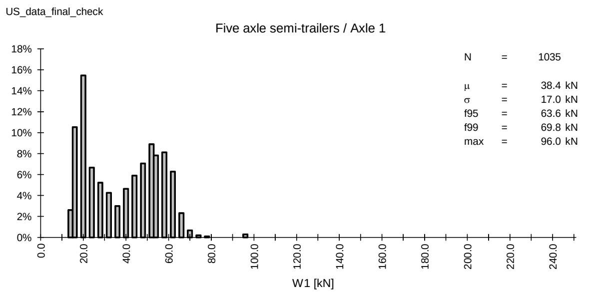


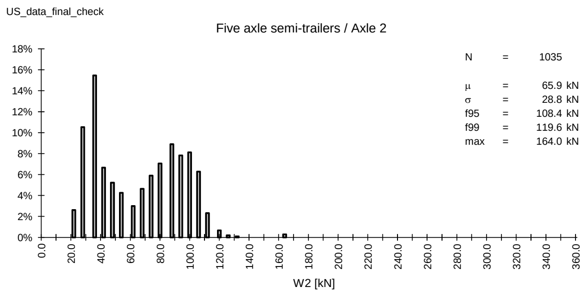


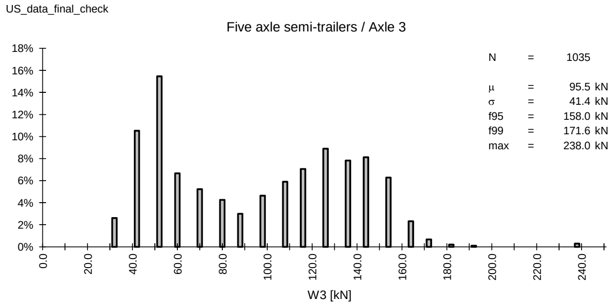
The total cantilever length is not displayed here because is equal to zero, as previously discussed.

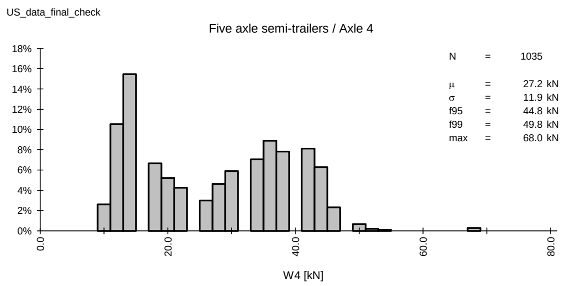
The weight of every group of axles is available for each vehicle category. The titles of these graphs are a little bit confusing because they are called "Axle n". Indeed, "Axle" refers to the group n of axles and not to the nth axle of the considered truck.

The histograms of the axle weights are shown in the figures below:



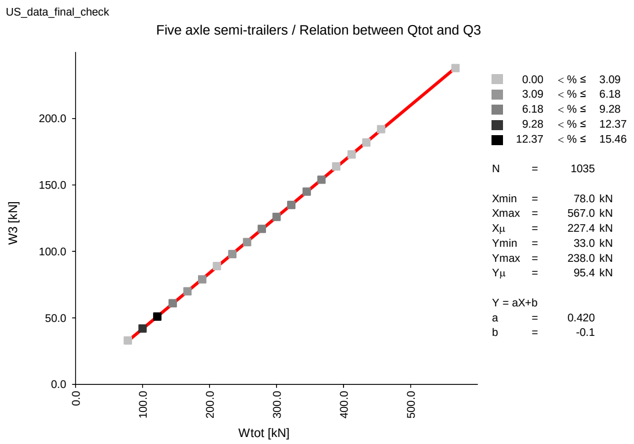


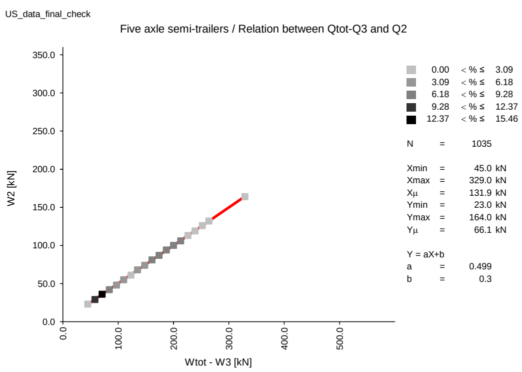


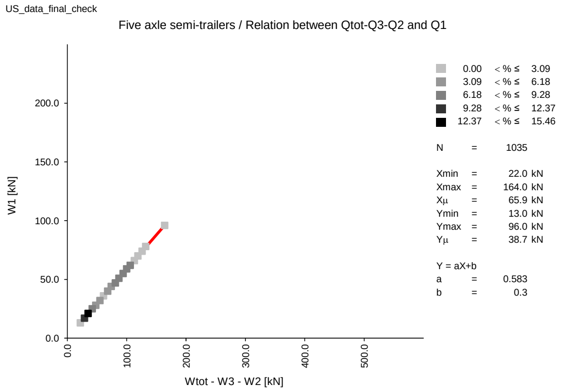


As it was already explained in Meystre et al. (2006) and in Fischer (2012), the correlation between the weights of the different groups of axles have to be defined. Indeed, the total gross weight of each simulated truck is chosen using a Monte-Carlo process. Then, the weights of the group of axles of the truck are defined using some relations of correlation based on the real traffic data. The relations between the different groups of axles can be fitted with some linear regression curves. So the determination of the weights of the different axles groups can be calculated by this way (e. g. a 4 groups of axles truck, like studied as an example in this section): first of all, it is required to identify the most loaded group of axles and to classify the other groups starting from the most loaded one to the less loaded one. Then a linear equation is used to calculate the most loaded group of axles, which is a function of the total gross weight of the truck: $Q_3 = a_3 Q_{tot} + b_3$. Then it's possible to calculate the weight of the second group of axles, based on the same principle: $Q_2 = a_2(Q_{tot} - Q_3) + b_2$. And finally: $Q_1 = a_1(Q_{tot} - Q_3 - Q_2) + b_1$. The weight of the less loaded group of axles is obtained by a simple subtraction: $Q_4 = Q_{tot} - Q_3 - Q_2 - Q_1$. Concerning the groups of multiple axles, the relation between the axles of the same group is defined by an analysis of the average ratio of the recorded weights. However, for the US traffic data, only the weights of the groups of axles are recorded, that's why the axles weights are no simulated and the relations between the axle weights of the different groups of axles do not have to be analyzed.

The relations between the different groups of axles for the vehicle category 171 are shown in the figures shown below:







The values of the different coefficients (obtained by regression) for this example are the following ones:

	a [-]	b [-]
Q_3=f(Q_{tot})	0.42	-0.1
Q_2=f(Q_{tot}-Q_3)	0.499	0.3
Q_1=f(Q_{tot}-Q_3-Q_2)	0.583	0.3

Figure 10: coefficients of the linear regression

It can be observed that the correlation between the weights of the groups of axles is perfectly linear. It's not surprising because it's already known that the weights of the axles groups were defined artificially as a ratio of the total gross weight of the truck.

As the geometrical characteristics of the different truck categories are defined as some fixed values (deterministic) and the correlation between the weights of the axles groups are perfectly linear, it means it's possible to simulate exactly the same traffic as the American traffic data, without approximations.

It is also required to calculate the percentage of every truck category in order to simulate the same amount of trucks of every vehicle category as in the real traffic data. The number of trucks counted in each category and the corresponding percentage are presented in the table below:

Category	# of trucks	Proportion [%]
121	3337	**12.9**
131	1746	**6.7**
141	820	**3.2**
151	2873	**11.1**
161	16090	**62.1**
171	1035	**4.0**
Total	25901	100.0

Tableau 15: composition of the American traffic database (percentage per category)

Since the geometrical characteristics, the weights of the axles groups and the global distribution (percentage of each truck category) are defined, it's possible to create the .qst file which will be used in WinQSIM in order to simulate the traffic corresponding to the real American traffic data (Fischer 2012).

I think it is not worth it to present the .qst file in this section. However, a comparison between the American traffic data analysis and the corresponding American WIM file simulated traffic analysis has been performed. The WIM file corresponds to the simulated traffic rawdata created from the .qst file. This file corresponds to the virtual traffic database which is supposed to be close to the original traffic data. As the WIM file is also a .trr file, it is possible to analyze the simulated traffic by using the ResultViewer.

As the American traffic database contains some deterministic values, the WIM file should be exactly the same as the original traffic database. It can be checked by comparison of the 2 files using the ResultViewer. The comparison between the two files has shown a perfect match. The only parameter which is different between the initial traffic and the simulated one concerns the total cantilever length. Indeed, as previously said, the "length" of every recorded truck in the initial American traffic database corresponds to the sum of the spacings between the different groups of axles. No information about the front and back cantilever length is available in the rawdata. That's why it was required to do an assumption about these cantilever lengths. I assumed a front and back cantilever lengths equal to 1m. each. The real distance between the front axle and the front of the vehicle should without doubts be close to the assumed distance of 1m. However, the distance between the last axle and the rear of the truck might be longer than 1m, depending on the considered vehicle category. Anyway, this rear cantilever length has a small influence on the traffic conditions. Indeed, this distance has an impact on the distance between vehicles only. Actually, the distance between vehicles is defined (in free-moving traffic conditions) by a shifted exponential probability distribution (Bailey, 1996), as it will discussed in section 4.2. This distance is measured during the simulation by WinQSIM from the back of the vehicle in front to the front of the vehicle at the back. This is why a rough estimation of the rear cantilever length does not have a big effect on the traffic simulation (it just makes the distance between vehicles a few tenth of meters shorter or longer). In a bridge loading point of view (stress range at mid-span for instance), the effect of these distance variations can reasonably be considered as small enough to be neglected. That's why both front and rear cantilever lengths have been estimated to 1m for every truck category. The total cantilever length for the simulated traffic is equal to 2m for every truck. This parameter is the only characteristic which is different between the American traffic database and the American simulated traffic database.

The proportion of each vehicle categories is checked in the following table (the simulated traffic in the WIM file included 50% of light vehicles). The total number of simulated vehicles (including light vehicles) was equal to 2 millions.

	American traffic rawdata		American WIM rawdata	
Category	**# of trucks**	**Proportion [%]**	**# of trucks**	**Proportion [%]**
121	3337	**12.9**	129730	**13.0**
131	1746	**6.7**	67691	**6.8**
141	820	**3.2**	31514	**3.2**
151	2873	**11.1**	110483	**11.0**
161	16090	**62.1**	620614	**62.0**
171	1035	**4.0**	40243	**4.0**
Total	25901	100.0	1000275	100.0

Tableau 16: comparison between the traffic database and the simulated traffic

3.1.2. Validation of the American traffic model

In order to validate the simulated traffic database for the American traffic defined in WinQSIM, a simulation was performed and the stress histograms were recorded and then compared with the results computed using the Fortran program.

As the Fortran program developed at the University of Waterloo cannot simulate simultaneous vehicle crossings, the traffic flow defined in WinQSIM for this simulation was low enough in order to avoid having multiple presence on the bridge in the same time. Thus, the history of the stress cycles should me the same by comparing the two different ways of simulating the same traffic traveling on the same bridge. Moreover, as the American traffic database is defined by some deterministic values, there is no approximation done by WinQSIM (no fitting of the distances between axles neither for the relations between axle weights).

The bridges and their influence lines considered for this comparative simulation were a 5 span bridge (span length: 30m, 24m for the exterior spans ($0.8l_{\text{interior span}}$)) and two different simple span bridges (span lengths: 60m and 12m). The probability density function (PDF) of the whole bending moments ranges were computed for the WinSIM and Fortran simulations and then compared. As the increment sizes of the two different histograms are not the same, the comparison of the probability density function is basically meaningless. That’s why it is really more interesting to compare the cumulative density functions (CDF).

The three different cumulative density functions are represented in the graphs below:

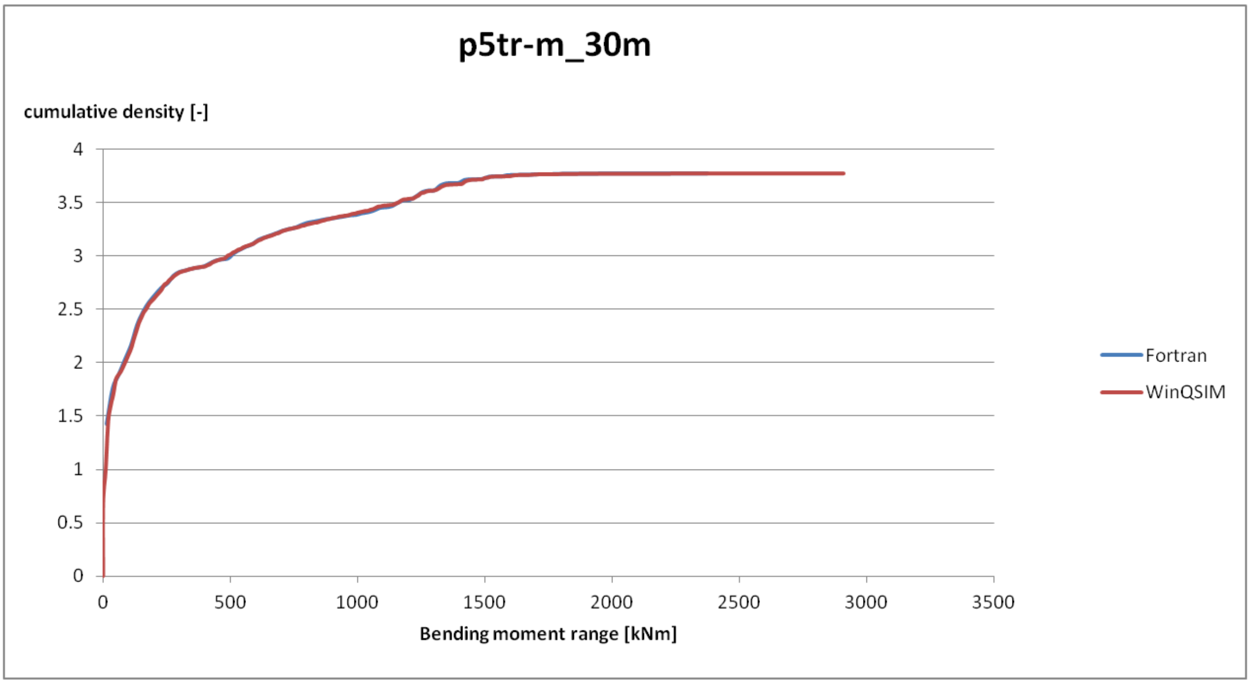


Figure 11: comparison between the WinQSIM and Fortran traffic simulations (influence line: p5tr-m_30m)

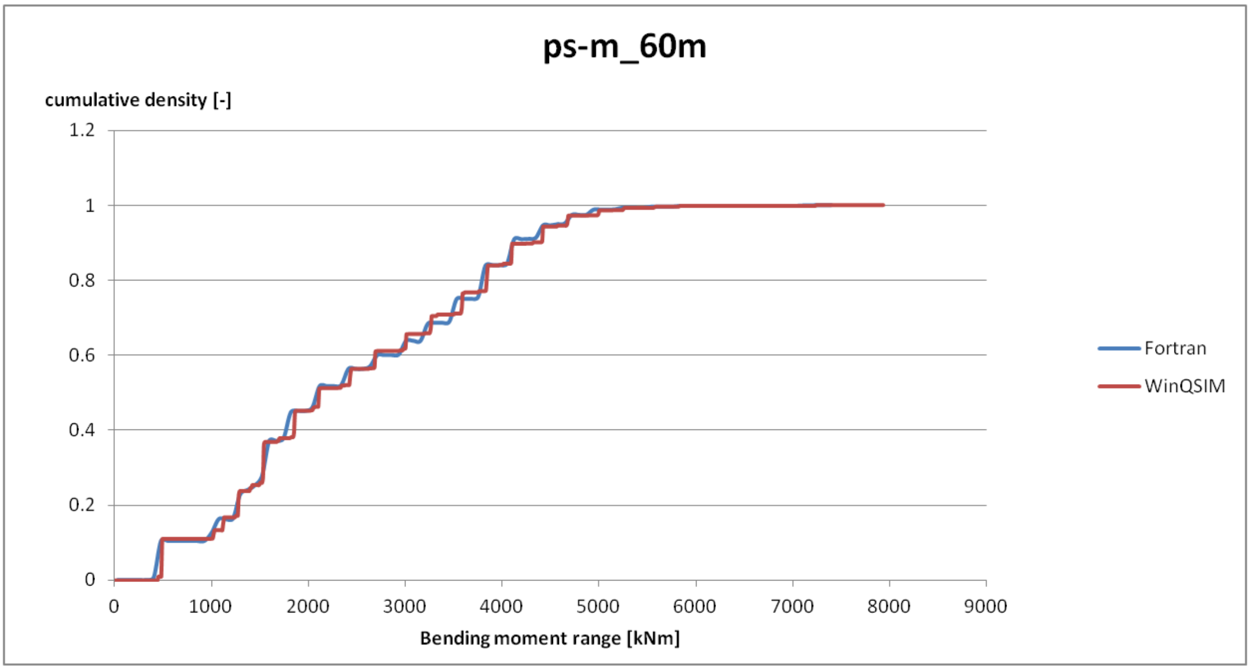


Figure 12: between the WinQSIM and Fortran traffic simulations (influence line: ps-m_60m)

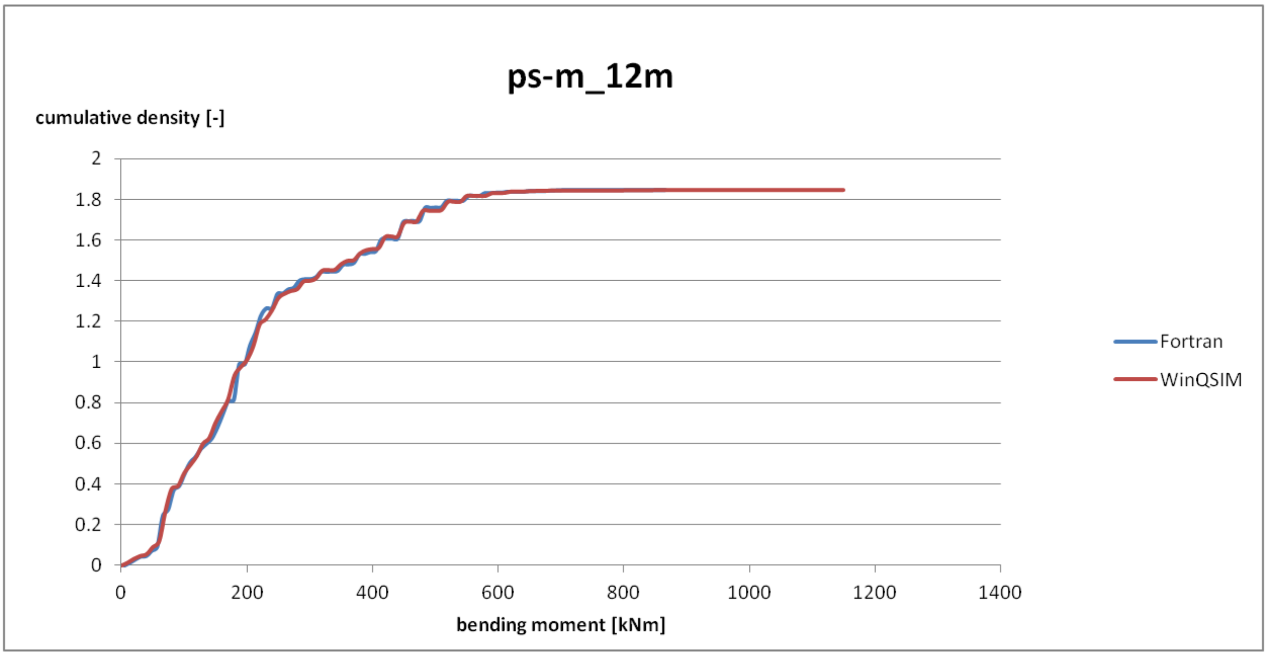


Figure 13: between the WinQSIM and Fortran traffic simulations (influence line: ps-m_12m)

It can be noticed that the two curves (WinQSIM and Fortran) are an almost perfect match for the three different influence lines. As the cumulative density curves are very close from one to each other, it can be verified that the traffic without simultaneous vehicle crossing simulated by WinQSIM is the same as the traffic considered in the previous analyses like the one performed by R. Coughlin and S. Walbridge (Coughlin et al. 2011). That way, the traffic model defined in WinQSIM can be validated and used to simulate some different traffic conditions, including simultaneous vehicles crossings. Another check will be performed later for the fatigue correction factor, but this is not the aim of this chapter. The verification of the fatigue correction factor value, to validate the computation method, will be presented later in this report. It can be noticed in figures 18 and 20 that the CDF curves go up to a value higher than one for the influence lines p5tr-m and ps-m_12m. Indeed, it means that the average number of cycles per truck is higher than one. It is obvious for the 5 spans influence line. For a simple span of 60 m, a truck creates only 1 single cycle. Nevertheless, for a shorter span (ps-m_12m), a truck cannot be considered as a single load, but more like a multiple loads body. Indeed, every axle group creates a bending moment cycle, depending on the spacing between axles.

In the next section, the Canadian traffic database used in this study is presented and discussed.

3.2.Canadian traffic database

The same approach has been used for the study of the Canadian traffic. The traffic database which has been considered is the traffic database constituted by the axle weight and spacing database including 10 198 trucks, measured using static weigh station throughout the province of Ontario in 1995 by the Ministry of Transportation of Ontario (MTO) (CSA 2007a) (Coughlin et al. 2011). The same traffic database was used in the study of the fatigue correction factors for welded aluminum highway structures, performed by R. Coughlin and S. Walbridge (Coughlin et al. 2011). It will make the comparison possible between the different analyses, for the cases without simultaneous vehicle crossings. It will be one of the checking methods, as it also has been done for the American traffic database.

3.2.1. Canadian traffic database treatment

As previously said, the Canadian traffic database includes 10 198 trucks, measured using static weigh stations. The Canadian design code (CAN/CSA-S6) was developed and the fatigue correction factor (0.52) calibrated using this traffic database. This is why it has been chosen to study the effect of simultaneous vehicle crossings on the Canadian fatigue correction factor by using this traffic database.

Thus, one of the first objective of this work is to create a traffic database in WinQSIM which will simulate a traffic as close as possible to the real traffic database constituted of the measurements of 10 198 trucks throughout the province of Ontario. This task is constituted by categorizing the different measured trucks into previously defined categories. Given the fact that the Canadian traffic database is not a traffic defined by some deterministic values (axle spacings and weights) as the American traffic is, the sorting of the trucks is a lot more difficult. Indeed, no truck category was available for this work. So, I had to analyze the traffic first in order to be able to define some vehicle categories.

First I tried to create only one category for the different number of axles per trucks. As the traffic database contains some trucks with up to eleven axles, I defined ten categories. I have noticed very soon that the distance between axles and especially the weights between axles couldn't be fitted by a beta curve or a fixed distance, or by a linear correlation, respectively. It is required to find at least the correct configurations of the axles groups in order to get a correct linear relation.

That's why it was absolutely necessary to define more than one category for a same number of axles per truck. Then, I had to define by myself some good vehicle categories. This part of my work was the most time demanding one. I wished I could have some vehicle categories already defined, in order to spend more time on the fatigue correction factor computations and analyzes, but it wouldn't even have been possible to do it without defining the vehicle categories for the Canadian traffic database. Indeed, the categorization of the traffic database was necessary to define the parameters of the simulated traffic by WinQSIM. I'm now going to present how I have defined the different truck categories.

3.2.2. Categorization of the Canadian truck traffic database

As previously said, the studied traffic database for the Canadian traffic was the database used in the calibration for the fatigue correction factor of the Canadian design code (CAN/CSA-S6). Given the fact that the aim of this work is to study the effect of simultaneous vehicle crossings on the fatigue correction factor (compared to the value of the code), this is very important to simulate a traffic which is as close as possible to the real traffic database. It means it has to be avoided dismissing too many trucks while classifying them in the defined categories.

3.2.2.1. Definition of the different truck categories

An objective was defined: at least 90% of the total amount of trucks has to be classified. The goal of classifying the trucks into different truck categories is to group some trucks which are close one to each other in a geometrical point of view. It should imply a similar distribution of the total gross weight between axles for the trucks within a same category. Indeed, another objective was defined: the distances between axles and the linear correlation between the axle loads have to be acceptable. Unfortunately, it does not really exist a very efficient method to find the best categories, which give the best fit of the considered data in every category.

I chose an iterative process to define the different vehicle categories, and then I checked the fit of the data of every category. In the case of no curve could accurately model the data, then I knew that the sorting criteria of the vehicle category had to be modified. I have proceeded this way until I assumed the data (geometry and correlation between axle weights) was good enough. It has to be admitted that this method is entirely based on some qualitative and subjective criteria. Indeed, it could be possible to perform an R^2 analysis for each statistical characteristic of every vehicle category, and then trying to get R^2 as close to 1 as possible (R^2 closer to 1 means less error of the fit) by changing the sorting criteria in order to put more or less vehicles of different geometrical characteristics in the studied vehicle category. Nevertheless, an R^2 analysis by using the statistical data and the model of the TrafficAnalysis software and the ResultViewer Excel sheet has not been achieved in this work for the following reasons: first of all, I did not know how to extract the value of the histograms in the ResultViewer Excel sheet in order to treat the data to calculate a R^2 value for instance. Then, I did not have enough time to perform such an analysis. Moreover, Nariman Maddah, my supervising PhD student at EPFL who is working on the same area of study has not done such an analysis to find the best parameters of the different statistical parameters. That is why I decided to find the proper vehicle categories by just looking at the histogram and the fit of the data and then decide by a subjective point of view if the data were accurately modeled. In order to get a target to be reached for a considered “good” fit of the data, I looked at the traffic data treatments which were already performed by Nariman Maddah. An example of traffic data treatment can be found in Maddah et al. (2011).

For a first try, I get inspired by Coughlin et al. (2011) to define the first vehicle categories. Indeed, I assumed that the types of trucks driving in Canada are sensitively the same as the ones driving in the USA. Thus, I used the same table as I used to define the truck categories for the American traffic database. Unfortunately, and as said before, the truck categories defined in Coughlin et al. (2011) represent some deterministic characteristics. It means that the geometrical and weight characteristics of every vehicle type are defined by some fixed values. Although, a range including a minimum and a maximum value are required in this case to define some vehicle types for the Canadian traffic, as the traffic database available for the Canada is a non-deterministic database. Thus, I used the vehicle categories defined in Coughlin et al. (2011) and I increased the range of every geometrical parameter (spacing between axles) around the deterministic value in order to classify as many trucks as possible. Doing this step, it is very important to avoid the overlapping criteria conditions otherwise a given truck can be classified in two different categories. Moreover, it has to be noted that three extra categories for the four axle trucks had to be defined in addition of the categories defined in Coughlin et al. (2011). Moreover, a category defining a three axle truck (semi-trailer without the trailer) had to be added.

Unfortunately, the categories of truck were defined for trucks up to 6 axles only. The Canadian traffic database is constituted by trucks from two to eleven axles. Taking into account the trucks with six or less axles only (considering only the categories defined by Caughlin et al. (2011)) would have made the objective of classifying 90% or more of the total amount of trucks not reachable. That's why it has been decided to take the required time to define some vehicle categories for trucks of seven and eight axles. As there were not many trucks of nine, ten, and eleven axles, it has been decided to dismiss these vehicles from the traffic database.

The simulated Canadian traffic will be constituted by trucks of two to eight axles only. As it will be shown later, the objective of 90% of classified trucks will be reached anyway.

I had to use another method to define the relevant vehicle categories for the seven and eight axles trucks. First of all, I created one single category for the seven axles trucks and another category for the eight axles trucks. Then, the histograms of the distance between axles were computed for both vehicle categories. Afterwards, the different categories could have been defined by using an "exponential" process to define the different categories. Indeed, the different groups of spacing for each geometrical characteristic were identified and a corresponding spacing range defined. An example is shown in the figure below:

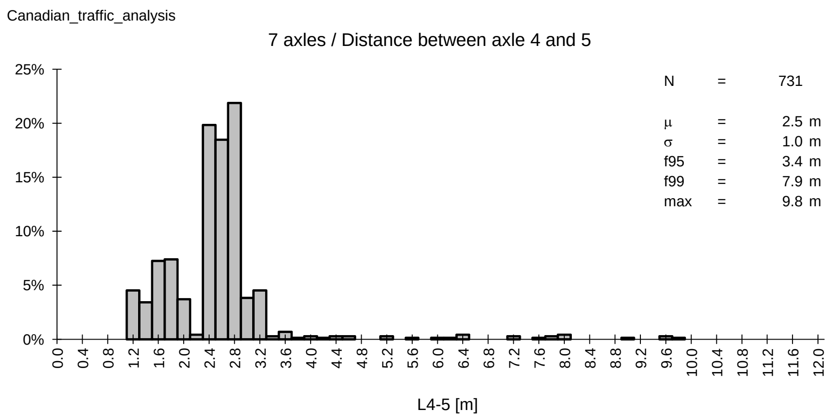


Tableau 17: distance between axle 4 and 5 of the 7 axles trucks

The figure represents the histogram of the distance between axle 4 and axle 5 of all trucks of seven axles. For the study of this geometrical characteristic, it looks like it exist three groups of seven axle trucks characterized by a different spacing range for the distance between axle 4 and axle 5. Indeed, the first spacing range could be from 0.8m to 2.2m, the second group from 2.2m to 3.6m and the third and last one for spacings over 3.6m. By using these criteria, no vehicle will be dismissed. The problem of the method is the exponential aspect of the number of categories. Indeed, we just defined 3 spacing groups for the distance between axle 4 and axle 5. As there are 6 distances between axles for the seven axles trucks, and if we assume there are 3 spacing groups for each distance between axles, the total number of possibilities of geometry for a seven axle trucks, i.e. the total number of truck categories will be equal to 3^6, which is equal to 729. It was the main problem that I had to face because 729 is a big number as a number of truck categories and it is not possible to define so many categories. Moreover, we need a minimum of trucks per category in order to fit properly the traffic data. That is why the definition of too many categories has to be avoided.

Anyway, it is important to keep in mind that the goal of the categorization of the seven and eight axles trucks is to sort the traffic database in order to group the trucks which have the same configuration of axles groups. Indeed, it is required to identify properly the groups of axles in order to fit as best as possible the axle weights. The linear correlation between axle groups can then be verified. That is how I defined the trucks categories for the seven and eight axle trucks. I identified the groups of axles to define the different possible categories. Then, I modified the minimum and maximum distance criteria in order to increase the number of trucks in the different categories. The target was to classify at least 90% of the seven and eight axle trucks. I deleted the categories which had less than 7 trucks. Finally, 11 truck categories were defined for the seven axle trucks, and 10 categories for the eight axle trucks.

Concerning the seven axles trucks, it has to be noted that many trucks had some unloaded axles. It was represented by an axle load equal to 0 in the traffic database. Nevertheless, this does not make any sense in a bridge loading point of view. Indeed, a seven axles truck with an unloaded axle should more likely considered like a six axles truck! This can be explained by the fact that the Canadian traffic database has been recorded using static weigh stations. Indeed, in a case of a truck with one of its axle lifted up, as we can see sometimes, we count seven axles with one of the seven axles lifted up. It explains why the load is equal to zero. As it caused some trouble in the definition of the axle weights for the simulated trucks, I decided to dismiss the seven axles trucks with one or more unloaded axle(s). The total number of trucks, dismissed and classified trucks for the seven axles trucks can be found in table 18 and 19.

Some trucks with a number of axles between 2 and 8 also have some unloaded axles, but I decided to keep them in the fit of the traffic data for each vehicle category. Indeed, they are not so many, and, moreover, the aim of the categorization was to simulate a traffic which is as close as possible to the Canadian traffic database. That's why it has been decided to dismiss as less trucks as possible, even if some of them have some unloaded axles and are more like some (n-1) axles than n axles trucks.

As it was very time demanding to sort the seven and eight axles trucks without the vehicle categories available, it has been decided to not take into account the nine, ten and eleven axles trucks. This decision does not have too much effect on the simulated traffic given the fact that there is a little few trucks with more than seven axles. The simulated traffic will be compared to the traffic simulated by the Fortran program used in Coughlin et al. (2011) anyway, in order to validate the model of the traffic simulation based on the Canadian traffic database.

As it can be noticed in the 2 different simulations present a perfect match.

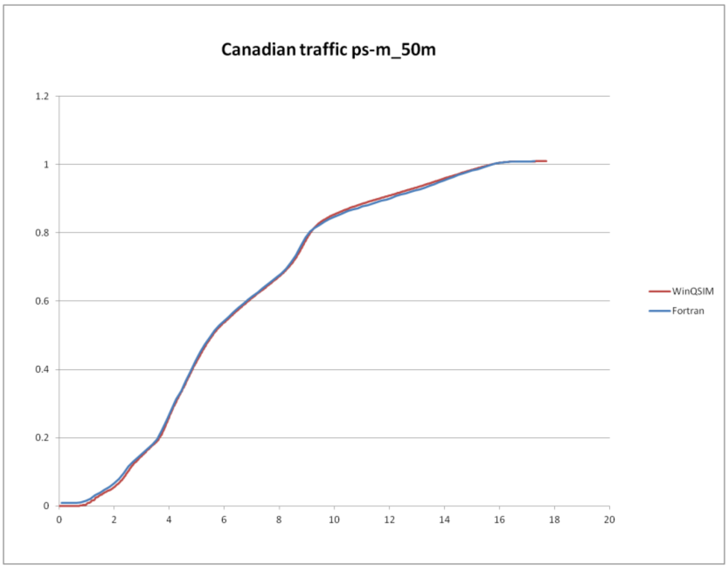


Figure 14: comparison between the Fortran and the WinQSIM analysis (PDF of the stress range histograms)

A study of the trucks classification for the Canadian traffic database has been performed in order to know if the percentage of classified vehicles was high enough. Indeed, if the percentage of classified trucks is acceptable and the fits of the geometrical and weights parameters are considered as satisfying, then we can consider that the simulated traffic will be close to the real traffic database.

A table of the study of the number of trucks per vehicle categories is available in the table below. The first column displays the number of trucks per number of axles. The sum of the first column is equal to the total number of trucks of the traffic database (number of lanes of the rawdata file). The aim of the second column is to show the number of seven axles trucks with one or more unloaded axle(s). As we can see, the values of the first and the second column for the other number of axles are equal. The third column shows the number of classified trucks, which will fit the data in order to simulate a traffic based on the fitted parameters. The percentage of classification is calculated by dividing the number of the third column by the number of the second one.

If the total number of trucks of the traffic database is taken into account, the percentage of classified trucks is equal to:

$$\frac{9437}{10198}100 = 92.5\%$$

The goal of over 90% of classified trucks is then reached. As most of the parameters of the traffic database are well fitted, we can assume that the simulated traffic will be close enough to the original traffic database.

	Number of trucks **before** unclassfying unloaded axles	Number of trucks **after** unclassifying unloaded axles	Number of classified trucks	Percentage of classification [%]
2 axles	1474	1474	1474	100.0
3 axles	668	668	647	96.9
4 axles	314	314	281	89.5
5 axles	4382	4382	4309	98.3
6 axles	1762	1762	1588	90.1
7 axles	731	488	465	95.3
8 axles	728	728	673	92.4
9 axles	119	119	0	0.0
10 axles	18	18	0	0.0
11 axles	2	2	0	0.0
	10198	9955	9437	**94.8**

Tableau 18: study of the traffic classification

The next table shows the comparison between the Canadian traffic database analysis and the simulated traffic analysis. The number of simulated trucks was equal to 2 millions, with 100% of trucks (0% of light vehicles). The percentages of trucks per category are very close. This is a way of checking if the simulated traffic corresponds to the analysis of the traffic database.

Canadian traffic database analysis				WIM analysis (simulated traffic)			
Vehicle category	Category name	Number of trucks	Percentage by category [%]	Vehicle category	Category name	Number of trucks	Percentage by category [%]
121	SU2	1474	**15.6**	121	SU2	312131	**15.6**
131	SU3	439	**4.7**	131	SU3	92493	**4.6**
141	SU4	8	**0.1**	141	SU4	1560	**0.1**
151	3-S2	4237	**44.9**	151	3-S2	899368	**45.0**
161	3-S3	1542	**16.3**	161	3-S3	326798	**16.3**
171		11	**0.1**	171		2478	**0.1**
231	2-S1	30	**0.3**	231	2-S1	6248	**0.3**
241	2-S2	85	**0.9**	241	2-S2	17741	**0.9**
251	2-S3	21	**0.2**	251	2-S3	4394	**0.2**
261	3-S1-2	46	**0.5**	261	3-S1-2	9702	**0.5**
331	3-ST	178	**1.9**	331	3-ST	37333	**1.9**
341	3S1	18	**0.2**	341	3S1	3708	**0.2**
351	2-S1-2	51	**0.5**	351	2-S1-2	10866	**0.5**
441	2-S2-bis	84	**0.9**	441	2-S2-bis	17728	**0.9**
471		29	**0.3**	471		6207	**0.3**
541	2S2-bis2	50	**0.5**	541	2S2-bis2	10882	**0.5**
571		13	**0.1**	571		2735	**0.1**
641	2S2-bis3	36	**0.4**	641	2S2-bis3	6944	**0.3**
771		89	**0.9**	771		18636	**0.9**
871		12	**0.1**	871		2600	**0.1**
1071		194	**2.1**	1071		41260	**2.1**
1171		19	**0.2**	1171		3974	**0.2**
1371		36	**0.4**	1371		7621	**0.4**
1471		42	**0.4**	1471		9007	**0.5**
1671		7	**0.1**	1671		1372	**0.1**
1971		13	**0.1**	1971		2734	**0.1**
2781		68	**0.7**	2781		14529	**0.7**
3181		24	**0.3**	3181		5020	**0.3**
3381		30	**0.3**	3381		6454	**0.3**
3881		118	**1.3**	3881		24997	**1.3**
3981		9	**0.1**	3981		2047	**0.1**
4381		34	**0.4**	4381		7200	**0.4**
4681		32	**0.3**	4681		6832	**0.3**
5181		113	**1.2**	5181		23883	**1.2**
5281		13	**0.1**	5281		2748	**0.1**
5381		232	**2.5**	5381		49100	**2.5**
		9437	**100.0**			1999330	**100.0**

Tableau 19: comparison between the traffic database and the simulated traffic

An analysis of the fit of the geometrical parameters and the linear correlation between the axle weights for the traffic database can be found in appendix. The fit of the corresponding parameter for the simulated traffic is also displayed and then can be compared to the traffic database.

3.2.2.2. Example of a seven axles truck category

An example of the fit of the geometrical parameters and the linear correlation between the axle groups weights is shown is the figures below. This is the analysis of the truck category 771. The graph which corresponds to the traffic database is first displayed, and then the graph of the same parameter of the simulated traffic. Thus, a very quick analysis is possible and it is very easy to compare the simulated traffic to the traffic database.

A schematic drawing of the configuration of the truck is presented in the figure below:

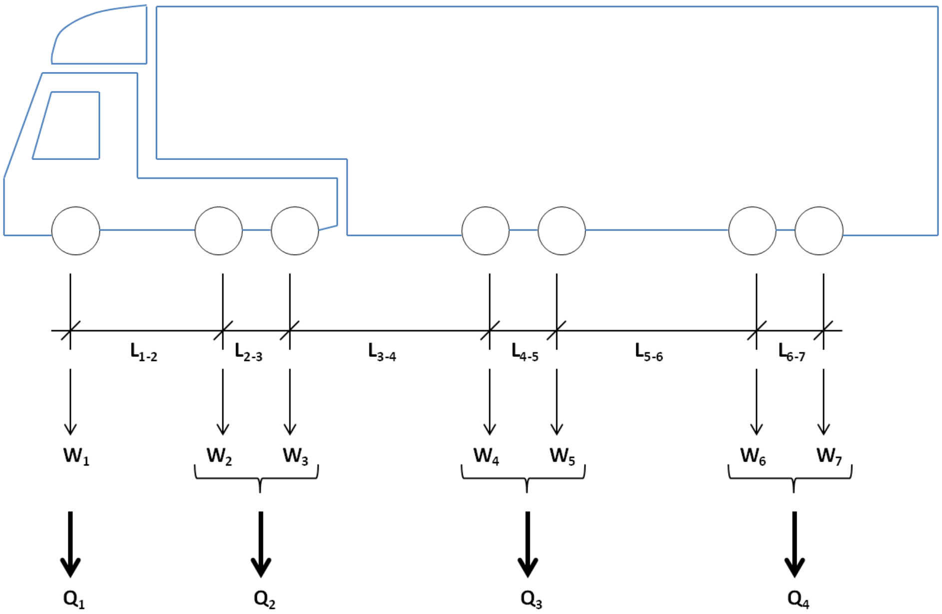
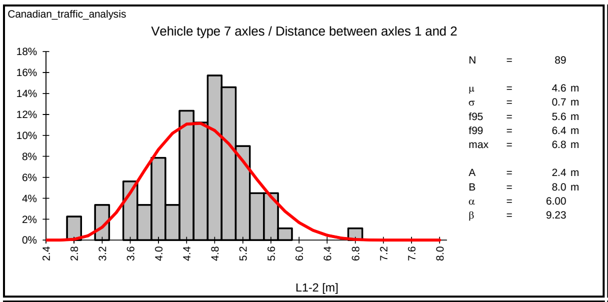
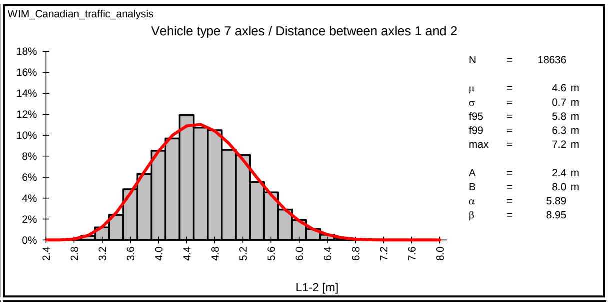
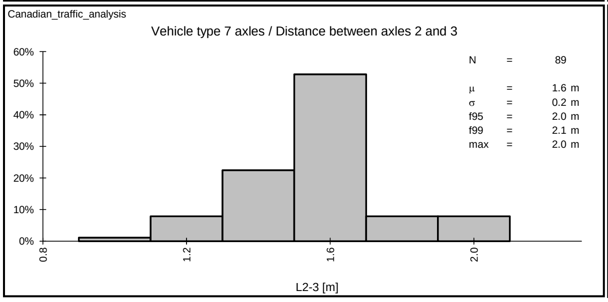
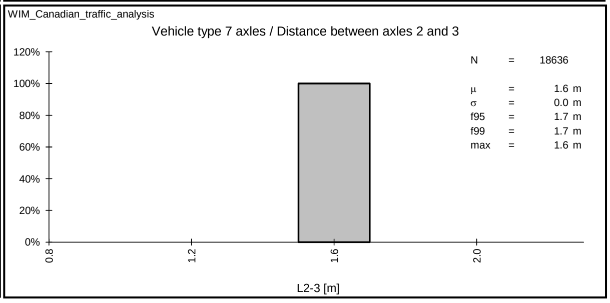


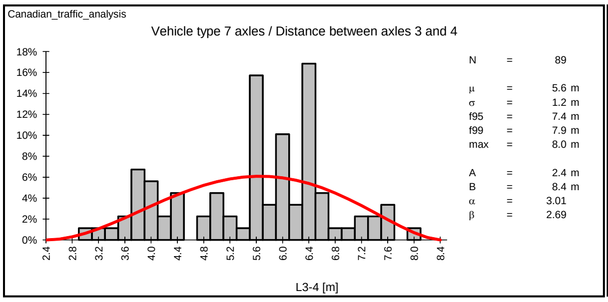
Figure 15: schematic configuration of 7 axle truck

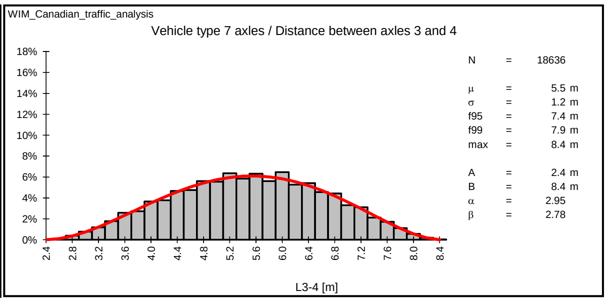

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
N = 89
μ = 4.6 m
σ = 0.7 m
f95 = 5.6 m
f99 = 6.4 m
max = 6.8 m
A = 2.4 m
B = 8.0 m
α = 6.00
β = 9.23
L1-2 [m]

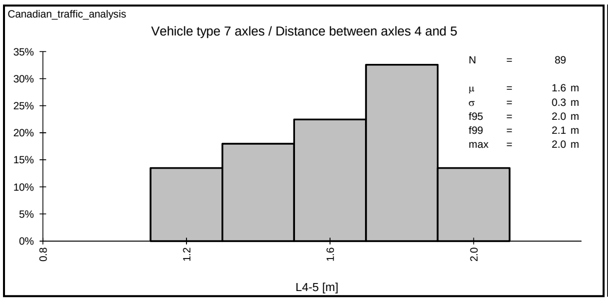

WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
N = 18636
μ = 4.6 m
σ = 0.7 m
f95 = 5.8 m
f99 = 6.3 m
max = 7.2 m
A = 2.4 m
B = 8.0 m
α = 5.89
β = 8.95
L1-2 [m]

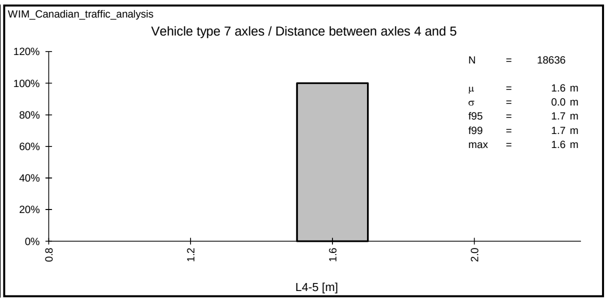

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
N = 89
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L2-3 [m]

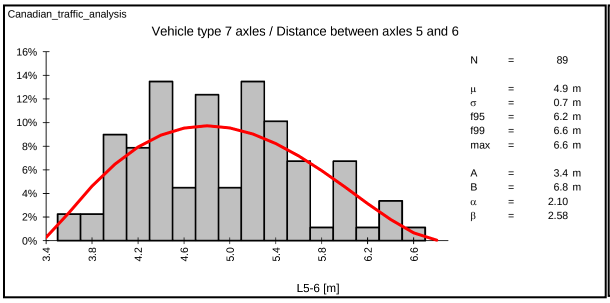

WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
N = 18636
μ = 1.6 m
σ = 0.0 m
f95 = 1.7 m
f99 = 1.7 m
max = 1.6 m
L2-3 [m]

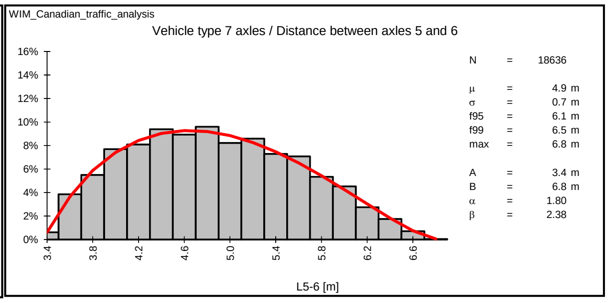

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
N = 89
μ = 5.6 m
σ = 1.2 m
f95 = 7.4 m
f99 = 7.9 m
max = 8.0 m
A = 2.4 m
B = 8.4 m
α = 3.01
β = 2.69
L3-4 [m]

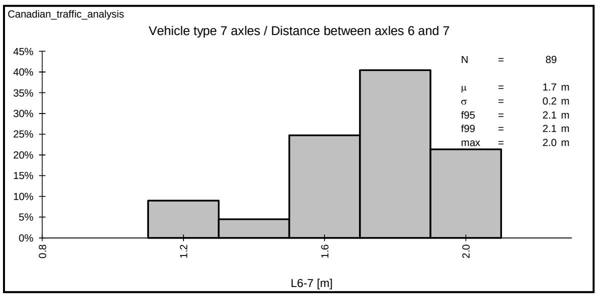

WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
N = 18636
μ = 5.5 m
σ = 1.2 m
f95 = 7.4 m
f99 = 7.9 m
max = 8.4 m
A = 2.4 m
B = 8.4 m
α = 2.95
β = 2.78
L3-4 [m]

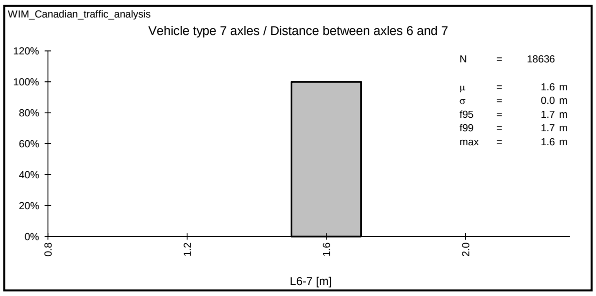

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
N = 89
μ = 1.6 m
σ = 0.3 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L4-5 [m]

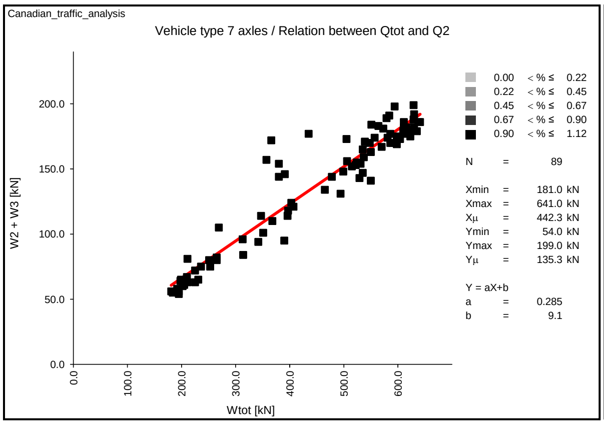

WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
N = 18636
μ = 1.6 m
σ = 0.0 m
f95 = 1.7 m
f99 = 1.7 m
max = 1.6 m
L4-5 [m]

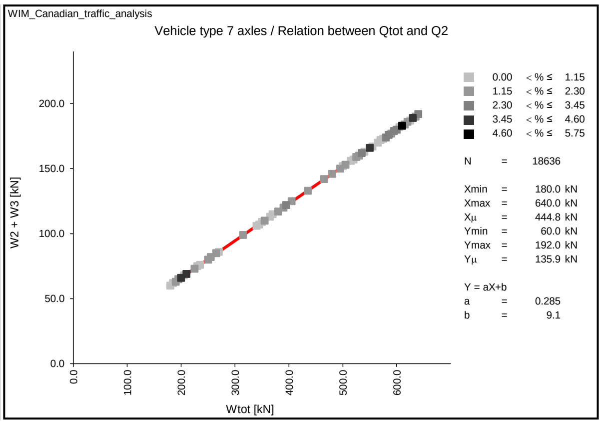

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
N = 89
μ = 4.9 m
σ = 0.7 m
f95 = 6.2 m
f99 = 6.6 m
max = 6.6 m
A = 3.4 m
B = 6.8 m
α = 2.10
β = 2.58
L5-6 [m]

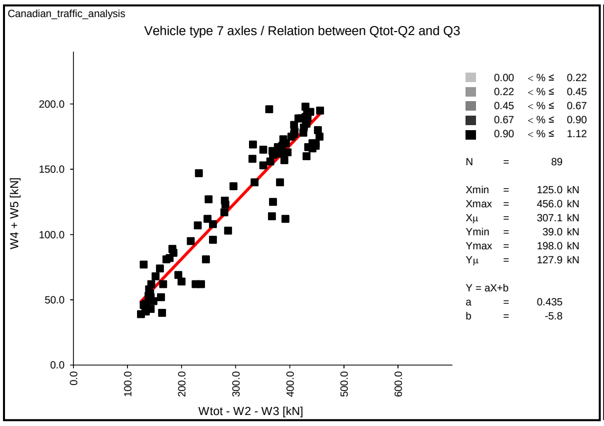

WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
N = 18636
μ = 4.9 m
σ = 0.7 m
f95 = 6.1 m
f99 = 6.5 m
max = 6.8 m
A = 3.4 m
B = 6.8 m
α = 1.80
β = 2.38
L5-6 [m]

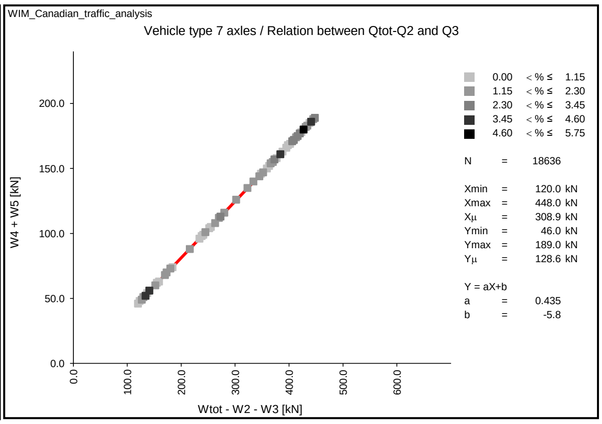

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
N = 89
μ = 1.7 m
σ = 0.2 m
f95 = 2.1 m
f99 = 2.1 m
max = 2.0 m
L6-7 [m]

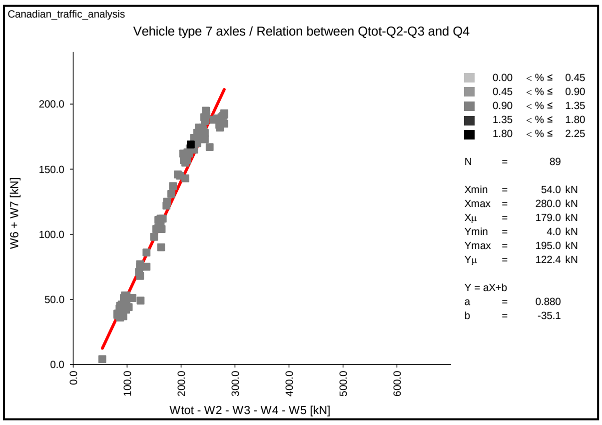

WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
N = 18636
μ = 1.6 m
σ = 0.0 m
f95 = 1.7 m
f99 = 1.7 m
max = 1.6 m
L6-7 [m]

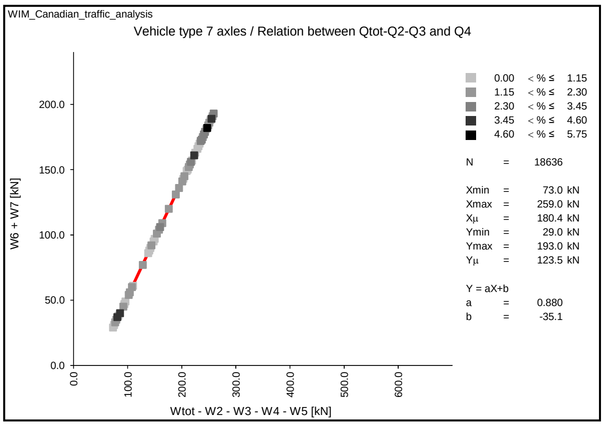

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
Wtot [kN]
0.00 < % ≤ 0.22
0.22 < % ≤ 0.45
0.45 < % ≤ 0.67
0.67 < % ≤ 0.90
0.90 < % ≤ 1.12
N = 89
Xmin = 181.0 kN
Xmax = 641.0 kN
Xμ = 442.3 kN
Ymin = 54.0 kN
Ymax = 199.0 kN
Yμ = 135.3 kN
Y = aX+b
a = 0.285
b = 9.1

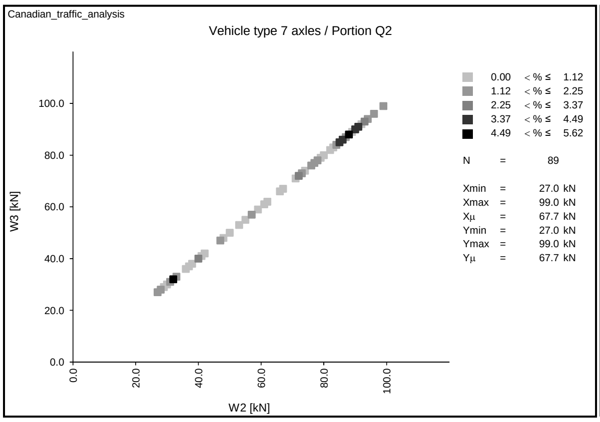

WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
Wtot [kN]
0.00 < % ≤ 1.15
1.15 < % ≤ 2.30
2.30 < % ≤ 3.45
3.45 < % ≤ 4.60
4.60 < % ≤ 5.75
N = 18636
Xmin = 180.0 kN
Xmax = 640.0 kN
Xμ = 444.8 kN
Ymin = 60.0 kN
Ymax = 192.0 kN
Yμ = 135.9 kN
Y = aX+b
a = 0.285
b = 9.1

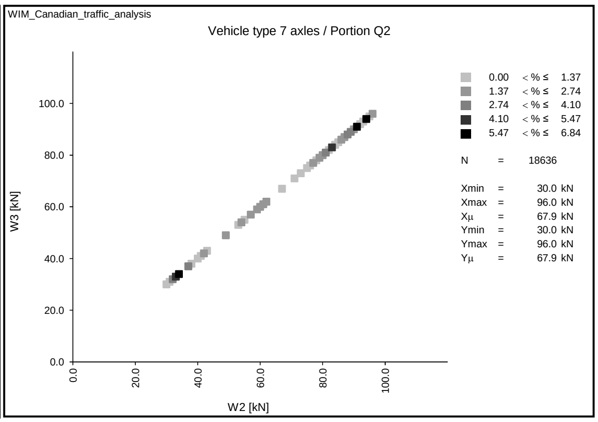

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q3
W4 + W5 [kN]
Wtot - W2 - W3 [kN]
0.00 < % ≤ 0.22
0.22 < % ≤ 0.45
0.45 < % ≤ 0.67
0.67 < % ≤ 0.90
0.90 < % ≤ 1.12
N = 89
Xmin = 125.0 kN
Xmax = 456.0 kN
Xμ = 307.1 kN
Ymin = 39.0 kN
Ymax = 198.0 kN
Yμ = 127.9 kN
Y = aX+b
a = 0.435
b = -5.8

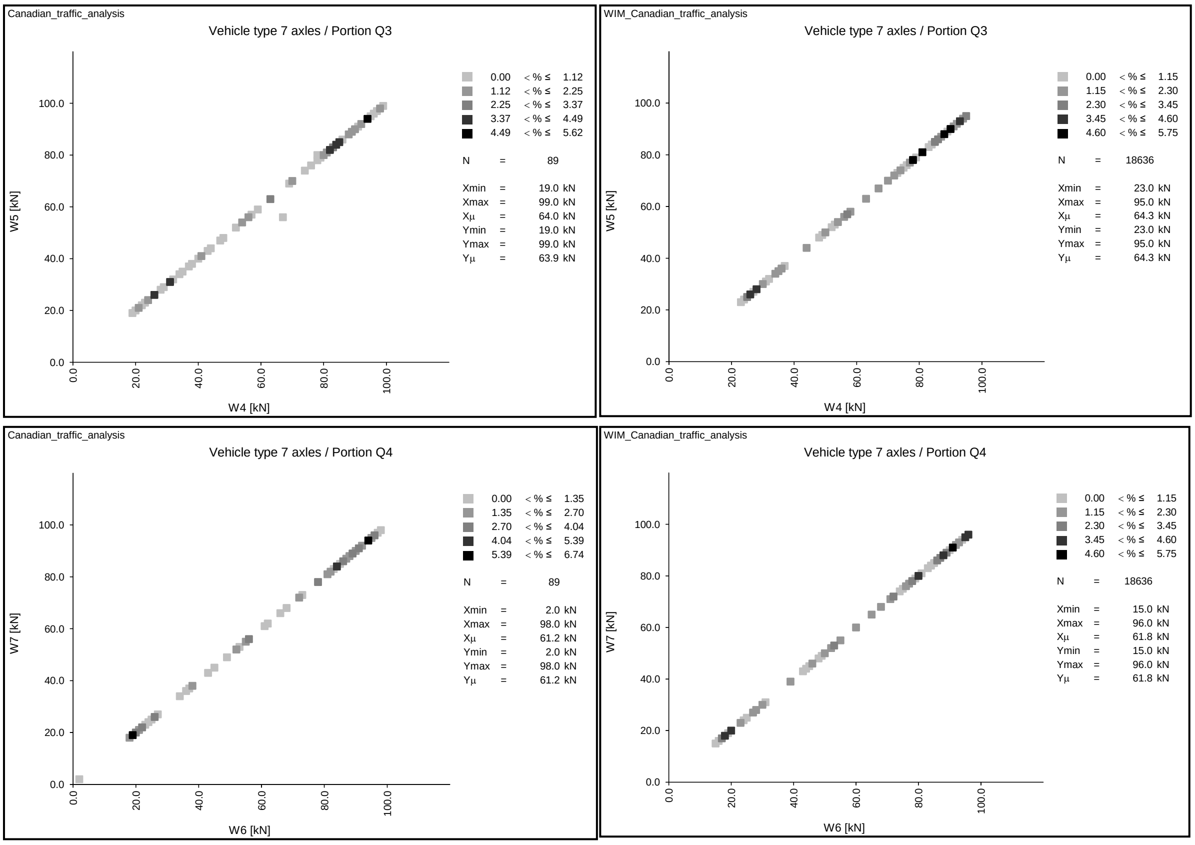

WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q3
W4 + W5 [kN]
Wtot - W2 - W3 [kN]
0.00 < % ≤ 1.15
1.15 < % ≤ 2.30
2.30 < % ≤ 3.45
3.45 < % ≤ 4.60
4.60 < % ≤ 5.75
N = 18636
Xmin = 120.0 kN
Xmax = 448.0 kN
Xμ = 308.9 kN
Ymin = 46.0 kN
Ymax = 189.0 kN
Yμ = 128.6 kN
Y = aX+b
a = 0.435
b = -5.8


Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q3 and Q4
W6 + W7 [kN]
Wtot - W2 - W3 - W4 - W5 [kN]
0.00 < % ≤ 0.45
0.45 < % ≤ 0.90
0.90 < % ≤ 1.35
1.35 < % ≤ 1.80
1.80 < % ≤ 2.25
N = 89
Xmin = 54.0 kN
Xmax = 280.0 kN
Xμ = 179.0 kN
Ymin = 4.0 kN
Ymax = 195.0 kN
Yμ = 122.4 kN
Y = aX+b
a = 0.880
b = -35.1


WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q3 and Q4
W6 + W7 [kN]
Wtot - W2 - W3 - W4 - W5 [kN]
0.00 < % ≤ 1.15
1.15 < % ≤ 2.30
2.30 < % ≤ 3.45
3.45 < % ≤ 4.60
4.60 < % ≤ 5.75
N = 18636
Xmin = 73.0 kN
Xmax = 259.0 kN
Xμ = 180.4 kN
Ymin = 29.0 kN
Ymax = 193.0 kN
Yμ = 123.5 kN
Y = aX+b
a = 0.880
b = -35.1


Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 1.12
1.12 < % ≤ 2.25
2.25 < % ≤ 3.37
3.37 < % ≤ 4.49
4.49 < % ≤ 5.62
N = 89
Xmin = 27.0 kN
Xmax = 99.0 kN
Xμ = 67.7 kN
Ymin = 27.0 kN
Ymax = 99.0 kN
Yμ = 67.7 kN


WIM_Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 1.37
1.37 < % ≤ 2.74
2.74 < % ≤ 4.10
4.10 < % ≤ 5.47
5.47 < % ≤ 6.84
N = 18636
Xmin = 30.0 kN
Xmax = 96.0 kN
Xμ = 67.9 kN
Ymin = 30.0 kN
Ymax = 96.0 kN
Yμ = 67.9 kN



One of the aims of the classification of the trucks for the Canadian traffic database was to identify the groups of axles, in order to fit accurately the data of the weights between groups of axles. It is obvious, for the example of the vehicle category 771, that the groups of axles have correctly been identified. Indeed, the repartition of the weight of a group of axles is perfectly divided by two (two axles per group of axles).

Moreover, as the comparison between the WinQSIM simulations and the Fortran simulation has shown a perfect match, we can conclude that the simulated traffic is very close to the Canadian traffic database.

4. FATIGUE CORRECTION FACTORS: ANALYSIS CASES

The procedure that has been used to study the effect of simultaneous vehicle crossing on the North American fatigue correction factor is presented in this chapter. This chapter is divided into two parts: the first one deals with the parameters that have been selected to study in order to demonstrate their influence on the fatigue correction factor values. It includes the presentation of the traffic data base, the S-N curves that have been considered, the influence lines that have been studied, the different bridge cross-section and finally the traffic conditions. The second part of this chapter deals with the explanation of the method which has been used to create more-or-less of simultaneous vehicle crossings. It is explained in details in this sub-chapter.

First of all, the other parameters of the simulations are presented.

4.1. Presentation of the parameters of the simulations

In this first sub-section, the main parameters which characterize the simulations are presented and justified. The parameters in question are:

- Traffic database
- S-N curves
- Influence lines
- Bridge cross-section
- Traffic conditions

These parameters will be discussed in details and one-by-one in the following sub-sections. The traffic conditions, which play a significant role in the simultaneous vehicle crossings parameter will be presented and explained in section 4.2.

The different choices that have been decided about these parameters are mainly due to the fact that it was required to simulate the same parameters than the ones in Caughlin et al. 2011. Indeed, it would make possible the comparison and the validation of the obtained result, at least for the case without simultaneous vehicle crossings.

4.1.1. Traffic database

As previously said and presented in section 2, the traffic database used in this work was the same traffic database which has been considered in Coughlin et al. (2011). It consists in the traffic database on which are calibrated the fatigue correction factors of the American (AASHTO) and Canadian (CAN/CSA-S6-06) codes.

These two traffic database have been studied, analyzed and discussed in depth in section 2.

It would have been interesting to compare the North American traffic database to the Swiss (European) traffic one, i.e. computing the same simulations with different traffic. Nevertheless, it hasn't been performed, given the fact that the study of the Swiss and European traffic was already studied by Nariman Maddah.

4.1.2. S-N curves

In this work, some very simple S-N curves were used. Indeed, only some single slope S-N curves were considered. As the main objective of this master thesis is to study the effect of simultaneous vehicle crossings, it does not really matter which slope we consider. Nevertheless, the most of the presented results in this work will be some values computed considering a slope of $m = 3$, usual value for steel structures, even though all the results are also available for the slope values of $m = 5$ and $m = 6.85$, typical extreme values of the S-N curves slopes for aluminum structures. Only some of these results considering these values of slopes will be shown in this work, in order to demonstrate the effect of the increase/decrease of the number of cycles versus the stress ranges.

Moreover, any constant amplitude fatigue limit $\Delta\sigma_D$, neither cut-off limit $\Delta\sigma_L$ (ECCS 2011) were considered in the computations of the fatigue correction factor values. This is a condition of validity of the conversion formula.

4.1.3. Influence lines

The influence lines that have been studied in this work were the same as the ones used in Coughlin et al. (2011). The positive bending moment at mid-span was studied for a simple span bridge, 2 span bridge and 5 spans bridge. Also the negative bending moment at mid-support for a 2 span bridge was considered. The results for the reaction support of a simple span bridge were also computed. It makes a total of 5 different internal forces. Moreover, some different span lengths were considered for each case: 15m, 25m, 50m and 100m. A few simulations were run using some shorter span lengths in order to check the conversion formula (more than 1 expected cycle per truck). The results of these simulations will be shown in section 5.

It has to be noted that the different span lengths for the 5 spans bridge are not equal. Indeed, the exterior spans are a little bit shorter than the interior spans, as it is often the case in bridge design. Their lengths are equal to 80% of the interior span lengths.

In the figures below are shown the different influences lines considered in this work, including their name definition. The presented influence lines are the ones considering a span length of 50m and without transversal load distribution ($\eta = 1$).

Mid-span section, simple span bridge, bending moment:

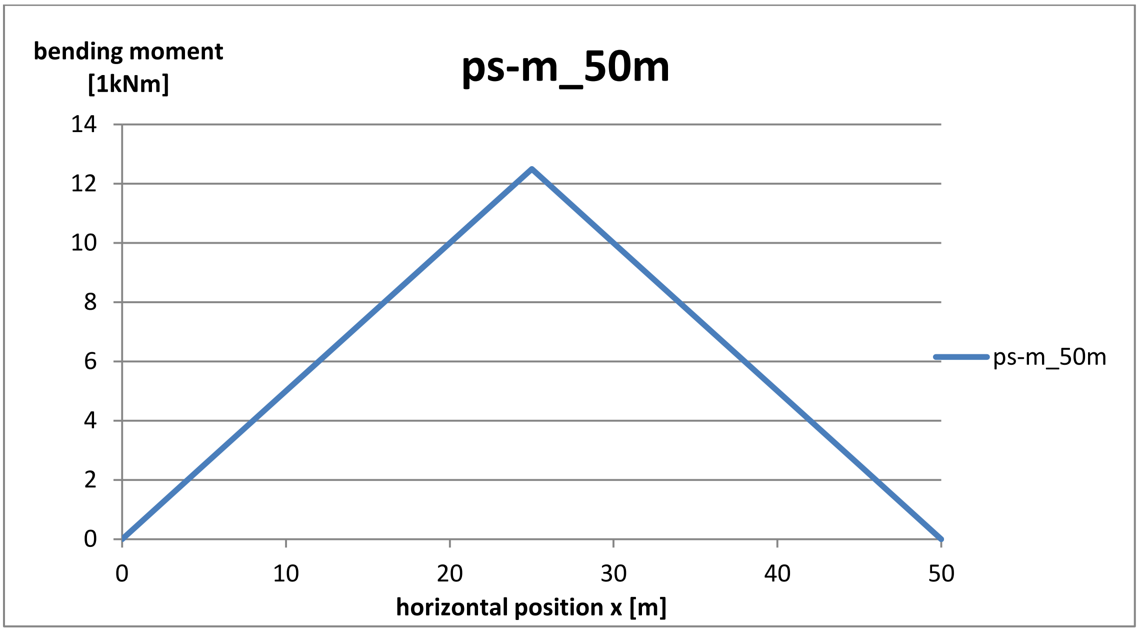


Figure 16: influence line ps-m_50m

Mid-span section, 2 spans bridge, bending moment:

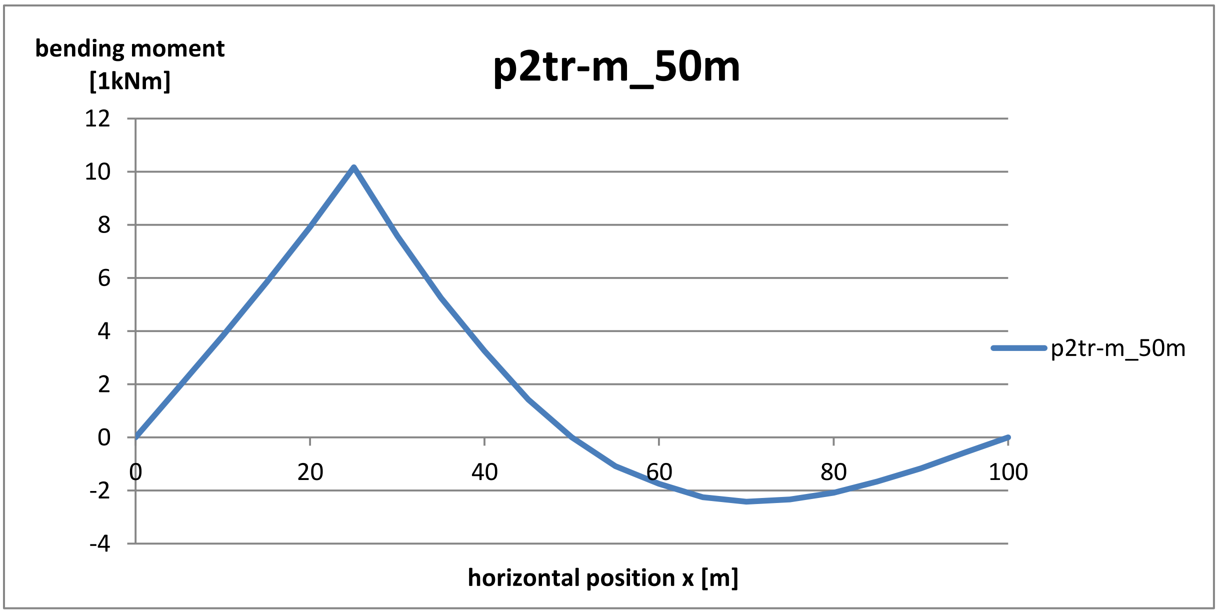


Figure 17: influence line p2tr-m_50m

Mid-span section, 5 spans bridge, bending moment:

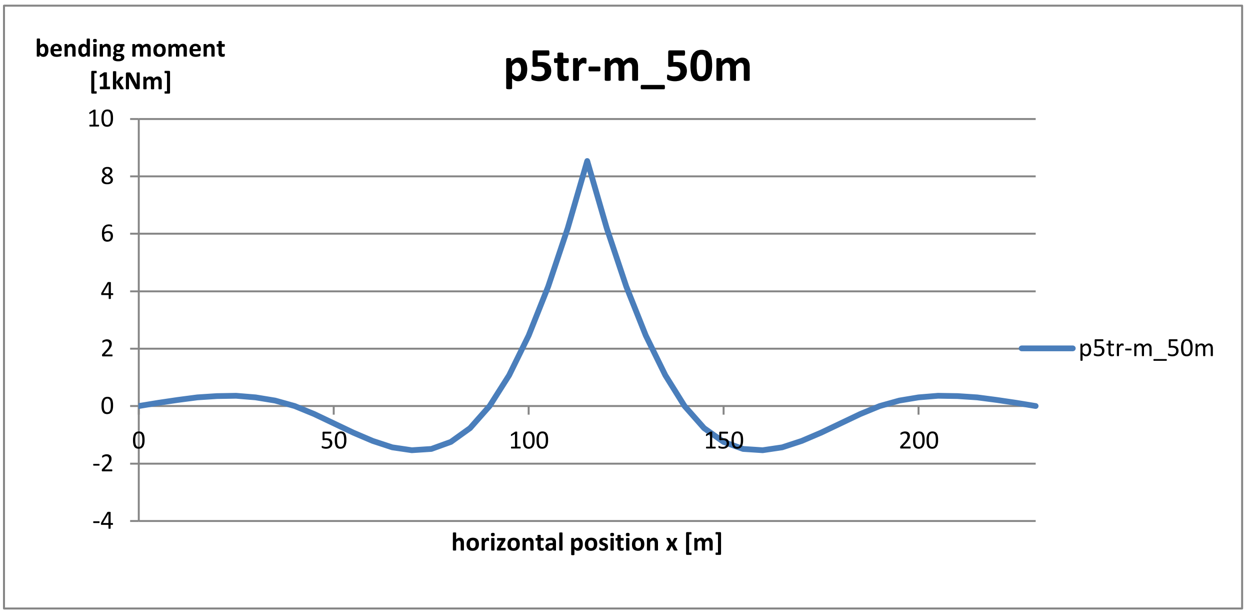


Figure 18: influence line p5tr-m_50m

Mid-support section, 2 spans bridge, bending moment:

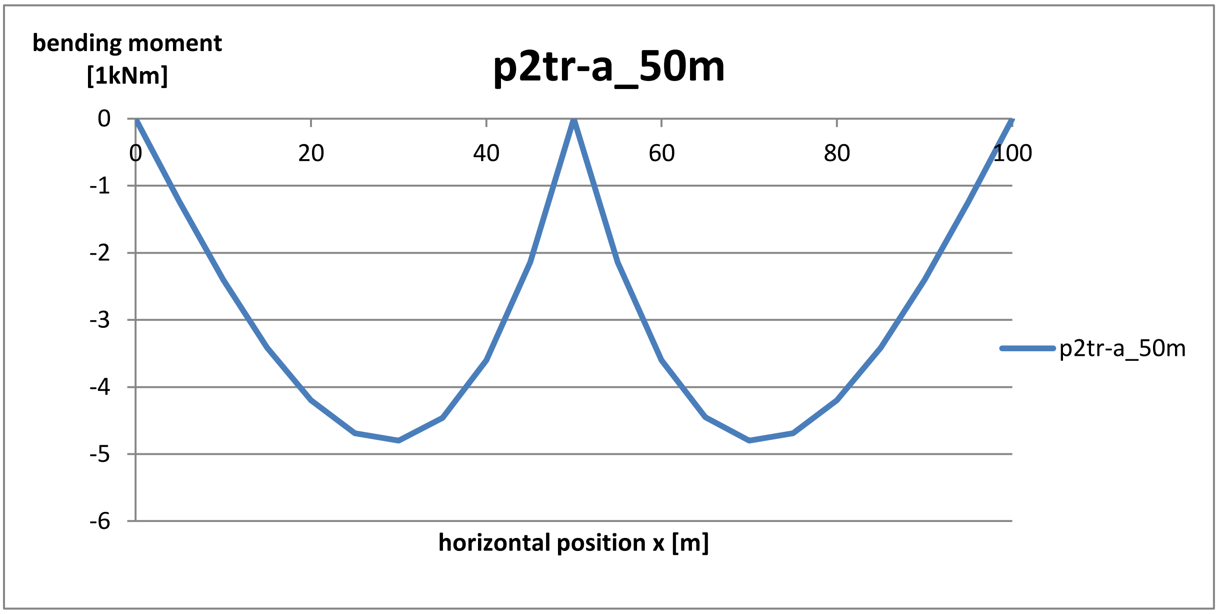


Figure 19: influence line p2tr-a_50m

Supper section, simple span bridge, support reaction:

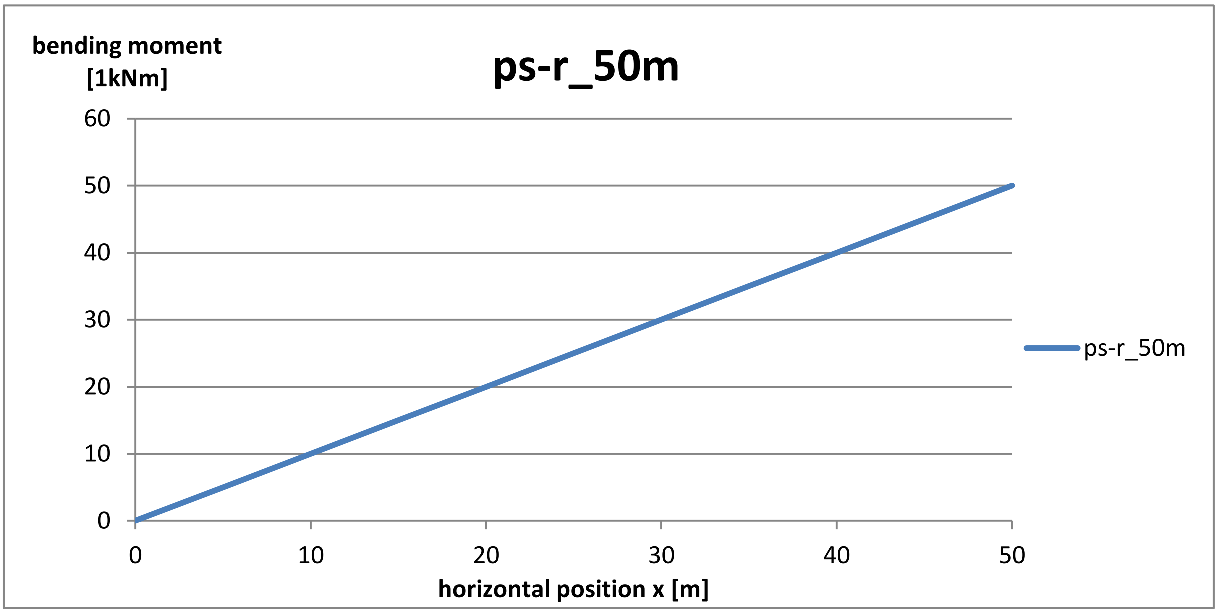


Figure 20: influence line ps-r_50m

4.1.4. Bridge cross-sections

The objective of this master thesis was to simulate traffic on some bridges constituted by 2 traffic lanes. Thus, it exists mostly two kinds of bridge cross-section that can carry a concrete slab with 2 traffic lanes travelling on it. The first type of cross-section is an open cross-section. The second type is constituted by a box cross-section.

Since these two kinds of cross-section are considered for the bridges carrying 2 traffic lanes, the transversal load distribution has to be studied. Indeed, it plays a key role in the stress range acting in the considered structural detail, and thus in the stress range, in the damage accumulation and finally in the fatigue correction factor. This parameter (η) has to be studied very carefully.

The transversal load distribution expresses the torsion mode of resistance. Indeed, a bridge girder can develop a torsion strength by developing some shear stress or normal stress. In the case of the torsion strength is mostly given by a shear flow, it means the torsion resistance is mostly some uniform torsion. This is the case for the closed cross-section. On the opposite side, it the torsion strength is given by the development of normal stresses due to the twisting moment, it means the torsion strength is mostly given by some non-uniform torsion. This kind of torsion resistance appears in the case of open cross-section (I-girder cross-section).

In the case of a 2 traffic lanes supported by a double I-girder cross-section bridge, the typical values for the coefficients of the transversal load distribution are 0.9 and 0.1 (TGC 12, Fig. 11.23). In this case, it is obvious that the vehicles (trucks) which are travelling on the lane with the coefficient of 0.1 will create a significant smaller effect on the studied structural detail. Indeed, the induced stress range in the structural detail due to the passage of a truck will be close to ten times smaller than if the same truck would have travelled on the other lane. Moreover, as the North American fatigue correction factor does not depend on the considered amount of trucks, the value of the fatigue correction factor will be much lower if some trucks are travelling on the lane with the coefficient of 0.1 for the transversal load distribution.

Indeed, the box girder is a lot more critical as a cross-section for carrying a two-lane traffic. The torsion strength developed by a box section is mostly constituted by some uniform torsion, i.e. a shear stress flow in the perimeter of the cross section. It means that the total load acting on the bridge slab will be equally divided by two and then be supported by the girder which form the box section. It can then be assumed, in a closed section, that the slope of the transversal load distribution is equal to zero. The coefficients corresponding to the loads acting on both lanes will be both equal to 0.5. It means that every truck passing over the bridge will create the same stress range in the considered structural detail, independently if the truck is crossing the bridge on a given lane or on the other one. As there is a higher probability of simultaneous vehicle crossing for a two-lane bridge than for the case of a single-lane bridge, the case of a two-lane traffic carried by a box girder will probably be the worst case in a fatigue correction factor point of view.

Another case of cross-section that has to be studied is the case of the multiple girder bridge. For this case of cross-section, the torsion strength is given both by some uniform and non-uniform torsion strength. The effective part of uniform or non-uniform torsion is given by the stiffness of the concrete or steel slab. Indeed, this stiffness will govern the repartition of the loads acting on the slab in the different I-girder underneath. This phenomenon is illustrated in the figure below:

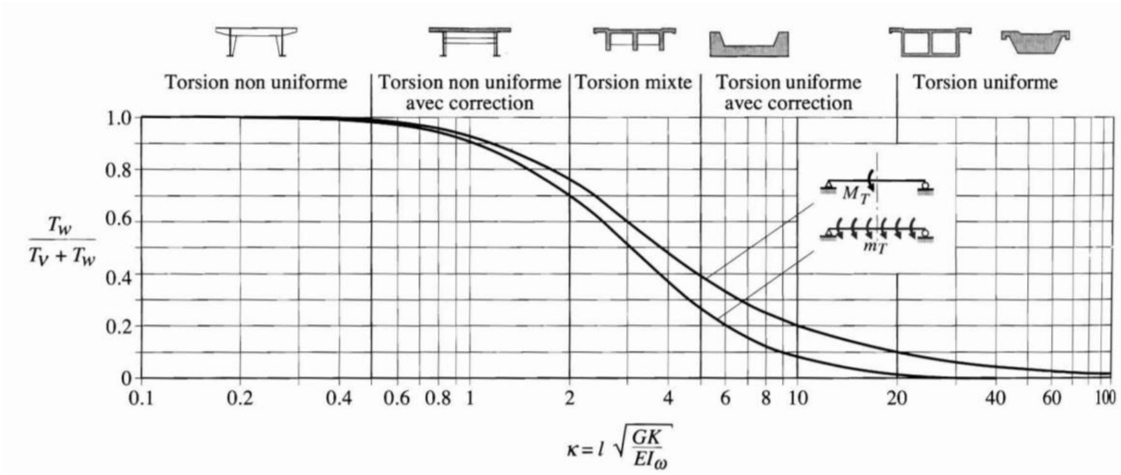


Figure 21: ratio between uniform and non-uniform torsion strength (TGC 12)

In this work, the slab of the multiple-girder bridge has been considered as extremely flexible in torsion. Indeed, every traffic lane is considered as carried by one single I-girder. It implies that (if the traffic is the same on both lanes) the two-lane traffic carried by some multiple I-girder can be considered as a 1-lane traffic carried by one single I-girder. The transversal load distribution coefficient will thus be equal to 1.

Finally, the simulated cases of cross-section can be summarized in the following table:

Number of traffic lanes	Type of cross-section	Transversal load distribution coefficient [-]	
		for the traffic lanes	considered for the fatigue truck model
2	box	0.5/0.5	0.5
2	I-girder	0.9/0.1	0.9
1	I-girder	1	1

Figure 22: cross-section considered in the traffic simulations

The case of 2 traffic lanes carried by a I-girder cross-section will not be studied in depth, as it is not critical. Some computations and fatigue correction factors results have been computed to confirm this, but they are not displayed in this work.

4.1.5. Traffic types

The different traffic types that will be simulated and considered in the computation of the fatigue correction factor are highly linked to the considered cross-section. Indeed, two types of road configuration have been selected: two-lane traffic and single lane traffic.

For the case of the single lane traffic, it has been considered that this lane is carried at 100% ($\eta = 1$) by an I-girder. This is this first type of traffic that has been simulated.

Then, a two-lane traffic has been considered. The worst case has been studied concerning the type of bridge, i.e. the box cross-section only has been studied for the two-lane traffic. For this kind of traffic, two type of traffic have been considered in order to know the influence on the fatigue correction factor values: unidirectionnal and bidirectionnal.

More details about the traffic conditions are presented in the next section (4.2).

4.1.6. Percentage of trucks

Another parameter related to the traffic which is important to define and to discuss here is the percentage of trucks assumed in the simulations. As considered as a common knowledge, the light vehicles as cars do not have an influence on the fatigue phenomenon of bridges. Indeed, the stress cycles created by cars are too small to create a fatigue damage. Indeed, the stress range would be under the cut-off limit in the case of a 2-slope S-N curve. In this work, only single-slope S-N curves have been studied, but the influence of cars has still been neglected. By considering that cars do not influence the fatigue damage, the effect of cars can be summarize as they increase the spacing between trucks. Indeed, as a loading of the bridge point of view, the presence of cars would increase the spacings between trucks and then decrease the equivalent truck flow, and then decrease the probability of simultaneous vehicle crossing. That is why it has been decided, in all simulations, to simulate a traffic without cars. The influence of cars on the equivalent truck flow is studied and discussed further in this work.

4.2.Simultaneous vehicle crossings traffic conditions

In this section, the way of creating simultaneous vehicle crossing in the simulations will be described. First of all, it has to be précised that no information about the real traffic conditions of the North American highways was available at the beginning of this study. That is why it has been decided to simulate some different traffic with more-or-less simultaneous vehicle crossings in order to emphasize the effect of this phenomenon on the fatigue correction factor. Some artificial traffic conditions were thus created. A discussion about the comparison between the artificial and the real traffic conditions will be performed at the end of this work.

The different simulations had to be different in a simultaneous vehicle crossings point of view, from a value “without simultaneous vehicle crossings” to a very high level of simultaneous vehicle crossings. Then it will be easy to know this effect of this parameter. The parameters that have been decided to change in the WinQSIM simulations are the traffic flow [veh/sec] and also the minimal interval between vehicles [sec]. Indeed, it is possible to force some vehicles to cross the bridge on the same time if the traffic flow is high enough. Moreover, the minimal interval between vehicles can be specified as very small if it is desired to have some simultaneous vehicle crossings. On the opposite side, the minimal interval can be defined as very high (and a low traffic flow) in order to avoid the simultaneous vehicle crossing.

As a reminder, the distance between vehicles for free-moving traffic condition is given by a shifted exponential probability distribution (Bailey, 1996). This is how is simulated the distance between vehicles by WinQSIM. The expression of the PDF of distance between vehicles is reproduced in the following expression:

$$f_D(d) = \frac{V}{3600 * 22} \exp\left(-\frac{V}{3600 * 22}(d - 5.5)\right)$$

This expression is valid for an assumed constant traffic speed of 22 m/s (80 km/h).

The influence of the traffic volume is shown in the figure below:

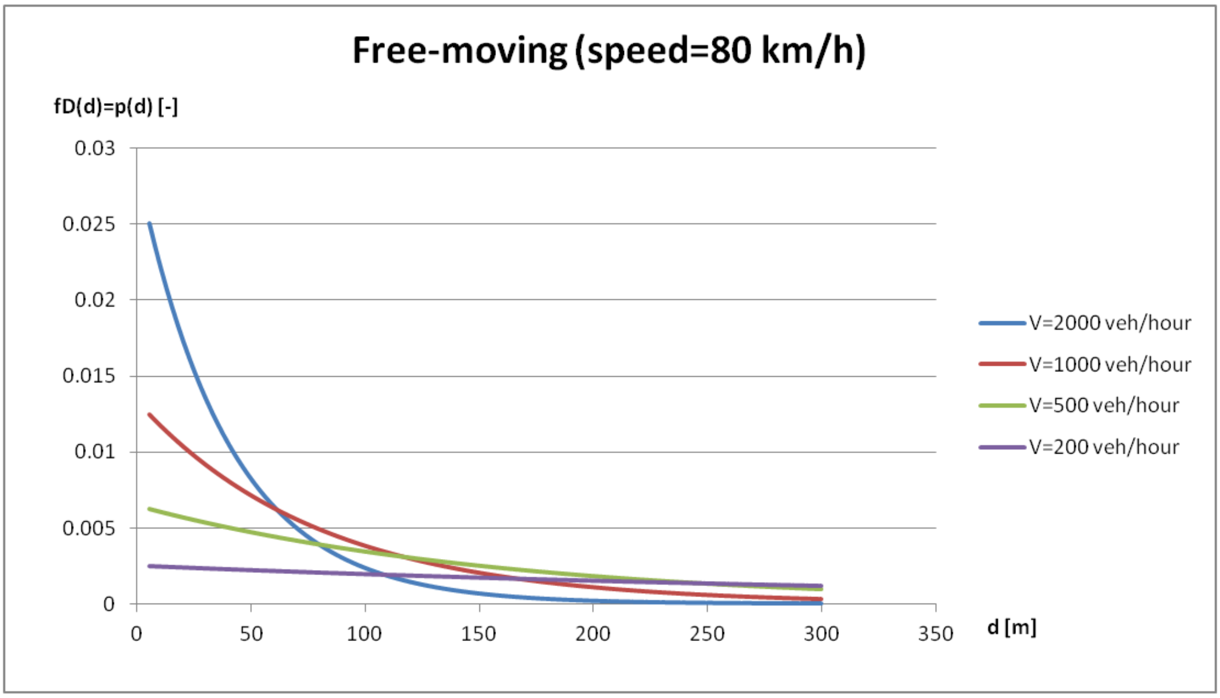


Figure 23: effect of the traffic volume on the distance between vehicles

Also, the probability density function of the distance between vehicles depends on the assumed traffic speed. This effect can be seen in the figure below:

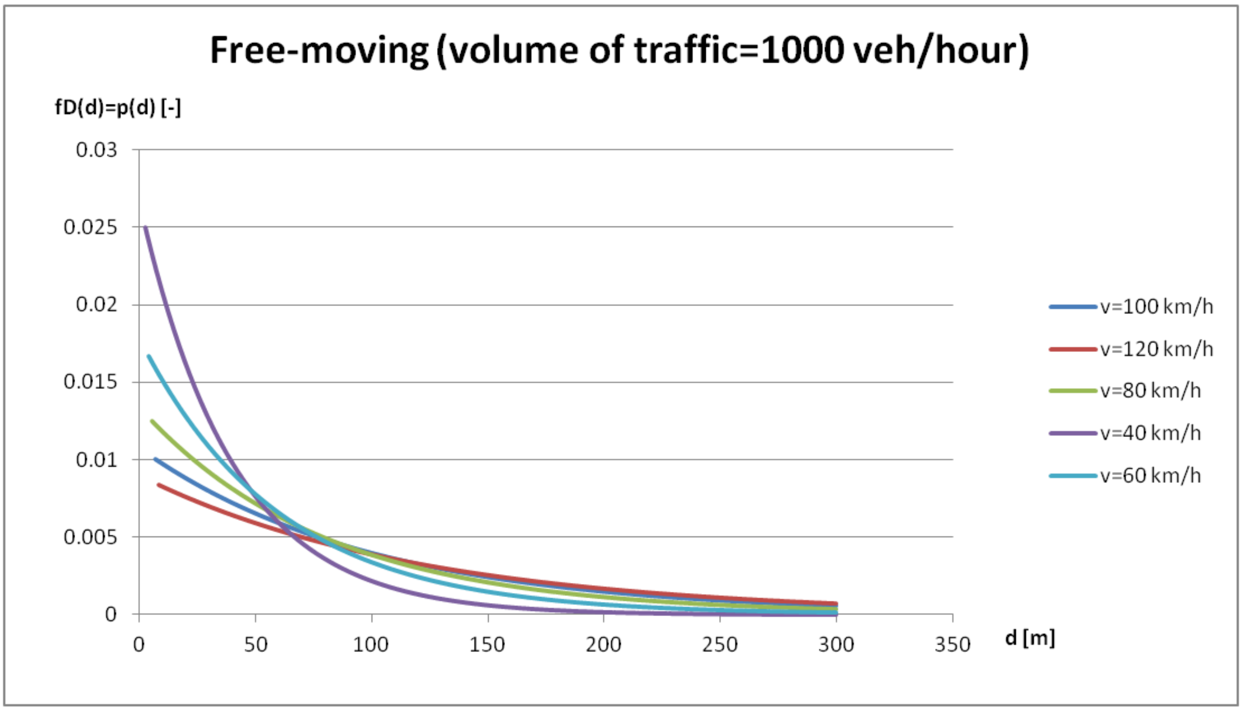


Figure 24: effect of the traffic speed on the distance between vehicles

Thus, it is obvious that the traffic volume has an influence on the distance between vehicles and then on the probability of simultaneous vehicle crossings. Moreover, the distance between vehicles is always modeled using a realistic model (developed in Bailey (1996)). Indeed, it is a probabilistic model.

This is why it has been chosen to change the traffic flow [veh/sec] to simulate more-or-less simultaneous vehicle crossing. An advantage of this method is that the simulated traffic is always created by using some realistic parameters (weights, geometry and distance between vehicles), even if the chosen value of the traffic flow is not possible assuming real traffic conditions. A drawback of this way to proceed is that it is a probabilistic data, and then it implies that there is a “random” process that has to be taken into account in the analysis of the results. For instance, it won’t be possible to check the results of FDA Bridge by computing a fatigue correction factor by hand considering a few trucks. Indeed, it is not possible to know what kinds of trucks have been simulated, the distances between the simulated trucks, etc. because these parameters are all some probabilistic parameters.

Since it has been decided to modify the traffic flow to create some simultaneous vehicle crossing effect, the traffic flow range has to be defined. The traffic flow has to simulate a traffic without simultaneous vehicle crossing to a traffic with a very high simultaneous vehicle crossing. As previously said, the simultaneous vehicle crossing effect depends on the traffic flow.

A very low, a very high and some intermediate traffic flows have to be selected for the simulations.

A very low traffic flow means no simultaneous vehicle crossing at all. It means that only one truck/vehicle can cross the bridge in the same time. This traffic flow value is thus dependant on the longest bridge which is selected for the different simulations. This bridge is the one created using the influence line p5tr and a span length of 100m. The total length of this bridge is equal to 460m (not 500m due to the shorter exterior spans). Then, the required crossing time can be calculated, assuming a traffic speed of 22 m/s:

$$crossing\ time = {}^{460\ m}/_{22m/s} = 20.9\ sec$$

It means that the interval between vehicles has to be equal to at least 20.9 seconds. Thus, the lowest traffic flow is equal to:

$$\min traffic\ flow = {}^{1}/_{20.9\ sec} = 0.047826\ veh/sec$$

Then, the traffic flow value and the minimal interval between vehicles have to be specified in order to simulate a traffic without more than one vehicle on the bridge, and with a good control of the distance between vehicles (smallest possible gap for the distance between vehicles). Thus, the chosen parameters are, for the traffic flow without simultaneous vehicle crossing:

Traffic condition: flow [veh/sec]	0.047
Minimal interval [sec]	21

Tableau 20: traffic condition parameters without simulataneous vehicle crossing

It means that the interval between each simulated vehicle will be in the gap between 21 sec and 21.27 sec. This gap is really small, and thus a good control of the traffic flow is possible. Moreover, the required time for each simulation is as short as possible, as since a vehicle just left the bridge, another one is crossing. This is valid only for the longest considered bridge.

For the highest traffic flow which is supposed to create a very high simultaneous vehicle crossing effect, a very high value has been chosen for the flow. It is an extreme value. Indeed, the maximal traffic flow considered in the simulations is equal to 1 vehicle per second. It is obvious that this value is not realist and cannot happen in the real traffic. Nevertheless, this aim of this work is to study the effect of simultaneous vehicle crossing. Thus, some extreme values have been chosen in order to emphasize this effect of the simultaneous vehicle crossing. It will then be possible to know easily the influence of the other parameters (traffic database, influence line, span lengths). If the different simulated traffic flow would have been too close from one to each other, then the influence of the other parameters would have been really more difficult to emphasize. This is why a traffic flow up to 1 vehicle per second has been simulated, even though it is not a realist value. Then, some intermediate values have been chosen between a traffic flow of 0.047 veh/sec and 1veh/sec. Four intermediate values have been selected: 0.1/0.2/0.5 and 0.75 vehicle per second.

As said in the sub-section 4.1.6, the percentage of trucks considered in the simulations is equal to 100. It means that the traffic flow is actually a truck flow. Indeed, only the truck flow has an influence on the fatigue damage, and thus on the fatigue correction factor. The presence of cars just increases the spacing between trucks and decrease the probability of simultaneous vehicle crossing. The study of the percentage of cars on the equivalent truck flow is studied further in this work.

4.3.Summary of the studied cases

The different parameters and their different values considered in the traffic simulations are summarized in the table below:

Traffic database	US traffic
	Canadian traffic
S-N curves (slope m)	3
	"(6.85)"
Influence lines	ps-m
	p2tr-m
	p5tr-m
	p2tr-a
	ps-r
Span length [m]	15m
	25m
	50m
	100m
Bridge cross section	I-girder (1 lane traffic)
	Box (2 lanes traffic)
Traffic	1 lane
	2 lanes unidirectionnal
	2 lanes bidirectionnal
Traffic condition: flow [veh/sec]	0.047
	0.1
	0.2
	0.5
	0.75
	1
Traffic composition (%age trucks)	100

Tableau 21: summary of the studied cases

Every value of each parameter has been linked to every other ones in order to run over 720 traffic simulations. The fatigue correction factors have been then computed with FDA Bridge for each simulation. Also, for some cases, the slope of the S-N curve has been changed to explain the influence of the number of cycles and of the stress range amplitude. Before the presentation of the results, the different methods and calculation which have been used to valid the traffic models, the fatigue correction factor computation procedure and the conversion formula are presented.

5. VALIDATION OF THE TRAFFIC MODELS AND THE FATIGUE CORRECTION FACTORS COMPUTATION

In order to validate the traffic models and the fatigue correction factor computation procedure, it has been chosen to simulate some traffic without simultaneous vehicle crossing. Thus, the obtained results will be comparable to the results computed by Caughlin et al. (2011), for the steel analysis (m=3.0).

The obtained results computed by using WinQSIM to simulate the traffic and FDA Bridge to compute the fatigue correction factor are presented in the table below:

	Analysis Name	Flow condition [veh/sec]	Bridge Name	λ(AASHTO)	λ(Caughlin et al.)
ps-m	US_1lane_ps-m_15m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-m_15m	0.8098	0.8
	US_1lane_ps-m_25m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-m_25m	0.7660	0.77
	US_1lane_ps-m_50m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-m_50m	0.7512	0.75
	US_1lane_ps-m_100m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-m_100m	0.7486	0.75
p2tr-m	US_1lane_p2tr-m_15m_0.047veh/sec_MinInt21sec	0.047	1_lane_p2tr-m_15m	0.7702	0.77
	US_1lane_p2tr-m_25m_0.047veh/sec_MinInt21sec	0.047	1_lane_p2tr-m_25m	0.7543	0.75
	US_1lane_p2tr-m_50m_0.047veh/sec_MinInt21sec	0.047	1_lane_p2tr-m_50m	0.7513	0.75
	US_1lane_p2tr-m_100m_0.047veh/sec_MinInt21sec	0.047	1_lane_p2tr-m_100m	0.7479	0.75
p5tr-m	US_1lane_p5tr-m_15m_0.047veh/sec_MinInt21sec	0.047	1_lane_p5tr-m_15m	0.8304	0.8
	US_1lane_p5tr-m_25m_0.047veh/sec_MinInt21sec	0.047	1_lane_p5tr-m_25m	0.7900	0.77
	US_1lane_p5tr-m_50m_0.047veh/sec_MinInt21sec	0.047	1_lane_p5tr-m_50m	0.7715	0.75
	US_1lane_p5tr-m_100m_0.047veh/sec_MinInt21sec	0.047	1_lane_p5tr-m_100m	0.7661	0.75
p2tr-a	US_1lane_p2tr-a_15m_0.047veh/sec_MinInt21sec	0.047	1_lane_p2tr-a_15m	0.6538	0.66
	US_1lane_p2tr-a_25m_0.047veh/sec_MinInt21sec	0.047	1_lane_p2tr-a_25m	0.6538	0.65
	US_1lane_p2tr-a_50m_0.047veh/sec_MinInt21sec	0.047	1_lane_p2tr-a_50m	0.6992	0.7
	US_1lane_p2tr-a_100m_0.047veh/sec_MinInt21sec	0.047	1_lane_p2tr-a_100m	0.7455	-
ps-r	US_1lane_ps-r_15m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-r_15m	0.7268	0.72
	US_1lane_ps-r_25m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-r_25m	0.7414	0.74
	US_1lane_ps-r_50m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-r_50m	0.7683	0.75
	US_1lane_ps-r_100m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-r_100m	0.7588	0.75

Tableau 22: comparison between the obtained results and the results of Caughlin et al. (20011)

By comparing the two columns on the right side of the table, it can be noticed that the values are very close. As looking at the values on the graphs is not enough accurate, some values of fatigue correction factors were computed again using the Fortran program and then compared to the results computed using WinQSIM and FDA Bridge. The comparison is available in the table below:

Analysis Name	Flow condition [veh/sec]	Bridge Name	λ(AASHTO)	λ(Caughlin et al.)
US_1lane_ps-m_12m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-m_12m	0.64525	0.65106
US_1lane_ps-m_60m_0.047veh/sec_MinInt21sec	0.047	1_lane_ps-m_60m	0.75177	0.75065
US_1lane_p5tr-m_30m_0.047veh/sec_MinInt21sec	0.047	1_lane_p5tr-m_30m	0.78716	0.78242

Tableau 23: comparison between the obtained results and the results of Caughlin et al. (20011)

The comparison between the two different methods used to compute the fatigue correction factor shows that the results are almost equal.

Moreover, the results for the influence lines ps-m_12m and p2tr-a contribute to the validation of the conversion formula. Indeed, the assumed number of cycles per truck n is equal to 1.5 for the p2tr-a influence line (bending moment at mid-support) and equal to 2.0 for the ps-m_12m influence line (span length shorter than 40 feet (12.191m)).

It can also be noticed that the average value of the fatigue correction factor without simultaneous vehicle crossing is very close to 0.75, the admitted value in the AASHTO code. In the case of the Canadian traffic database and fatigue truck model, the average value is close to 0.52, the admitted value in the Canadian code. This is a way to validate the traffic model created in WinQSIM for the Canadian traffic database. Indeed, no computation of fatigue correction factor have been performed using the Fortran program in order to compare the results using the Canadian traffic database.

6. RESULTS OF FATIGUE CORRECTION FACTORS WITH SIMULTANEOUS VEHICLE CROSSING

In this chapter, the results obtained for the different cases summarized in the previous section are presented. In the first sub-section, the effect of the influence line is emphasized and a report of the different encountered phenomena is performed.

In the second sub-section, a summary of the results is presented, for both American and Canadian traffic database.

6.1. Effect of the influence lines and study of the encountered phenomena

As the different phenomena and the analysis of the results are very close considering the American traffic database or the Canadian one, it has been decided to study and comment in this section the results of the American traffic database only. The presented results always refer to a S-N curve slope equal to 3 (steel).

First of all, the results for the 1 lane traffic are shown. This case corresponds to a single lane of traffic, and the fatigue truck model is put on the same lane. There is no transversal load distribution ($\eta = 1$.

A graph has been created for each influence line, in order to be aware of the effect of the different influence lines. The fatigue correction factor is plotted in function of the traffic flow, i.e. the probability of simultaneous vehicle crossing. Every curve represents a different span length.

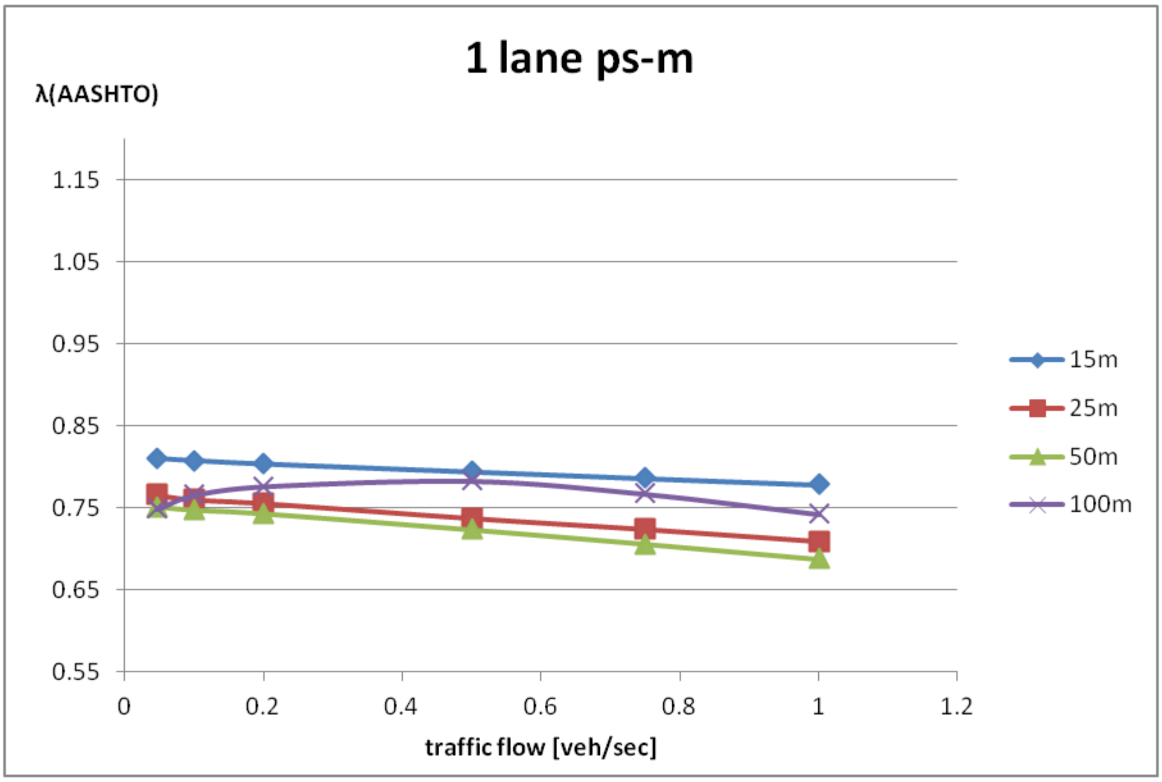


Figure 25: American traffic, 1 lane, ps-m

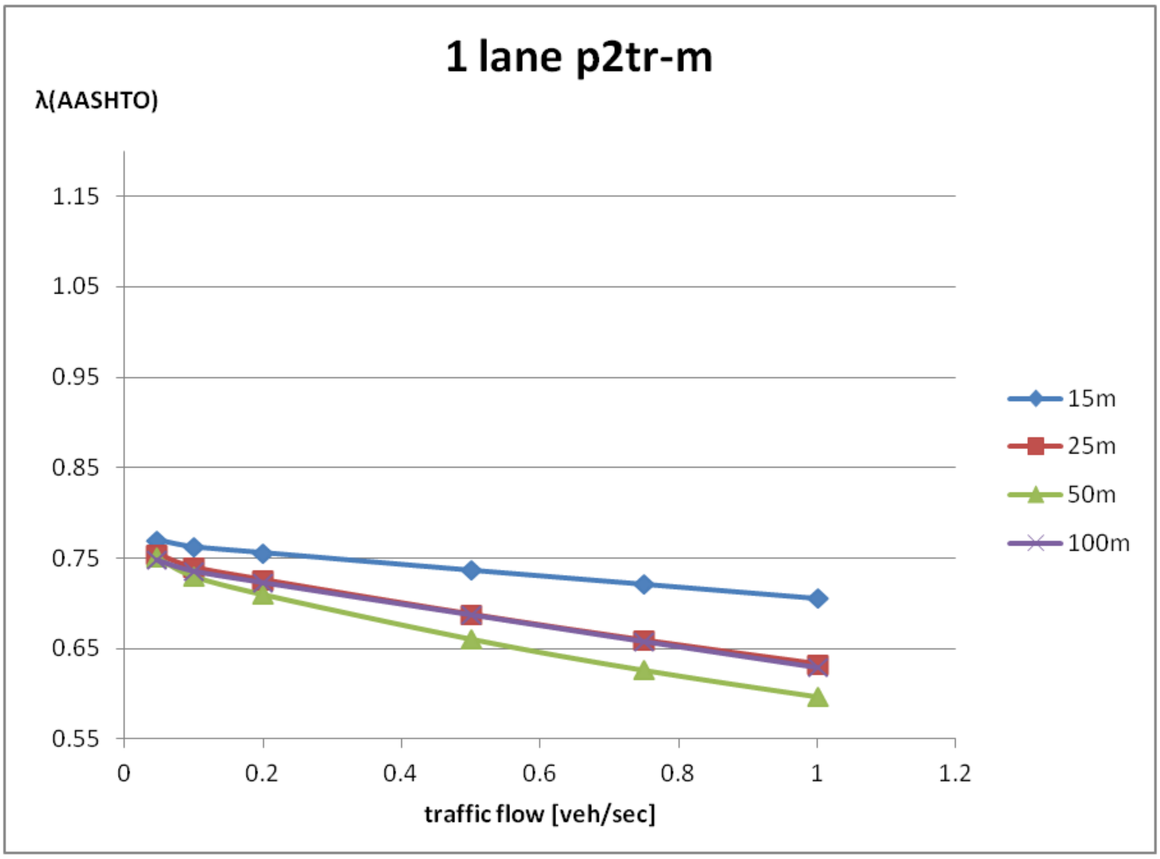


Figure 26: American traffic, 1 lane, p2tr-m

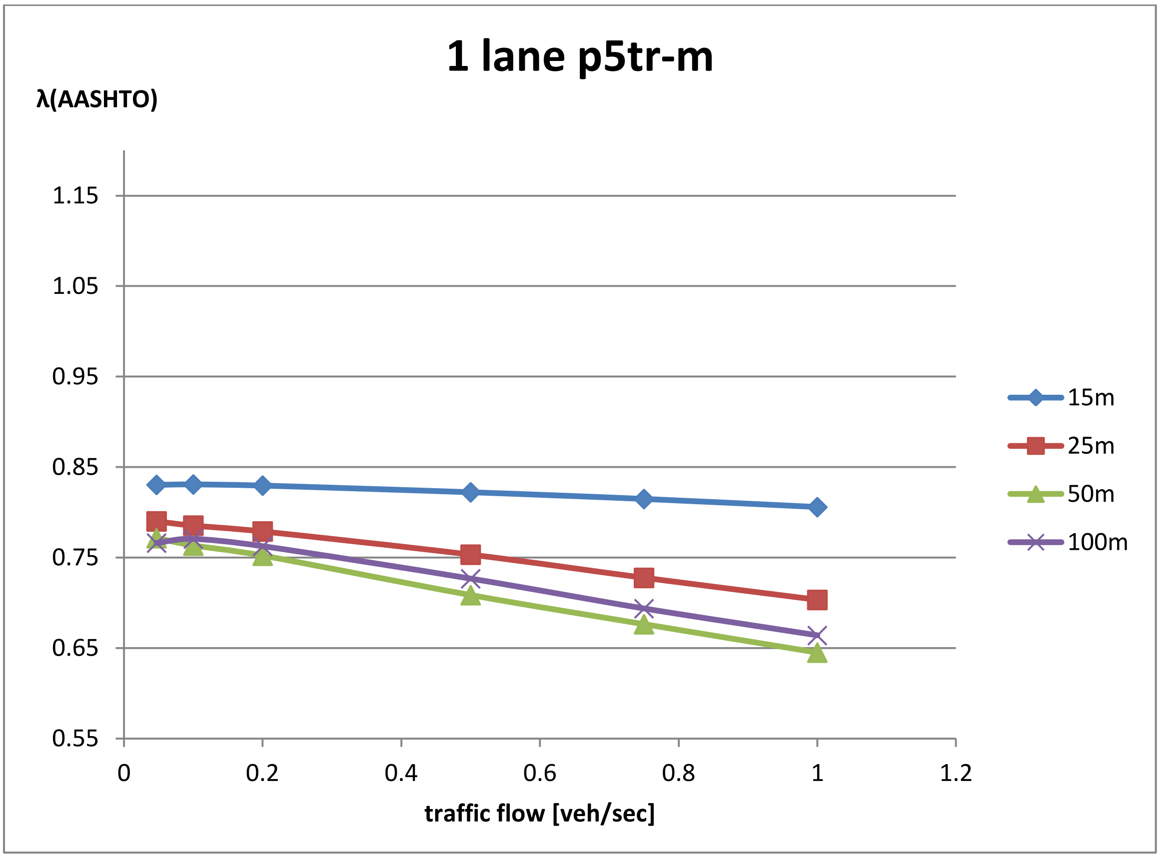


Figure 27: American traffic, 1 lane, p5tr-m

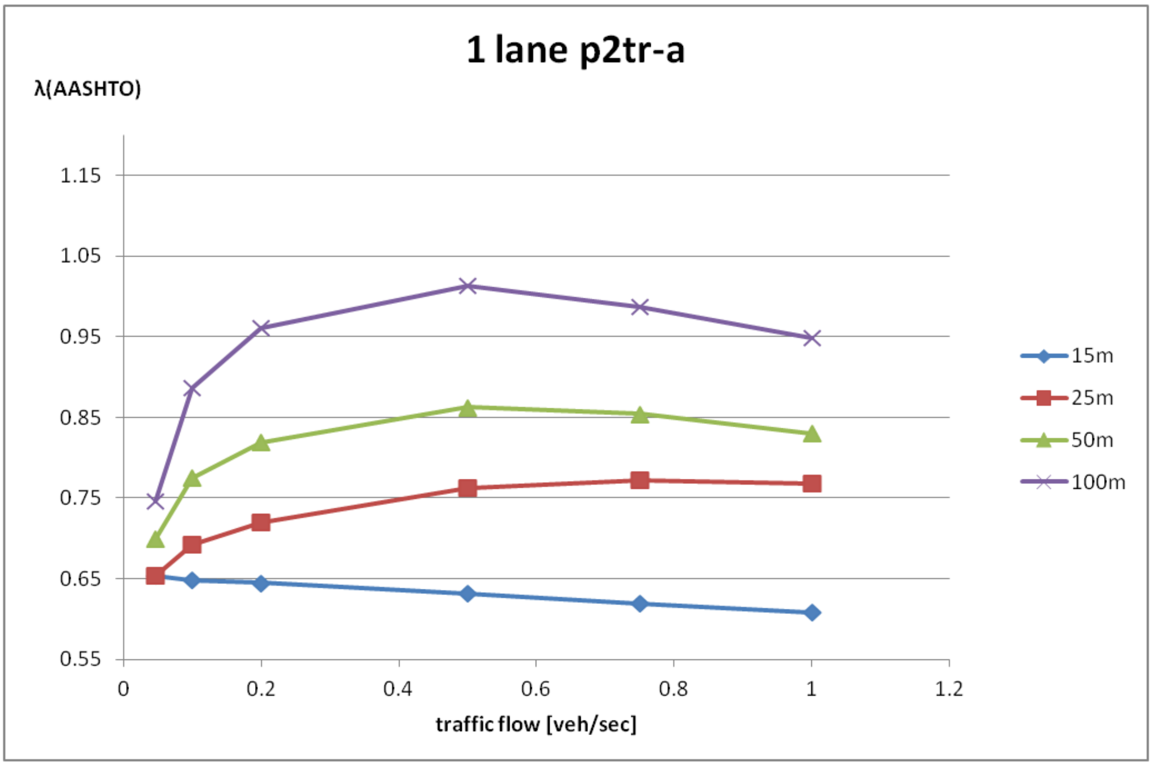


Figure 28: American traffic, 1 lane, p2tr-a

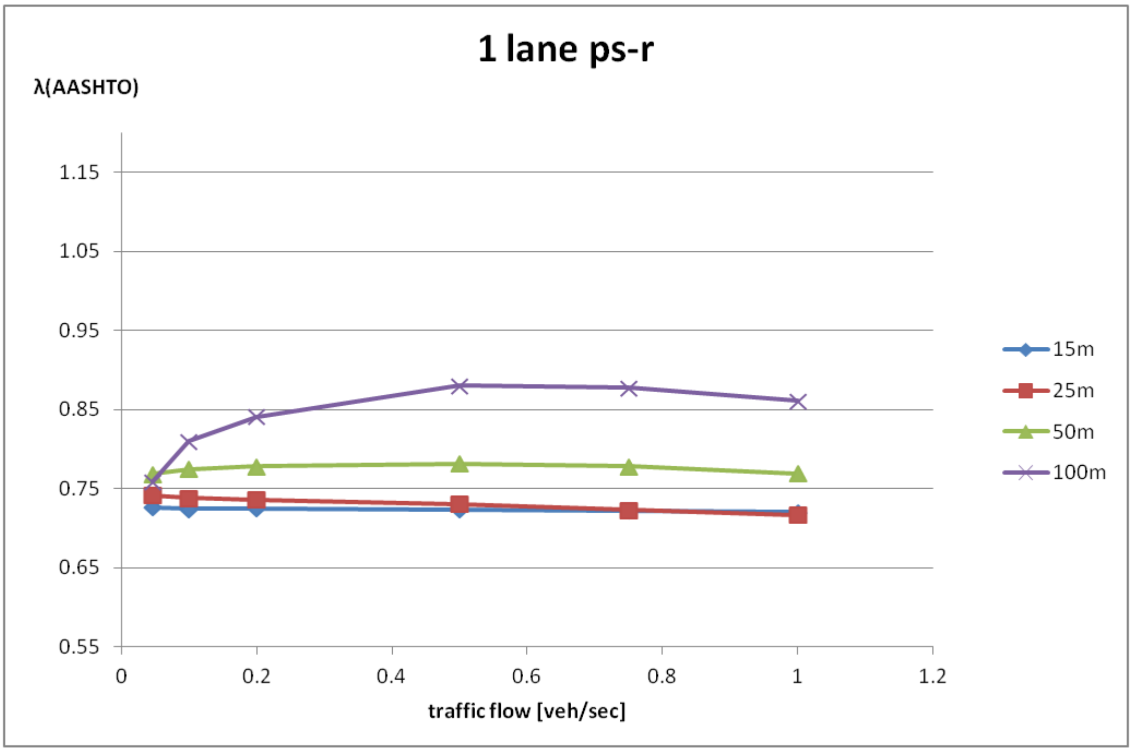


Figure 29: American traffic, 1 lane, ps-r

It can be noticed that only the p2tr-a and ps-r influence lines are critical if the simultaneous vehicle crossing is considered. Indeed, these are the only 2 cases where the fatigue correction factors increases with the traffic flow. This can be explained with the shape of the influence line and the analysis of the positive and negative area under the influence line. Indeed, in the case of the p2tr-m influence line (reaction at mid-span), the two halfs of the bridge have an opposite sign for the influence line. It means that a truck on the first span will decrease significantly the stress range created by the truck travelling along the second span.

Another explanation that can be found to explain the fact that the fatigue correction factor decreases with the increase of the traffic flow is the effect of the diminution of the number of cycles with simultaneous vehicle crossing, considering the same number of trucks travelling over the bridge. Indeed, for some very high values of traffic flows, it can be noticed that the bridge is always loaded. As there are all the time many trucks travelling over the bridge, the effect of one truck becomes much smaller. It will create only a small stress cycle within the big single stress cycle (due to the beginning and end of total loading at the start and the end of the traffic flow).

This effect can be checked by running a “Réponse” analysis in WinQSIM. Indeed, such an analysis will record the stress cycles and display these ones and also a zoom of a typical succession of stress cycles. This type of analysis has been performed considering a simple span bridge of 100m length (influence line ps-m_100m). The stress cycles of the traffic “without simultaneous vehicle crossing” were compared to the stress cycles of the traffic with “high simultaneous vehicle crossing”.

The results are shown in the figures below (the horizontal axis does not have unit. The cycles are just sticked together one-by-one):

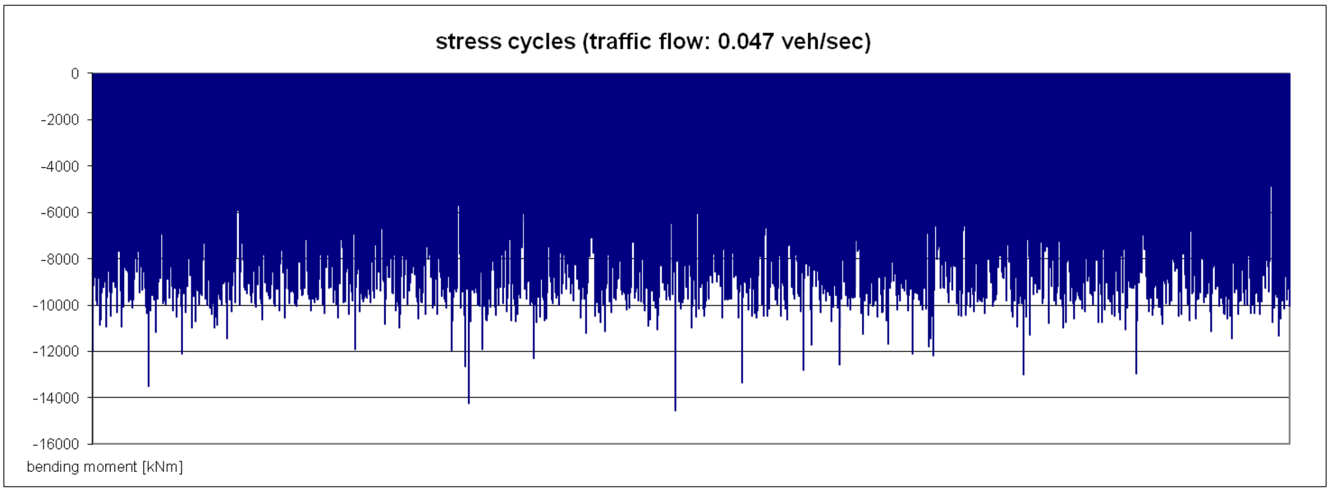


Figure 30: stress cycles (American traffic, ps-m_100m, no simultaneous vehicle crossing)

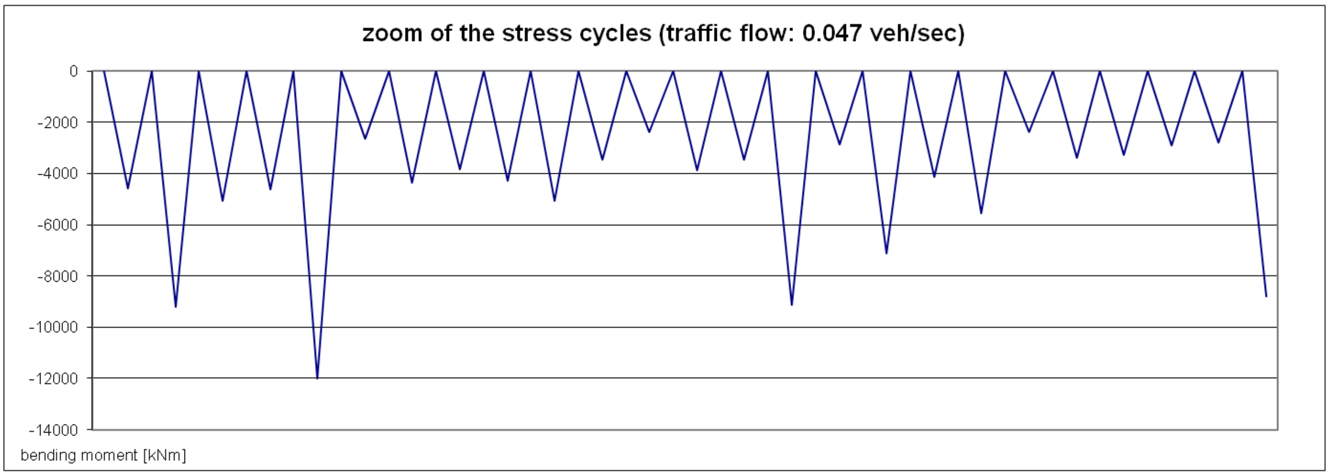


Figure 31: zoom of the stress cycles (American traffic, ps-m_100m, no simultaneous vehicle crossing)

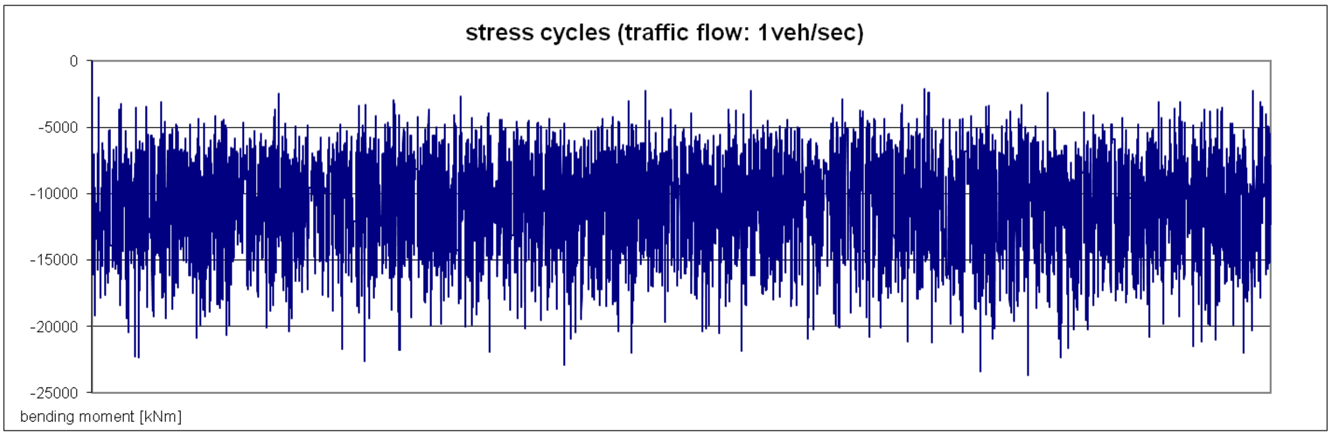


Figure 32: stress cycles (American traffic, ps-m_100m, high simultaneous vehicle crossing)

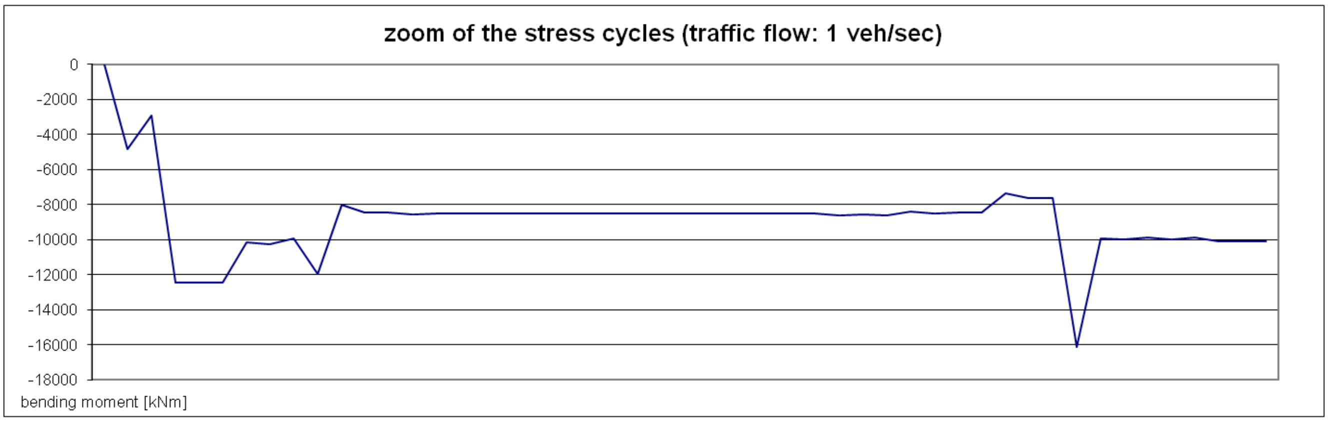


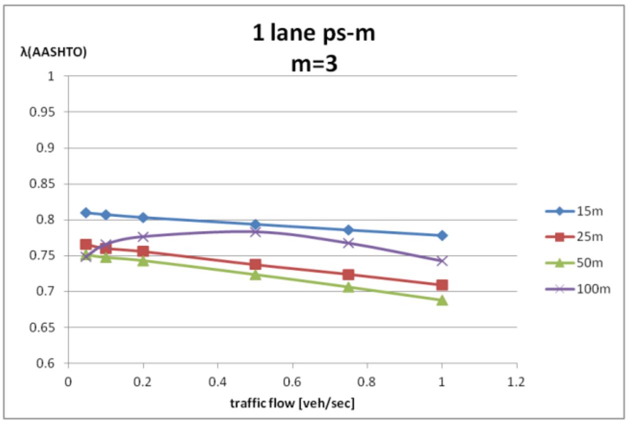
Figure 33: zoom of the stress cycles (American traffic, ps-m_100m, high simultaneous vehicle crossing)

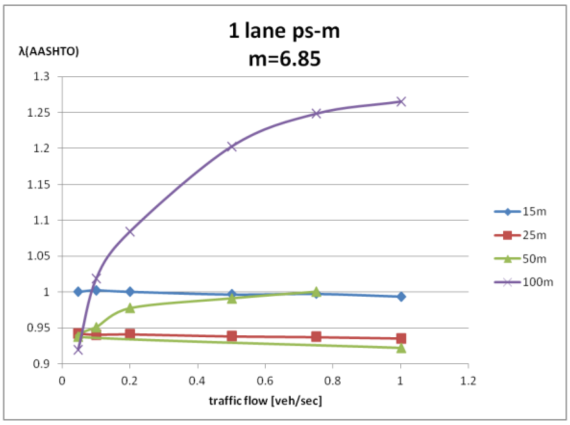
It is obvious that the stress level never reaches 0 for the case of high simultaneous vehicle crossing (actually only twice: at the beginning and at the end of the total loading). The figure 33 shows the zoom-in of the first cycles. It means that the stress ranges in the case of the high traffic flow are much lower than the stress cycles in the case without simultaneous vehicle crossing.

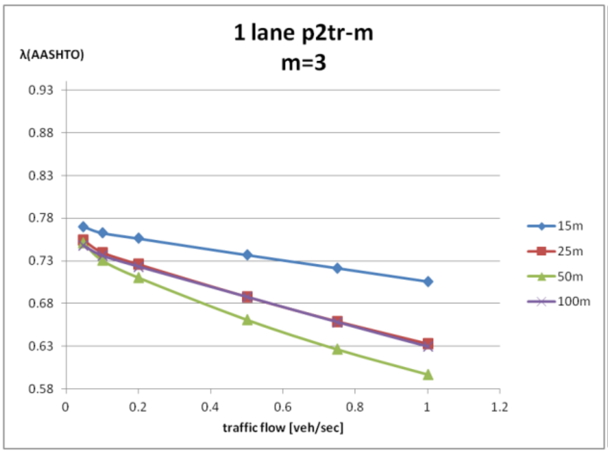
This reduction of the number of stress cycles and also the stress range explains the fact that the fatigue correction factor decreases when the traffic flow increases for the influence lines of the mid-span bending moment (ps-m, p2tr-m, p5tr-m).

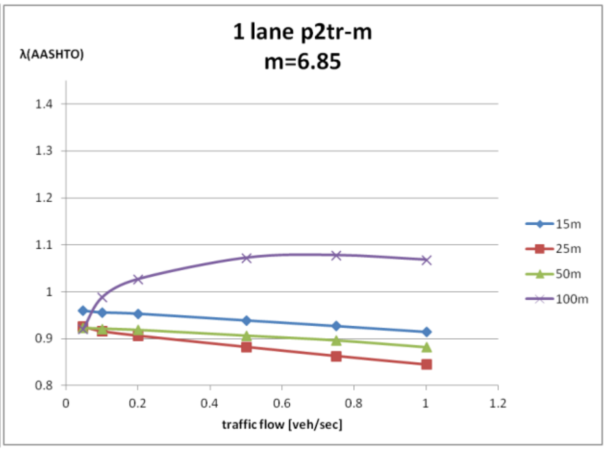
The impact of the phenomenon can be noticed on the values of the fatigue correction factor by considering a shallower S-N curve slope. Indeed, a higher value of m (slope of the S-N curve) will give more importance to the stress range and less importance to the number of cycles.

In the two next figures are compared the fatigue correction factors considering a S-N curve slope of 3 and 6.85 (highest value of m for aluminum structures) for the American traffic and the influence line ps-m and p2tr-m:









By comparing the results of each influence line with the different values of slope, it can be confirmed that the number of cycles is significantly decreasing while the traffic flow and the span length are increasing. As these two parameters control the probability of simultaneous vehicle crossing, it can be verified that the simultaneous vehicle crossing decreases the number of cycles (for the same number of trucks) and this is why the fatigue correction factor decreases with the growth of the traffic flow for some specific influence lines.

Concerning the 2 lane traffic, as the results of fatigue correction factor are very close for the unidirectional and bidirectional cases, only the bidirectional traffic results will be presented. These results are still computed using the American traffic database and an S-N curve slope equal to 3.

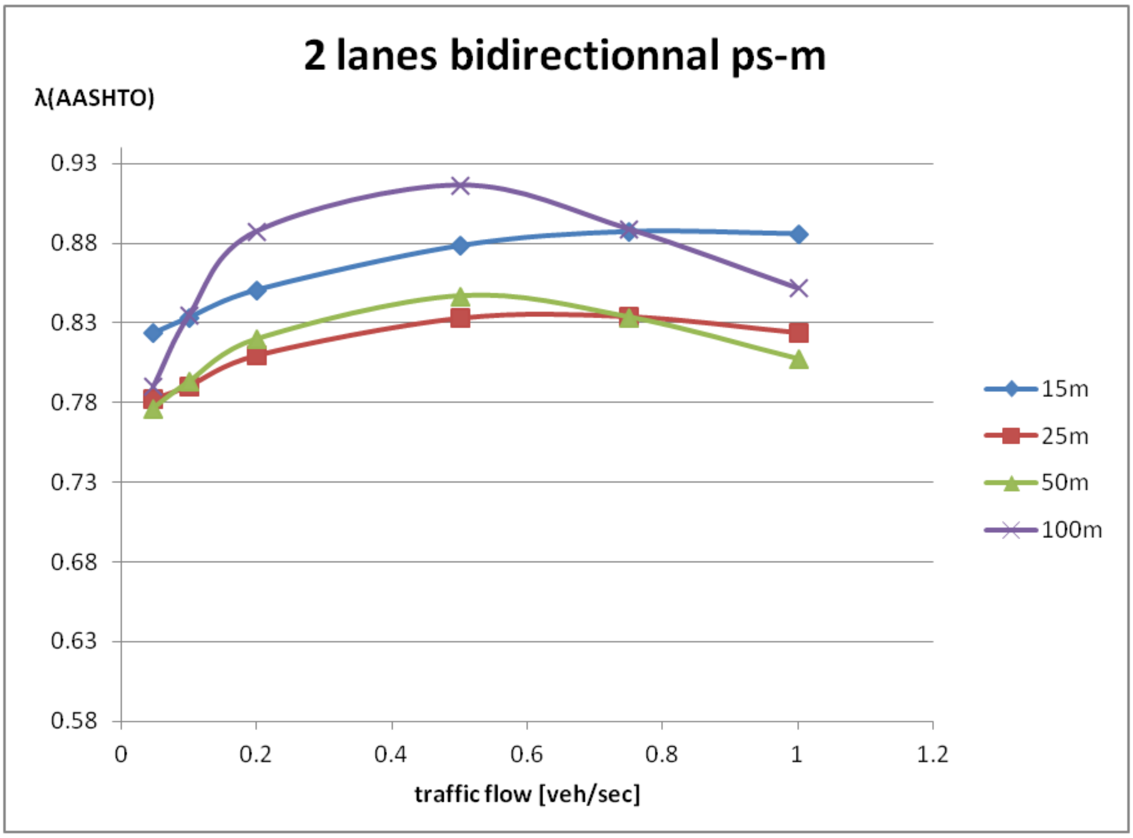


Figure 34: American traffic, 2 lanes bidirectionnal, ps-m

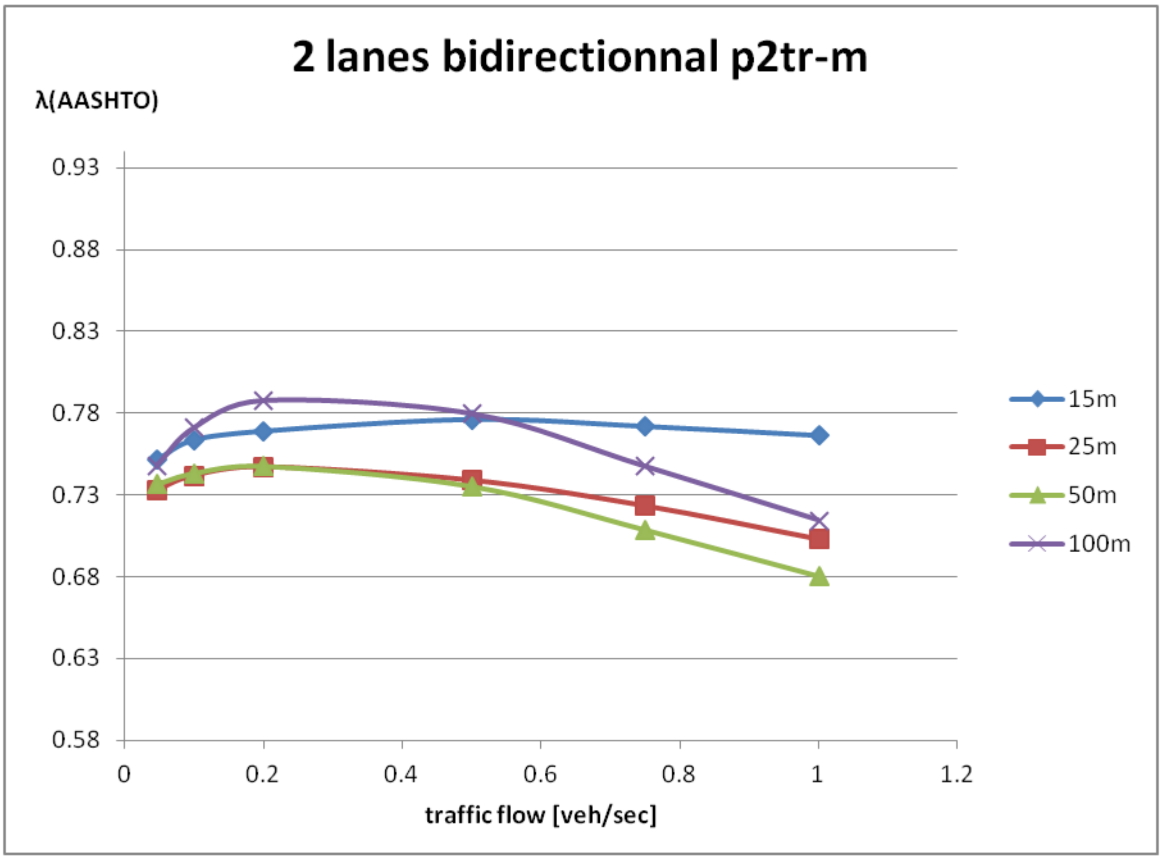


Figure 35:American traffic, 2 lanes bidirectionnal, p2tr-m

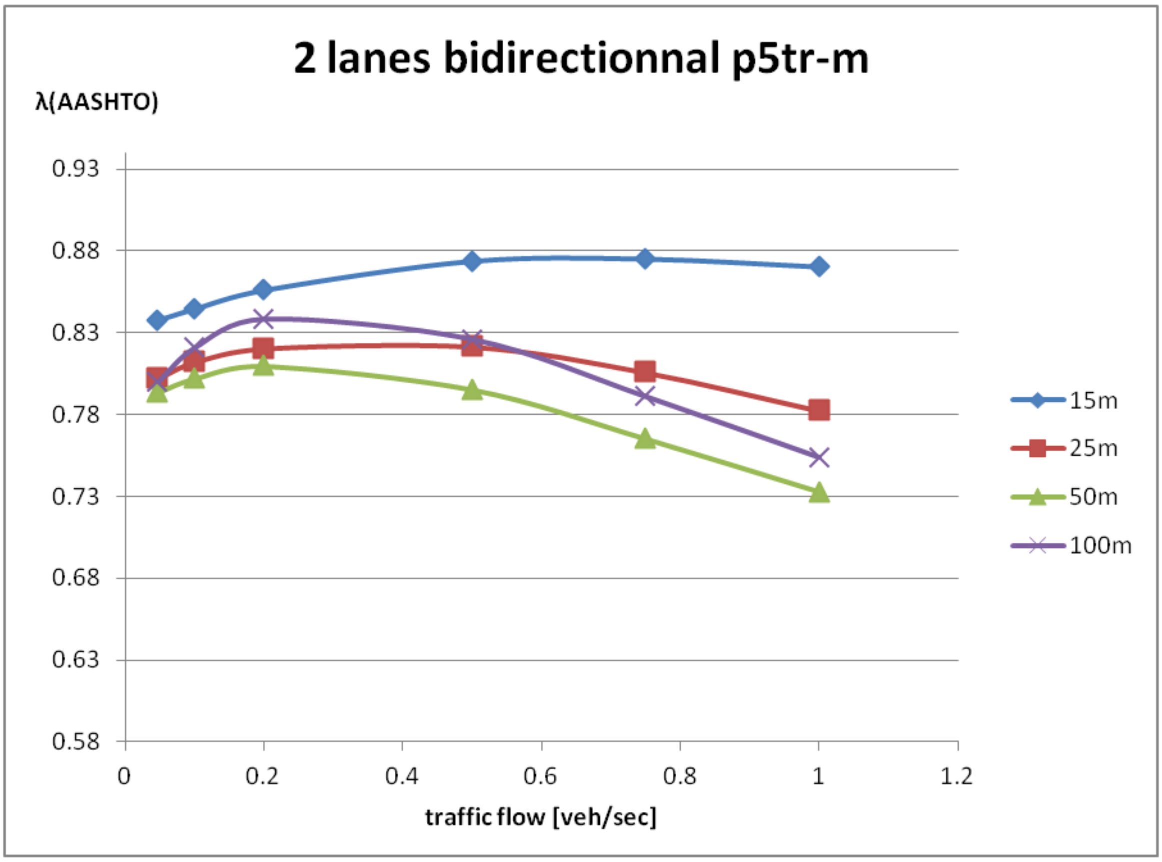


Figure 36: American traffic, 2 lanes bidirectionnal, p5tr-m

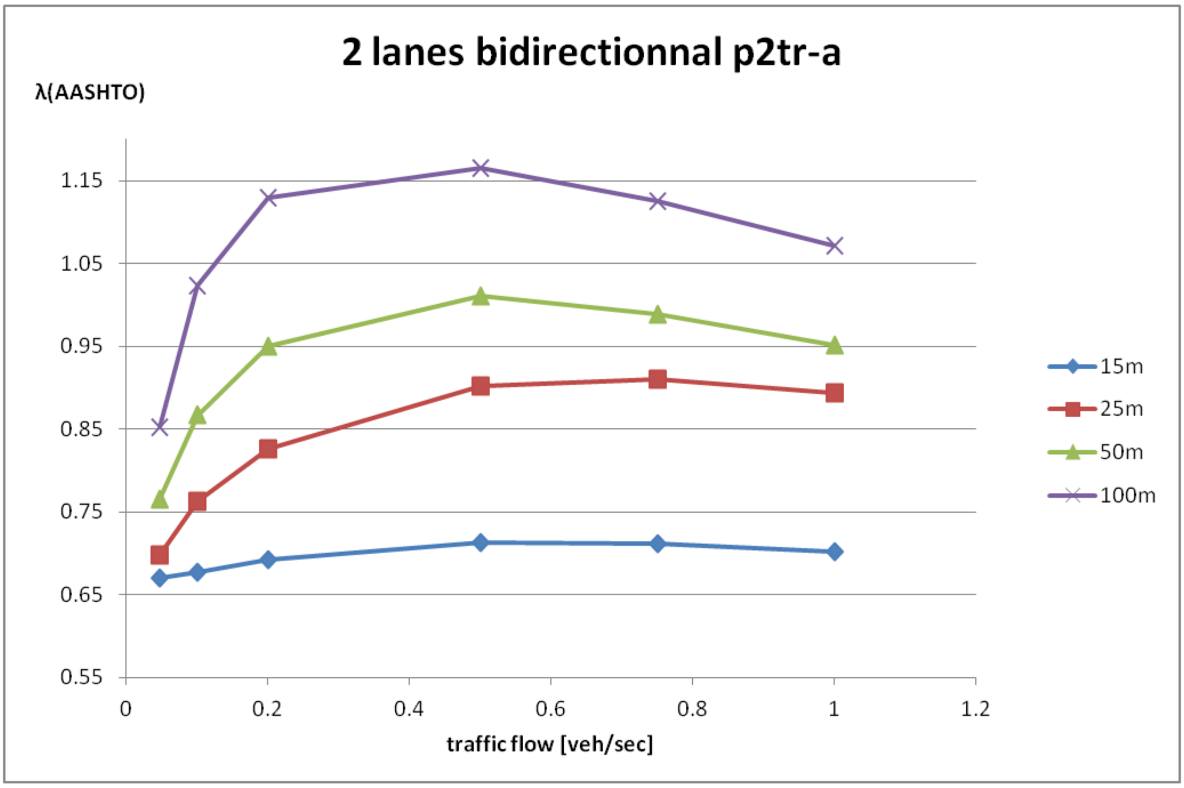


Figure 37: American traffic, 2 lanes bidirectionnal, p2tra-a

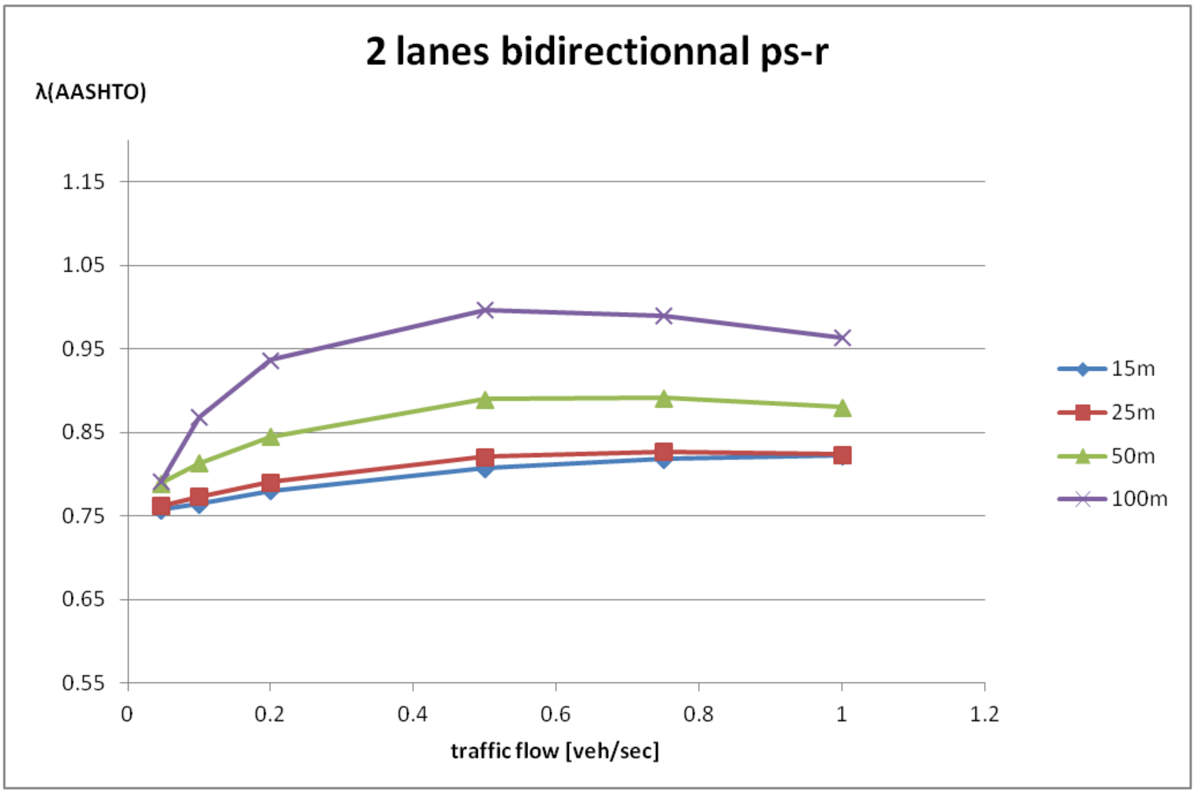


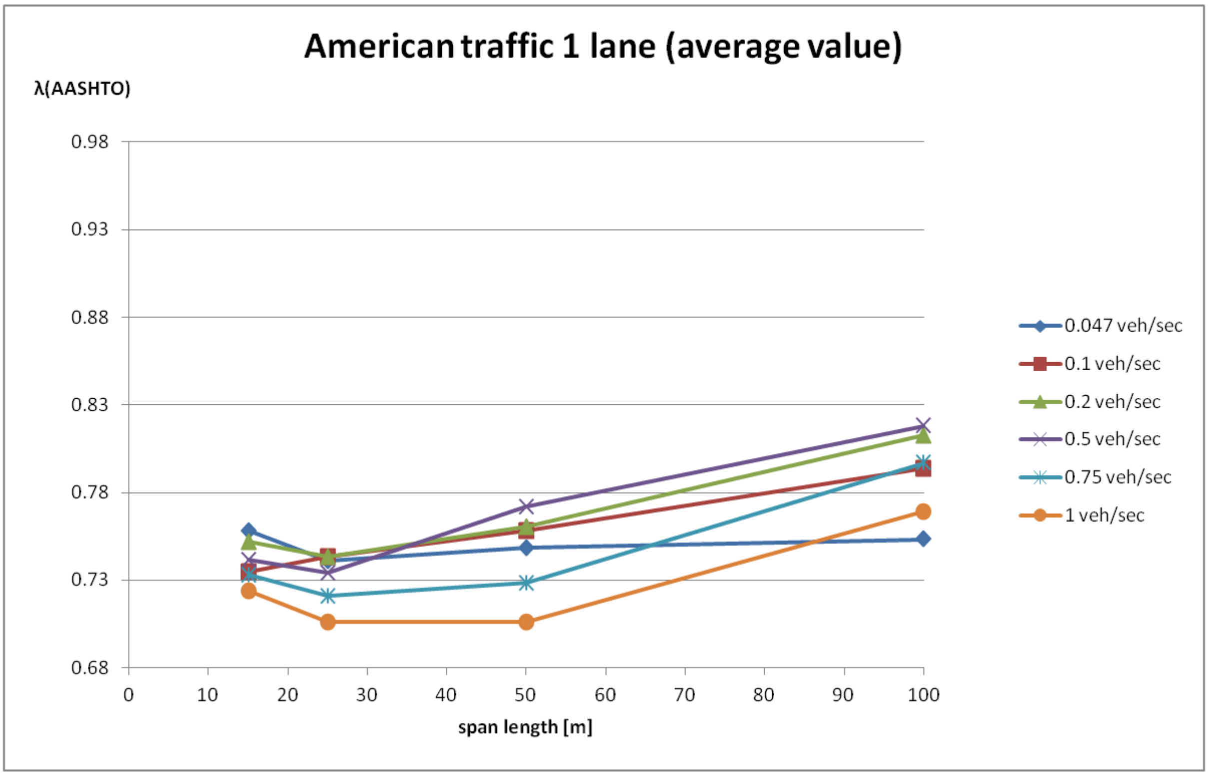
Figure 38: American traffic, 2 lanes bidirectionnal, ps-r

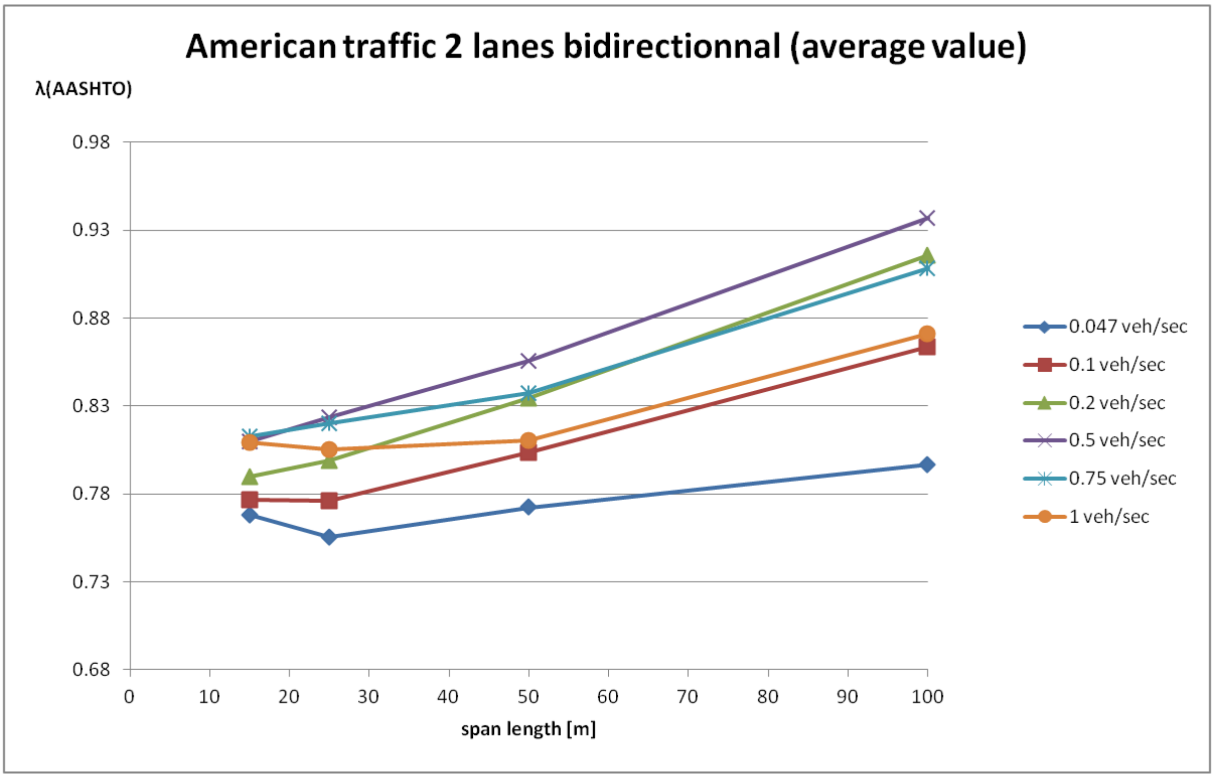
The worst cases can easily be identified by looking at the results for the bidirectional traffic. Indeed, the influence line p2tr-a is the most critical one, for the same reasons as previously presented: As the influence line has the same sign on the both spans, all the trucks on the bridge in the same time will increase the stress range (bending moment at mid-support).

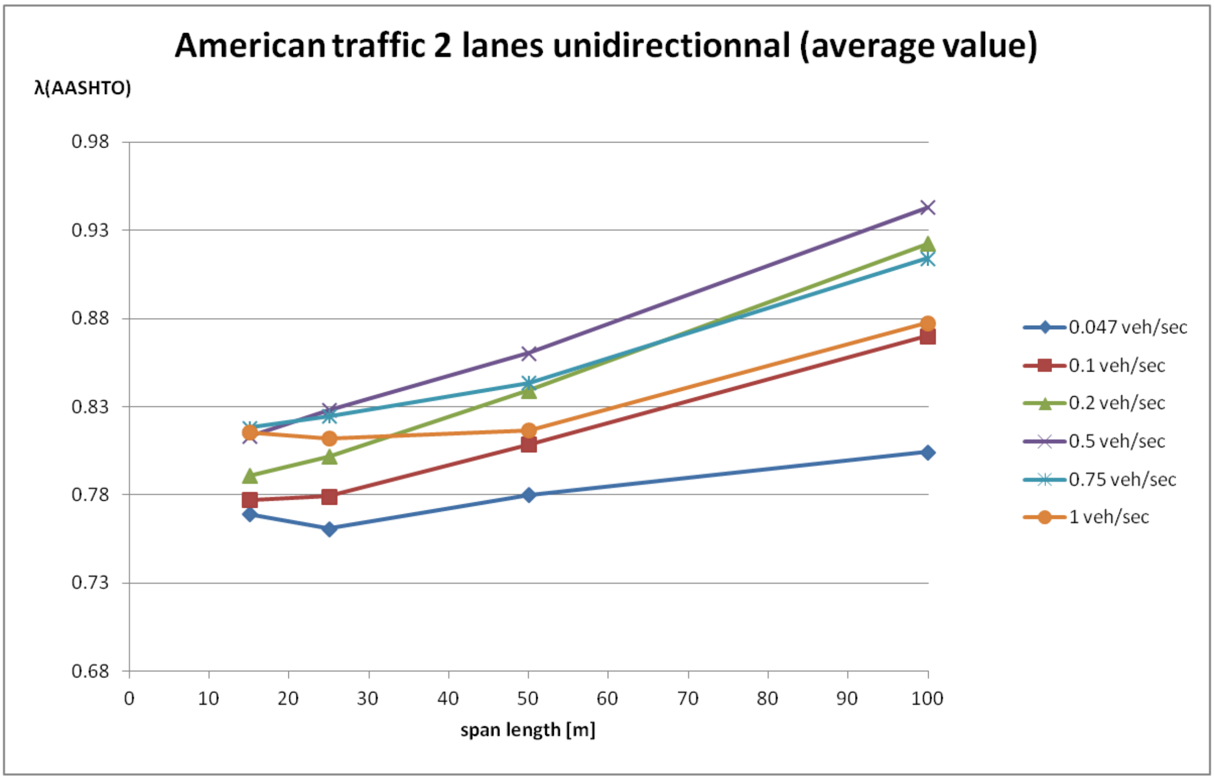
Another important comment that can be done is the fact that the highest fatigue correction factor does not correspond to an extreme value of traffic flow. Indeed, the highest fatigue correction factor often corresponds to a traffic flow between 0.2 veh/sec and 0.5 veh/sec. The fatigue correction factor is decreasing when the bridge is always loaded. Indeed, there are less cycles and the stress range is getting smaller.

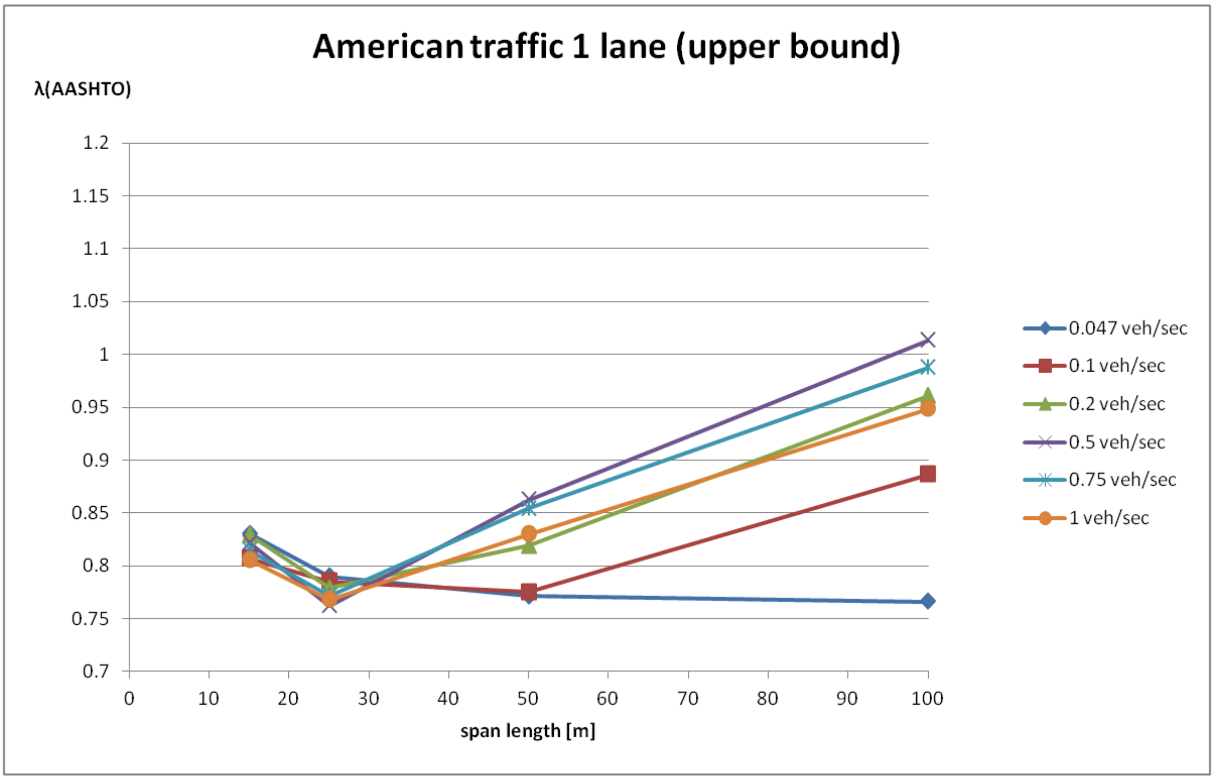
6.2.Summary of the results

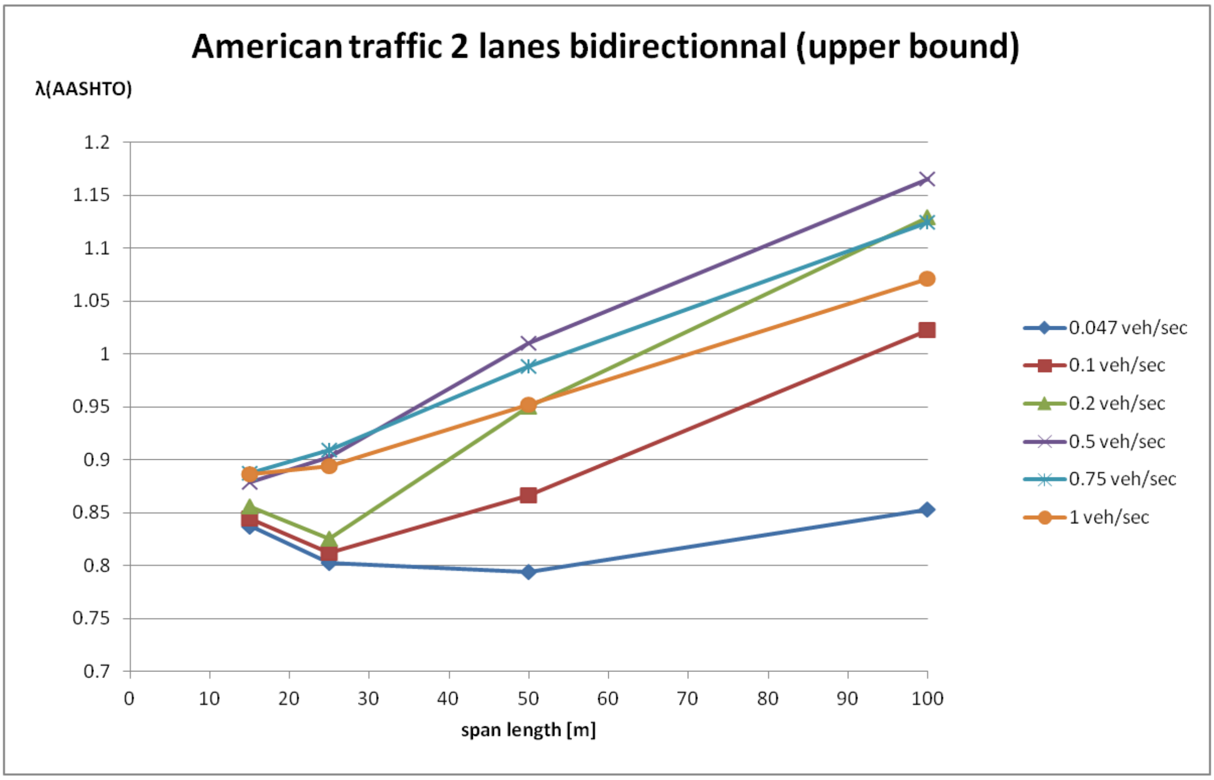
To summarize the different results, it has been decided to calculate, for a given type of traffic (American/Canadian and 1lane/2 lanes bidirectional/2 lanes unidirectional), the average and the upper bound of the different influence lines considered in this work. The graphs are shown below:

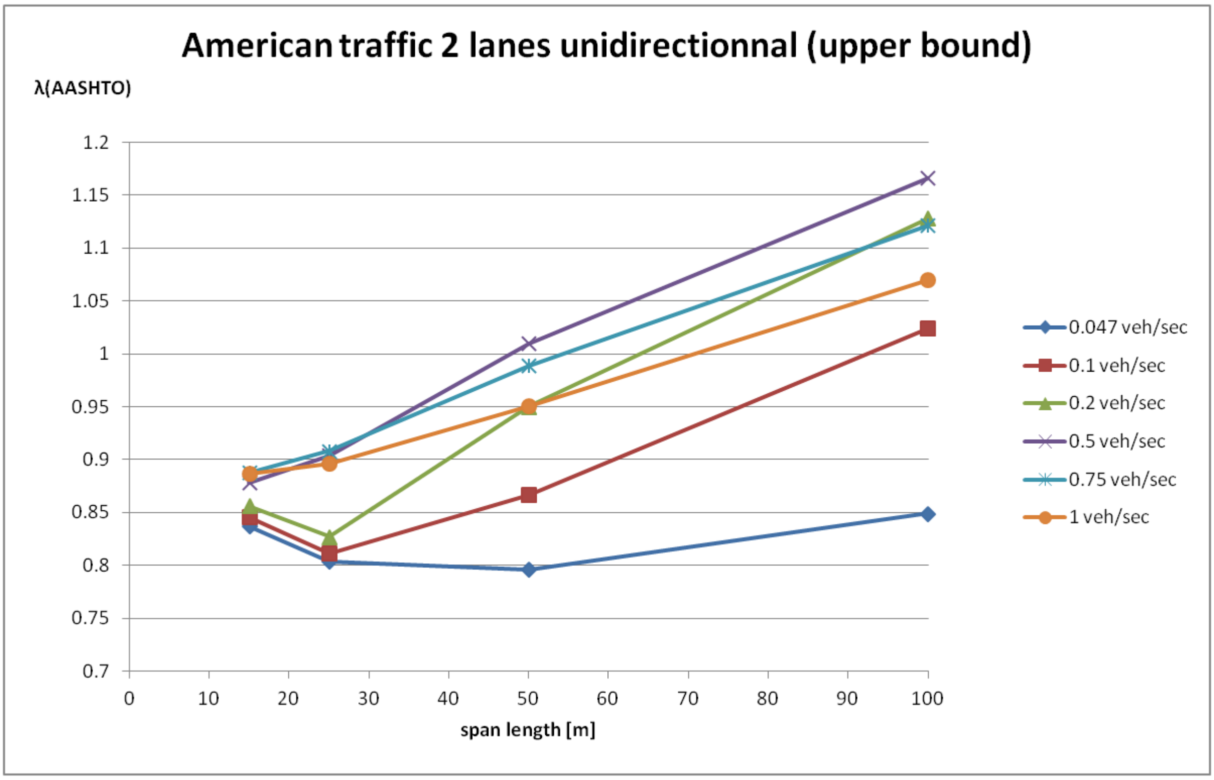


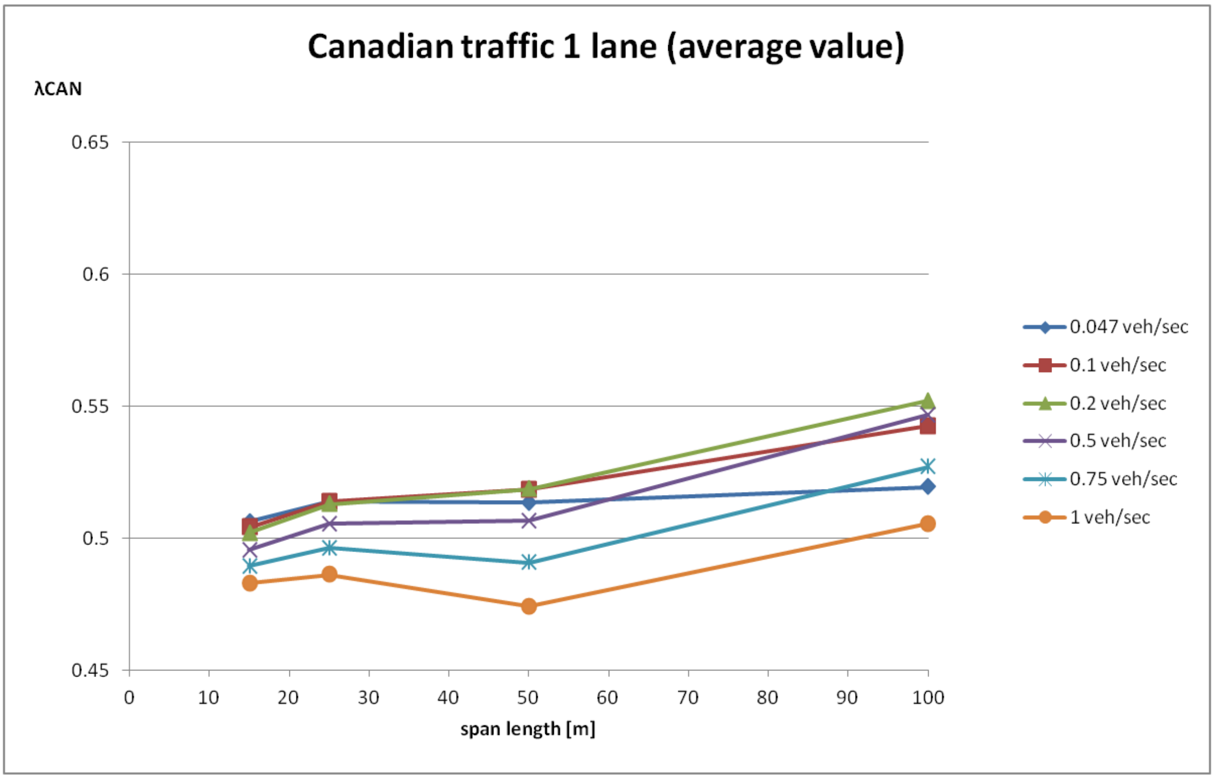

American traffic 2 lanes bidirectionnal (average value)
λ(AASHTO)
0.98
0.93
0.88
0.83
0.78
0.73
0.68
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec

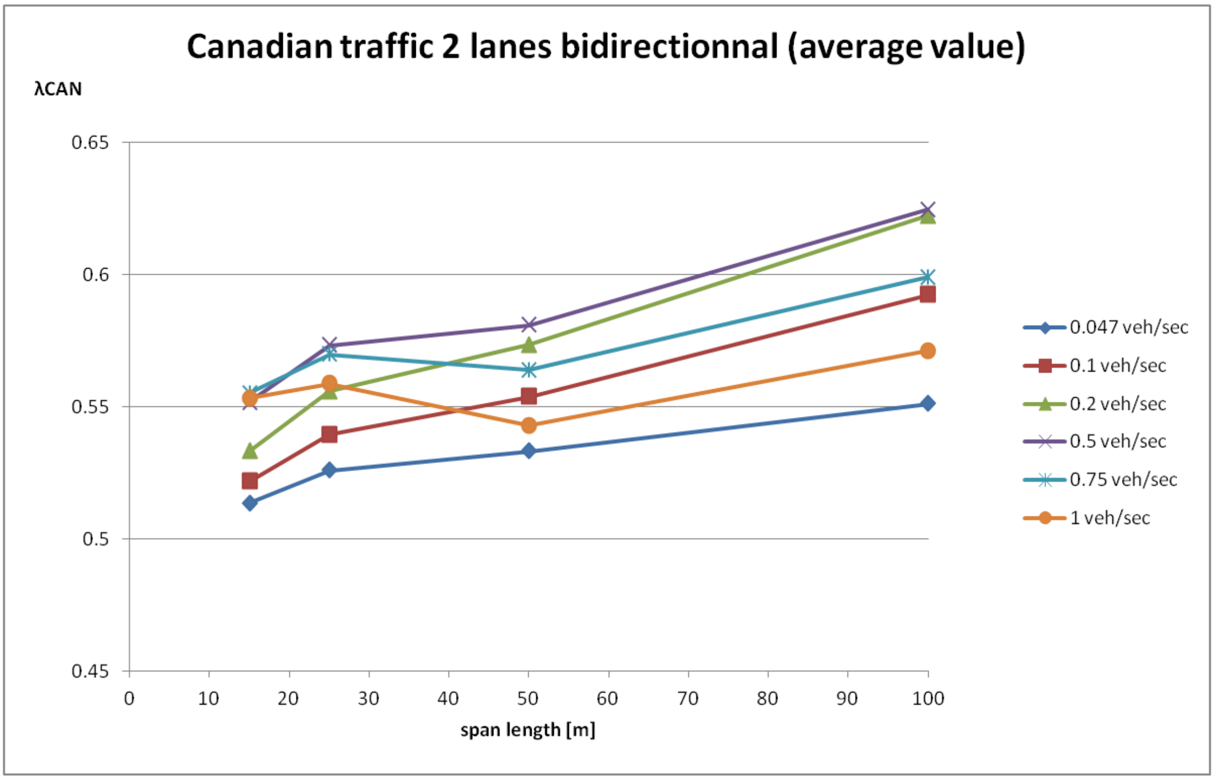

American traffic 2 lanes unidirectionnal (average value)
λ(AASHTO)
0.98
0.93
0.88
0.83
0.78
0.73
0.68
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec

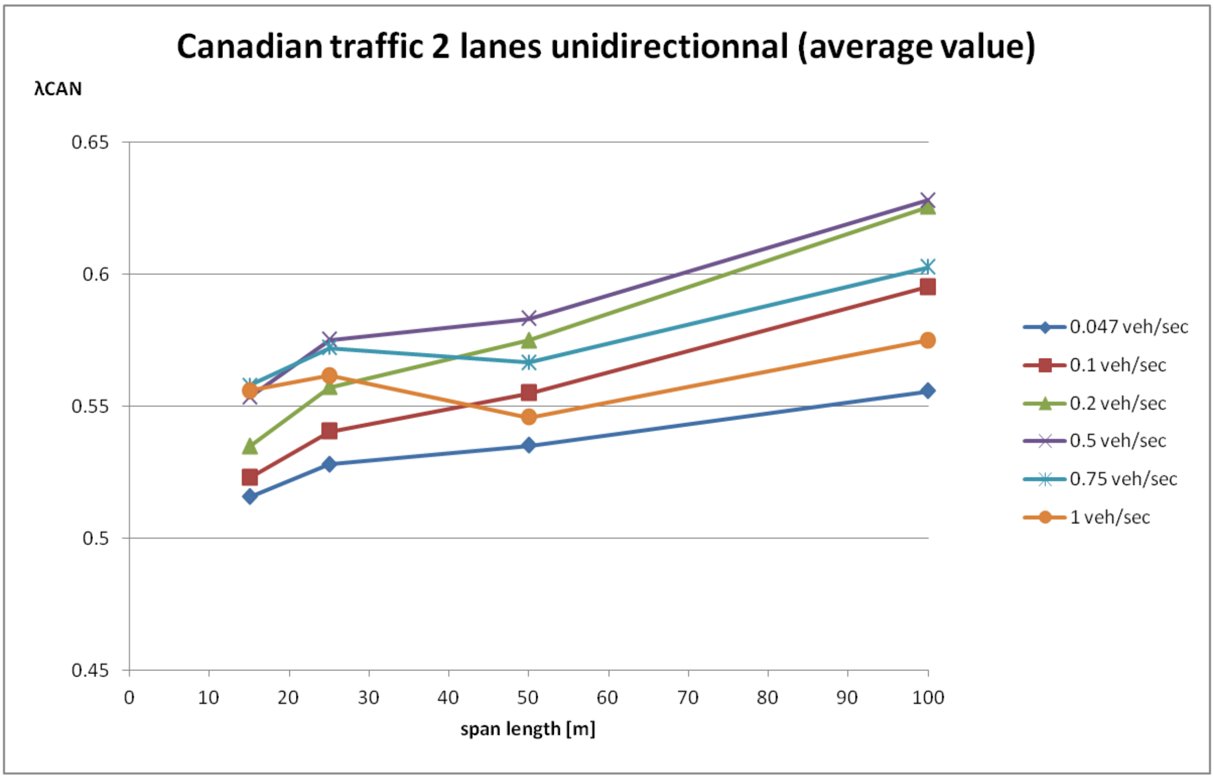

American traffic 1 lane (upper bound)
λ(AASHTO)
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec

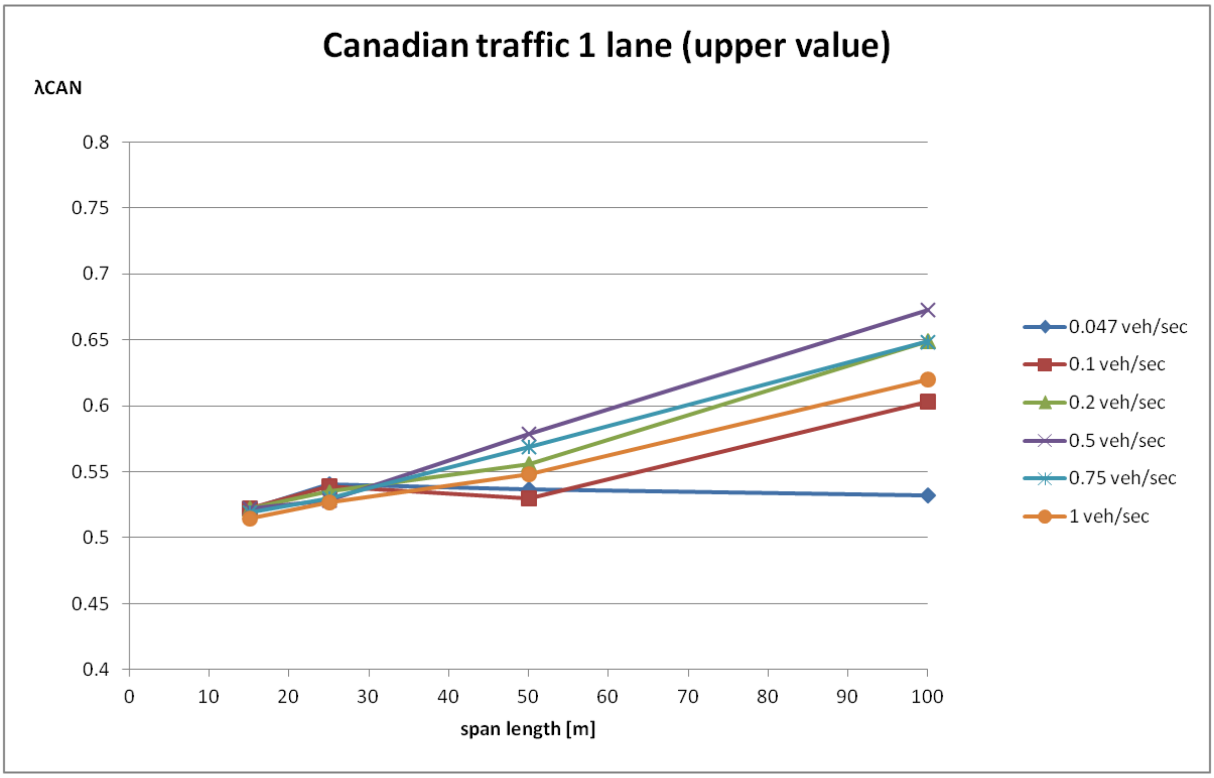

American traffic 2 lanes bidirectionnal (upper bound)
λ(AASHTO)
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec

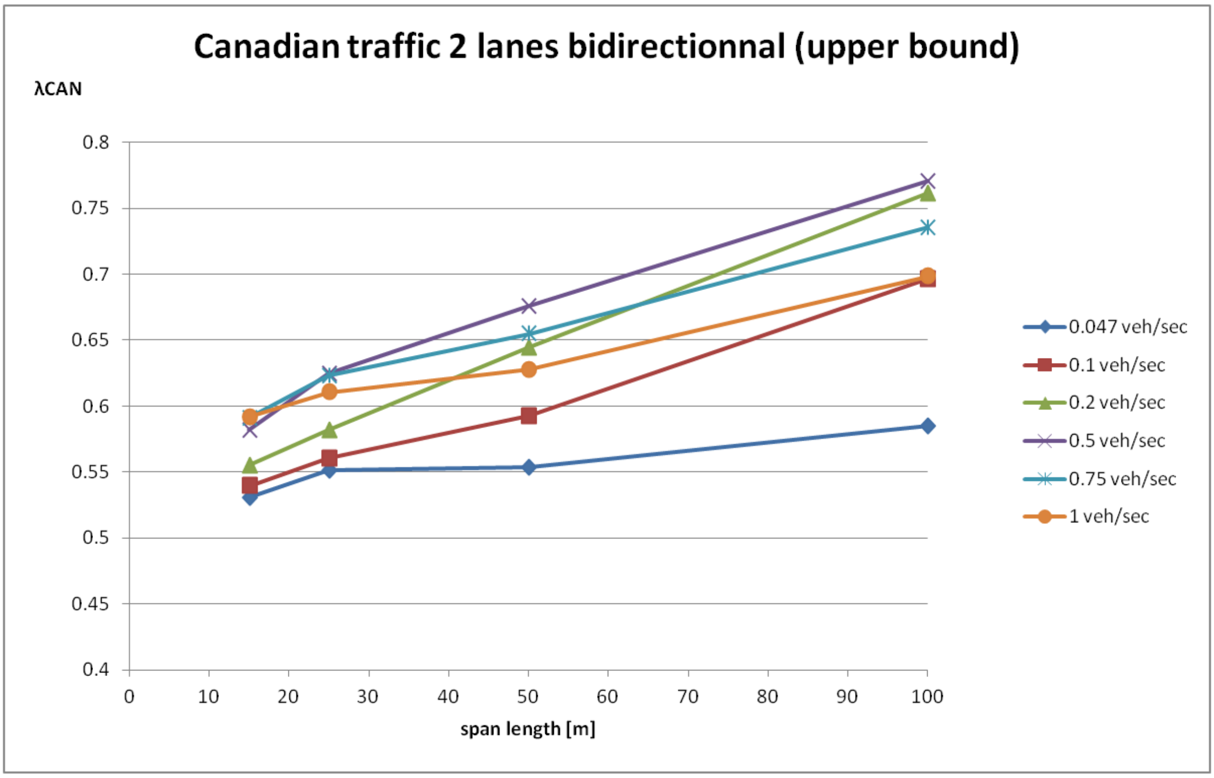

American traffic 2 lanes unidirectionnal (upper bound)
λ(AASHTO)
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec

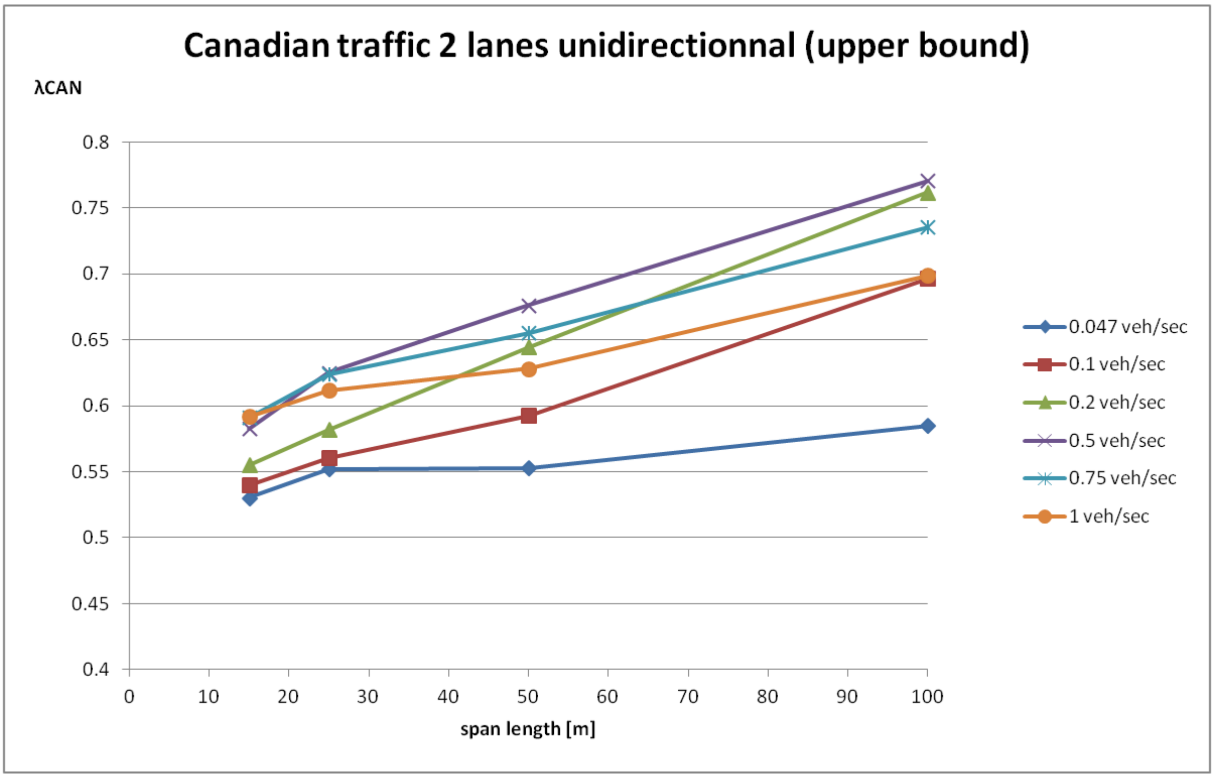

Canadian traffic 1 lane (average value)
λCAN
0.65
0.6
0.55
0.5
0.45
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec


Canadian traffic 2 lanes bidirectionnal (average value)
λCAN
0.65
0.6
0.55
0.5
0.45
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec


Canadian traffic 2 lanes unidirectionnal (average value)
λCAN
0.65
0.6
0.55
0.5
0.45
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec


Canadian traffic 1 lane (upper value)
λCAN
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec


Canadian traffic 2 lanes bidirectionnal (upper bound)
λCAN
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0
10
20
30
40
50
60
70
80
90
100
span length [m]
0.047 veh/sec
0.1 veh/sec
0.2 veh/sec
0.5 veh/sec
0.75 veh/sec
1 veh/sec



By looking at the graphs, it can be noticed that the worst truck flow is a truck flow between 0.2 and 0.5 truck per second. Considering these traffic conditions, a significant higher value of fatigue correction factor is observed, compared to the design value of the corresponding code.

The purpose of the next chapter is to know if a truck flow of 0.2 or 0.5 truck per second is realistic value or not. Indeed, and as previously said in the previous sections, the traffic flow which have been simulated are totally artificial. This is why it is now important to know it the considered traffic flow can be encountered in a real situation, and which fatigue correction factor value must be applied in reality instead of the value specified in the code.

7. REAL TRAFFIC CONDITIONS

Before studying the real possible traffic conditions, some definitions have to be presented first. The definitions concern the different types of highways that can be encountered through Canada. The terminology is specific; this is why it is presented here.

It exists three types of highways in North America (Highway Capacity Manual, 2010):

- freeways
- multilane highways
- 2-lanes highways

The freeways designate a type a highway with two or more lanes for each direction. The traffic is controlled and thus the speed limit can be above 100 km/h.

The multilane highways are some highways with at least 2 lanes for each direction. The difference between this type and the freeways is that there is a lower speed limit on the multilane highways due to the fact that the traffic is not controlled.

The 2-lane highways designate a type of highway with only one lane in each direction. It means it is needed to find a gap on the opposite direction if a vehicle wants to overtake another one.

As the access to the freeways is restricted, this type of highways hasn't been taken into account in this study of the real traffic conditions.

In order to know if the traffic flows simulated in this work are realist, it is required to know the highest possible traffic flow which can occur on each type of highways. The Highway Capacity Manual (2010) gives the maximal capacity and the traffic speed at capacity (for an initial traffic speed of 80 km/h).

Type of highway	Maximal capacity [epc/h]	Traffic speed at capacity [km/h]
Multi-lane highway	2000	72
2-lanes highway	1700	64

Tableau 24: maximal capacity of the different types of highway

The unit of the capacity is expressed as an "equivalent passenger car" per hour. The equivalent passenger car is equal to the number of vehicles times the coefficient of equivalence specific to the vehicle considered. For the trucks and buses, this PCE (passenger cars equivalent) coefficient depends on the type of terrain. This value can be equal to 1.5 (level terrain), 2.5 (rolling terrain) or 4.5 (mountainous terrain). A reasonable assumption consists in taking an average value for the passenger cars equivalent of 2.5. It means that a truck is equal to 2.5 cars in a highway capacity point of view. Knowing the value of this coefficient, it is possible to calculate the effective truck flow, which is function of the total equivalent passenger cars (max. 2000 or 1700) and also function of the considered percentage of trucks.

This is what has been plotted in the figures below:

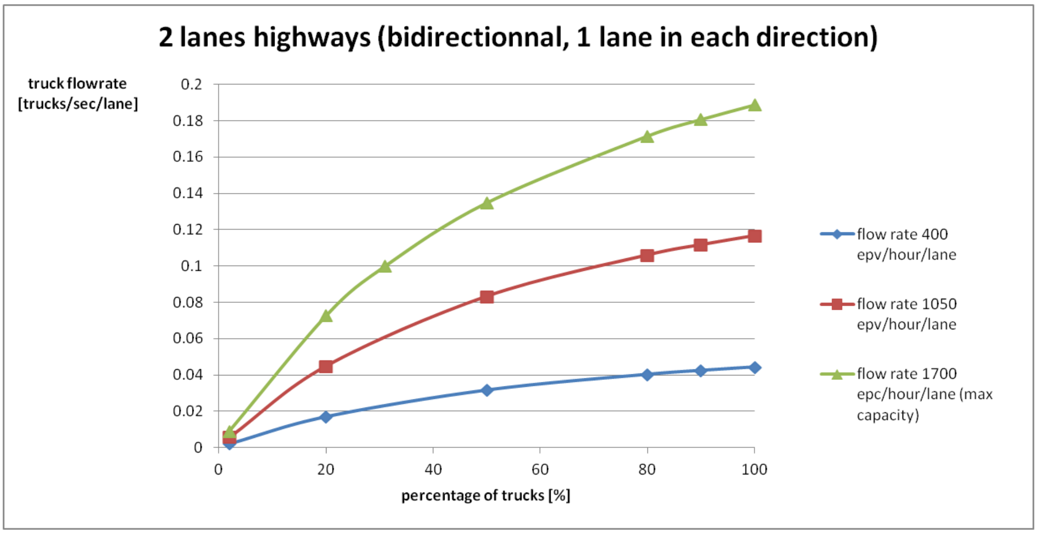


Figure 39: real traffic conditions for 2 lanes highways

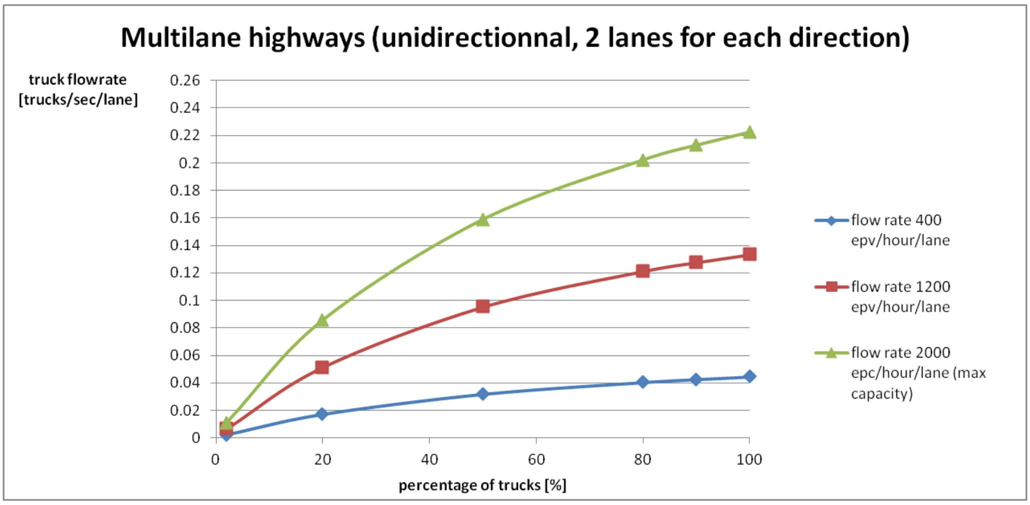


Figure 40: real traffic conditions for multilane highways

It can be noticed that the maximal truck flow rate which can be encountered in reality is around 0.2 trucks/sec/lane. It means that the simulated traffic flows of 0.5/0.75 and 1 veh/sec will not be encountered in reality. Nevertheless, the simulation of theses traffic flows have shown some interesting phenomena (the decrease of the fatigue correction factor when the bridge is always loaded for instance).

Considering a bidirectional traffic and the Canadian traffic database, some real simulations (including a given percentage of cars, and considering a realist traffic flow) have been run and the fatigue correction factors computed. Then, the results have been compared to the results of the previous section, for the equivalent truck flow, in order to know if the “real traffic conditions” results can be extrapolated from the obtained results considering a percentage of cars equal to 0%.

The previous results have been computed considering a truck flow of 0.1 truck/sec. Assuming a 2 lanes highway, the corresponding percentage of truck for a maximal traffic flow (at capacity) is equal to 31.05%. This is a possible truck rate that can be easily encountered in a real traffic.

The comparison of the fatigue correction factor between the case of 100% of trucks (truck flow equal to the traffic flow) and the case of 31.05% of trucks (at capacity, equivalent truck flow equal to 0.1 truck/sec) is shown in the table below:

Traffic data base	Influence line	Equivalent truck flow [truck/sec]	Percentage of trucks [%]	WinQSIM traffic flow [veh/sec]	λCAN [-]
Canadian	p2tr-a_100m	0.1	100	0.1	**0.6967**
			31.05	0.322	**0.6937**
Canadian	p2tr-m_100m	0.1	100	0.1	**0.5312**
			31.05	0.322	**0.5308**
Canadian	p5tr-m_100m	0.1	100	0.1	**0.5654**
			31.05	0.322	**0.5675**
Canadian	ps-r_50m	0.1	100	0.1	**0.5532**
			31.05	0.322	**0.5539**
Canadian	ps-m_50m	0.1	100	0.1	**0.5488**
			31.05	0.322	**0.5491**

It can notice that the results are very close and can then be considered as equal. The concept of "equivalent truck traffic" can thus be validated. Indeed, only the equivalent truck flow has an influence on the fatigue correction factor. Adding cars in the traffic decreases the equivalent truck flow.

It is interesting to note that the traffic speed as a non-negligible effect on the fatigue correction factor.

Indeed, if the real speed of the 2 lanes highway at capacity (influence line p2tr-a_100m) is considered (64 km/h instead of 80 km/h), the fatigue correction factor is slightly higher: $\lambda CAN = 0.714631$.

This phenomena can be explained by the fact that the minimal distance between vehicles is given in seconds. It means this distance depends on the traffic speed. This is why the vehicles can be closer if the traffic speed is lower, and then the simultaneous vehicle crossing effect is increased.

Finally, if we consider only some equivalent truck flows up to 0.2 truck/sec, the results can be summarized in the following tables:

For the Canadian traffic:

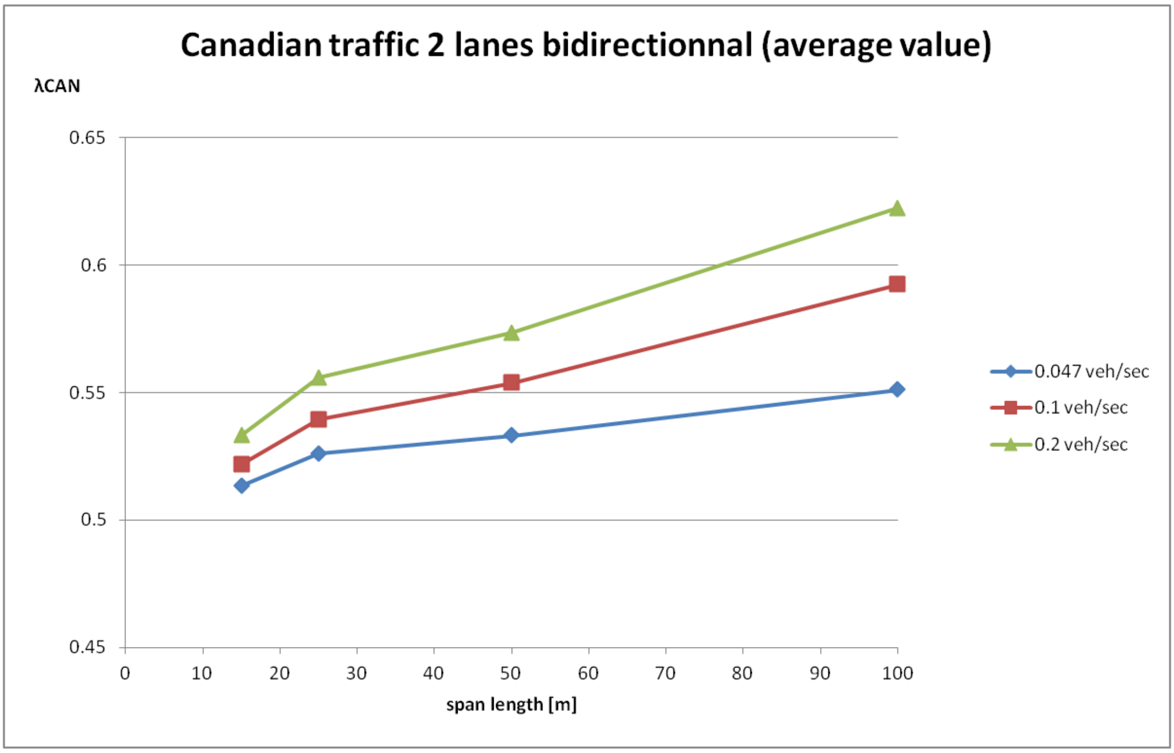


Figure 41 : average FCF values (Canadian traffic 2 lanes bidirectionnal)

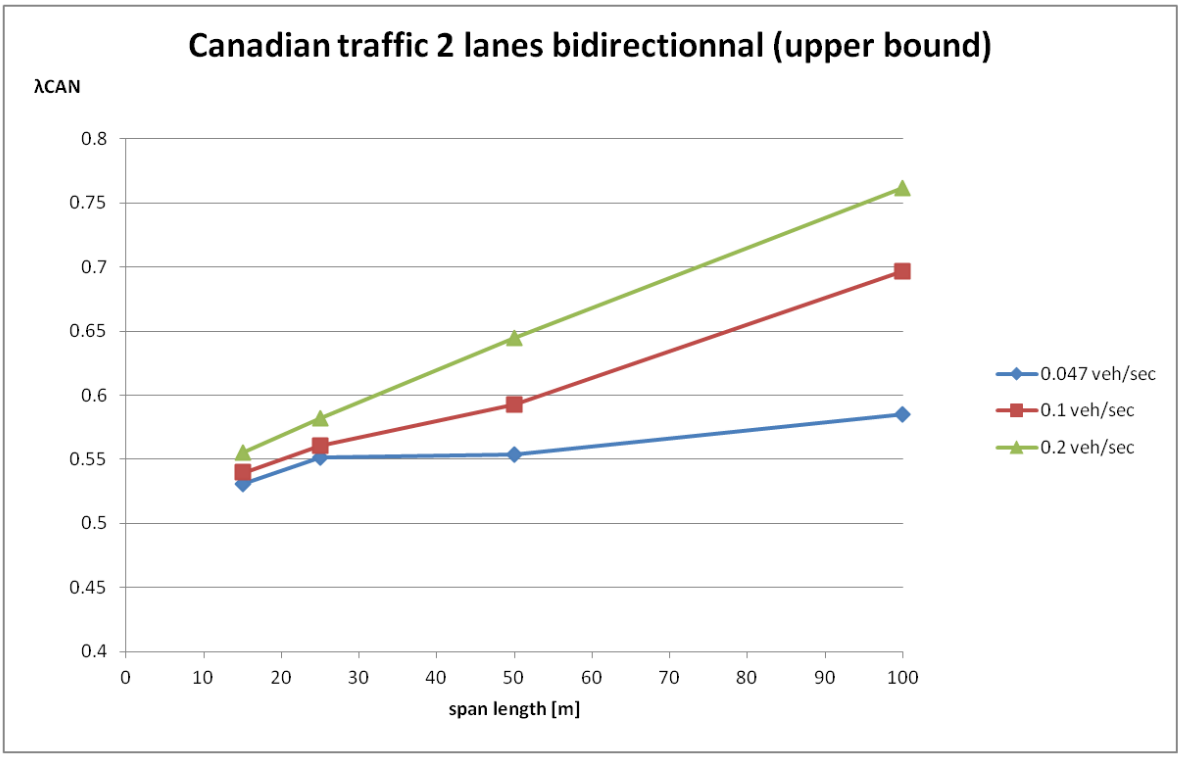


Figure 42 : FCF upper bound values (Canadian traffic, 2 lanes bidirectional)

For the American traffic:

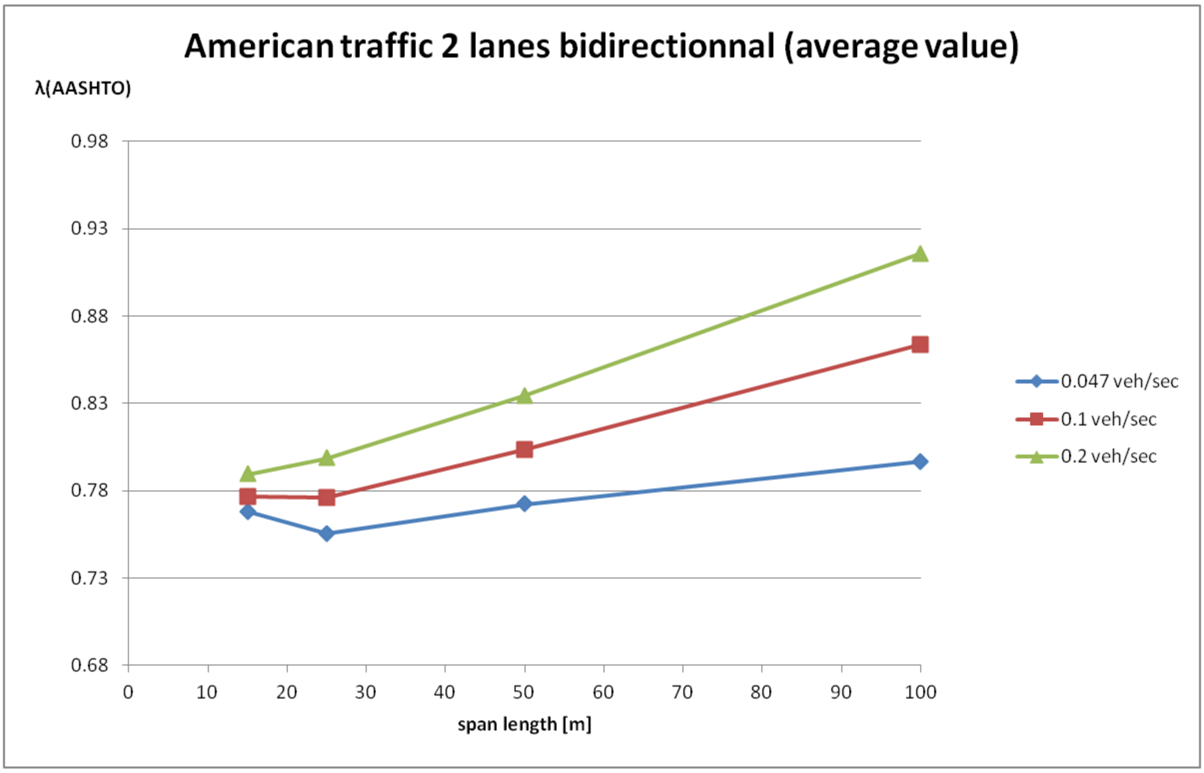


Figure 43 : average FCF values (American traffic, 2 lanes bidirectional)

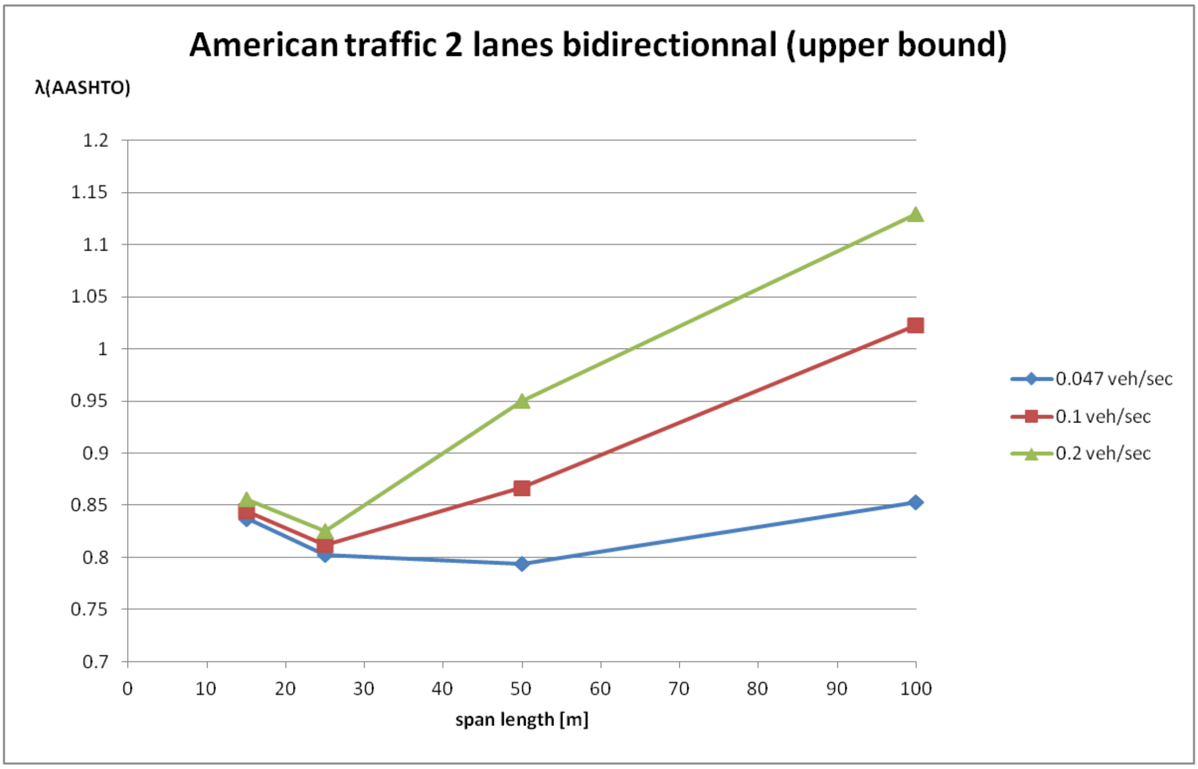


Figure 44 : FCF upper bound values (American traffic, 2 lanes bidirectional)

We can notice that the length of the span has a high effect on the fatigue correction factor. Indeed, the longer the span is, the higher is the probability of simultaneous vehicle crossing. As it has been said at the beginning of this work, the worst case concerning the structural design is represented by a box girder. This is the case that has been studied for the 2 lanes traffic. The direction of traffic has absolutely no influence on the fatigue correction factor.

If the average values of the different tested influence lines are taken into account, the fatigue correction factor is 20% higher than the design value of the code for the Canadian code. The fatigue correction factor can be 46% higher than the value of the code if the reaction at mid-support of a 2 spans bridge (box girder) is considered.

Concerning the American traffic, the average values show that the fatigue correction factor is 26% higher that the fatigue correction factor specified in the ASSHTO code when the capacity of the highway is reached in both directions. The worst case is represented by a fatigue correction factor of 1.13. This value is more than 55% higher than the design value. Such a result can be observed for the bending moment at mid-support of a 2 spans bridge and a span length of 100m. The cross section is a box girder.

8. CONCLUSION

In this master thesis, the effect of simultaneous vehicle crossings on the North American fatigue correction factors has been demonstrated. First, it had been necessary to learn how to use the different software used in the framework of this study (WinQSIM and FDA Bridge), which had been performed during the pre-study. Then, the North American fatigue design codes have been studied and compared to the SIA code (Switzerland). Then, the American and Canadian traffic databases had to be treated in order to be able to use them to simulate some realistic traffic using WinQSIM. It was the most time demanding part of this work. Indeed, the vehicle categories were not available, and the use of WinQSIM is absolutely not user-friendly. Finding the vehicle categories for the Canadian traffic was very long. I wish I could take that time to go a little bit further in the study of the fatigue correction factor in order to simulate more cases. Anyway, it has been shown that the simulated Canadian traffic was finally very close to the traffic simulated in the previous studies performed by R. Caughlin and prof. S. Walbridge.

The simulation of traffic with simultaneous vehicle crossings has shown some very interesting phenomena. Indeed, it has been noticed that the fatigue correction factor can be much higher than the design value of the North American codes. The studied cases correspond to the most unfavorable ones, but the traffic conditions can be encountered in reality.

It would have been great to develop a model like the concept of the λ_4 (SIA code) adapted to the North American codes. Unfortunately, a lack of time at disposal is the main reason why such a research hasn't been performed. Anyway, the computed results of the different simulations will be transmitted to prof. Walbridge and further research about this topic will be performed in a close future for sure. This is a very interesting research area and the potential of improving the North American codes is real.

9. ACKNOWLEDGEMENTS

I would like to acknowledge my two supervisors, prof. A. Nussbaumer (EPFL) and prof. S. Walbridge (Waterloo) for the great support in this master thesis. I also want to thank very much Nariman Maddah and Thierry Meystre. Indeed, without their help for the use of WinQSIM and FDA Bridge, I would never be able to achieve this master thesis. I also want to thank prof. Hellinga and his PhD student Rezza Noroozi for their precious help about the real traffic conditions that we can encountered in North America. It had helped giving some value to this work.

Finally, I want to thank again prof. A. Nussbaumer and prof. S. Walbridge who accepted my proposal to perform my master thesis in Waterloo. I really enjoyed this experience.

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Eurocode EN 1993-1-9:2005 and EN 1991-2

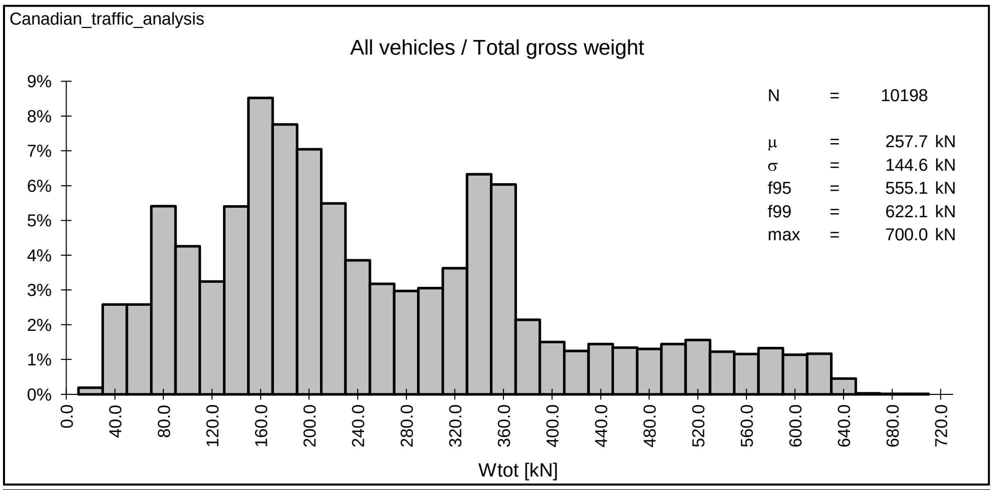
SIA 260, 261, 263

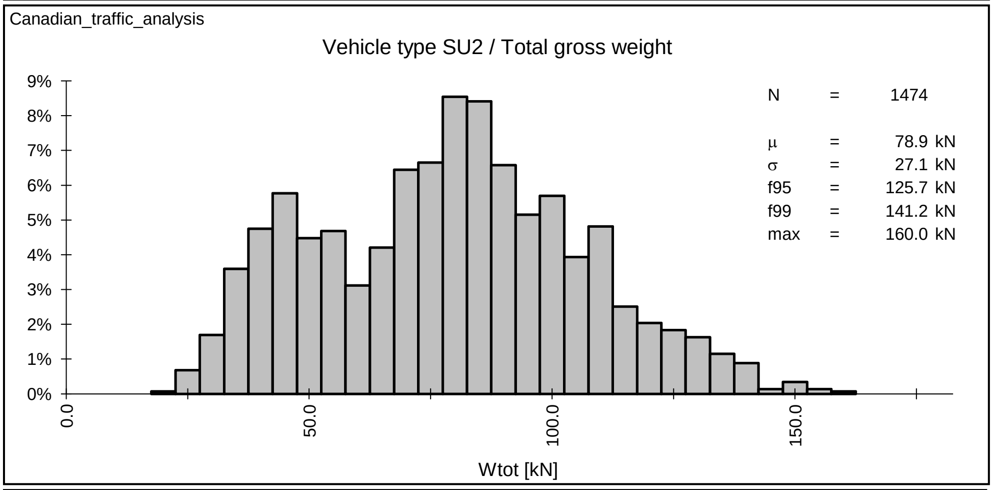
AASHTO code (section 3 and 6)

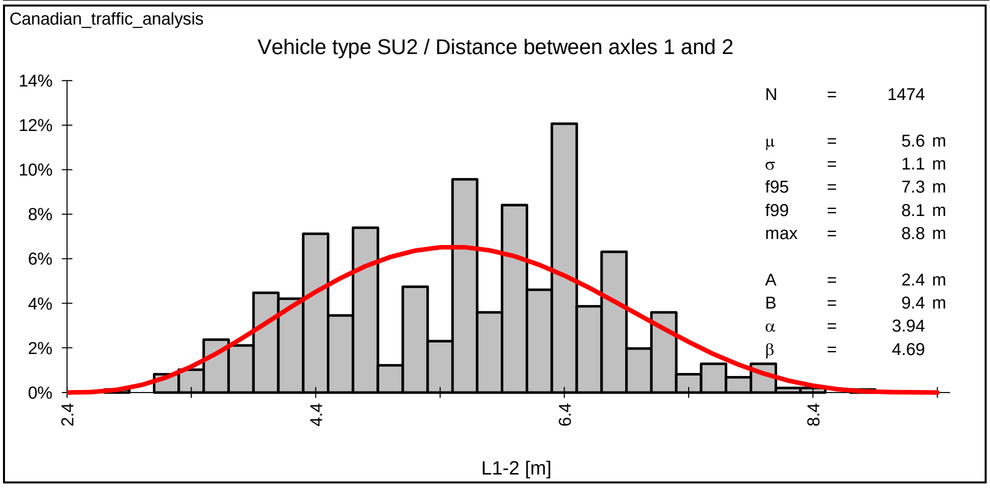
CAN/CSA-S6-06

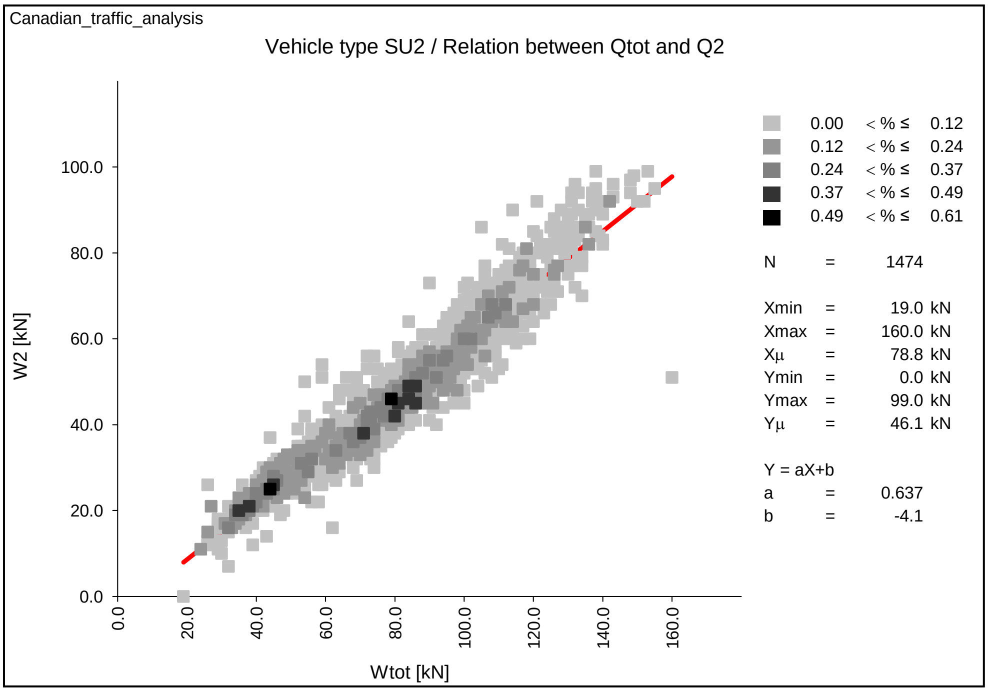
11.APPENDIX

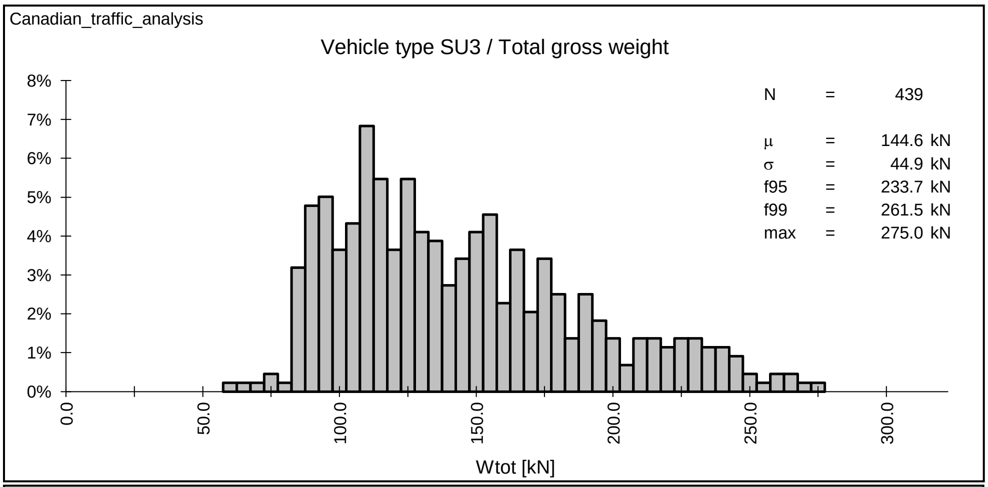
In this annex is displayed the traffic data of the Canadian traffic database and the corresponding fittings.

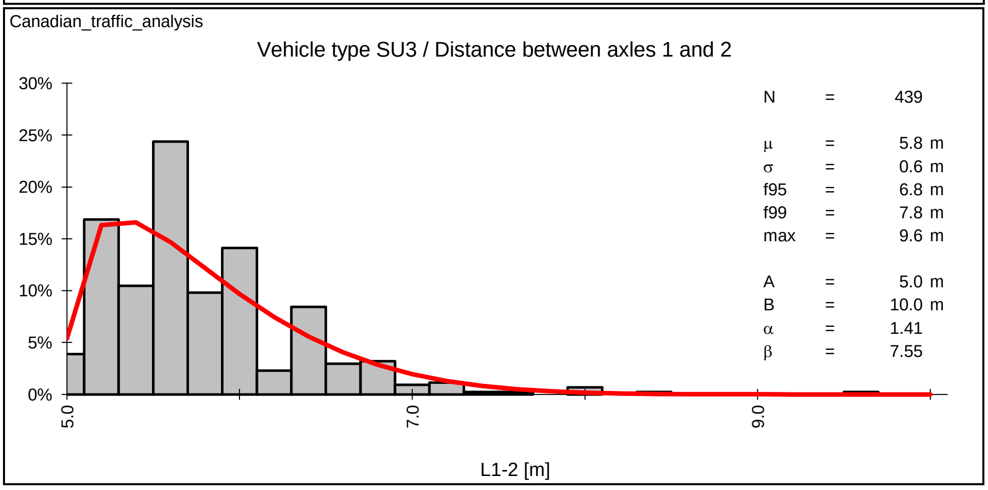


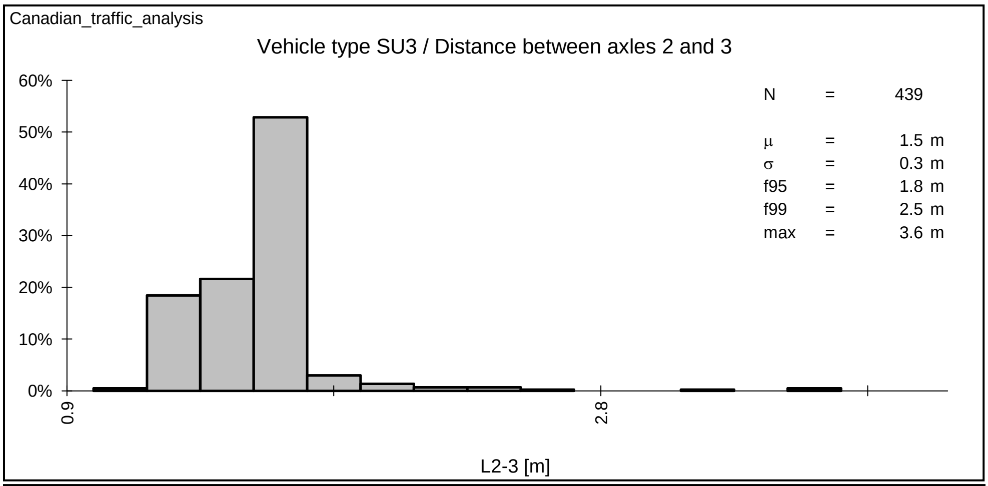


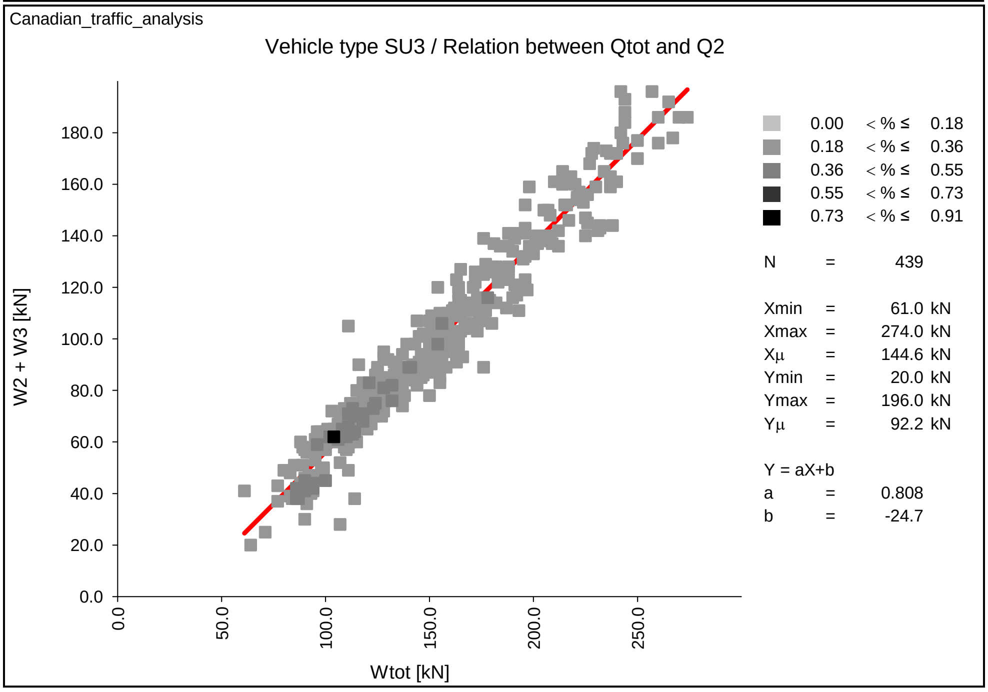


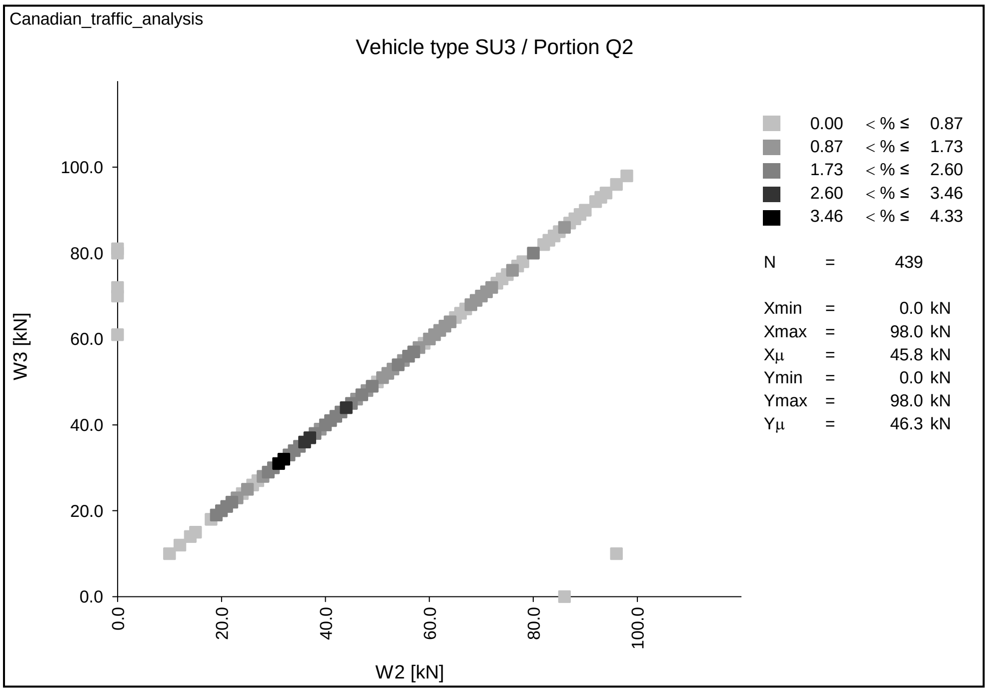

Canadian_traffic_analysis
Vehicle type SU2 / Relation between Qtot and Q2
W2 [kN]
Wtot [kN]
0.00 < % ≤ 0.12
0.12 < % ≤ 0.24
0.24 < % ≤ 0.37
0.37 < % ≤ 0.49
0.49 < % ≤ 0.61
N = 1474
Xmin = 19.0 kN
Xmax = 160.0 kN
Xμ = 78.8 kN
Ymin = 0.0 kN
Ymax = 99.0 kN
Yμ = 46.1 kN
Y = aX+b
a = 0.637
b = -4.1

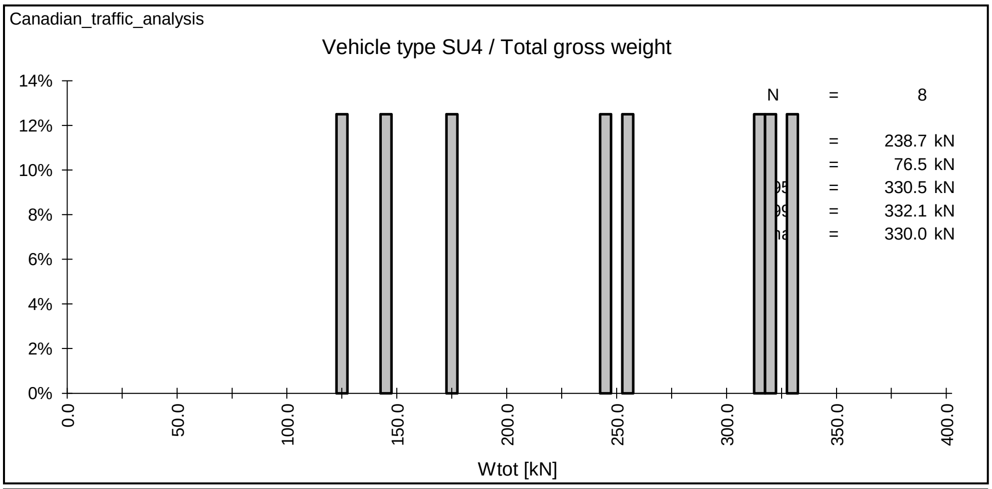

Canadian_traffic_analysis
Vehicle type SU3 / Total gross weight
Wtot [kN]
N = 439
μ = 144.6 kN
σ = 44.9 kN
f95 = 233.7 kN
f99 = 261.5 kN
max = 275.0 kN

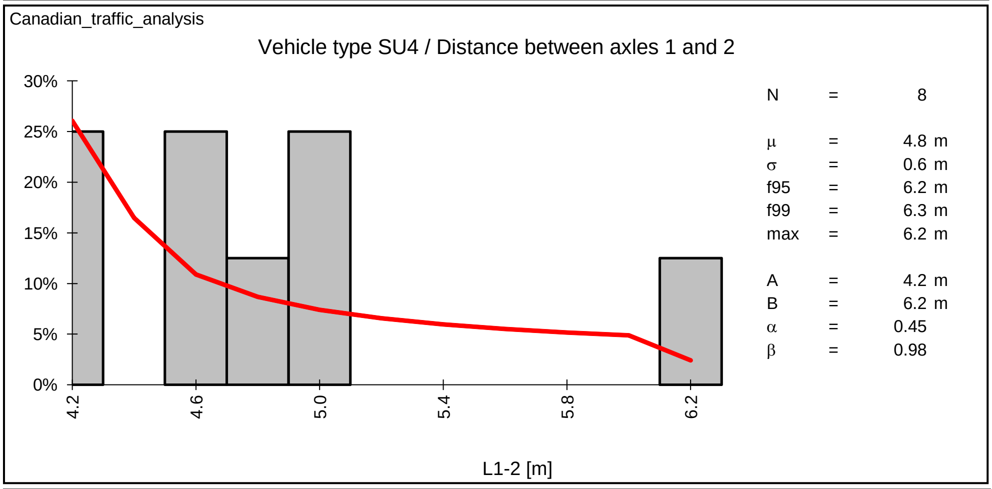

Canadian_traffic_analysis
Vehicle type SU3 / Distance between axles 1 and 2
L1-2 [m]
N = 439
μ = 5.8 m
σ = 0.6 m
f95 = 6.8 m
f99 = 7.8 m
max = 9.6 m
A = 5.0 m
B = 10.0 m
α = 1.41
β = 7.55

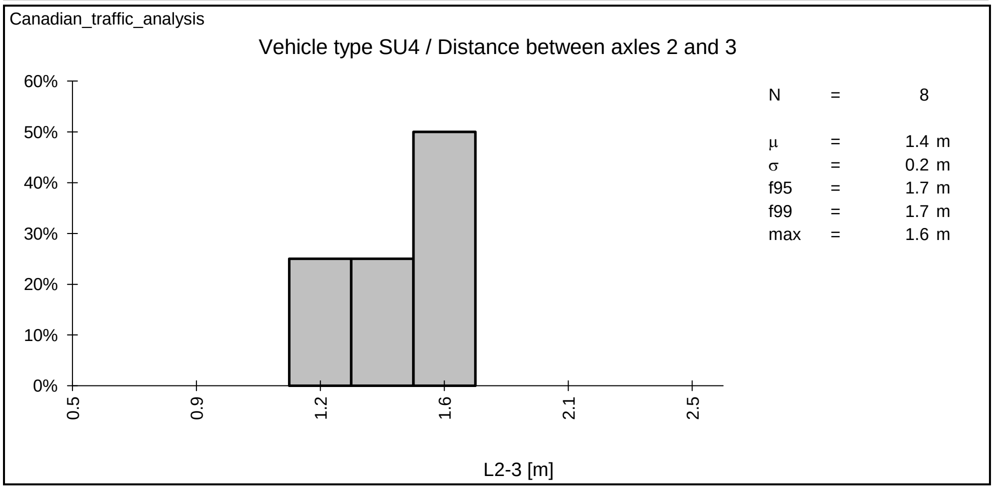

Canadian_traffic_analysis
Vehicle type SU3 / Distance between axles 2 and 3
60%
50%
40%
30%
20%
10%
0%
0.9
2.8
L2-3 [m]
N = 439
μ = 1.5 m
σ = 0.3 m
f95 = 1.8 m
f99 = 2.5 m
max = 3.6 m

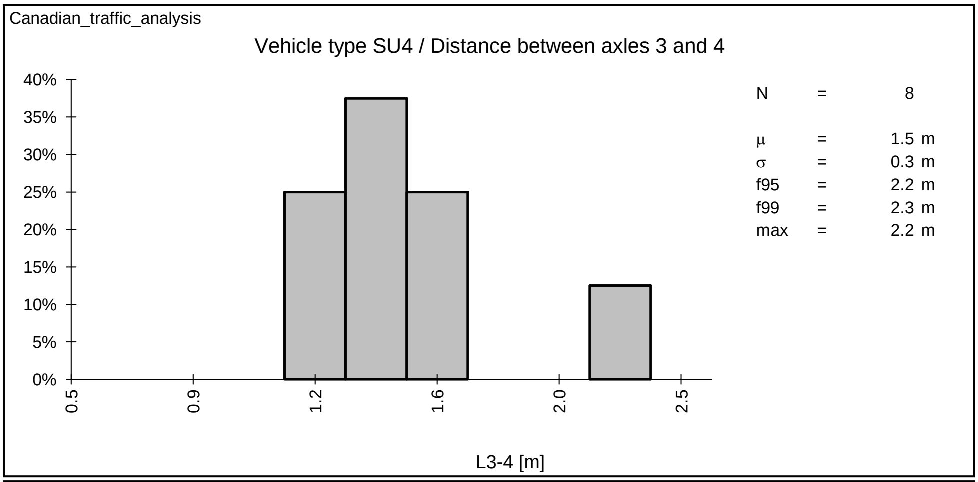

Canadian_traffic_analysis
Vehicle type SU3 / Relation between Qtot and Q2
W2 + W3 [kN]
Wtot [kN]
0.00 < % ≤ 0.18
0.18 < % ≤ 0.36
0.36 < % ≤ 0.55
0.55 < % ≤ 0.73
0.73 < % ≤ 0.91
N = 439
Xmin = 61.0 kN
Xmax = 274.0 kN
Xμ = 144.6 kN
Ymin = 20.0 kN
Ymax = 196.0 kN
Yμ = 92.2 kN
Y = aX+b
a = 0.808
b = -24.7

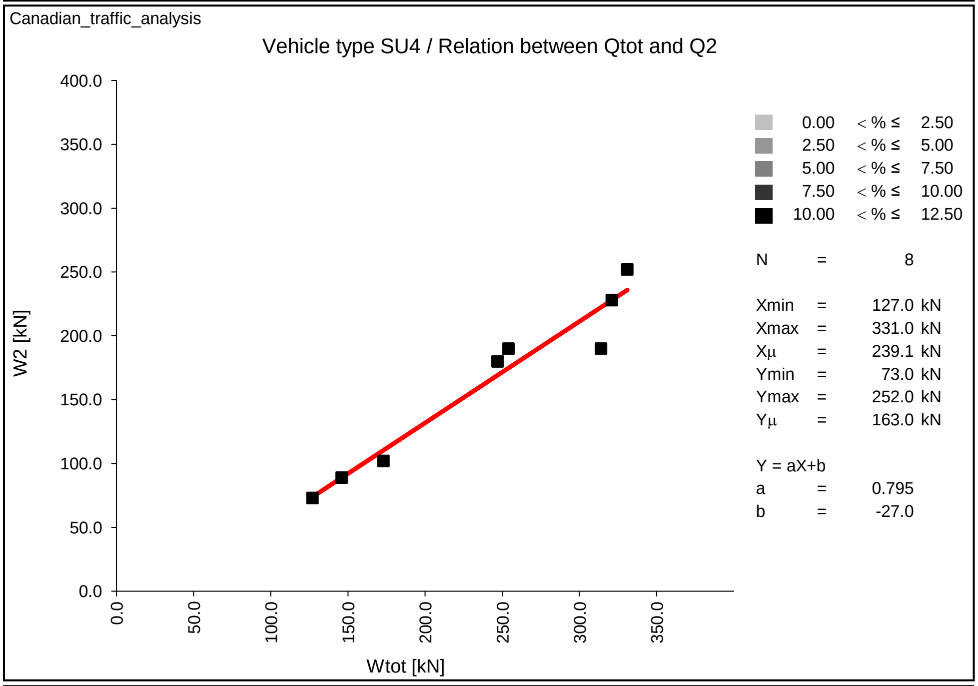

Canadian_traffic_analysis
Vehicle type SU3 / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 0.87
0.87 < % ≤ 1.73
1.73 < % ≤ 2.60
2.60 < % ≤ 3.46
3.46 < % ≤ 4.33
N = 439
Xmin = 0.0 kN
Xmax = 98.0 kN
Xμ = 45.8 kN
Ymin = 0.0 kN
Ymax = 98.0 kN
Yμ = 46.3 kN

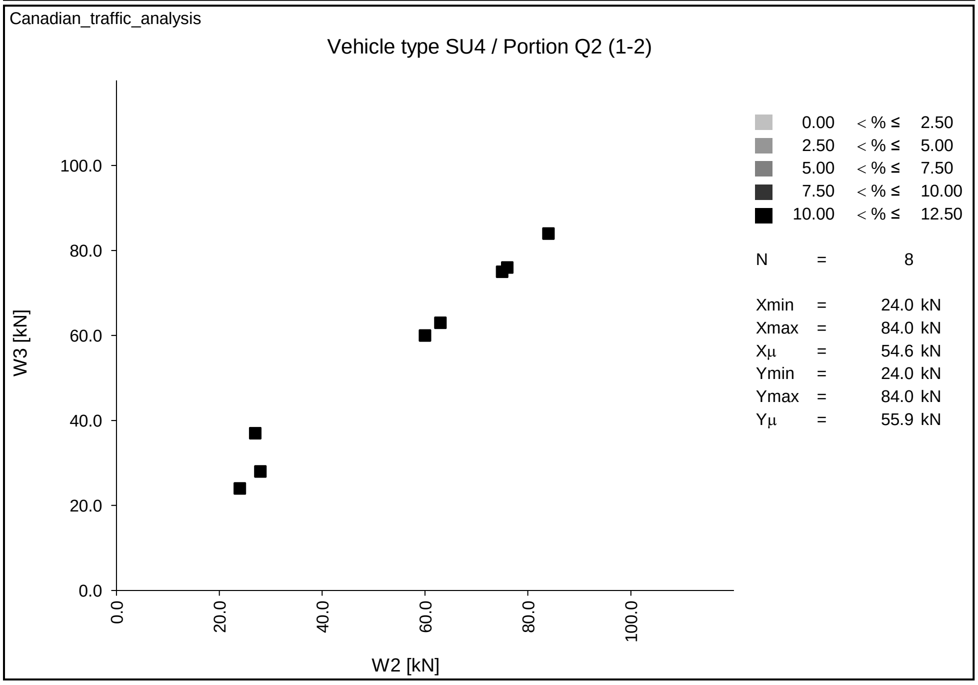

Canadian_traffic_analysis
Vehicle type SU4 / Total gross weight
14%
12%
10%
8%
6%
4%
2%
0%
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
Wtot [kN]
N = 8
= 238.7 kN
= 76.5 kN
= 330.5 kN
= 332.1 kN
= 330.0 kN

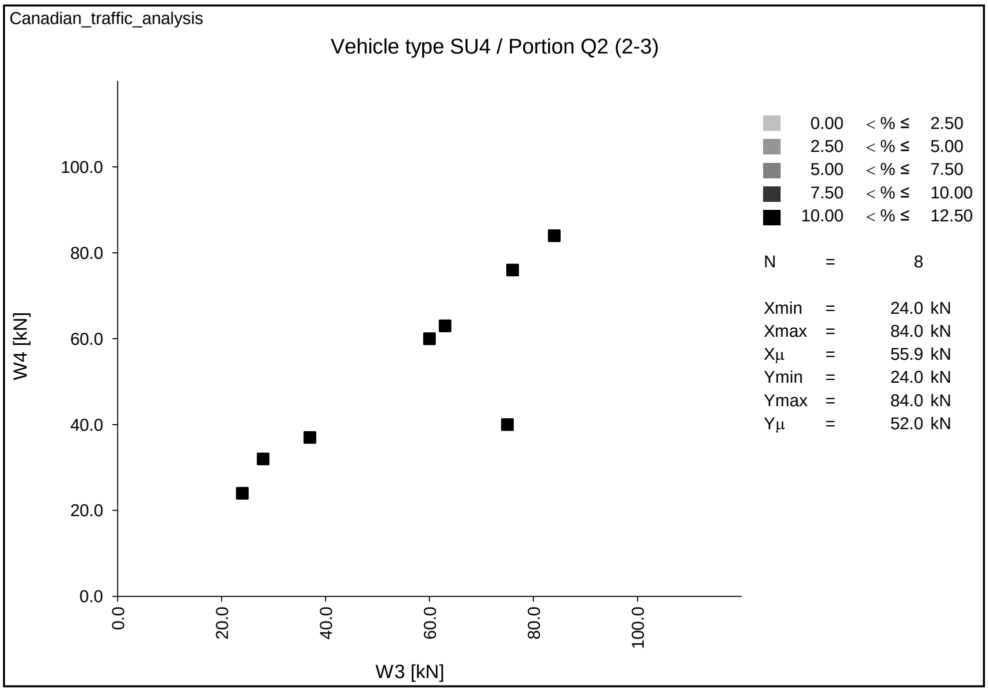

Canadian_traffic_analysis
Vehicle type SU4 / Distance between axles 1 and 2
30%
25%
20%
15%
10%
5%
0%
4.2
4.6
5.0
5.4
5.8
6.2
L1-2 [m]
N = 8
μ = 4.8 m
σ = 0.6 m
f95 = 6.2 m
f99 = 6.3 m
max = 6.2 m
A = 4.2 m
B = 6.2 m
α = 0.45
β = 0.98

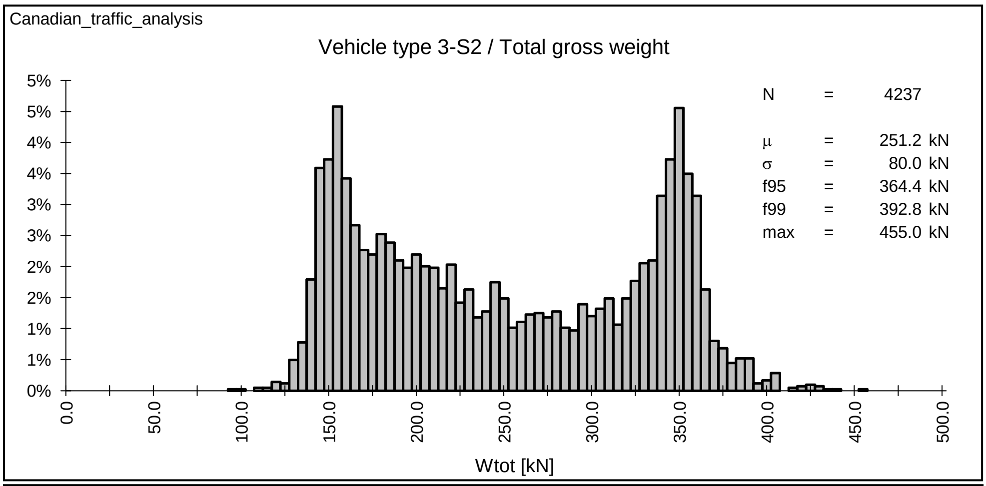

Canadian_traffic_analysis
Vehicle type SU4 / Distance between axles 2 and 3
60%
50%
40%
30%
20%
10%
0%
0.5
0.9
1.2
1.6
2.1
2.5
L2-3 [m]
N = 8
μ = 1.4 m
σ = 0.2 m
f95 = 1.7 m
f99 = 1.7 m
max = 1.6 m

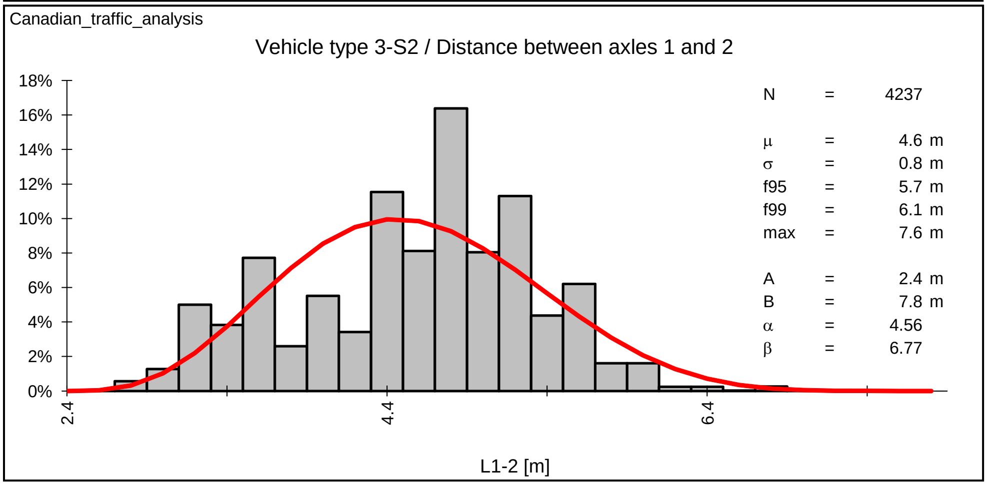

Canadian_traffic_analysis
Vehicle type SU4 / Distance between axles 3 and 4
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.5
0.9
1.2
1.6
2.0
2.5
L3-4 [m]
N = 8
μ = 1.5 m
σ = 0.3 m
f95 = 2.2 m
f99 = 2.3 m
max = 2.2 m

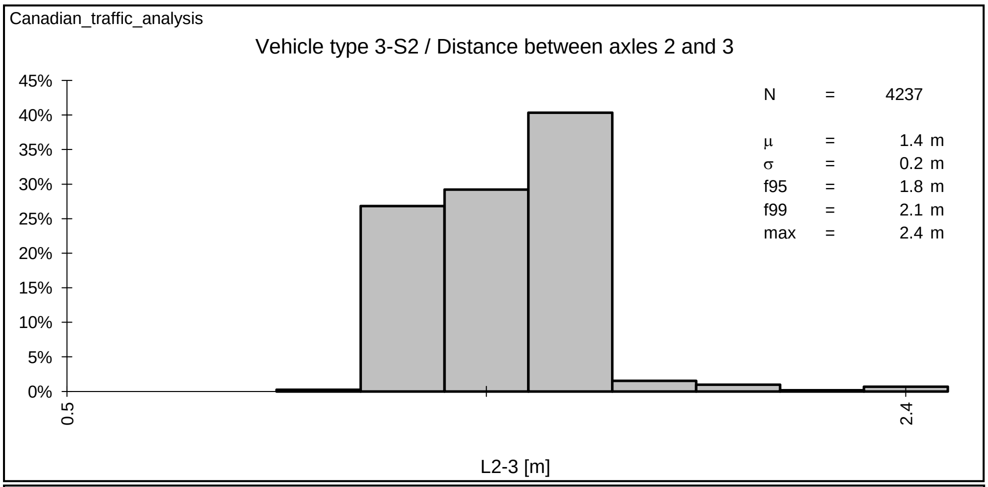

Canadian_traffic_analysis
Vehicle type SU4 / Relation between Qtot and Q2
W2 [kN]
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Wtot [kN]
0.00 < % ≤ 2.50
2.50 < % ≤ 5.00
5.00 < % ≤ 7.50
7.50 < % ≤ 10.00
10.00 < % ≤ 12.50
N = 8
Xmin = 127.0 kN
Xmax = 331.0 kN
Xμ = 239.1 kN
Ymin = 73.0 kN
Ymax = 252.0 kN
Yμ = 163.0 kN
Y = aX+b
a = 0.795
b = -27.0

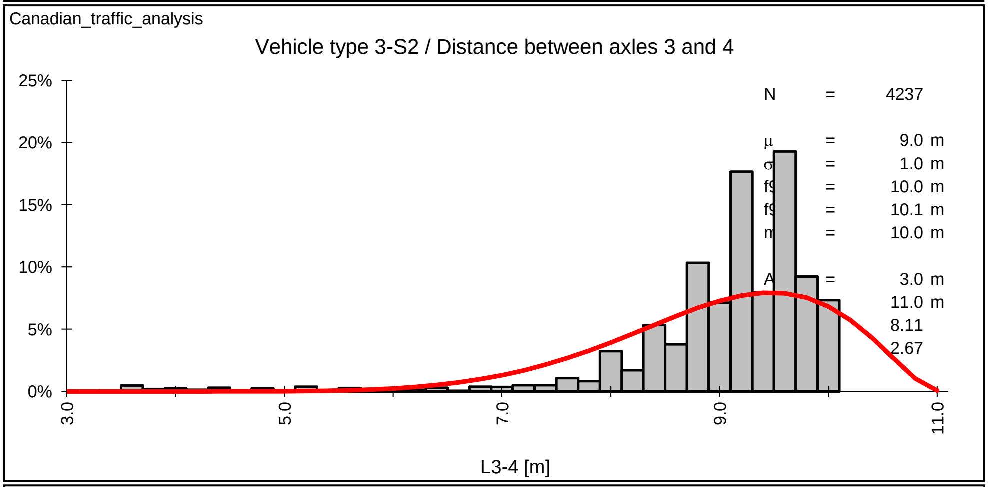

Canadian_traffic_analysis
Vehicle type SU4 / Portion Q2 (1-2)
W3 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
0.0
20.0
40.0
60.0
80.0
100.0
W2 [kN]
0.00 < % ≤ 2.50
2.50 < % ≤ 5.00
5.00 < % ≤ 7.50
7.50 < % ≤ 10.00
10.00 < % ≤ 12.50
N = 8
Xmin = 24.0 kN
Xmax = 84.0 kN
Xμ = 54.6 kN
Ymin = 24.0 kN
Ymax = 84.0 kN
Yμ = 55.9 kN

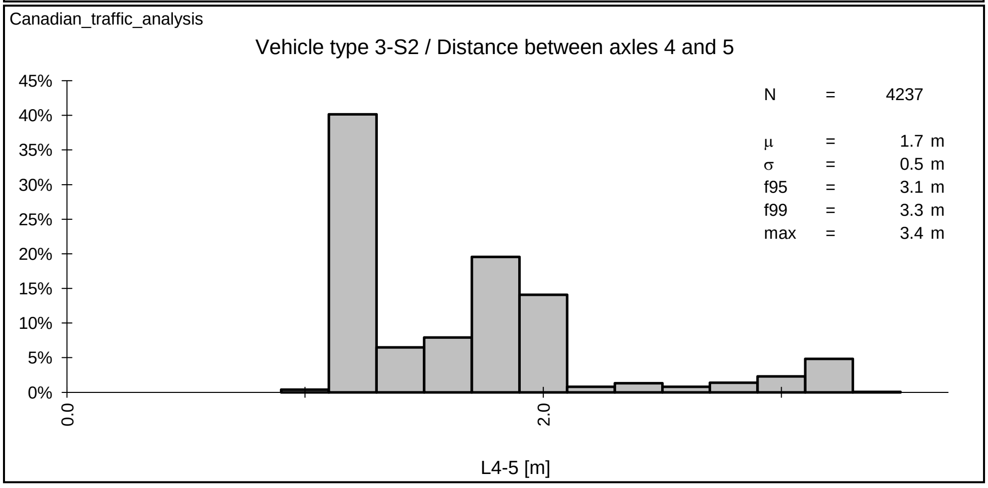

Canadian_traffic_analysis
Vehicle type SU4 / Portion Q2 (2-3)
W4 [kN]
W3 [kN]
0.00 < % ≤ 2.50
2.50 < % ≤ 5.00
5.00 < % ≤ 7.50
7.50 < % ≤ 10.00
10.00 < % ≤ 12.50
N = 8
Xmin = 24.0 kN
Xmax = 84.0 kN
Xμ = 55.9 kN
Ymin = 24.0 kN
Ymax = 84.0 kN
Yμ = 52.0 kN

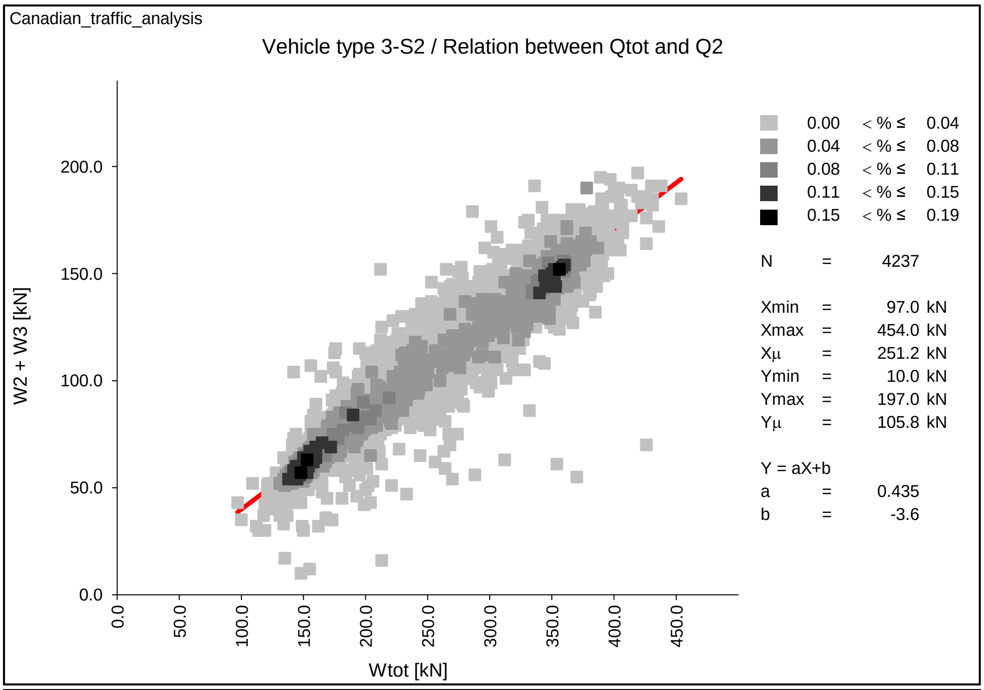

Canadian_traffic_analysis
Vehicle type 3-S2 / Total gross weight
Wtot [kN]
N = 4237
μ = 251.2 kN
σ = 80.0 kN
f95 = 364.4 kN
f99 = 392.8 kN
max = 455.0 kN

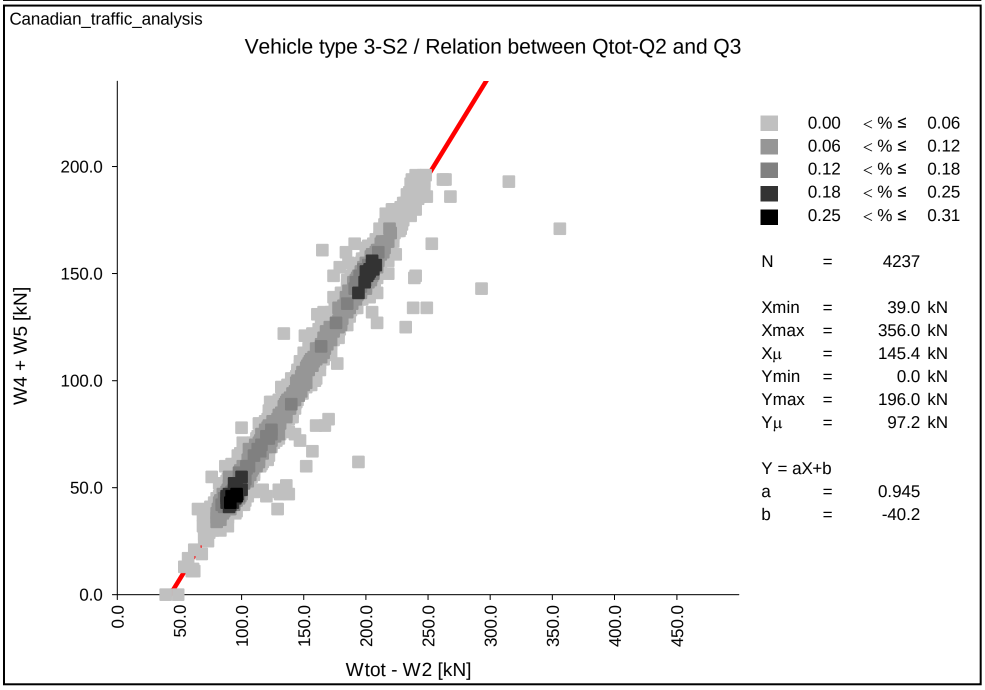

Canadian_traffic_analysis
Vehicle type 3-S2 / Distance between axles 1 and 2
L1-2 [m]
N = 4237
μ = 4.6 m
σ = 0.8 m
f95 = 5.7 m
f99 = 6.1 m
max = 7.6 m
A = 2.4 m
B = 7.8 m
α = 4.56
β = 6.77

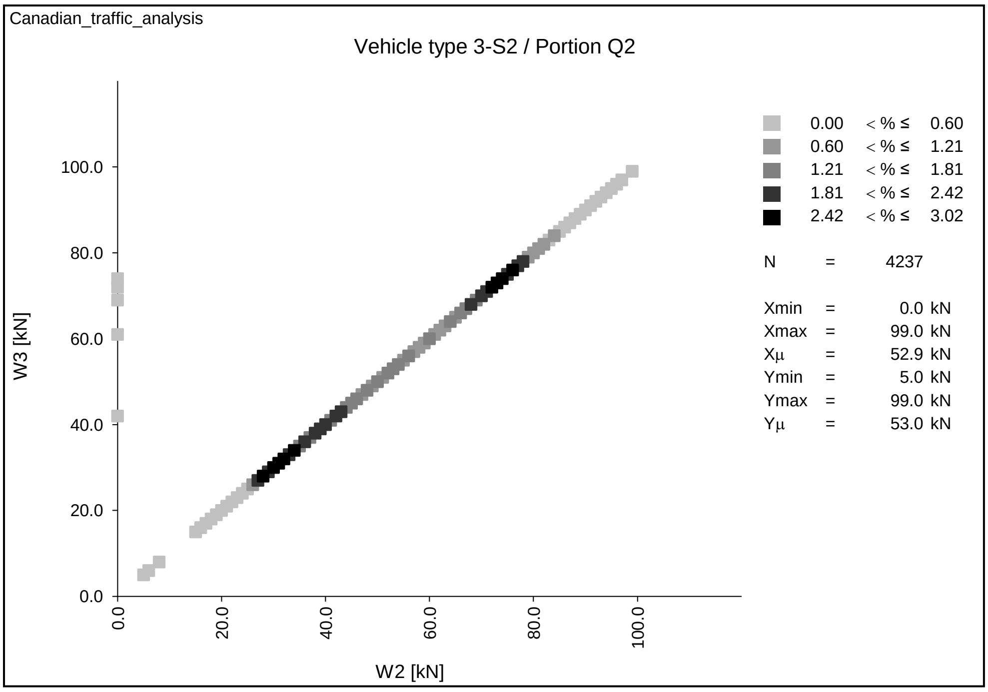

Canadian_traffic_analysis
Vehicle type 3-S2 / Distance between axles 2 and 3
N = 4237
μ = 1.4 m
σ = 0.2 m
f95 = 1.8 m
f99 = 2.1 m
max = 2.4 m
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.5
2.4
L2-3 [m]

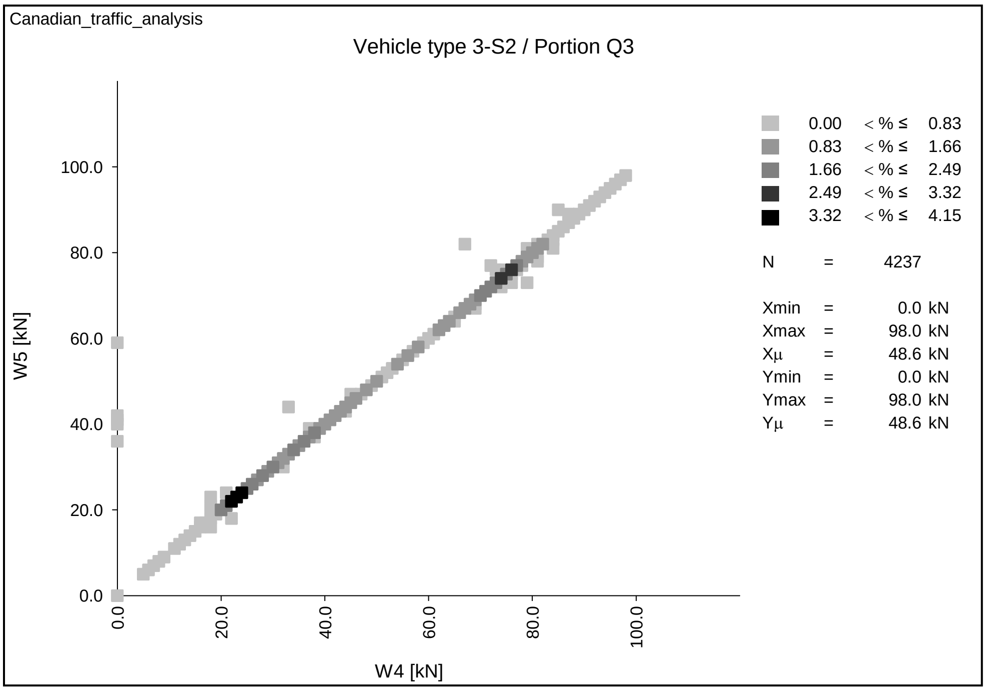

Canadian_traffic_analysis
Vehicle type 3-S2 / Distance between axles 3 and 4
N = 4237
μ = 9.0 m
σ = 1.0 m
f9 = 10.0 m
f9 = 10.1 m
m = 10.0 m
A = 3.0 m
11.0 m
8.11
2.67
25%
20%
15%
10%
5%
0%
3.0
5.0
7.0
9.0
11.0
L3-4 [m]

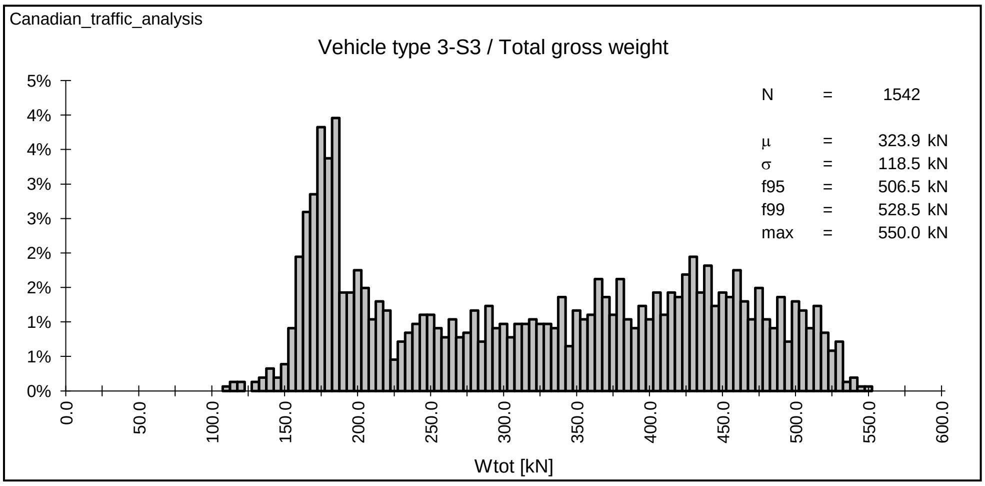

Canadian_traffic_analysis
Vehicle type 3-S2 / Distance between axles 4 and 5
N = 4237
μ = 1.7 m
σ = 0.5 m
f95 = 3.1 m
f99 = 3.3 m
max = 3.4 m
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.0
2.0
L4-5 [m]

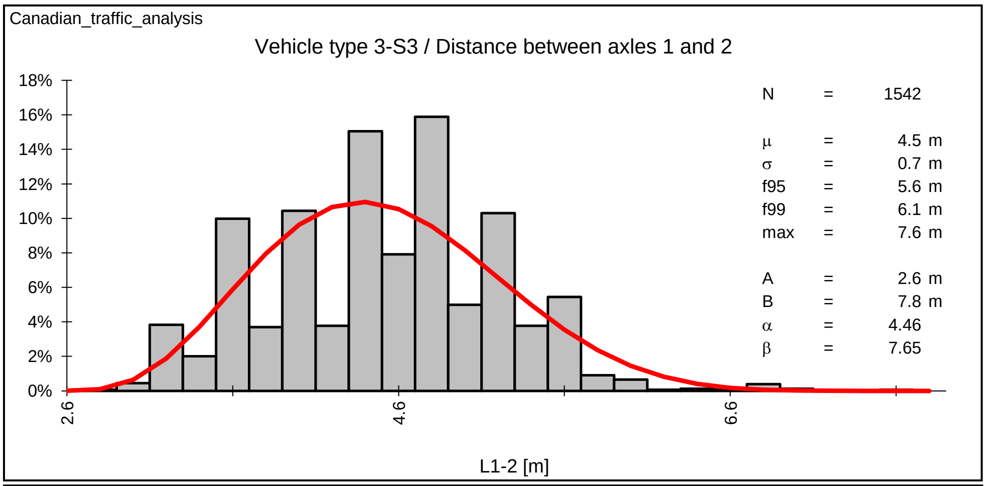

Canadian_traffic_analysis
Vehicle type 3-S2 / Relation between Qtot and Q2
W2 + W3 [kN]
Wtot [kN]
0.00 < % ≤ 0.04
0.04 < % ≤ 0.08
0.08 < % ≤ 0.11
0.11 < % ≤ 0.15
0.15 < % ≤ 0.19
N = 4237
Xmin = 97.0 kN
Xmax = 454.0 kN
Xμ = 251.2 kN
Ymin = 10.0 kN
Ymax = 197.0 kN
Yμ = 105.8 kN
Y = aX+b
a = 0.435
b = -3.6

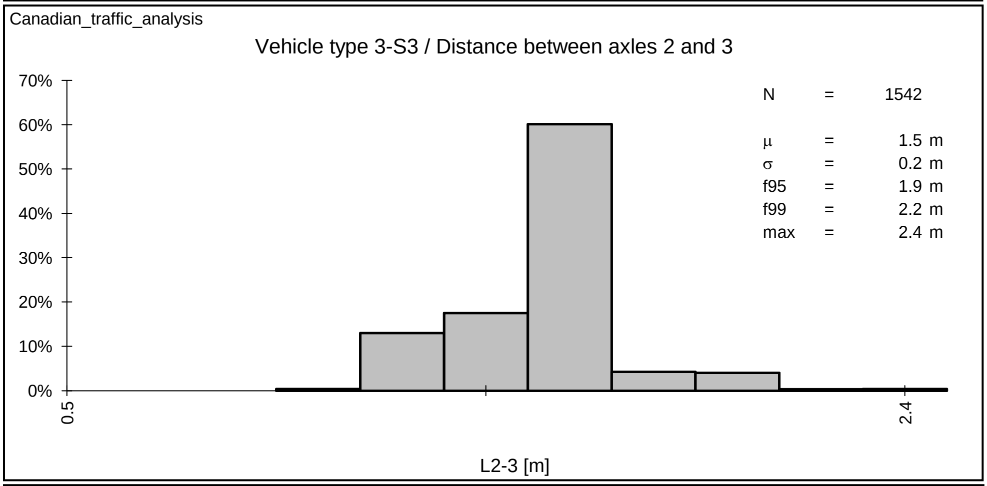

Canadian_traffic_analysis
Vehicle type 3-S2 / Relation between Qtot-Q2 and Q3
W4 + W5 [kN]
Wtot - W2 [kN]
0.00 < % ≤ 0.06
0.06 < % ≤ 0.12
0.12 < % ≤ 0.18
0.18 < % ≤ 0.25
0.25 < % ≤ 0.31
N = 4237
Xmin = 39.0 kN
Xmax = 356.0 kN
Xμ = 145.4 kN
Ymin = 0.0 kN
Ymax = 196.0 kN
Yμ = 97.2 kN
Y = aX+b
a = 0.945
b = -40.2

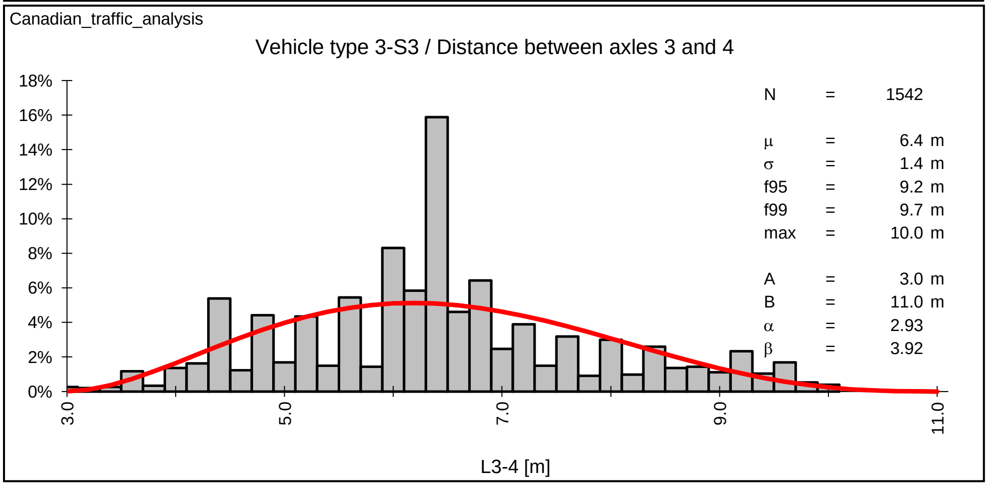

Canadian_traffic_analysis
Vehicle type 3-S2 / Portion Q2
0.00 < % ≤ 0.60
0.60 < % ≤ 1.21
1.21 < % ≤ 1.81
1.81 < % ≤ 2.42
2.42 < % ≤ 3.02
N = 4237
Xmin = 0.0 kN
Xmax = 99.0 kN
Xμ = 52.9 kN
Ymin = 5.0 kN
Ymax = 99.0 kN
Yμ = 53.0 kN
W3 [kN]
W2 [kN]

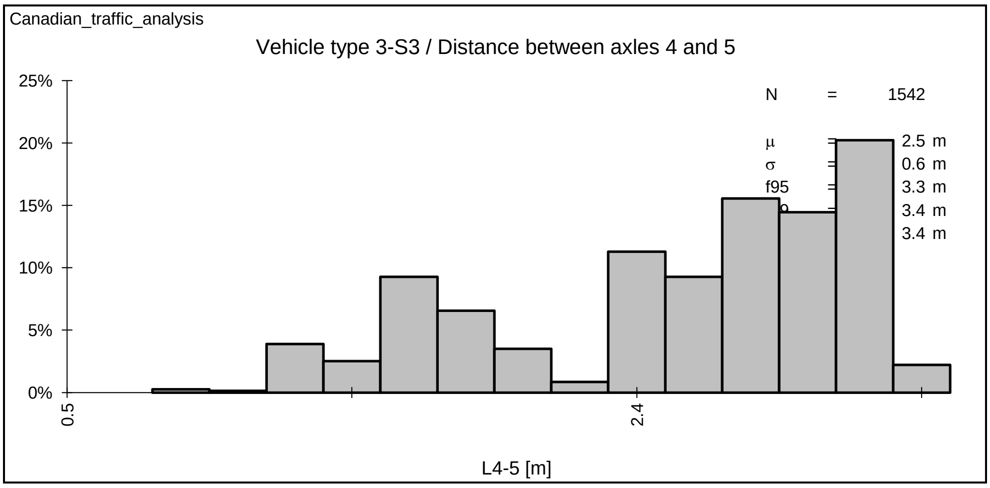

Canadian_traffic_analysis
Vehicle type 3-S2 / Portion Q3
0.00 < % ≤ 0.83
0.83 < % ≤ 1.66
1.66 < % ≤ 2.49
2.49 < % ≤ 3.32
3.32 < % ≤ 4.15
N = 4237
Xmin = 0.0 kN
Xmax = 98.0 kN
Xμ = 48.6 kN
Ymin = 0.0 kN
Ymax = 98.0 kN
Yμ = 48.6 kN
W5 [kN]
W4 [kN]

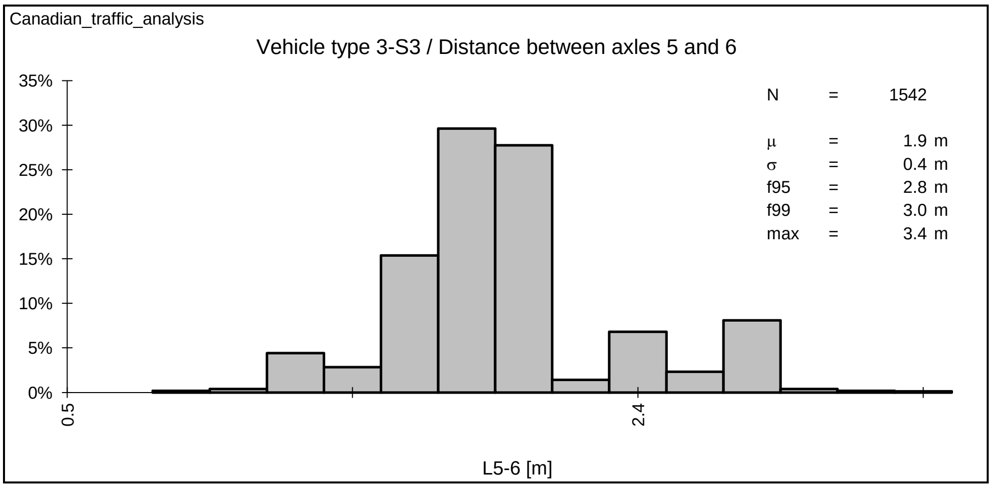

Canadian_traffic_analysis
Vehicle type 3-S3 / Total gross weight
N = 1542
μ = 323.9 kN
σ = 118.5 kN
f95 = 506.5 kN
f99 = 528.5 kN
max = 550.0 kN
Wtot [kN]

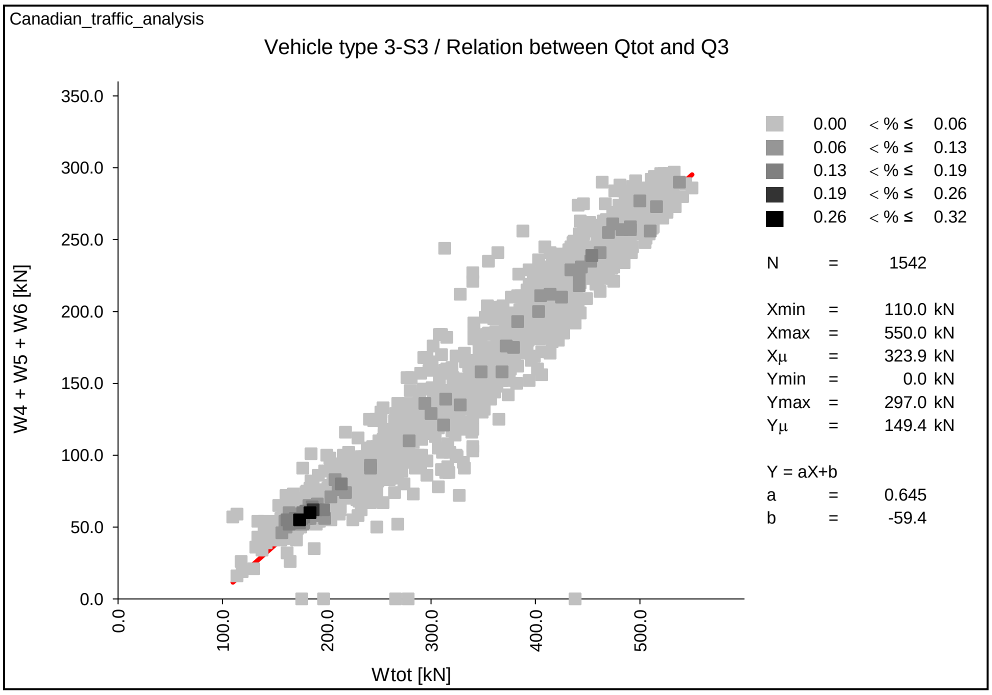

Canadian_traffic_analysis
Vehicle type 3-S3 / Distance between axles 1 and 2
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2.6
4.6
6.6
L1-2 [m]
N = 1542
μ = 4.5 m
σ = 0.7 m
f95 = 5.6 m
f99 = 6.1 m
max = 7.6 m
A = 2.6 m
B = 7.8 m
α = 4.46
β = 7.65

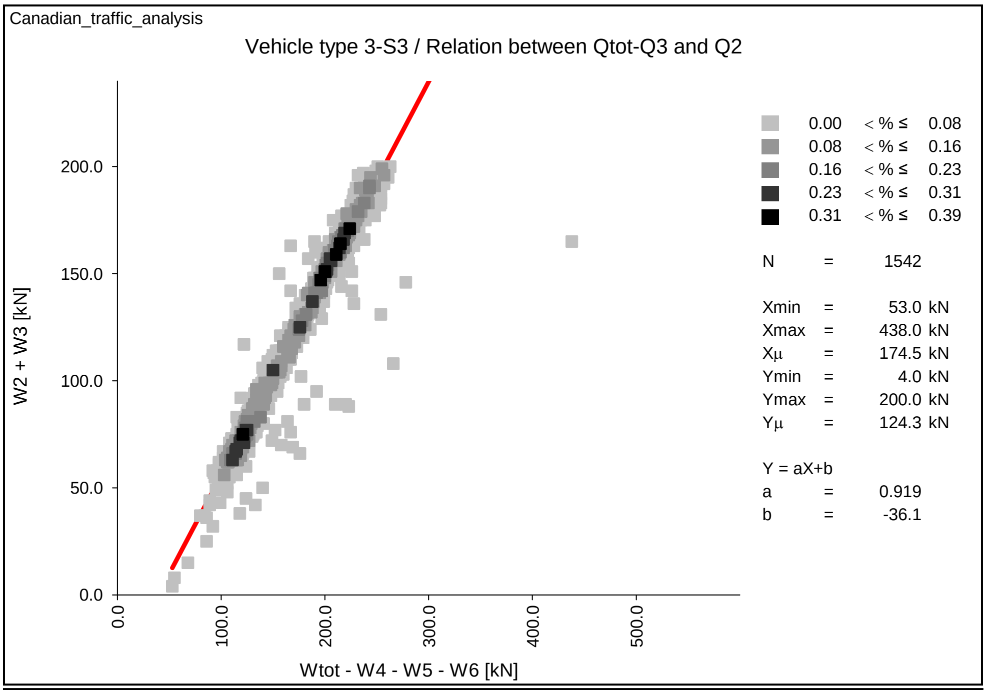

Canadian_traffic_analysis
Vehicle type 3-S3 / Distance between axles 2 and 3
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.4
L2-3 [m]
N = 1542
μ = 1.5 m
σ = 0.2 m
f95 = 1.9 m
f99 = 2.2 m
max = 2.4 m

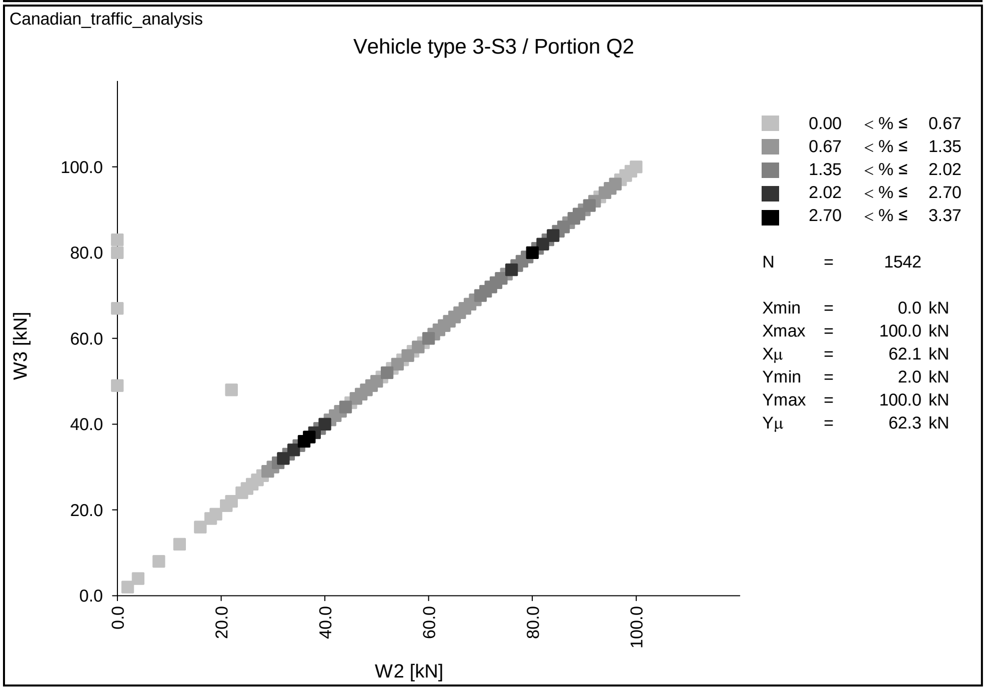

Canadian_traffic_analysis
Vehicle type 3-S3 / Distance between axles 3 and 4
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
3.0
5.0
7.0
9.0
11.0
L3-4 [m]
N = 1542
μ = 6.4 m
σ = 1.4 m
f95 = 9.2 m
f99 = 9.7 m
max = 10.0 m
A = 3.0 m
B = 11.0 m
α = 2.93
β = 3.92

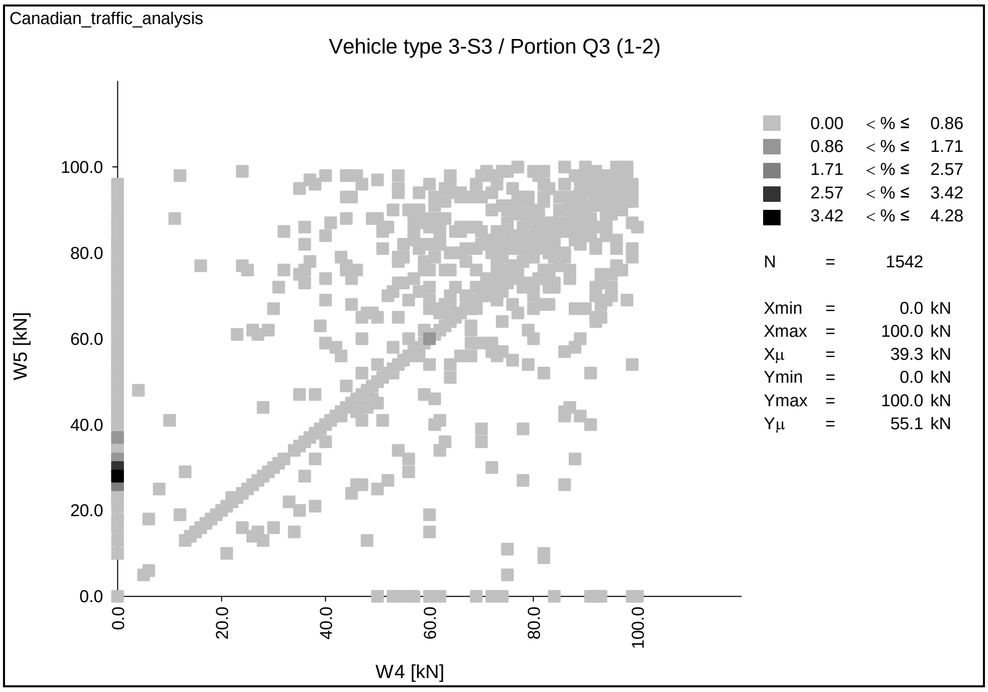

Canadian_traffic_analysis
Vehicle type 3-S3 / Distance between axles 4 and 5
N = 1542
μ = 2.5 m
σ = 0.6 m
f95 = 3.3 m
3.4 m
3.4 m
25%
20%
15%
10%
5%
0%
0.5
2.4
L4-5 [m]

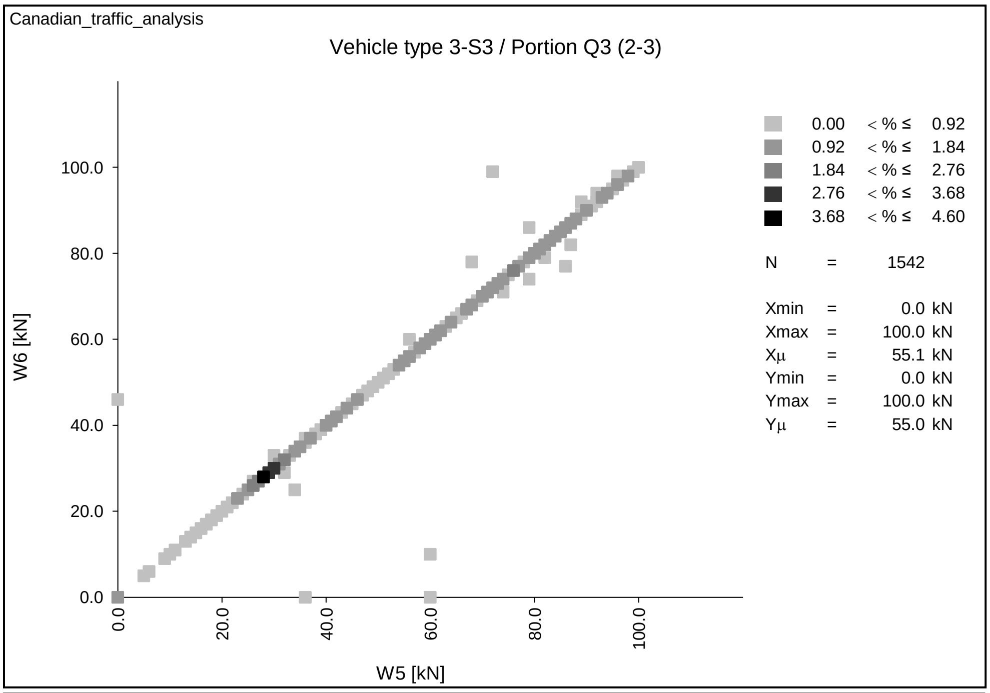

Canadian_traffic_analysis
Vehicle type 3-S3 / Distance between axles 5 and 6
N = 1542
μ = 1.9 m
σ = 0.4 m
f95 = 2.8 m
f99 = 3.0 m
max = 3.4 m
35%
30%
25%
20%
15%
10%
5%
0%
0.5
2.4
L5-6 [m]

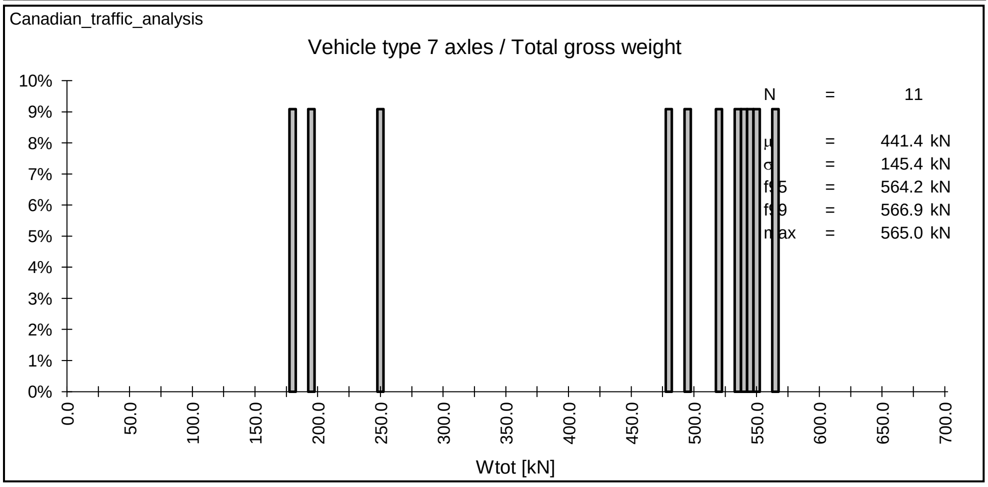

Canadian_traffic_analysis
Vehicle type 3-S3 / Relation between Qtot and Q3
0.00 < % ≤ 0.06
0.06 < % ≤ 0.13
0.13 < % ≤ 0.19
0.19 < % ≤ 0.26
0.26 < % ≤ 0.32
N = 1542
Xmin = 110.0 kN
Xmax = 550.0 kN
Xμ = 323.9 kN
Ymin = 0.0 kN
Ymax = 297.0 kN
Yμ = 149.4 kN
Y = aX+b
a = 0.645
b = -59.4
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
W4 + W5 + W6 [kN]
0.0
100.0
200.0
300.0
400.0
500.0
Wtot [kN]

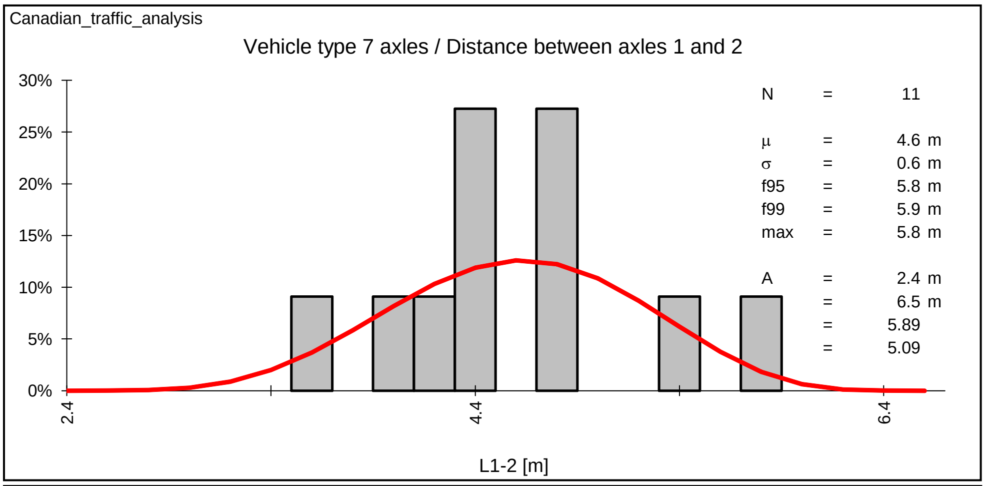

Canadian_traffic_analysis
Vehicle type 3-S3 / Relation between Qtot-Q3 and Q2
W2 + W3 [kN]
Wtot - W4 - W5 - W6 [kN]
0.0
50.0
100.0
150.0
200.0
0.0
100.0
200.0
300.0
400.0
500.0
0.00 < % ≤ 0.08
0.08 < % ≤ 0.16
0.16 < % ≤ 0.23
0.23 < % ≤ 0.31
0.31 < % ≤ 0.39
N = 1542
Xmin = 53.0 kN
Xmax = 438.0 kN
Xμ = 174.5 kN
Ymin = 4.0 kN
Ymax = 200.0 kN
Yμ = 124.3 kN
Y = aX+b
a = 0.919
b = -36.1

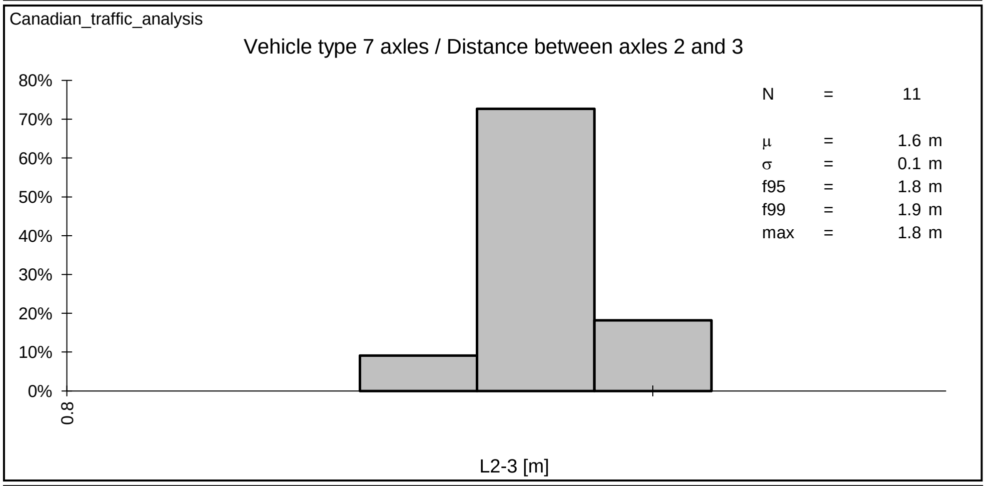

Canadian_traffic_analysis
Vehicle type 3-S3 / Portion Q2
W3 [kN]
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 0.67
0.67 < % ≤ 1.35
1.35 < % ≤ 2.02
2.02 < % ≤ 2.70
2.70 < % ≤ 3.37
N = 1542
Xmin = 0.0 kN
Xmax = 100.0 kN
Xμ = 62.1 kN
Ymin = 2.0 kN
Ymax = 100.0 kN
Yμ = 62.3 kN

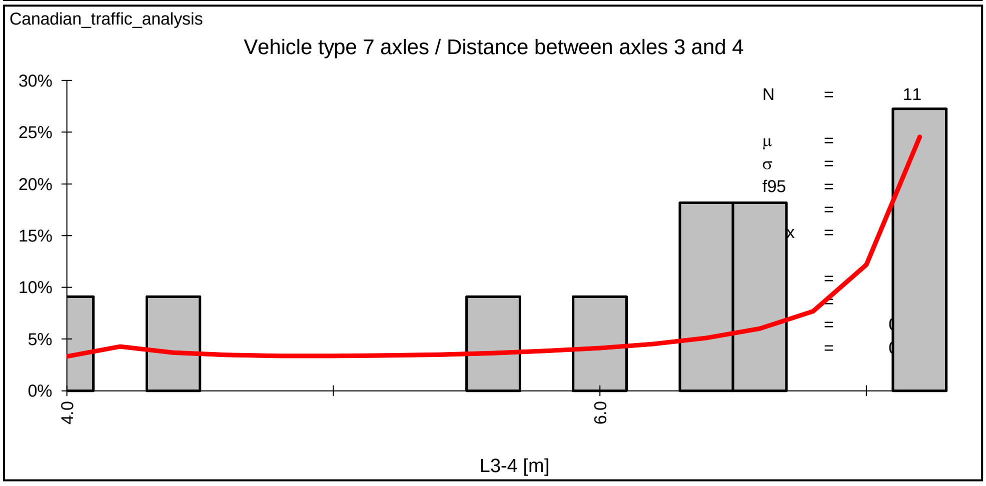

Canadian_traffic_analysis
Vehicle type 3-S3 / Portion Q3 (1-2)
0.00 < % ≤ 0.86
0.86 < % ≤ 1.71
1.71 < % ≤ 2.57
2.57 < % ≤ 3.42
3.42 < % ≤ 4.28
N = 1542
Xmin = 0.0 kN
Xmax = 100.0 kN
Xμ = 39.3 kN
Ymin = 0.0 kN
Ymax = 100.0 kN
Yμ = 55.1 kN
W5 [kN]
W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

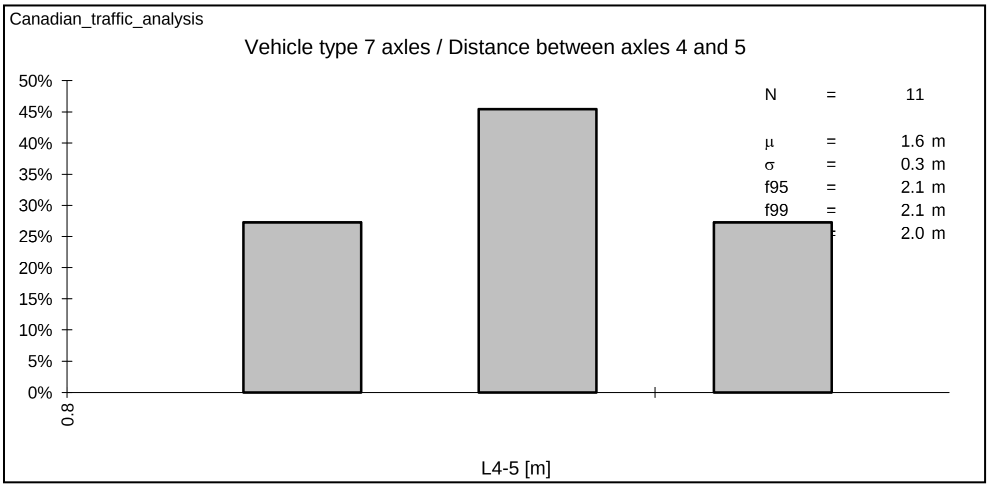

Canadian_traffic_analysis
Vehicle type 3-S3 / Portion Q3 (2-3)
0.00 < % ≤ 0.92
0.92 < % ≤ 1.84
1.84 < % ≤ 2.76
2.76 < % ≤ 3.68
3.68 < % ≤ 4.60
N = 1542
Xmin = 0.0 kN
Xmax = 100.0 kN
Xμ = 55.1 kN
Ymin = 0.0 kN
Ymax = 100.0 kN
Yμ = 55.0 kN
W6 [kN]
W5 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

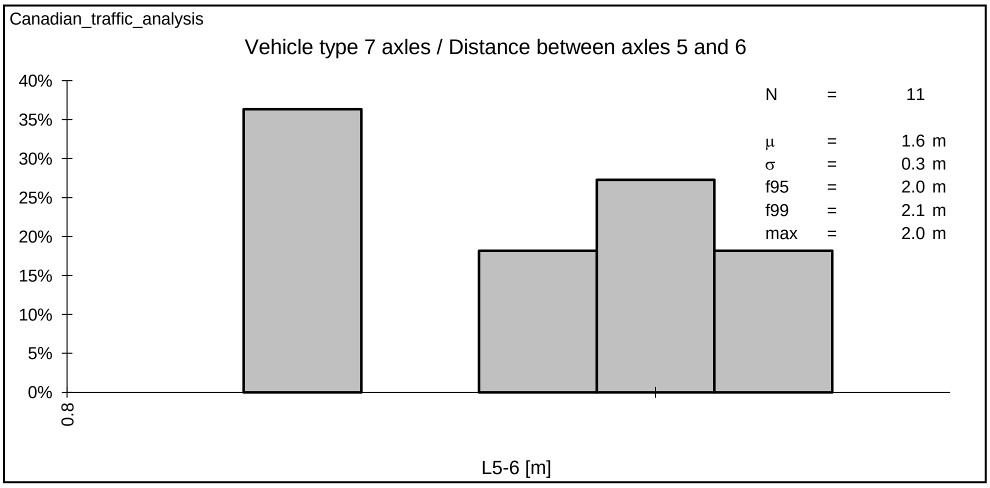

Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
N = 11
μ = 441.4 kN
σ = 145.4 kN
= 564.2 kN
= 566.9 kN
= 565.0 kN
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
Wtot [kN]

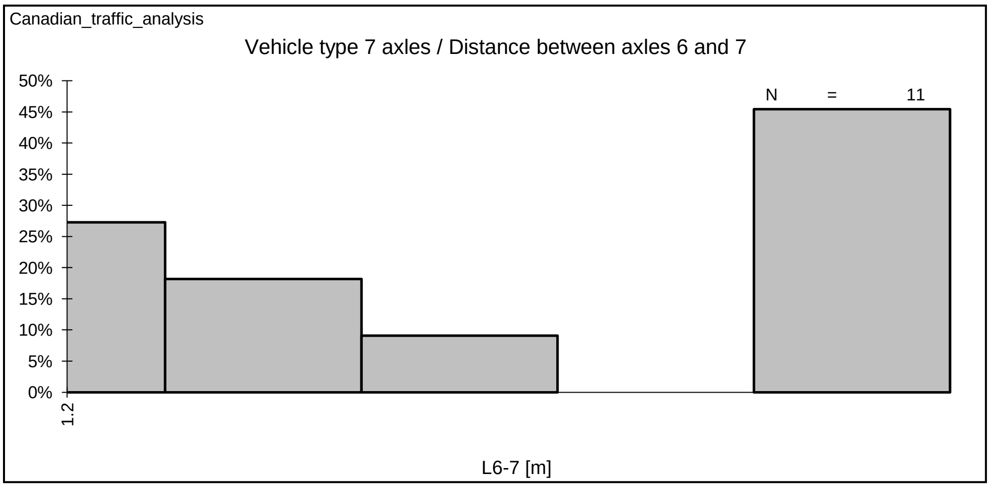

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
30%
25%
20%
15%
10%
5%
0%
2.4
4.4
6.4
L1-2 [m]
N = 11
μ = 4.6 m
σ = 0.6 m
f95 = 5.8 m
f99 = 5.9 m
max = 5.8 m
A = 2.4 m
= 6.5 m
= 5.89
= 5.09

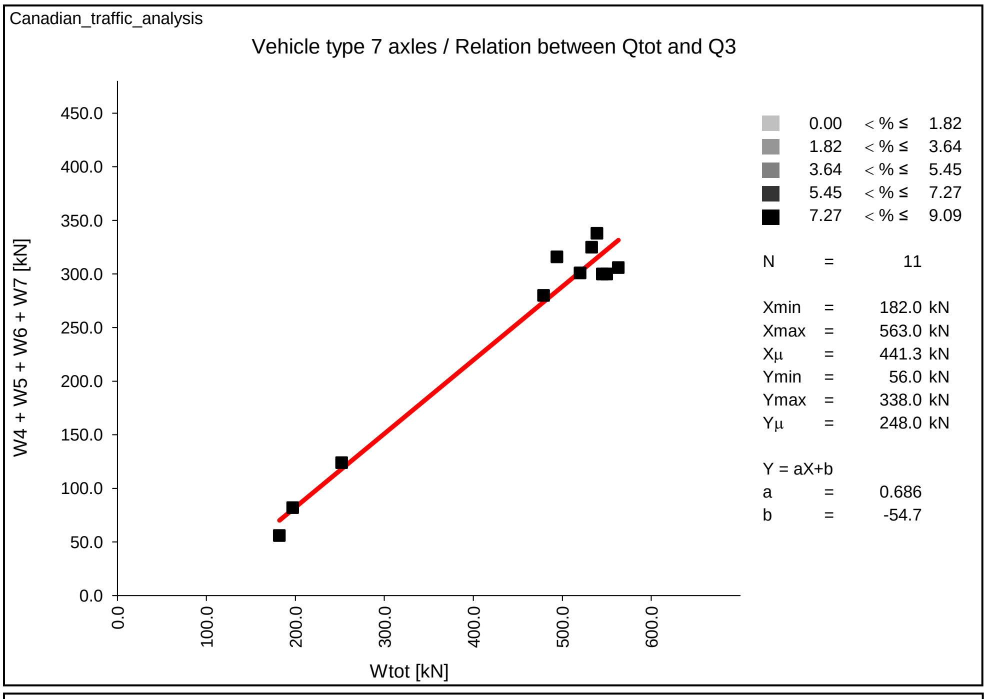

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L2-3 [m]
N = 11
μ = 1.6 m
σ = 0.1 m
f95 = 1.8 m
f99 = 1.9 m
max = 1.8 m

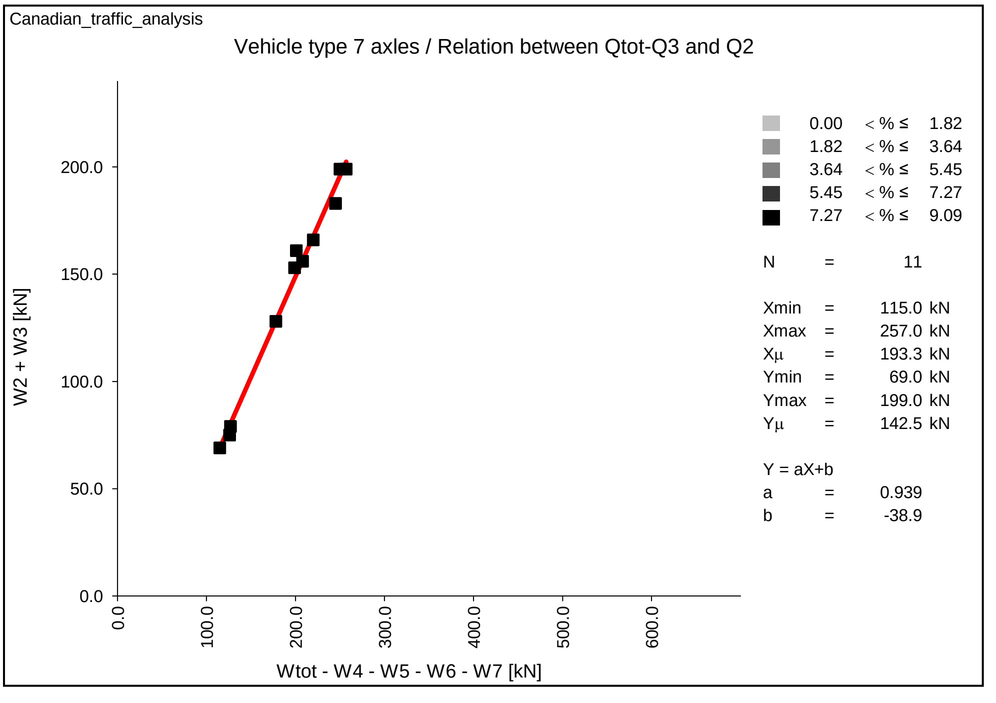

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
30%
25%
20%
15%
10%
5%
0%
4.0
6.0
L3-4 [m]
N = 11
μ =
σ =
f95 =

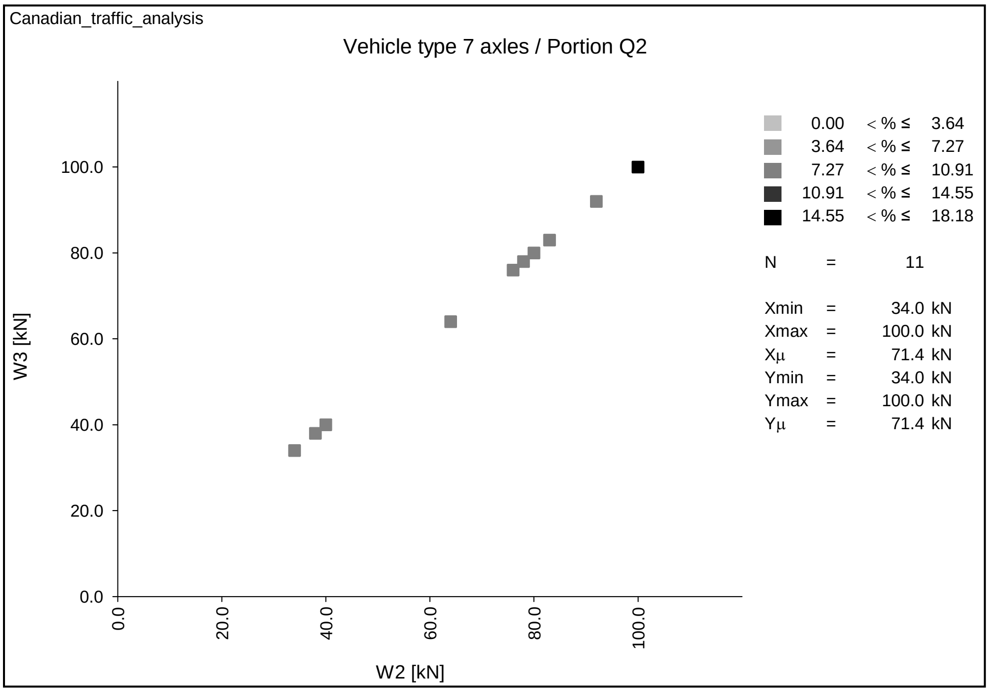

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
N = 11
μ = 1.6 m
σ = 0.3 m
f95 = 2.1 m
f99 = 2.1 m
2.0 m
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L4-5 [m]

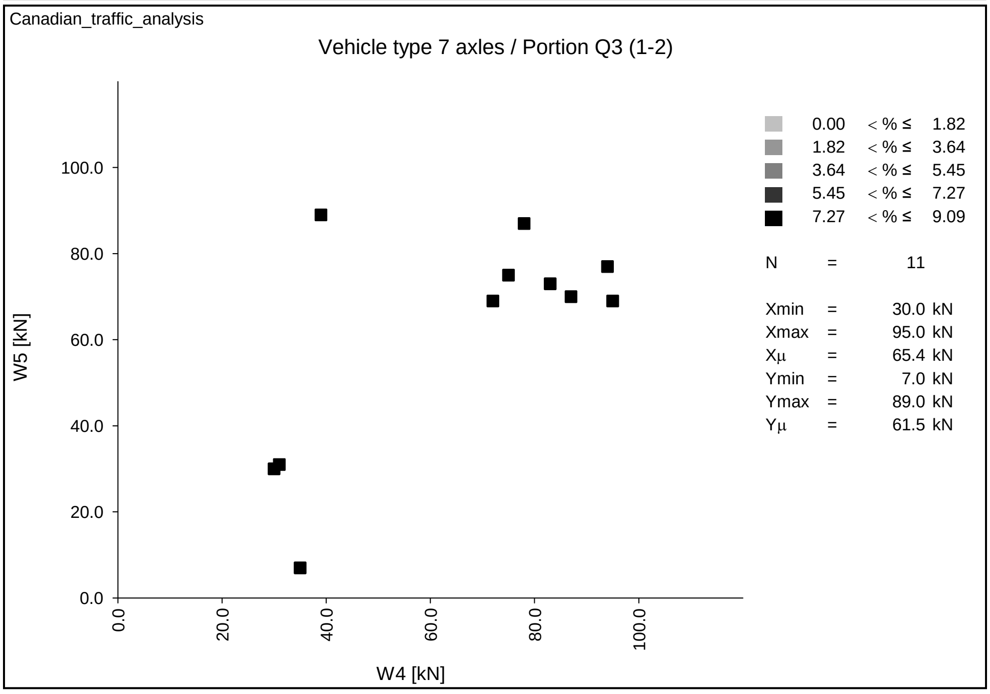

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
N = 11
μ = 1.6 m
σ = 0.3 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L5-6 [m]

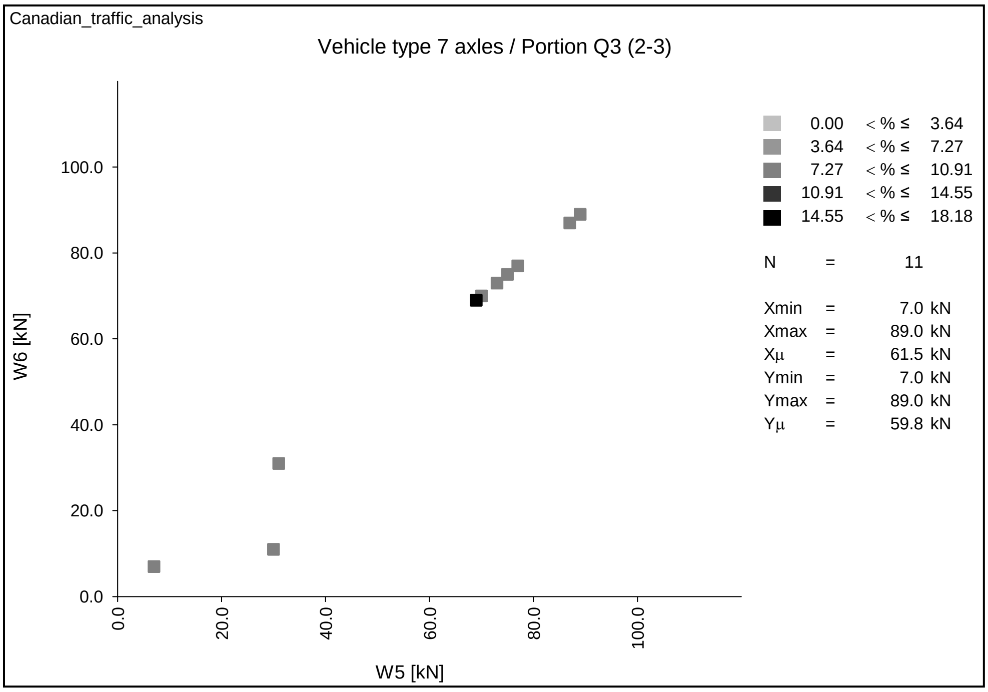

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
N = 11
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
1.2
L6-7 [m]

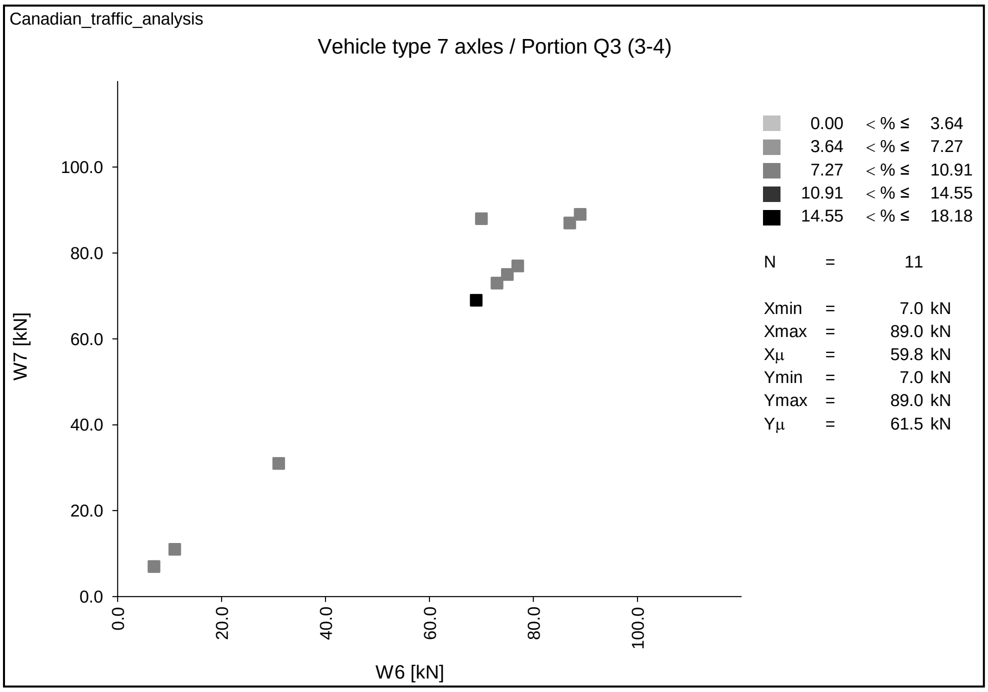

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q3
W4 + W5 + W6 + W7 [kN]
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]
0.00 < % ≤ 1.82
1.82 < % ≤ 3.64
3.64 < % ≤ 5.45
5.45 < % ≤ 7.27
7.27 < % ≤ 9.09
N = 11
Xmin = 182.0 kN
Xmax = 563.0 kN
Xµ = 441.3 kN
Ymin = 56.0 kN
Ymax = 338.0 kN
Yµ = 248.0 kN
Y = aX+b
a = 0.686
b = -54.7

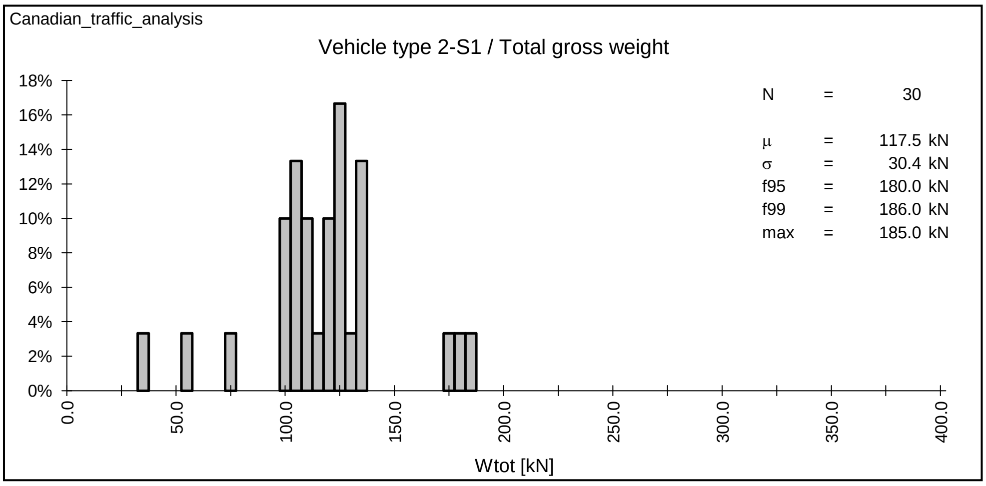

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q3 and Q2
W2 + W3 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot - W4 - W5 - W6 - W7 [kN]
0.00 < % ≤ 1.82
1.82 < % ≤ 3.64
3.64 < % ≤ 5.45
5.45 < % ≤ 7.27
7.27 < % ≤ 9.09
N = 11
Xmin = 115.0 kN
Xmax = 257.0 kN
Xµ = 193.3 kN
Ymin = 69.0 kN
Ymax = 199.0 kN
Yµ = 142.5 kN
Y = aX+b
a = 0.939
b = -38.9

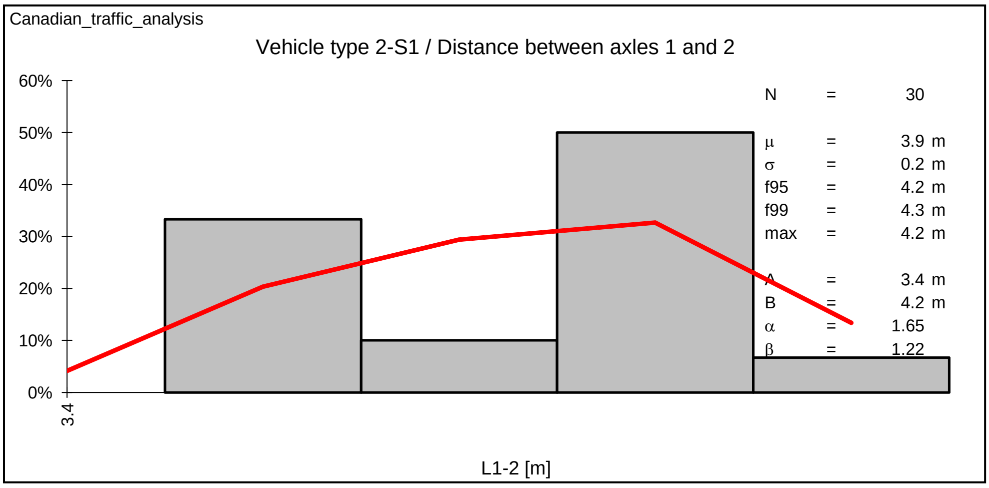

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
W3 [kN]
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 3.64
3.64 < % ≤ 7.27
7.27 < % ≤ 10.91
10.91 < % ≤ 14.55
14.55 < % ≤ 18.18
N = 11
Xmin = 34.0 kN
Xmax = 100.0 kN
Xμ = 71.4 kN
Ymin = 34.0 kN
Ymax = 100.0 kN
Yμ = 71.4 kN

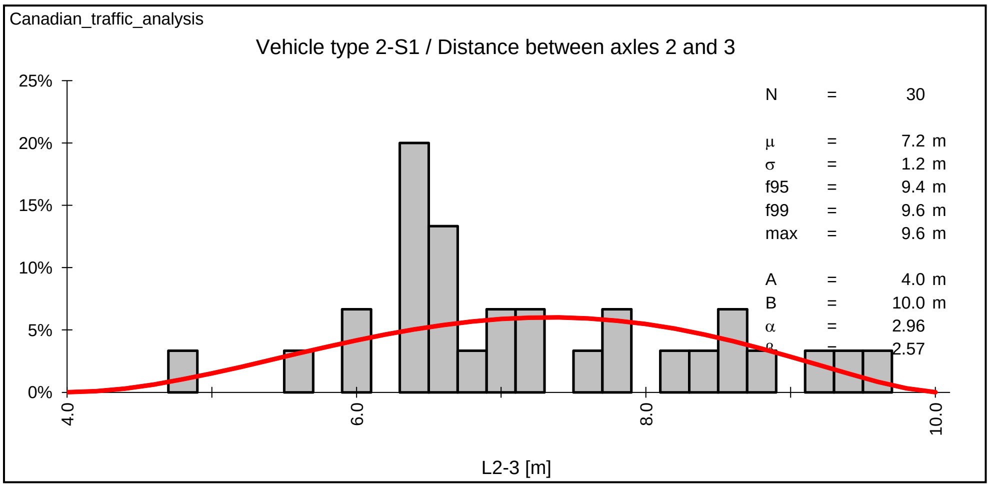

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q3 (1-2)
W5 [kN]
W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 1.82
1.82 < % ≤ 3.64
3.64 < % ≤ 5.45
5.45 < % ≤ 7.27
7.27 < % ≤ 9.09
N = 11
Xmin = 30.0 kN
Xmax = 95.0 kN
Xμ = 65.4 kN
Ymin = 7.0 kN
Ymax = 89.0 kN
Yμ = 61.5 kN

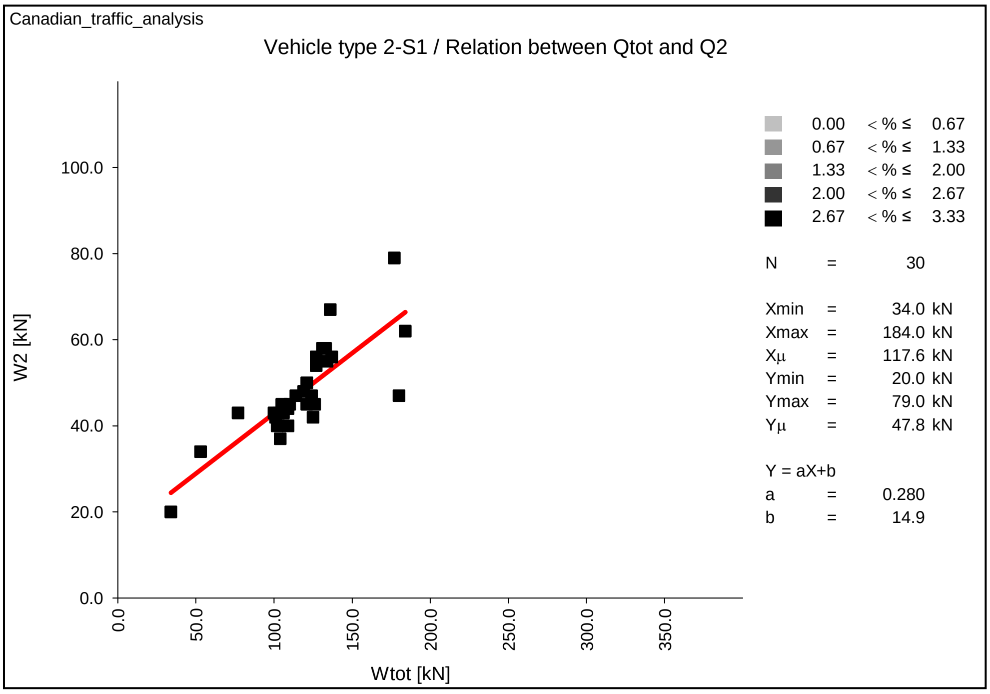

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q3 (2-3)
W6 [kN]
W5 [kN]
0.00 < % ≤ 3.64
3.64 < % ≤ 7.27
7.27 < % ≤ 10.91
10.91 < % ≤ 14.55
14.55 < % ≤ 18.18
N = 11
Xmin = 7.0 kN
Xmax = 89.0 kN
Xµ = 61.5 kN
Ymin = 7.0 kN
Ymax = 89.0 kN
Yµ = 59.8 kN

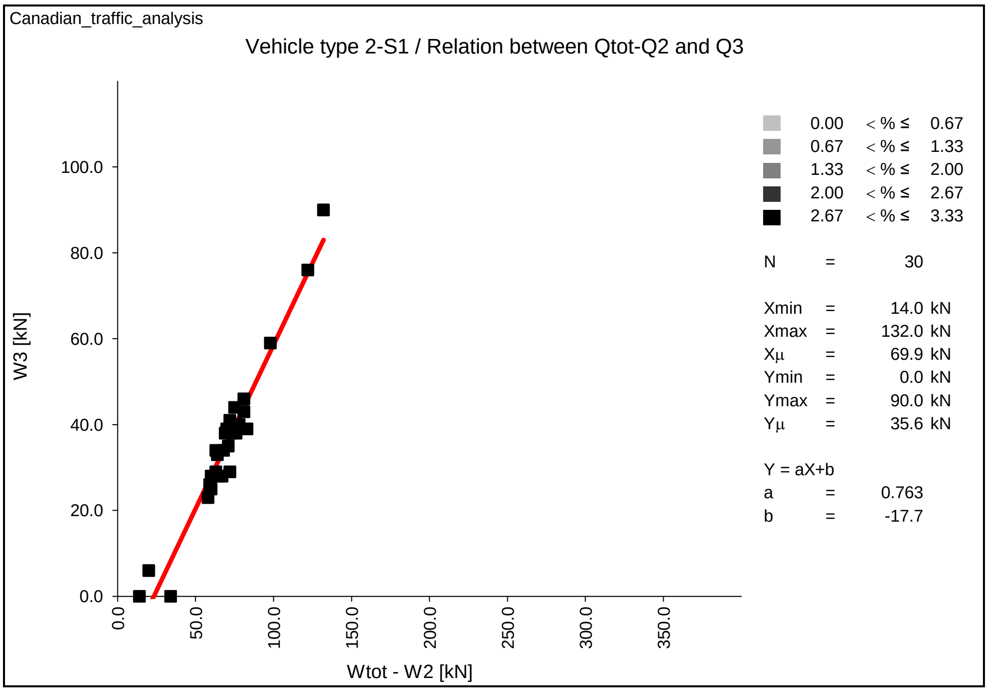

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q3 (3-4)
W7 [kN]
W6 [kN]
0.00 < % ≤ 3.64
3.64 < % ≤ 7.27
7.27 < % ≤ 10.91
10.91 < % ≤ 14.55
14.55 < % ≤ 18.18
N = 11
Xmin = 7.0 kN
Xmax = 89.0 kN
Xµ = 59.8 kN
Ymin = 7.0 kN
Ymax = 89.0 kN
Yµ = 61.5 kN

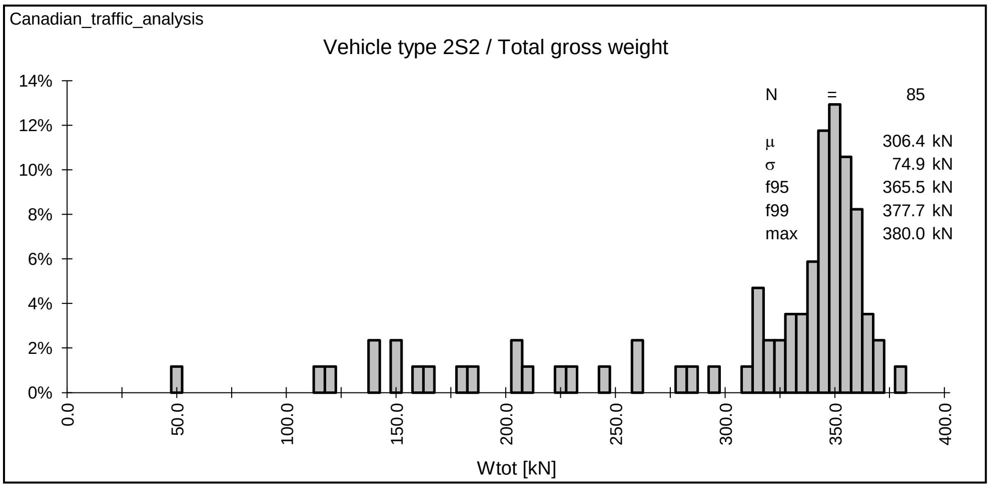

Canadian_traffic_analysis
Vehicle type 2-S1 / Total gross weight
Wtot [kN]
N = 30
µ = 117.5 kN
σ = 30.4 kN
f95 = 180.0 kN
f99 = 186.0 kN
max = 185.0 kN

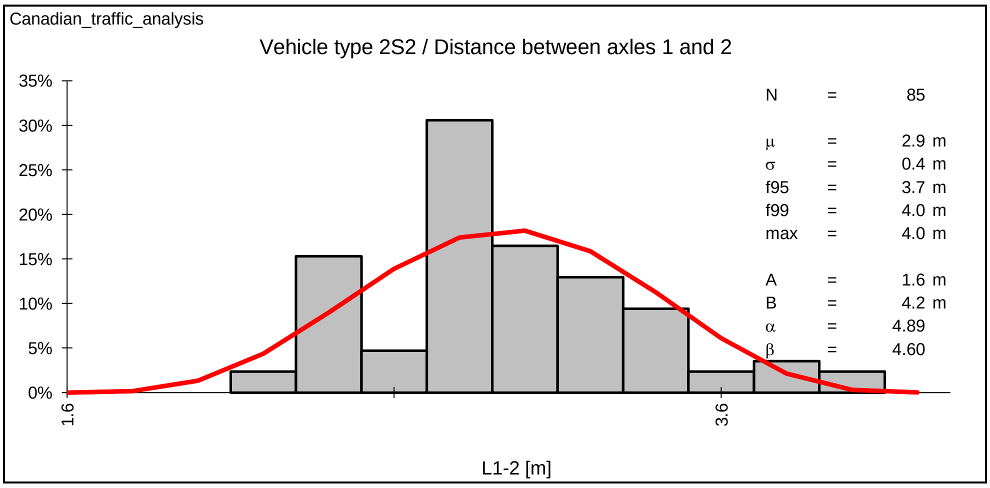

Canadian_traffic_analysis
Vehicle type 2-S1 / Distance between axles 1 and 2
60%
50%
40%
30%
20%
10%
0%
3.4
L1-2 [m]
N = 30
μ = 3.9 m
σ = 0.2 m
f95 = 4.2 m
f99 = 4.3 m
max = 4.2 m
A = 3.4 m
B = 4.2 m
α = 1.65
β = 1.22

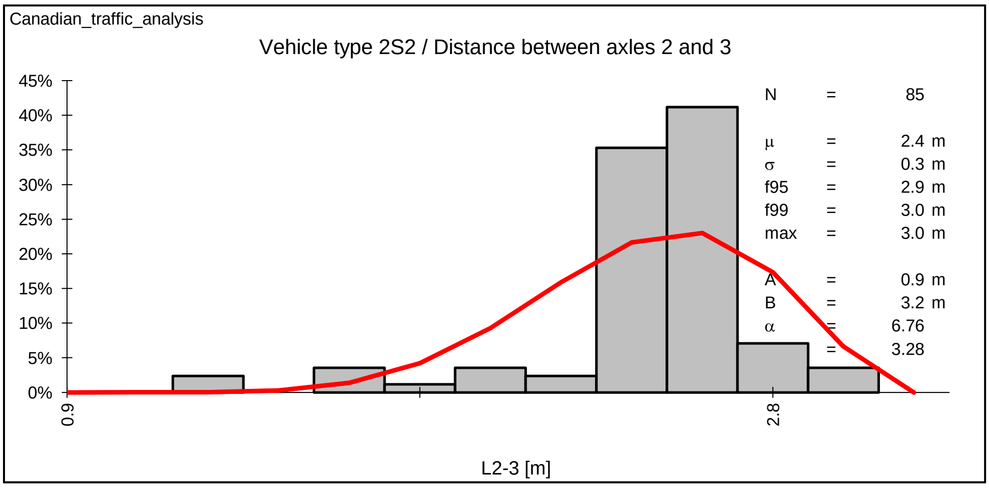

Canadian_traffic_analysis
Vehicle type 2-S1 / Distance between axles 2 and 3
25%
20%
15%
10%
5%
0%
4.0
6.0
8.0
10.0
L2-3 [m]
N = 30
μ = 7.2 m
σ = 1.2 m
f95 = 9.4 m
f99 = 9.6 m
max = 9.6 m
A = 4.0 m
B = 10.0 m
α = 2.96
β = 2.57

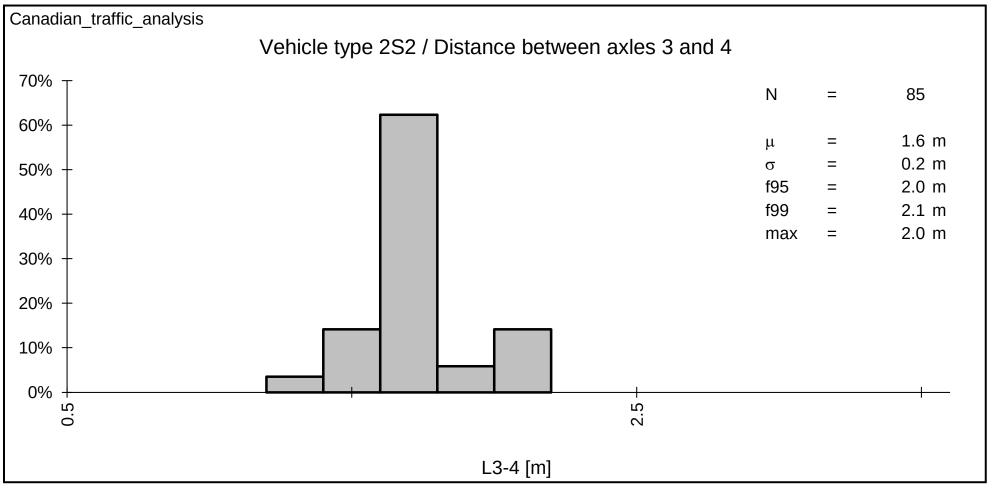

Canadian_traffic_analysis
Vehicle type 2-S1 / Relation between Qtot and Q2
100.0
80.0
60.0
40.0
20.0
0.0
W2 [kN]
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Wtot [kN]
0.00 < % ≤ 0.67
0.67 < % ≤ 1.33
1.33 < % ≤ 2.00
2.00 < % ≤ 2.67
2.67 < % ≤ 3.33
N = 30
Xmin = 34.0 kN
Xmax = 184.0 kN
Xμ = 117.6 kN
Ymin = 20.0 kN
Ymax = 79.0 kN
Yμ = 47.8 kN
Y = aX+b
a = 0.280
b = 14.9

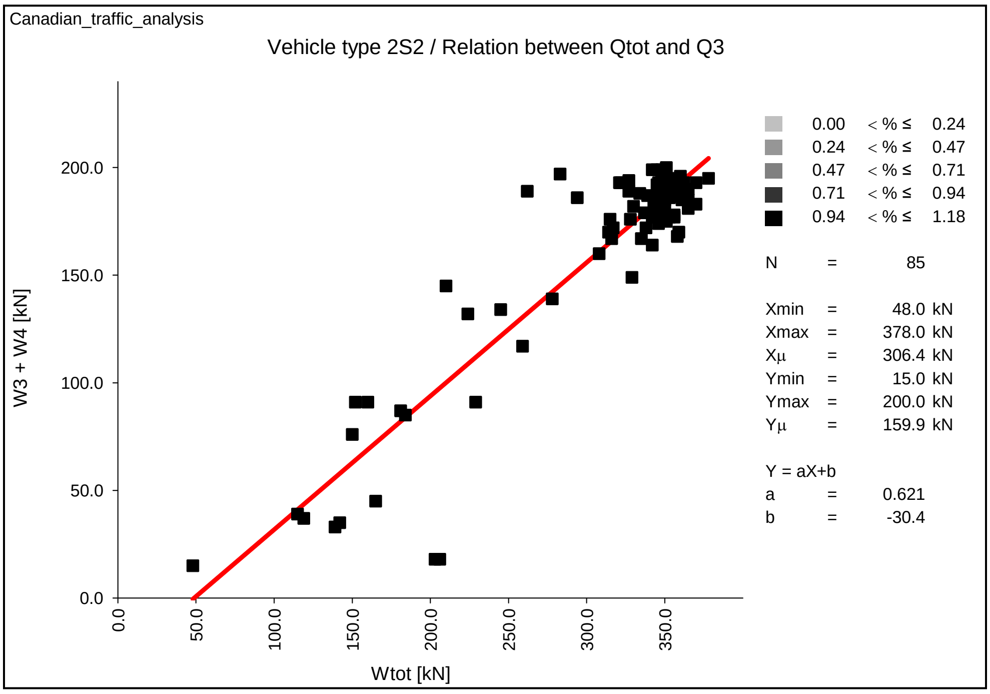

Canadian_traffic_analysis
Vehicle type 2-S1 / Relation between Qtot-Q2 and Q3
W3 [kN]
Wtot - W2 [kN]
0.00 < % ≤ 0.67
0.67 < % ≤ 1.33
1.33 < % ≤ 2.00
2.00 < % ≤ 2.67
2.67 < % ≤ 3.33
N = 30
Xmin = 14.0 kN
Xmax = 132.0 kN
Xμ = 69.9 kN
Ymin = 0.0 kN
Ymax = 90.0 kN
Yμ = 35.6 kN
Y = aX+b
a = 0.763
b = -17.7

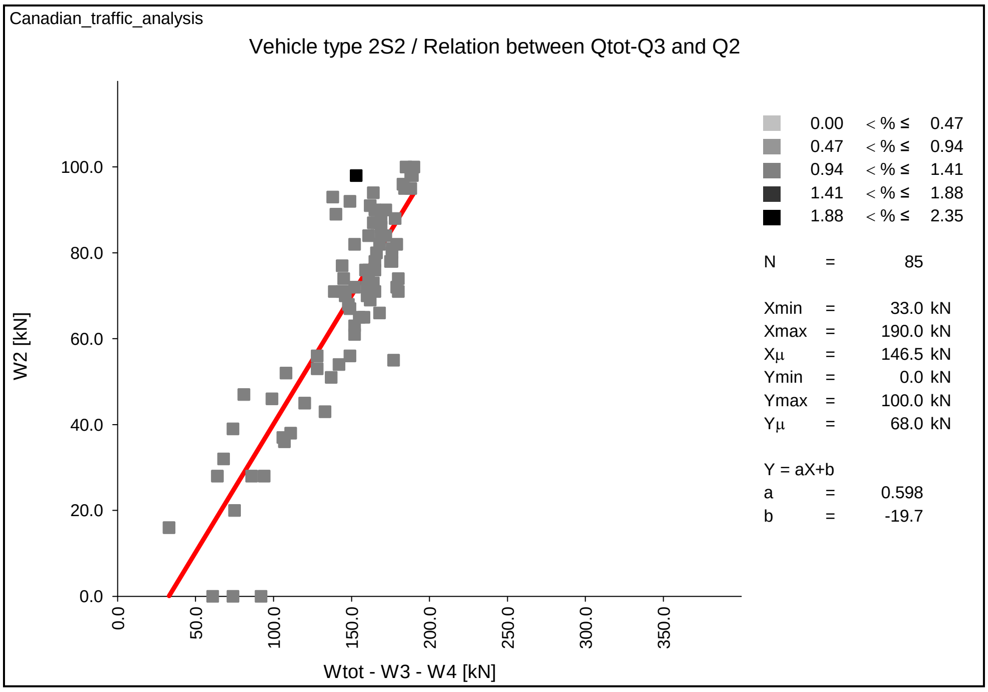

Canadian_traffic_analysis
Vehicle type 2S2 / Total gross weight
Wtot [kN]
N = 85
μ 306.4 kN
σ 74.9 kN
f95 365.5 kN
f99 377.7 kN
max 380.0 kN

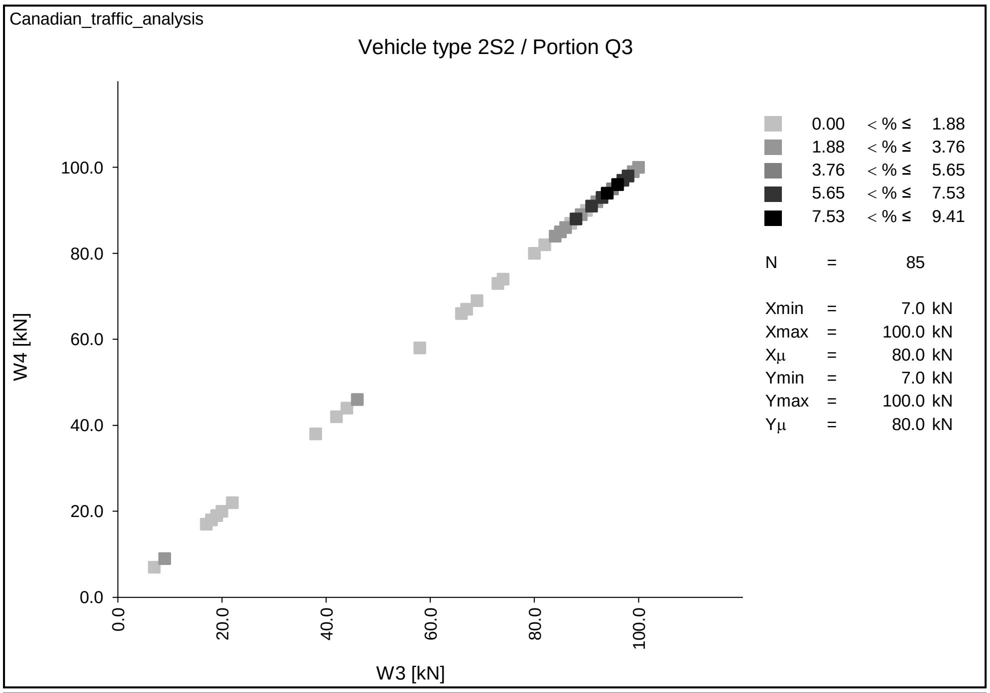

Canadian_traffic_analysis
Vehicle type 2S2 / Distance between axles 1 and 2
L1-2 [m]
N = 85
μ = 2.9 m
σ = 0.4 m
f95 = 3.7 m
f99 = 4.0 m
max = 4.0 m
A = 1.6 m
B = 4.2 m
α = 4.89
β = 4.60

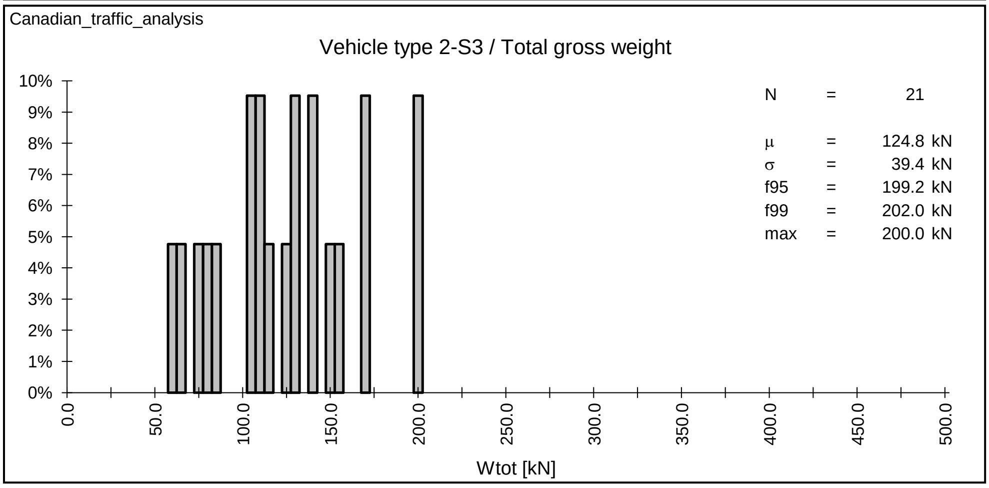

Canadian_traffic_analysis
Vehicle type 2S2 / Distance between axles 2 and 3
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.9
2.8
L2-3 [m]
N = 85
μ = 2.4 m
σ = 0.3 m
f95 = 2.9 m
f99 = 3.0 m
max = 3.0 m
A = 0.9 m
B = 3.2 m
α = 6.76
= 3.28

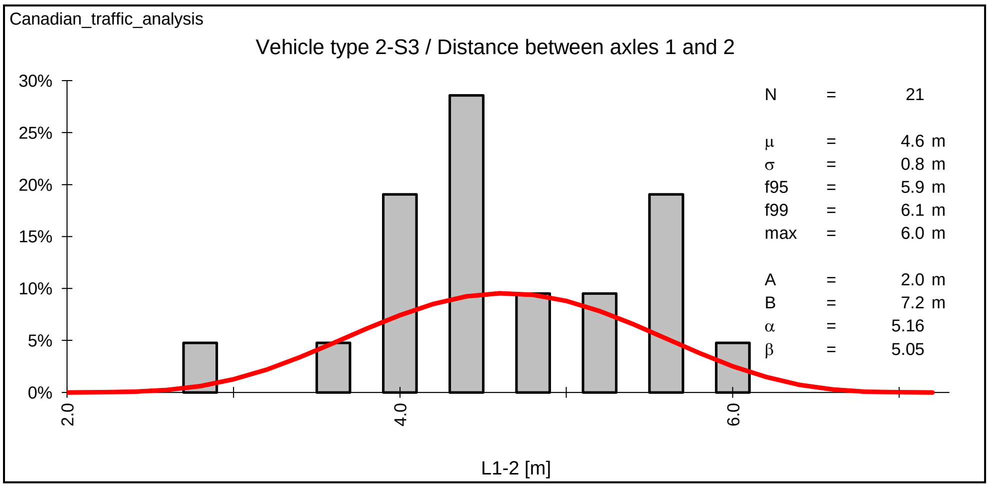

Canadian_traffic_analysis
Vehicle type 2S2 / Distance between axles 3 and 4
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.5
L3-4 [m]
N = 85
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

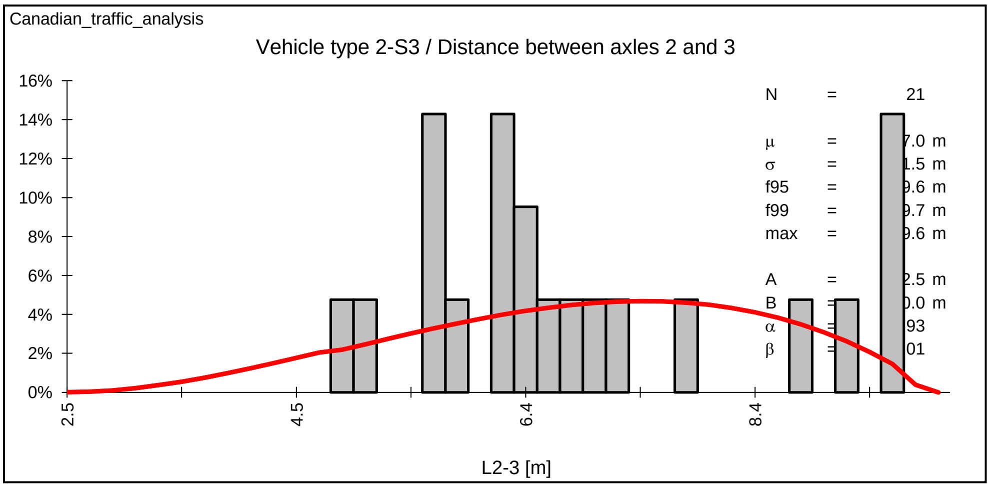

Canadian_traffic_analysis
Vehicle type 2S2 / Relation between Qtot and Q3
W3 + W4 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Wtot [kN]
0.00 < % ≤ 0.24
0.24 < % ≤ 0.47
0.47 < % ≤ 0.71
0.71 < % ≤ 0.94
0.94 < % ≤ 1.18
N = 85
Xmin = 48.0 kN
Xmax = 378.0 kN
Xμ = 306.4 kN
Ymin = 15.0 kN
Ymax = 200.0 kN
Yμ = 159.9 kN
Y = aX+b
a = 0.621
b = -30.4

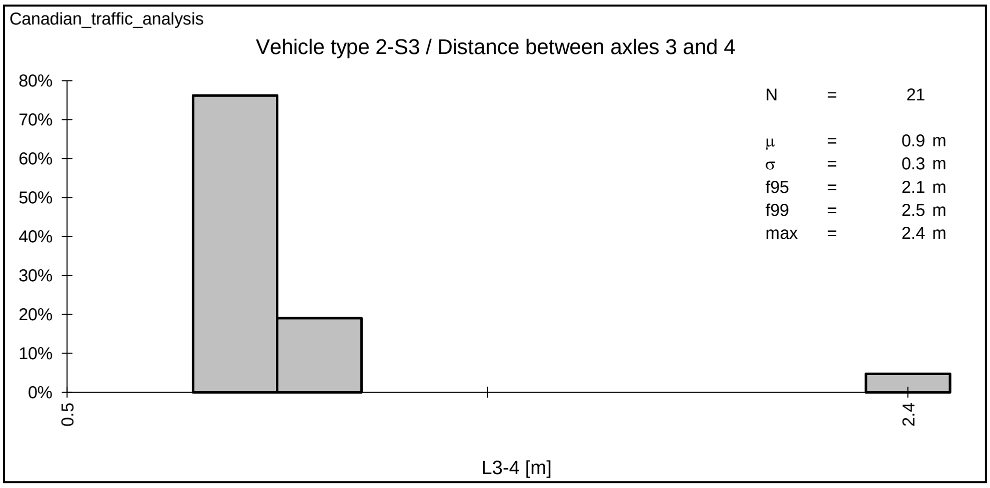

Canadian_traffic_analysis
Vehicle type 2S2 / Relation between Qtot-Q3 and Q2
W2 [kN]
Wtot - W3 - W4 [kN]
0.00 < % ≤ 0.47
0.47 < % ≤ 0.94
0.94 < % ≤ 1.41
1.41 < % ≤ 1.88
1.88 < % ≤ 2.35
N = 85
Xmin = 33.0 kN
Xmax = 190.0 kN
Xμ = 146.5 kN
Ymin = 0.0 kN
Ymax = 100.0 kN
Yμ = 68.0 kN
Y = aX+b
a = 0.598
b = -19.7

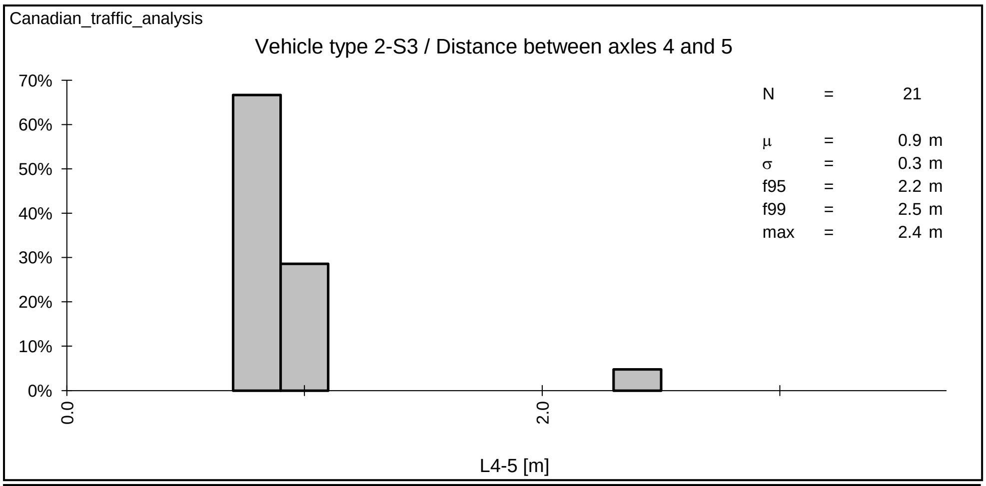

Canadian_traffic_analysis
Vehicle type 2S2 / Portion Q3
W4 [kN]
W3 [kN]
0.00 < % ≤ 1.88
1.88 < % ≤ 3.76
3.76 < % ≤ 5.65
5.65 < % ≤ 7.53
7.53 < % ≤ 9.41
N = 85
Xmin = 7.0 kN
Xmax = 100.0 kN
Xμ = 80.0 kN
Ymin = 7.0 kN
Ymax = 100.0 kN
Yμ = 80.0 kN

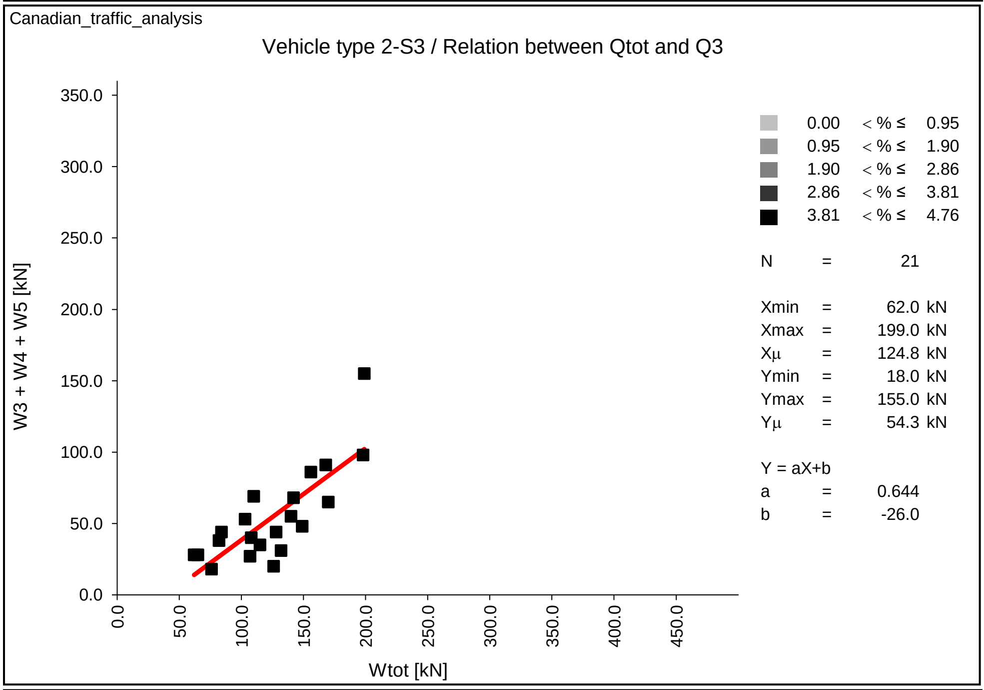

Canadian_traffic_analysis
Vehicle type 2-S3 / Total gross weight
Wtot [kN]
N = 21
μ = 124.8 kN
σ = 39.4 kN
f95 = 199.2 kN
f99 = 202.0 kN
max = 200.0 kN

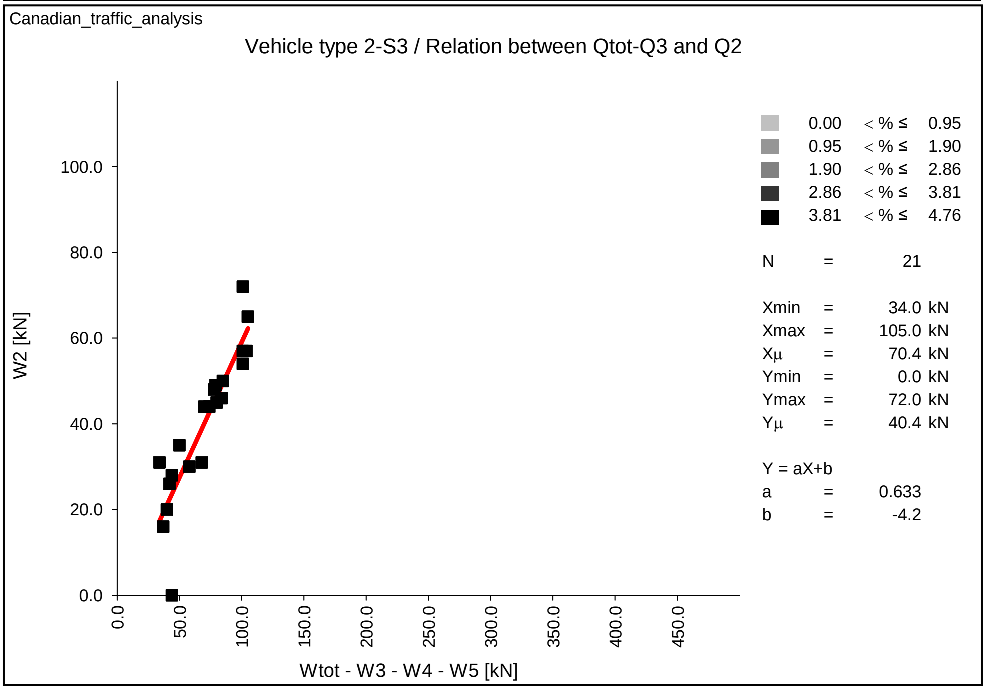

Canadian_traffic_analysis
Vehicle type 2-S3 / Distance between axles 1 and 2
30%
25%
20%
15%
10%
5%
0%
2.0
4.0
6.0
L1-2 [m]
N = 21
μ = 4.6 m
σ = 0.8 m
f95 = 5.9 m
f99 = 6.1 m
max = 6.0 m
A = 2.0 m
B = 7.2 m
α = 5.16
β = 5.05

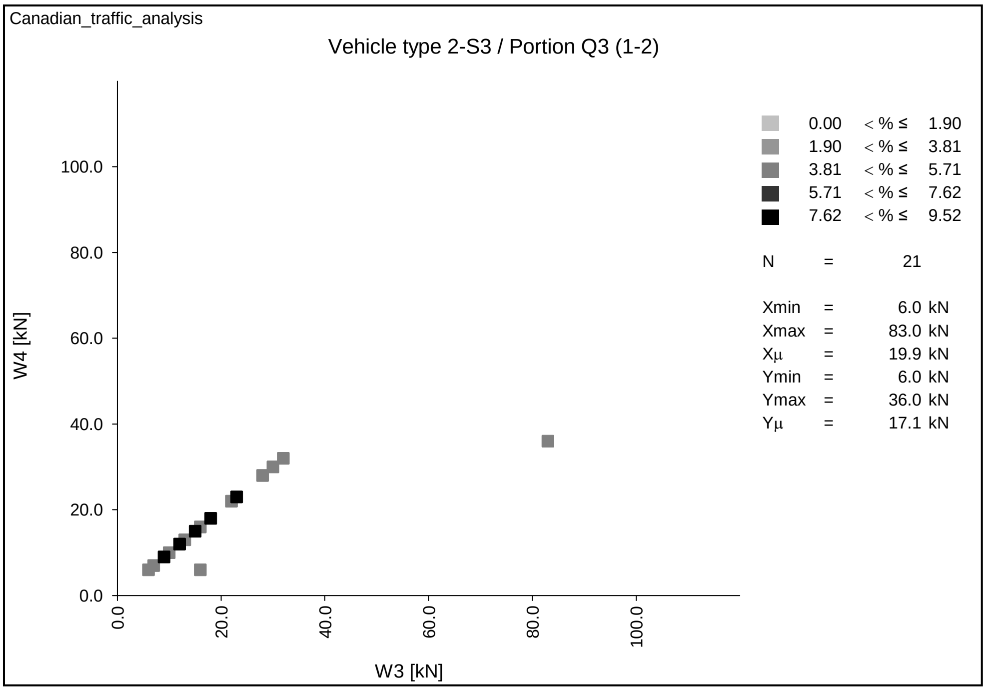

Canadian_traffic_analysis
Vehicle type 2-S3 / Distance between axles 2 and 3
16%
14%
12%
10%
8%
6%
4%
2%
0%
2.5
4.5
6.4
8.4
L2-3 [m]
N = 21
μ =
σ =
f95 =
f99 =
max =
A =
B
α
β

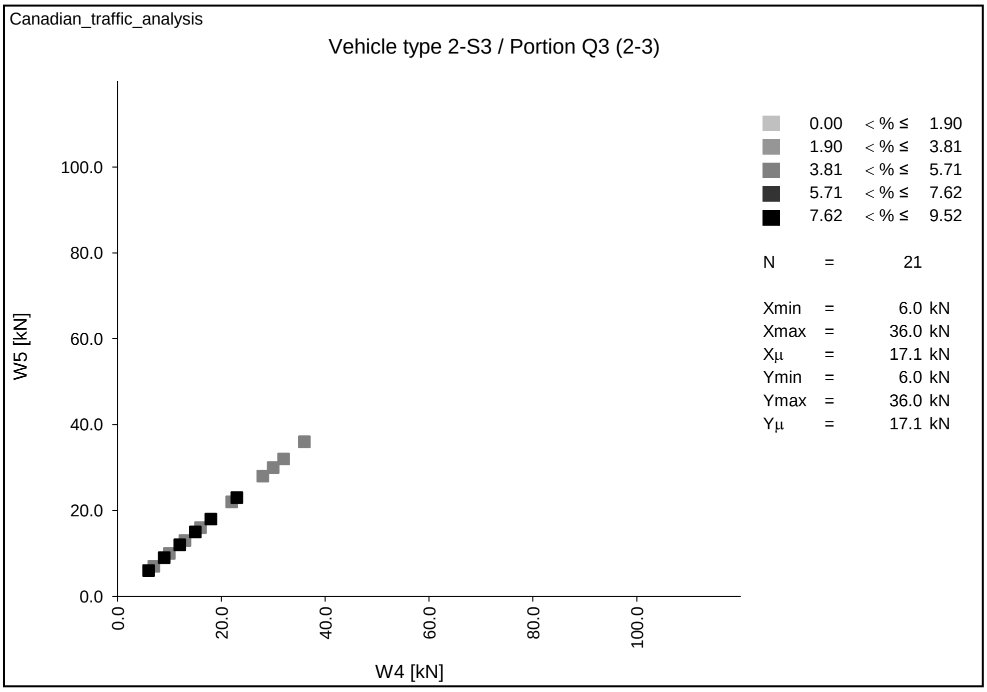

Canadian_traffic_analysis
Vehicle type 2-S3 / Distance between axles 3 and 4
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.4
L3-4 [m]
N = 21
μ = 0.9 m
σ = 0.3 m
f95 = 2.1 m
f99 = 2.5 m
max = 2.4 m

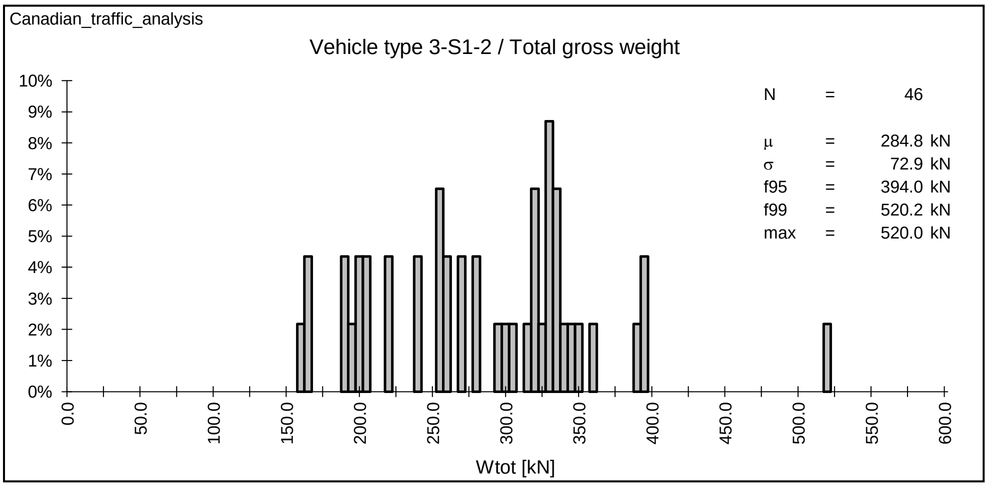

Canadian_traffic_analysis
Vehicle type 2-S3 / Distance between axles 4 and 5
70%
60%
50%
40%
30%
20%
10%
0%
0.0
2.0
L4-5 [m]
N = 21
μ = 0.9 m
σ = 0.3 m
f95 = 2.2 m
f99 = 2.5 m
max = 2.4 m

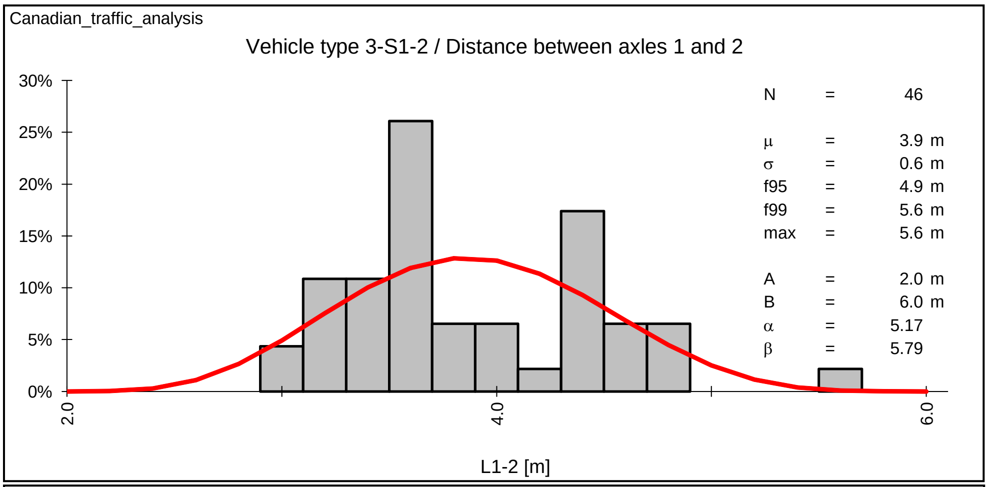

Canadian_traffic_analysis
Vehicle type 2-S3 / Relation between Qtot and Q3
W3 + W4 + W5 [kN]
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
Wtot [kN]
0.00 < % ≤ 0.95
0.95 < % ≤ 1.90
1.90 < % ≤ 2.86
2.86 < % ≤ 3.81
3.81 < % ≤ 4.76
N = 21
Xmin = 62.0 kN
Xmax = 199.0 kN
Xμ = 124.8 kN
Ymin = 18.0 kN
Ymax = 155.0 kN
Yμ = 54.3 kN
Y = aX+b
a = 0.644
b = -26.0

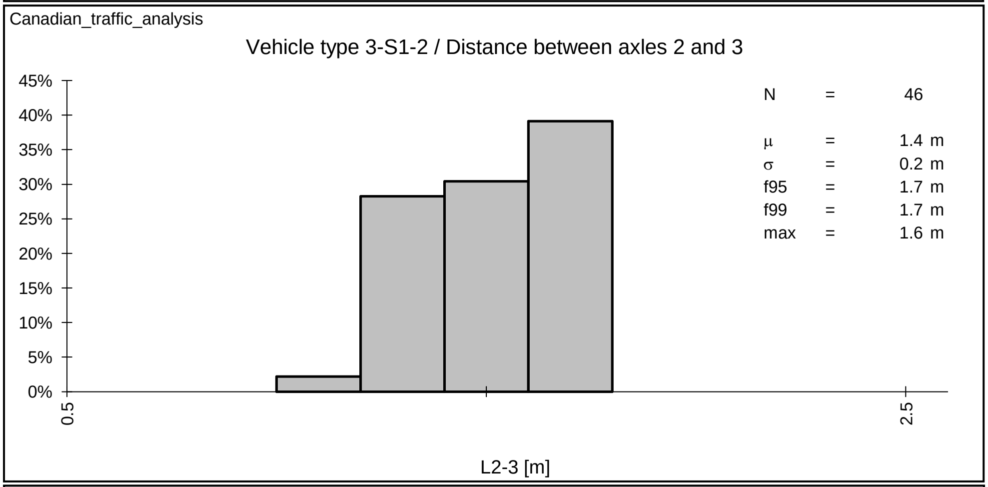

Canadian_traffic_analysis
Vehicle type 2-S3 / Relation between Qtot-Q3 and Q2
W2 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
Wtot - W3 - W4 - W5 [kN]
0.00 < % ≤ 0.95
0.95 < % ≤ 1.90
1.90 < % ≤ 2.86
2.86 < % ≤ 3.81
3.81 < % ≤ 4.76
N = 21
Xmin = 34.0 kN
Xmax = 105.0 kN
Xμ = 70.4 kN
Ymin = 0.0 kN
Ymax = 72.0 kN
Yμ = 40.4 kN
Y = aX+b
a = 0.633
b = -4.2

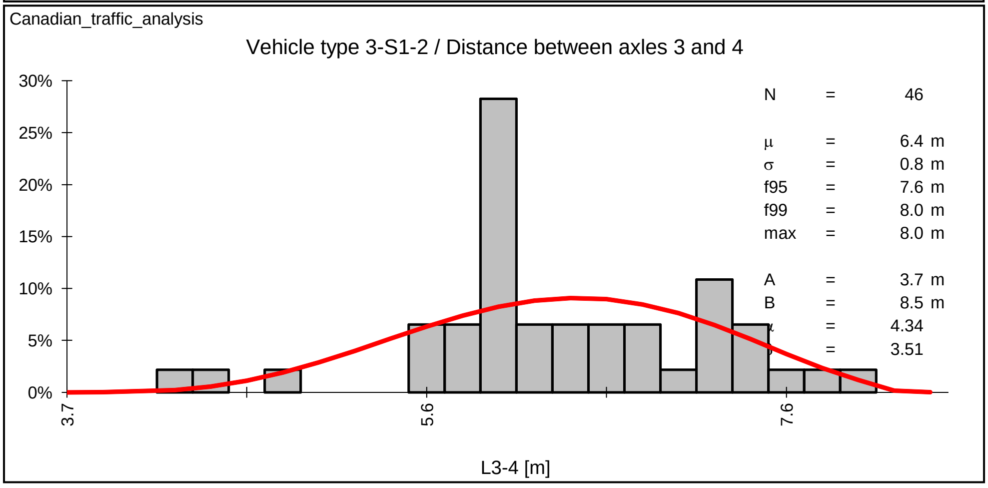

Canadian_traffic_analysis
Vehicle type 2-S3 / Portion Q3 (1-2)
W4 [kN]
W3 [kN]
0.00 < % ≤ 1.90
1.90 < % ≤ 3.81
3.81 < % ≤ 5.71
5.71 < % ≤ 7.62
7.62 < % ≤ 9.52
N = 21
Xmin = 6.0 kN
Xmax = 83.0 kN
Xμ = 19.9 kN
Ymin = 6.0 kN
Ymax = 36.0 kN
Yμ = 17.1 kN

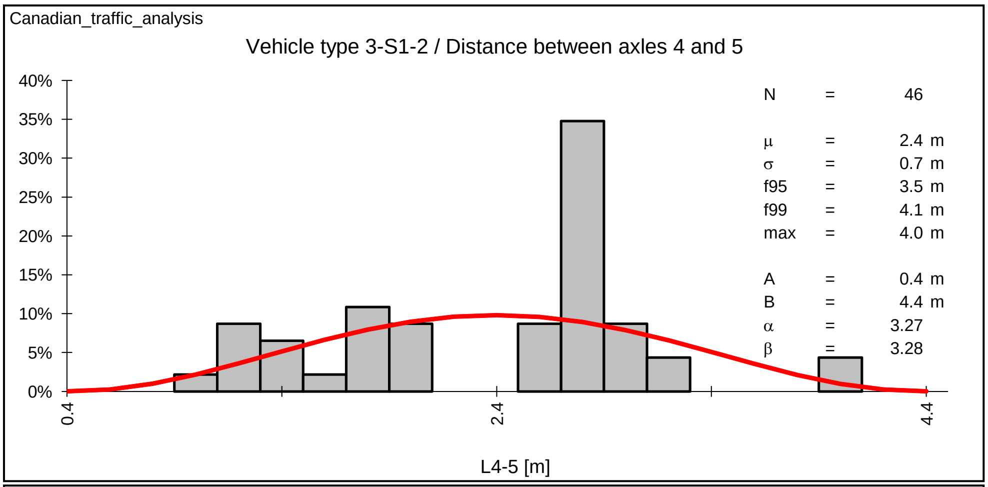

Canadian_traffic_analysis
Vehicle type 2-S3 / Portion Q3 (2-3)
W5 [kN]
W4 [kN]
0.00 < % ≤ 1.90
1.90 < % ≤ 3.81
3.81 < % ≤ 5.71
5.71 < % ≤ 7.62
7.62 < % ≤ 9.52
N = 21
Xmin = 6.0 kN
Xmax = 36.0 kN
Xμ = 17.1 kN
Ymin = 6.0 kN
Ymax = 36.0 kN
Yμ = 17.1 kN

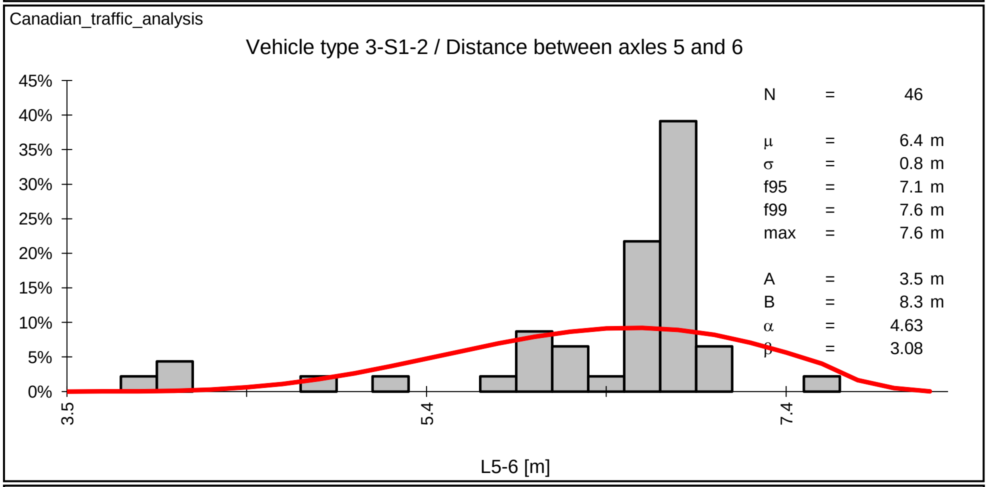

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Total gross weight
Wtot [kN]
N = 46
μ = 284.8 kN
σ = 72.9 kN
f95 = 394.0 kN
f99 = 520.2 kN
max = 520.0 kN

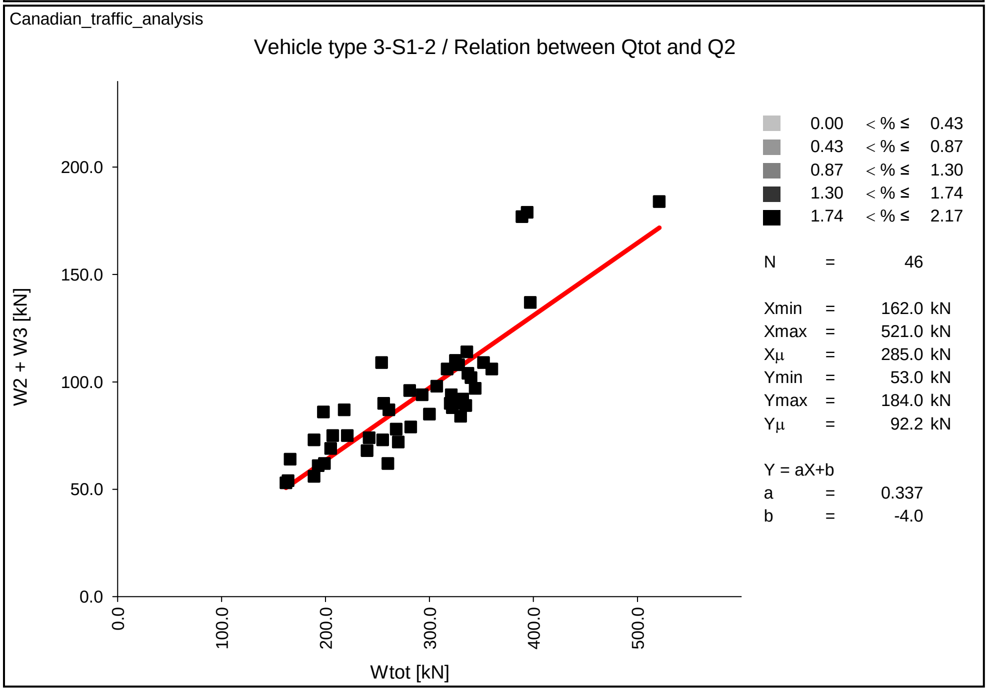

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Distance between axles 1 and 2
30%
25%
20%
15%
10%
5%
0%
2.0
4.0
6.0
L1-2 [m]
N = 46
μ = 3.9 m
σ = 0.6 m
f95 = 4.9 m
f99 = 5.6 m
max = 5.6 m
A = 2.0 m
B = 6.0 m
α = 5.17
β = 5.79

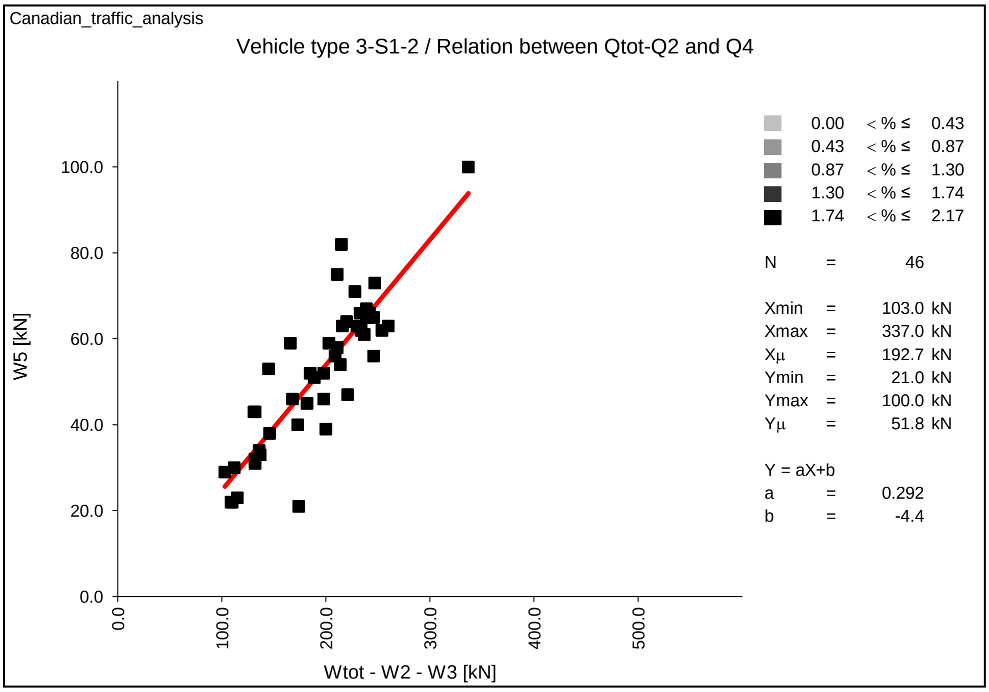

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Distance between axles 2 and 3
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.5
2.5
L2-3 [m]
N = 46
μ = 1.4 m
σ = 0.2 m
f95 = 1.7 m
f99 = 1.7 m
max = 1.6 m

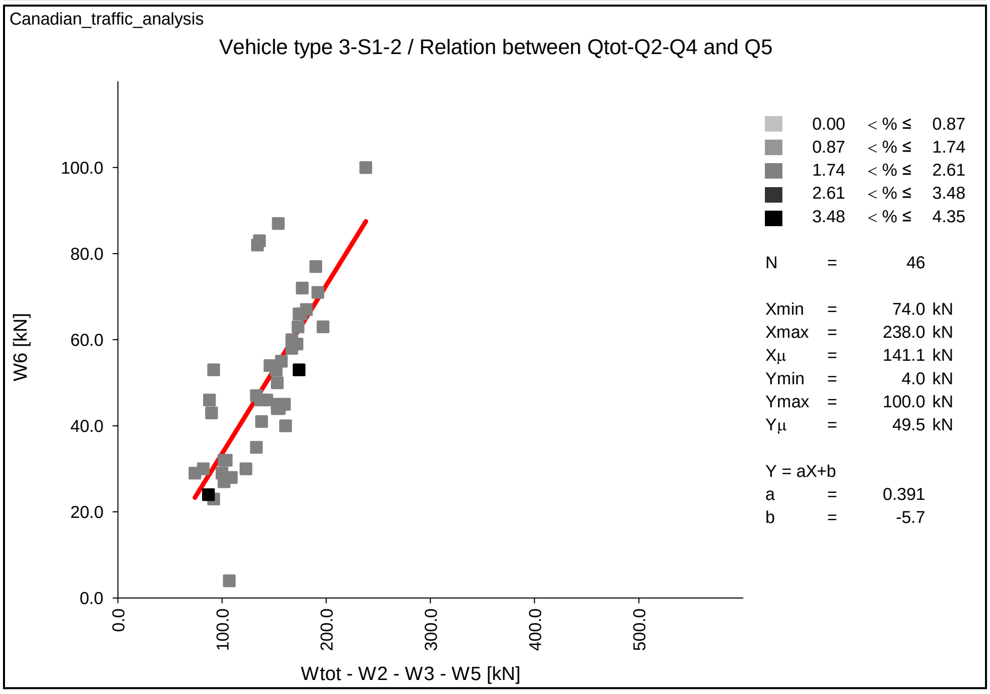

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Distance between axles 3 and 4
30%
25%
20%
15%
10%
5%
0%
3.7
5.6
7.6
L3-4 [m]
N = 46
μ = 6.4 m
σ = 0.8 m
f95 = 7.6 m
f99 = 8.0 m
max = 8.0 m
A = 3.7 m
B = 8.5 m
= 4.34
= 3.51

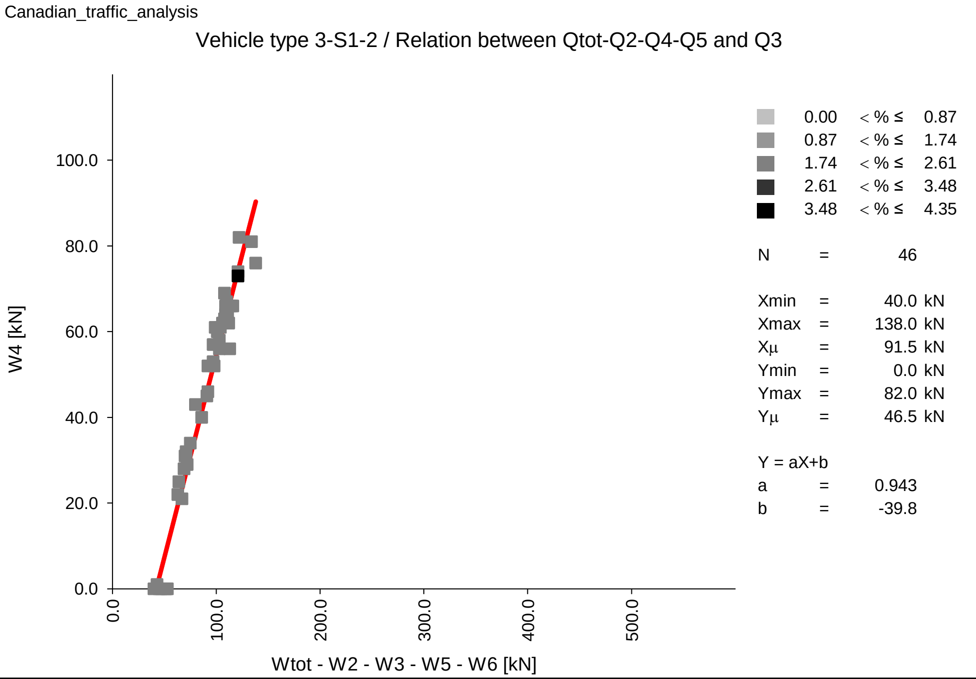

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Distance between axles 4 and 5
N = 46
μ = 2.4 m
σ = 0.7 m
f95 = 3.5 m
f99 = 4.1 m
max = 4.0 m
A = 0.4 m
B = 4.4 m
α = 3.27
β = 3.28
L4-5 [m]

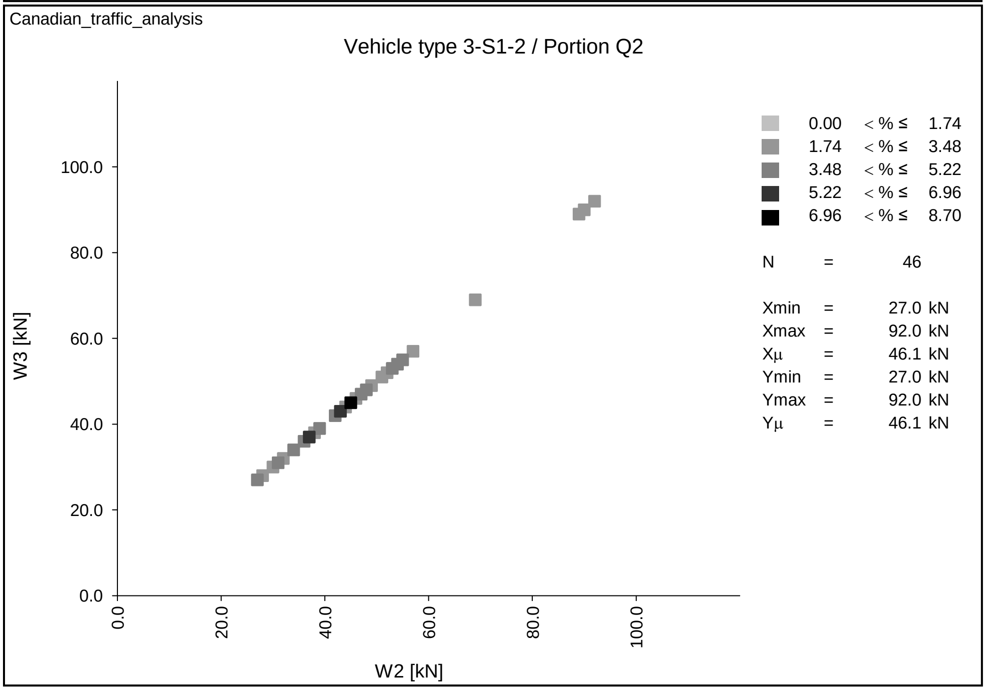

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Distance between axles 5 and 6
N = 46
μ = 6.4 m
σ = 0.8 m
f95 = 7.1 m
f99 = 7.6 m
max = 7.6 m
A = 3.5 m
B = 8.3 m
α = 4.63
β = 3.08
L5-6 [m]

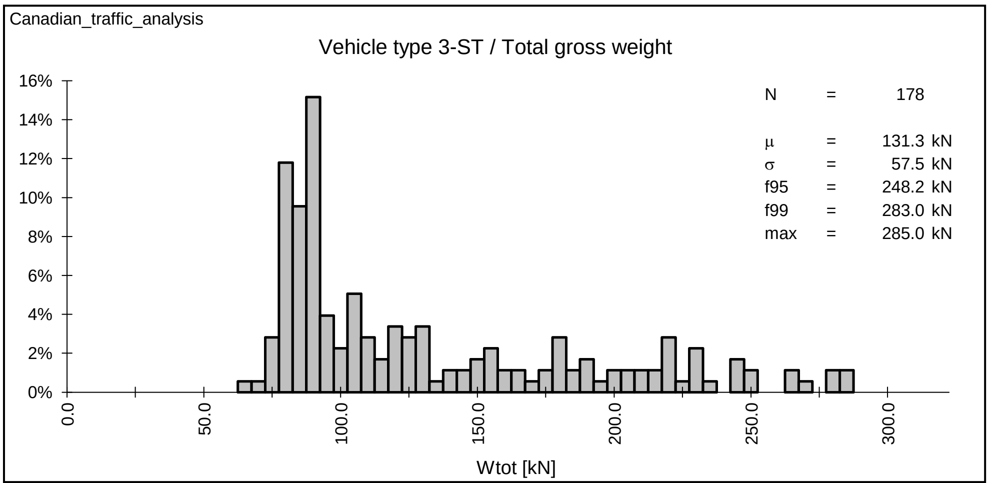

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Relation between Qtot and Q2
0.00 < % ≤ 0.43
0.43 < % ≤ 0.87
0.87 < % ≤ 1.30
1.30 < % ≤ 1.74
1.74 < % ≤ 2.17
N = 46
Xmin = 162.0 kN
Xmax = 521.0 kN
Xμ = 285.0 kN
Ymin = 53.0 kN
Ymax = 184.0 kN
Yμ = 92.2 kN
Y = aX+b
a = 0.337
b = -4.0
W2 + W3 [kN]
Wtot [kN]

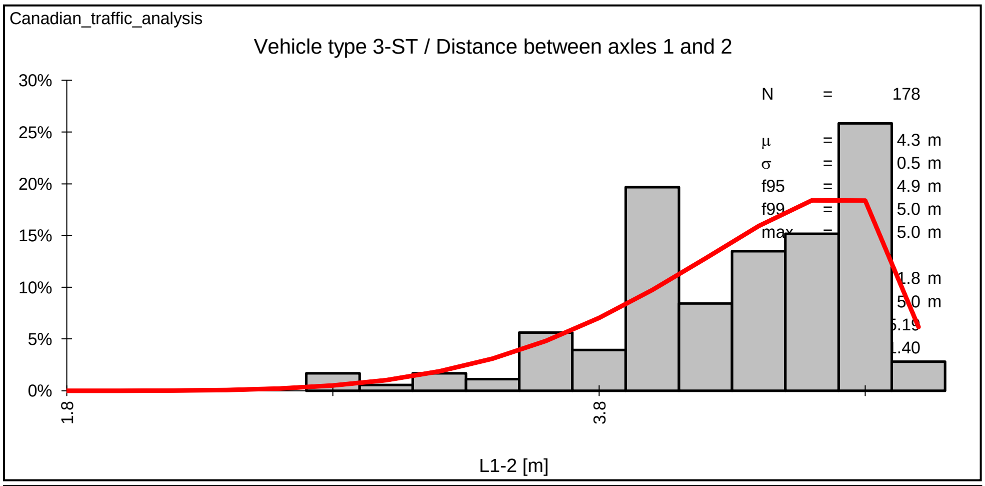

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Relation between Qtot-Q2 and Q4
W5 [kN]
Wtot - W2 - W3 [kN]
0.00 < % ≤ 0.43
0.43 < % ≤ 0.87
0.87 < % ≤ 1.30
1.30 < % ≤ 1.74
1.74 < % ≤ 2.17
N = 46
Xmin = 103.0 kN
Xmax = 337.0 kN
Xμ = 192.7 kN
Ymin = 21.0 kN
Ymax = 100.0 kN
Yμ = 51.8 kN
Y = aX+b
a = 0.292
b = -4.4

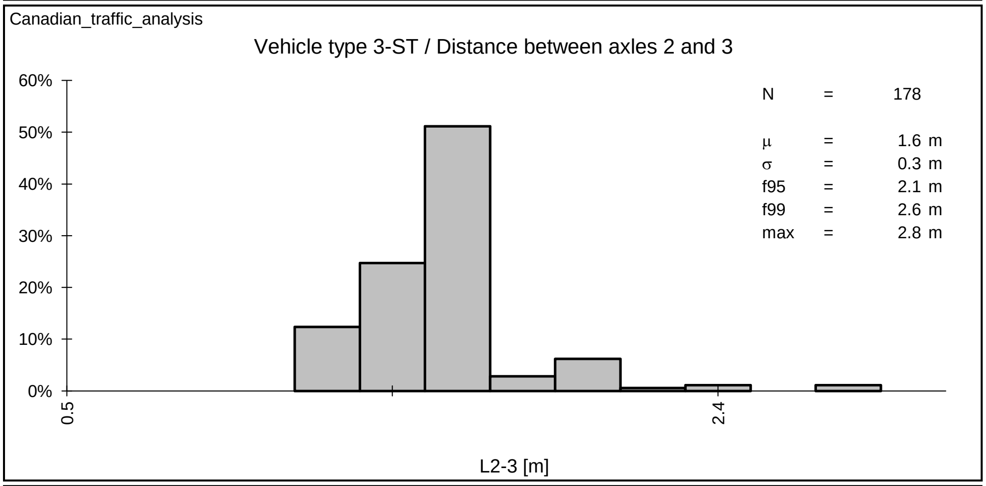

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Relation between Qtot-Q2-Q4 and Q5
W6 [kN]
Wtot - W2 - W3 - W5 [kN]
0.00 < % ≤ 0.87
0.87 < % ≤ 1.74
1.74 < % ≤ 2.61
2.61 < % ≤ 3.48
3.48 < % ≤ 4.35
N = 46
Xmin = 74.0 kN
Xmax = 238.0 kN
Xμ = 141.1 kN
Ymin = 4.0 kN
Ymax = 100.0 kN
Yμ = 49.5 kN
Y = aX+b
a = 0.391
b = -5.7

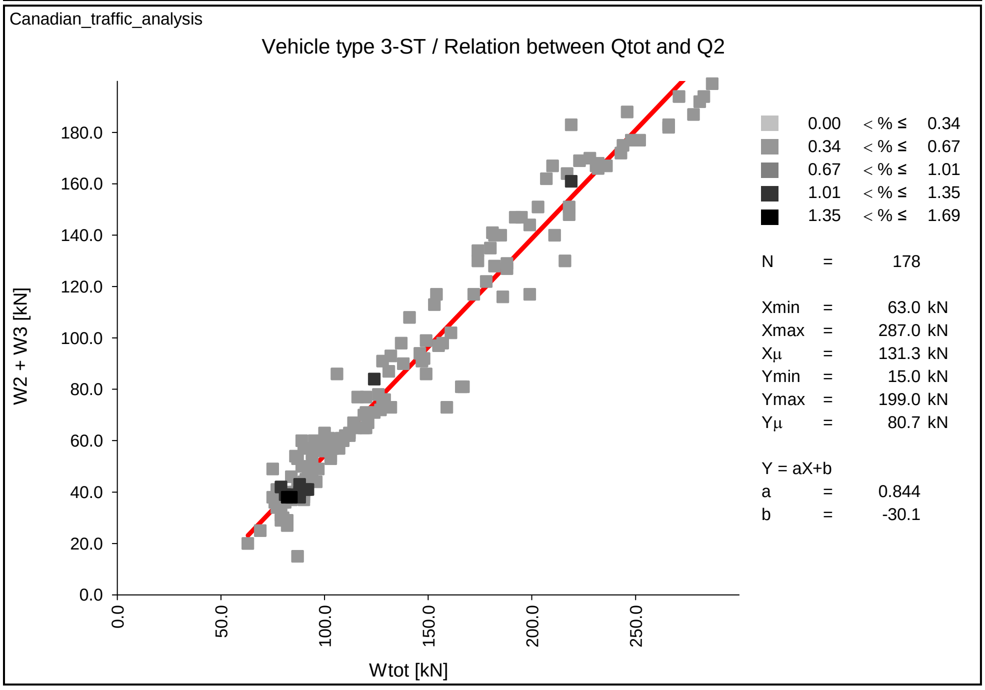

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Relation between Qtot-Q2-Q4-Q5 and Q3
W4 [kN]
Wtot - W2 - W3 - W5 - W6 [kN]
0.00 < % ≤ 0.87
0.87 < % ≤ 1.74
1.74 < % ≤ 2.61
2.61 < % ≤ 3.48
3.48 < % ≤ 4.35
N = 46
Xmin = 40.0 kN
Xmax = 138.0 kN
Xµ = 91.5 kN
Ymin = 0.0 kN
Ymax = 82.0 kN
Yµ = 46.5 kN
Y = aX+b
a = 0.943
b = -39.8

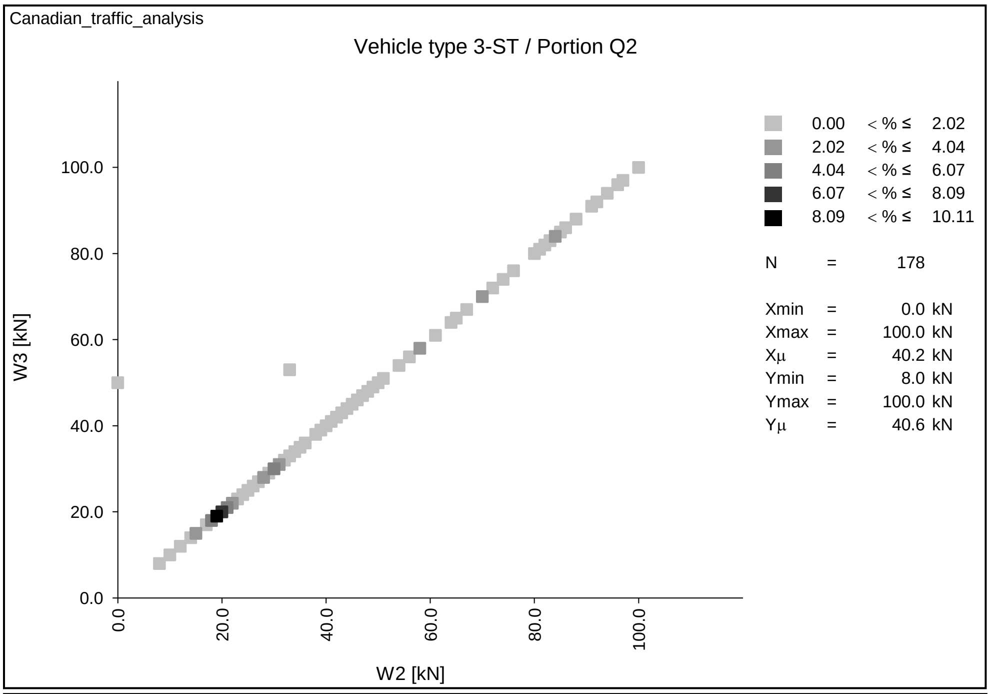

Canadian_traffic_analysis
Vehicle type 3-S1-2 / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 1.74
1.74 < % ≤ 3.48
3.48 < % ≤ 5.22
5.22 < % ≤ 6.96
6.96 < % ≤ 8.70
N = 46
Xmin = 27.0 kN
Xmax = 92.0 kN
Xµ = 46.1 kN
Ymin = 27.0 kN
Ymax = 92.0 kN
Yµ = 46.1 kN

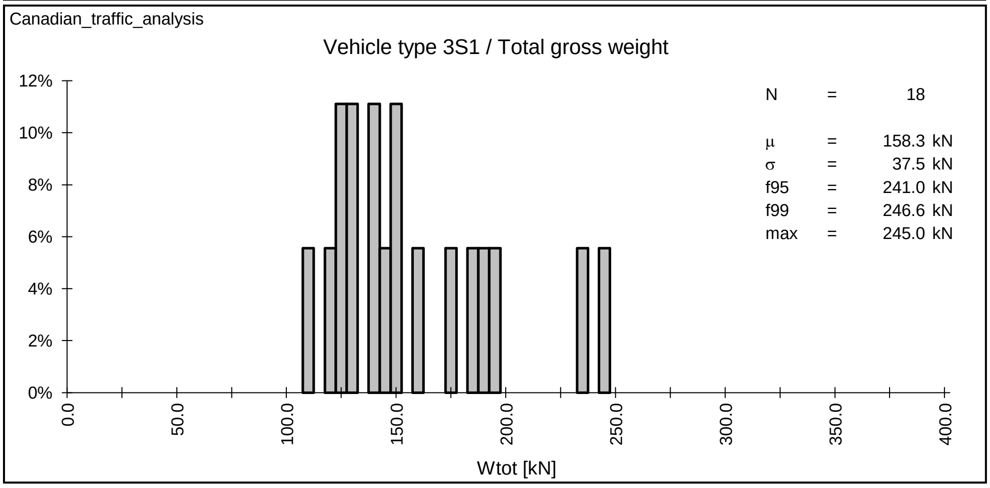

Canadian_traffic_analysis
Vehicle type 3-ST / Total gross weight
Wtot [kN]
N = 178
µ = 131.3 kN
σ = 57.5 kN
f95 = 248.2 kN
f99 = 283.0 kN
max = 285.0 kN

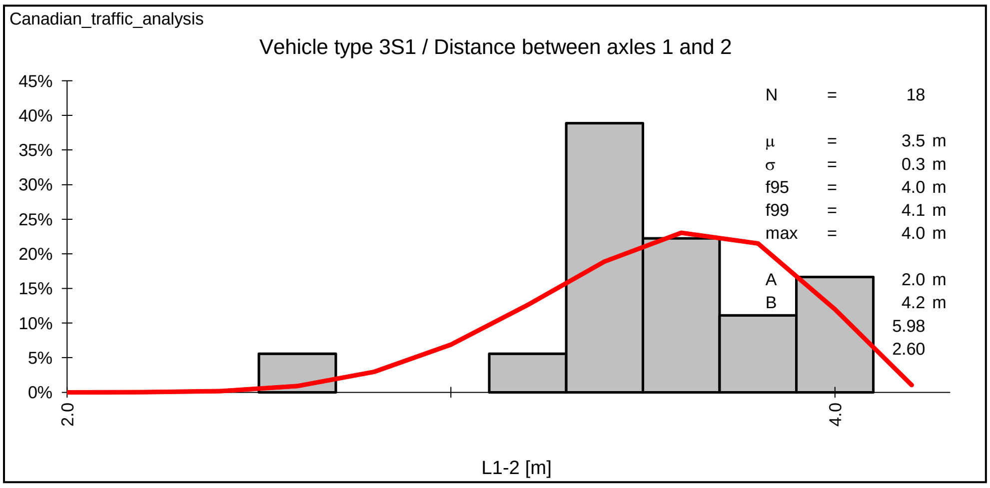

Canadian_traffic_analysis
Vehicle type 3-ST / Distance between axles 1 and 2
30%
25%
20%
15%
10%
5%
0%
1.8
3.8
N = 178
μ = 4.3 m
σ = 0.5 m
f95 = 4.9 m
f99 = 5.0 m
max = 5.0 m
L1-2 [m]

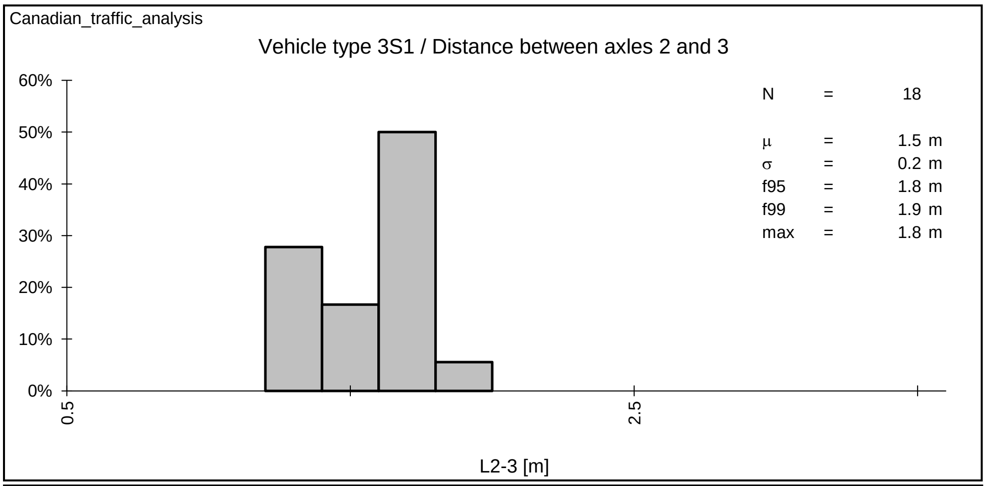

Canadian_traffic_analysis
Vehicle type 3-ST / Distance between axles 2 and 3
60%
50%
40%
30%
20%
10%
0%
0.5
2.4
N = 178
μ = 1.6 m
σ = 0.3 m
f95 = 2.1 m
f99 = 2.6 m
max = 2.8 m
L2-3 [m]

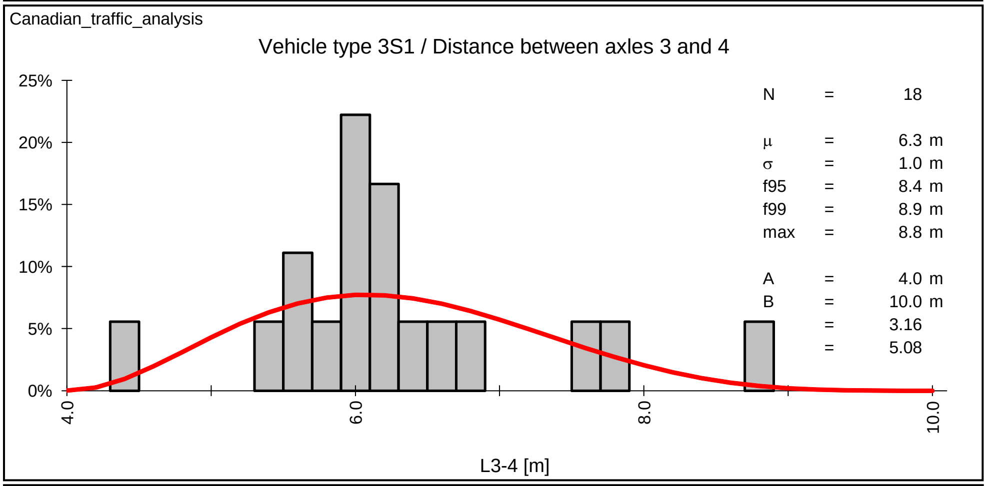

Canadian_traffic_analysis
Vehicle type 3-ST / Relation between Qtot and Q2
W2 + W3 [kN]
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
Wtot [kN]
0.00 < % ≤ 0.34
0.34 < % ≤ 0.67
0.67 < % ≤ 1.01
1.01 < % ≤ 1.35
1.35 < % ≤ 1.69
N = 178
Xmin = 63.0 kN
Xmax = 287.0 kN
Xμ = 131.3 kN
Ymin = 15.0 kN
Ymax = 199.0 kN
Yμ = 80.7 kN
Y = aX+b
a = 0.844
b = -30.1

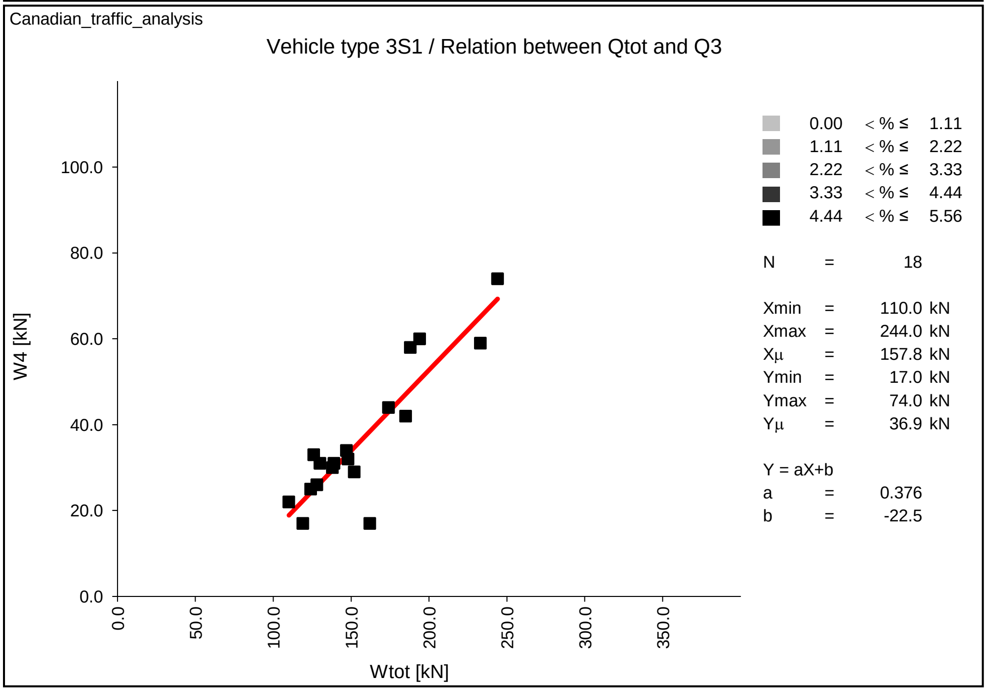

Canadian_traffic_analysis
Vehicle type 3-ST / Portion Q2
0.00 < % ≤ 2.02
2.02 < % ≤ 4.04
4.04 < % ≤ 6.07
6.07 < % ≤ 8.09
8.09 < % ≤ 10.11
N = 178
Xmin = 0.0 kN
Xmax = 100.0 kN
Xµ = 40.2 kN
Ymin = 8.0 kN
Ymax = 100.0 kN
Yµ = 40.6 kN
W3 [kN]
W2 [kN]

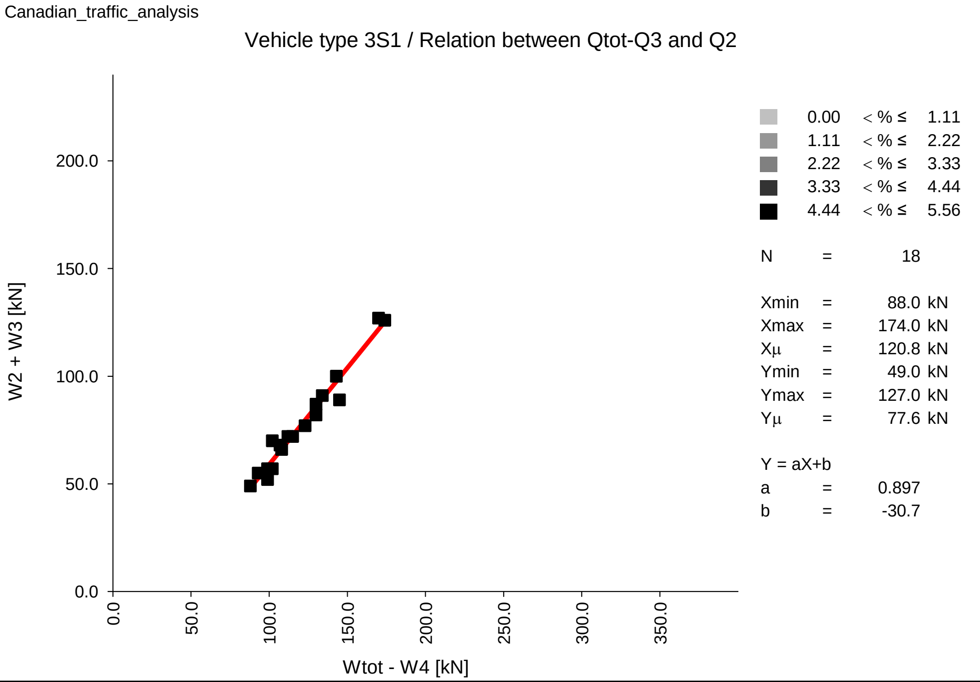

Canadian_traffic_analysis
Vehicle type 3S1 / Total gross weight
N = 18
µ = 158.3 kN
σ = 37.5 kN
f95 = 241.0 kN
f99 = 246.6 kN
max = 245.0 kN
Wtot [kN]

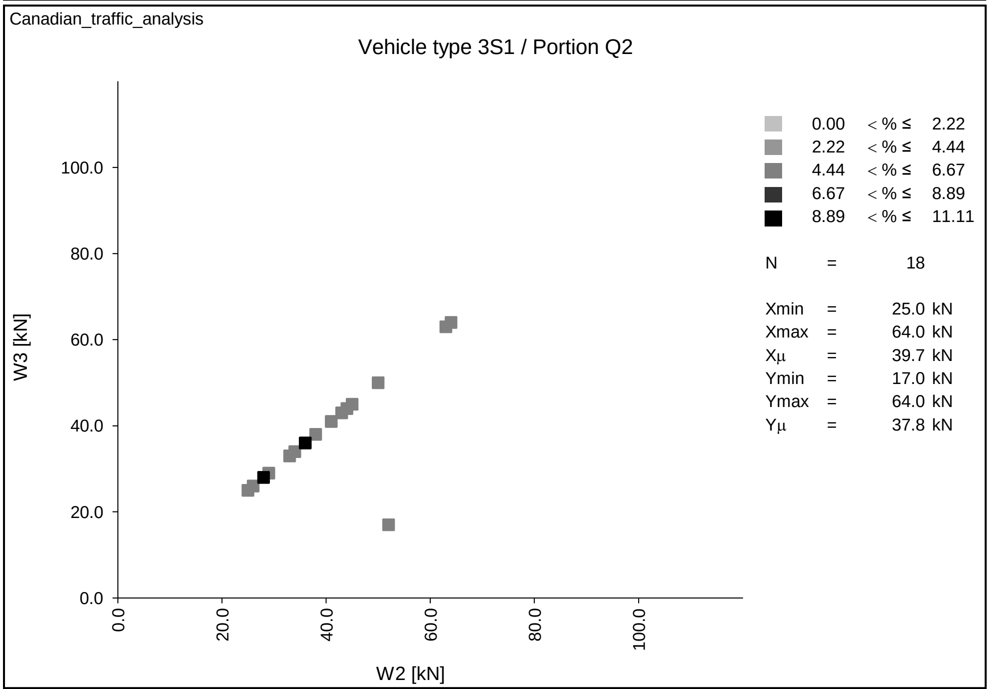

Canadian_traffic_analysis
Vehicle type 3S1 / Distance between axles 1 and 2
N = 18
µ = 3.5 m
σ = 0.3 m
f95 = 4.0 m
f99 = 4.1 m
max = 4.0 m
A 2.0 m
B 4.2 m
5.98
2.60
L1-2 [m]

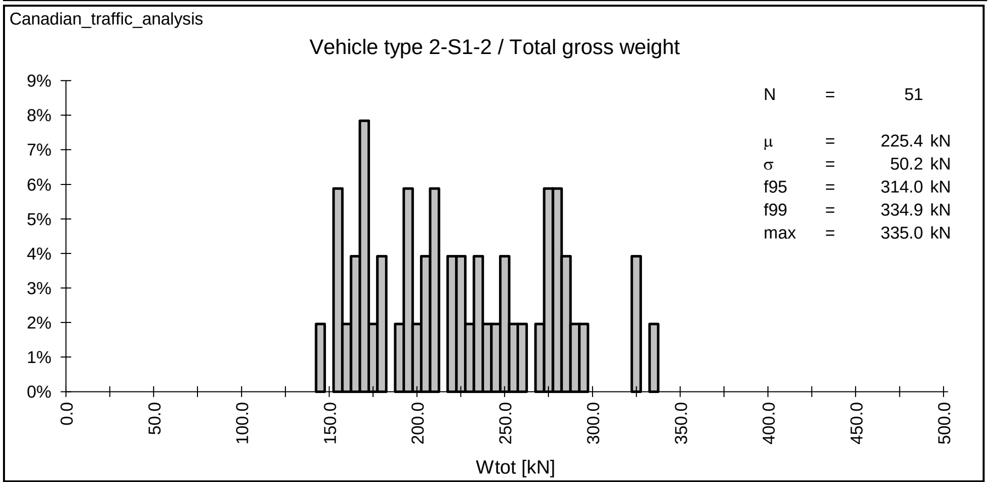

Canadian_traffic_analysis
Vehicle type 3S1 / Distance between axles 2 and 3
60%
50%
40%
30%
20%
10%
0%
0.5
2.5
L2-3 [m]
N = 18
μ = 1.5 m
σ = 0.2 m
f95 = 1.8 m
f99 = 1.9 m
max = 1.8 m

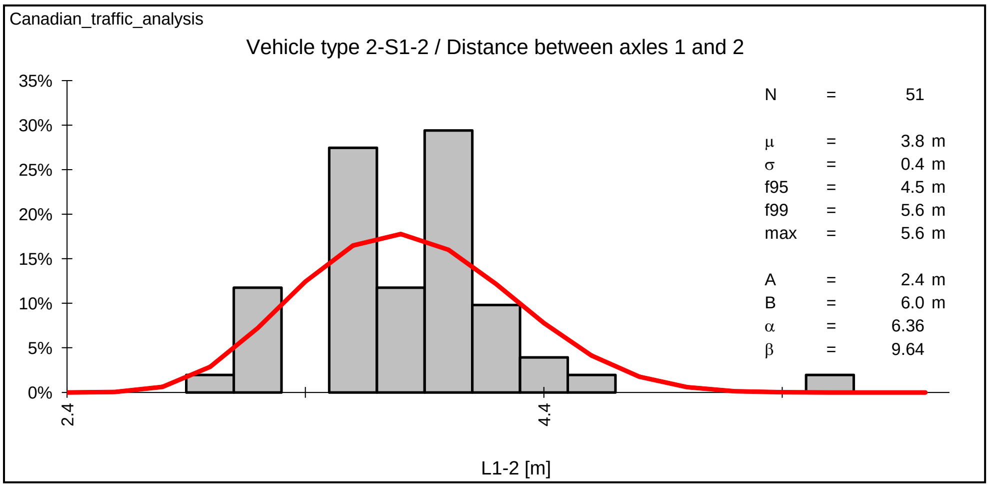

Canadian_traffic_analysis
Vehicle type 3S1 / Distance between axles 3 and 4
25%
20%
15%
10%
5%
0%
4.0
6.0
8.0
10.0
L3-4 [m]
N = 18
μ = 6.3 m
σ = 1.0 m
f95 = 8.4 m
f99 = 8.9 m
max = 8.8 m
A = 4.0 m
B = 10.0 m
= 3.16
= 5.08

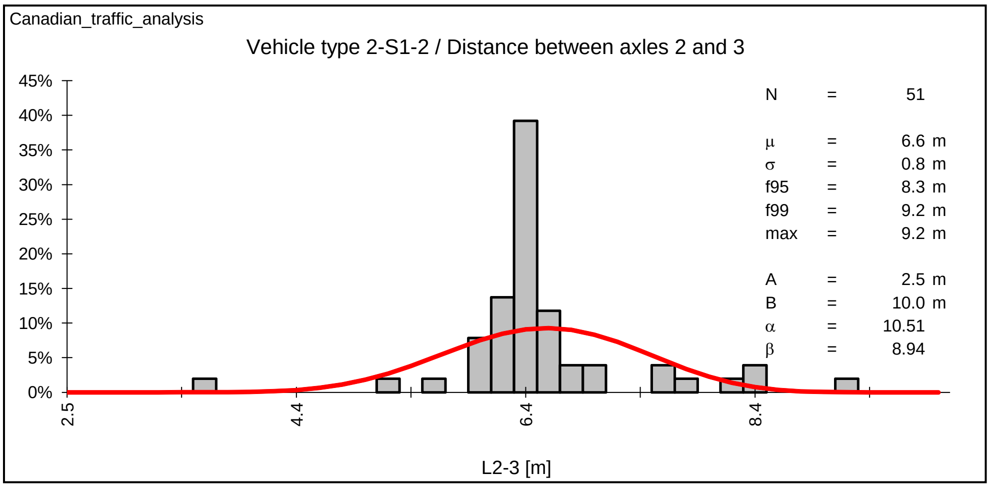

Canadian_traffic_analysis
Vehicle type 3S1 / Relation between Qtot and Q3
W4 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Wtot [kN]
0.00 < % ≤ 1.11
1.11 < % ≤ 2.22
2.22 < % ≤ 3.33
3.33 < % ≤ 4.44
4.44 < % ≤ 5.56
N = 18
Xmin = 110.0 kN
Xmax = 244.0 kN
Xμ = 157.8 kN
Ymin = 17.0 kN
Ymax = 74.0 kN
Yμ = 36.9 kN
Y = aX+b
a = 0.376
b = -22.5

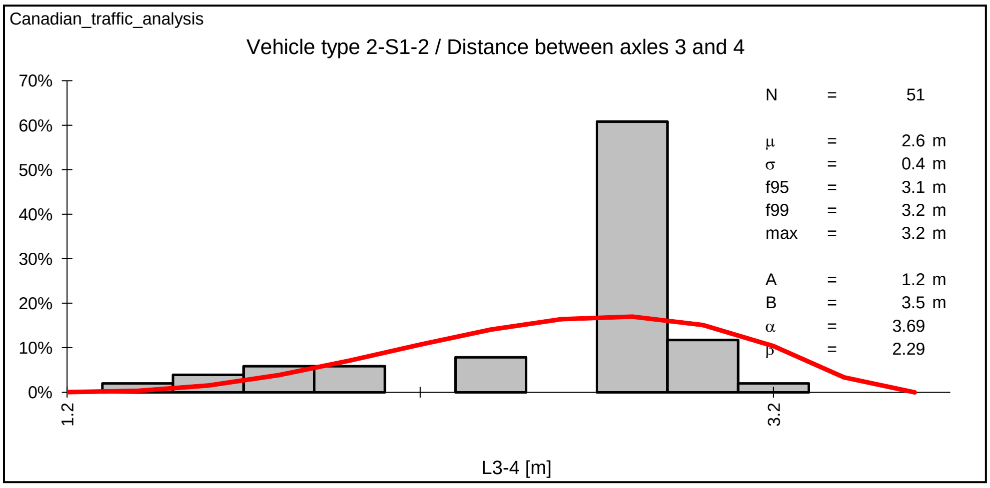

Canadian_traffic_analysis
Vehicle type 3S1 / Relation between Qtot-Q3 and Q2
W2 + W3 [kN]
Wtot - W4 [kN]
0.00 < % ≤ 1.11
1.11 < % ≤ 2.22
2.22 < % ≤ 3.33
3.33 < % ≤ 4.44
4.44 < % ≤ 5.56
N = 18
Xmin = 88.0 kN
Xmax = 174.0 kN
Xμ = 120.8 kN
Ymin = 49.0 kN
Ymax = 127.0 kN
Yμ = 77.6 kN
Y = aX+b
a = 0.897
b = -30.7

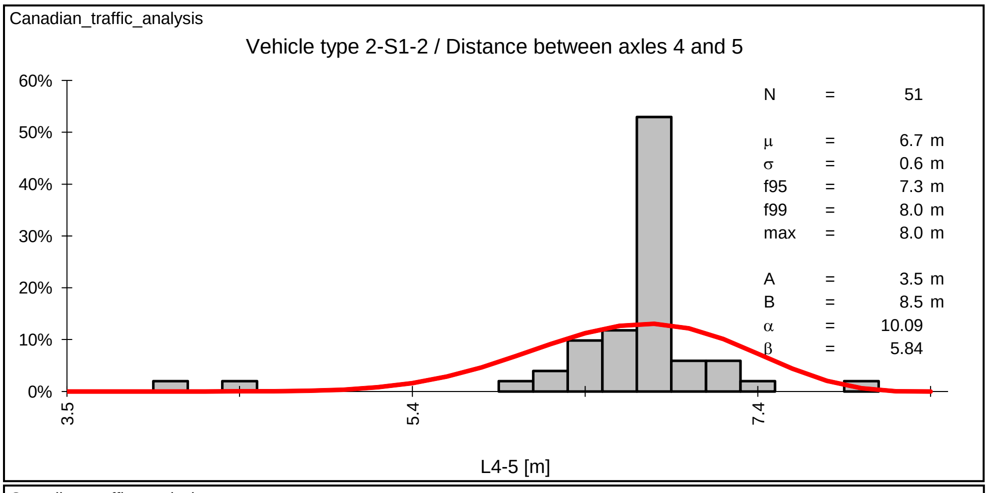

Canadian_traffic_analysis
Vehicle type 3S1 / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 2.22
2.22 < % ≤ 4.44
4.44 < % ≤ 6.67
6.67 < % ≤ 8.89
8.89 < % ≤ 11.11
N = 18
Xmin = 25.0 kN
Xmax = 64.0 kN
Xμ = 39.7 kN
Ymin = 17.0 kN
Ymax = 64.0 kN
Yμ = 37.8 kN

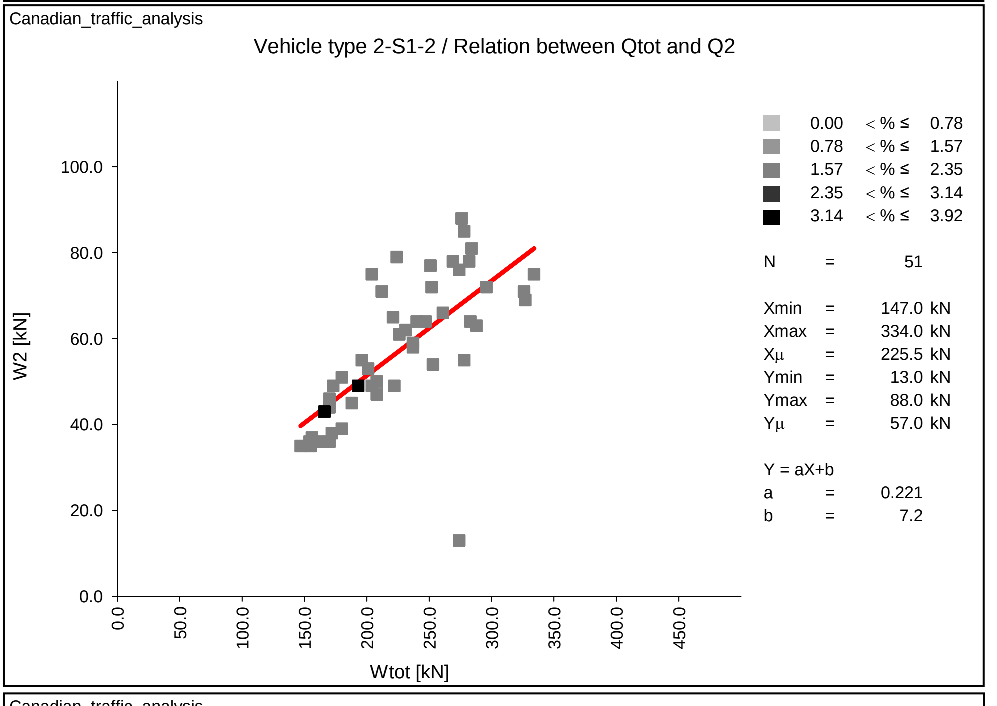

Canadian_traffic_analysis
Vehicle type 2-S1-2 / Total gross weight
Wtot [kN]
N = 51
μ = 225.4 kN
σ = 50.2 kN
f95 = 314.0 kN
f99 = 334.9 kN
max = 335.0 kN

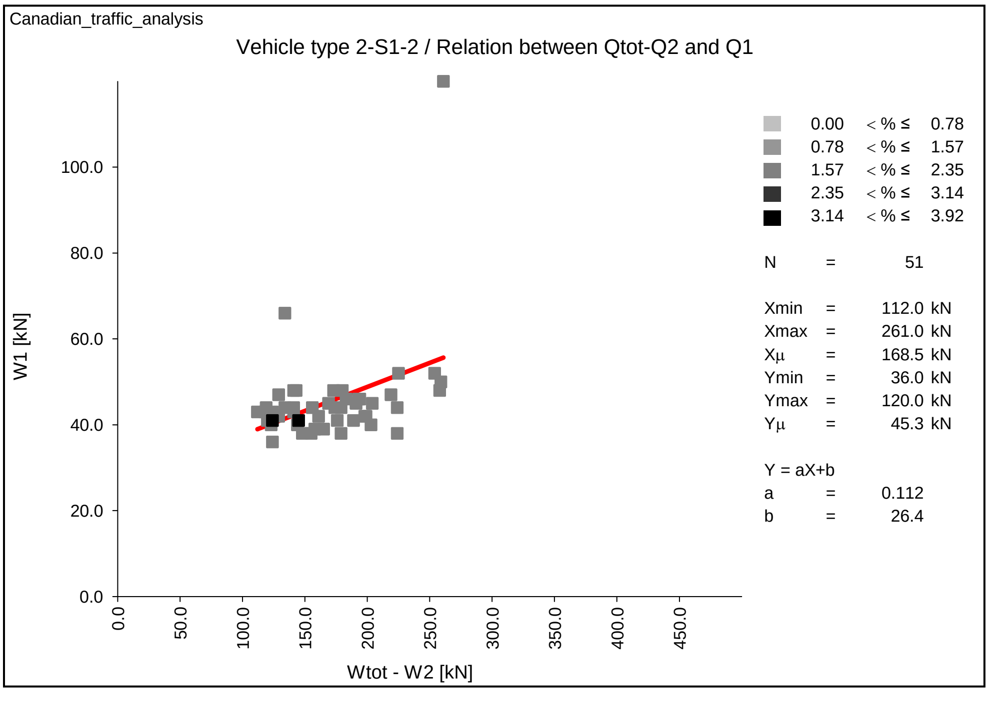

Canadian_traffic_analysis
Vehicle type 2-S1-2 / Distance between axles 1 and 2
35%
30%
25%
20%
15%
10%
5%
0%
2.4
4.4
L1-2 [m]
N = 51
μ = 3.8 m
σ = 0.4 m
f95 = 4.5 m
f99 = 5.6 m
max = 5.6 m
A = 2.4 m
B = 6.0 m
α = 6.36
β = 9.64

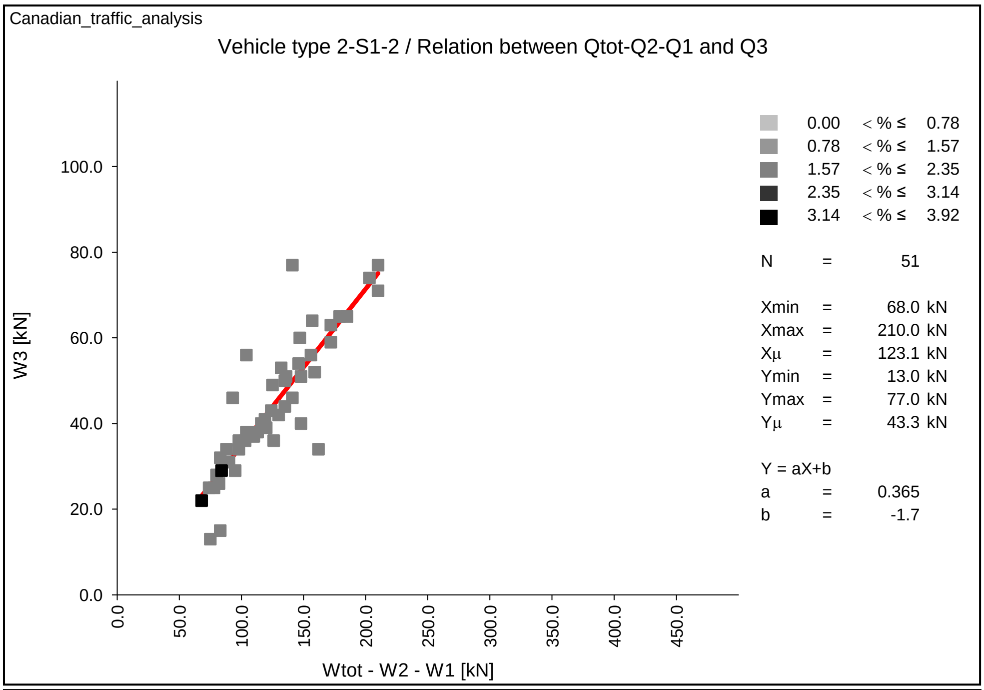

Canadian_traffic_analysis
Vehicle type 2-S1-2 / Distance between axles 2 and 3
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.5
4.4
6.4
8.4
L2-3 [m]
N = 51
μ = 6.6 m
σ = 0.8 m
f95 = 8.3 m
f99 = 9.2 m
max = 9.2 m
A = 2.5 m
B = 10.0 m
α = 10.51
β = 8.94

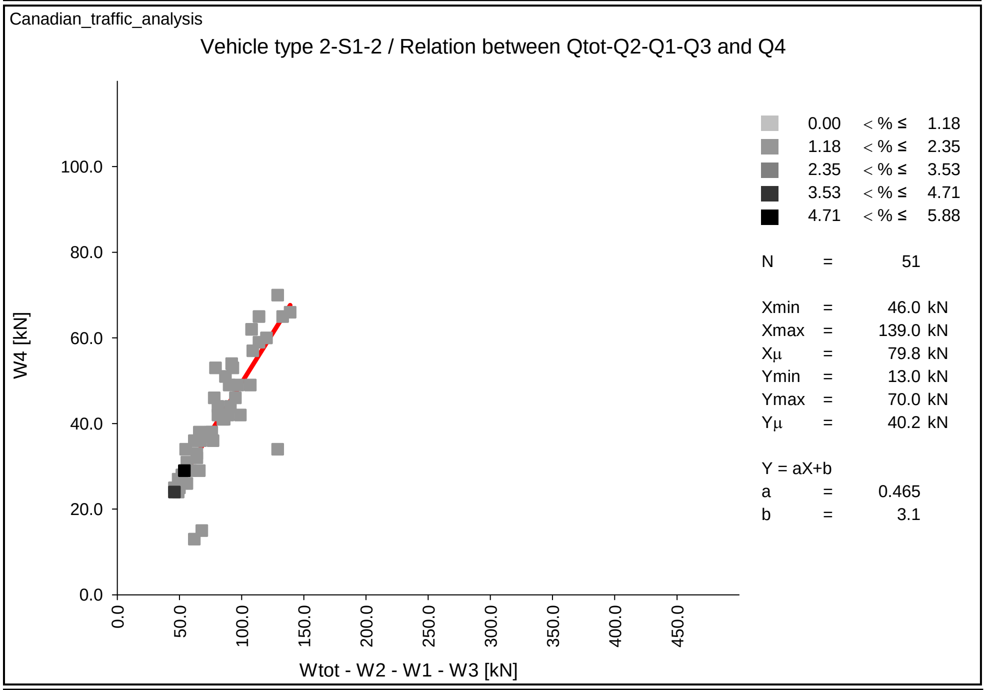

Canadian_traffic_analysis
Vehicle type 2-S1-2 / Distance between axles 3 and 4
70%
60%
50%
40%
30%
20%
10%
0%
1.2
3.2
L3-4 [m]
N = 51
μ = 2.6 m
σ = 0.4 m
f95 = 3.1 m
f99 = 3.2 m
max = 3.2 m
A = 1.2 m
B = 3.5 m
α = 3.69
β = 2.29

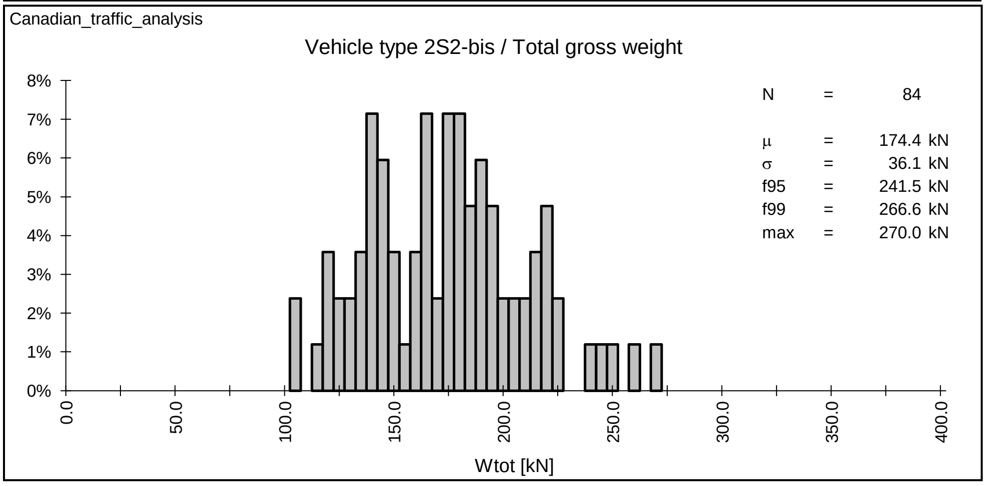

Canadian_traffic_analysis
Vehicle type 2-S1-2 / Distance between axles 4 and 5
60%
50%
40%
30%
20%
10%
0%
3.5
5.4
7.4
L4-5 [m]
N = 51
μ = 6.7 m
σ = 0.6 m
f95 = 7.3 m
f99 = 8.0 m
max = 8.0 m
A = 3.5 m
B = 8.5 m
α = 10.09
β = 5.84

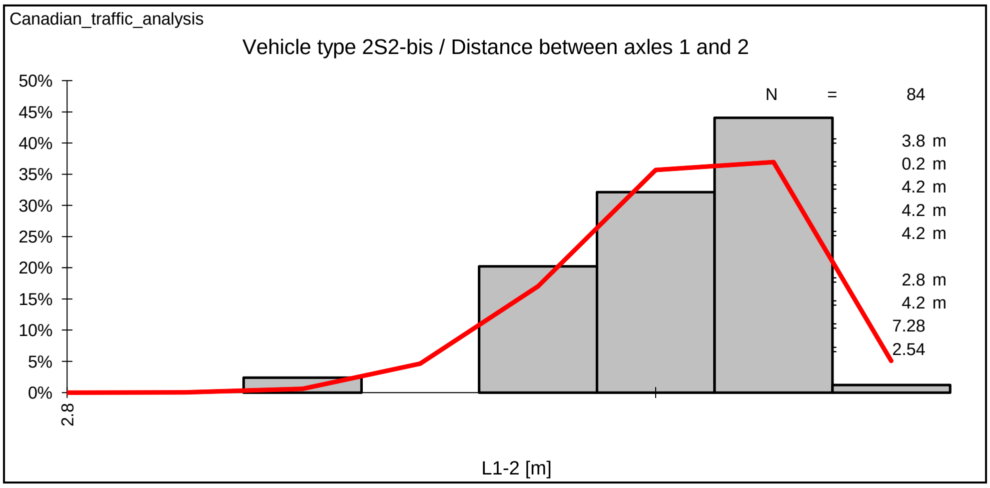

Canadian_traffic_analysis
Vehicle type 2-S1-2 / Relation between Qtot and Q2
W2 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
Wtot [kN]
0.00 < % ≤ 0.78
0.78 < % ≤ 1.57
1.57 < % ≤ 2.35
2.35 < % ≤ 3.14
3.14 < % ≤ 3.92
N = 51
Xmin = 147.0 kN
Xmax = 334.0 kN
Xμ = 225.5 kN
Ymin = 13.0 kN
Ymax = 88.0 kN
Yμ = 57.0 kN
Y = aX+b
a = 0.221
b = 7.2

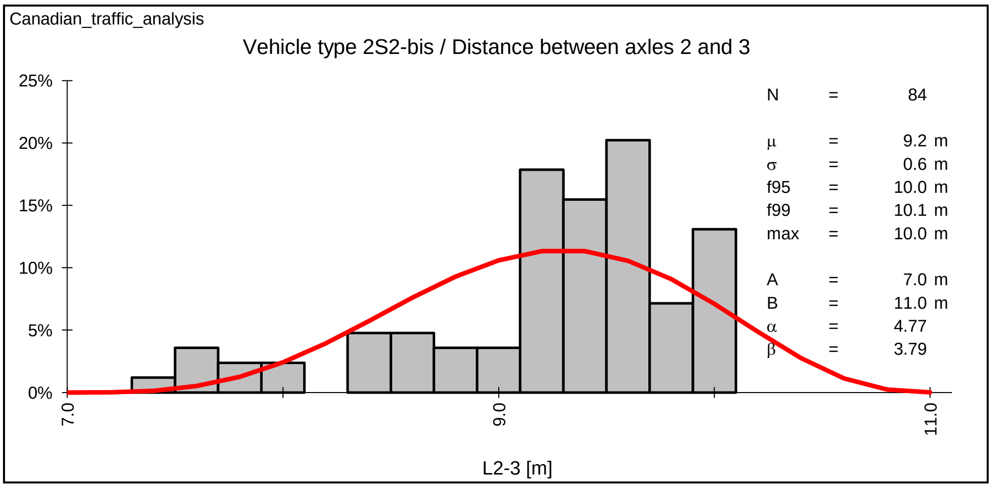

Canadian_traffic_analysis
Vehicle type 2-S1-2 / Relation between Qtot-Q2 and Q1
W1 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
Wtot - W2 [kN]
0.00 < % ≤ 0.78
0.78 < % ≤ 1.57
1.57 < % ≤ 2.35
2.35 < % ≤ 3.14
3.14 < % ≤ 3.92
N = 51
Xmin = 112.0 kN
Xmax = 261.0 kN
Xμ = 168.5 kN
Ymin = 36.0 kN
Ymax = 120.0 kN
Yμ = 45.3 kN
Y = aX+b
a = 0.112
b = 26.4

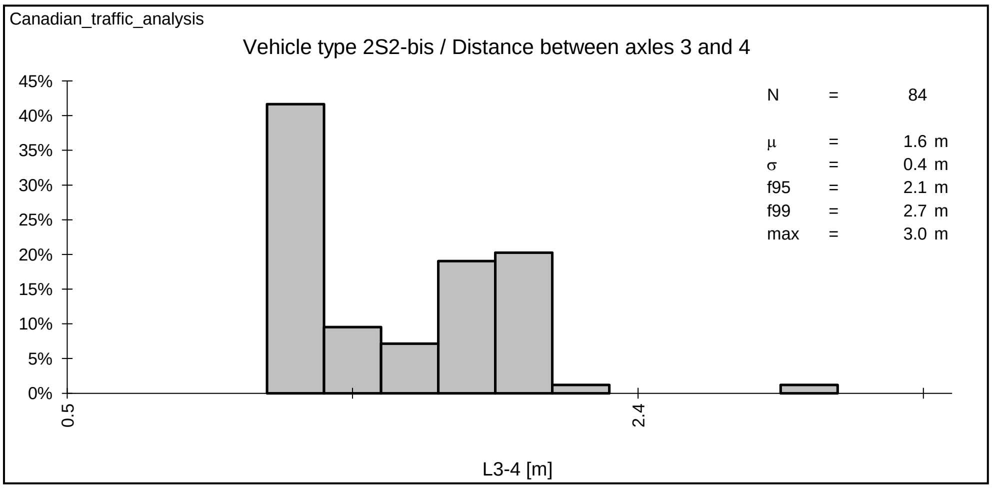

Canadian_traffic_analysis
Vehicle type 2-S1-2 / Relation between Qtot-Q2-Q1 and Q3
W3 [kN]
Wtot - W2 - W1 [kN]
0.00 < % ≤ 0.78
0.78 < % ≤ 1.57
1.57 < % ≤ 2.35
2.35 < % ≤ 3.14
3.14 < % ≤ 3.92
N = 51
Xmin = 68.0 kN
Xmax = 210.0 kN
Xµ = 123.1 kN
Ymin = 13.0 kN
Ymax = 77.0 kN
Yµ = 43.3 kN
Y = aX+b
a = 0.365
b = -1.7

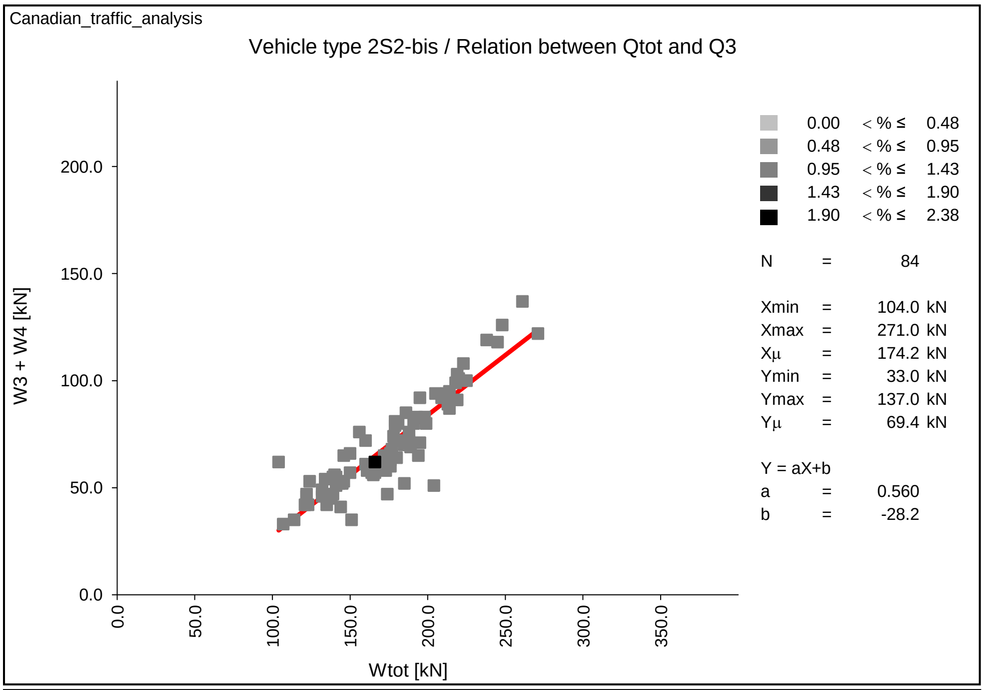

Canadian_traffic_analysis
Vehicle type 2-S1-2 / Relation between Qtot-Q2-Q1-Q3 and Q4
W4 [kN]
Wtot - W2 - W1 - W3 [kN]
0.00 < % ≤ 1.18
1.18 < % ≤ 2.35
2.35 < % ≤ 3.53
3.53 < % ≤ 4.71
4.71 < % ≤ 5.88
N = 51
Xmin = 46.0 kN
Xmax = 139.0 kN
Xµ = 79.8 kN
Ymin = 13.0 kN
Ymax = 70.0 kN
Yµ = 40.2 kN
Y = aX+b
a = 0.465
b = 3.1

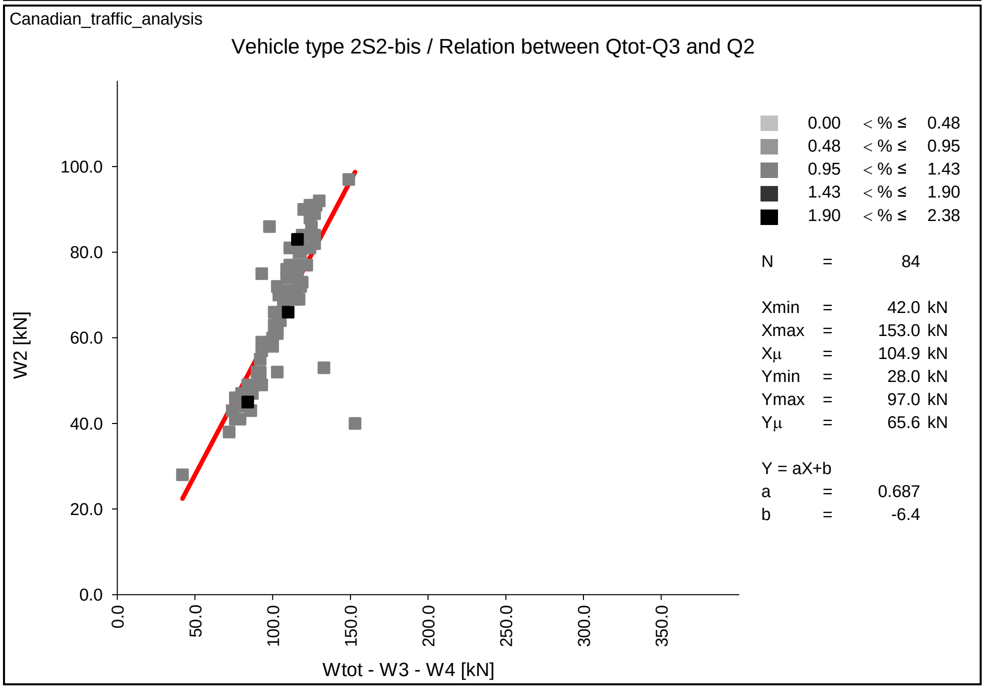

Canadian_traffic_analysis
Vehicle type 2S2-bis / Total gross weight
Wtot [kN]
N = 84
µ = 174.4 kN
σ = 36.1 kN
f95 = 241.5 kN
f99 = 266.6 kN
max = 270.0 kN

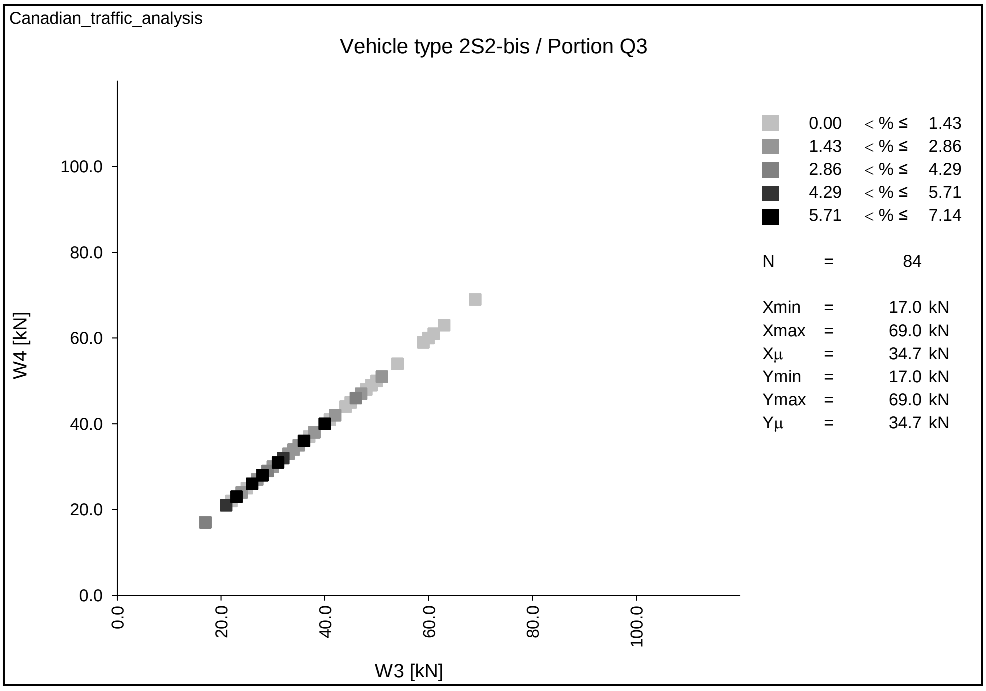

Canadian_traffic_analysis
Vehicle type 2S2-bis / Distance between axles 1 and 2
N = 84
3.8 m
0.2 m
4.2 m
4.2 m
4.2 m
2.8 m
4.2 m
7.28
2.54
L1-2 [m]

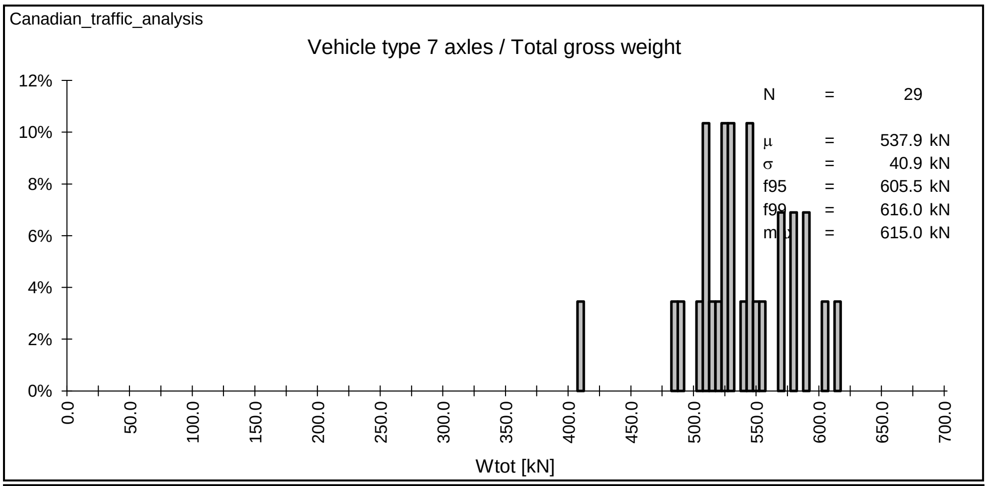

Canadian_traffic_analysis
Vehicle type 2S2-bis / Distance between axles 2 and 3
N = 84
μ = 9.2 m
σ = 0.6 m
f95 = 10.0 m
f99 = 10.1 m
max = 10.0 m
A = 7.0 m
B = 11.0 m
α = 4.77
β = 3.79
L2-3 [m]

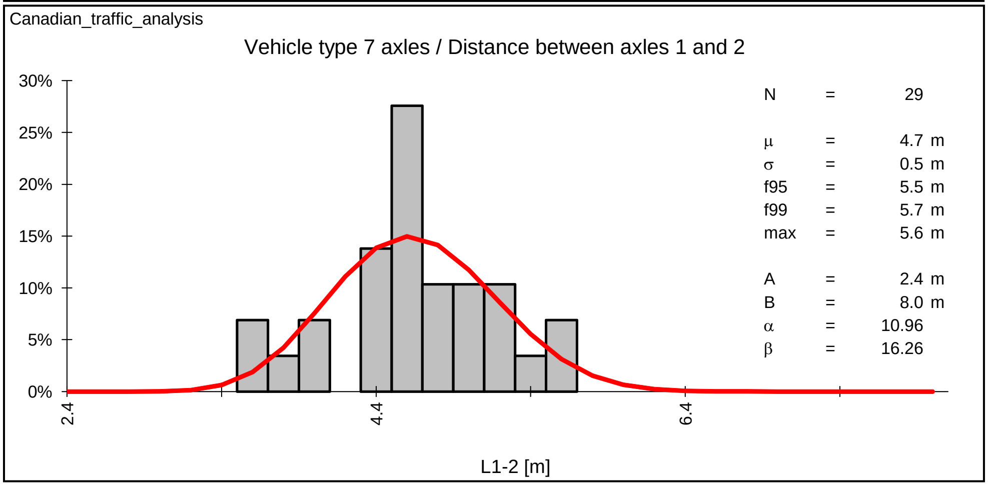

Canadian_traffic_analysis
Vehicle type 2S2-bis / Distance between axles 3 and 4
N = 84
μ = 1.6 m
σ = 0.4 m
f95 = 2.1 m
f99 = 2.7 m
max = 3.0 m
L3-4 [m]


Canadian_traffic_analysis
Vehicle type 2S2-bis / Relation between Qtot and Q3
W3 + W4 [kN]
0.0
50.0
100.0
150.0
200.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Wtot [kN]
0.00 < % ≤ 0.48
0.48 < % ≤ 0.95
0.95 < % ≤ 1.43
1.43 < % ≤ 1.90
1.90 < % ≤ 2.38
N = 84
Xmin = 104.0 kN
Xmax = 271.0 kN
Xµ = 174.2 kN
Ymin = 33.0 kN
Ymax = 137.0 kN
Yµ = 69.4 kN
Y = aX+b
a = 0.560
b = -28.2

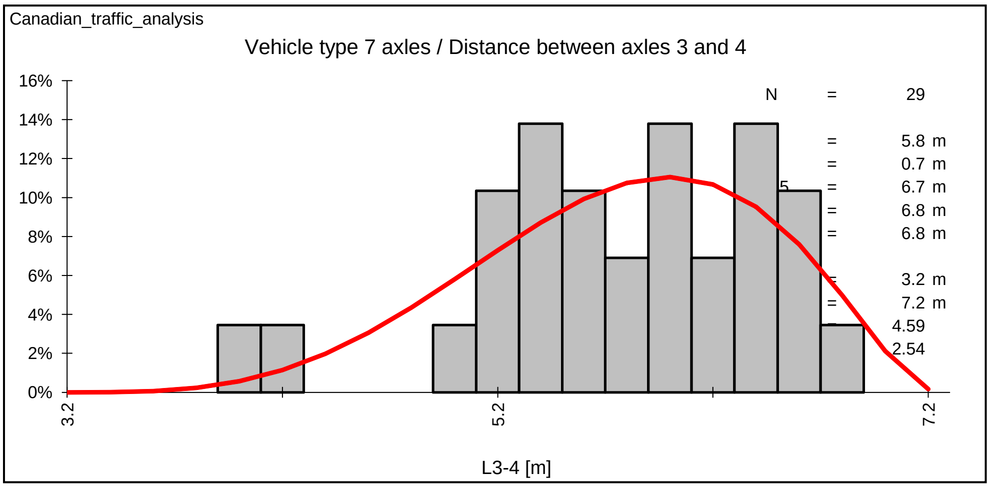

Canadian_traffic_analysis
Vehicle type 2S2-bis / Relation between Qtot-Q3 and Q2
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Wtot - W3 - W4 [kN]
0.00 < % ≤ 0.48
0.48 < % ≤ 0.95
0.95 < % ≤ 1.43
1.43 < % ≤ 1.90
1.90 < % ≤ 2.38
N = 84
Xmin = 42.0 kN
Xmax = 153.0 kN
Xµ = 104.9 kN
Ymin = 28.0 kN
Ymax = 97.0 kN
Yµ = 65.6 kN
Y = aX+b
a = 0.687
b = -6.4

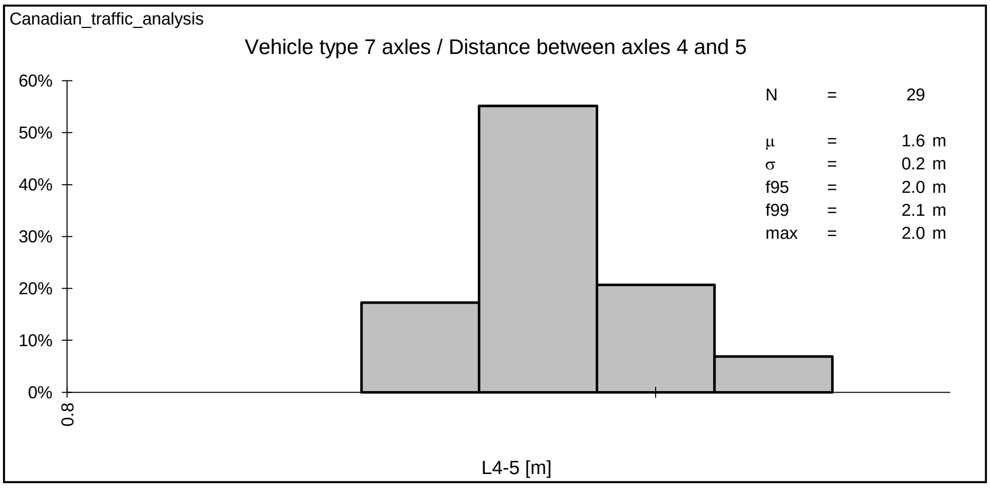

Canadian_traffic_analysis
Vehicle type 2S2-bis / Portion Q3
W4 [kN]
W3 [kN]
0.00 < % ≤ 1.43
1.43 < % ≤ 2.86
2.86 < % ≤ 4.29
4.29 < % ≤ 5.71
5.71 < % ≤ 7.14
N = 84
Xmin = 17.0 kN
Xmax = 69.0 kN
Xμ = 34.7 kN
Ymin = 17.0 kN
Ymax = 69.0 kN
Yμ = 34.7 kN

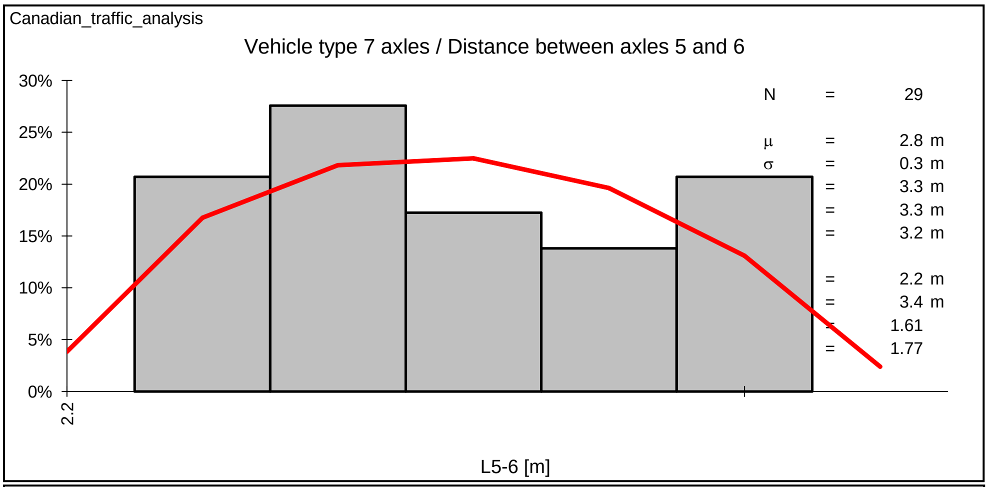

Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
Wtot [kN]
N = 29
μ = 537.9 kN
σ = 40.9 kN
f95 = 605.5 kN
f99 = 616.0 kN
max = 615.0 kN

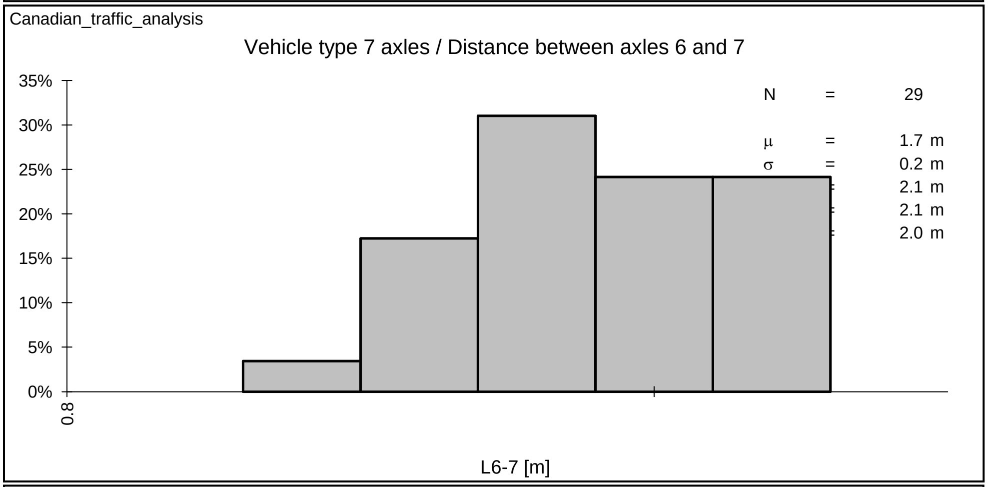

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
L1-2 [m]
N = 29
μ = 4.7 m
σ = 0.5 m
f95 = 5.5 m
f99 = 5.7 m
max = 5.6 m
A = 2.4 m
B = 8.0 m
α = 10.96
β = 16.26

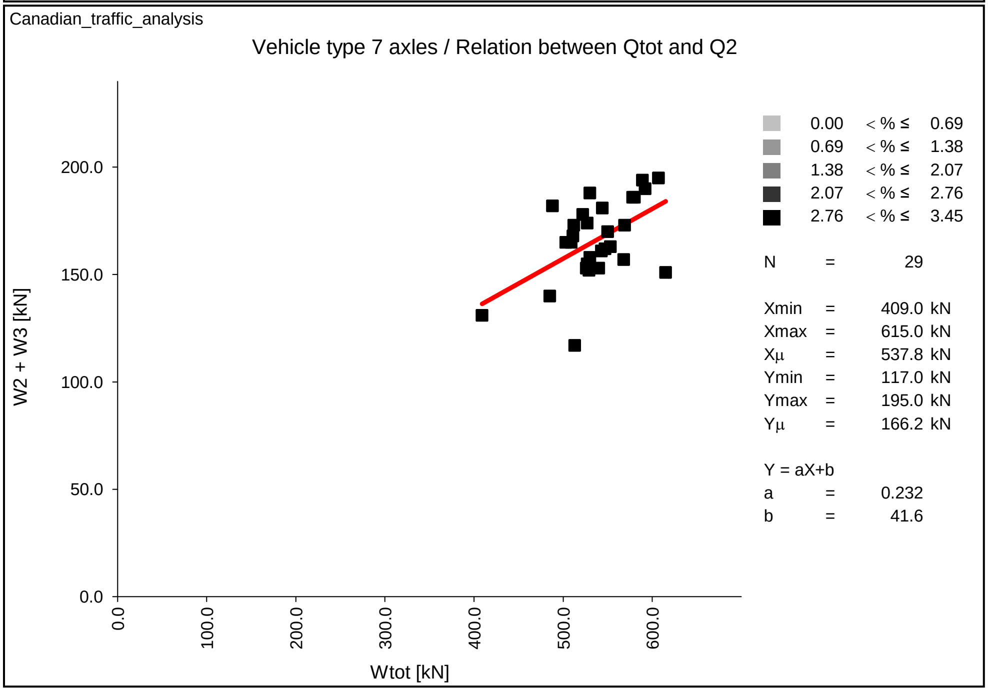

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
70%
60%
50%
40%
30%
20%
10%
0%
0.8
N = 29
μ = 1.7 m
σ = 0.1 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L2-3 [m]

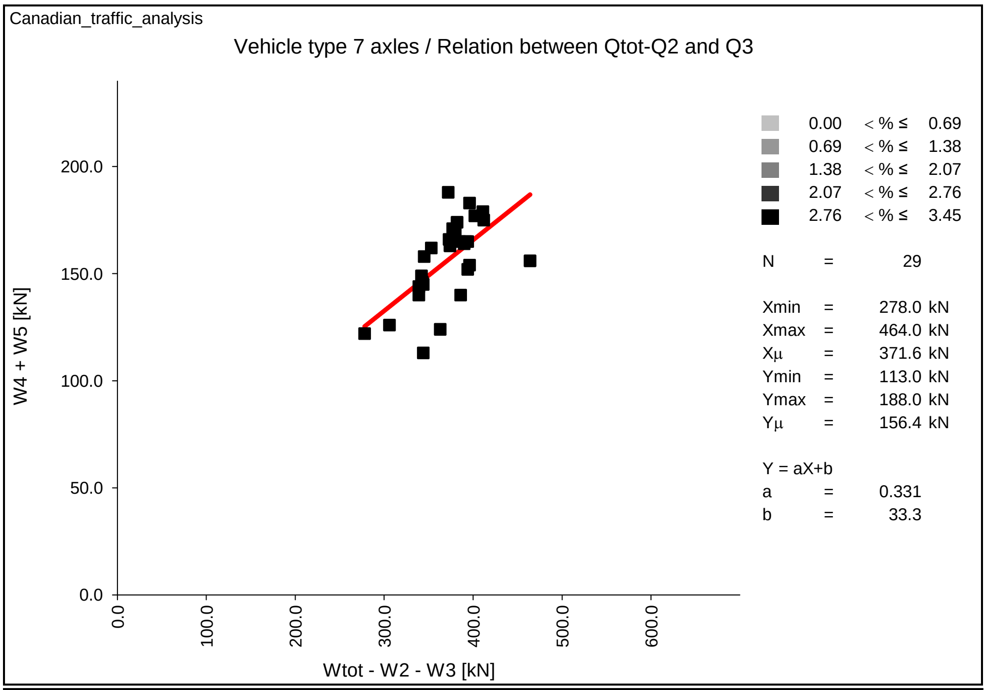

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
16%
14%
12%
10%
8%
6%
4%
2%
0%
3.2
5.2
7.2
N = 29
= 5.8 m
= 0.7 m
= 6.7 m
= 6.8 m
= 6.8 m
3.2 m
= 7.2 m
4.59
2.54
L3-4 [m]

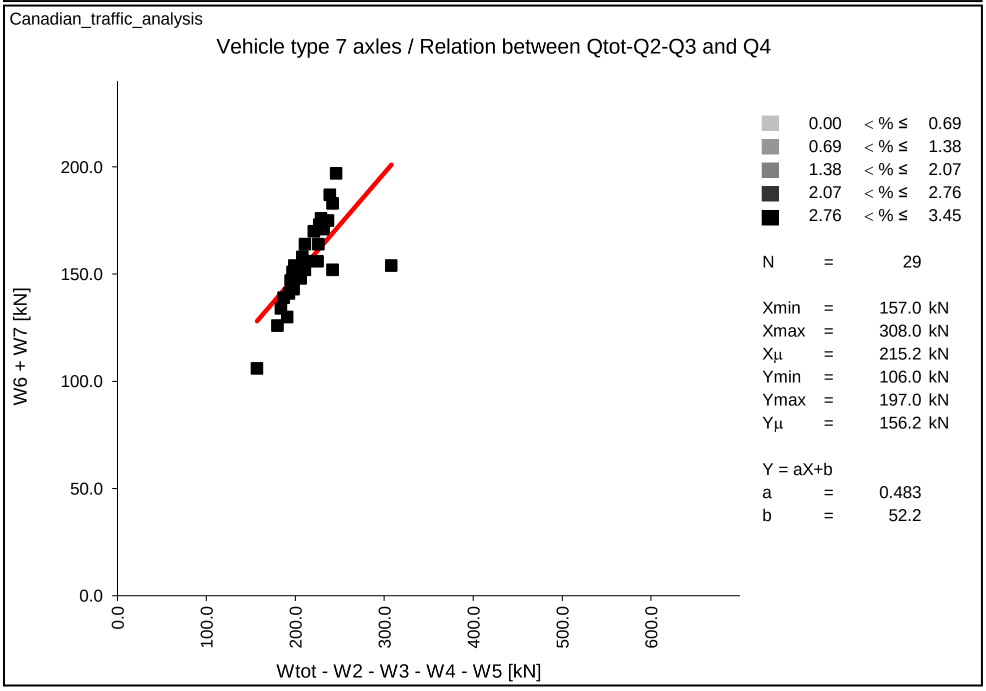

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
60%
50%
40%
30%
20%
10%
0%
0.8
N = 29
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L4-5 [m]

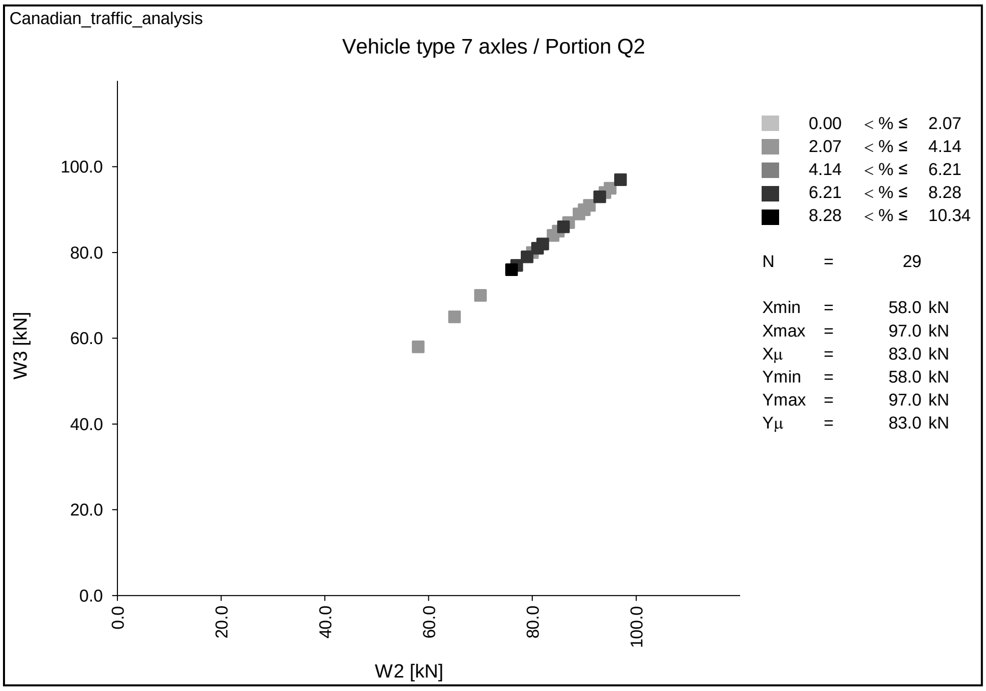

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
30%
25%
20%
15%
10%
5%
0%
2.2
N = 29
μ = 2.8 m
σ = 0.3 m
= 3.3 m
= 3.3 m
= 3.2 m
= 2.2 m
= 3.4 m
1.61
= 1.77
L5-6 [m]

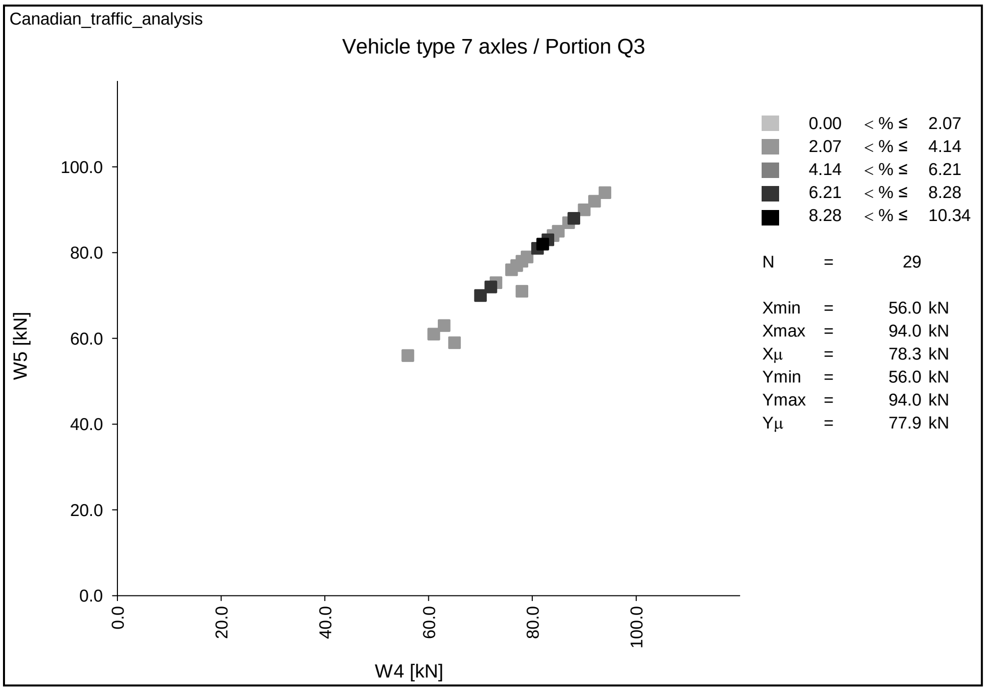

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
35%
30%
25%
20%
15%
10%
5%
0%
0.8
N = 29
μ = 1.7 m
σ = 0.2 m
2.1 m
2.1 m
2.0 m
L6-7 [m]

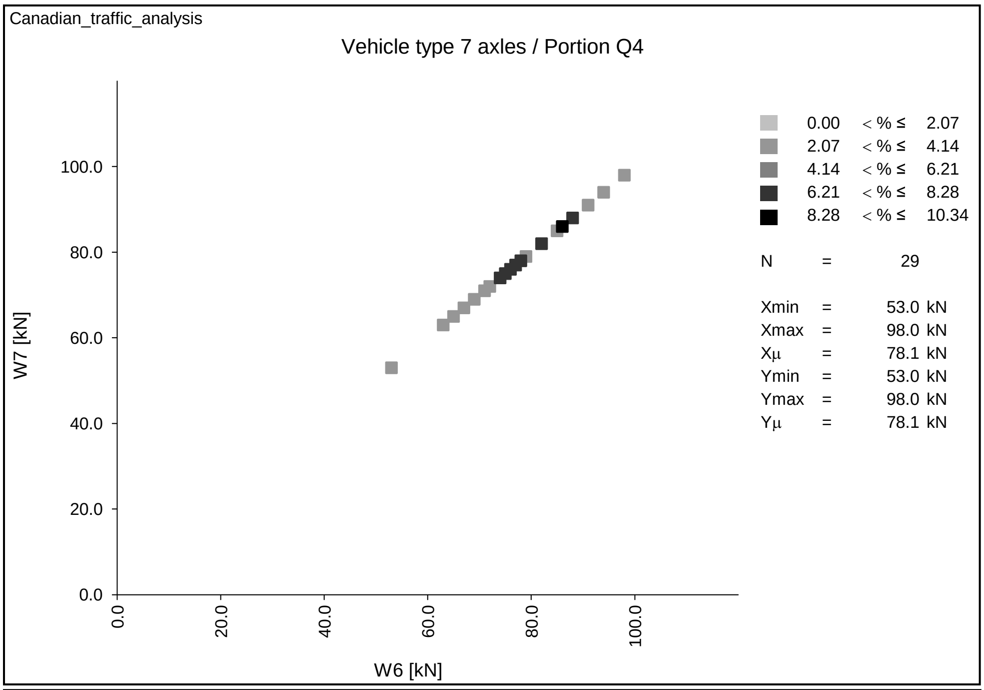

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]
0.00 < % ≤ 0.69
0.69 < % ≤ 1.38
1.38 < % ≤ 2.07
2.07 < % ≤ 2.76
2.76 < % ≤ 3.45
N = 29
Xmin = 409.0 kN
Xmax = 615.0 kN
Xμ = 537.8 kN
Ymin = 117.0 kN
Ymax = 195.0 kN
Yμ = 166.2 kN
Y = aX+b
a = 0.232
b = 41.6

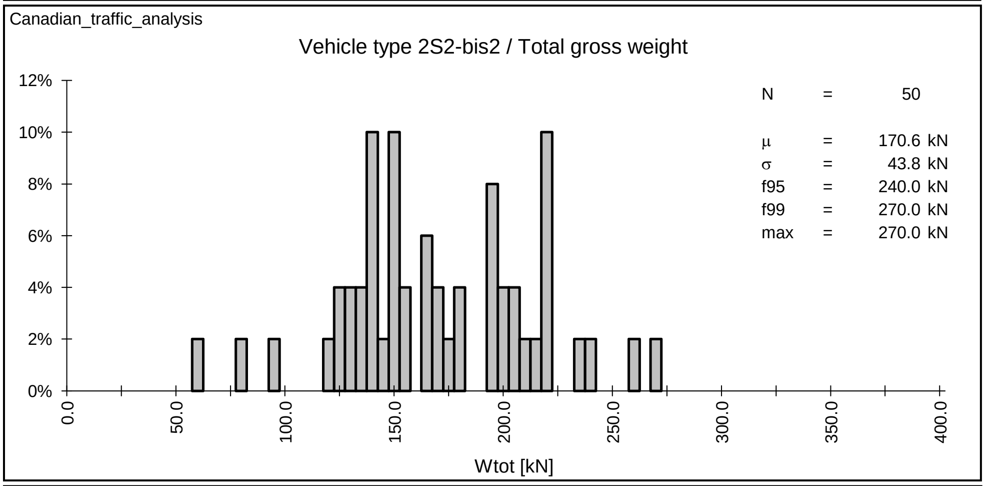

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q3
W4 + W5 [kN]
Wtot - W2 - W3 [kN]
0.0
50.0
100.0
150.0
200.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.69
0.69 < % ≤ 1.38
1.38 < % ≤ 2.07
2.07 < % ≤ 2.76
2.76 < % ≤ 3.45
N = 29
Xmin = 278.0 kN
Xmax = 464.0 kN
Xµ = 371.6 kN
Ymin = 113.0 kN
Ymax = 188.0 kN
Yµ = 156.4 kN
Y = aX+b
a = 0.331
b = 33.3

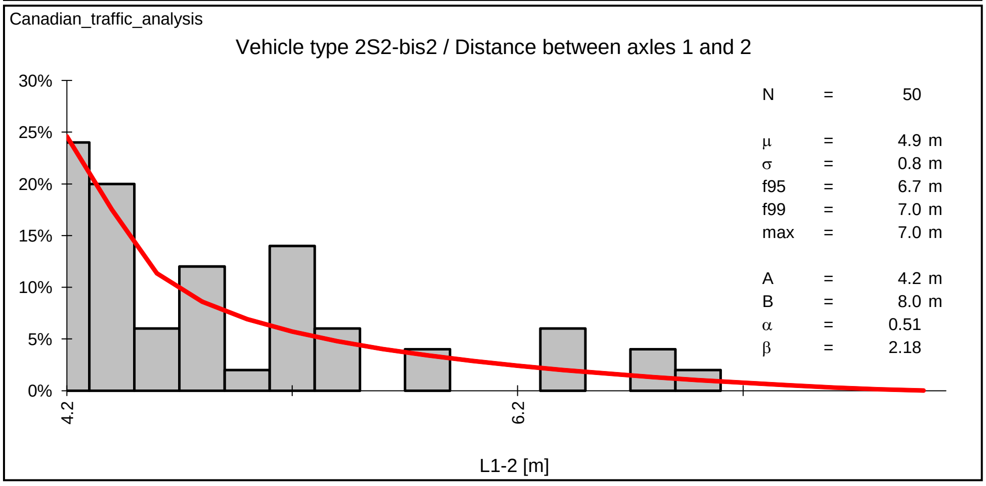

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q3 and Q4
W6 + W7 [kN]
Wtot - W2 - W3 - W4 - W5 [kN]
0.0
50.0
100.0
150.0
200.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.69
0.69 < % ≤ 1.38
1.38 < % ≤ 2.07
2.07 < % ≤ 2.76
2.76 < % ≤ 3.45
N = 29
Xmin = 157.0 kN
Xmax = 308.0 kN
Xµ = 215.2 kN
Ymin = 106.0 kN
Ymax = 197.0 kN
Yµ = 156.2 kN
Y = aX+b
a = 0.483
b = 52.2

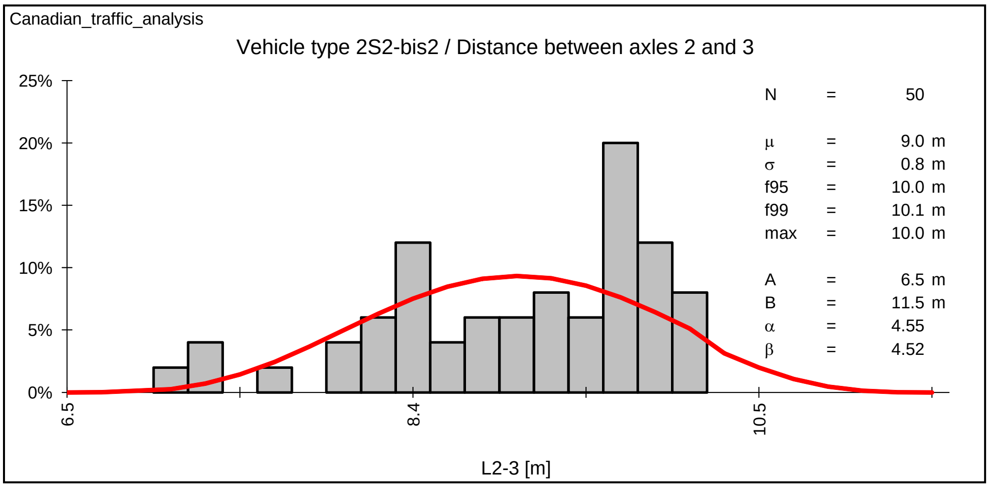

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
0.00 < % ≤ 2.07
2.07 < % ≤ 4.14
4.14 < % ≤ 6.21
6.21 < % ≤ 8.28
8.28 < % ≤ 10.34
N = 29
Xmin = 58.0 kN
Xmax = 97.0 kN
Xμ = 83.0 kN
Ymin = 58.0 kN
Ymax = 97.0 kN
Yμ = 83.0 kN
W3 [kN]
W2 [kN]

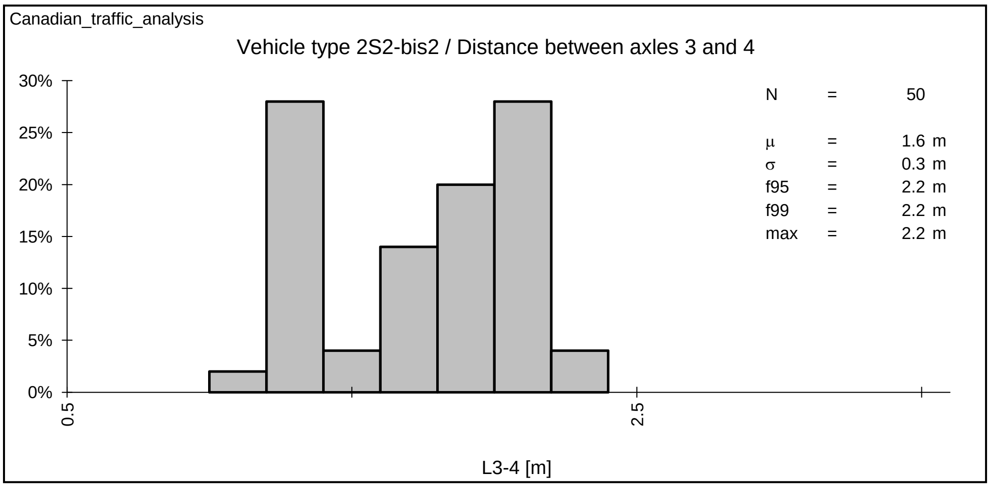

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q3
0.00 < % ≤ 2.07
2.07 < % ≤ 4.14
4.14 < % ≤ 6.21
6.21 < % ≤ 8.28
8.28 < % ≤ 10.34
N = 29
Xmin = 56.0 kN
Xmax = 94.0 kN
Xμ = 78.3 kN
Ymin = 56.0 kN
Ymax = 94.0 kN
Yμ = 77.9 kN
W5 [kN]
W4 [kN]

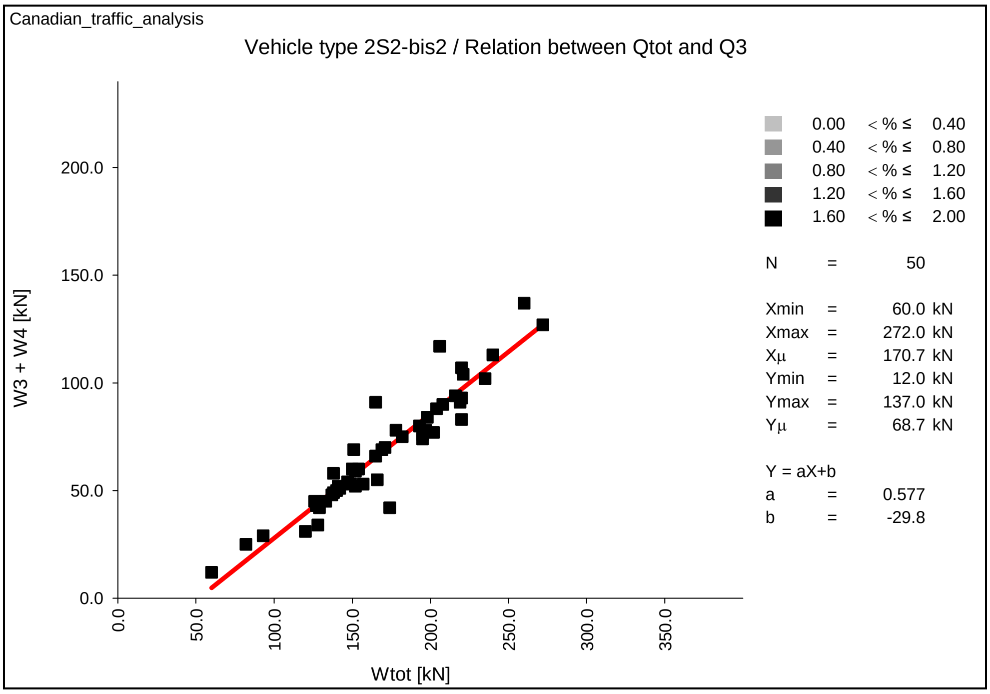

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q4
W7 [kN]
W6 [kN]
0.00 < % ≤ 2.07
2.07 < % ≤ 4.14
4.14 < % ≤ 6.21
6.21 < % ≤ 8.28
8.28 < % ≤ 10.34
N = 29
Xmin = 53.0 kN
Xmax = 98.0 kN
Xμ = 78.1 kN
Ymin = 53.0 kN
Ymax = 98.0 kN
Yμ = 78.1 kN

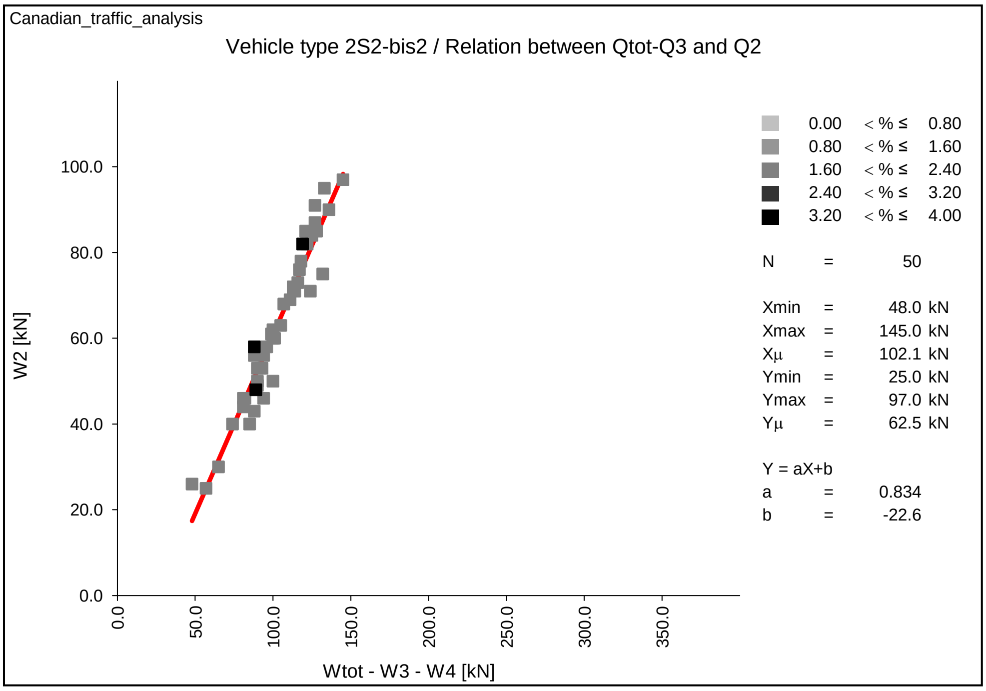

Canadian_traffic_analysis
Vehicle type 2S2-bis2 / Total gross weight
Wtot [kN]
N = 50
μ = 170.6 kN
σ = 43.8 kN
f95 = 240.0 kN
f99 = 270.0 kN
max = 270.0 kN

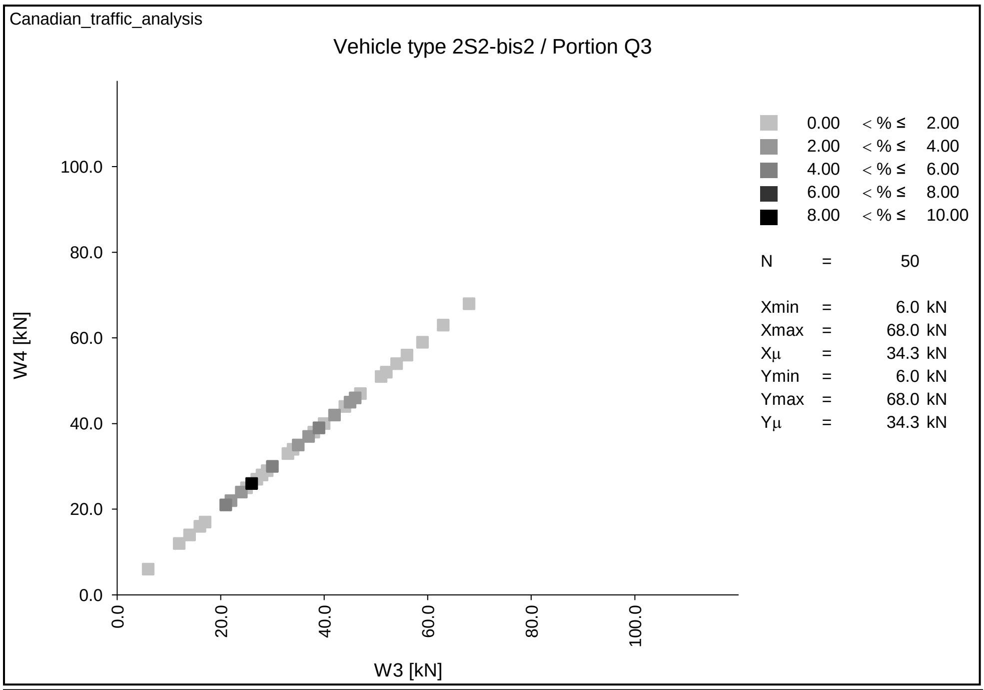

Canadian_traffic_analysis
Vehicle type 2S2-bis2 / Distance between axles 1 and 2
L1-2 [m]
N = 50
μ = 4.9 m
σ = 0.8 m
f95 = 6.7 m
f99 = 7.0 m
max = 7.0 m
A = 4.2 m
B = 8.0 m
α = 0.51
β = 2.18

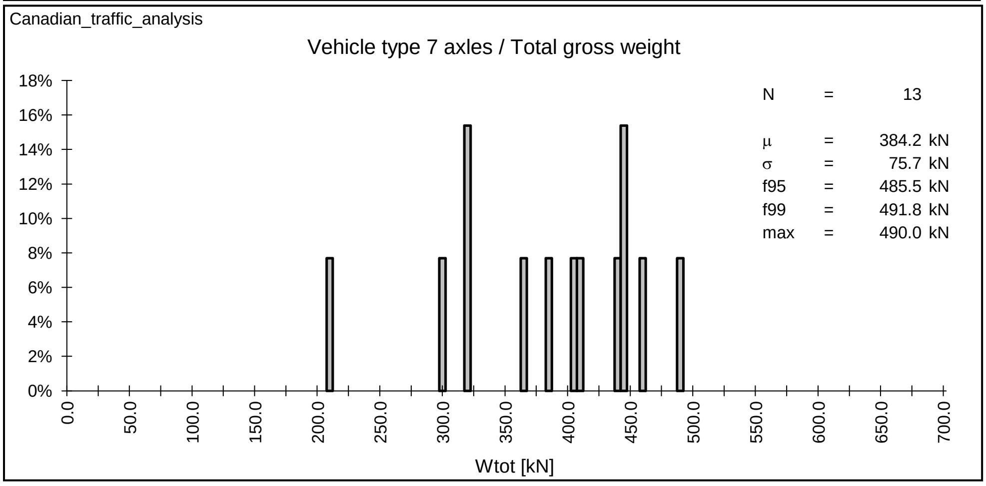

Canadian_traffic_analysis
Vehicle type 2S2-bis2 / Distance between axles 2 and 3
25%
20%
15%
10%
5%
0%
6.5
8.4
10.5
L2-3 [m]
N = 50
μ = 9.0 m
σ = 0.8 m
f95 = 10.0 m
f99 = 10.1 m
max = 10.0 m
A = 6.5 m
B = 11.5 m
α = 4.55
β = 4.52

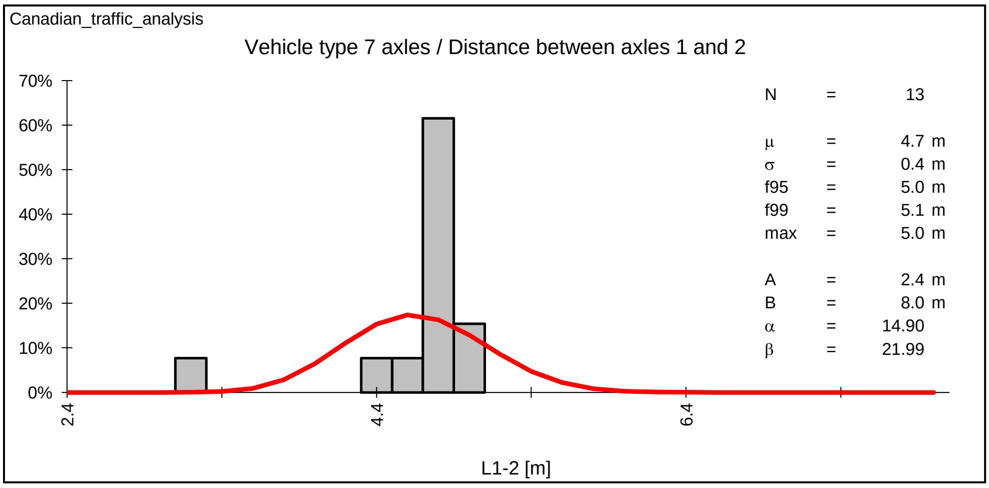

Canadian_traffic_analysis
Vehicle type 2S2-bis2 / Distance between axles 3 and 4
30%
25%
20%
15%
10%
5%
0%
0.5
2.5
L3-4 [m]
N = 50
μ = 1.6 m
σ = 0.3 m
f95 = 2.2 m
f99 = 2.2 m
max = 2.2 m

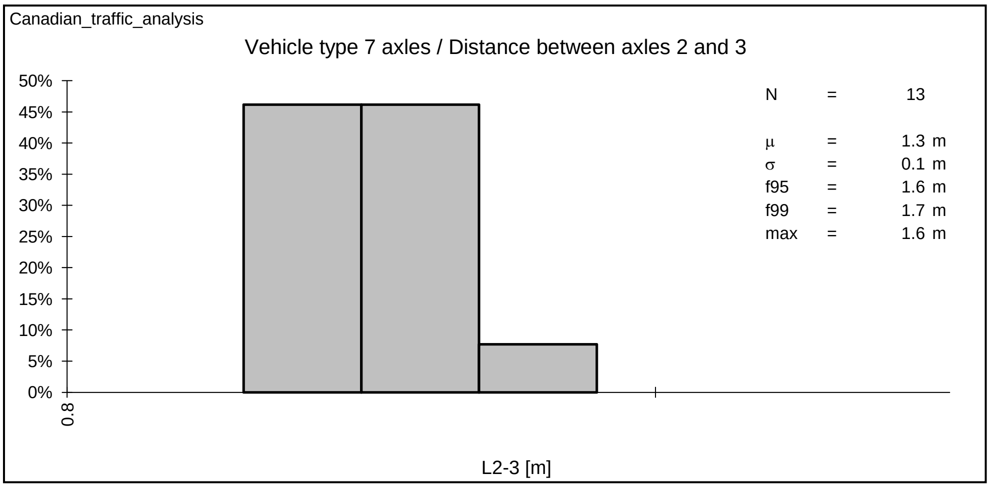

Canadian_traffic_analysis
Vehicle type 2S2-bis2 / Relation between Qtot and Q3
W3 + W4 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Wtot [kN]
0.00 < % ≤ 0.40
0.40 < % ≤ 0.80
0.80 < % ≤ 1.20
1.20 < % ≤ 1.60
1.60 < % ≤ 2.00
N = 50
Xmin = 60.0 kN
Xmax = 272.0 kN
Xμ = 170.7 kN
Ymin = 12.0 kN
Ymax = 137.0 kN
Yμ = 68.7 kN
Y = aX+b
a = 0.577
b = -29.8

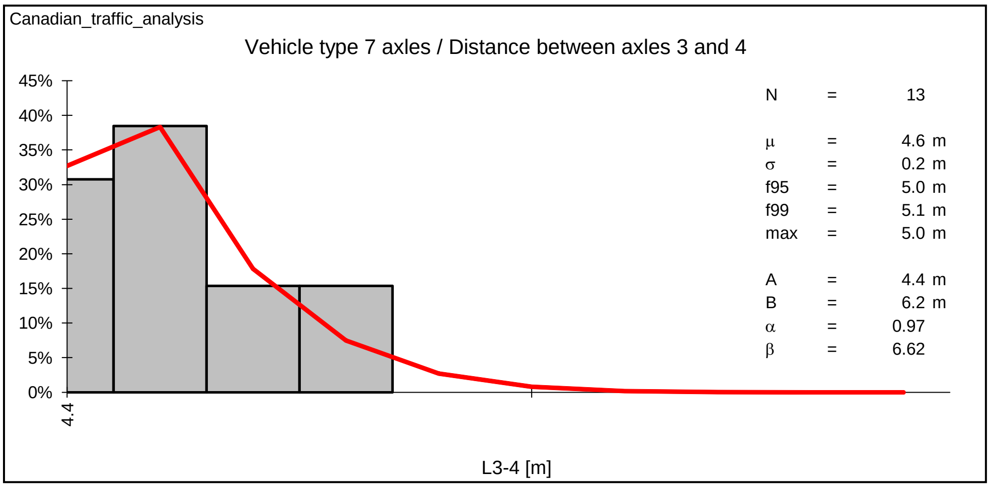

Canadian_traffic_analysis
Vehicle type 2S2-bis2 / Relation between Qtot-Q3 and Q2
0.00 < % ≤ 0.80
0.80 < % ≤ 1.60
1.60 < % ≤ 2.40
2.40 < % ≤ 3.20
3.20 < % ≤ 4.00
N = 50
Xmin = 48.0 kN
Xmax = 145.0 kN
Xµ = 102.1 kN
Ymin = 25.0 kN
Ymax = 97.0 kN
Yµ = 62.5 kN
Y = aX+b
a = 0.834
b = -22.6
W2 [kN]
Wtot - W3 - W4 [kN]

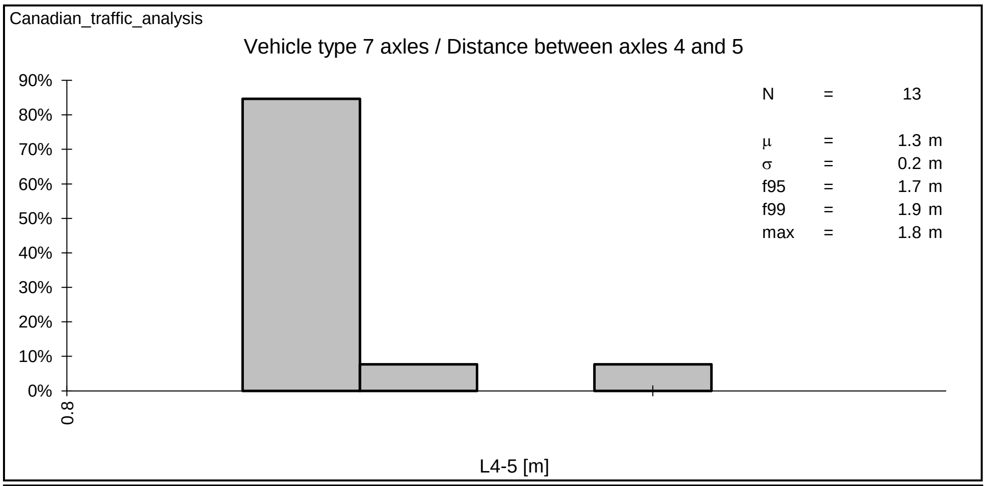

Canadian_traffic_analysis
Vehicle type 2S2-bis2 / Portion Q3
0.00 < % ≤ 2.00
2.00 < % ≤ 4.00
4.00 < % ≤ 6.00
6.00 < % ≤ 8.00
8.00 < % ≤ 10.00
N = 50
Xmin = 6.0 kN
Xmax = 68.0 kN
Xµ = 34.3 kN
Ymin = 6.0 kN
Ymax = 68.0 kN
Yµ = 34.3 kN
W4 [kN]
W3 [kN]

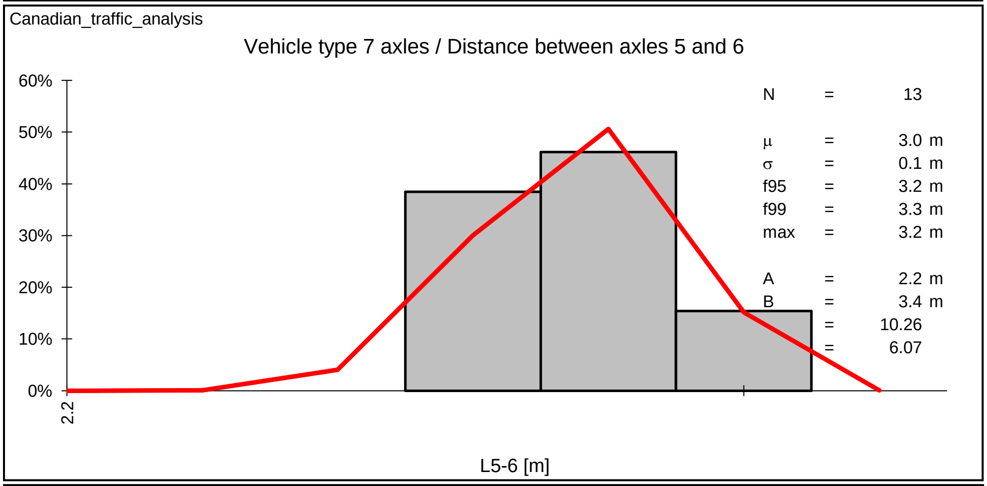

Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
N = 13
µ = 384.2 kN
σ = 75.7 kN
f95 = 485.5 kN
f99 = 491.8 kN
max = 490.0 kN
Wtot [kN]

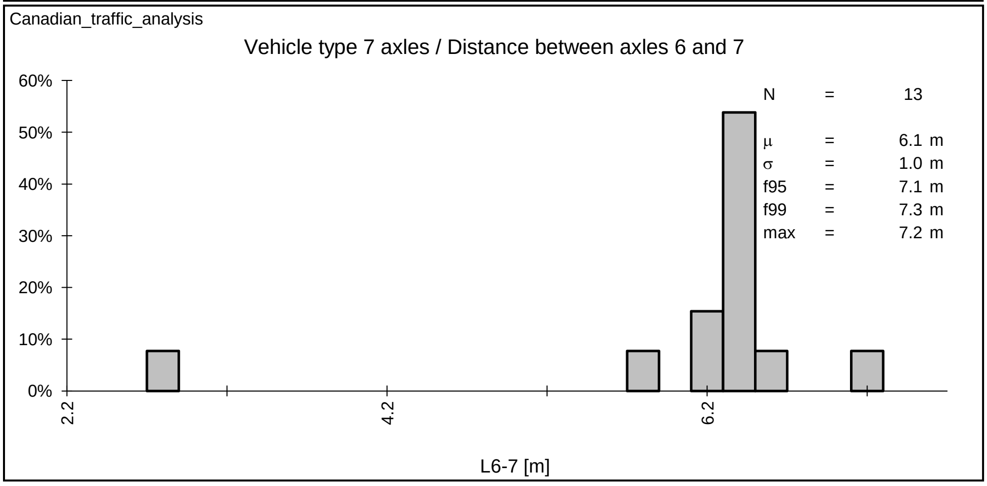

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
70%
60%
50%
40%
30%
20%
10%
0%
2.4
4.4
6.4
L1-2 [m]
N = 13
μ = 4.7 m
σ = 0.4 m
f95 = 5.0 m
f99 = 5.1 m
max = 5.0 m
A = 2.4 m
B = 8.0 m
α = 14.90
β = 21.99

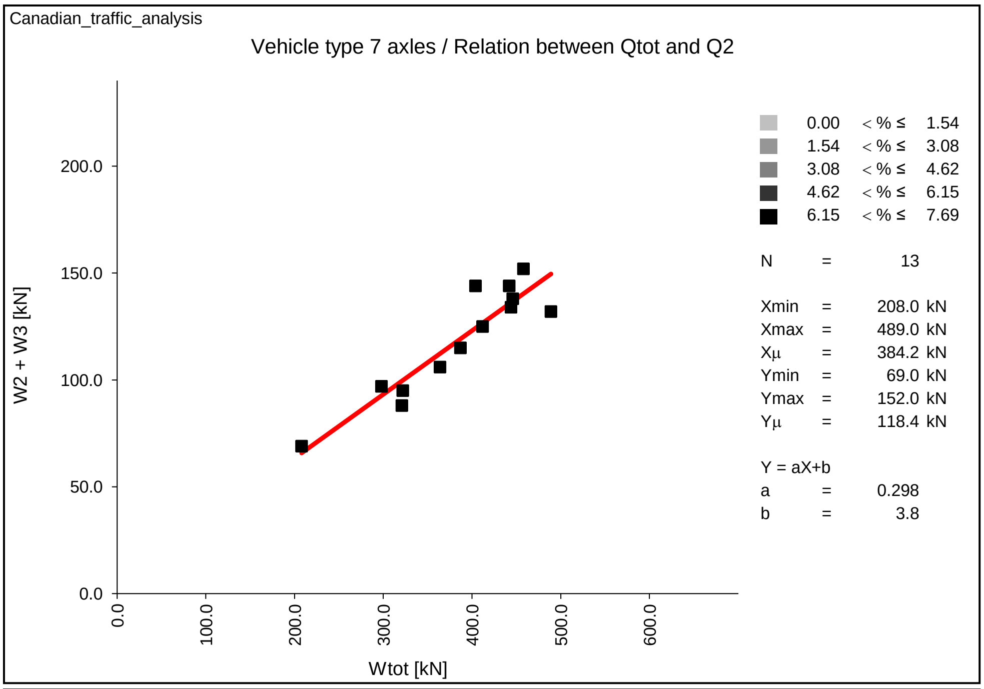

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L2-3 [m]
N = 13
μ = 1.3 m
σ = 0.1 m
f95 = 1.6 m
f99 = 1.7 m
max = 1.6 m

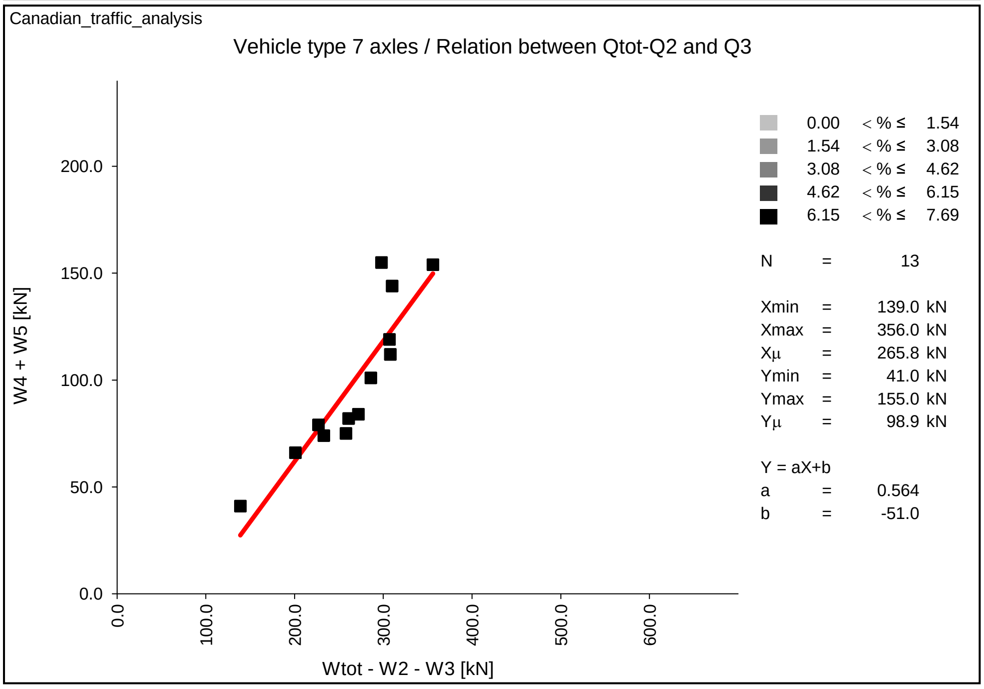

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
4.4
L3-4 [m]
N = 13
μ = 4.6 m
σ = 0.2 m
f95 = 5.0 m
f99 = 5.1 m
max = 5.0 m
A = 4.4 m
B = 6.2 m
α = 0.97
β = 6.62

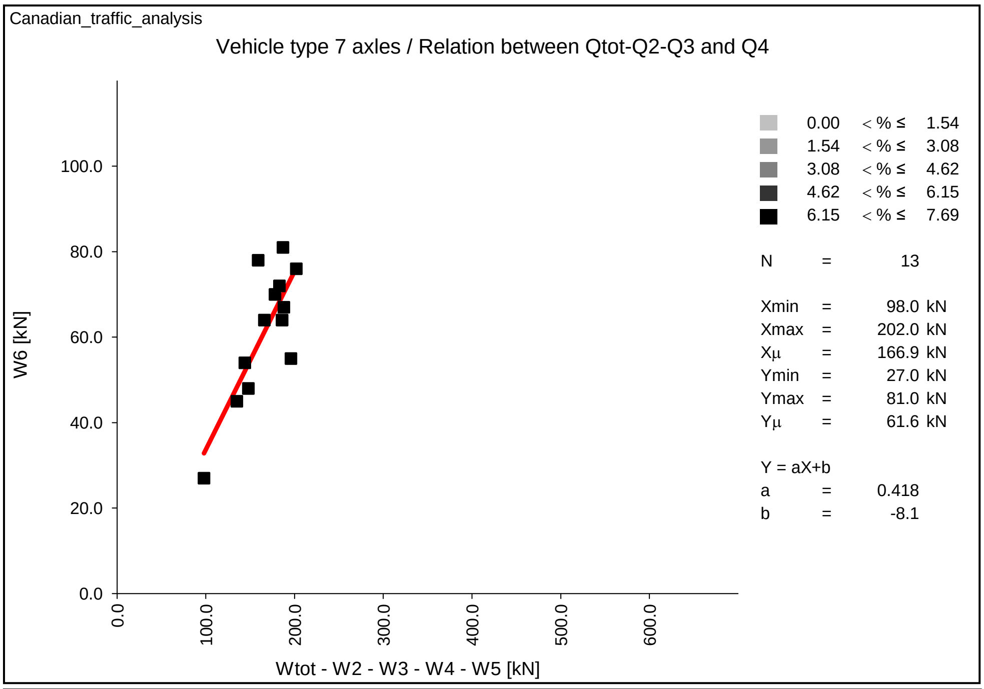

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L4-5 [m]
N = 13
μ = 1.3 m
σ = 0.2 m
f95 = 1.7 m
f99 = 1.9 m
max = 1.8 m

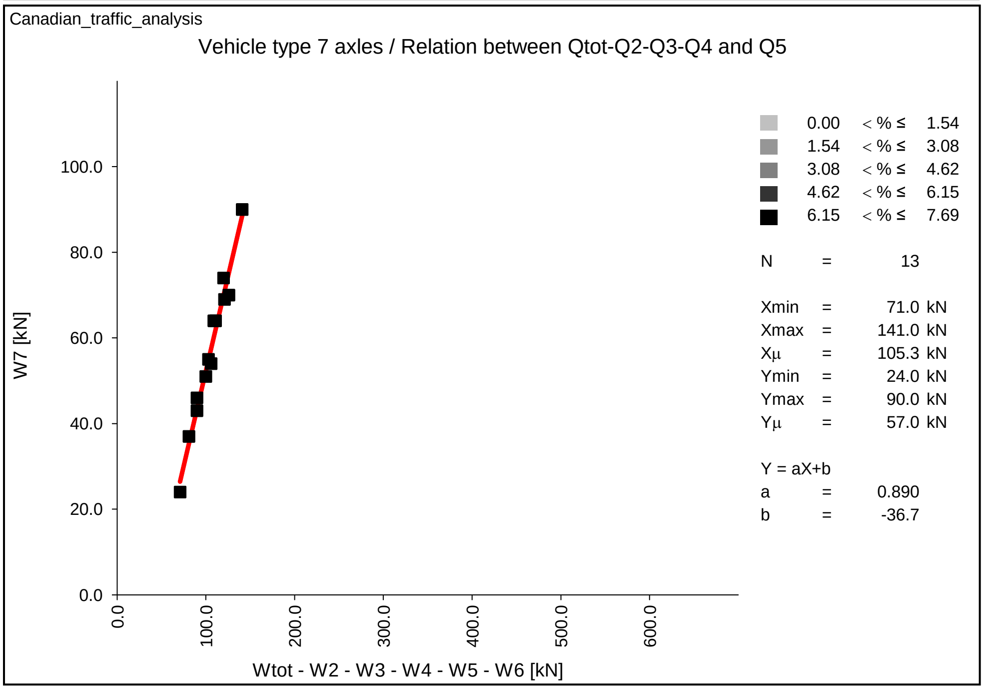

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
60%
50%
40%
30%
20%
10%
0%
2.2
L5-6 [m]
N = 13
μ = 3.0 m
σ = 0.1 m
f95 = 3.2 m
f99 = 3.3 m
max = 3.2 m
A = 2.2 m
B = 3.4 m
= 10.26
= 6.07

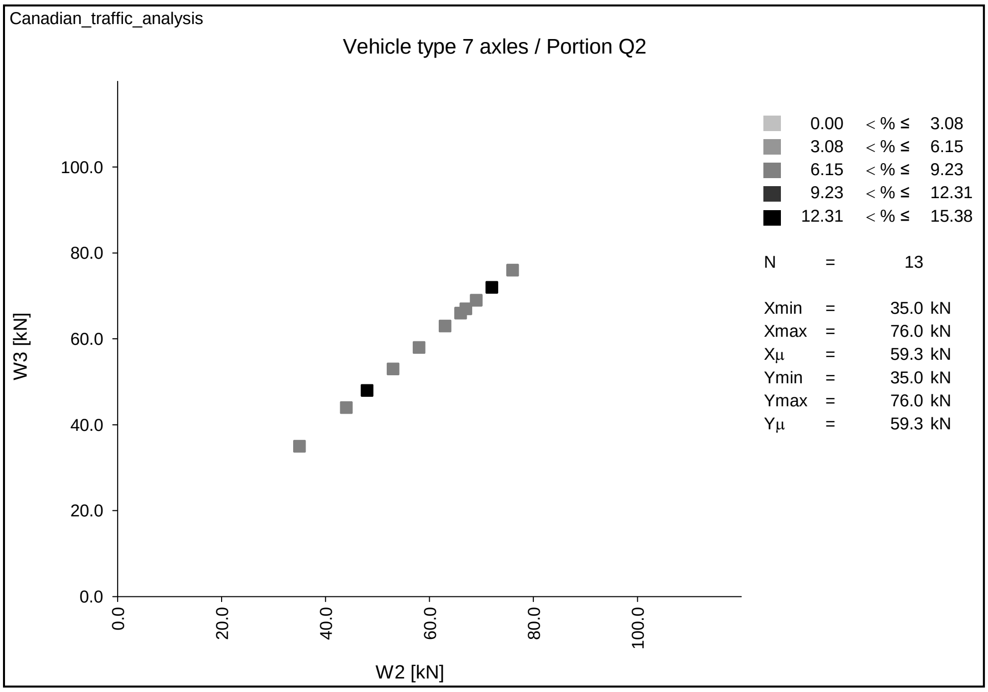

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
60%
50%
40%
30%
20%
10%
0%
2.2
4.2
6.2
L6-7 [m]
N = 13
μ = 6.1 m
σ = 1.0 m
f95 = 7.1 m
f99 = 7.3 m
max = 7.2 m

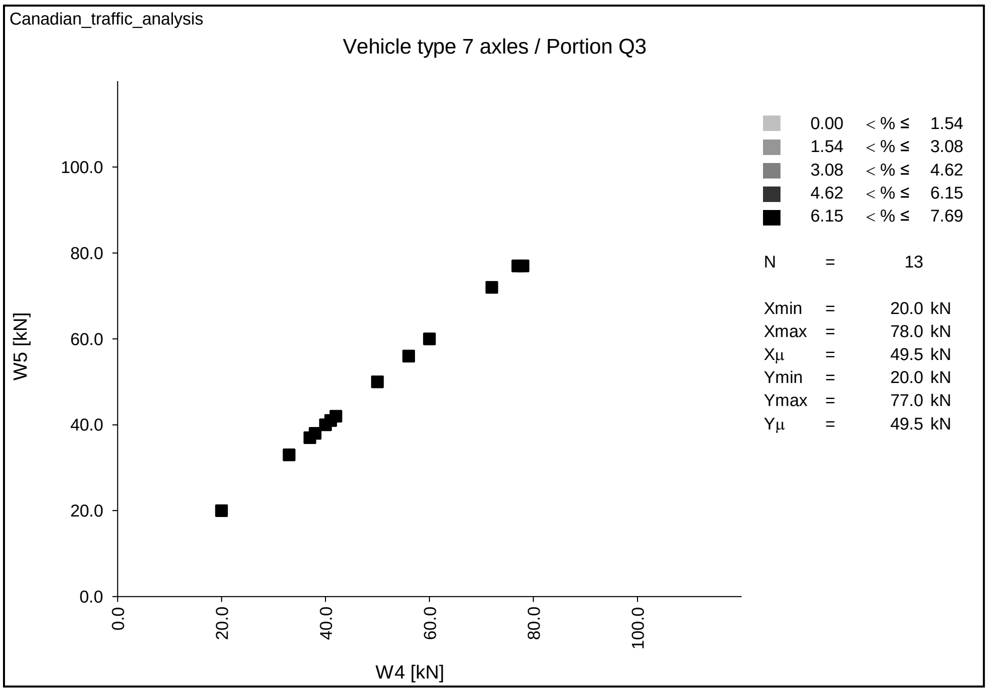

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
Wtot [kN]
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 208.0 kN
Xmax = 489.0 kN
Xμ = 384.2 kN
Ymin = 69.0 kN
Ymax = 152.0 kN
Yμ = 118.4 kN
Y = aX+b
a = 0.298
b = 3.8

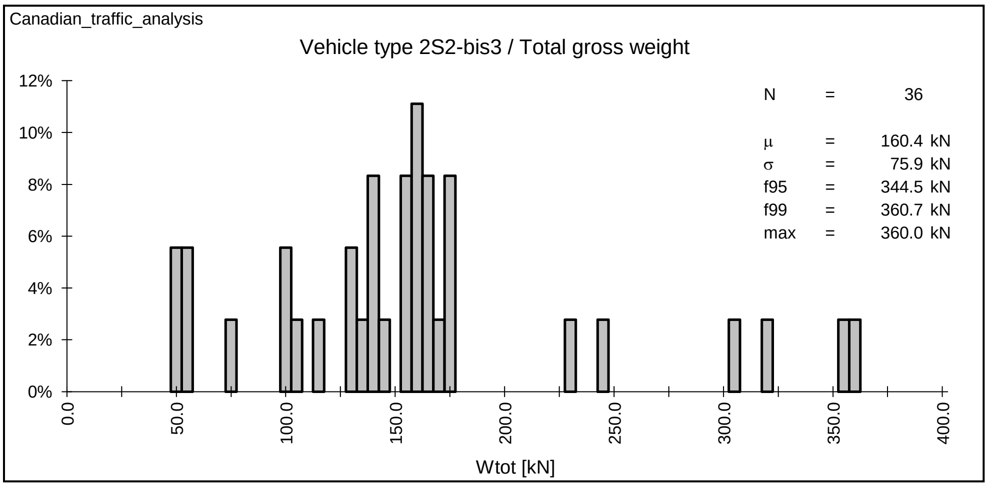

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q3
W4 + W5 [kN]
Wtot - W2 - W3 [kN]
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 139.0 kN
Xmax = 356.0 kN
Xμ = 265.8 kN
Ymin = 41.0 kN
Ymax = 155.0 kN
Yμ = 98.9 kN
Y = aX+b
a = 0.564
b = -51.0

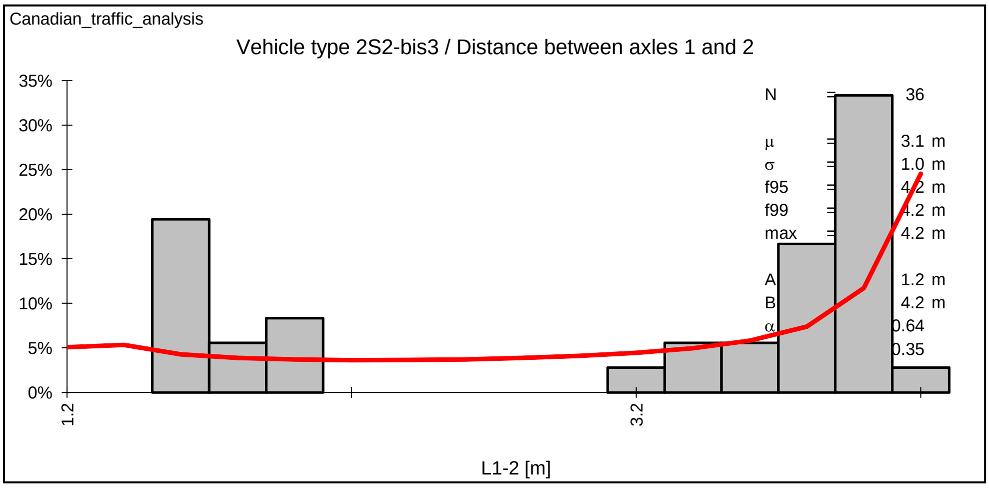

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q3 and Q4
W6 [kN]
Wtot - W2 - W3 - W4 - W5 [kN]
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 98.0 kN
Xmax = 202.0 kN
Xμ = 166.9 kN
Ymin = 27.0 kN
Ymax = 81.0 kN
Yμ = 61.6 kN
Y = aX+b
a = 0.418
b = -8.1

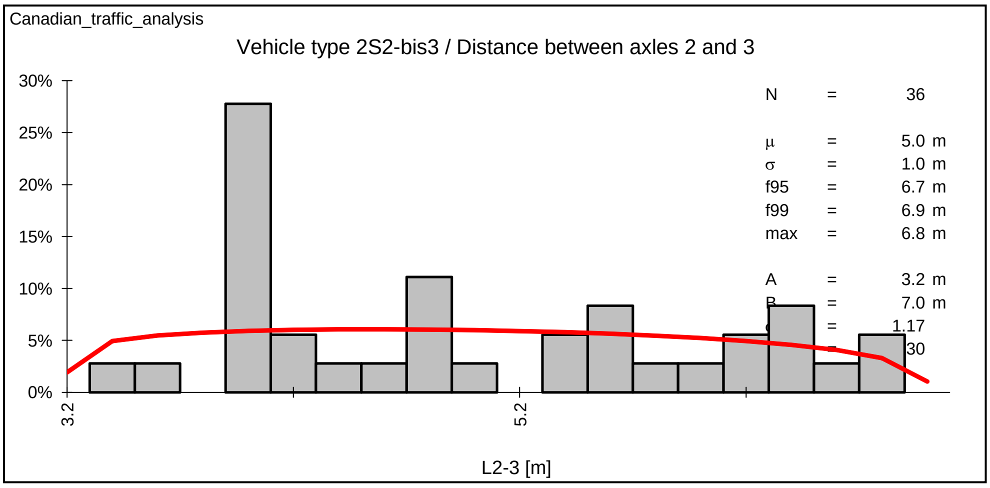

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q3-Q4 and Q5
W7 [kN]
Wtot - W2 - W3 - W4 - W5 - W6 [kN]
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 71.0 kN
Xmax = 141.0 kN
Xμ = 105.3 kN
Ymin = 24.0 kN
Ymax = 90.0 kN
Yμ = 57.0 kN
Y = aX+b
a = 0.890
b = -36.7

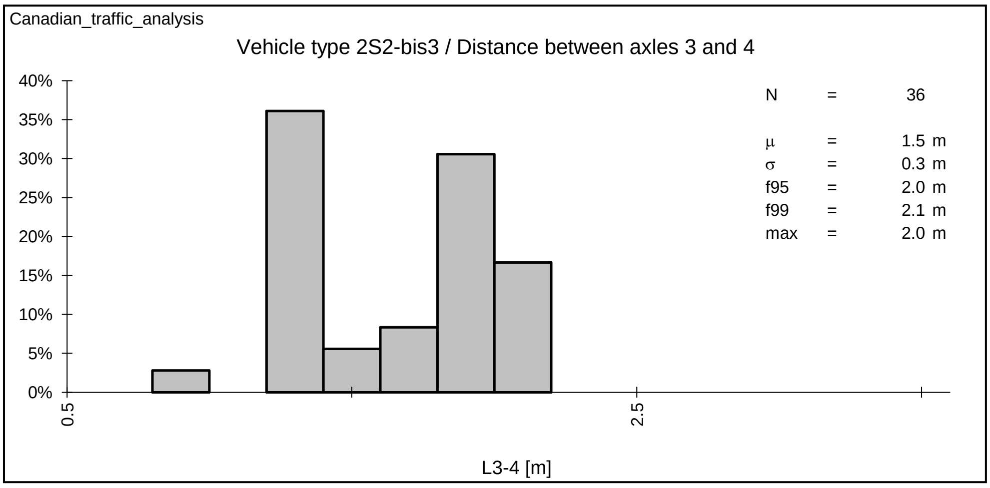

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
0.00 < % ≤ 3.08
3.08 < % ≤ 6.15
6.15 < % ≤ 9.23
9.23 < % ≤ 12.31
12.31 < % ≤ 15.38
N = 13
Xmin = 35.0 kN
Xmax = 76.0 kN
Xμ = 59.3 kN
Ymin = 35.0 kN
Ymax = 76.0 kN
Yμ = 59.3 kN
W3 [kN]
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

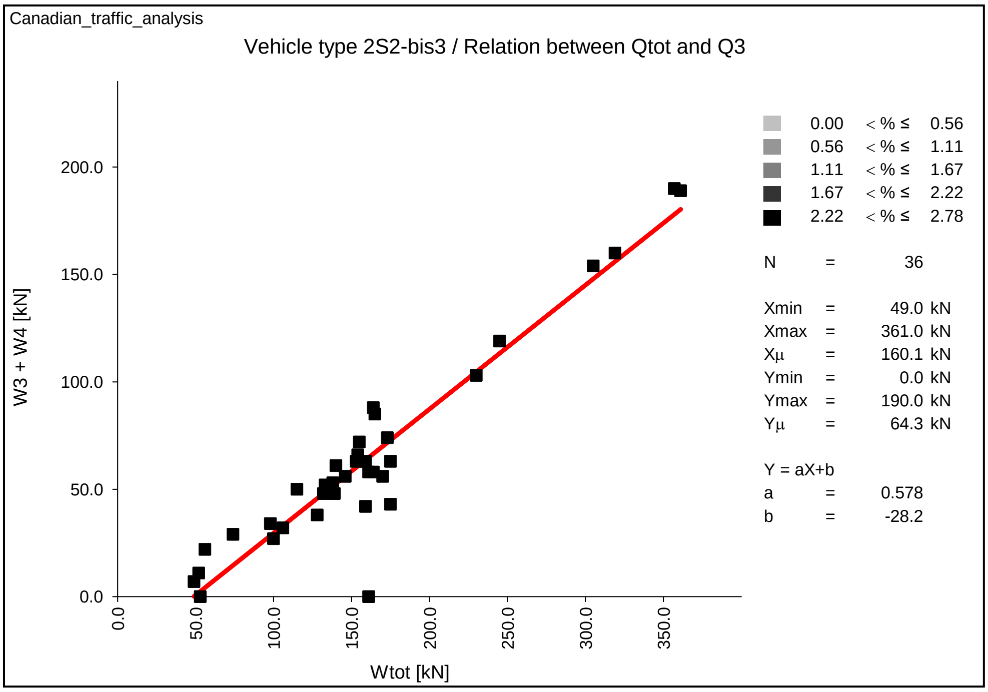

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q3
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 20.0 kN
Xmax = 78.0 kN
Xμ = 49.5 kN
Ymin = 20.0 kN
Ymax = 77.0 kN
Yμ = 49.5 kN
W5 [kN]
W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

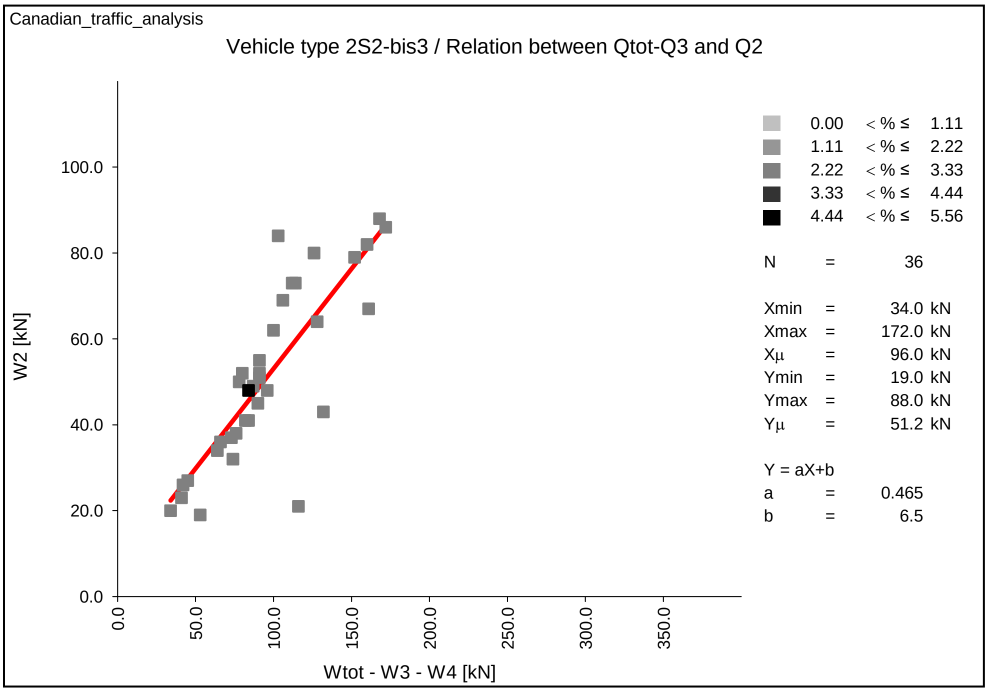

Canadian_traffic_analysis
Vehicle type 2S2-bis3 / Total gross weight
N = 36
μ = 160.4 kN
σ = 75.9 kN
f95 = 344.5 kN
f99 = 360.7 kN
max = 360.0 kN
0%
2%
4%
6%
8%
10%
12%
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
Wtot [kN]

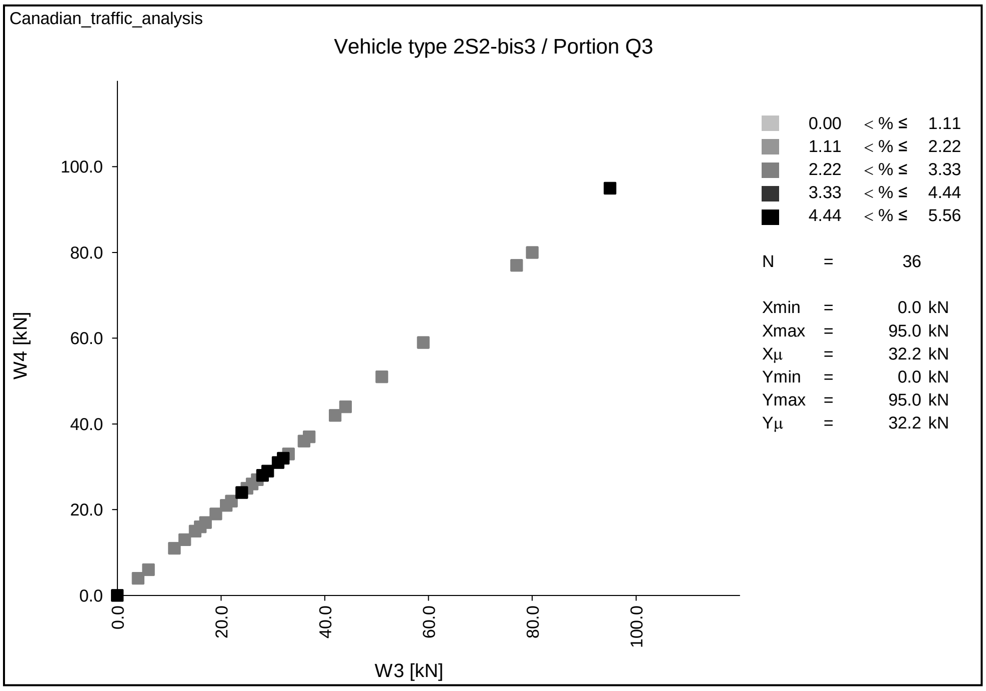

Canadian_traffic_analysis
Vehicle type 2S2-bis3 / Distance between axles 1 and 2
35%
30%
25%
20%
15%
10%
5%
0%
1.2
3.2
L1-2 [m]
N = 36
μ = 3.1 m
σ = 1.0 m
f95 = 4.2 m
f99 = 4.2 m
max = 4.2 m
A = 1.2 m
B = 4.2 m
α = 0.64
0.35

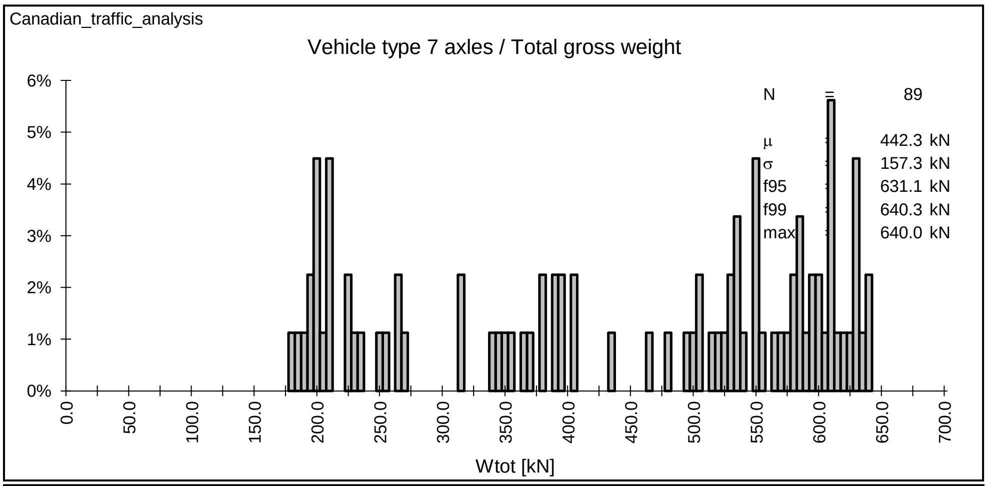

Canadian_traffic_analysis
Vehicle type 2S2-bis3 / Distance between axles 2 and 3
30%
25%
20%
15%
10%
5%
0%
3.2
5.2
L2-3 [m]
N = 36
μ = 5.0 m
σ = 1.0 m
f95 = 6.7 m
f99 = 6.9 m
max = 6.8 m
A = 3.2 m
= 7.0 m
= 1.17
30

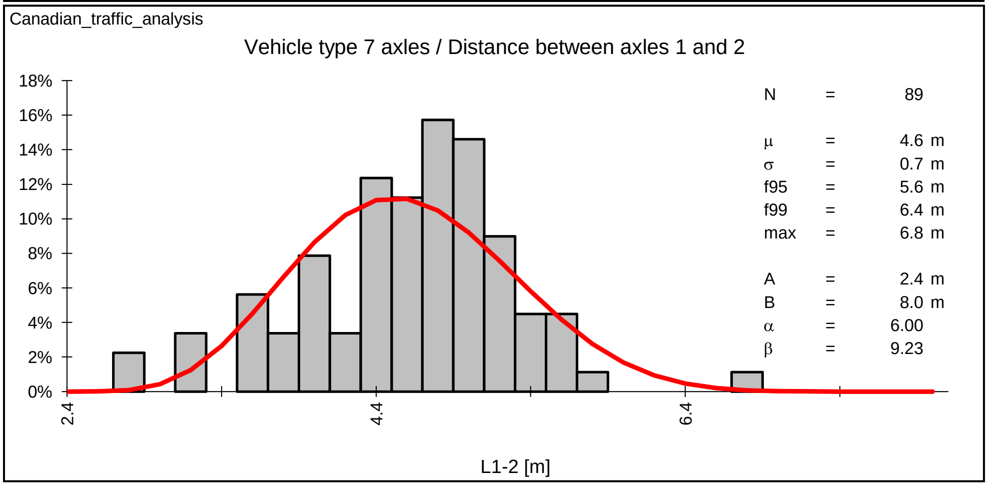

Canadian_traffic_analysis
Vehicle type 2S2-bis3 / Distance between axles 3 and 4
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.5
2.5
L3-4 [m]
N = 36
μ = 1.5 m
σ = 0.3 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

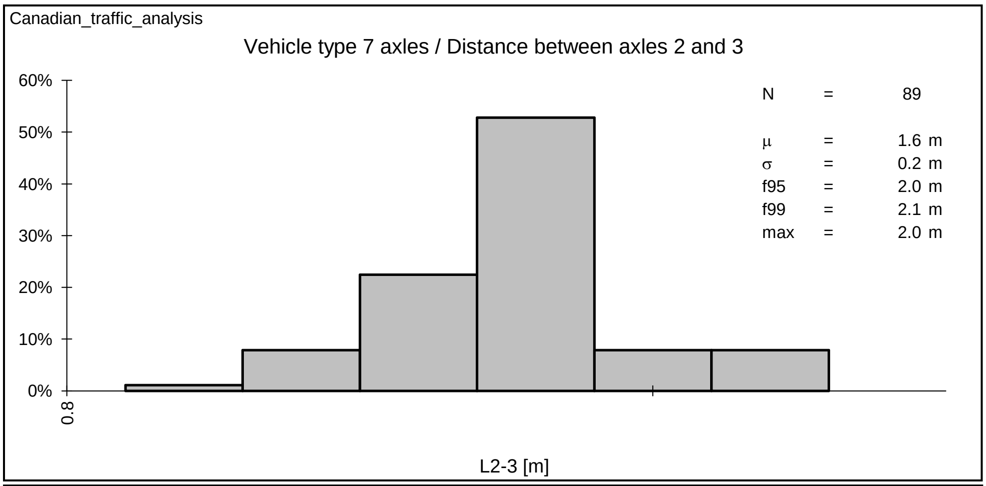

Canadian_traffic_analysis
Vehicle type 2S2-bis3 / Relation between Qtot and Q3
W3 + W4 [kN]
Wtot [kN]
0.00 < % ≤ 0.56
0.56 < % ≤ 1.11
1.11 < % ≤ 1.67
1.67 < % ≤ 2.22
2.22 < % ≤ 2.78
N = 36
Xmin = 49.0 kN
Xmax = 361.0 kN
Xµ = 160.1 kN
Ymin = 0.0 kN
Ymax = 190.0 kN
Yµ = 64.3 kN
Y = aX+b
a = 0.578
b = -28.2

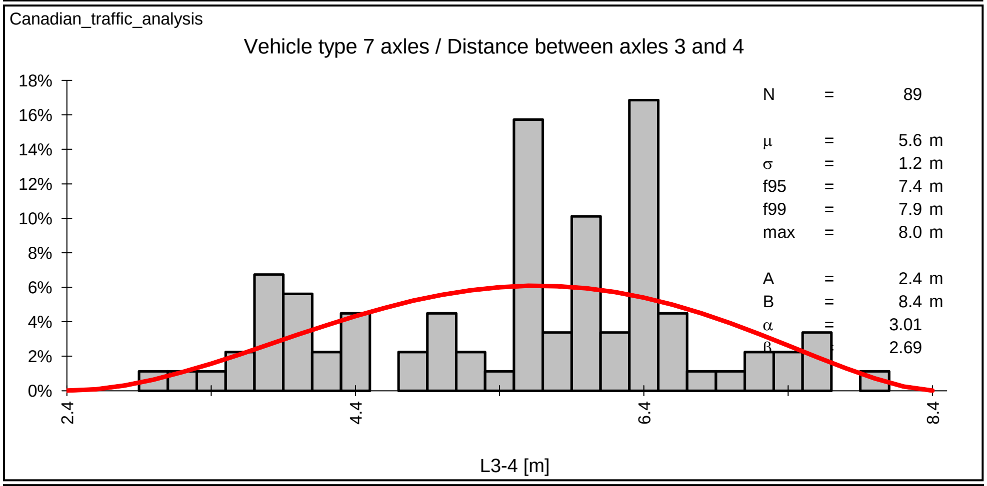

Canadian_traffic_analysis
Vehicle type 2S2-bis3 / Relation between Qtot-Q3 and Q2
W2 [kN]
Wtot - W3 - W4 [kN]
0.00 < % ≤ 1.11
1.11 < % ≤ 2.22
2.22 < % ≤ 3.33
3.33 < % ≤ 4.44
4.44 < % ≤ 5.56
N = 36
Xmin = 34.0 kN
Xmax = 172.0 kN
Xµ = 96.0 kN
Ymin = 19.0 kN
Ymax = 88.0 kN
Yµ = 51.2 kN
Y = aX+b
a = 0.465
b = 6.5

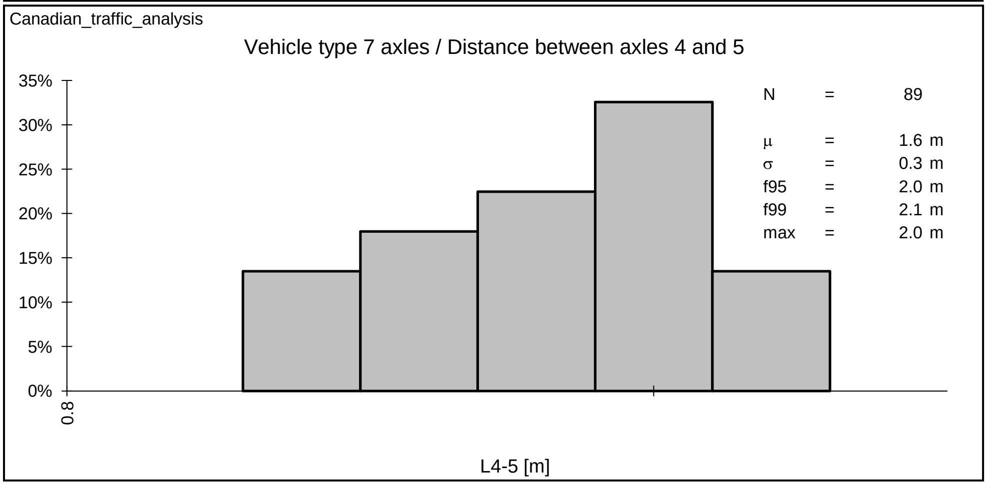

Canadian_traffic_analysis
Vehicle type 2S2-bis3 / Portion Q3
W4 [kN]
W3 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 1.11
1.11 < % ≤ 2.22
2.22 < % ≤ 3.33
3.33 < % ≤ 4.44
4.44 < % ≤ 5.56
N = 36
Xmin = 0.0 kN
Xmax = 95.0 kN
Xμ = 32.2 kN
Ymin = 0.0 kN
Ymax = 95.0 kN
Yμ = 32.2 kN

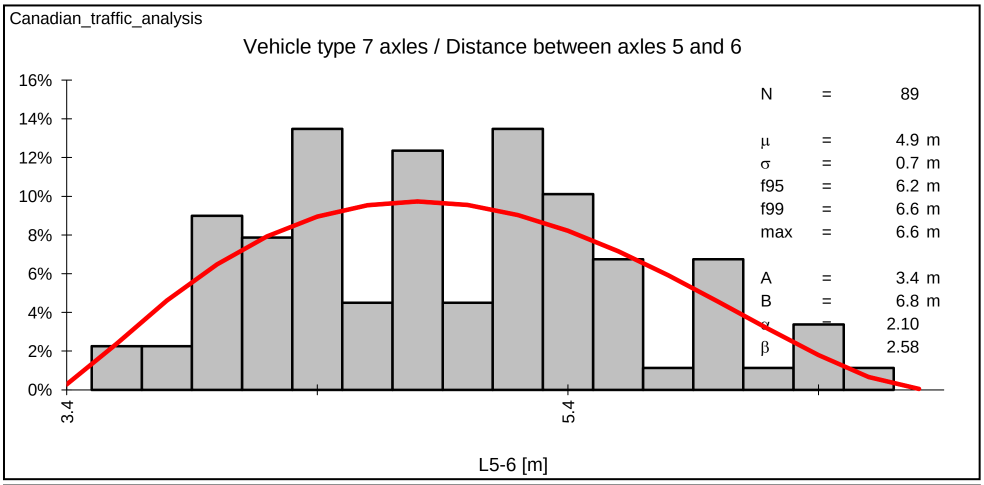

Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
0%
1%
2%
3%
4%
5%
6%
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
Wtot [kN]
N = 89
μ = 442.3 kN
σ = 157.3 kN
f95 = 631.1 kN
f99 = 640.3 kN
max = 640.0 kN


Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
0%
2%
4%
6%
8%
10%
12%
14%
16%
18%
2.4
4.4
6.4
L1-2 [m]
N = 89
μ = 4.6 m
σ = 0.7 m
f95 = 5.6 m
f99 = 6.4 m
max = 6.8 m
A = 2.4 m
B = 8.0 m
α = 6.00
β = 9.23

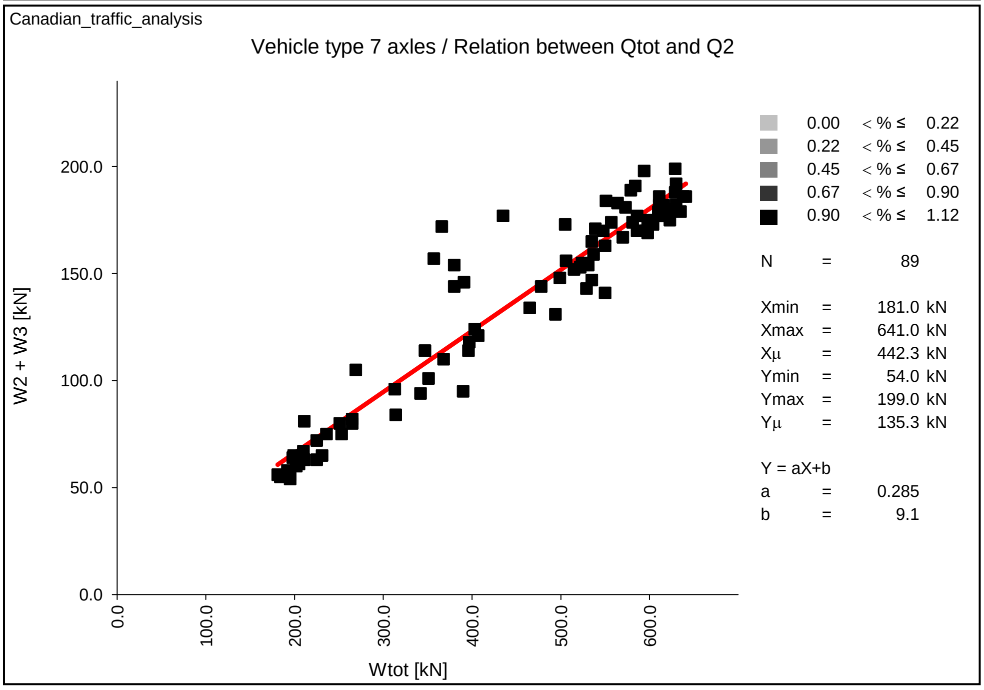

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
60%
50%
40%
30%
20%
10%
0%
0.8
N = 89
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L2-3 [m]

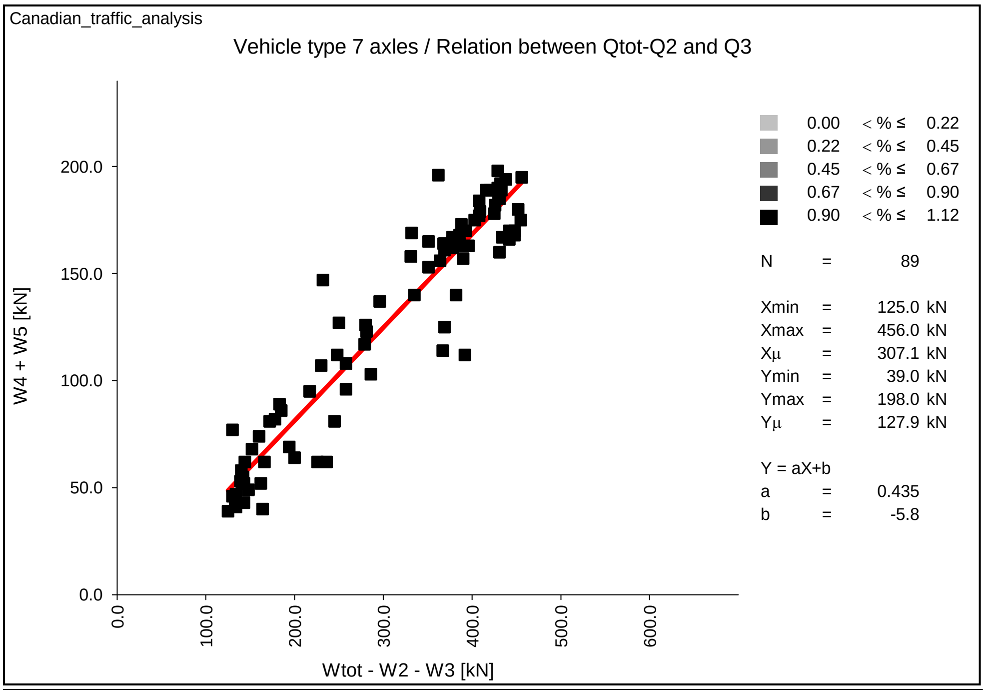

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2.4
4.4
6.4
8.4
N = 89
μ = 5.6 m
σ = 1.2 m
f95 = 7.4 m
f99 = 7.9 m
max = 8.0 m
A = 2.4 m
B = 8.4 m
α = 3.01
β = 2.69
L3-4 [m]

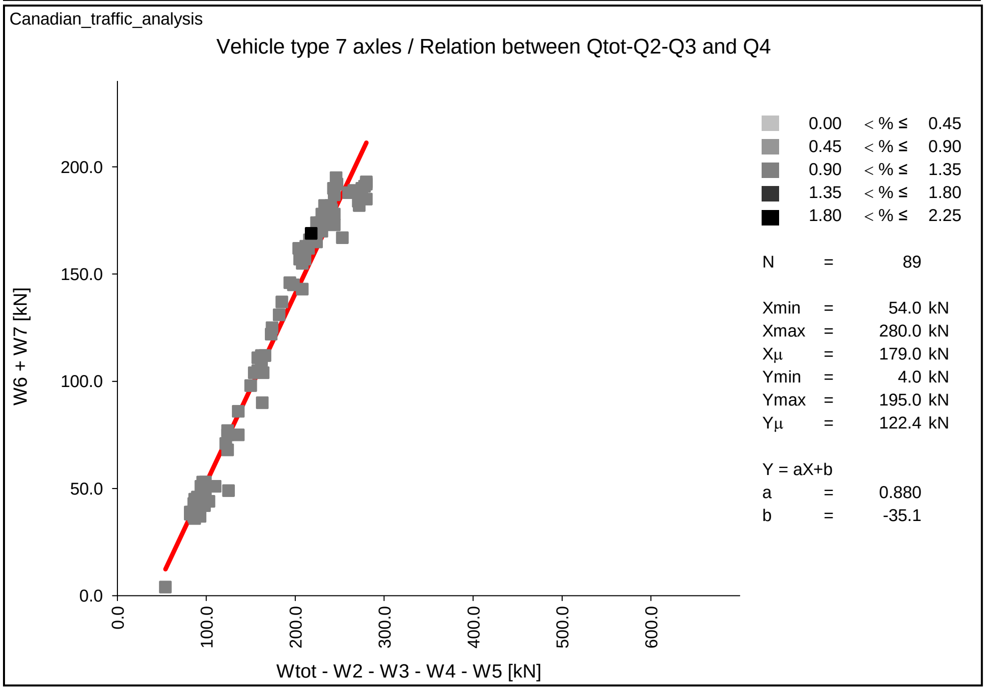

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
35%
30%
25%
20%
15%
10%
5%
0%
0.8
N = 89
μ = 1.6 m
σ = 0.3 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L4-5 [m]

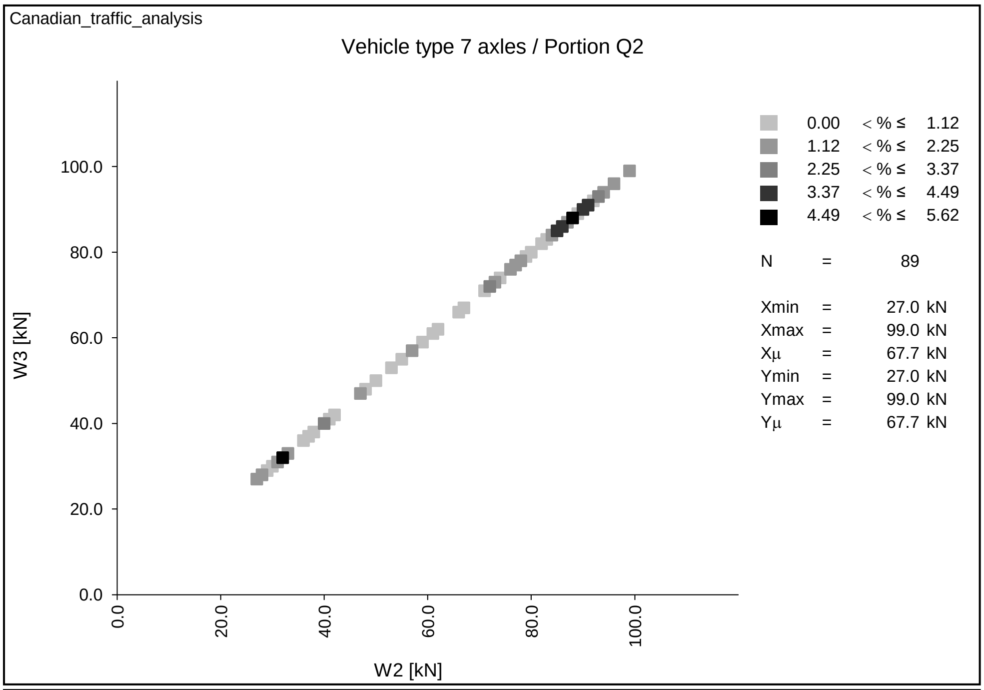

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
16%
14%
12%
10%
8%
6%
4%
2%
0%
3.4
5.4
L5-6 [m]
N = 89
μ = 4.9 m
σ = 0.7 m
f95 = 6.2 m
f99 = 6.6 m
max = 6.6 m
A = 3.4 m
B = 6.8 m
α = 2.10
β = 2.58

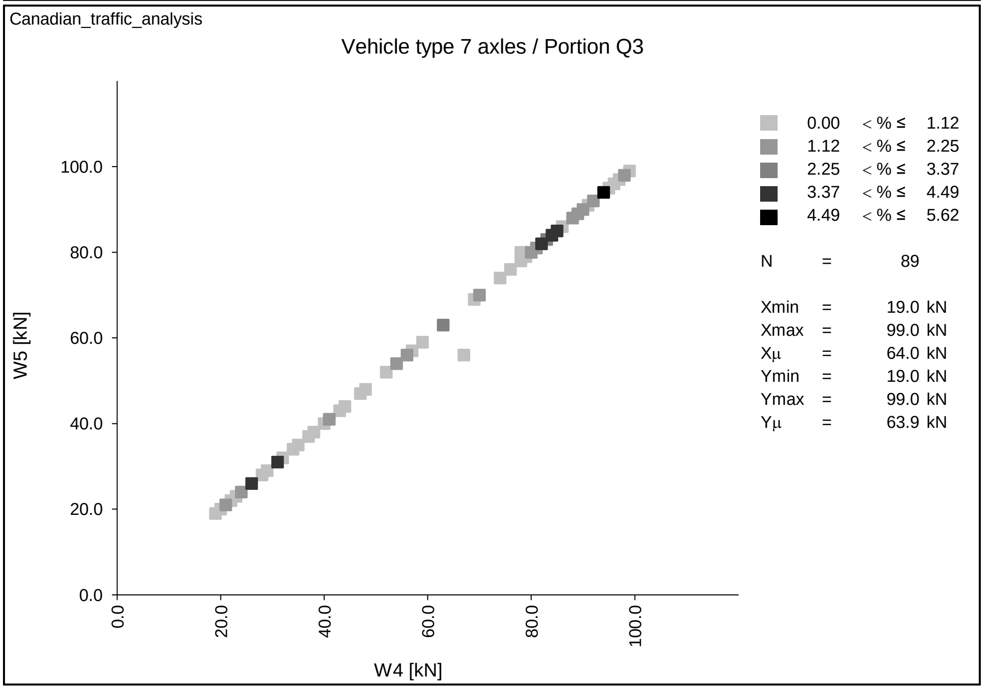

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L6-7 [m]
N = 89
μ = 1.7 m
σ = 0.2 m
f95 = 2.1 m
f99 = 2.1 m
max = 2.0 m

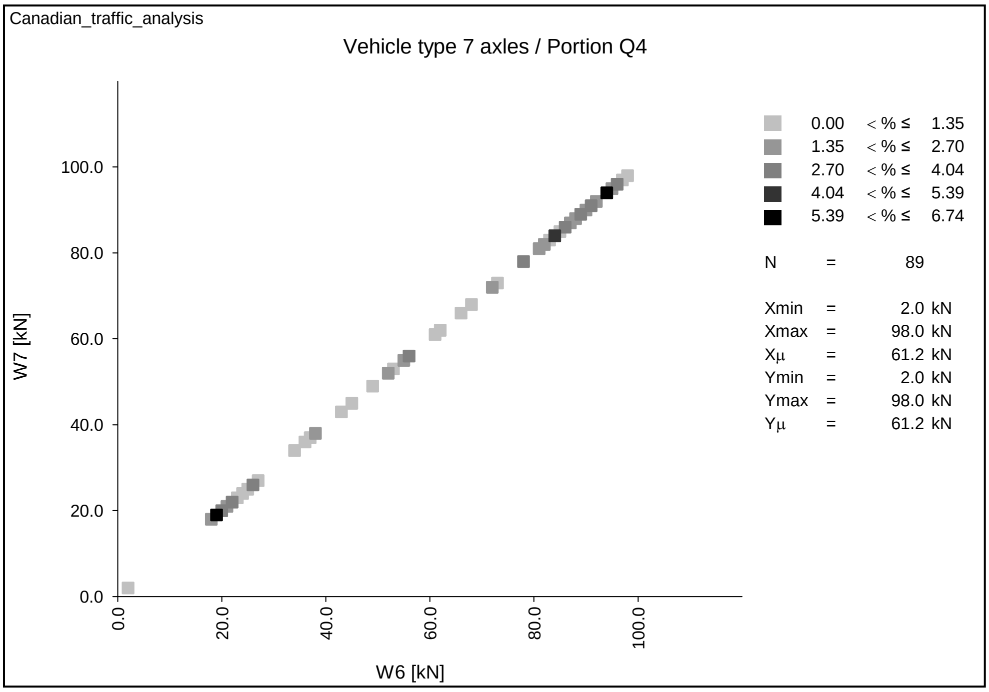

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]
0.00 < % ≤ 0.22
0.22 < % ≤ 0.45
0.45 < % ≤ 0.67
0.67 < % ≤ 0.90
0.90 < % ≤ 1.12
N = 89
Xmin = 181.0 kN
Xmax = 641.0 kN
Xμ = 442.3 kN
Ymin = 54.0 kN
Ymax = 199.0 kN
Yμ = 135.3 kN
Y = aX+b
a = 0.285
b = 9.1

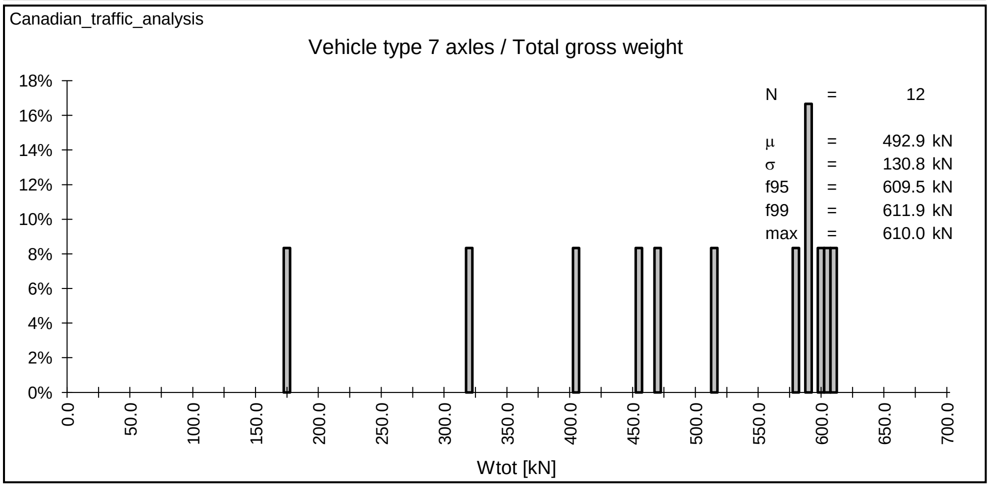

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q3
W4 + W5 [kN]
Wtot - W2 - W3 [kN]
0.0
50.0
100.0
150.0
200.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.22
0.22 < % ≤ 0.45
0.45 < % ≤ 0.67
0.67 < % ≤ 0.90
0.90 < % ≤ 1.12
N = 89
Xmin = 125.0 kN
Xmax = 456.0 kN
Xµ = 307.1 kN
Ymin = 39.0 kN
Ymax = 198.0 kN
Yµ = 127.9 kN
Y = aX+b
a = 0.435
b = -5.8

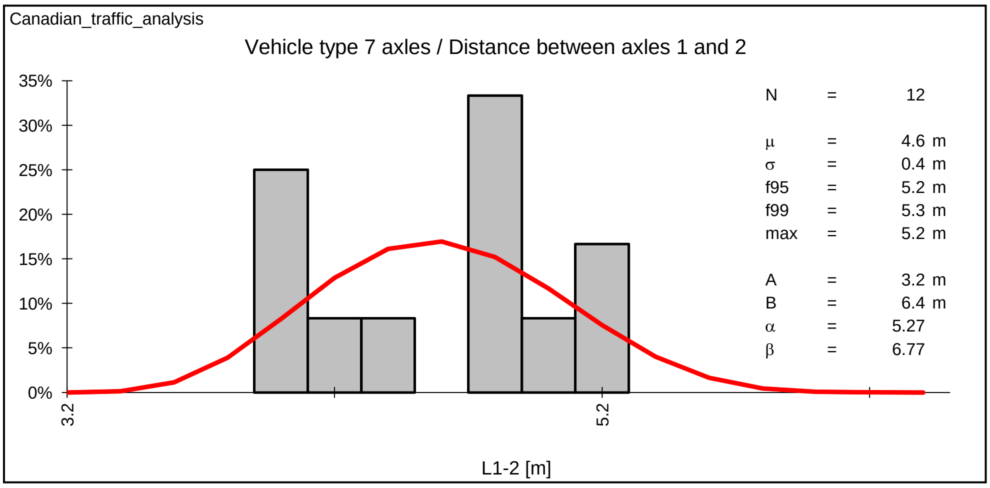

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q3 and Q4
W6 + W7 [kN]
Wtot - W2 - W3 - W4 - W5 [kN]
0.0
50.0
100.0
150.0
200.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.45
0.45 < % ≤ 0.90
0.90 < % ≤ 1.35
1.35 < % ≤ 1.80
1.80 < % ≤ 2.25
N = 89
Xmin = 54.0 kN
Xmax = 280.0 kN
Xµ = 179.0 kN
Ymin = 4.0 kN
Ymax = 195.0 kN
Yµ = 122.4 kN
Y = aX+b
a = 0.880
b = -35.1

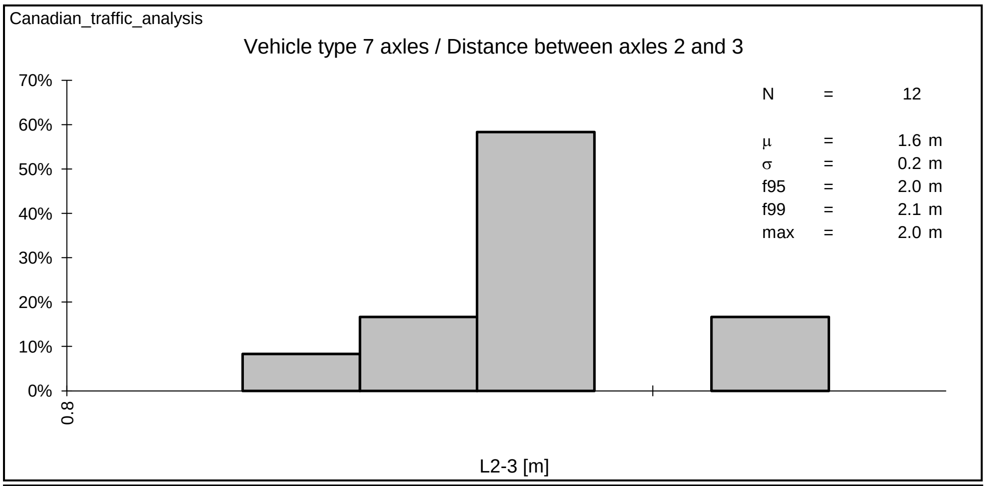

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
0.00 < % ≤ 1.12
1.12 < % ≤ 2.25
2.25 < % ≤ 3.37
3.37 < % ≤ 4.49
4.49 < % ≤ 5.62
N = 89
Xmin = 27.0 kN
Xmax = 99.0 kN
Xμ = 67.7 kN
Ymin = 27.0 kN
Ymax = 99.0 kN
Yμ = 67.7 kN
W3 [kN]
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

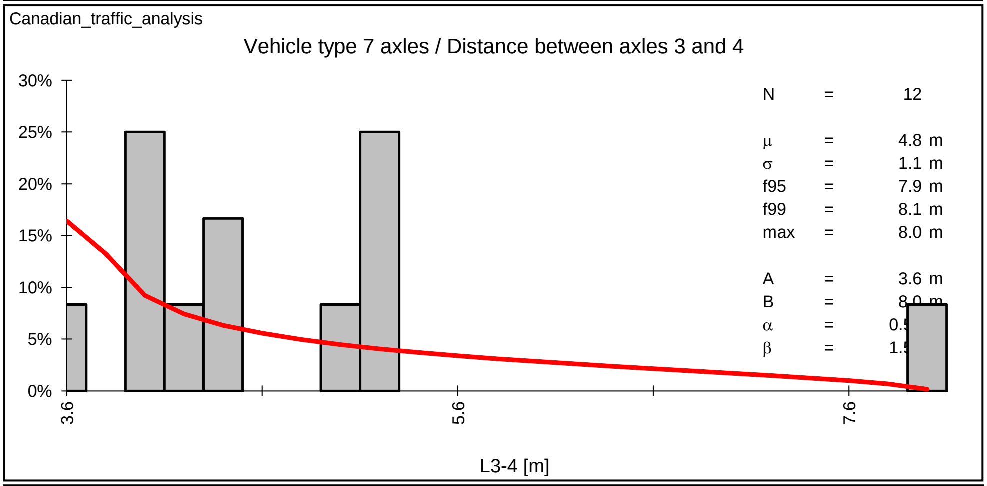

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q3
0.00 < % ≤ 1.12
1.12 < % ≤ 2.25
2.25 < % ≤ 3.37
3.37 < % ≤ 4.49
4.49 < % ≤ 5.62
N = 89
Xmin = 19.0 kN
Xmax = 99.0 kN
Xμ = 64.0 kN
Ymin = 19.0 kN
Ymax = 99.0 kN
Yμ = 63.9 kN
W5 [kN]
W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

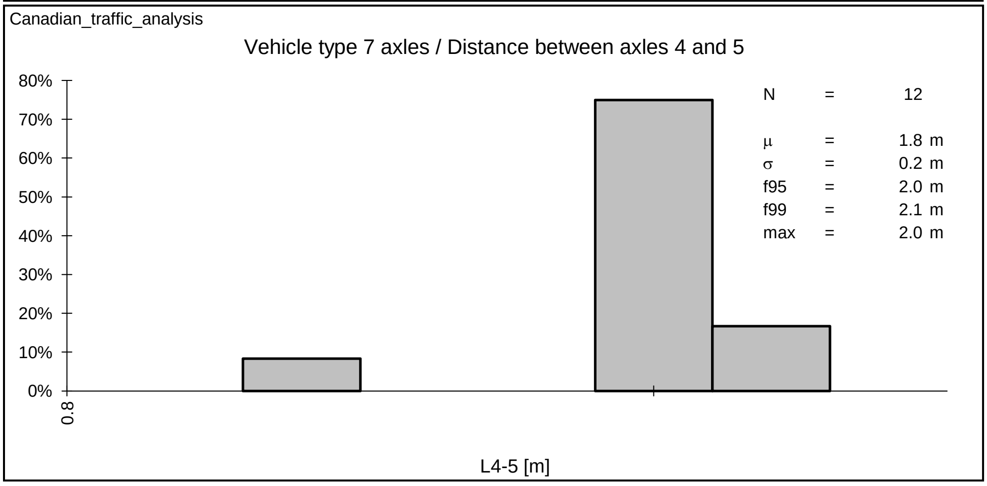

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q4
W7 [kN]
W6 [kN]
0.00 < % ≤ 1.35
1.35 < % ≤ 2.70
2.70 < % ≤ 4.04
4.04 < % ≤ 5.39
5.39 < % ≤ 6.74
N = 89
Xmin = 2.0 kN
Xmax = 98.0 kN
Xμ = 61.2 kN
Ymin = 2.0 kN
Ymax = 98.0 kN
Yμ = 61.2 kN

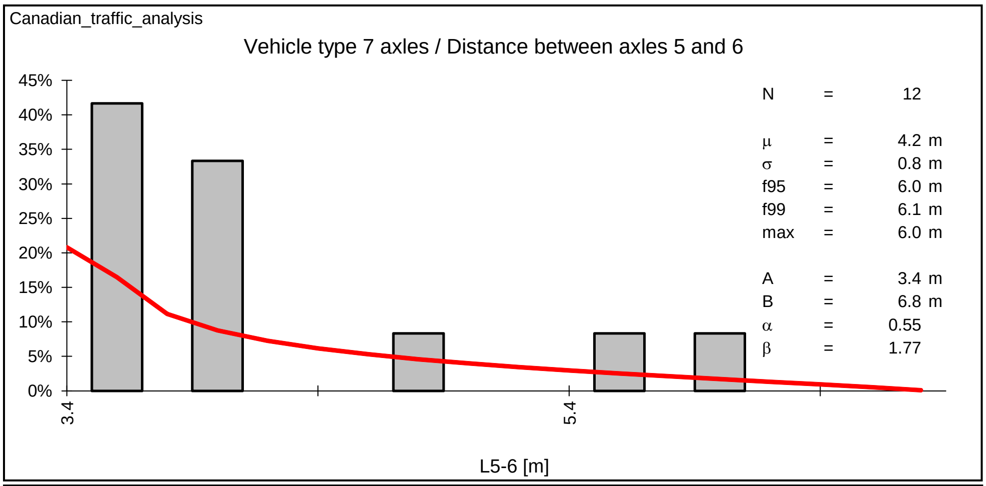

Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
Wtot [kN]
N = 12
μ = 492.9 kN
σ = 130.8 kN
f95 = 609.5 kN
f99 = 611.9 kN
max = 610.0 kN

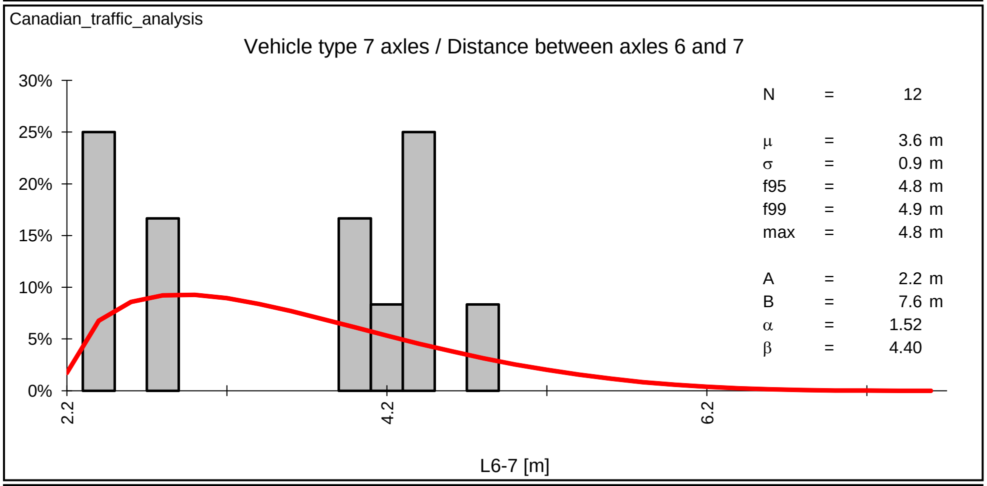

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
L1-2 [m]
N = 12
μ = 4.6 m
σ = 0.4 m
f95 = 5.2 m
f99 = 5.3 m
max = 5.2 m
A = 3.2 m
B = 6.4 m
α = 5.27
β = 6.77

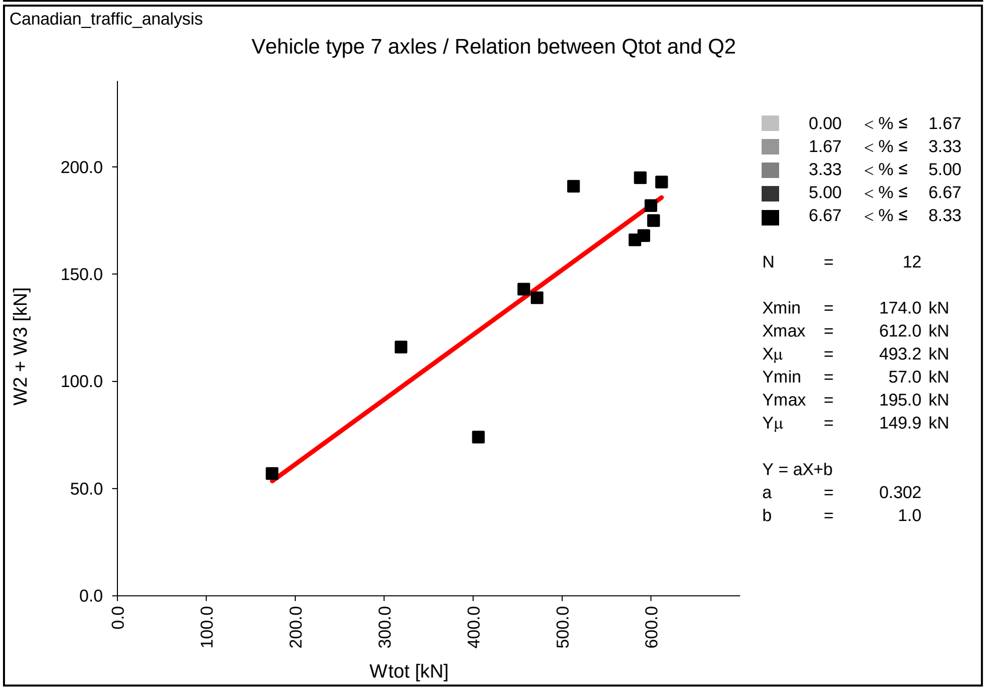

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L2-3 [m]
N = 12
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

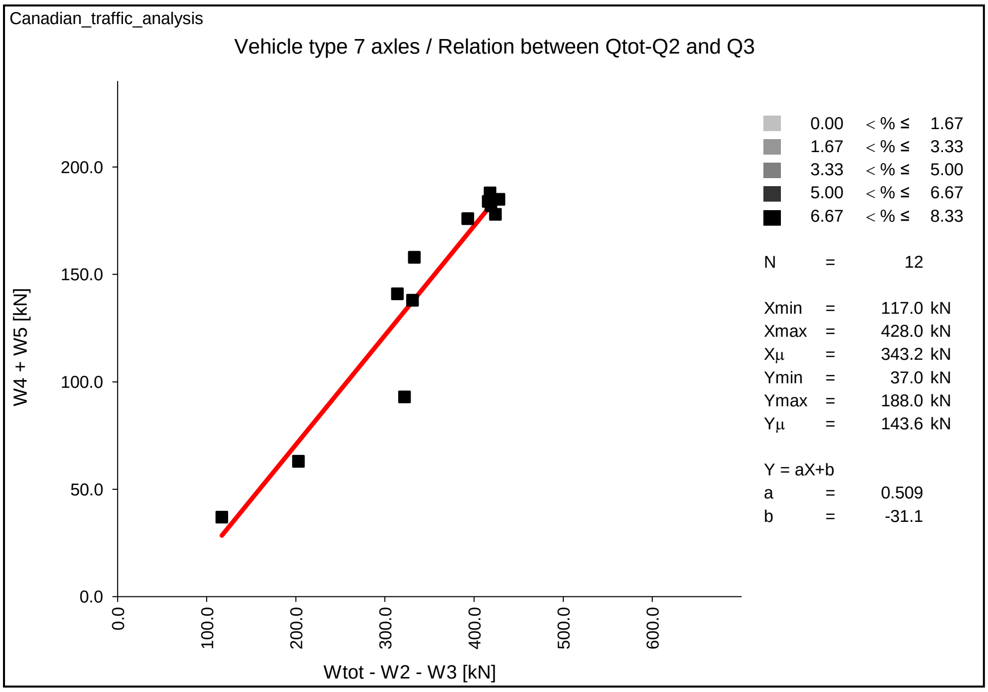

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
30%
25%
20%
15%
10%
5%
0%
3.6
5.6
7.6
L3-4 [m]
N = 12
μ = 4.8 m
σ = 1.1 m
f95 = 7.9 m
f99 = 8.1 m
max = 8.0 m
A = 3.6 m
B = 8.0 m
α =
β =

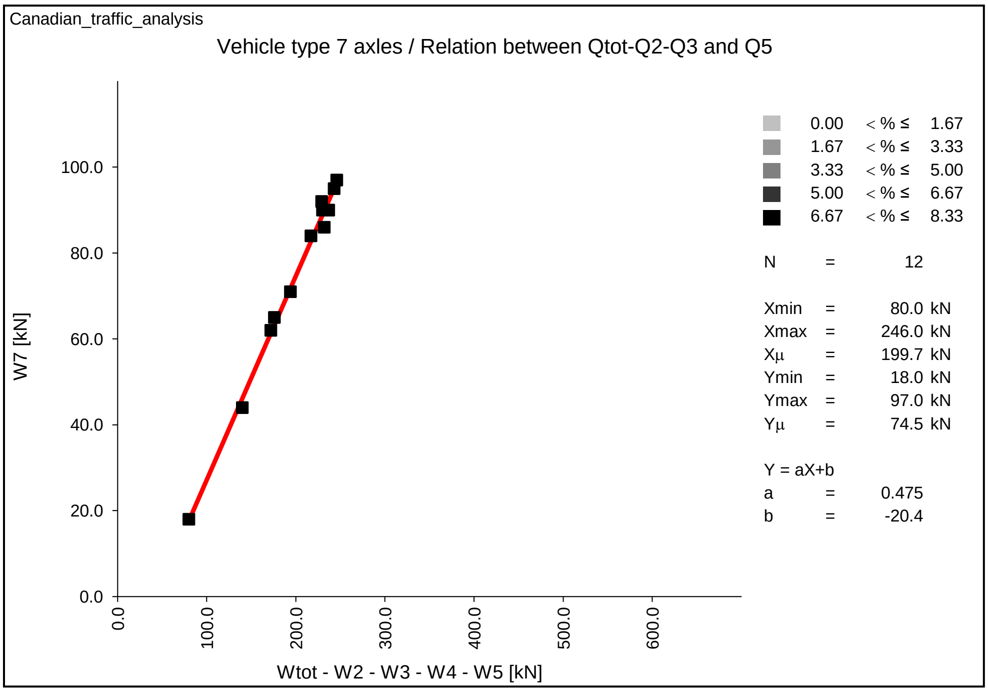

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L4-5 [m]
N = 12
μ = 1.8 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

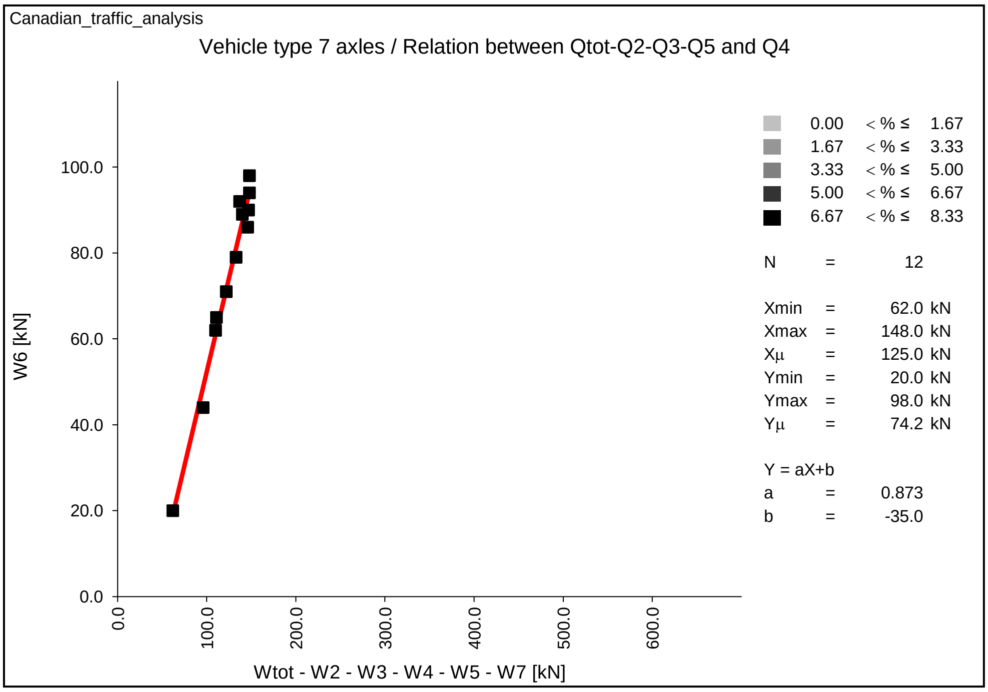

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
3.4
5.4
L5-6 [m]
N = 12
μ = 4.2 m
σ = 0.8 m
f95 = 6.0 m
f99 = 6.1 m
max = 6.0 m
A = 3.4 m
B = 6.8 m
α = 0.55
β = 1.77

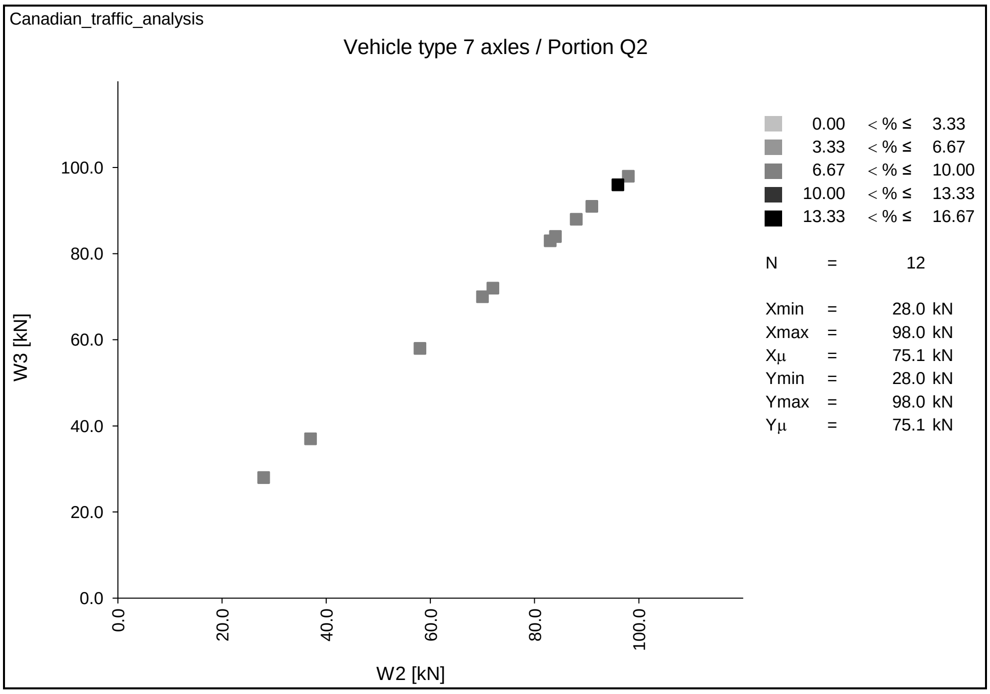

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
6.2
L6-7 [m]
N = 12
μ = 3.6 m
σ = 0.9 m
f95 = 4.8 m
f99 = 4.9 m
max = 4.8 m
A = 2.2 m
B = 7.6 m
α = 1.52
β = 4.40

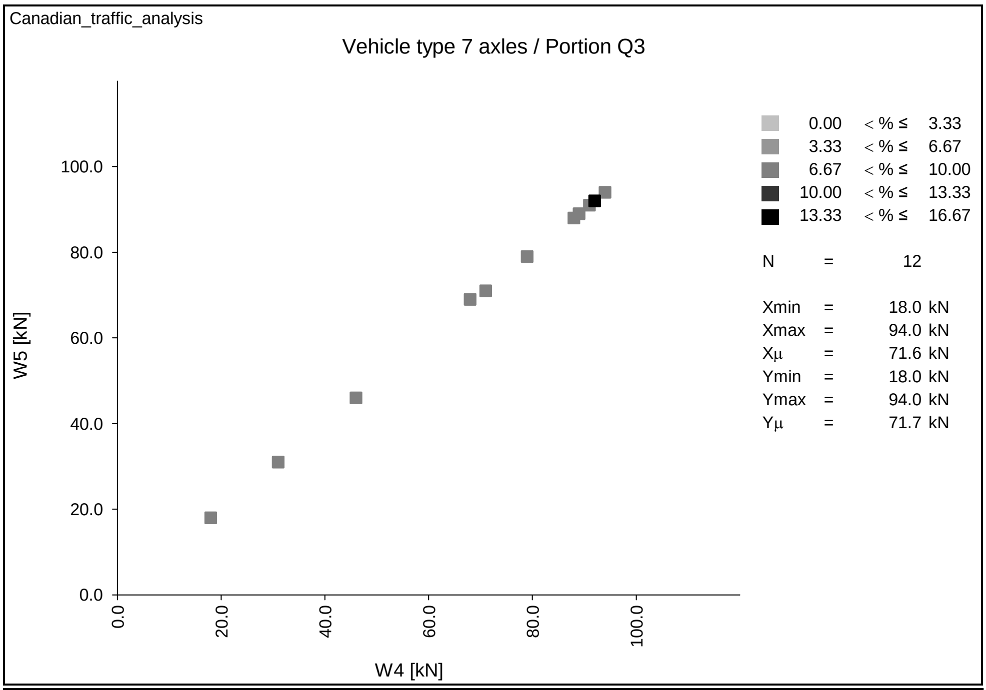

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]
0.00 < % ≤ 1.67
1.67 < % ≤ 3.33
3.33 < % ≤ 5.00
5.00 < % ≤ 6.67
6.67 < % ≤ 8.33
N = 12
Xmin = 174.0 kN
Xmax = 612.0 kN
Xμ = 493.2 kN
Ymin = 57.0 kN
Ymax = 195.0 kN
Yμ = 149.9 kN
Y = aX+b
a = 0.302
b = 1.0

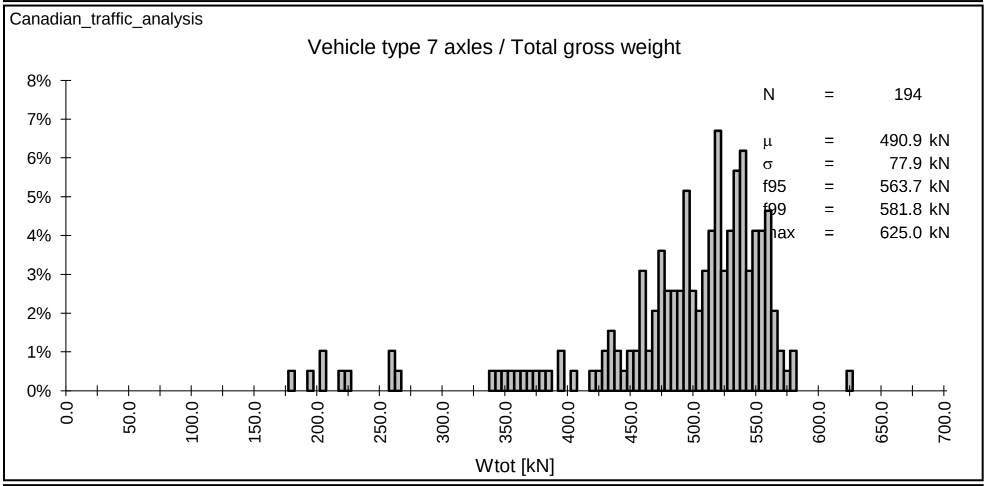

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q3
W4 + W5 [kN]
Wtot - W2 - W3 [kN]
0.00 < % ≤ 1.67
1.67 < % ≤ 3.33
3.33 < % ≤ 5.00
5.00 < % ≤ 6.67
6.67 < % ≤ 8.33
N = 12
Xmin = 117.0 kN
Xmax = 428.0 kN
Xµ = 343.2 kN
Ymin = 37.0 kN
Ymax = 188.0 kN
Yµ = 143.6 kN
Y = aX+b
a = 0.509
b = -31.1

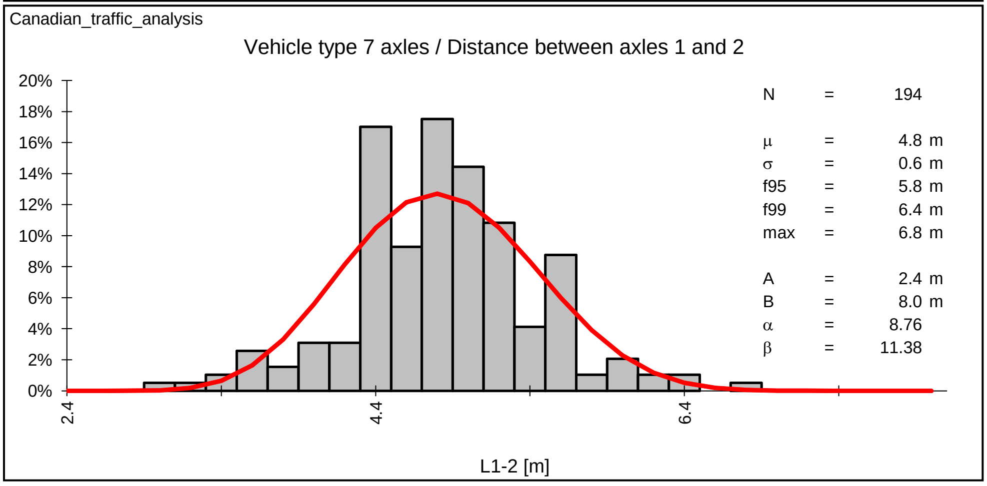

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q3 and Q5
W7 [kN]
Wtot - W2 - W3 - W4 - W5 [kN]
0.00 < % ≤ 1.67
1.67 < % ≤ 3.33
3.33 < % ≤ 5.00
5.00 < % ≤ 6.67
6.67 < % ≤ 8.33
N = 12
Xmin = 80.0 kN
Xmax = 246.0 kN
Xµ = 199.7 kN
Ymin = 18.0 kN
Ymax = 97.0 kN
Yµ = 74.5 kN
Y = aX+b
a = 0.475
b = -20.4

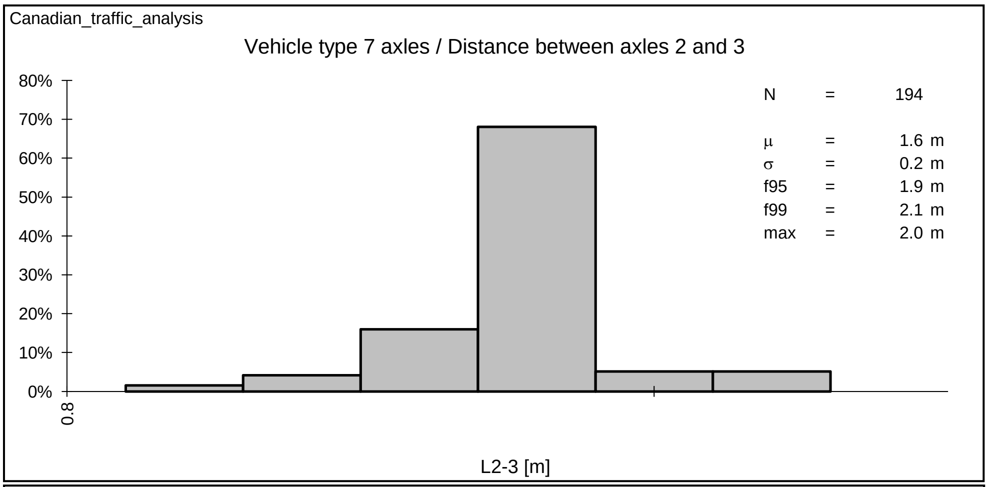

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q3-Q5 and Q4
W6 [kN]
Wtot - W2 - W3 - W4 - W5 - W7 [kN]
0.00 < % ≤ 1.67
1.67 < % ≤ 3.33
3.33 < % ≤ 5.00
5.00 < % ≤ 6.67
6.67 < % ≤ 8.33
N = 12
Xmin = 62.0 kN
Xmax = 148.0 kN
Xμ = 125.0 kN
Ymin = 20.0 kN
Ymax = 98.0 kN
Yμ = 74.2 kN
Y = aX+b
a = 0.873
b = -35.0

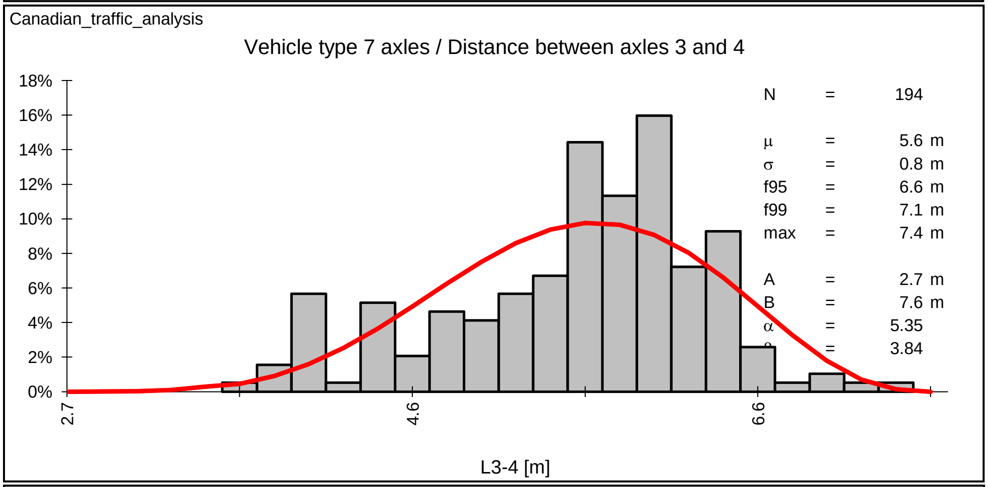

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 3.33
3.33 < % ≤ 6.67
6.67 < % ≤ 10.00
10.00 < % ≤ 13.33
13.33 < % ≤ 16.67
N = 12
Xmin = 28.0 kN
Xmax = 98.0 kN
Xμ = 75.1 kN
Ymin = 28.0 kN
Ymax = 98.0 kN
Yμ = 75.1 kN

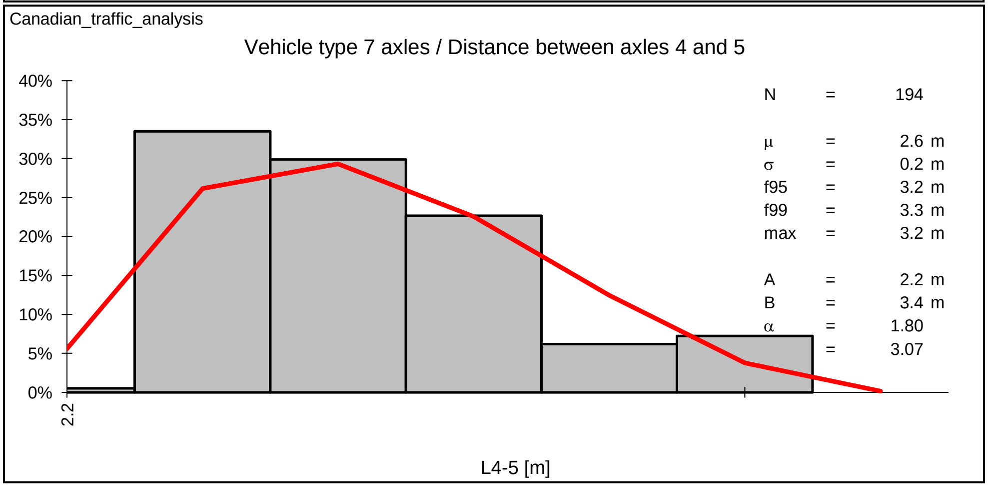

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q3
0.00 < % ≤ 3.33
3.33 < % ≤ 6.67
6.67 < % ≤ 10.00
10.00 < % ≤ 13.33
13.33 < % ≤ 16.67
N = 12
Xmin = 18.0 kN
Xmax = 94.0 kN
Xµ = 71.6 kN
Ymin = 18.0 kN
Ymax = 94.0 kN
Yµ = 71.7 kN
W5 [kN]
W4 [kN]

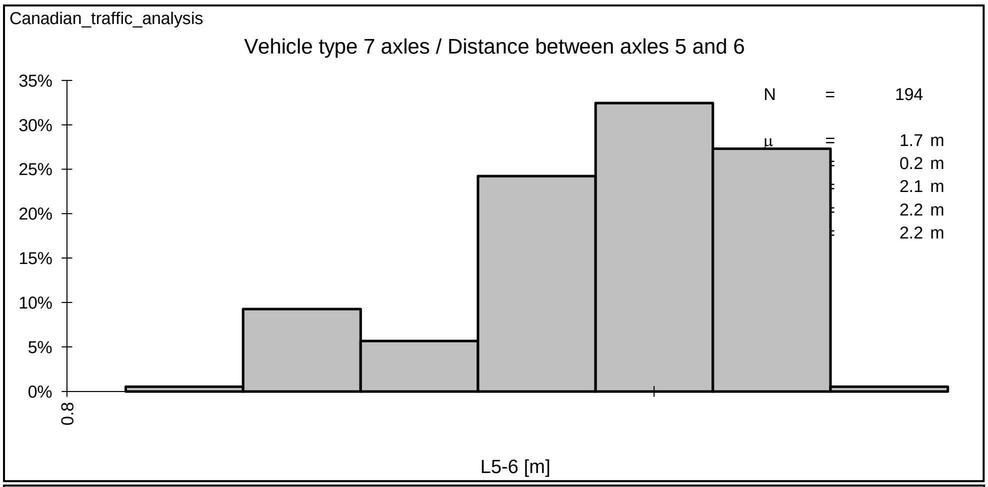

Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
N = 194
µ = 490.9 kN
σ = 77.9 kN
f95 = 563.7 kN
f99 = 581.8 kN
max = 625.0 kN
Wtot [kN]

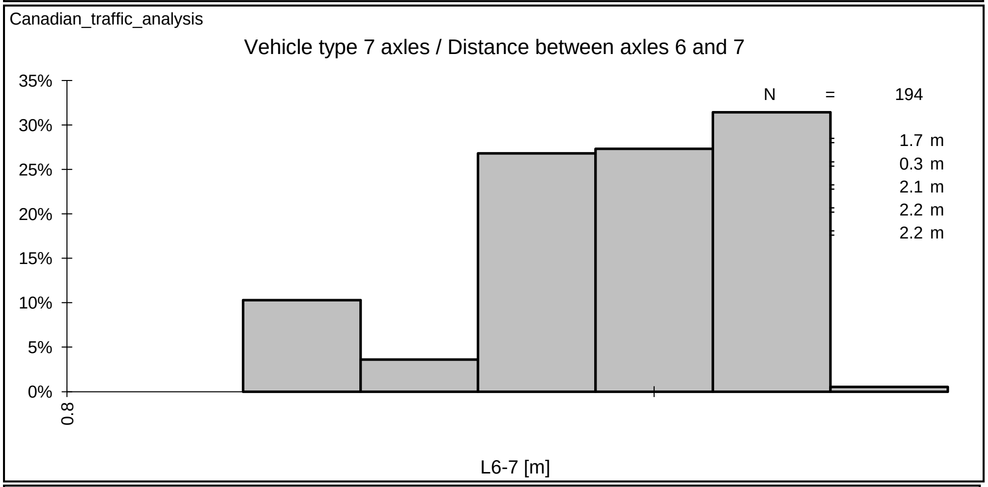

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
N = 194
µ = 4.8 m
σ = 0.6 m
f95 = 5.8 m
f99 = 6.4 m
max = 6.8 m
A = 2.4 m
B = 8.0 m
α = 8.76
β = 11.38
L1-2 [m]

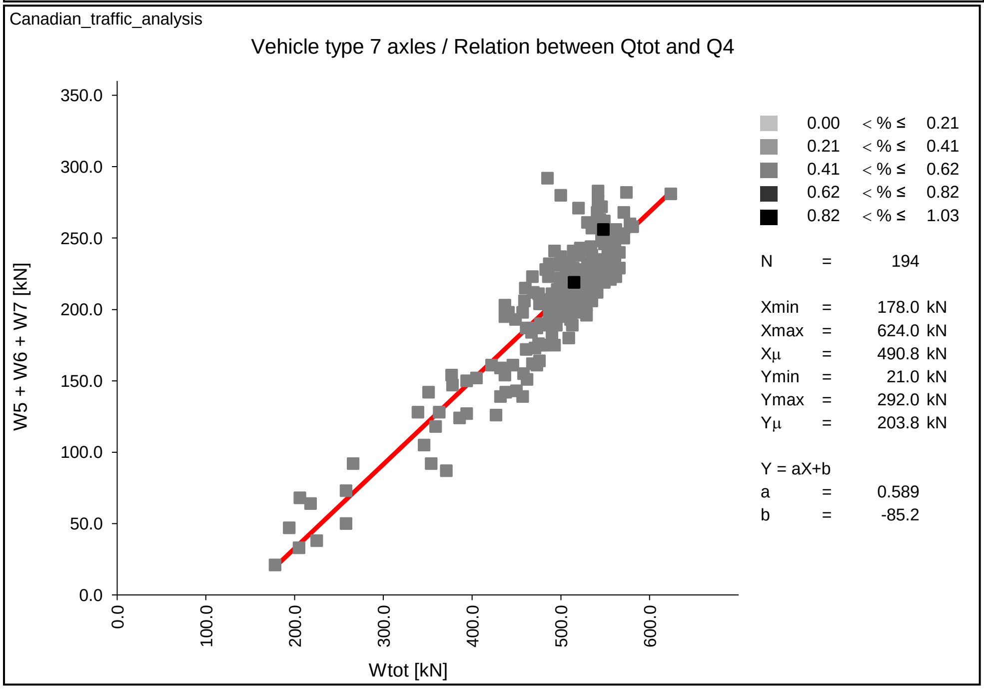

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
N = 194
μ = 1.6 m
σ = 0.2 m
f95 = 1.9 m
f99 = 2.1 m
max = 2.0 m
L2-3 [m]

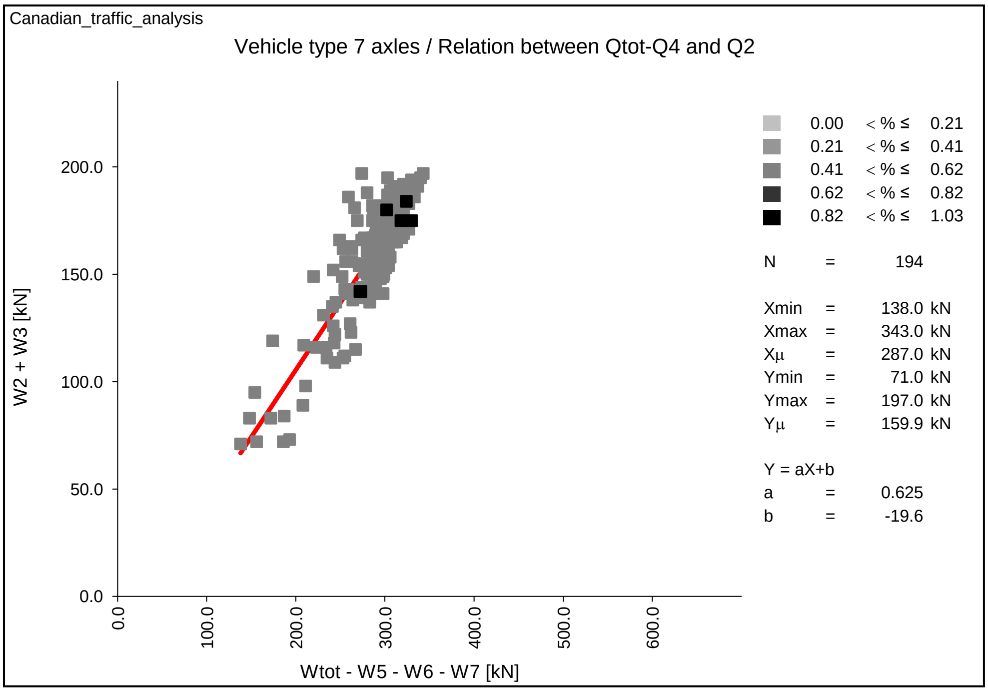

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2.7
4.6
6.6
N = 194
μ = 5.6 m
σ = 0.8 m
f95 = 6.6 m
f99 = 7.1 m
max = 7.4 m
A = 2.7 m
B = 7.6 m
α = 5.35
= 3.84
L3-4 [m]

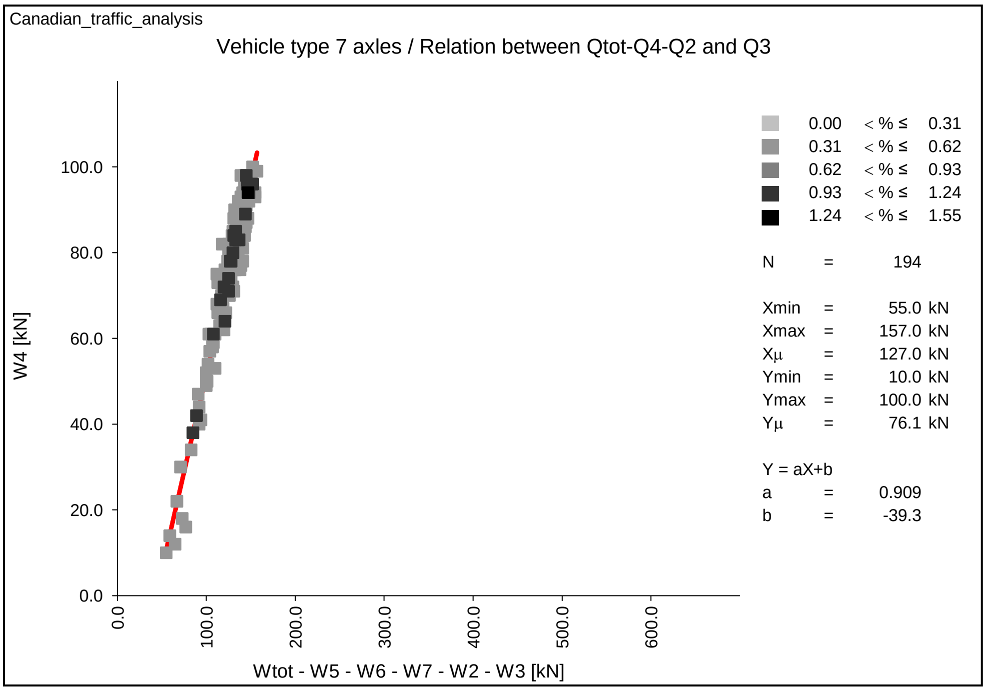

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
N = 194
μ = 2.6 m
σ = 0.2 m
f95 = 3.2 m
f99 = 3.3 m
max = 3.2 m
A = 2.2 m
B = 3.4 m
α = 1.80
= 3.07
L4-5 [m]

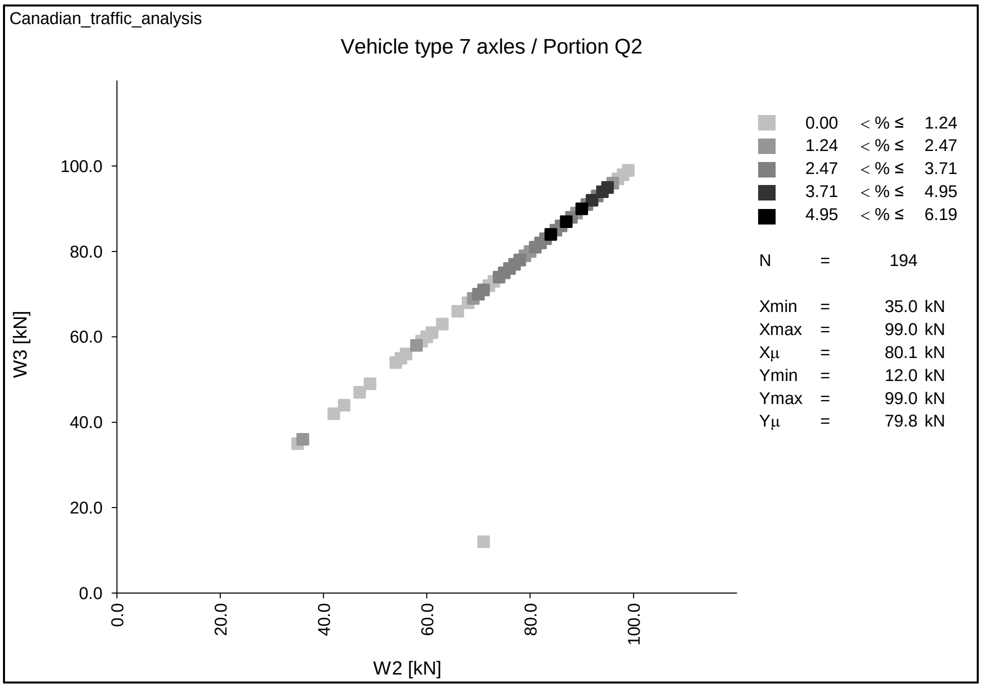

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
N = 194
μ = 1.7 m
0.2 m
2.1 m
2.2 m
2.2 m
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L5-6 [m]

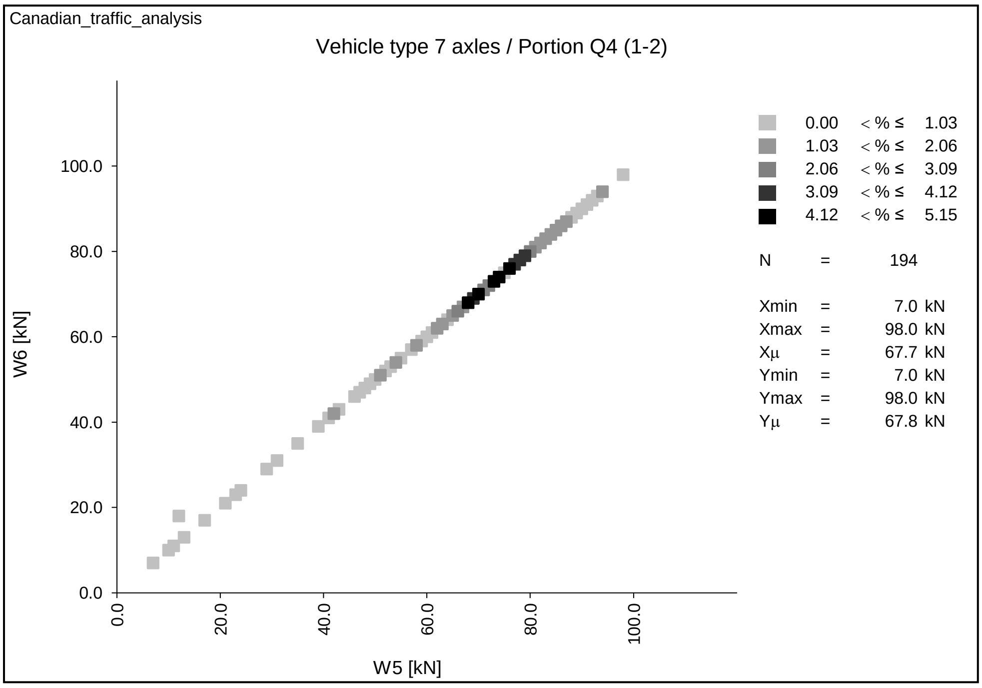

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
N = 194
1.7 m
0.3 m
2.1 m
2.2 m
2.2 m
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L6-7 [m]

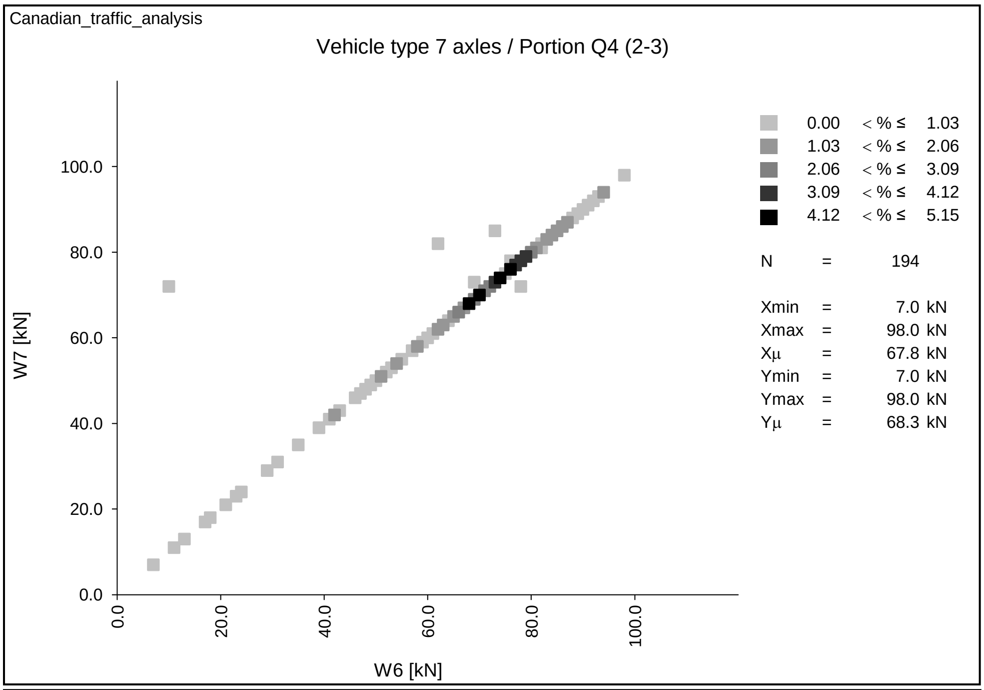

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q4
0.00 < % ≤ 0.21
0.21 < % ≤ 0.41
0.41 < % ≤ 0.62
0.62 < % ≤ 0.82
0.82 < % ≤ 1.03
N = 194
Xmin = 178.0 kN
Xmax = 624.0 kN
Xμ = 490.8 kN
Ymin = 21.0 kN
Ymax = 292.0 kN
Yμ = 203.8 kN
Y = aX+b
a = 0.589
b = -85.2
W5 + W6 + W7 [kN]
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]

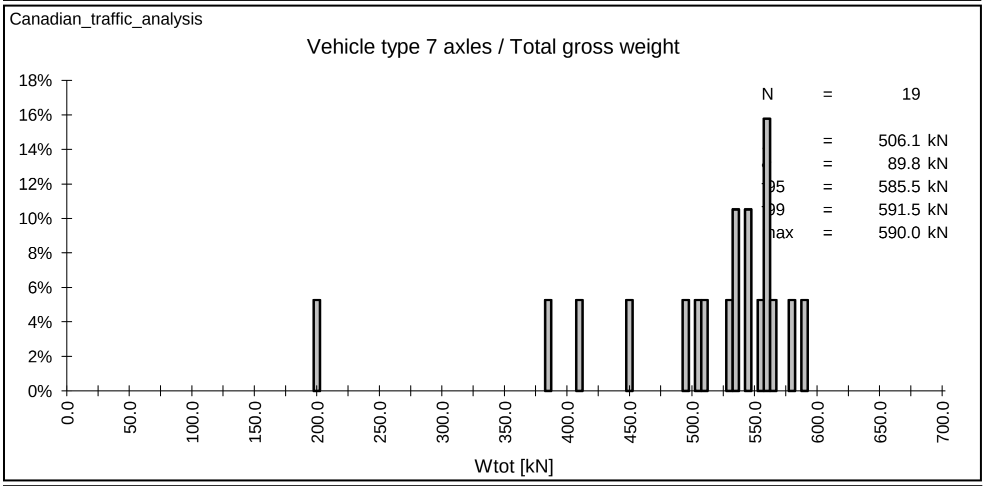

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q4 and Q2
W2 + W3 [kN]
Wtot - W5 - W6 - W7 [kN]
0.00 < % ≤ 0.21
0.21 < % ≤ 0.41
0.41 < % ≤ 0.62
0.62 < % ≤ 0.82
0.82 < % ≤ 1.03
N = 194
Xmin = 138.0 kN
Xmax = 343.0 kN
Xµ = 287.0 kN
Ymin = 71.0 kN
Ymax = 197.0 kN
Yµ = 159.9 kN
Y = aX+b
a = 0.625
b = -19.6

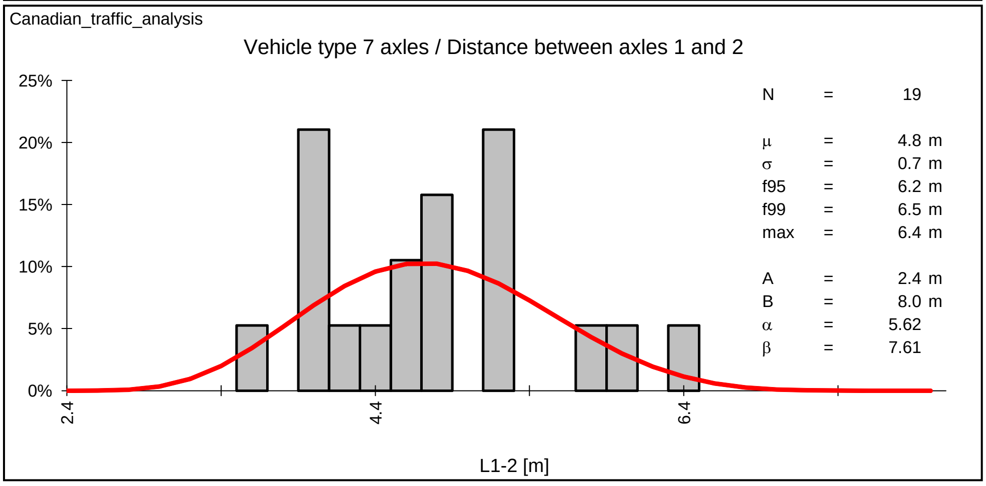

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q4-Q2 and Q3
W4 [kN]
Wtot - W5 - W6 - W7 - W2 - W3 [kN]
0.00 < % ≤ 0.31
0.31 < % ≤ 0.62
0.62 < % ≤ 0.93
0.93 < % ≤ 1.24
1.24 < % ≤ 1.55
N = 194
Xmin = 55.0 kN
Xmax = 157.0 kN
Xµ = 127.0 kN
Ymin = 10.0 kN
Ymax = 100.0 kN
Yµ = 76.1 kN
Y = aX+b
a = 0.909
b = -39.3


Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
0.00 < % ≤ 1.24
1.24 < % ≤ 2.47
2.47 < % ≤ 3.71
3.71 < % ≤ 4.95
4.95 < % ≤ 6.19
N = 194
Xmin = 35.0 kN
Xmax = 99.0 kN
Xμ = 80.1 kN
Ymin = 12.0 kN
Ymax = 99.0 kN
Yμ = 79.8 kN
W3 [kN]
W2 [kN]

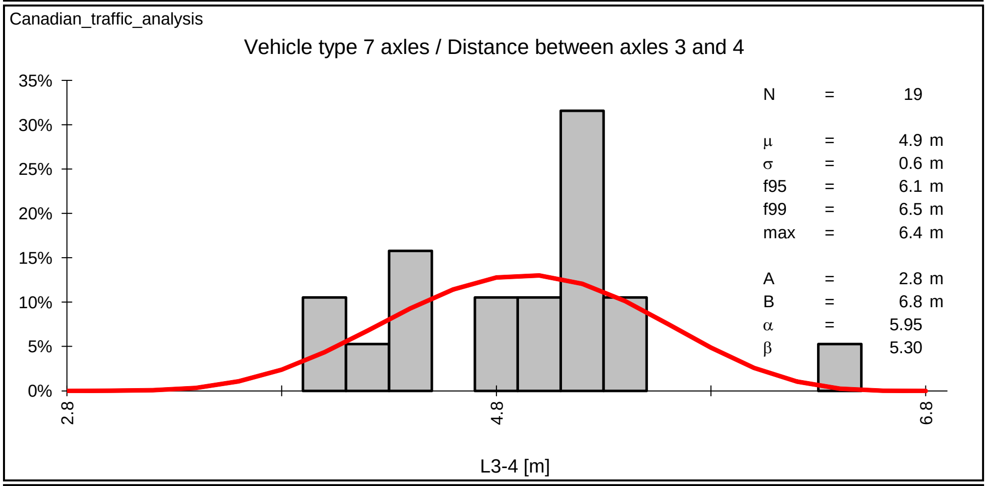

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q4 (1-2)
0.00 < % ≤ 1.03
1.03 < % ≤ 2.06
2.06 < % ≤ 3.09
3.09 < % ≤ 4.12
4.12 < % ≤ 5.15
N = 194
Xmin = 7.0 kN
Xmax = 98.0 kN
Xμ = 67.7 kN
Ymin = 7.0 kN
Ymax = 98.0 kN
Yμ = 67.8 kN
W6 [kN]
W5 [kN]

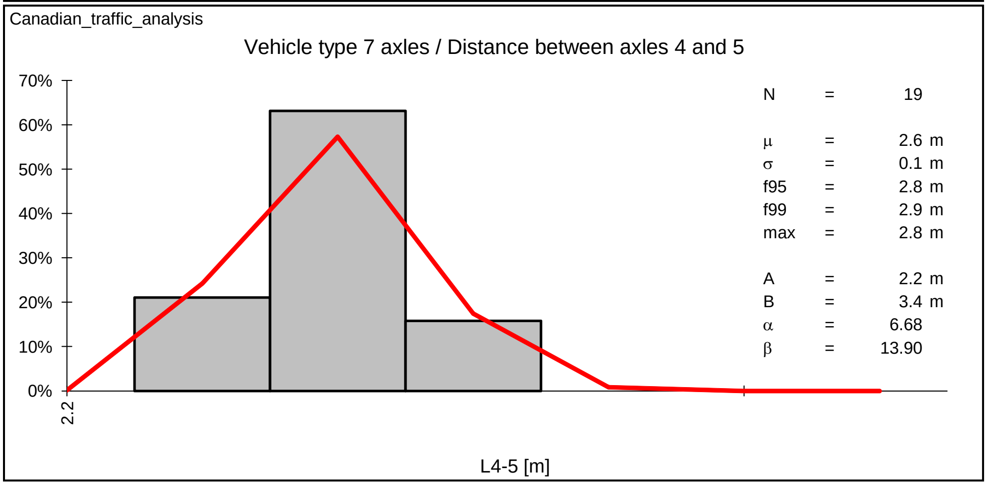

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q4 (2-3)
W7 [kN]
W6 [kN]
0.00 < % ≤ 1.03
1.03 < % ≤ 2.06
2.06 < % ≤ 3.09
3.09 < % ≤ 4.12
4.12 < % ≤ 5.15
N = 194
Xmin = 7.0 kN
Xmax = 98.0 kN
Xμ = 67.8 kN
Ymin = 7.0 kN
Ymax = 98.0 kN
Yμ = 68.3 kN


Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
Wtot [kN]
N = 19
= 506.1 kN
= 89.8 kN
= 585.5 kN
= 591.5 kN
= 590.0 kN

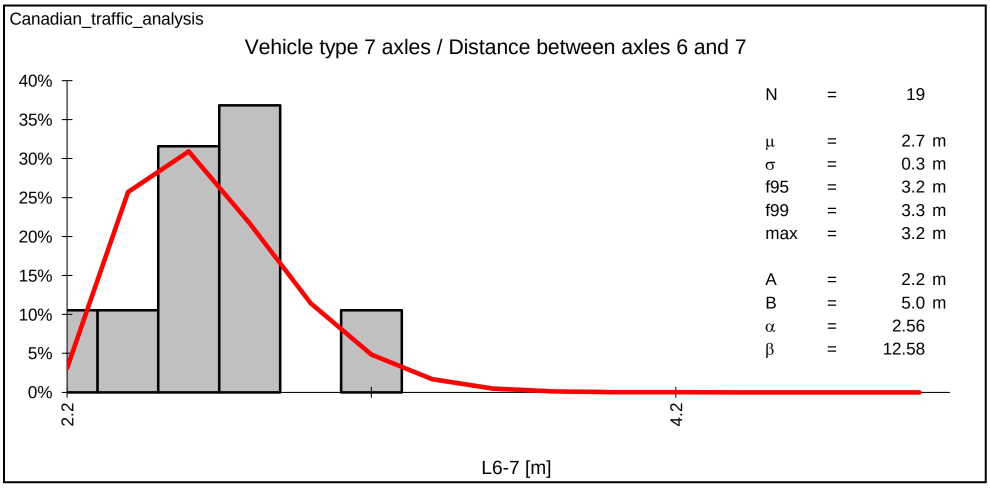

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
L1-2 [m]
N = 19
μ = 4.8 m
σ = 0.7 m
f95 = 6.2 m
f99 = 6.5 m
max = 6.4 m
A = 2.4 m
B = 8.0 m
α = 5.62
β = 7.61


Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L2-3 [m]
N = 19
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

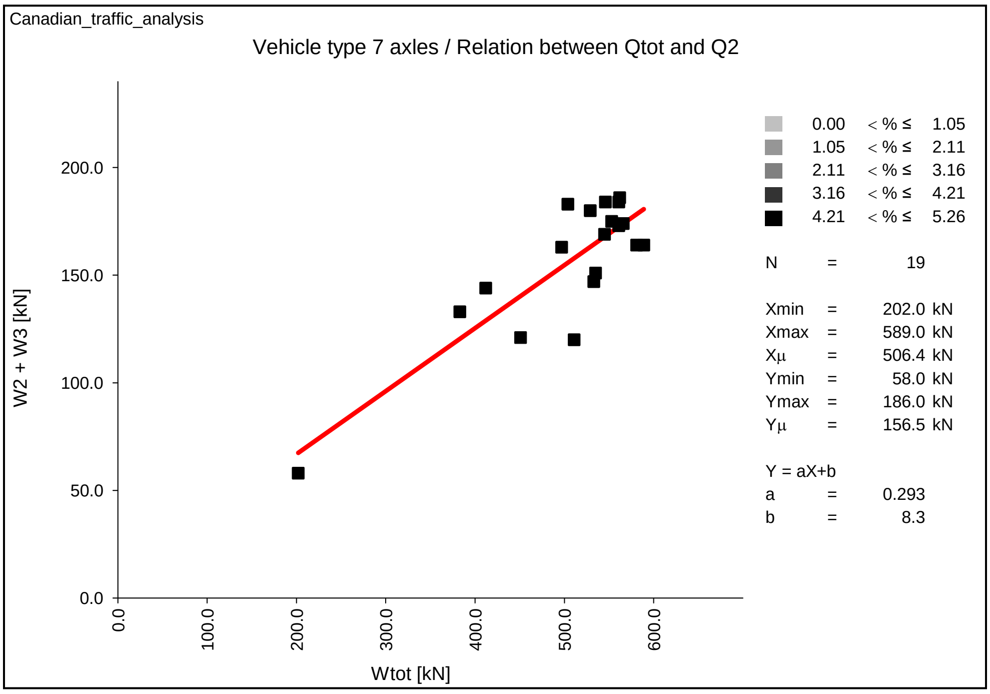

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
35%
30%
25%
20%
15%
10%
5%
0%
2.8
4.8
6.8
L3-4 [m]
N = 19
μ = 4.9 m
σ = 0.6 m
f95 = 6.1 m
f99 = 6.5 m
max = 6.4 m
A = 2.8 m
B = 6.8 m
α = 5.95
β = 5.30


Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
70%
60%
50%
40%
30%
20%
10%
0%
2.2
L4-5 [m]
N = 19
μ = 2.6 m
σ = 0.1 m
f95 = 2.8 m
f99 = 2.9 m
max = 2.8 m
A = 2.2 m
B = 3.4 m
α = 6.68
β = 13.90

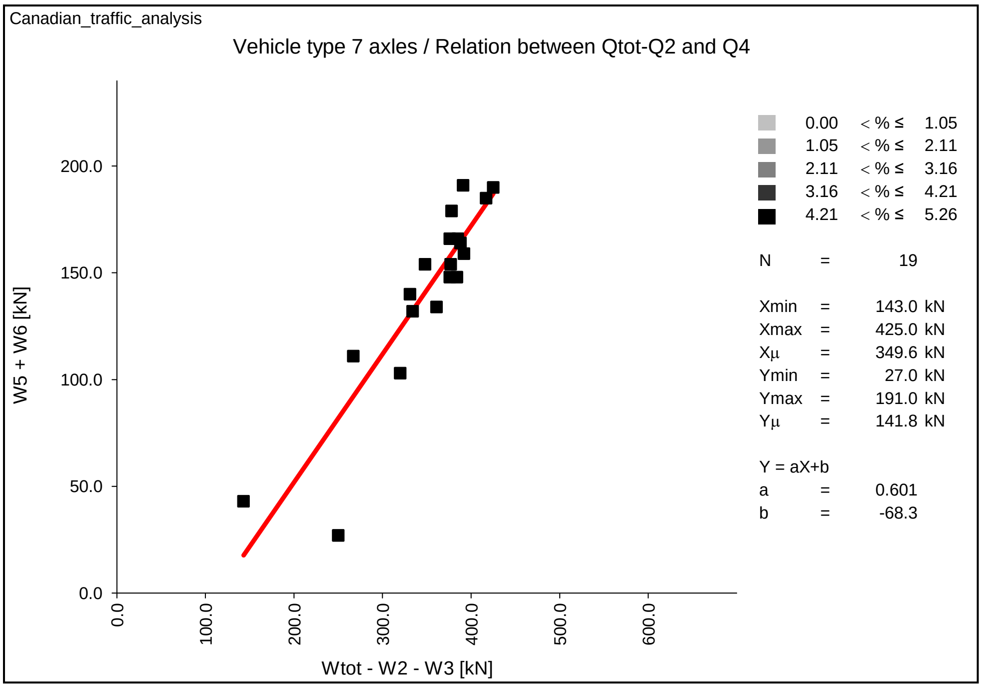
Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L5-6 [m]
N = 19
μ = 1.6 m
σ = 0.3 m
f95 = 2.1 m
2.1 m
2.0 m



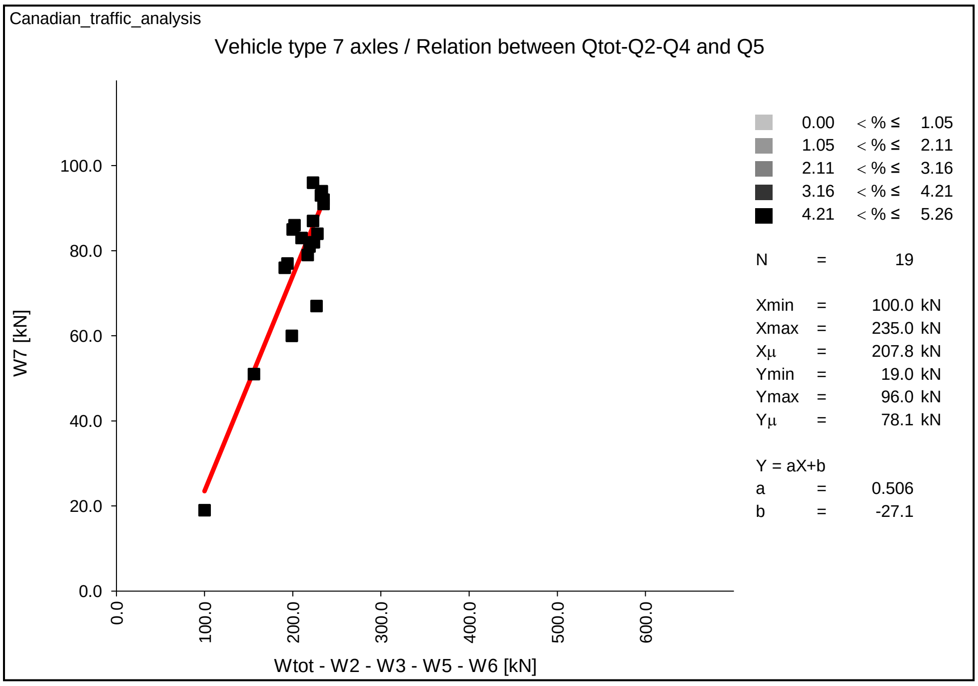
Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
L6-7 [m]
N = 19
μ = 2.7 m
σ = 0.3 m
f95 = 3.2 m
f99 = 3.3 m
max = 3.2 m
A = 2.2 m
B = 5.0 m
α = 2.56
β = 12.58



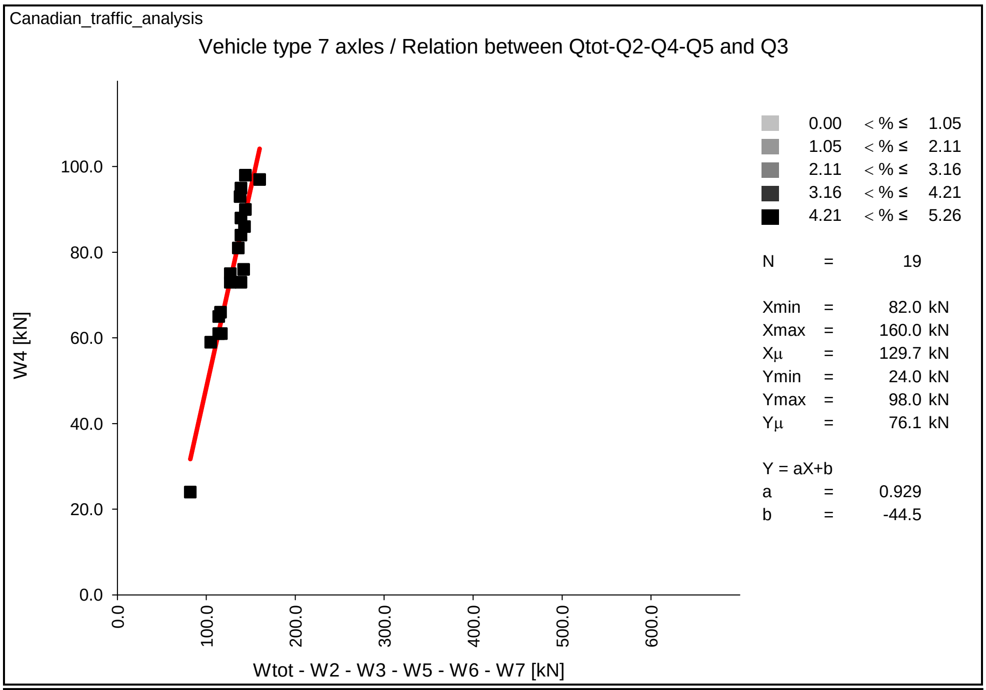
Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]
0.00 < % ≤ 1.05
1.05 < % ≤ 2.11
2.11 < % ≤ 3.16
3.16 < % ≤ 4.21
4.21 < % ≤ 5.26
N = 19
Xmin = 202.0 kN
Xmax = 589.0 kN
Xμ = 506.4 kN
Ymin = 58.0 kN
Ymax = 186.0 kN
Yμ = 156.5 kN
Y = aX+b
a = 0.293
b = 8.3

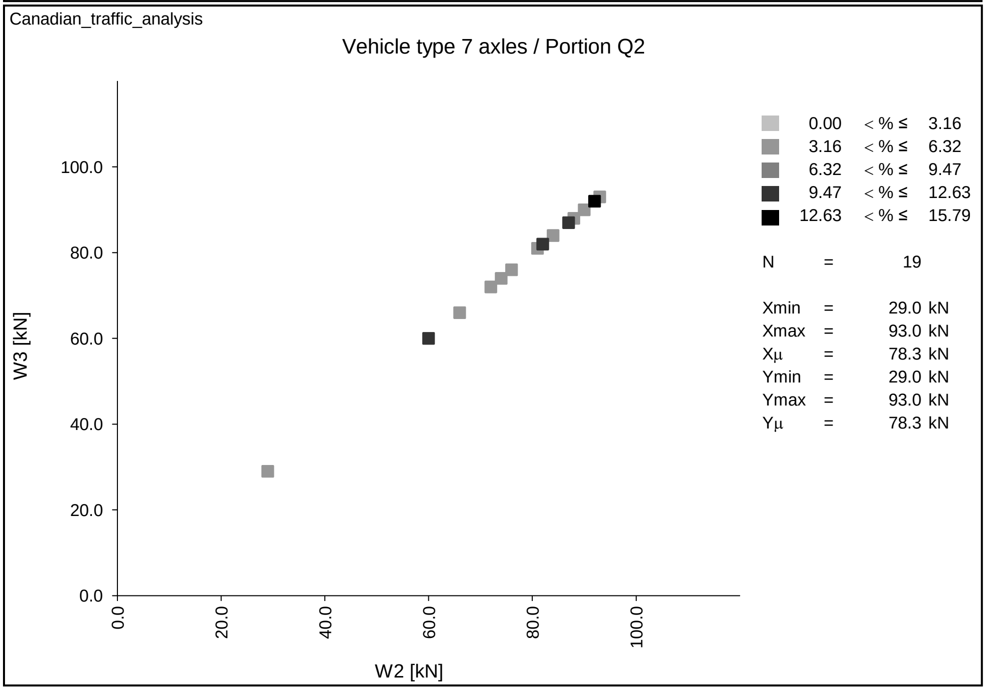


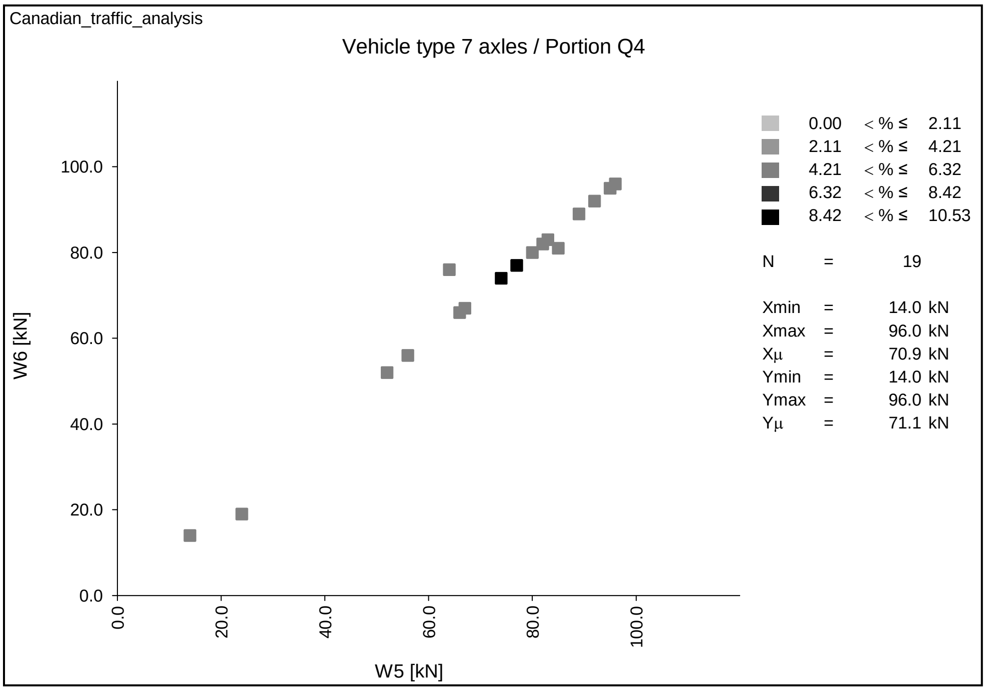
Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q4
W5 + W6 [kN]
Wtot - W2 - W3 [kN]
0.00 < % ≤ 1.05
1.05 < % ≤ 2.11
2.11 < % ≤ 3.16
3.16 < % ≤ 4.21
4.21 < % ≤ 5.26
N = 19
Xmin = 143.0 kN
Xmax = 425.0 kN
Xμ = 349.6 kN
Ymin = 27.0 kN
Ymax = 191.0 kN
Yμ = 141.8 kN
Y = aX+b
a = 0.601
b = -68.3

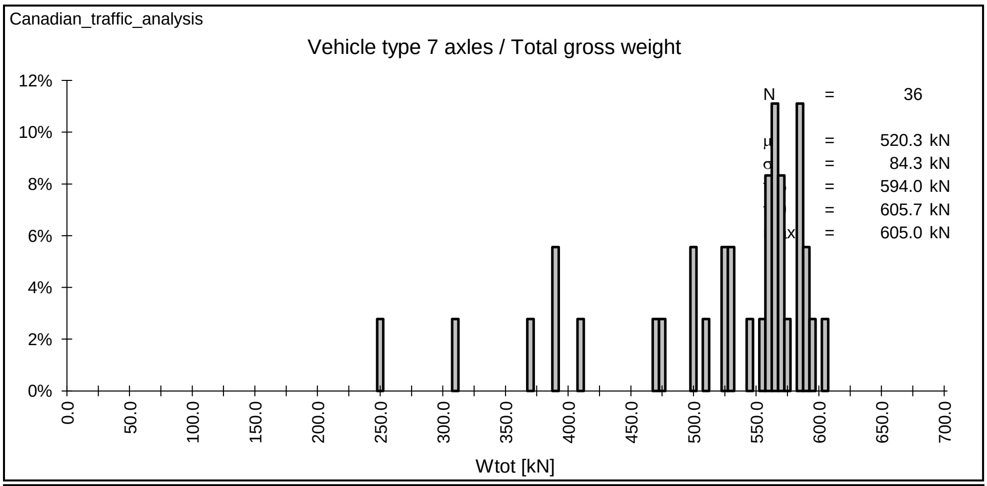


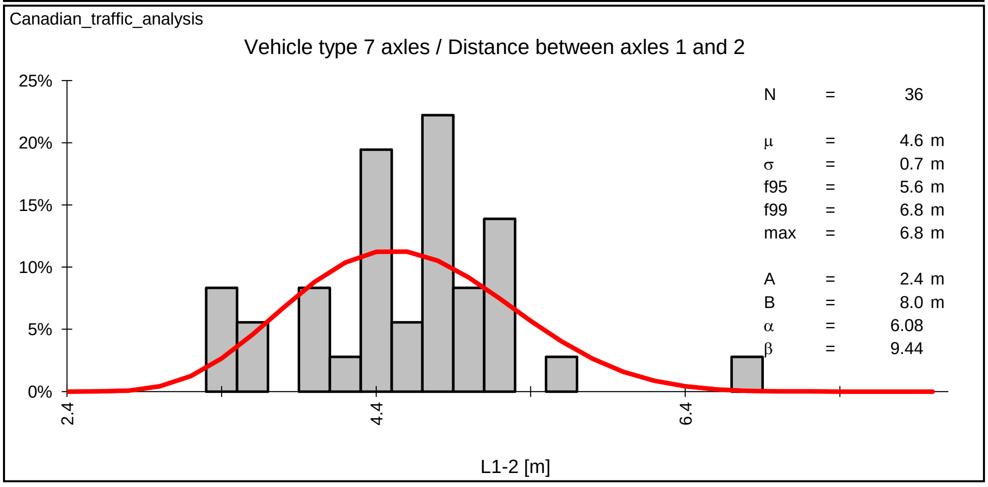
Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q4 and Q5
W7 [kN]
Wtot - W2 - W3 - W5 - W6 [kN]
0.00 < % ≤ 1.05
1.05 < % ≤ 2.11
2.11 < % ≤ 3.16
3.16 < % ≤ 4.21
4.21 < % ≤ 5.26
N = 19
Xmin = 100.0 kN
Xmax = 235.0 kN
Xμ = 207.8 kN
Ymin = 19.0 kN
Ymax = 96.0 kN
Yμ = 78.1 kN
Y = aX+b
a = 0.506
b = -27.1


Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q4-Q5 and Q3
0.00 < % ≤ 1.05
1.05 < % ≤ 2.11
2.11 < % ≤ 3.16
3.16 < % ≤ 4.21
4.21 < % ≤ 5.26
N = 19
Xmin = 82.0 kN
Xmax = 160.0 kN
Xµ = 129.7 kN
Ymin = 24.0 kN
Ymax = 98.0 kN
Yµ = 76.1 kN
Y = aX+b
a = 0.929
b = -44.5
W4 [kN]
Wtot - W2 - W3 - W5 - W6 - W7 [kN]

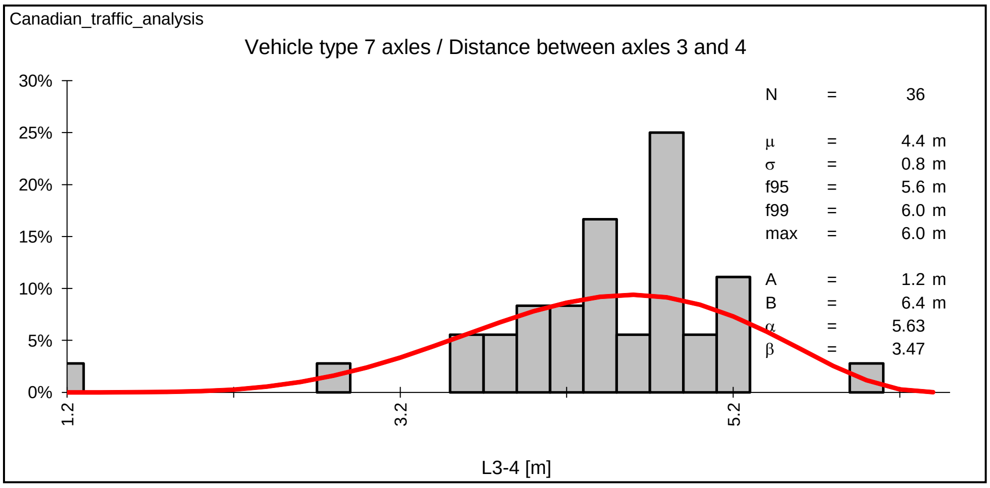

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
0.00 < % ≤ 3.16
3.16 < % ≤ 6.32
6.32 < % ≤ 9.47
9.47 < % ≤ 12.63
12.63 < % ≤ 15.79
N = 19
Xmin = 29.0 kN
Xmax = 93.0 kN
Xµ = 78.3 kN
Ymin = 29.0 kN
Ymax = 93.0 kN
Yµ = 78.3 kN
W3 [kN]
W2 [kN]

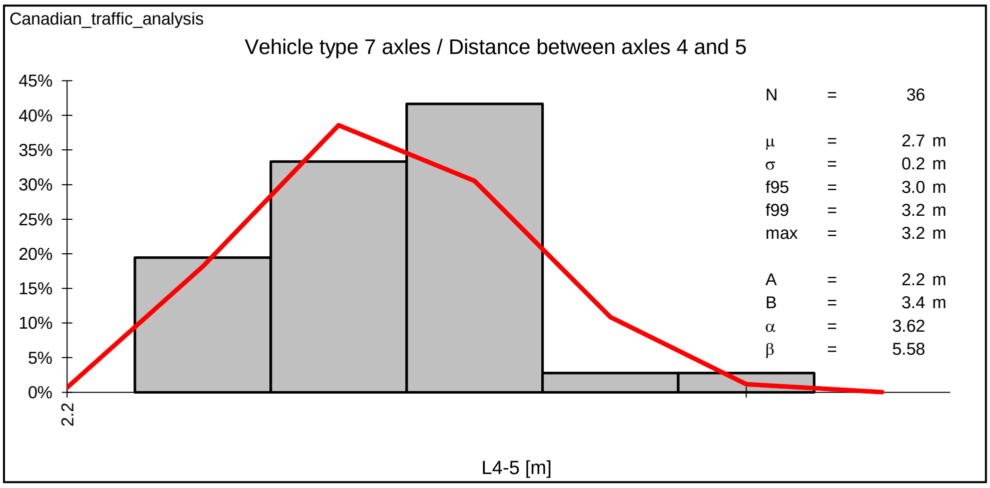

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q4
W6 [kN]
W5 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 2.11
2.11 < % ≤ 4.21
4.21 < % ≤ 6.32
6.32 < % ≤ 8.42
8.42 < % ≤ 10.53
N = 19
Xmin = 14.0 kN
Xmax = 96.0 kN
Xμ = 70.9 kN
Ymin = 14.0 kN
Ymax = 96.0 kN
Yμ = 71.1 kN

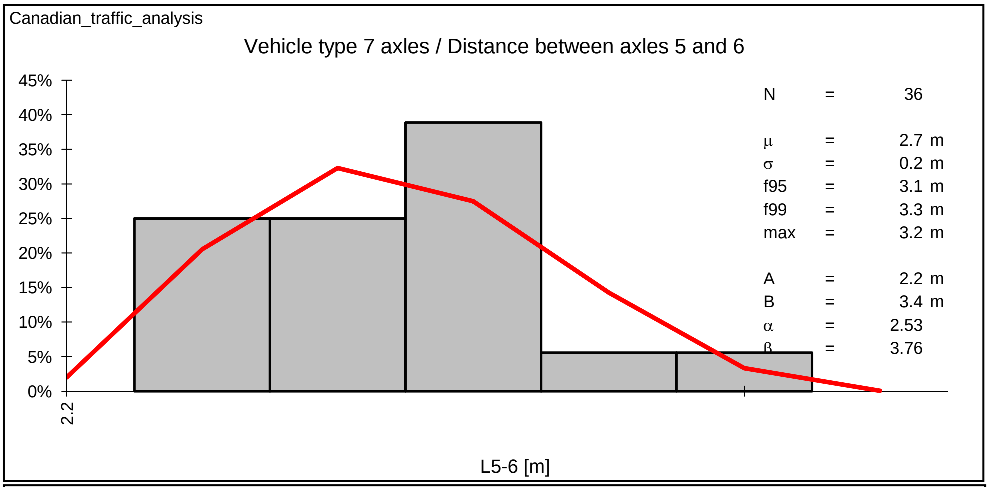

Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
0%
2%
4%
6%
8%
10%
12%
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
Wtot [kN]
N = 36
= 520.3 kN
= 84.3 kN
= 594.0 kN
= 605.7 kN
= 605.0 kN


Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
0%
5%
10%
15%
20%
25%
2.4
4.4
6.4
L1-2 [m]
N = 36
μ = 4.6 m
σ = 0.7 m
f95 = 5.6 m
f99 = 6.8 m
max = 6.8 m
A = 2.4 m
B = 8.0 m
α = 6.08
β = 9.44

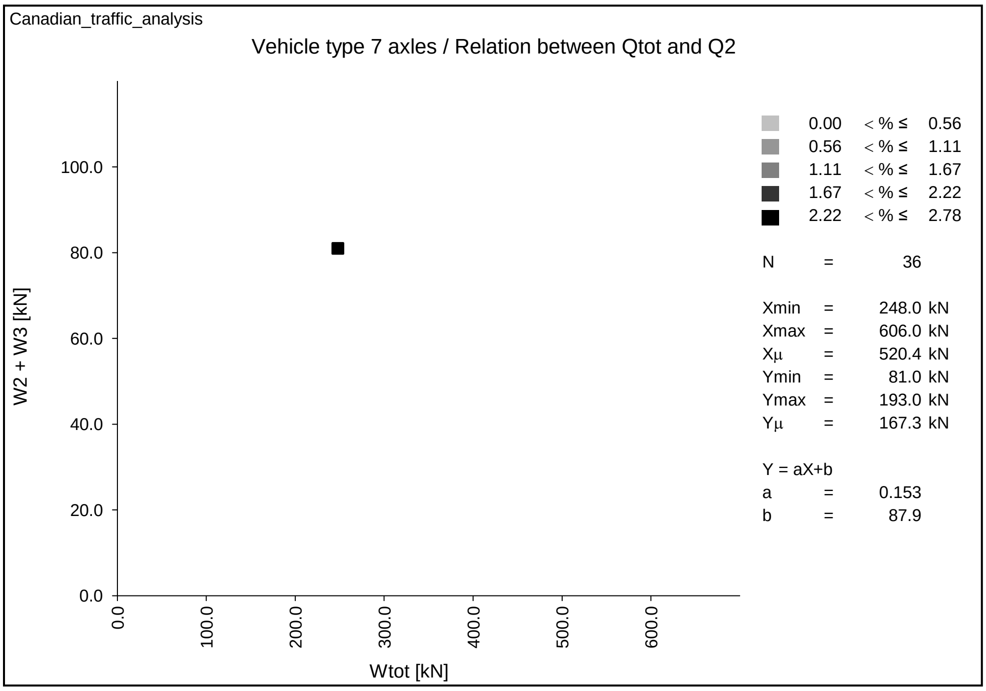

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
70%
60%
50%
40%
30%
20%
10%
0%
0.8
N = 36
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L2-3 [m]

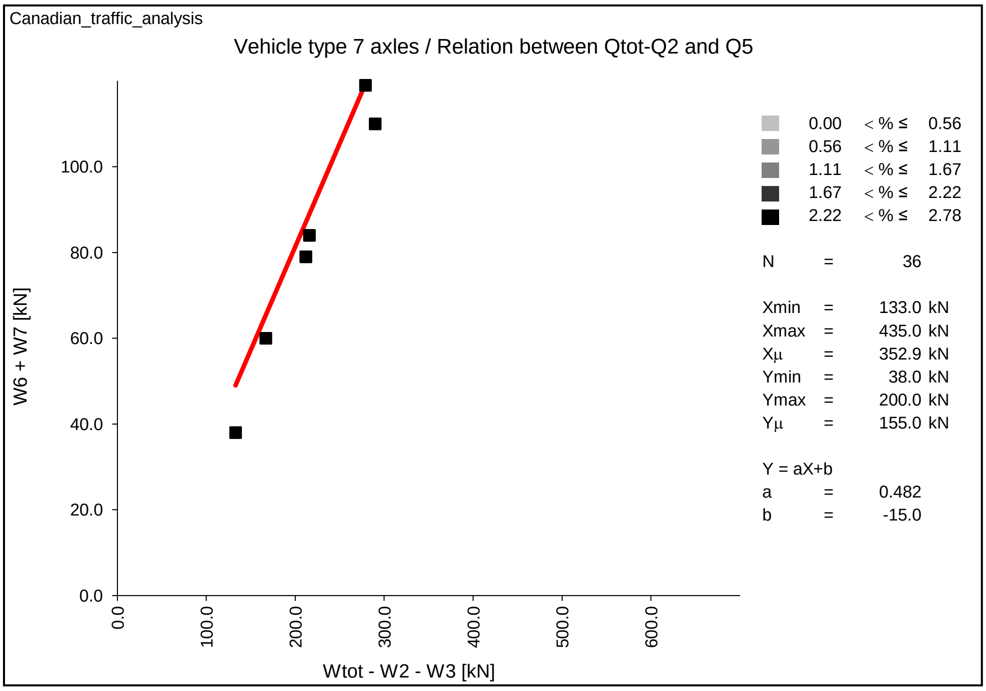

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
30%
25%
20%
15%
10%
5%
0%
1.2
3.2
5.2
N = 36
μ = 4.4 m
σ = 0.8 m
f95 = 5.6 m
f99 = 6.0 m
max = 6.0 m
A = 1.2 m
B = 6.4 m
α = 5.63
β = 3.47
L3-4 [m]

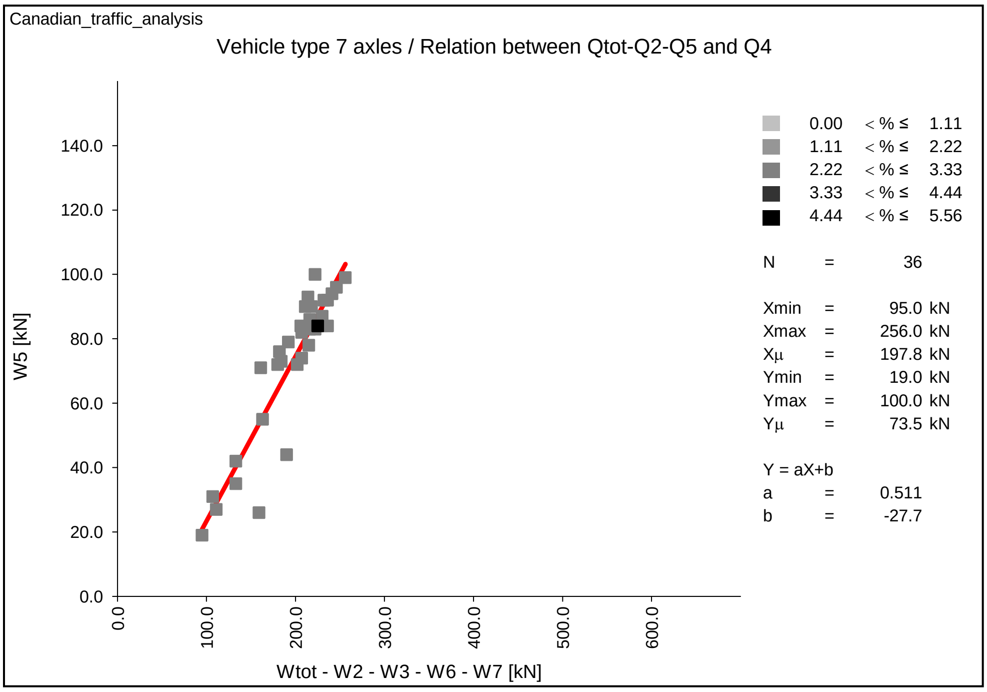

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
N = 36
μ = 2.7 m
σ = 0.2 m
f95 = 3.0 m
f99 = 3.2 m
max = 3.2 m
A = 2.2 m
B = 3.4 m
α = 3.62
β = 5.58
L4-5 [m]

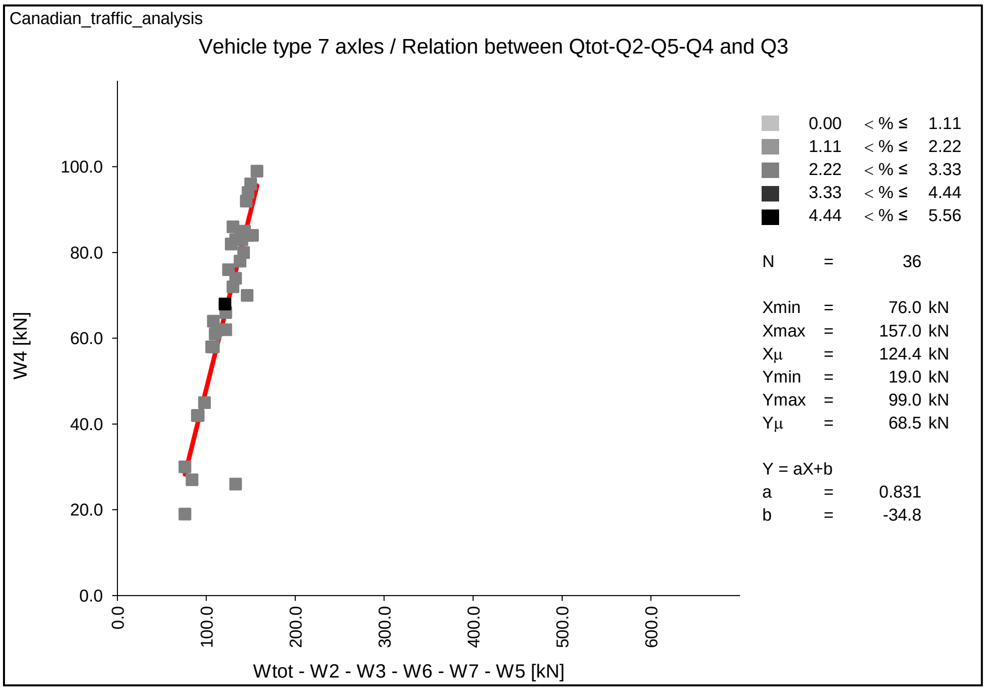

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
N = 36
μ = 2.7 m
σ = 0.2 m
f95 = 3.1 m
f99 = 3.3 m
max = 3.2 m
A = 2.2 m
B = 3.4 m
α = 2.53
β = 3.76
L5-6 [m]

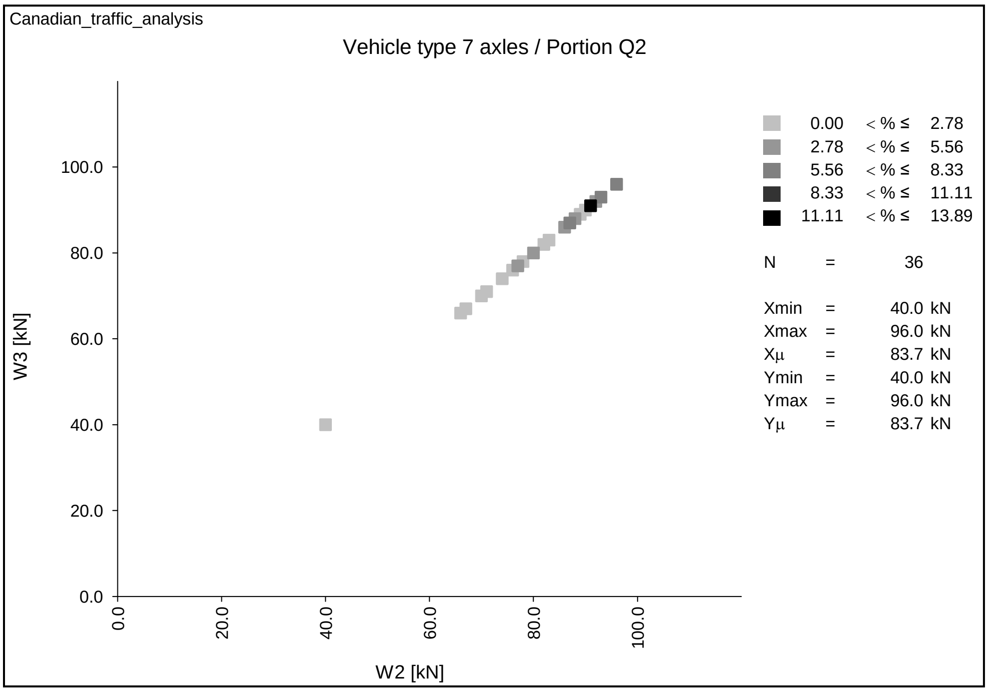

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
60%
50%
40%
30%
20%
10%
0%
0.8
N = 36
μ = 1.8 m
σ = 0.1 m
2.1 m
2.1 m
2.0 m
L6-7 [m]

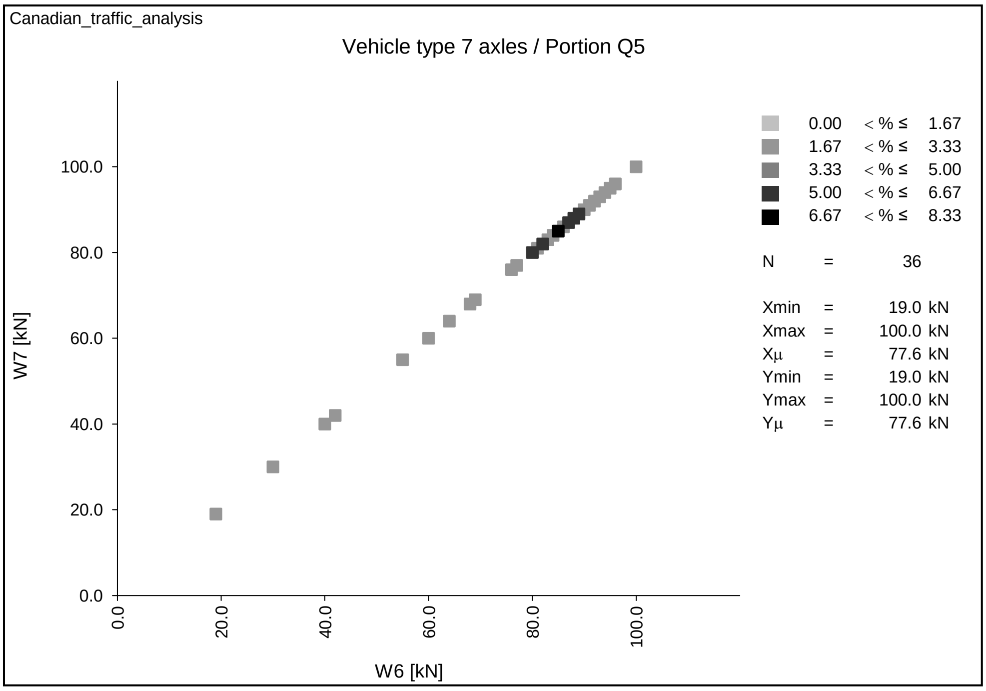

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
0.00 < % ≤ 0.56
0.56 < % ≤ 1.11
1.11 < % ≤ 1.67
1.67 < % ≤ 2.22
2.22 < % ≤ 2.78
N = 36
Xmin = 248.0 kN
Xmax = 606.0 kN
Xμ = 520.4 kN
Ymin = 81.0 kN
Ymax = 193.0 kN
Yμ = 167.3 kN
Y = aX+b
a = 0.153
b = 87.9
100.0
80.0
60.0
40.0
20.0
0.0
W2 + W3 [kN]
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]

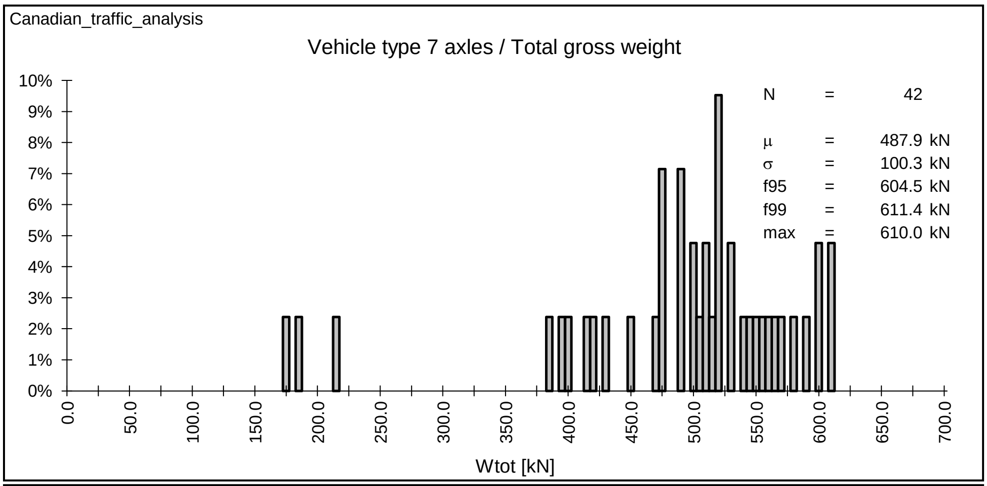

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q5
0.00 < % ≤ 0.56
0.56 < % ≤ 1.11
1.11 < % ≤ 1.67
1.67 < % ≤ 2.22
2.22 < % ≤ 2.78
N = 36
Xmin = 133.0 kN
Xmax = 435.0 kN
Xμ = 352.9 kN
Ymin = 38.0 kN
Ymax = 200.0 kN
Yμ = 155.0 kN
Y = aX+b
a = 0.482
b = -15.0
W6 + W7 [kN]
Wtot - W2 - W3 [kN]

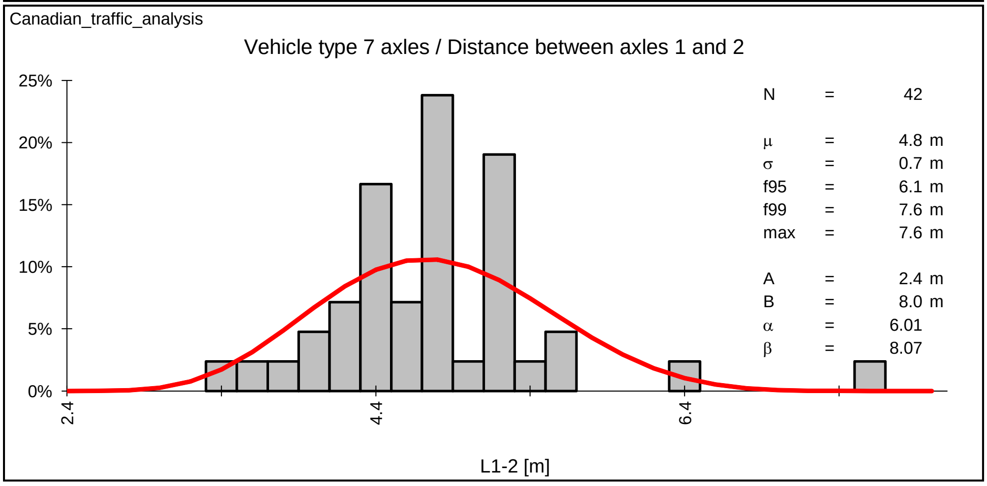

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q5 and Q4
0.00 < % ≤ 1.11
1.11 < % ≤ 2.22
2.22 < % ≤ 3.33
3.33 < % ≤ 4.44
4.44 < % ≤ 5.56
N = 36
Xmin = 95.0 kN
Xmax = 256.0 kN
Xμ = 197.8 kN
Ymin = 19.0 kN
Ymax = 100.0 kN
Yμ = 73.5 kN
Y = aX+b
a = 0.511
b = -27.7
W5 [kN]
Wtot - W2 - W3 - W6 - W7 [kN]

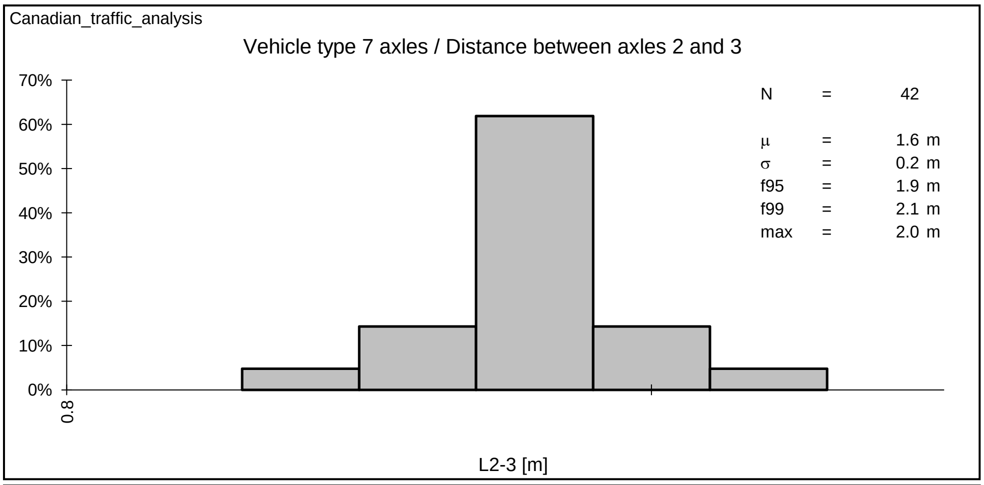

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q5-Q4 and Q3
W4 [kN]
Wtot - W2 - W3 - W6 - W7 - W5 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 1.11
1.11 < % ≤ 2.22
2.22 < % ≤ 3.33
3.33 < % ≤ 4.44
4.44 < % ≤ 5.56
N = 36
Xmin = 76.0 kN
Xmax = 157.0 kN
Xµ = 124.4 kN
Ymin = 19.0 kN
Ymax = 99.0 kN
Yµ = 68.5 kN
Y = aX+b
a = 0.831
b = -34.8

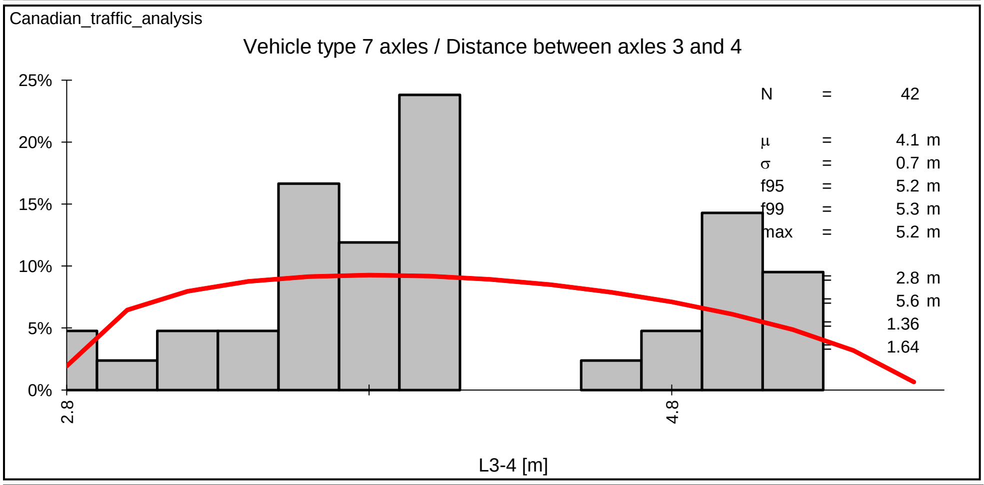

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
W3 [kN]
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 2.78
2.78 < % ≤ 5.56
5.56 < % ≤ 8.33
8.33 < % ≤ 11.11
11.11 < % ≤ 13.89
N = 36
Xmin = 40.0 kN
Xmax = 96.0 kN
Xµ = 83.7 kN
Ymin = 40.0 kN
Ymax = 96.0 kN
Yµ = 83.7 kN

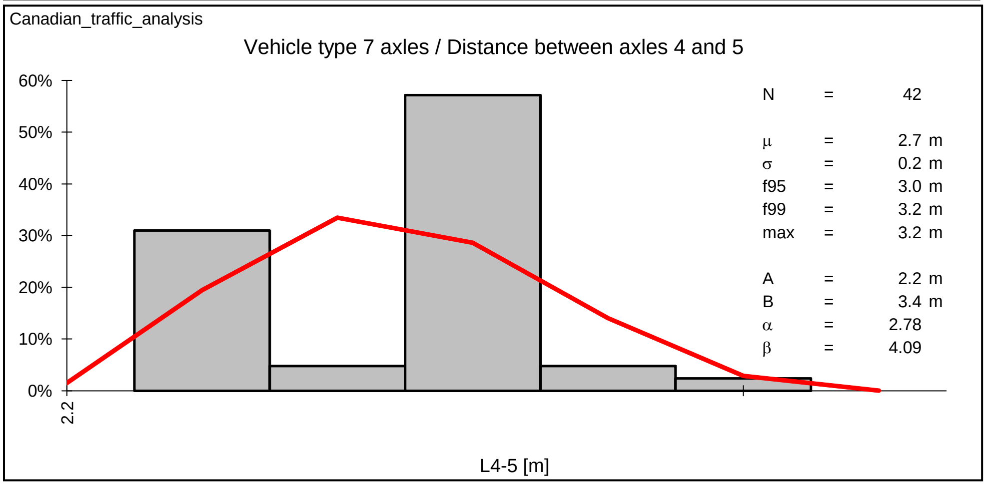

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q5
W7 [kN]
W6 [kN]
0.00 < % ≤ 1.67
1.67 < % ≤ 3.33
3.33 < % ≤ 5.00
5.00 < % ≤ 6.67
6.67 < % ≤ 8.33
N = 36
Xmin = 19.0 kN
Xmax = 100.0 kN
Xµ = 77.6 kN
Ymin = 19.0 kN
Ymax = 100.0 kN
Yµ = 77.6 kN

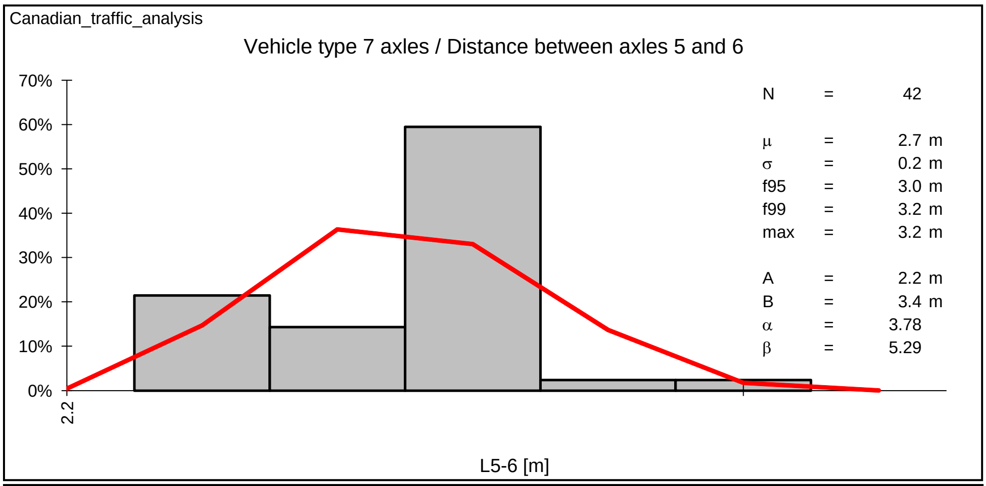

Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
Wtot [kN]
N = 42
µ = 487.9 kN
σ = 100.3 kN
f95 = 604.5 kN
f99 = 611.4 kN
max = 610.0 kN

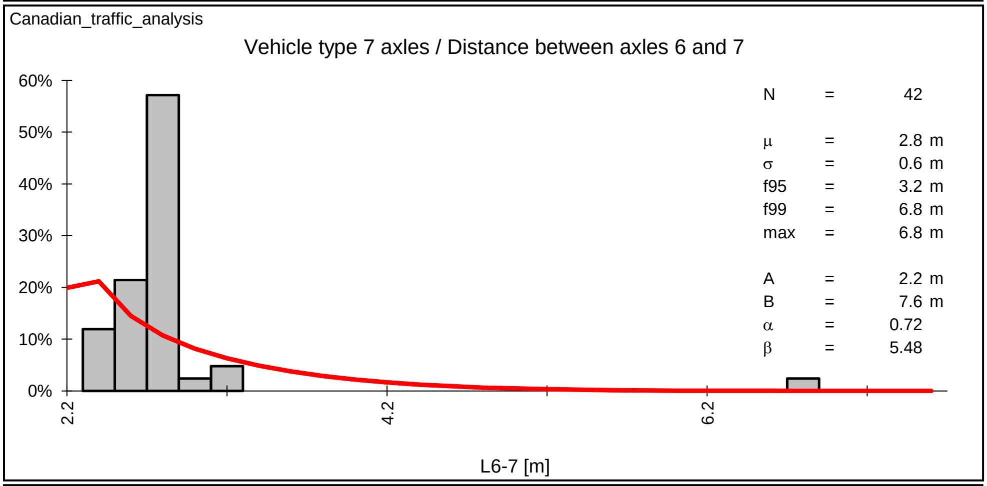

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
L1-2 [m]
N = 42
µ = 4.8 m
σ = 0.7 m
f95 = 6.1 m
f99 = 7.6 m
max = 7.6 m
A = 2.4 m
B = 8.0 m
α = 6.01
β = 8.07

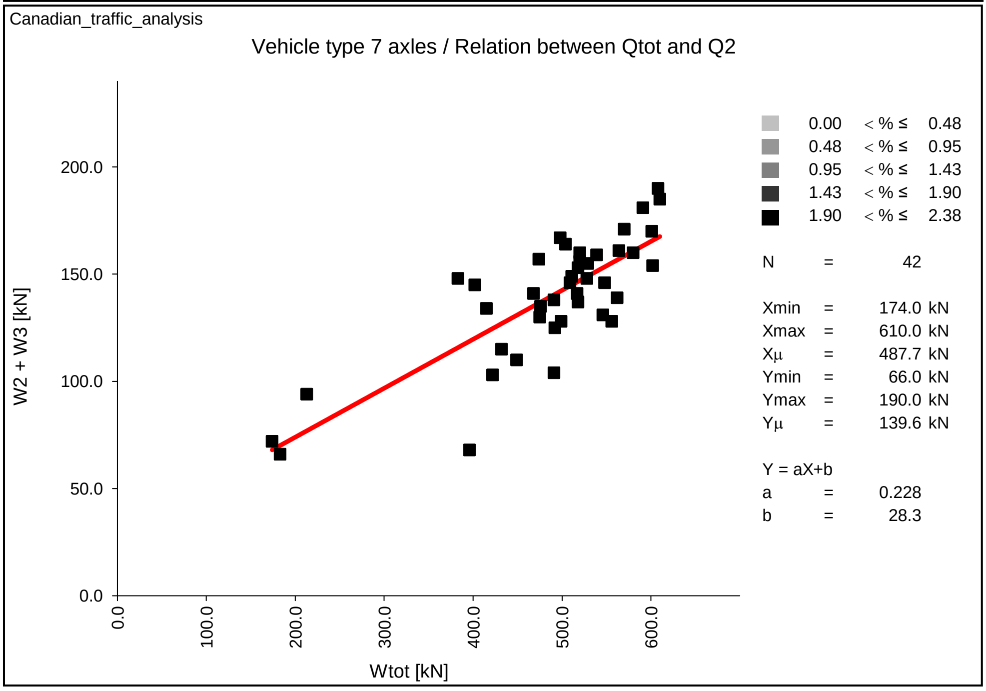

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L2-3 [m]
N = 42
μ = 1.6 m
σ = 0.2 m
f95 = 1.9 m
f99 = 2.1 m
max = 2.0 m

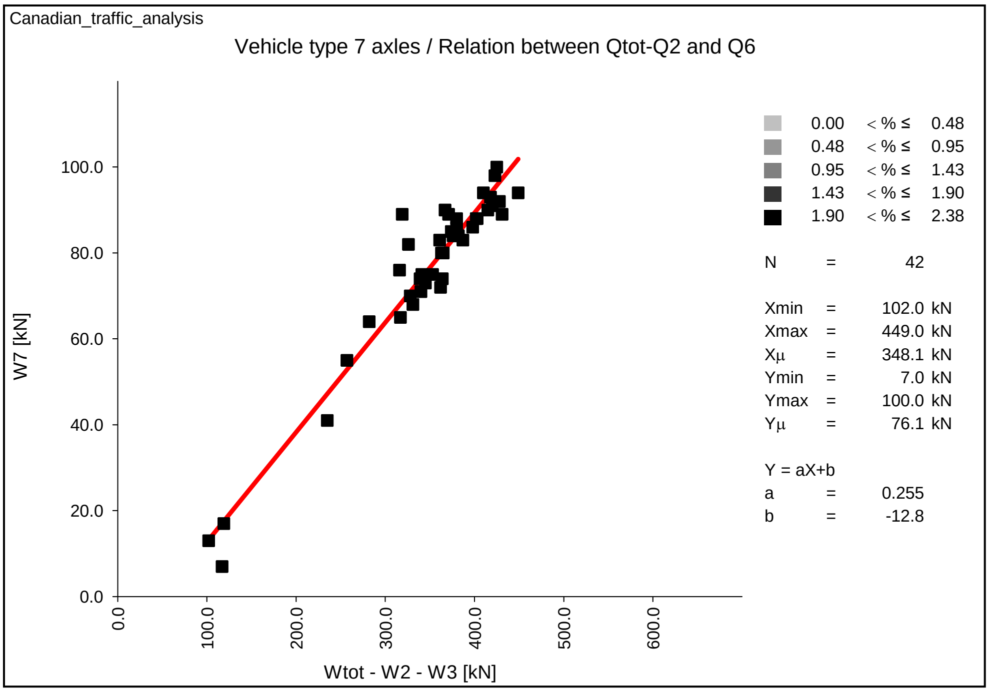

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
25%
20%
15%
10%
5%
0%
2.8
4.8
L3-4 [m]
N = 42
μ = 4.1 m
σ = 0.7 m
f95 = 5.2 m
f99 = 5.3 m
max = 5.2 m
2.8 m
5.6 m
1.36
1.64

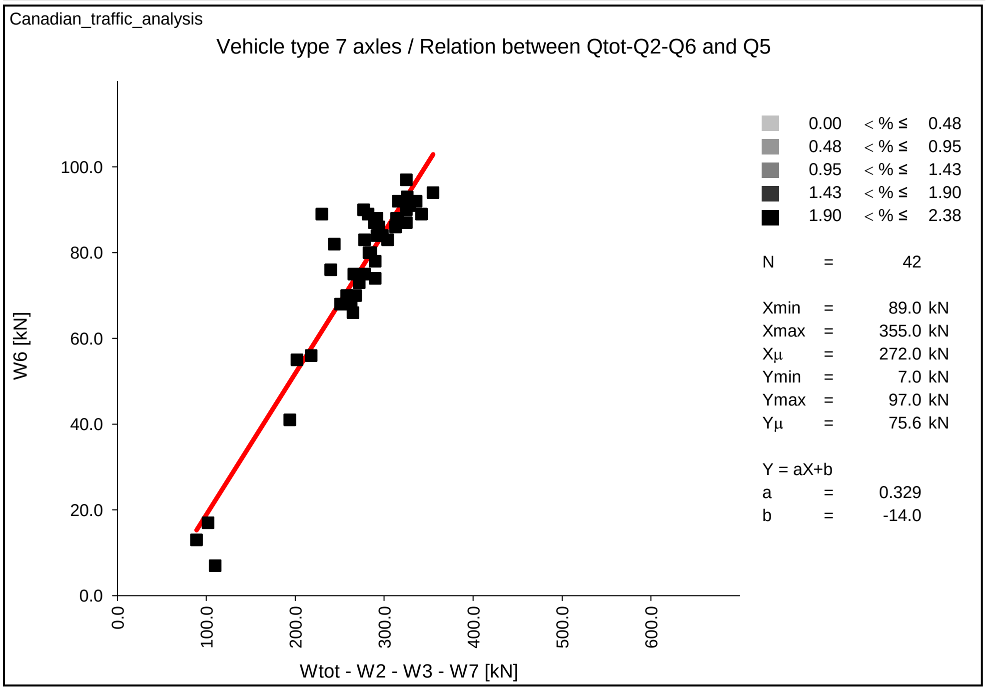

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
60%
50%
40%
30%
20%
10%
0%
2.2
L4-5 [m]
N = 42
μ = 2.7 m
σ = 0.2 m
f95 = 3.0 m
f99 = 3.2 m
max = 3.2 m
A = 2.2 m
B = 3.4 m
α = 2.78
β = 4.09

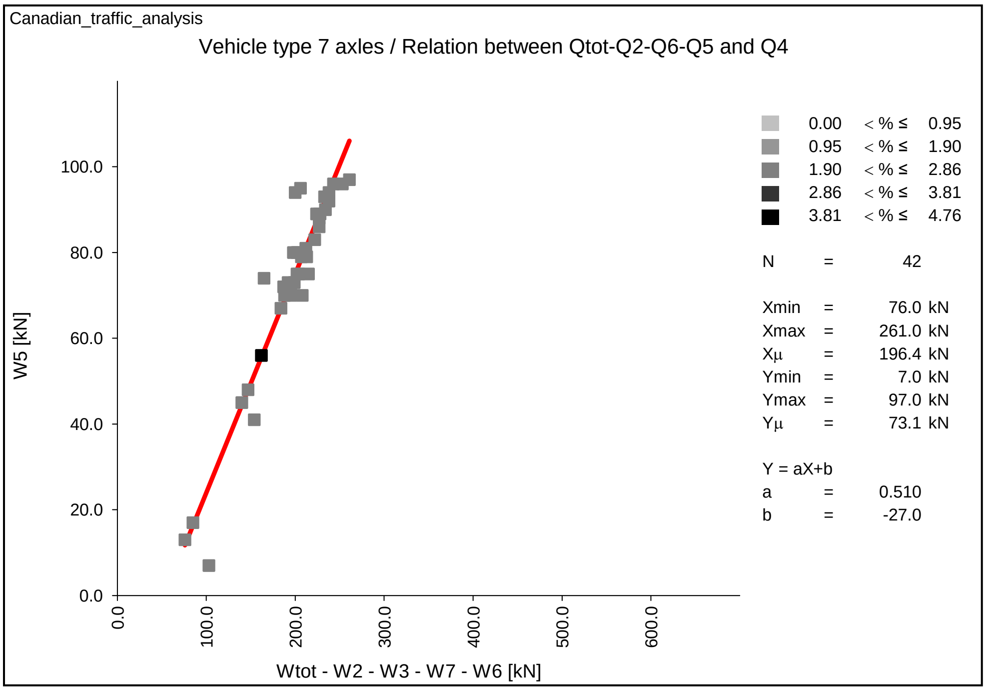

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
70%
60%
50%
40%
30%
20%
10%
0%
2.2
L5-6 [m]
N = 42
μ = 2.7 m
σ = 0.2 m
f95 = 3.0 m
f99 = 3.2 m
max = 3.2 m
A = 2.2 m
B = 3.4 m
α = 3.78
β = 5.29

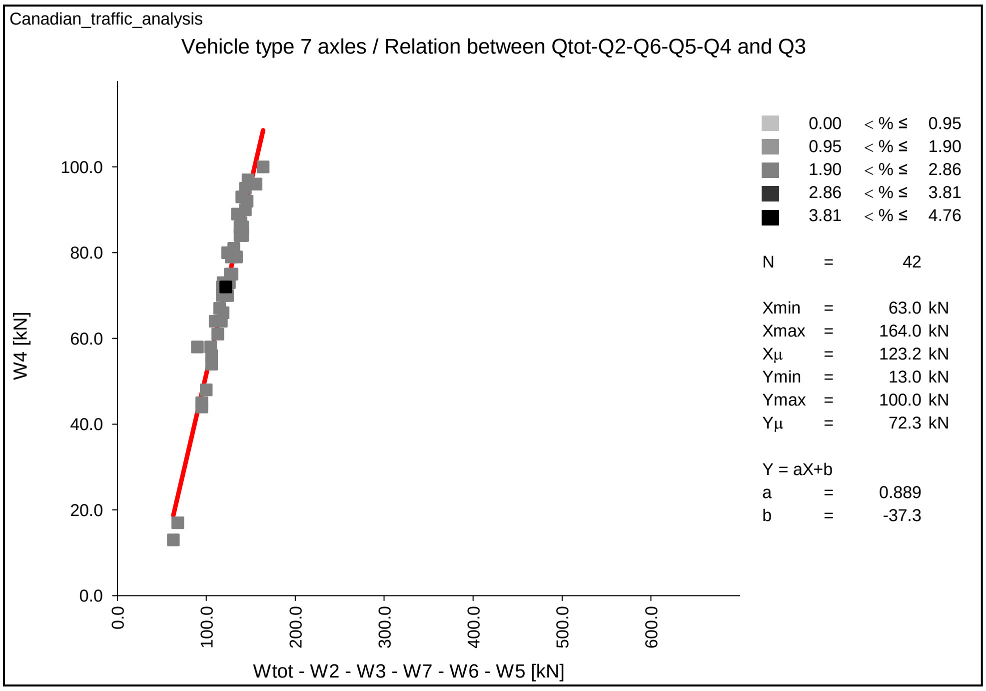

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
60%
50%
40%
30%
20%
10%
0%
2.2
4.2
6.2
L6-7 [m]
N = 42
μ = 2.8 m
σ = 0.6 m
f95 = 3.2 m
f99 = 6.8 m
max = 6.8 m
A = 2.2 m
B = 7.6 m
α = 0.72
β = 5.48

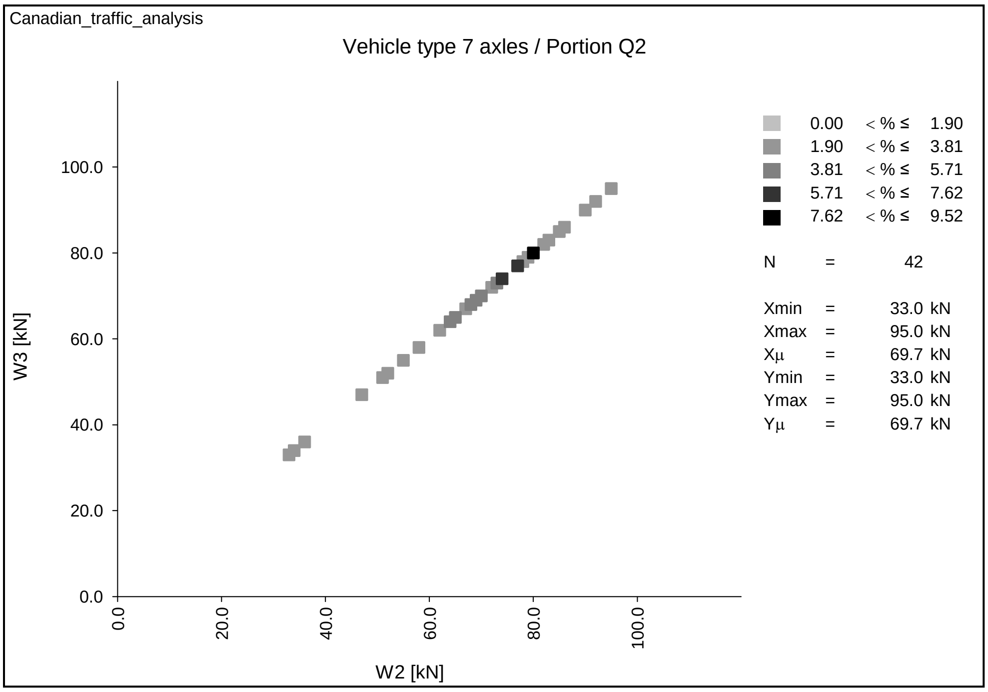

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]
0.00 < % ≤ 0.48
0.48 < % ≤ 0.95
0.95 < % ≤ 1.43
1.43 < % ≤ 1.90
1.90 < % ≤ 2.38
N = 42
Xmin = 174.0 kN
Xmax = 610.0 kN
Xμ = 487.7 kN
Ymin = 66.0 kN
Ymax = 190.0 kN
Yμ = 139.6 kN
Y = aX+b
a = 0.228
b = 28.3

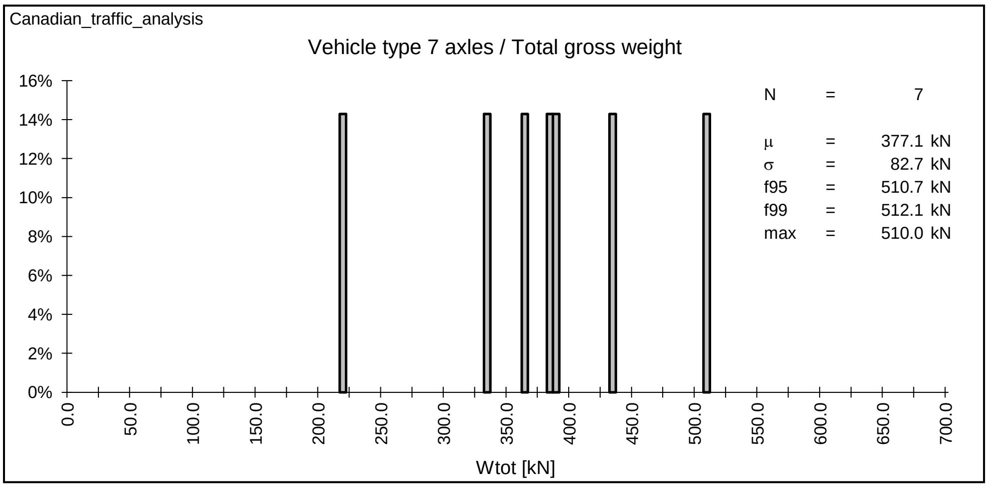

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q6
W7 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot - W2 - W3 [kN]
0.00 < % ≤ 0.48
0.48 < % ≤ 0.95
0.95 < % ≤ 1.43
1.43 < % ≤ 1.90
1.90 < % ≤ 2.38
N = 42
Xmin = 102.0 kN
Xmax = 449.0 kN
Xμ = 348.1 kN
Ymin = 7.0 kN
Ymax = 100.0 kN
Yμ = 76.1 kN
Y = aX+b
a = 0.255
b = -12.8

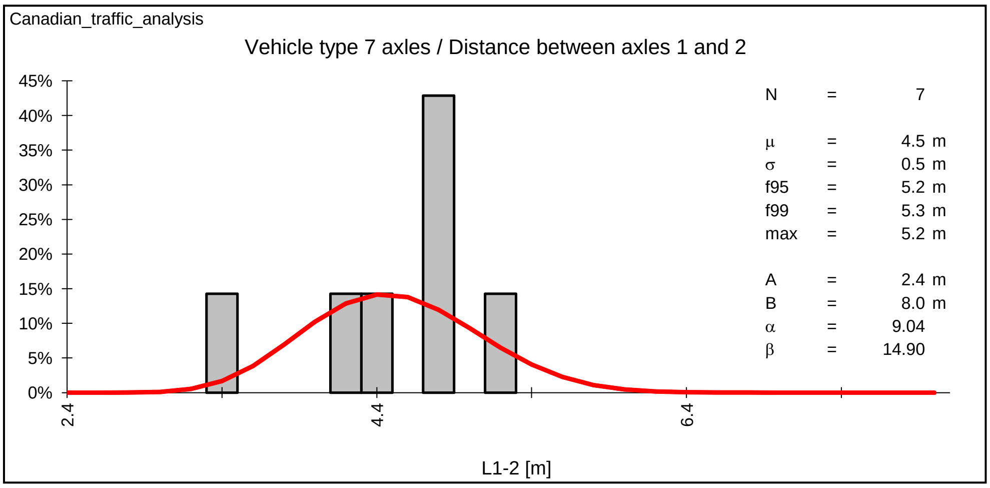

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q6 and Q5
W6 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot - W2 - W3 - W7 [kN]
0.00 < % ≤ 0.48
0.48 < % ≤ 0.95
0.95 < % ≤ 1.43
1.43 < % ≤ 1.90
1.90 < % ≤ 2.38
N = 42
Xmin = 89.0 kN
Xmax = 355.0 kN
Xμ = 272.0 kN
Ymin = 7.0 kN
Ymax = 97.0 kN
Yμ = 75.6 kN
Y = aX+b
a = 0.329
b = -14.0

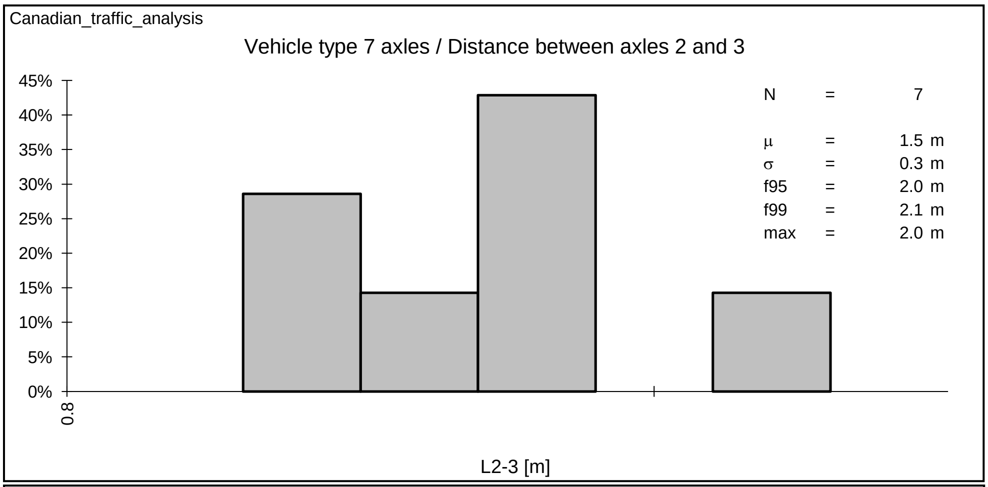

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q6-Q5 and Q4
W5 [kN]
Wtot - W2 - W3 - W7 - W6 [kN]
0.00 < % ≤ 0.95
0.95 < % ≤ 1.90
1.90 < % ≤ 2.86
2.86 < % ≤ 3.81
3.81 < % ≤ 4.76
N = 42
Xmin = 76.0 kN
Xmax = 261.0 kN
Xµ = 196.4 kN
Ymin = 7.0 kN
Ymax = 97.0 kN
Yµ = 73.1 kN
Y = aX+b
a = 0.510
b = -27.0

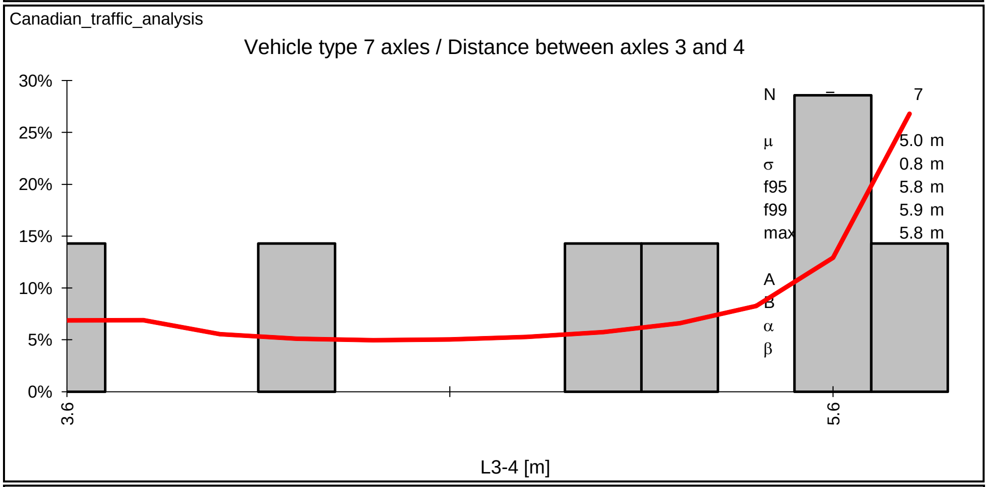

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q6-Q5-Q4 and Q3
W4 [kN]
Wtot - W2 - W3 - W7 - W6 - W5 [kN]
0.00 < % ≤ 0.95
0.95 < % ≤ 1.90
1.90 < % ≤ 2.86
2.86 < % ≤ 3.81
3.81 < % ≤ 4.76
N = 42
Xmin = 63.0 kN
Xmax = 164.0 kN
Xµ = 123.2 kN
Ymin = 13.0 kN
Ymax = 100.0 kN
Yµ = 72.3 kN
Y = aX+b
a = 0.889
b = -37.3

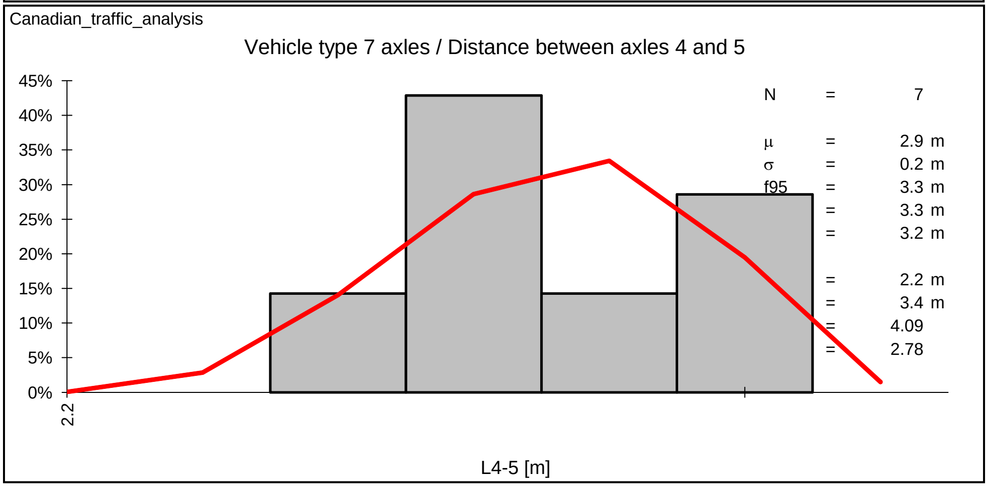

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 1.90
1.90 < % ≤ 3.81
3.81 < % ≤ 5.71
5.71 < % ≤ 7.62
7.62 < % ≤ 9.52
N = 42
Xmin = 33.0 kN
Xmax = 95.0 kN
Xμ = 69.7 kN
Ymin = 33.0 kN
Ymax = 95.0 kN
Yμ = 69.7 kN

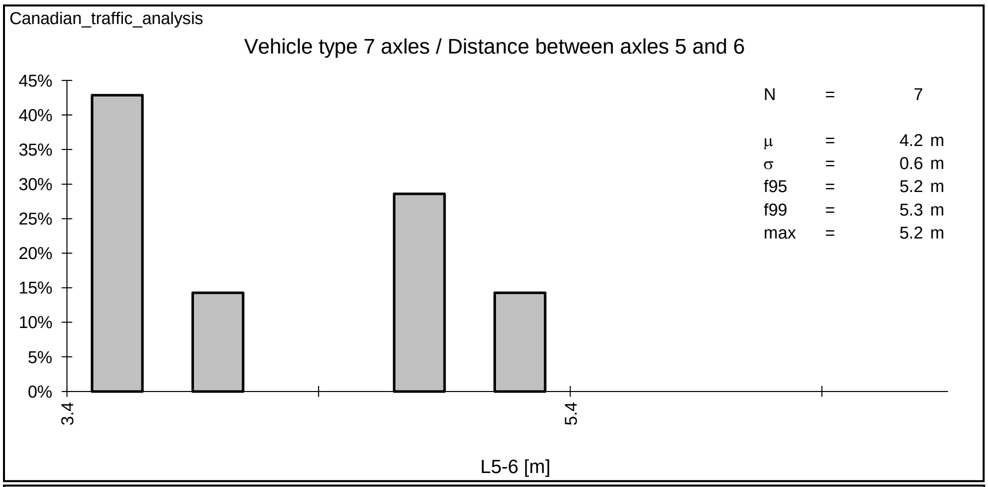

Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
Wtot [kN]
N = 7
μ = 377.1 kN
σ = 82.7 kN
f95 = 510.7 kN
f99 = 512.1 kN
max = 510.0 kN

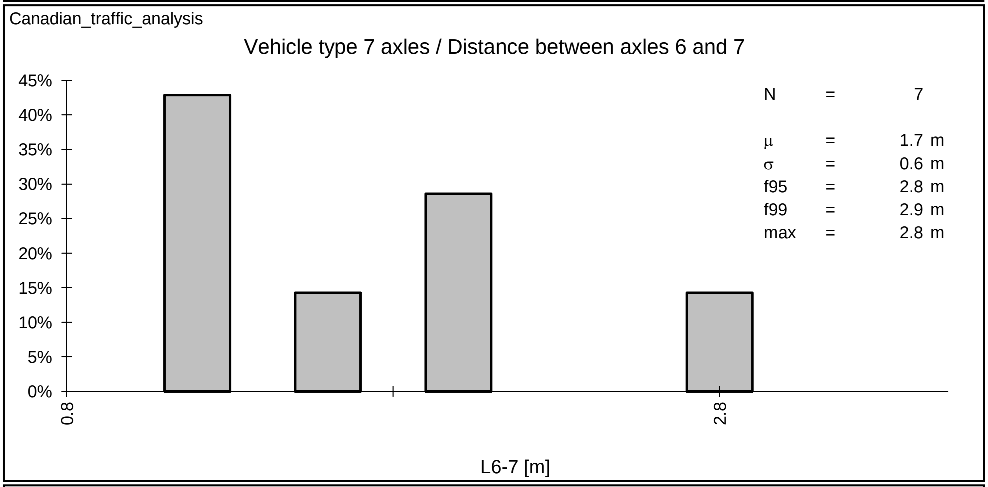

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
L1-2 [m]
N = 7
μ = 4.5 m
σ = 0.5 m
f95 = 5.2 m
f99 = 5.3 m
max = 5.2 m
A = 2.4 m
B = 8.0 m
α = 9.04
β = 14.90

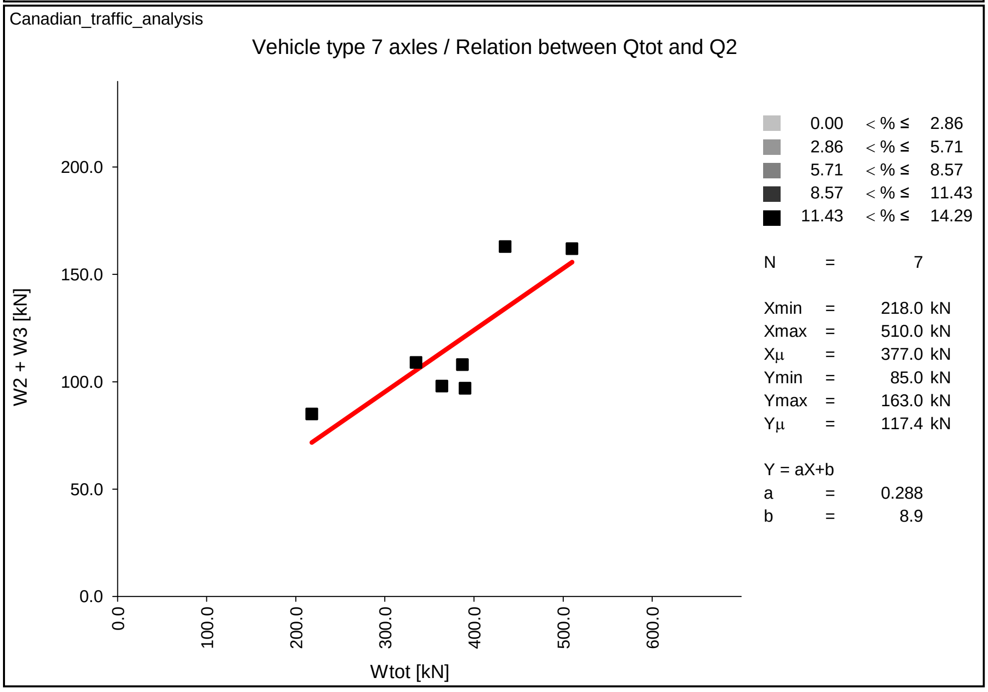

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
N = 7
μ = 1.5 m
σ = 0.3 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L2-3 [m]

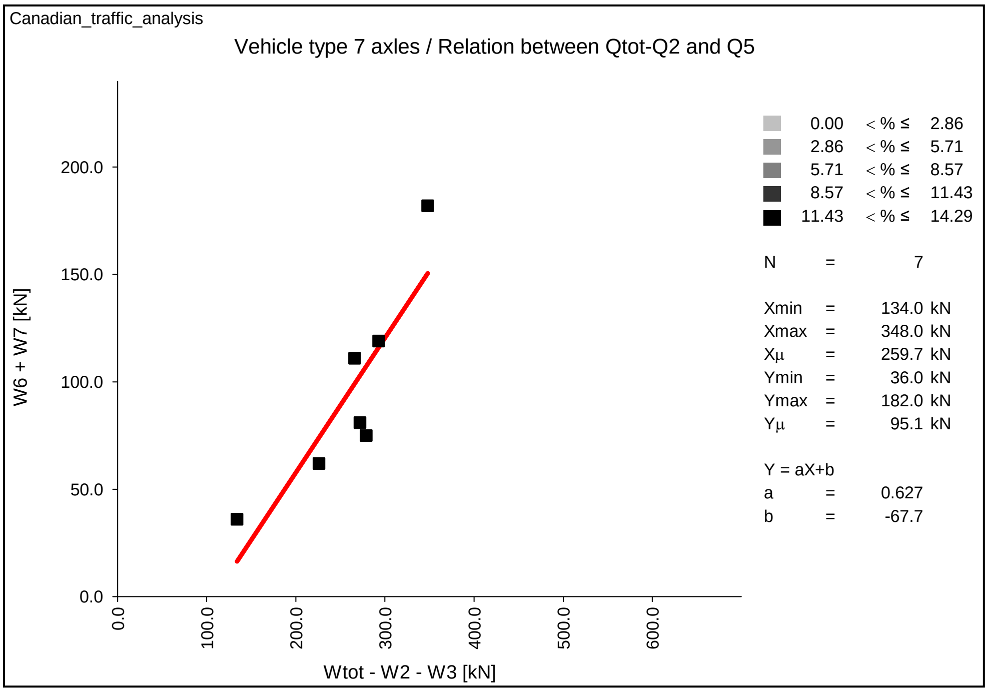

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
30%
25%
20%
15%
10%
5%
0%
3.6
5.6
N 7
μ 5.0 m
σ 0.8 m
f95 5.8 m
f99 5.9 m
max 5.8 m
A
B
α
β
L3-4 [m]

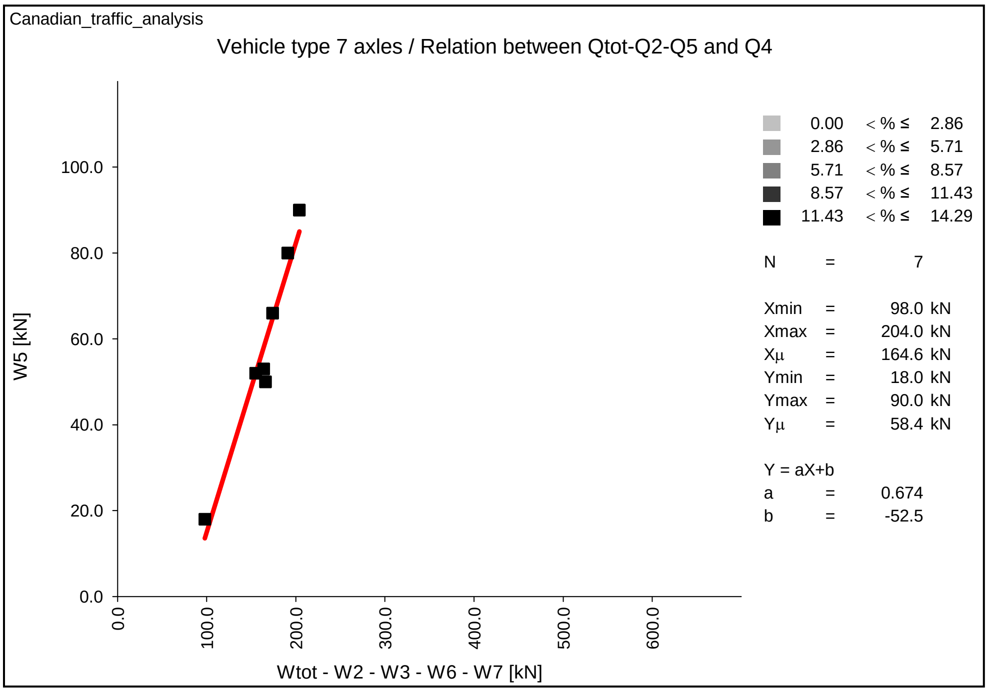

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
N = 7
μ = 2.9 m
σ = 0.2 m
f95 = 3.3 m
= 3.3 m
= 3.2 m
= 2.2 m
= 3.4 m
= 4.09
= 2.78
L4-5 [m]

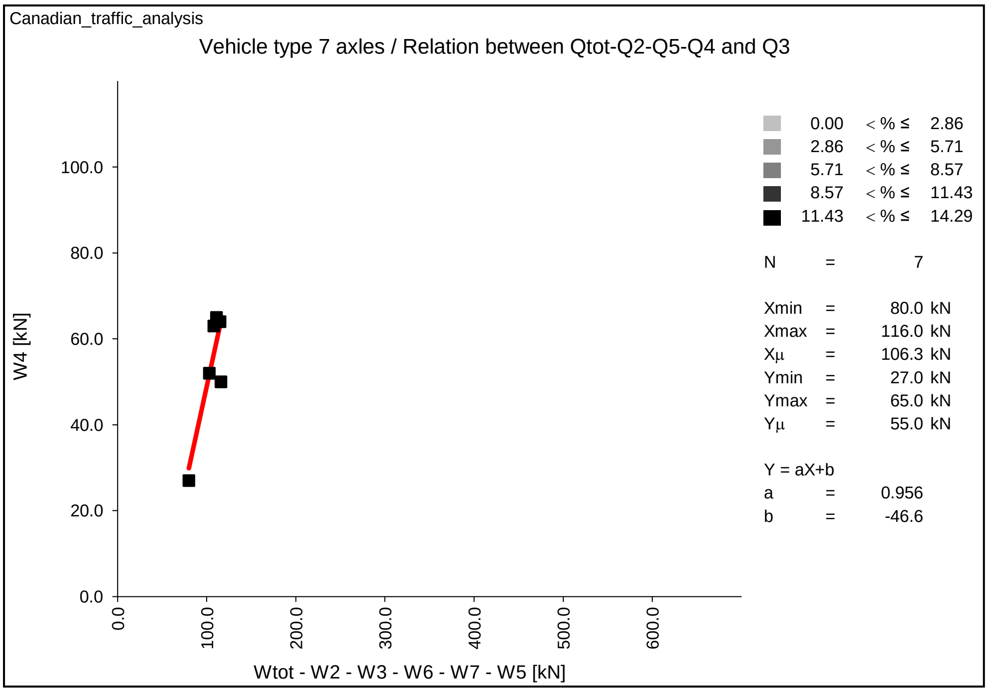

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
3.4
5.4
L5-6 [m]
N = 7
μ = 4.2 m
σ = 0.6 m
f95 = 5.2 m
f99 = 5.3 m
max = 5.2 m

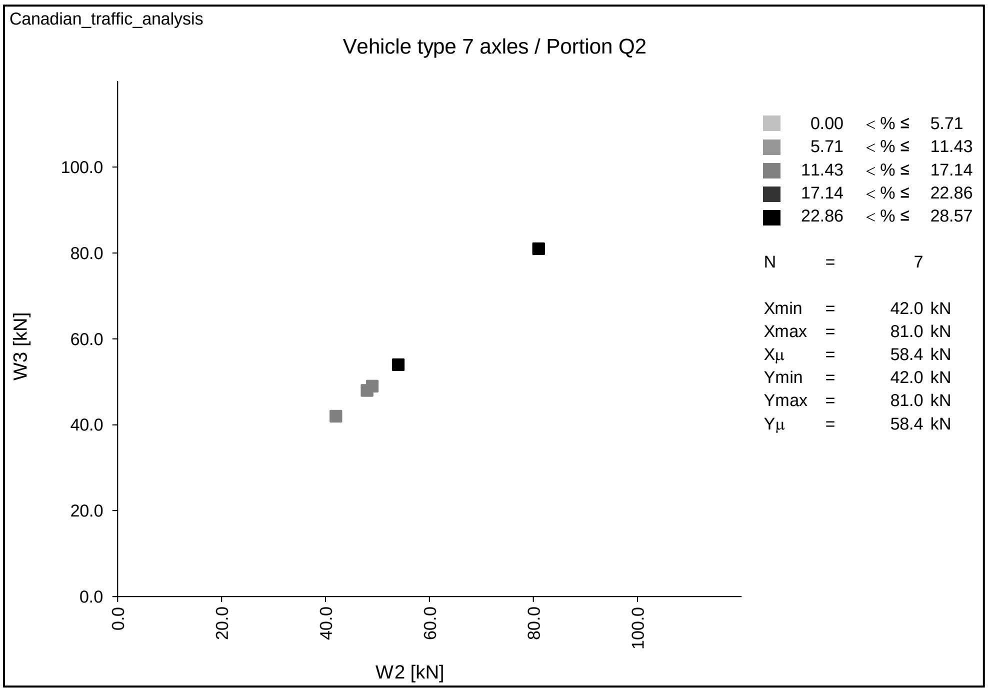

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
2.8
L6-7 [m]
N = 7
μ = 1.7 m
σ = 0.6 m
f95 = 2.8 m
f99 = 2.9 m
max = 2.8 m

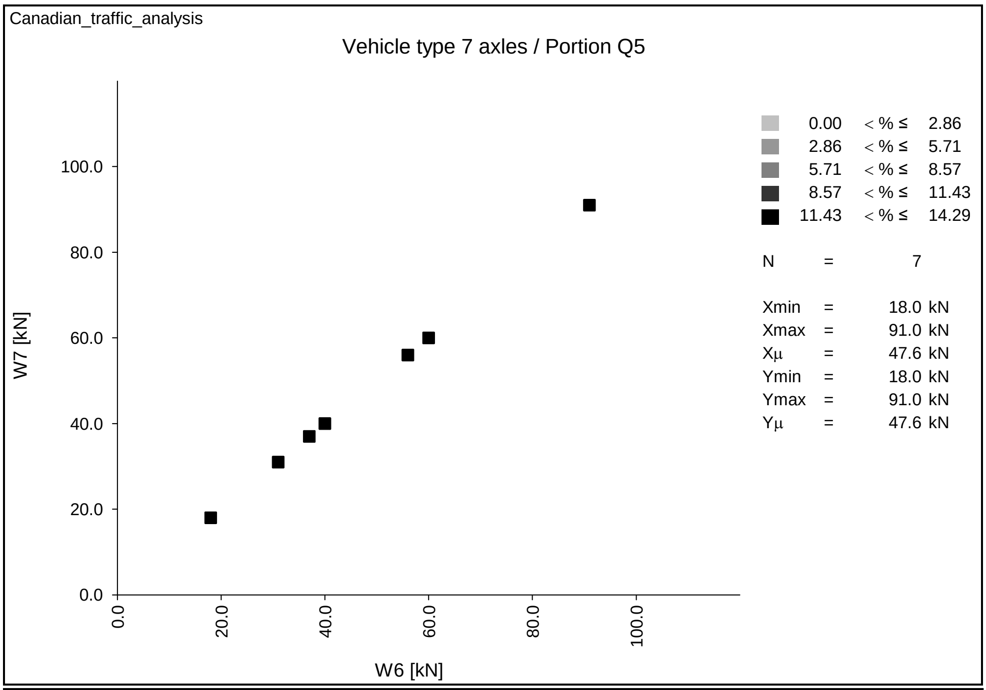

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]
0.00 < % ≤ 2.86
2.86 < % ≤ 5.71
5.71 < % ≤ 8.57
8.57 < % ≤ 11.43
11.43 < % ≤ 14.29
N = 7
Xmin = 218.0 kN
Xmax = 510.0 kN
Xμ = 377.0 kN
Ymin = 85.0 kN
Ymax = 163.0 kN
Yμ = 117.4 kN
Y = aX+b
a = 0.288
b = 8.9

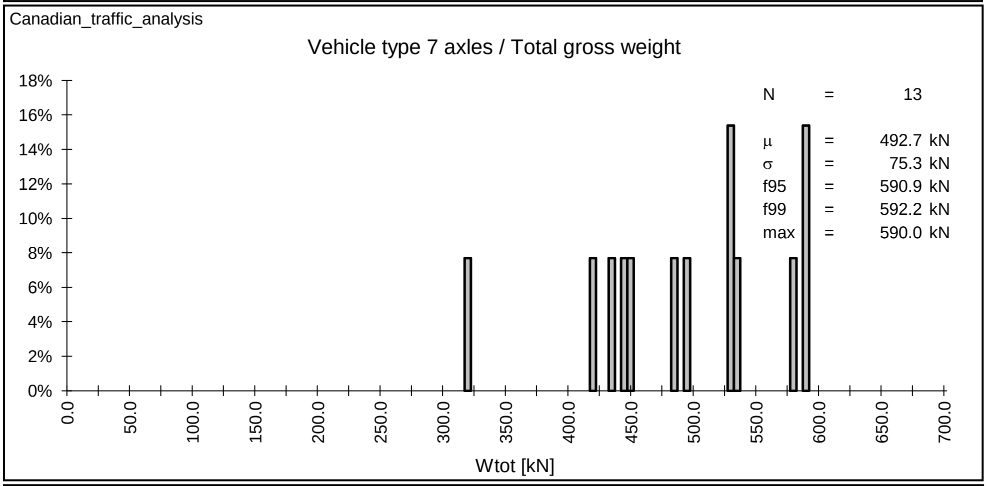

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q5
W6 + W7 [kN]
0.0
50.0
100.0
150.0
200.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot - W2 - W3 [kN]
0.00 < % ≤ 2.86
2.86 < % ≤ 5.71
5.71 < % ≤ 8.57
8.57 < % ≤ 11.43
11.43 < % ≤ 14.29
N = 7
Xmin = 134.0 kN
Xmax = 348.0 kN
Xµ = 259.7 kN
Ymin = 36.0 kN
Ymax = 182.0 kN
Yµ = 95.1 kN
Y = aX+b
a = 0.627
b = -67.7

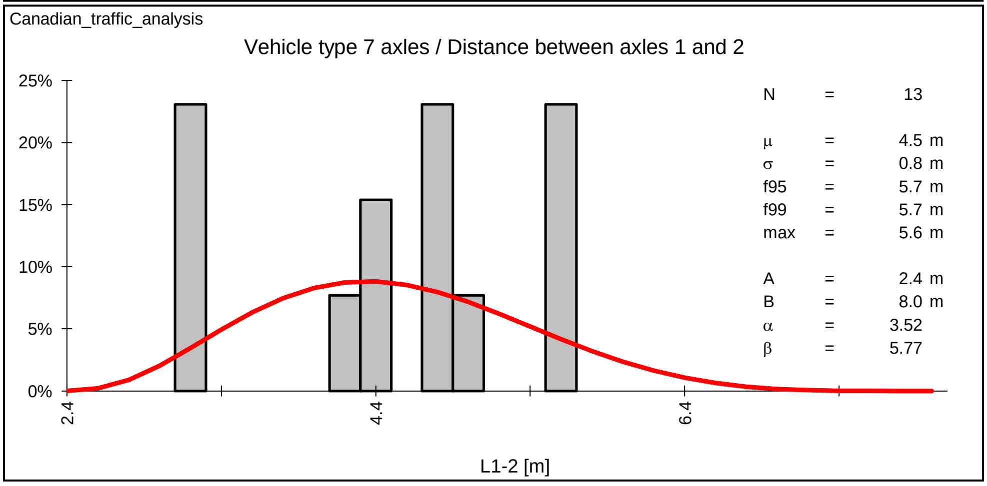

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q5 and Q4
W5 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot - W2 - W3 - W6 - W7 [kN]
0.00 < % ≤ 2.86
2.86 < % ≤ 5.71
5.71 < % ≤ 8.57
8.57 < % ≤ 11.43
11.43 < % ≤ 14.29
N = 7
Xmin = 98.0 kN
Xmax = 204.0 kN
Xµ = 164.6 kN
Ymin = 18.0 kN
Ymax = 90.0 kN
Yµ = 58.4 kN
Y = aX+b
a = 0.674
b = -52.5

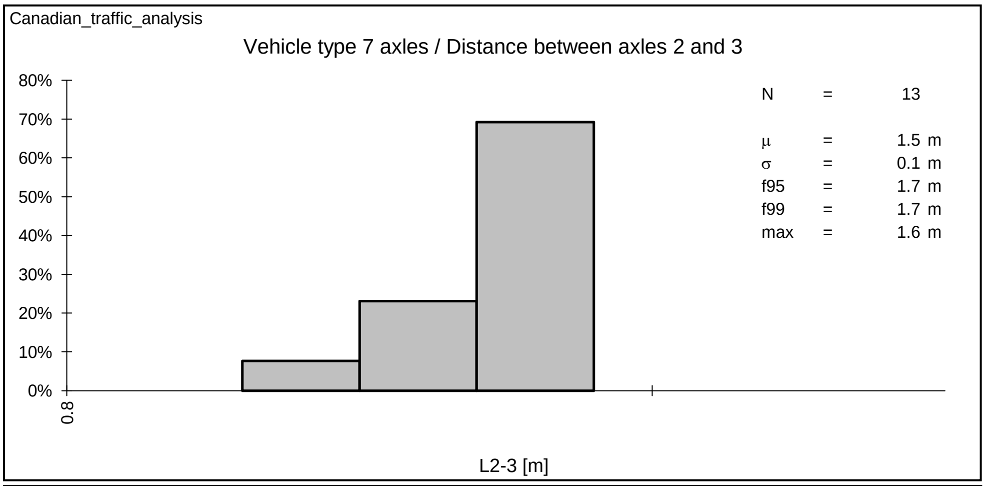

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q5-Q4 and Q3
W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot - W2 - W3 - W6 - W7 - W5 [kN]
0.00 < % ≤ 2.86
2.86 < % ≤ 5.71
5.71 < % ≤ 8.57
8.57 < % ≤ 11.43
11.43 < % ≤ 14.29
N = 7
Xmin = 80.0 kN
Xmax = 116.0 kN
Xµ = 106.3 kN
Ymin = 27.0 kN
Ymax = 65.0 kN
Yµ = 55.0 kN
Y = aX+b
a = 0.956
b = -46.6

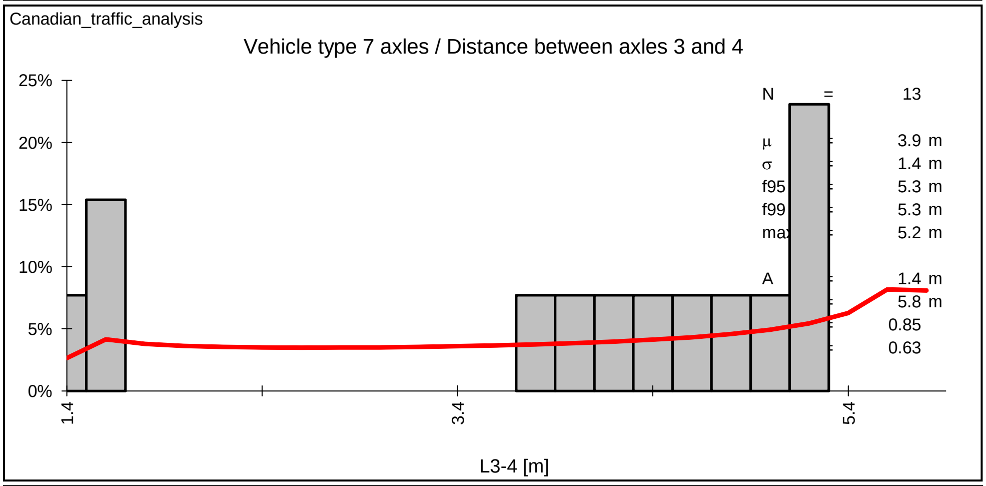

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
W3 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.0
20.0
40.0
60.0
80.0
100.0
W2 [kN]
0.00 < % ≤ 5.71
5.71 < % ≤ 11.43
11.43 < % ≤ 17.14
17.14 < % ≤ 22.86
22.86 < % ≤ 28.57
N = 7
Xmin = 42.0 kN
Xmax = 81.0 kN
Xµ = 58.4 kN
Ymin = 42.0 kN
Ymax = 81.0 kN
Yµ = 58.4 kN

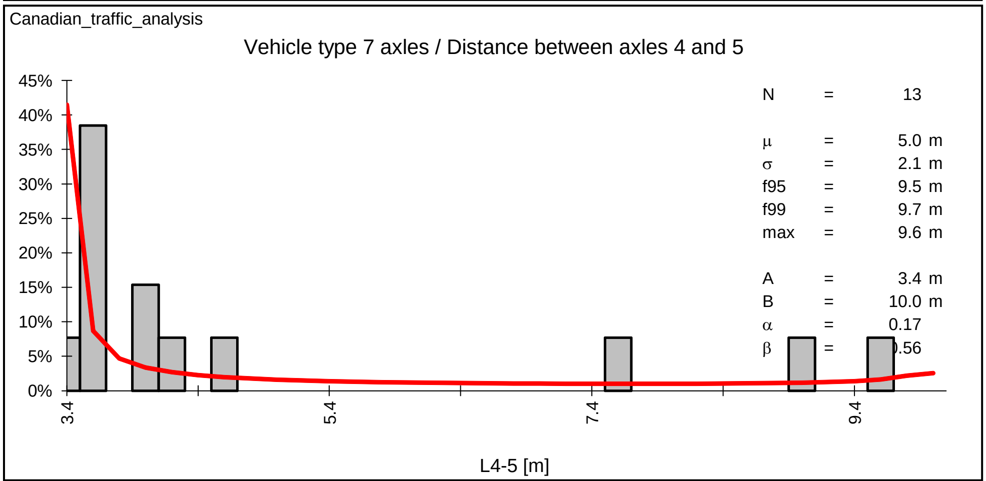

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q5
0.00 < % ≤ 2.86
2.86 < % ≤ 5.71
5.71 < % ≤ 8.57
8.57 < % ≤ 11.43
11.43 < % ≤ 14.29
N = 7
Xmin = 18.0 kN
Xmax = 91.0 kN
Xμ = 47.6 kN
Ymin = 18.0 kN
Ymax = 91.0 kN
Yμ = 47.6 kN
W7 [kN]
W6 [kN]


Canadian_traffic_analysis
Vehicle type 7 axles / Total gross weight
N = 13
μ = 492.7 kN
σ = 75.3 kN
f95 = 590.9 kN
f99 = 592.2 kN
max = 590.0 kN
Wtot [kN]

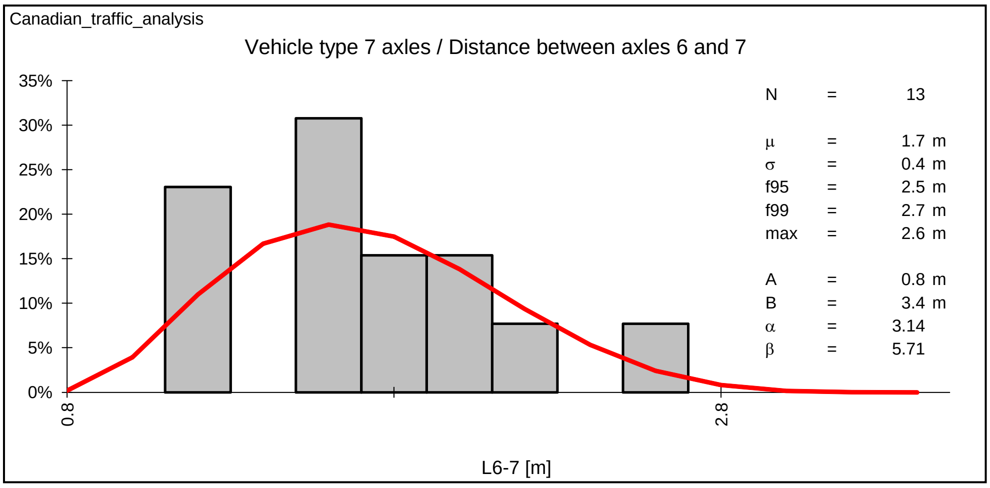

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 1 and 2
N = 13
μ = 4.5 m
σ = 0.8 m
f95 = 5.7 m
f99 = 5.7 m
max = 5.6 m
A = 2.4 m
B = 8.0 m
α = 3.52
β = 5.77
L1-2 [m]

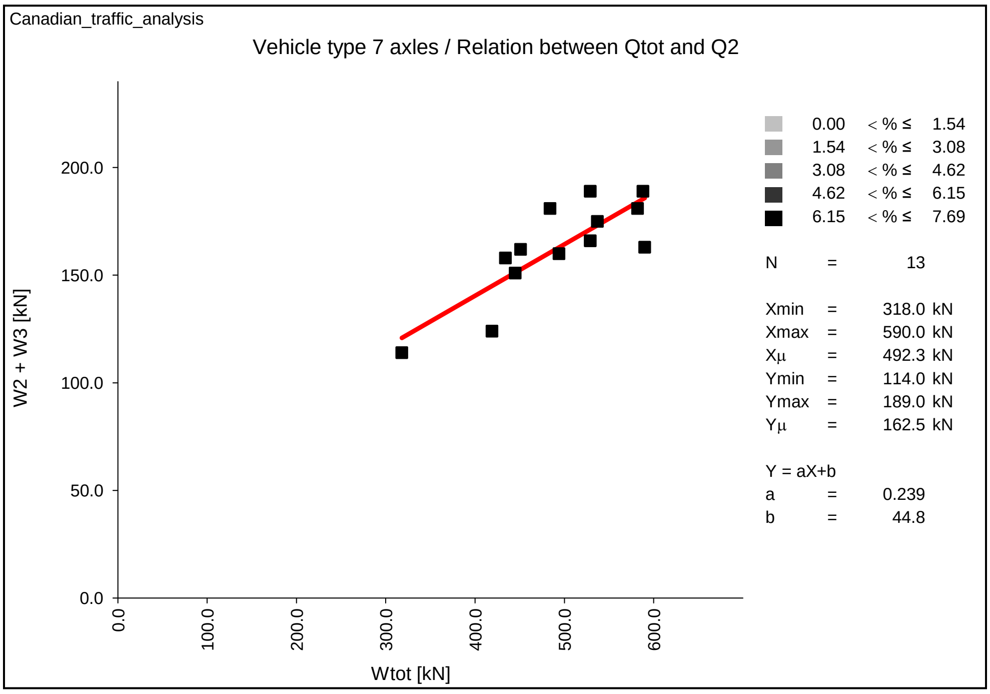

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 2 and 3
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
N = 13
μ = 1.5 m
σ = 0.1 m
f95 = 1.7 m
f99 = 1.7 m
max = 1.6 m
L2-3 [m]

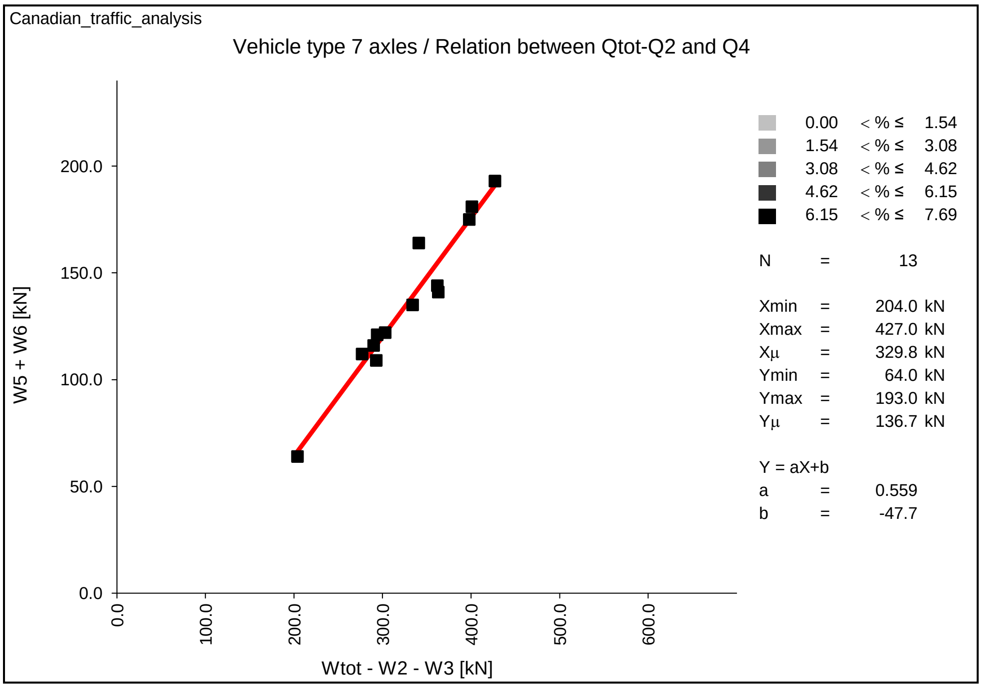

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 3 and 4
25%
20%
15%
10%
5%
0%
1.4
3.4
5.4
N = 13
3.9 m
1.4 m
5.3 m
5.3 m
5.2 m
1.4 m
5.8 m
0.85
0.63
L3-4 [m]

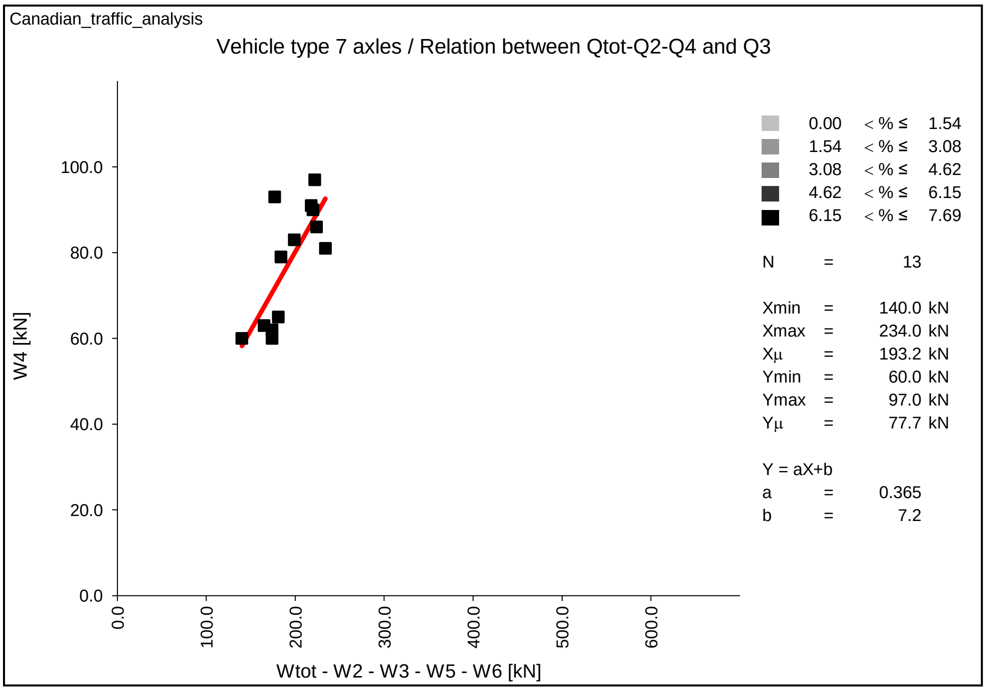

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 4 and 5
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
3.4
5.4
7.4
9.4
N = 13
μ = 5.0 m
σ = 2.1 m
f95 = 9.5 m
f99 = 9.7 m
max = 9.6 m
A = 3.4 m
B = 10.0 m
α = 0.17
L4-5 [m]

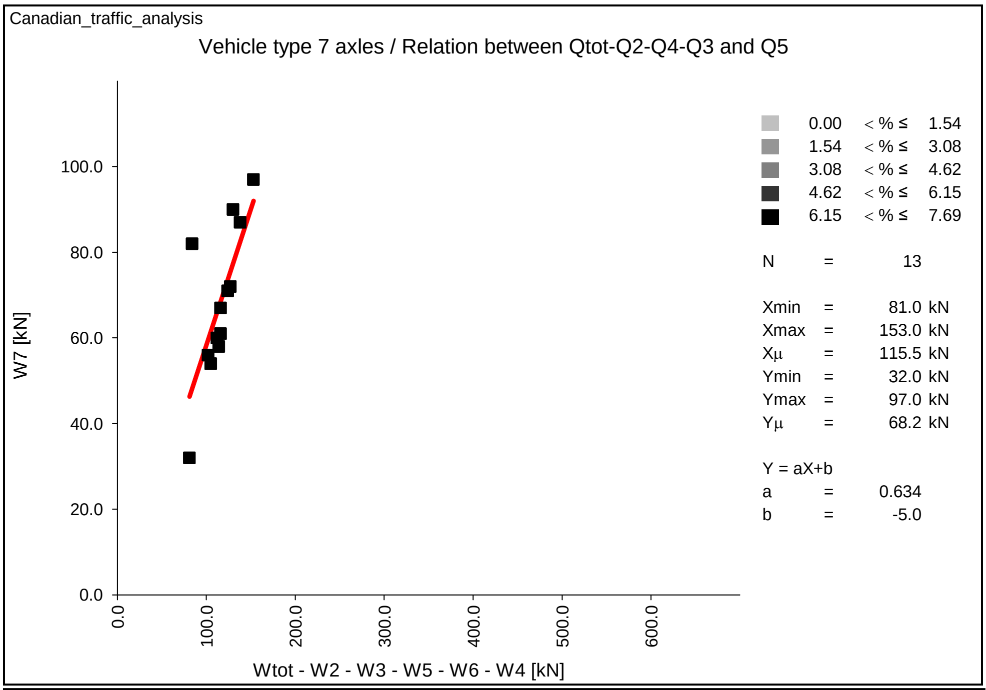

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 5 and 6
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
N = 13
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L5-6 [m]

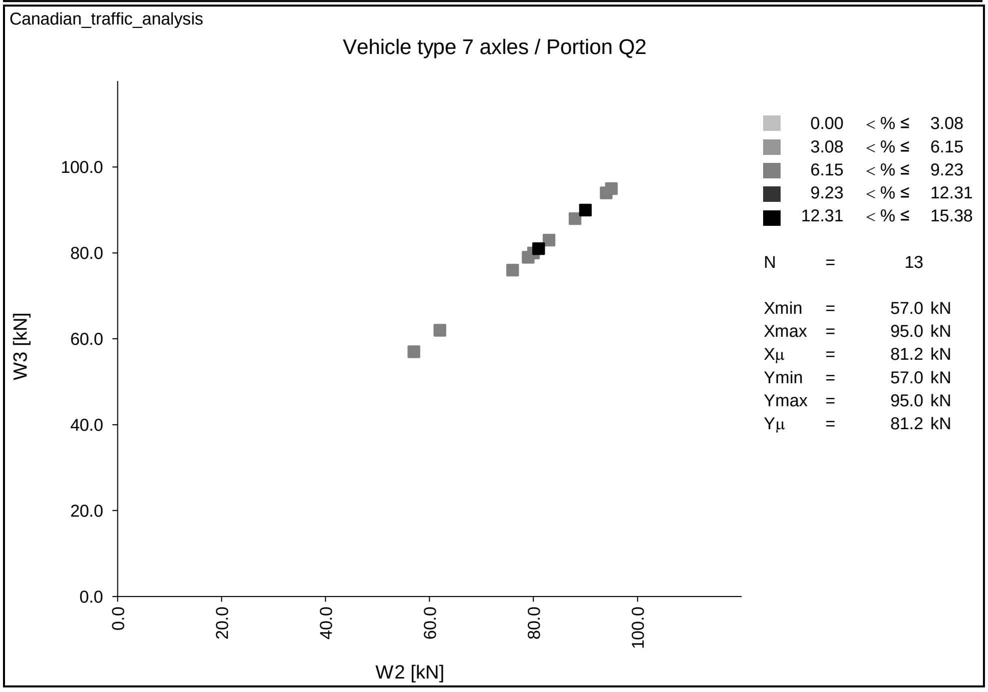

Canadian_traffic_analysis
Vehicle type 7 axles / Distance between axles 6 and 7
35%
30%
25%
20%
15%
10%
5%
0%
0.8
2.8
N = 13
μ = 1.7 m
σ = 0.4 m
f95 = 2.5 m
f99 = 2.7 m
max = 2.6 m
A = 0.8 m
B = 3.4 m
α = 3.14
β = 5.71
L6-7 [m]

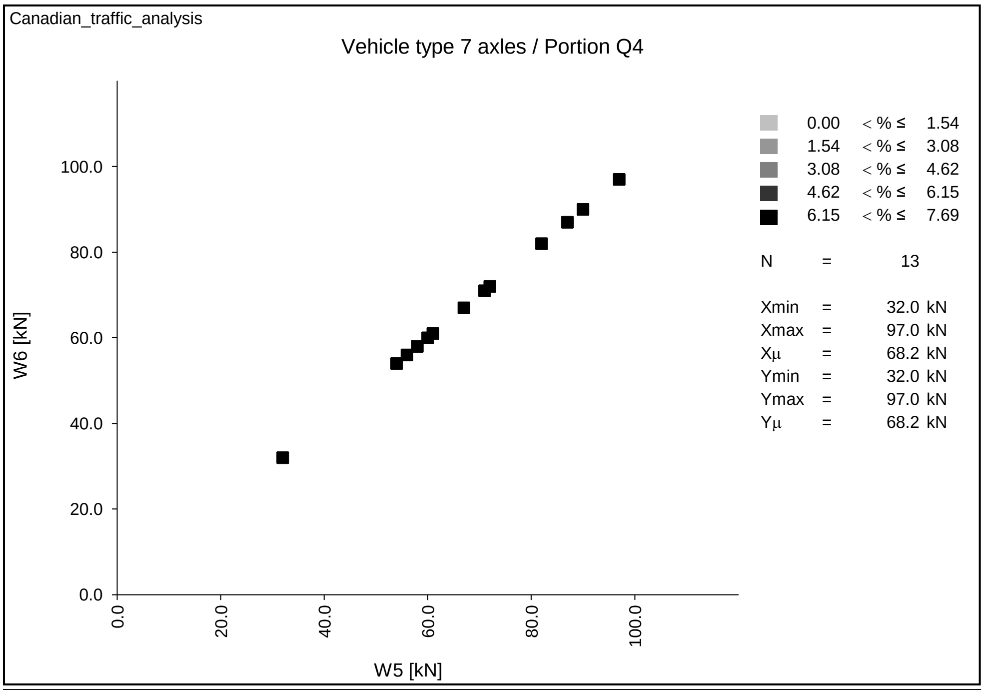

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot and Q2
W2 + W3 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 318.0 kN
Xmax = 590.0 kN
Xμ = 492.3 kN
Ymin = 114.0 kN
Ymax = 189.0 kN
Yμ = 162.5 kN
Y = aX+b
a = 0.239
b = 44.8

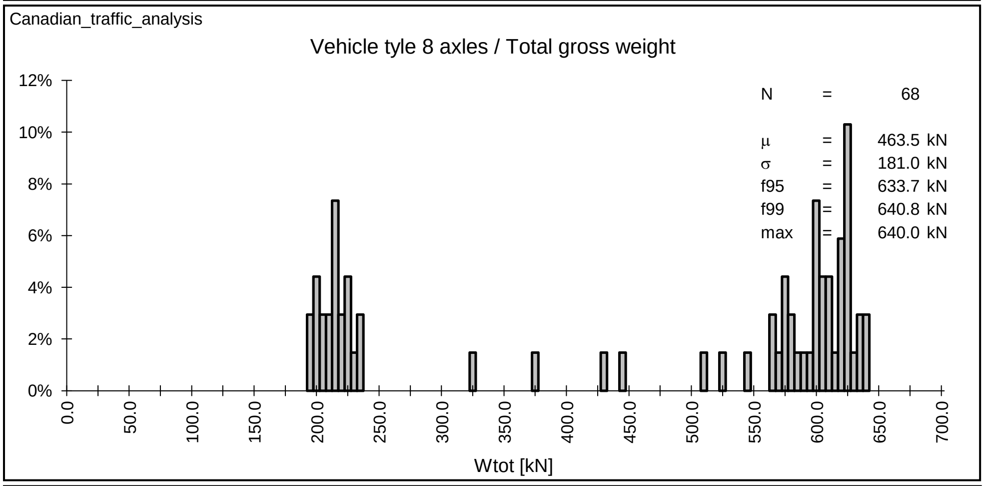

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2 and Q4
W5 + W6 [kN]
Wtot - W2 - W3 [kN]
0.0
50.0
100.0
150.0
200.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 204.0 kN
Xmax = 427.0 kN
Xµ = 329.8 kN
Ymin = 64.0 kN
Ymax = 193.0 kN
Yµ = 136.7 kN
Y = aX+b
a = 0.559
b = -47.7

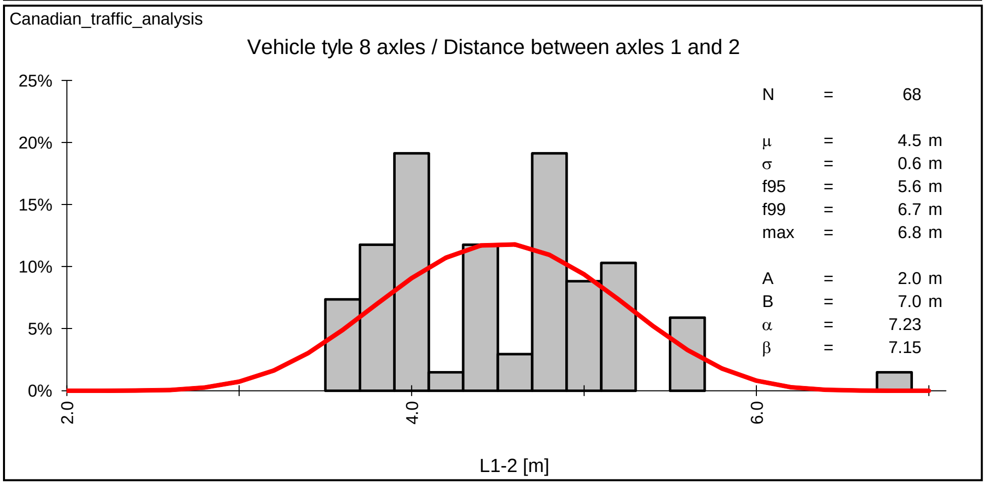

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q4 and Q3
W4 [kN]
Wtot - W2 - W3 - W5 - W6 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 140.0 kN
Xmax = 234.0 kN
Xµ = 193.2 kN
Ymin = 60.0 kN
Ymax = 97.0 kN
Yµ = 77.7 kN
Y = aX+b
a = 0.365
b = 7.2

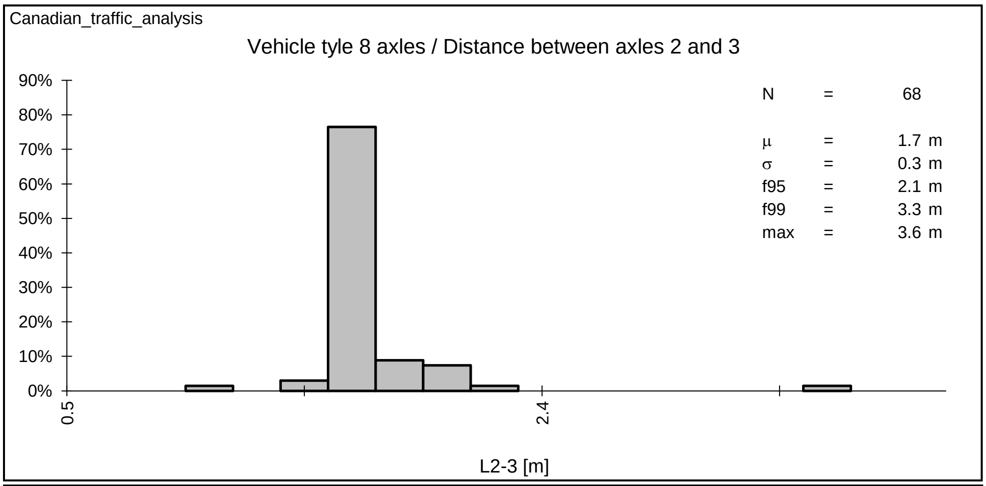

Canadian_traffic_analysis
Vehicle type 7 axles / Relation between Qtot-Q2-Q4-Q3 and Q5
W7 [kN]
Wtot - W2 - W3 - W5 - W6 - W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 81.0 kN
Xmax = 153.0 kN
Xμ = 115.5 kN
Ymin = 32.0 kN
Ymax = 97.0 kN
Yμ = 68.2 kN
Y = aX+b
a = 0.634
b = -5.0

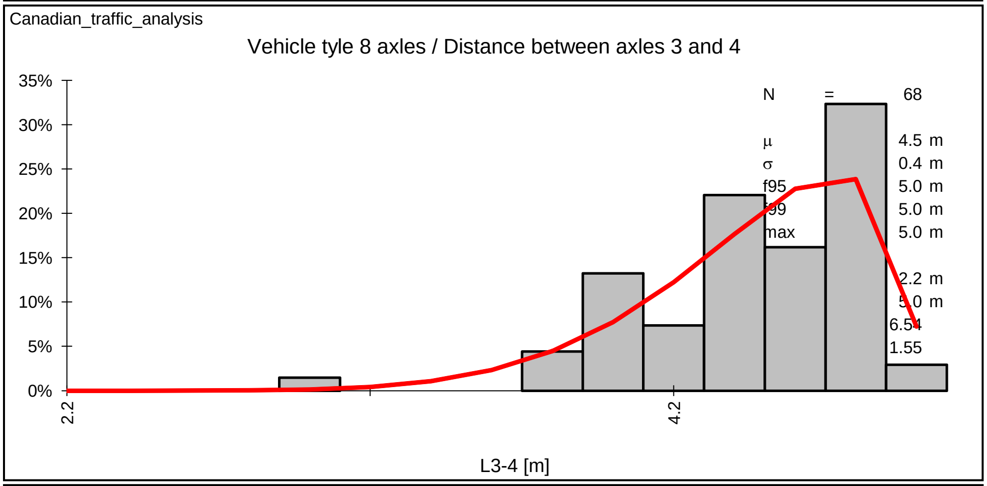

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q2
W3 [kN]
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 3.08
3.08 < % ≤ 6.15
6.15 < % ≤ 9.23
9.23 < % ≤ 12.31
12.31 < % ≤ 15.38
N = 13
Xmin = 57.0 kN
Xmax = 95.0 kN
Xμ = 81.2 kN
Ymin = 57.0 kN
Ymax = 95.0 kN
Yμ = 81.2 kN

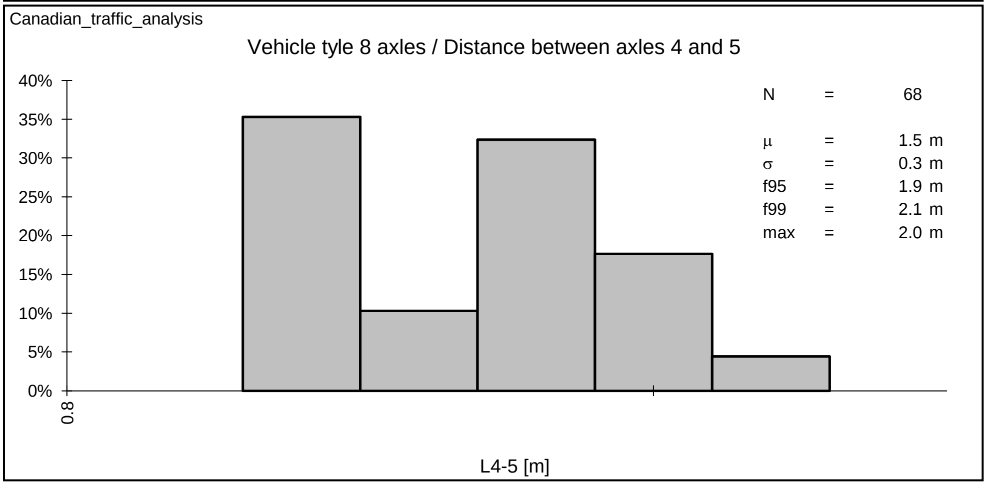

Canadian_traffic_analysis
Vehicle type 7 axles / Portion Q4
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 32.0 kN
Xmax = 97.0 kN
Xμ = 68.2 kN
Ymin = 32.0 kN
Ymax = 97.0 kN
Yμ = 68.2 kN
W6 [kN]
W5 [kN]

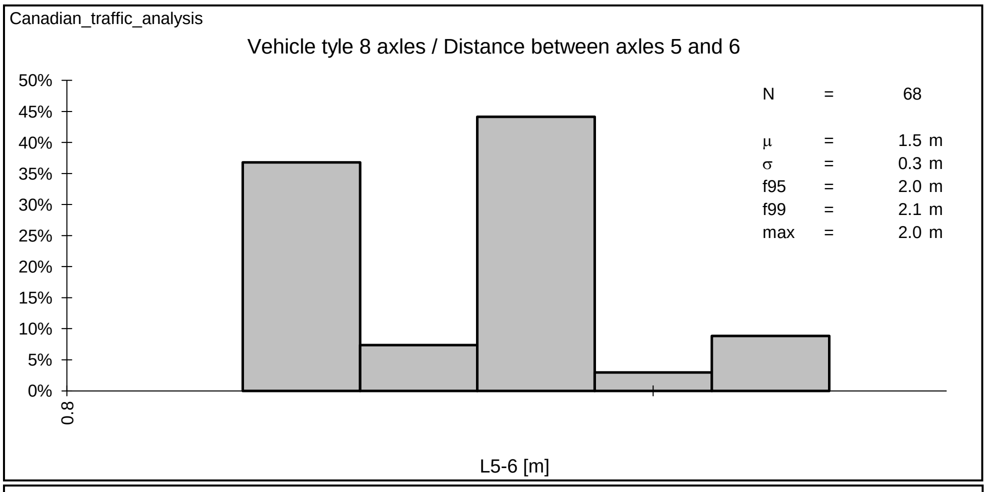

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
N = 68
μ = 463.5 kN
σ = 181.0 kN
f95 = 633.7 kN
f99 = 640.8 kN
max = 640.0 kN
Wtot [kN]

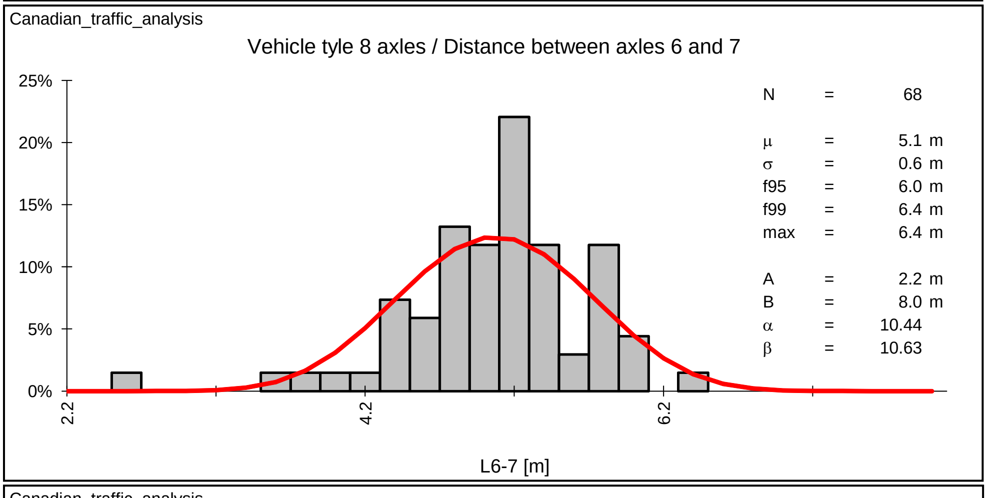

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
N = 68
μ = 4.5 m
σ = 0.6 m
f95 = 5.6 m
f99 = 6.7 m
max = 6.8 m
A = 2.0 m
B = 7.0 m
α = 7.23
β = 7.15
L1-2 [m]

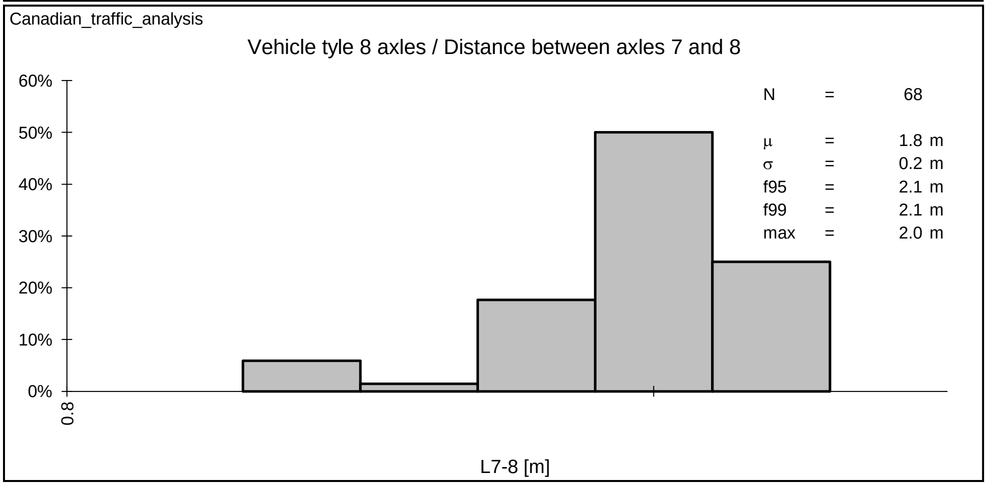

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.4
L2-3 [m]
N = 68
μ = 1.7 m
σ = 0.3 m
f95 = 2.1 m
f99 = 3.3 m
max = 3.6 m

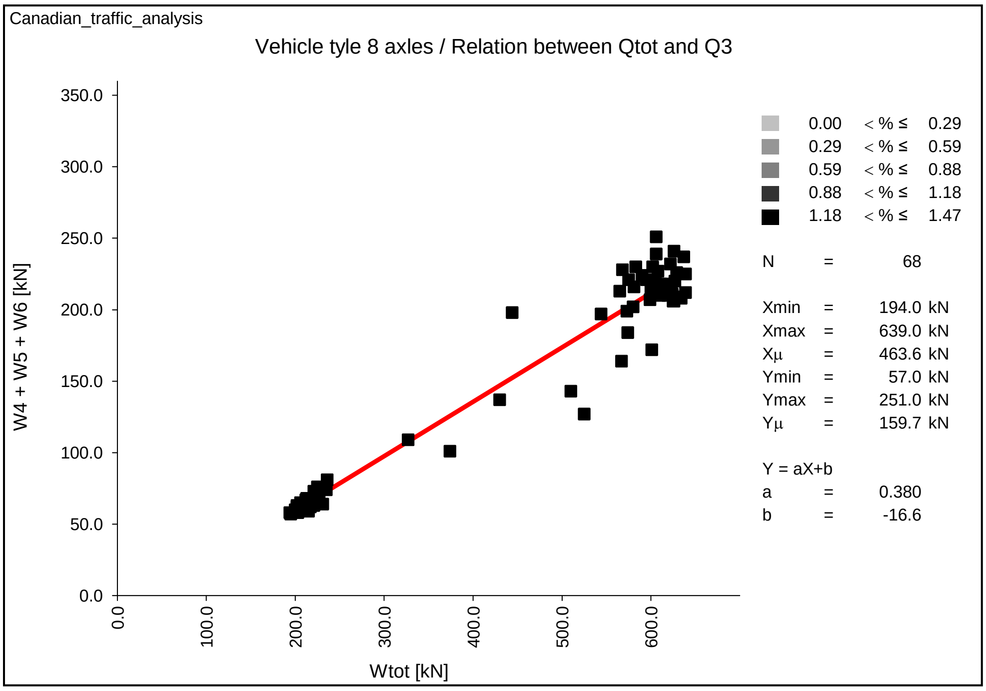

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
L3-4 [m]
N = 68
μ 4.5 m
σ 0.4 m
f95 5.0 m
5.0 m
max 5.0 m
2.2 m
5.0 m
6.54
1.55

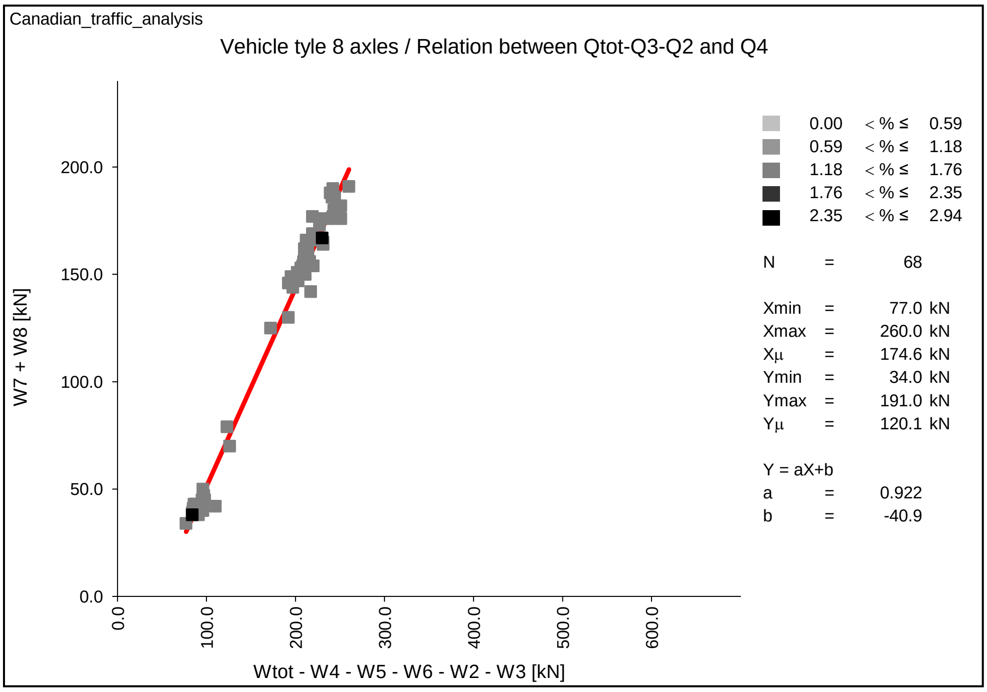

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L4-5 [m]
N = 68
μ = 1.5 m
σ = 0.3 m
f95 = 1.9 m
f99 = 2.1 m
max = 2.0 m

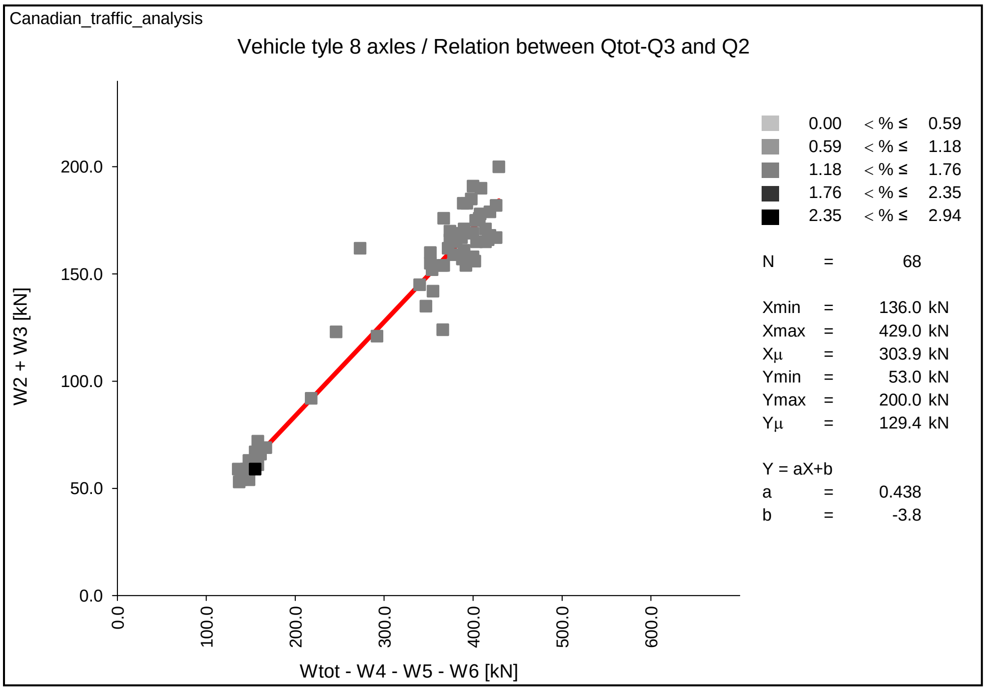

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
N = 68
μ = 1.5 m
σ = 0.3 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m
L5-6 [m]

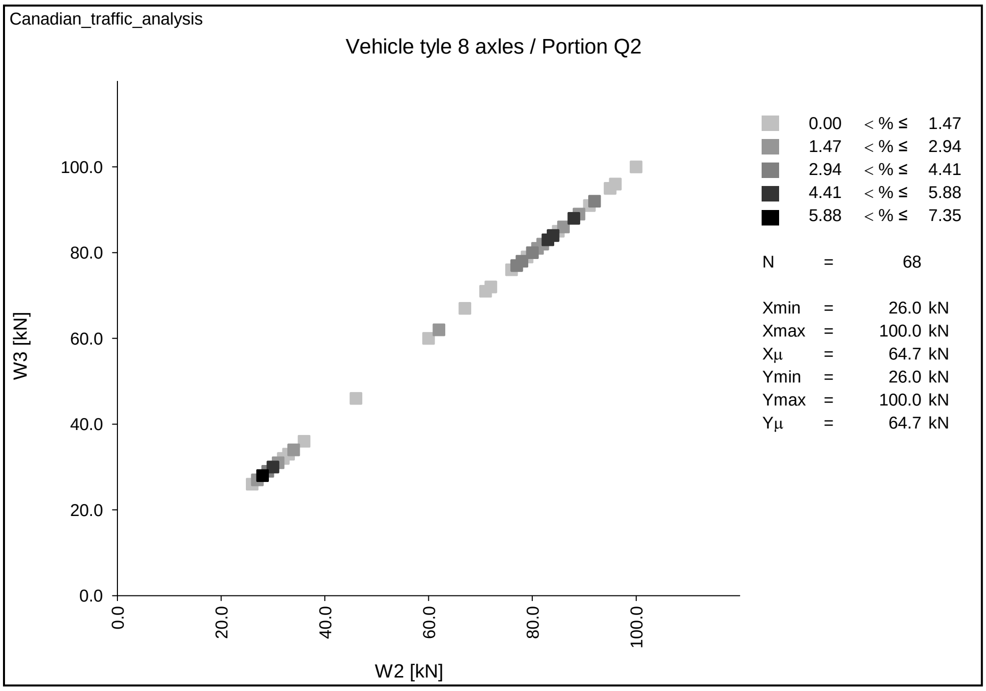

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
25%
20%
15%
10%
5%
0%
2.2
4.2
6.2
N = 68
μ = 5.1 m
σ = 0.6 m
f95 = 6.0 m
f99 = 6.4 m
max = 6.4 m
A = 2.2 m
B = 8.0 m
α = 10.44
β = 10.63
L6-7 [m]

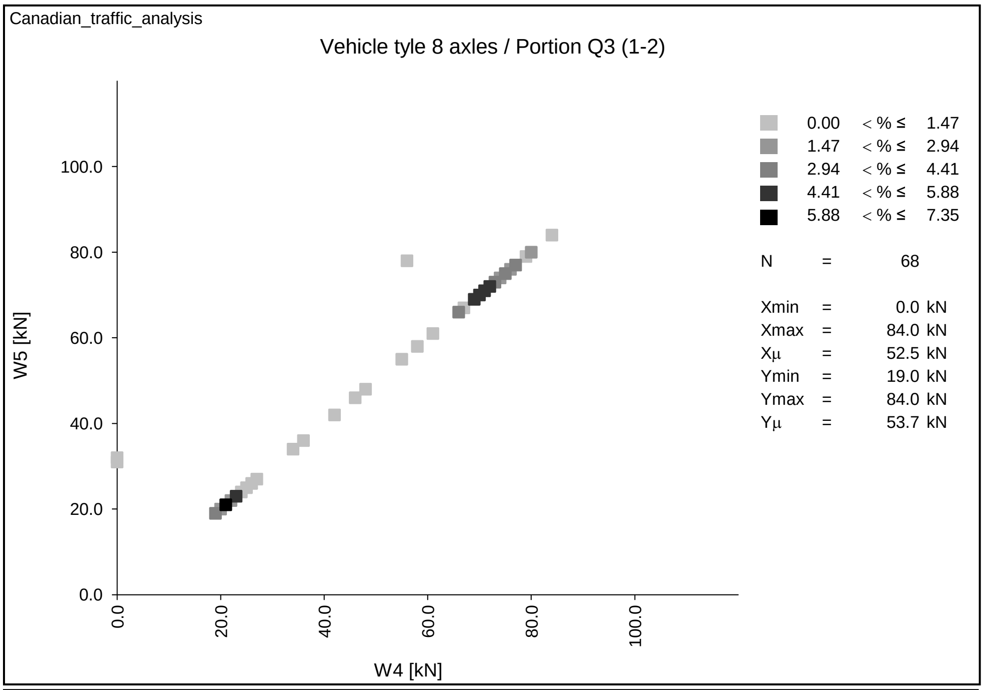

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
60%
50%
40%
30%
20%
10%
0%
0.8
N = 68
μ = 1.8 m
σ = 0.2 m
f95 = 2.1 m
f99 = 2.1 m
max = 2.0 m
L7-8 [m]

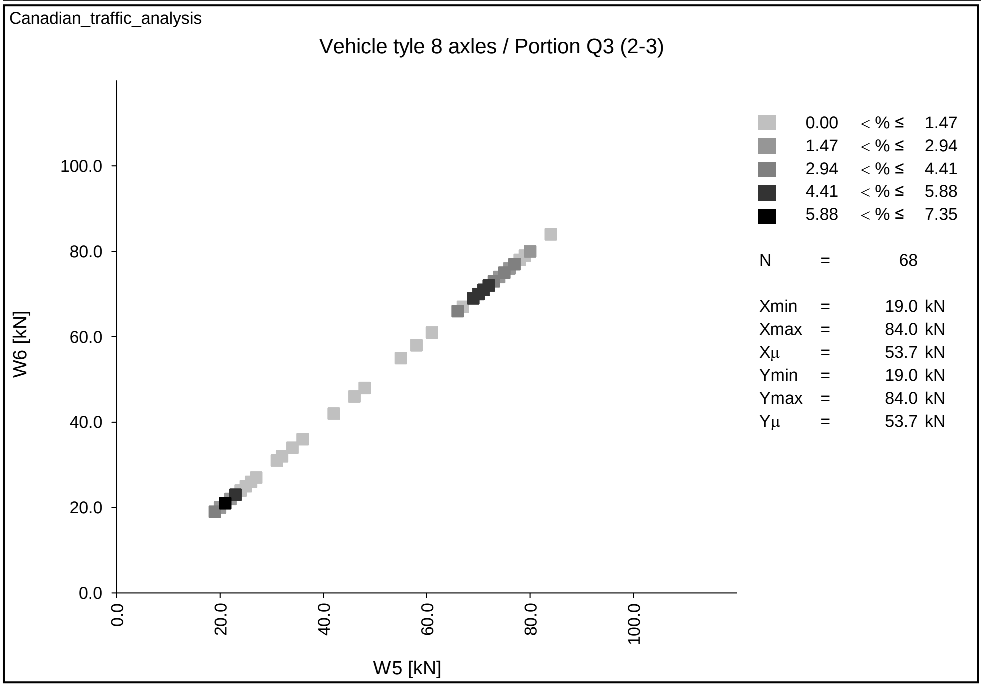

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q3
W4 + W5 + W6 [kN]
Wtot [kN]
0.00 < % ≤ 0.29
0.29 < % ≤ 0.59
0.59 < % ≤ 0.88
0.88 < % ≤ 1.18
1.18 < % ≤ 1.47
N = 68
Xmin = 194.0 kN
Xmax = 639.0 kN
Xµ = 463.6 kN
Ymin = 57.0 kN
Ymax = 251.0 kN
Yµ = 159.7 kN
Y = aX+b
a = 0.380
b = -16.6

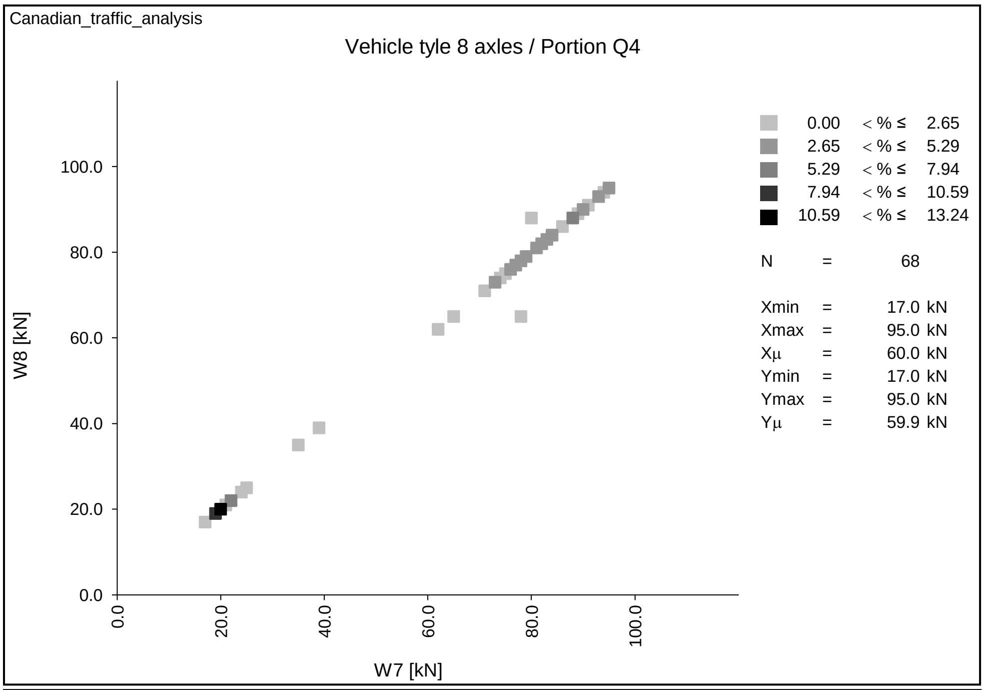

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3-Q2 and Q4
W7 + W8 [kN]
Wtot - W4 - W5 - W6 - W2 - W3 [kN]
0.00 < % ≤ 0.59
0.59 < % ≤ 1.18
1.18 < % ≤ 1.76
1.76 < % ≤ 2.35
2.35 < % ≤ 2.94
N = 68
Xmin = 77.0 kN
Xmax = 260.0 kN
Xµ = 174.6 kN
Ymin = 34.0 kN
Ymax = 191.0 kN
Yµ = 120.1 kN
Y = aX+b
a = 0.922
b = -40.9

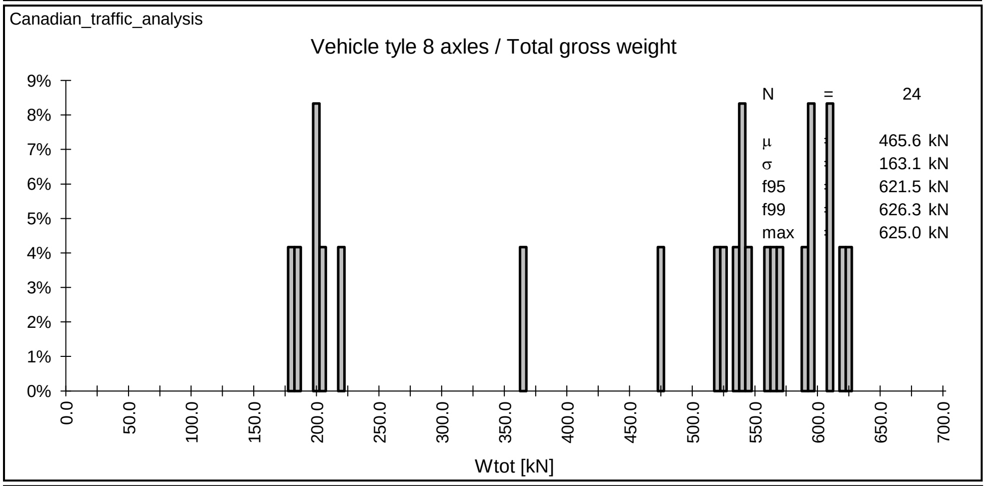

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3 and Q2
W2 + W3 [kN]
Wtot - W4 - W5 - W6 [kN]
0.00 < % ≤ 0.59
0.59 < % ≤ 1.18
1.18 < % ≤ 1.76
1.76 < % ≤ 2.35
2.35 < % ≤ 2.94
N = 68
Xmin = 136.0 kN
Xmax = 429.0 kN
Xμ = 303.9 kN
Ymin = 53.0 kN
Ymax = 200.0 kN
Yμ = 129.4 kN
Y = aX+b
a = 0.438
b = -3.8

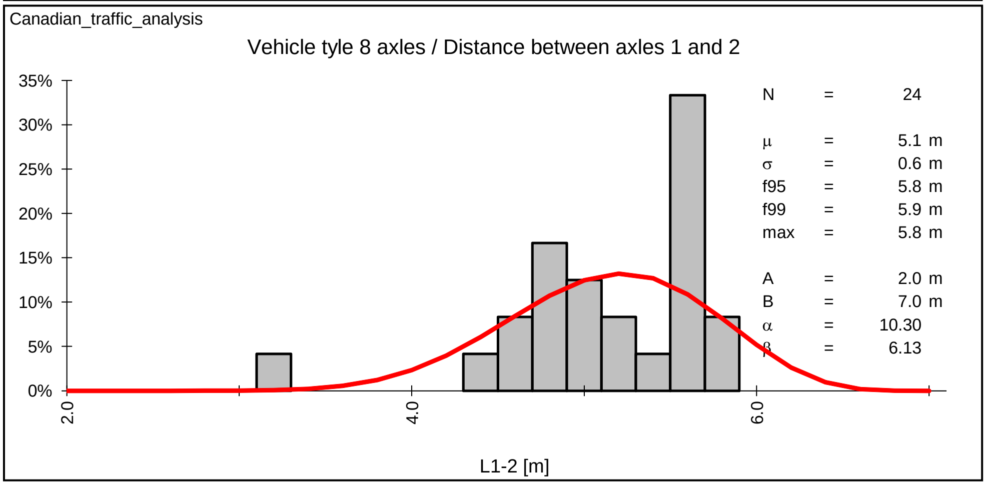

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 1.47
1.47 < % ≤ 2.94
2.94 < % ≤ 4.41
4.41 < % ≤ 5.88
5.88 < % ≤ 7.35
N = 68
Xmin = 26.0 kN
Xmax = 100.0 kN
Xμ = 64.7 kN
Ymin = 26.0 kN
Ymax = 100.0 kN
Yμ = 64.7 kN

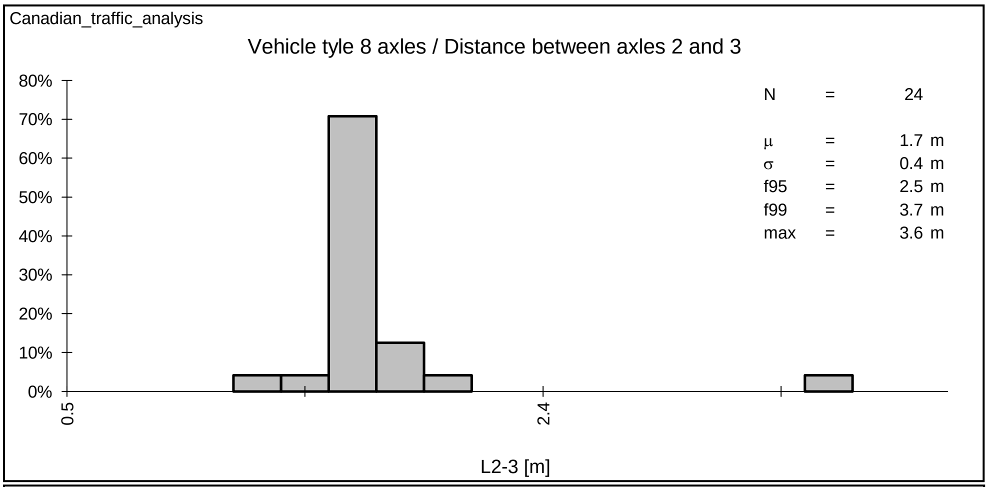

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3 (1-2)
W5 [kN]
W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 1.47
1.47 < % ≤ 2.94
2.94 < % ≤ 4.41
4.41 < % ≤ 5.88
5.88 < % ≤ 7.35
N = 68
Xmin = 0.0 kN
Xmax = 84.0 kN
Xμ = 52.5 kN
Ymin = 19.0 kN
Ymax = 84.0 kN
Yμ = 53.7 kN

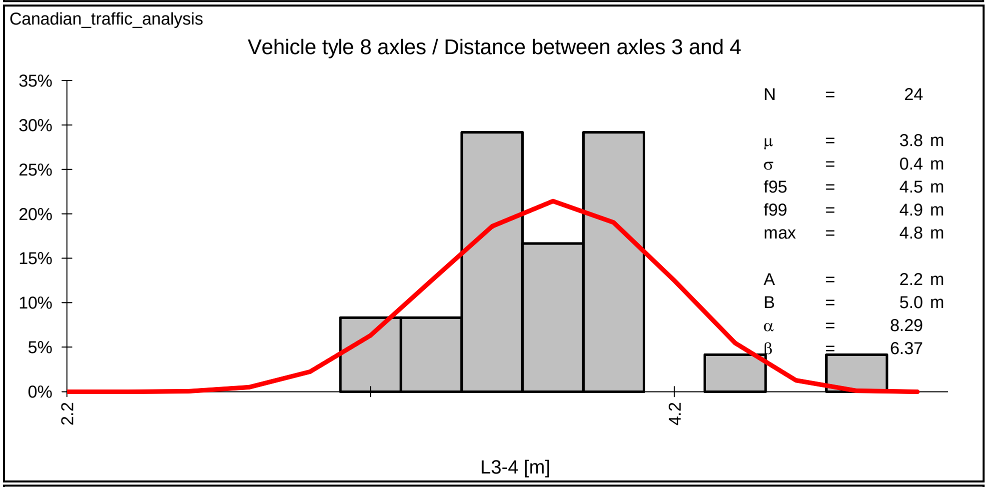

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3 (2-3)
W6 [kN]
W5 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 1.47
1.47 < % ≤ 2.94
2.94 < % ≤ 4.41
4.41 < % ≤ 5.88
5.88 < % ≤ 7.35
N = 68
Xmin = 19.0 kN
Xmax = 84.0 kN
Xμ = 53.7 kN
Ymin = 19.0 kN
Ymax = 84.0 kN
Yμ = 53.7 kN

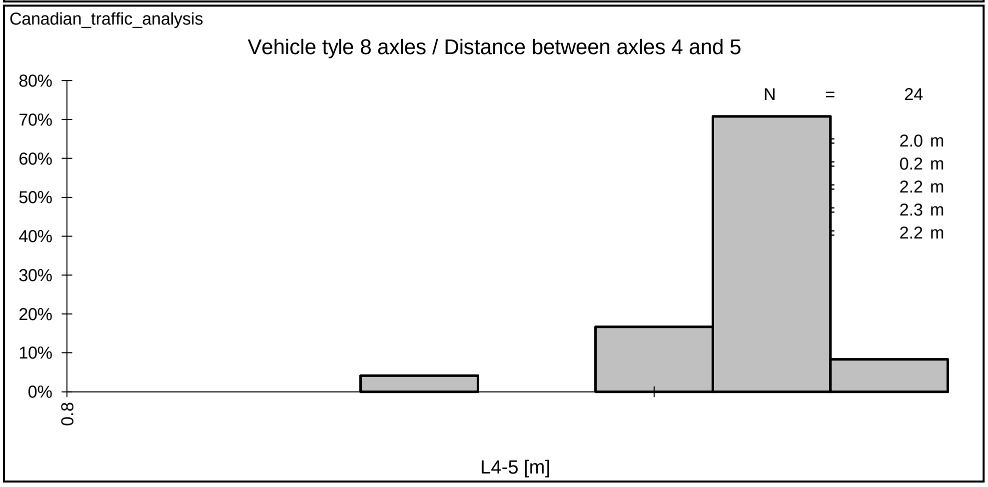

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4
0.00 < % ≤ 2.65
2.65 < % ≤ 5.29
5.29 < % ≤ 7.94
7.94 < % ≤ 10.59
10.59 < % ≤ 13.24
N = 68
Xmin = 17.0 kN
Xmax = 95.0 kN
Xμ = 60.0 kN
Ymin = 17.0 kN
Ymax = 95.0 kN
Yμ = 59.9 kN
W8 [kN]
W7 [kN]

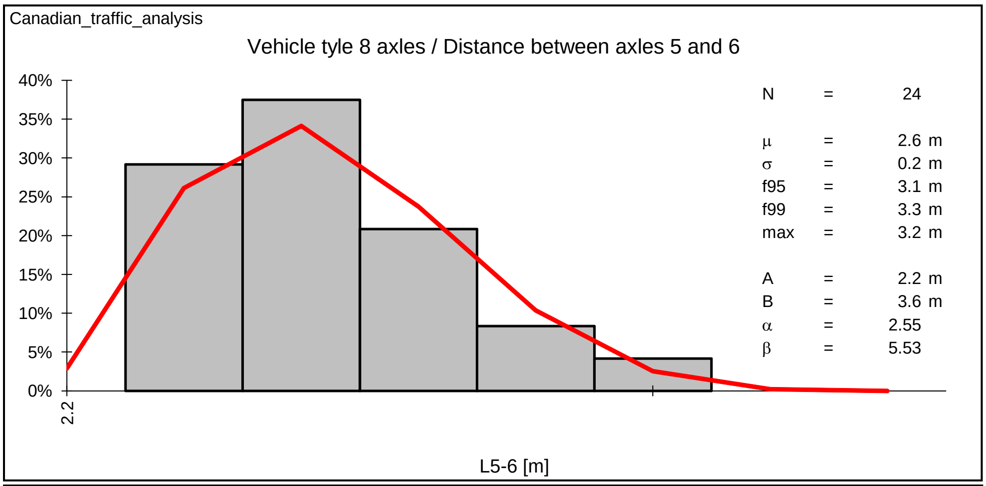

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
N = 24
μ = 465.6 kN
σ = 163.1 kN
f95 = 621.5 kN
f99 = 626.3 kN
max = 625.0 kN
Wtot [kN]

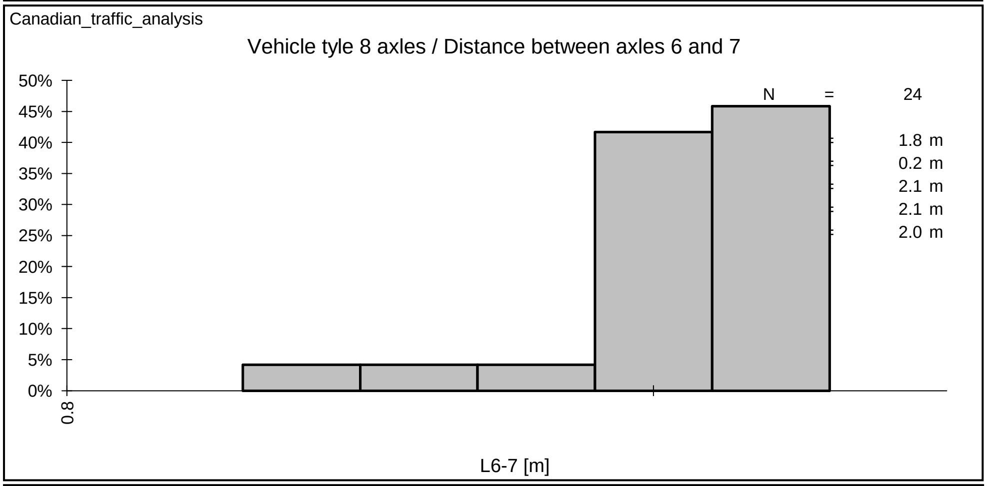

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
N = 24
μ = 5.1 m
σ = 0.6 m
f95 = 5.8 m
f99 = 5.9 m
max = 5.8 m
A = 2.0 m
B = 7.0 m
α = 10.30
β = 6.13
L1-2 [m]

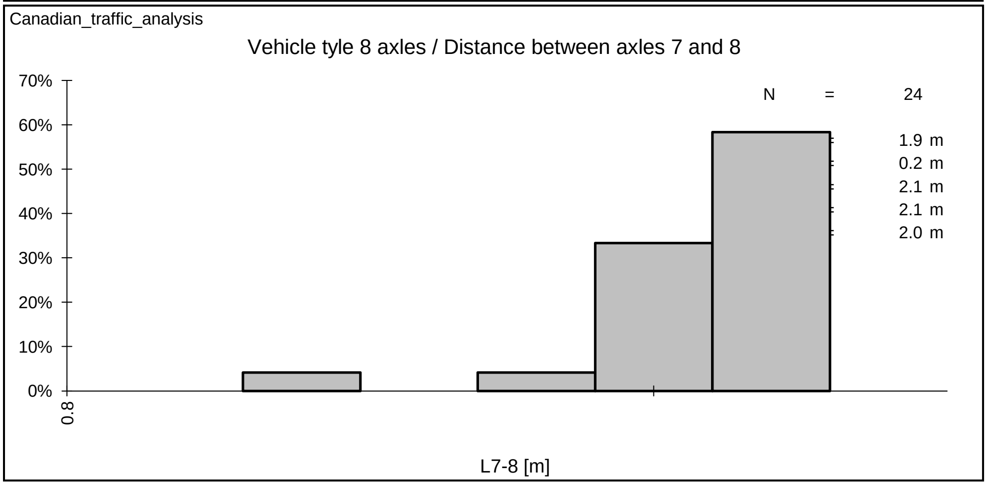

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.4
N = 24
μ = 1.7 m
σ = 0.4 m
f95 = 2.5 m
f99 = 3.7 m
max = 3.6 m
L2-3 [m]

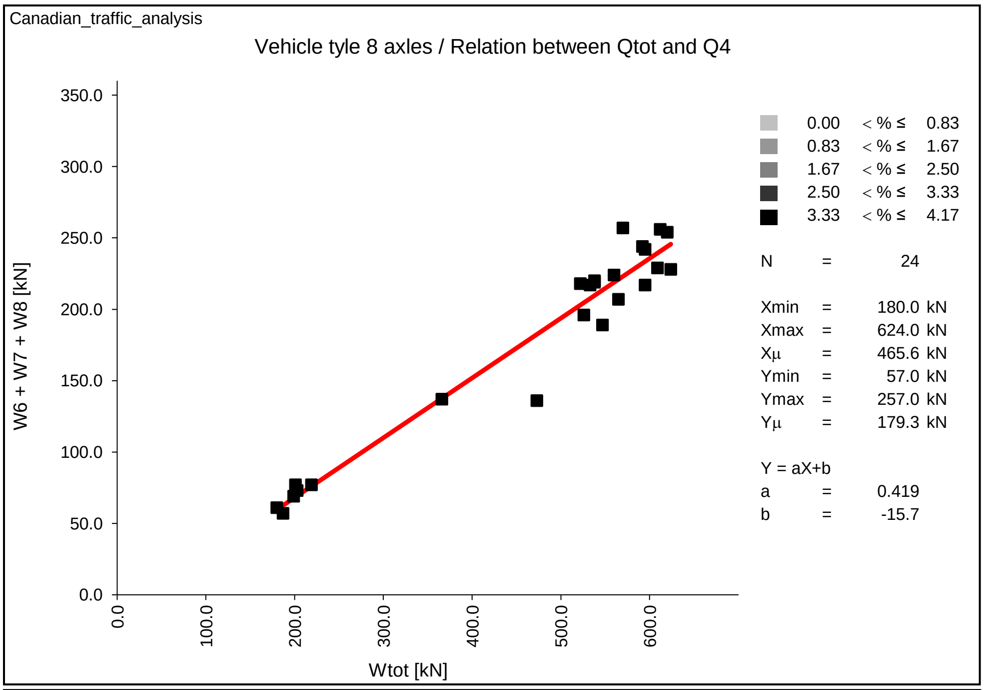

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
N = 24
μ = 3.8 m
σ = 0.4 m
f95 = 4.5 m
f99 = 4.9 m
max = 4.8 m
A = 2.2 m
B = 5.0 m
α = 8.29
β = 6.37
L3-4 [m]

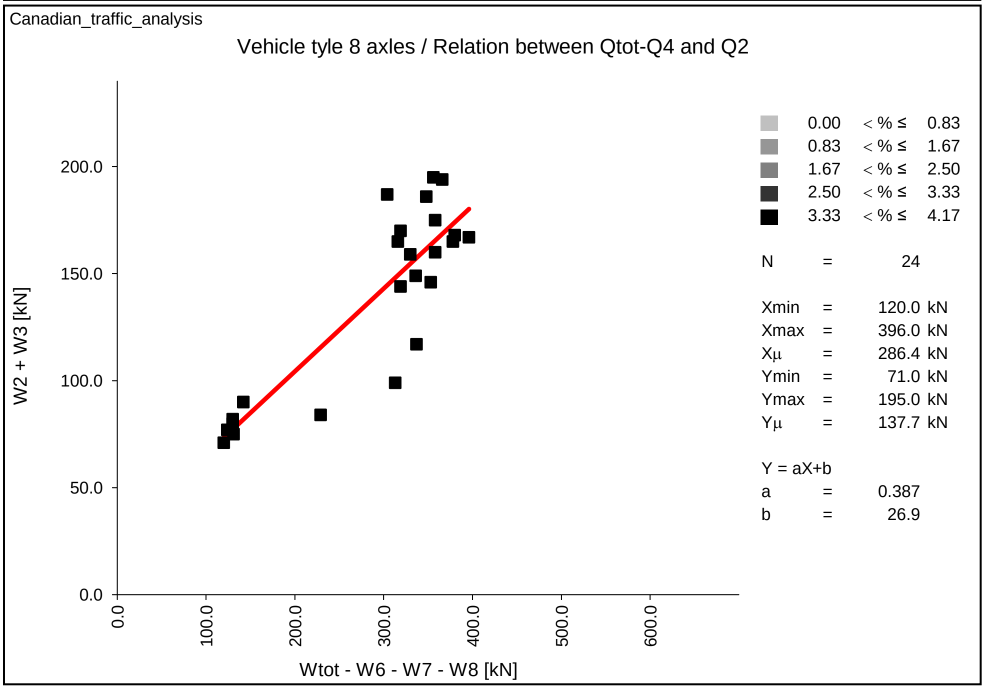

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
N = 24
2.0 m
0.2 m
2.2 m
2.3 m
2.2 m
L4-5 [m]

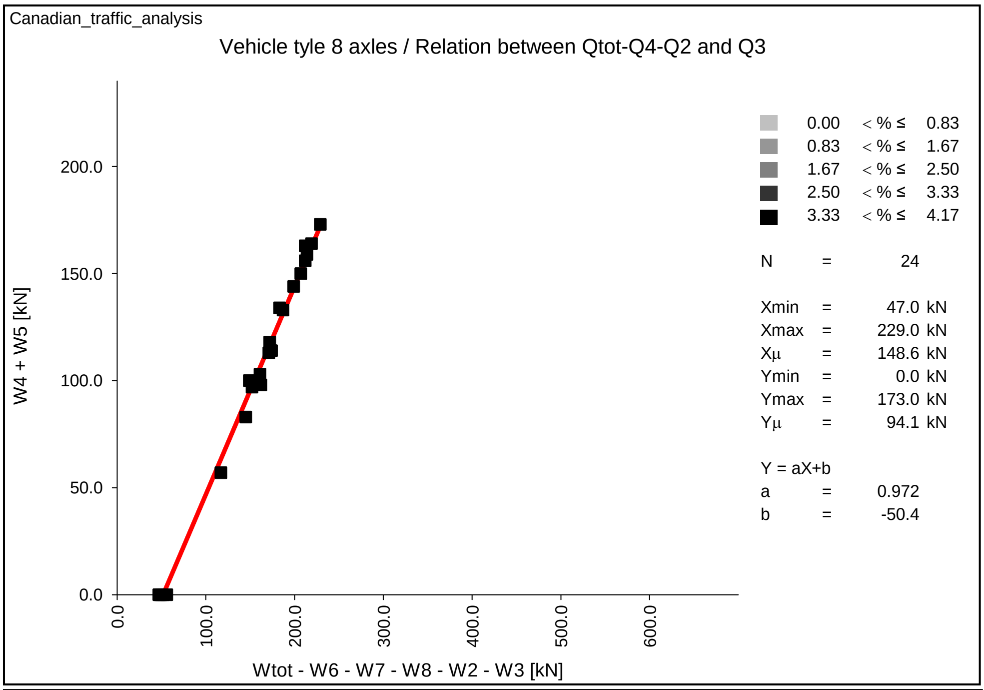

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
N = 24
μ = 2.6 m
σ = 0.2 m
f95 = 3.1 m
f99 = 3.3 m
max = 3.2 m
A = 2.2 m
B = 3.6 m
α = 2.55
β = 5.53
L5-6 [m]

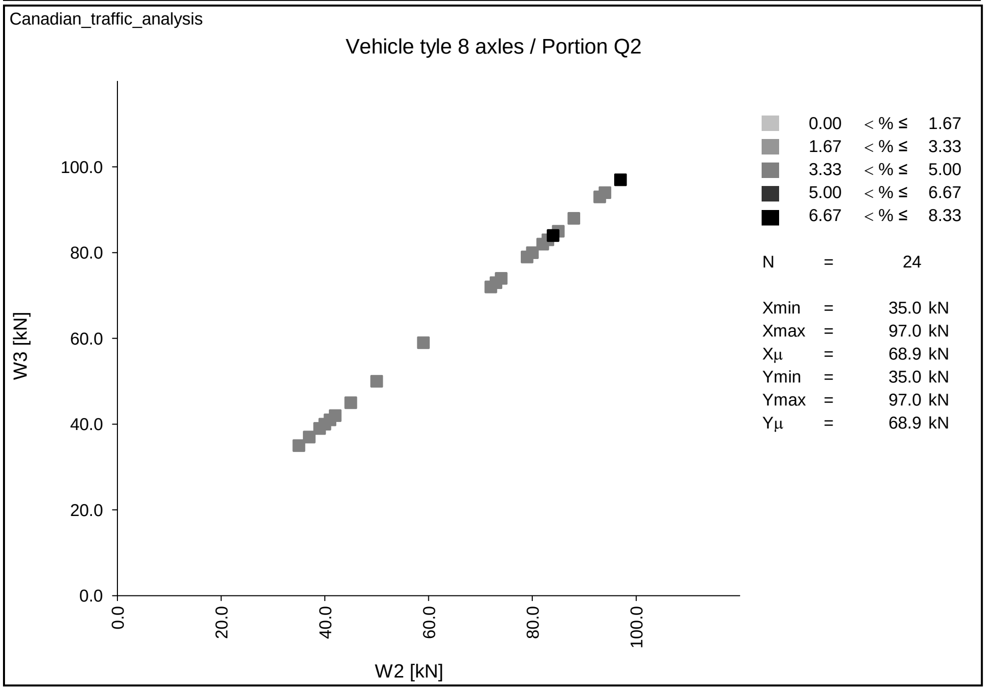

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
N = 24
1.8 m
0.2 m
2.1 m
2.1 m
2.0 m
L6-7 [m]

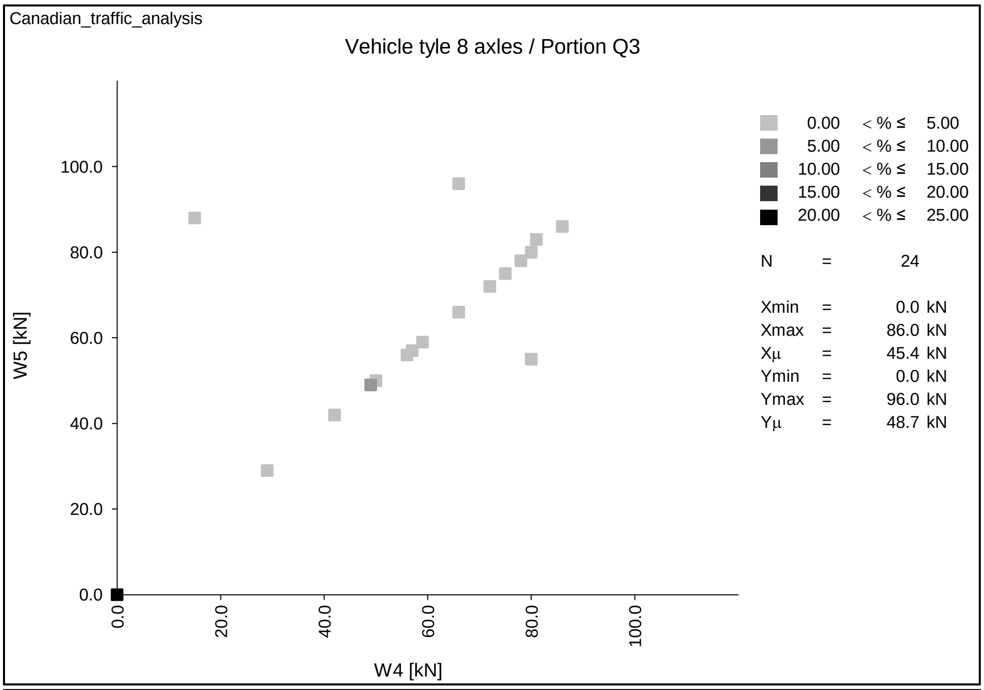

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
70%
60%
50%
40%
30%
20%
10%
0%
0.8
N = 24
1.9 m
0.2 m
2.1 m
2.1 m
2.0 m
L7-8 [m]

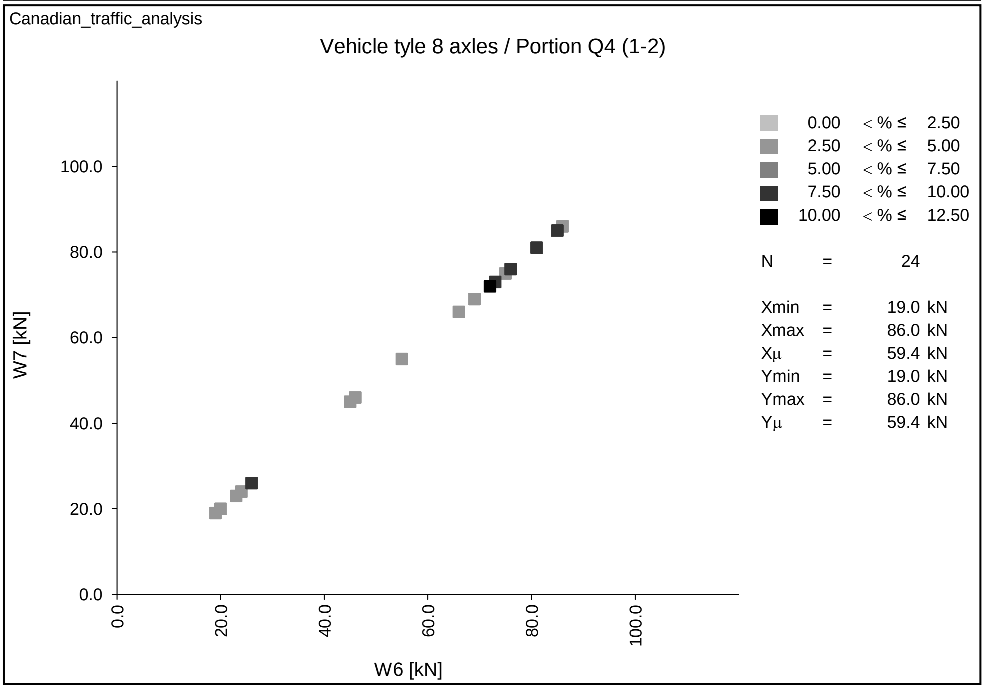

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q4
W6 + W7 + W8 [kN]
Wtot [kN]
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.83
0.83 < % ≤ 1.67
1.67 < % ≤ 2.50
2.50 < % ≤ 3.33
3.33 < % ≤ 4.17
N = 24
Xmin = 180.0 kN
Xmax = 624.0 kN
Xμ = 465.6 kN
Ymin = 57.0 kN
Ymax = 257.0 kN
Yμ = 179.3 kN
Y = aX+b
a = 0.419
b = -15.7

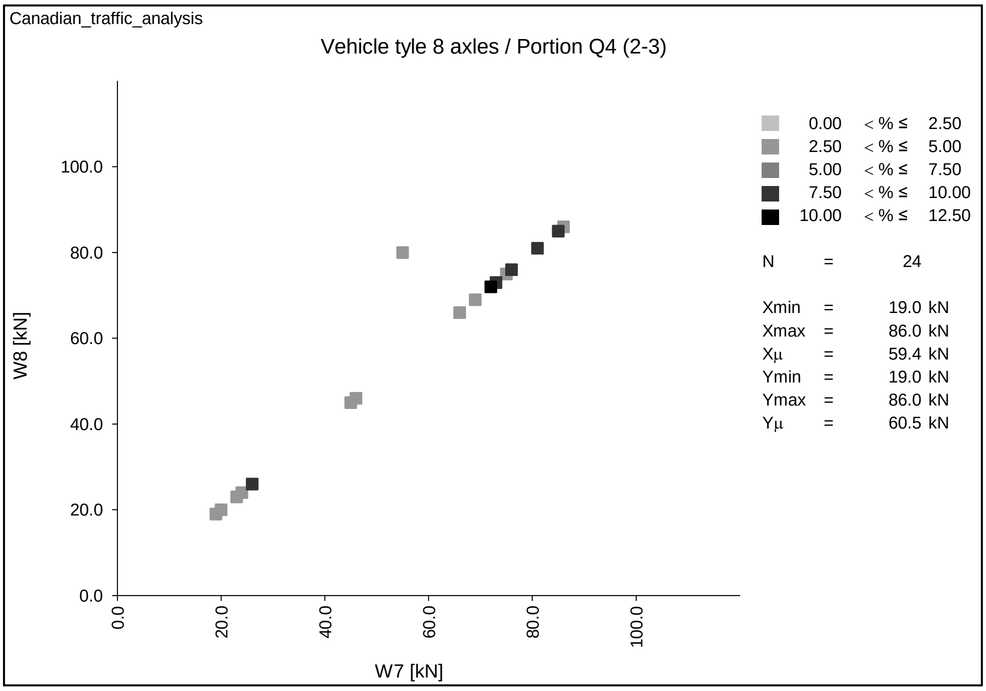

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q4 and Q2
W2 + W3 [kN]
Wtot - W6 - W7 - W8 [kN]
0.0
50.0
100.0
150.0
200.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.83
0.83 < % ≤ 1.67
1.67 < % ≤ 2.50
2.50 < % ≤ 3.33
3.33 < % ≤ 4.17
N = 24
Xmin = 120.0 kN
Xmax = 396.0 kN
Xμ = 286.4 kN
Ymin = 71.0 kN
Ymax = 195.0 kN
Yμ = 137.7 kN
Y = aX+b
a = 0.387
b = 26.9

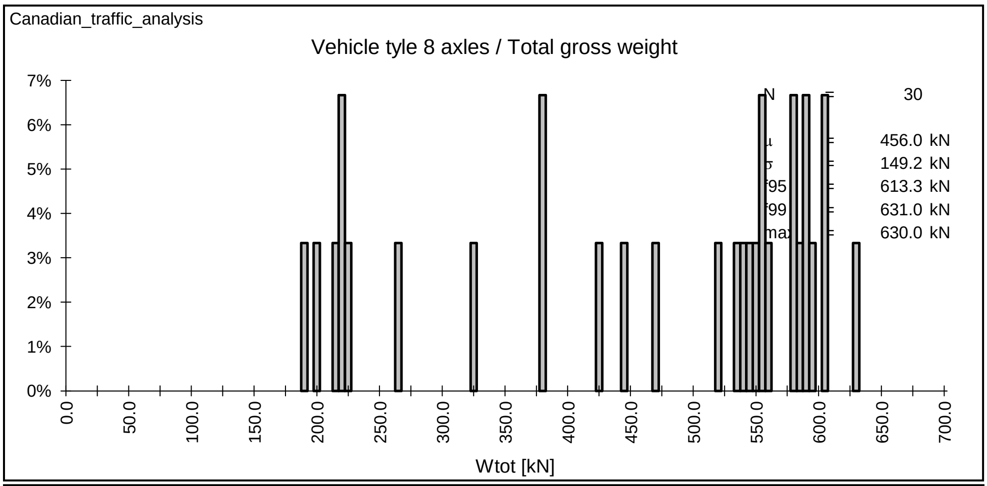

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q4-Q2 and Q3
W4 + W5 [kN]
Wtot - W6 - W7 - W8 - W2 - W3 [kN]
0.00 < % ≤ 0.83
0.83 < % ≤ 1.67
1.67 < % ≤ 2.50
2.50 < % ≤ 3.33
3.33 < % ≤ 4.17
N = 24
Xmin = 47.0 kN
Xmax = 229.0 kN
Xμ = 148.6 kN
Ymin = 0.0 kN
Ymax = 173.0 kN
Yμ = 94.1 kN
Y = aX+b
a = 0.972
b = -50.4

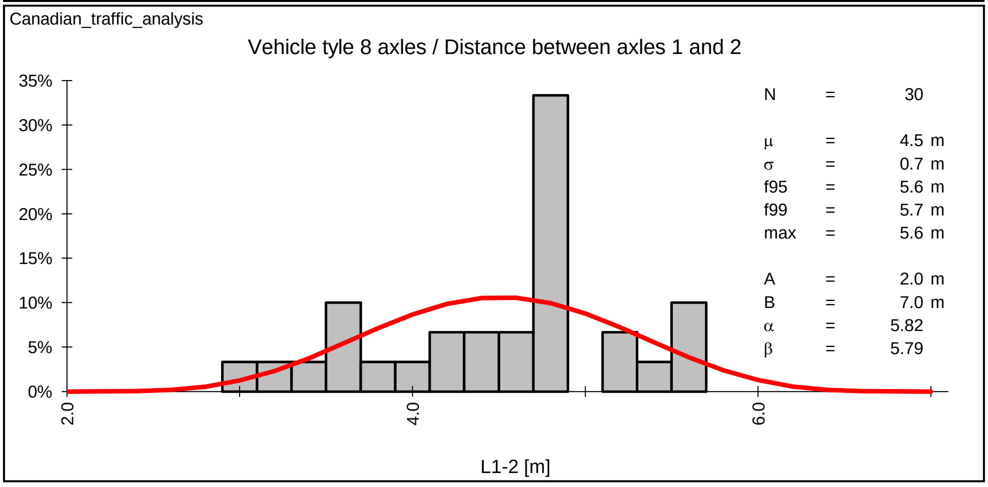

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 1.67
1.67 < % ≤ 3.33
3.33 < % ≤ 5.00
5.00 < % ≤ 6.67
6.67 < % ≤ 8.33
N = 24
Xmin = 35.0 kN
Xmax = 97.0 kN
Xμ = 68.9 kN
Ymin = 35.0 kN
Ymax = 97.0 kN
Yμ = 68.9 kN

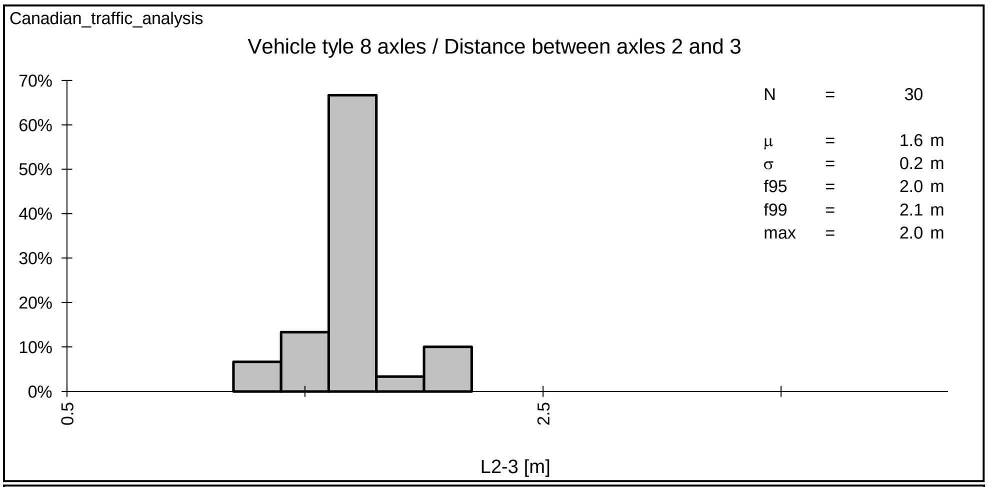

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3
W5 [kN]
W4 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 5.00
5.00 < % ≤ 10.00
10.00 < % ≤ 15.00
15.00 < % ≤ 20.00
20.00 < % ≤ 25.00
N = 24
Xmin = 0.0 kN
Xmax = 86.0 kN
Xμ = 45.4 kN
Ymin = 0.0 kN
Ymax = 96.0 kN
Yμ = 48.7 kN

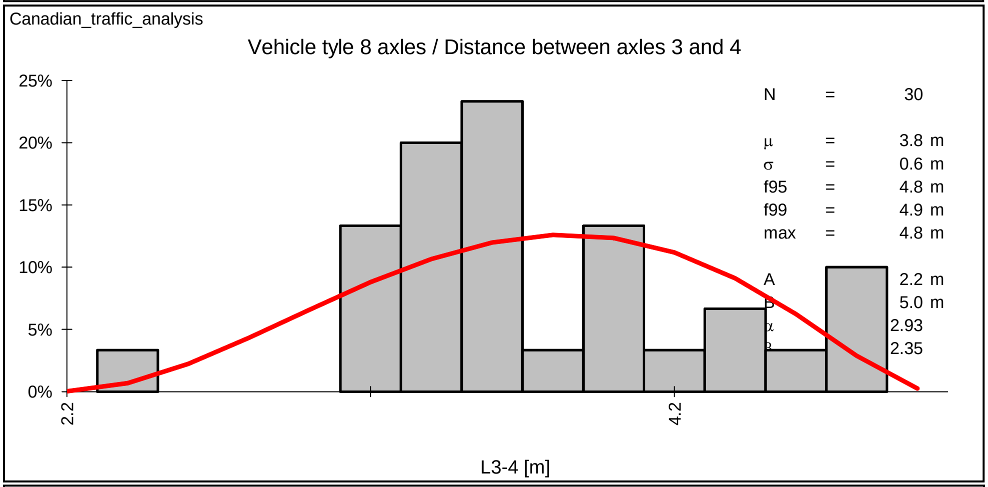

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4 (1-2)
W7 [kN]
W6 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 2.50
2.50 < % ≤ 5.00
5.00 < % ≤ 7.50
7.50 < % ≤ 10.00
10.00 < % ≤ 12.50
N = 24
Xmin = 19.0 kN
Xmax = 86.0 kN
Xμ = 59.4 kN
Ymin = 19.0 kN
Ymax = 86.0 kN
Yμ = 59.4 kN

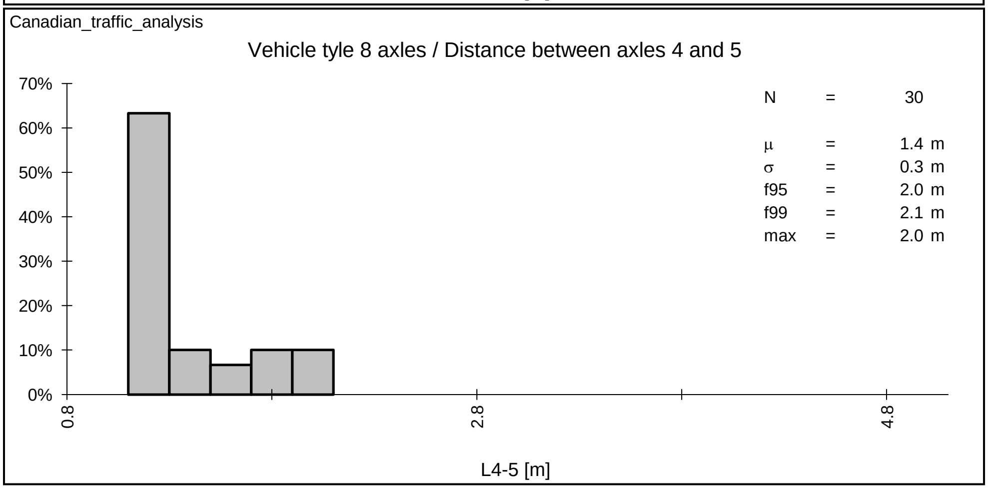

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4 (2-3)
W8 [kN]
W7 [kN]
0.00 < % ≤ 2.50
2.50 < % ≤ 5.00
5.00 < % ≤ 7.50
7.50 < % ≤ 10.00
10.00 < % ≤ 12.50
N = 24
Xmin = 19.0 kN
Xmax = 86.0 kN
Xµ = 59.4 kN
Ymin = 19.0 kN
Ymax = 86.0 kN
Yµ = 60.5 kN

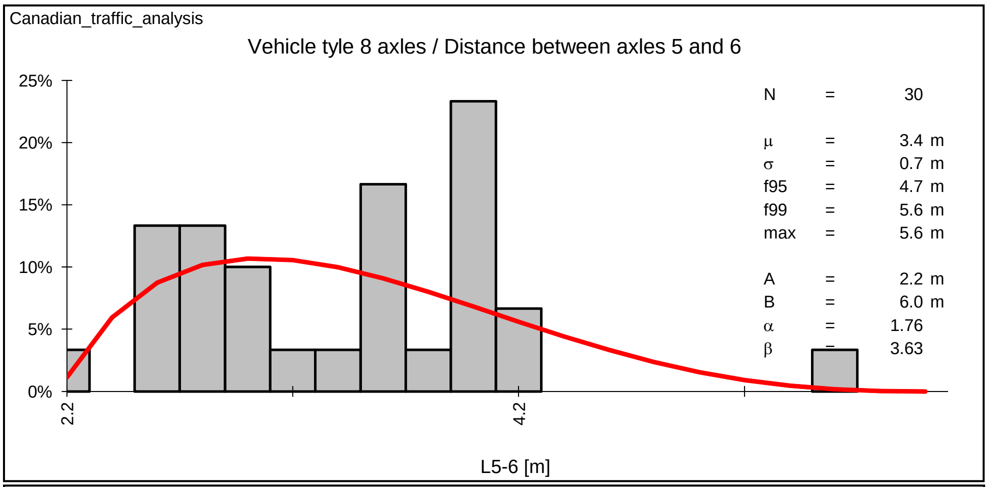

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
Wtot [kN]
N = 30
456.0 kN
149.2 kN
613.3 kN
631.0 kN
630.0 kN

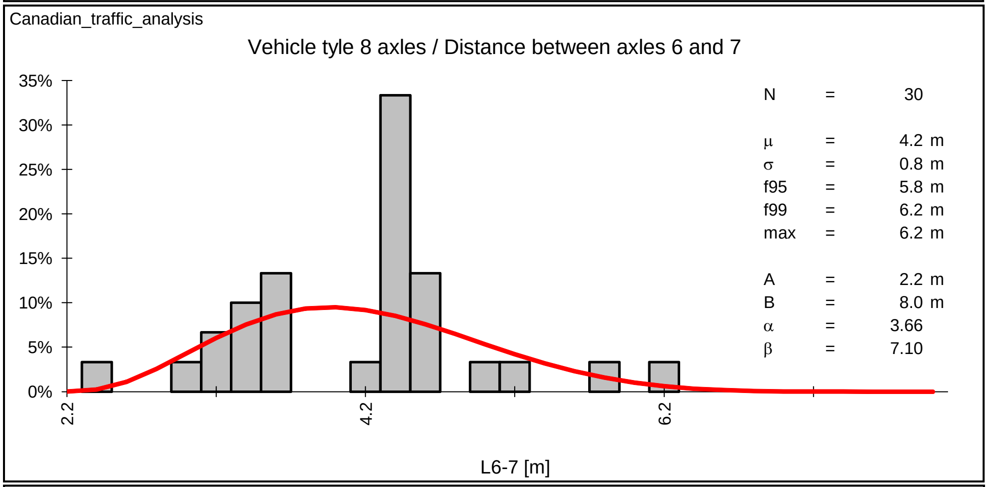

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
L1-2 [m]
N = 30
µ = 4.5 m
σ = 0.7 m
f95 = 5.6 m
f99 = 5.7 m
max = 5.6 m
A = 2.0 m
B = 7.0 m
α = 5.82
β = 5.79

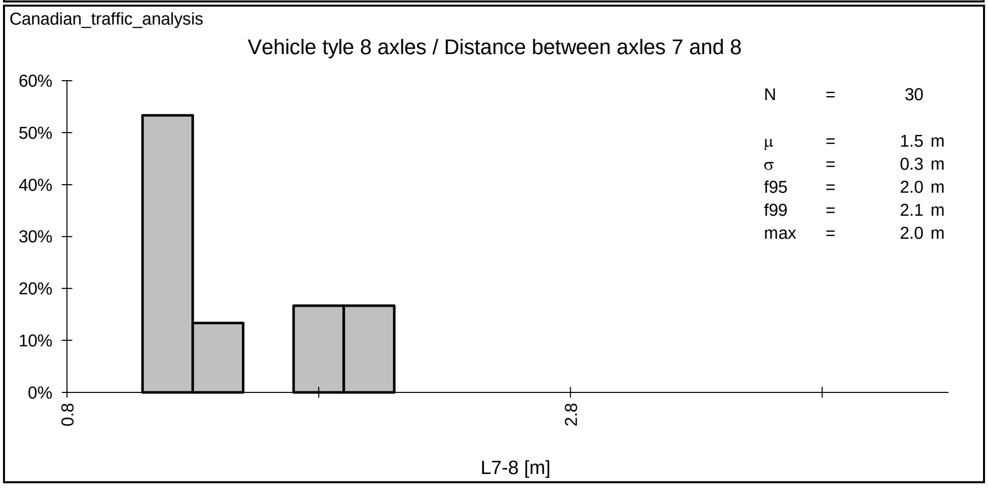

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.5
L2-3 [m]
N = 30
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

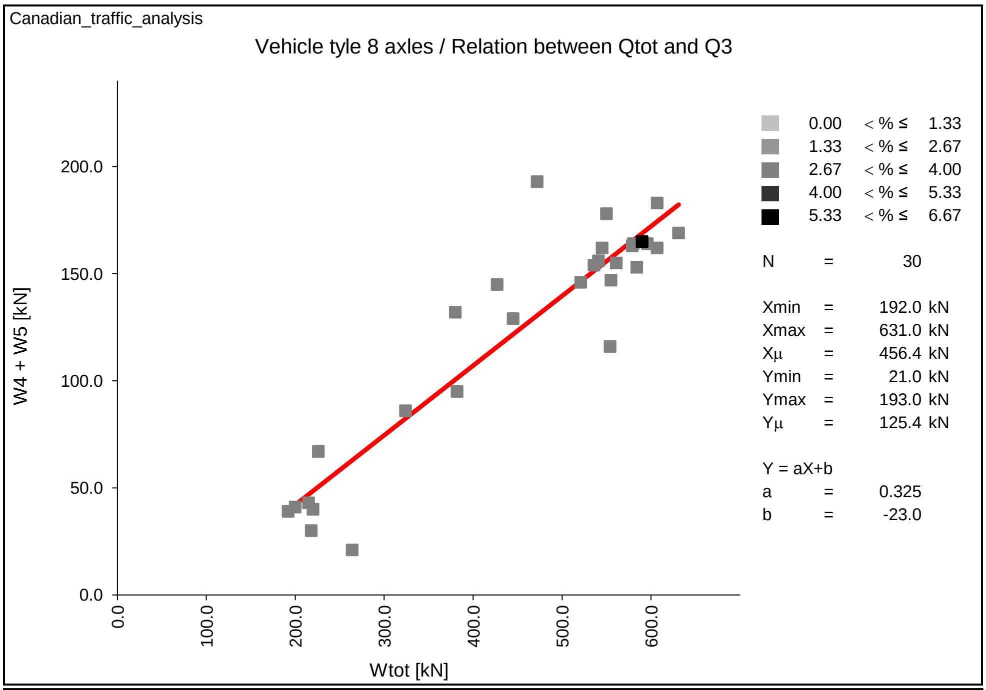

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
25%
20%
15%
10%
5%
0%
2.2
4.2
L3-4 [m]
N = 30
μ = 3.8 m
σ = 0.6 m
f95 = 4.8 m
f99 = 4.9 m
max = 4.8 m
A 2.2 m
5.0 m
2.93
2.35

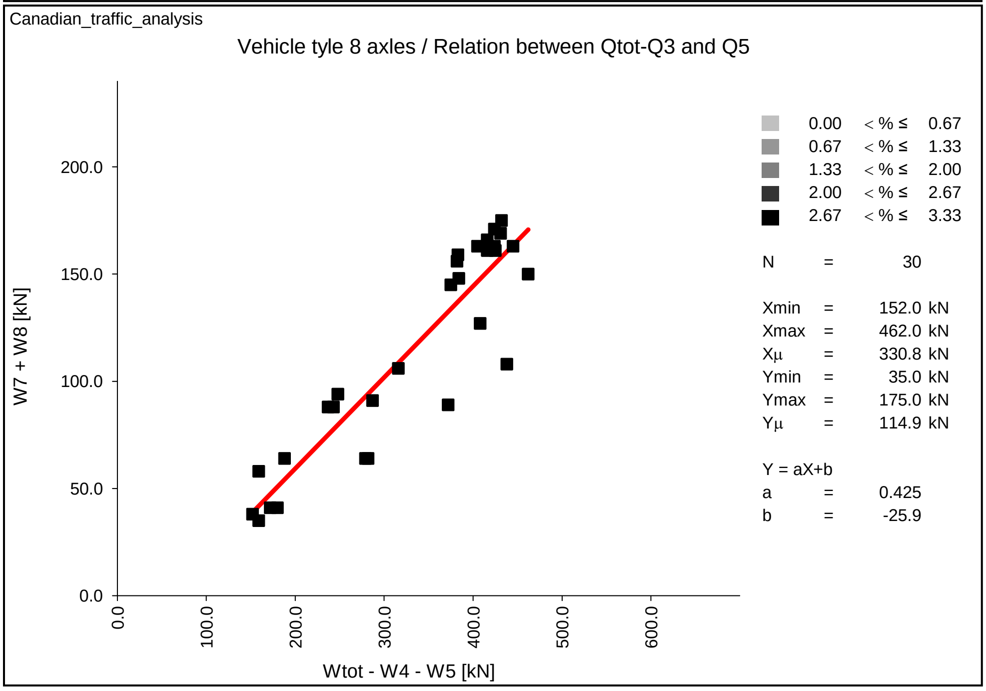

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
70%
60%
50%
40%
30%
20%
10%
0%
0.8
2.8
4.8
L4-5 [m]
N = 30
μ = 1.4 m
σ = 0.3 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

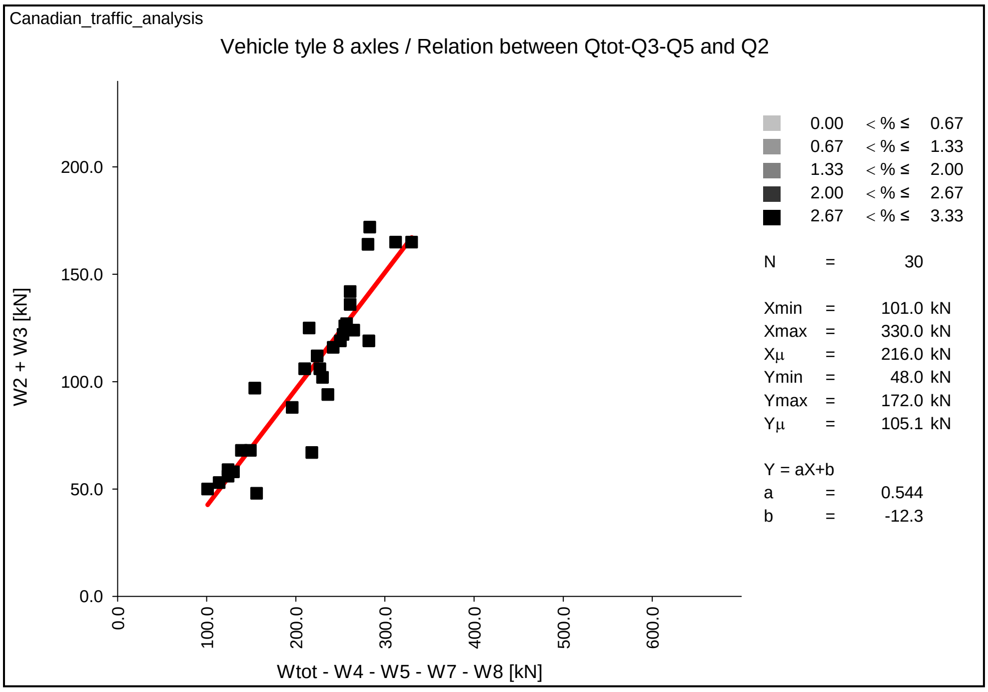

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
25%
20%
15%
10%
5%
0%
2.2
4.2
L5-6 [m]
N = 30
μ = 3.4 m
σ = 0.7 m
f95 = 4.7 m
f99 = 5.6 m
max = 5.6 m
A = 2.2 m
B = 6.0 m
α = 1.76
β = 3.63

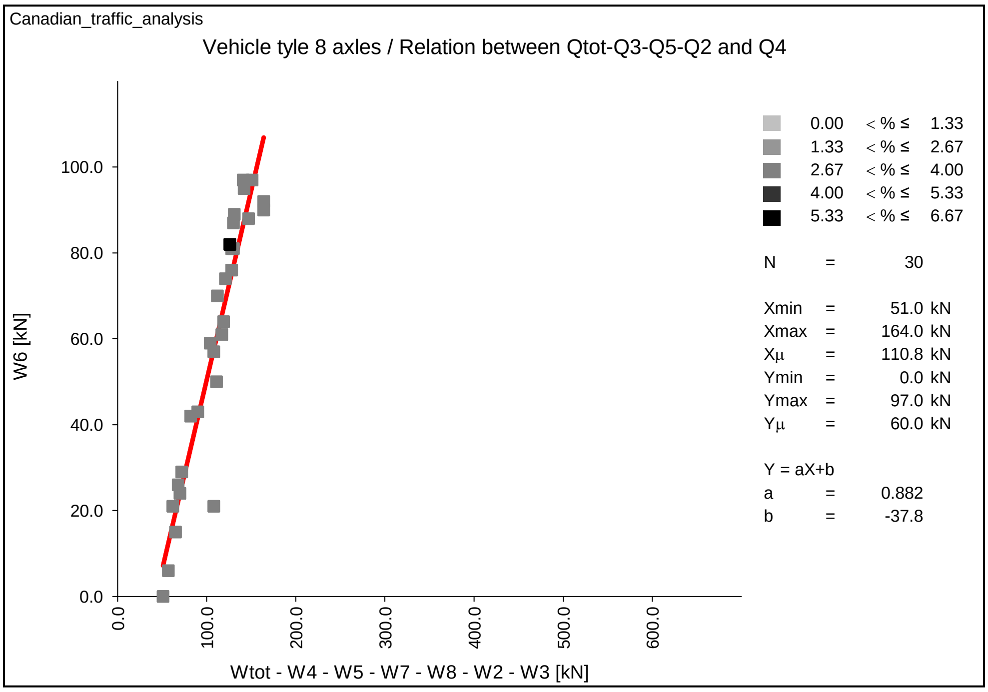

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
6.2
L6-7 [m]
N = 30
μ = 4.2 m
σ = 0.8 m
f95 = 5.8 m
f99 = 6.2 m
max = 6.2 m
A = 2.2 m
B = 8.0 m
α = 3.66
β = 7.10

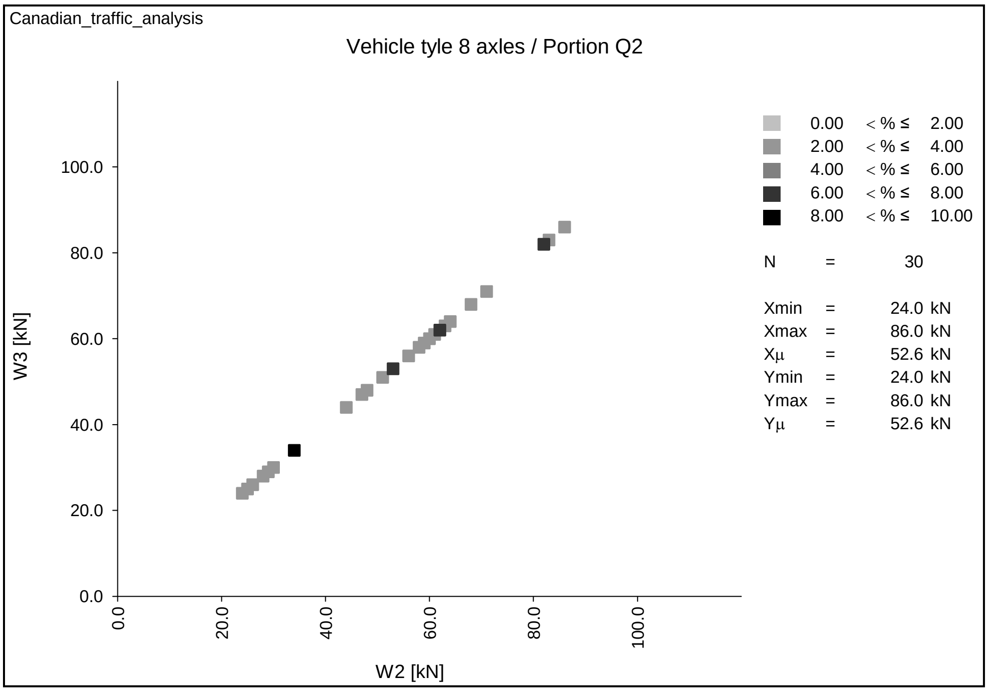

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
60%
50%
40%
30%
20%
10%
0%
0.8
2.8
L7-8 [m]
N = 30
μ = 1.5 m
σ = 0.3 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

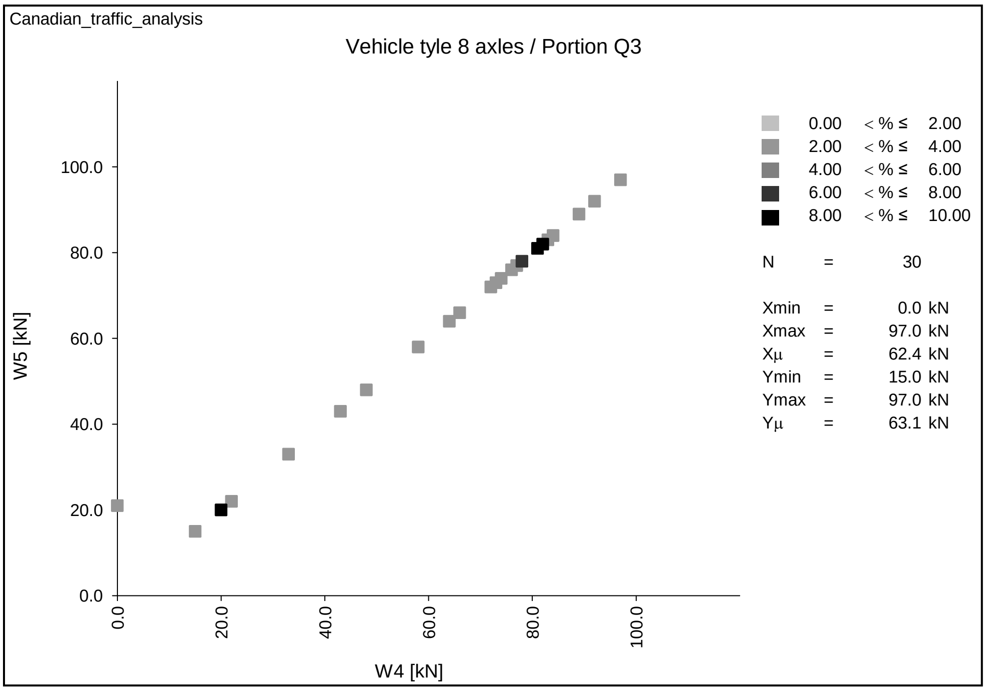

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q3
W4 + W5 [kN]
Wtot [kN]
0.0
50.0
100.0
150.0
200.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 1.33
1.33 < % ≤ 2.67
2.67 < % ≤ 4.00
4.00 < % ≤ 5.33
5.33 < % ≤ 6.67
N = 30
Xmin = 192.0 kN
Xmax = 631.0 kN
Xμ = 456.4 kN
Ymin = 21.0 kN
Ymax = 193.0 kN
Yμ = 125.4 kN
Y = aX+b
a = 0.325
b = -23.0

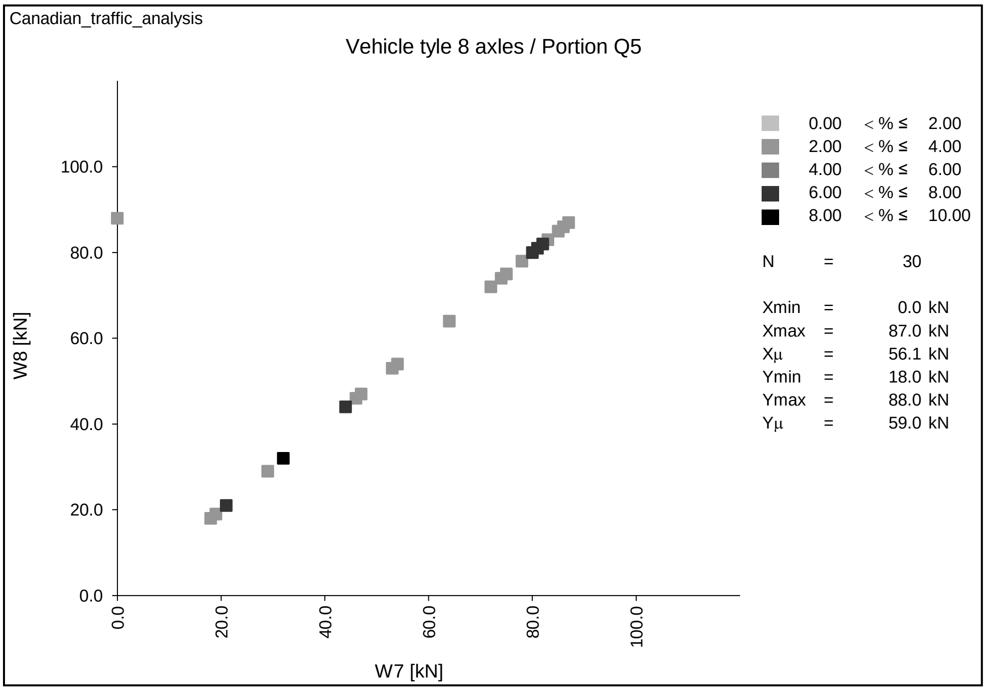

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3 and Q5
W7 + W8 [kN]
Wtot - W4 - W5 [kN]
0.0
50.0
100.0
150.0
200.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.67
0.67 < % ≤ 1.33
1.33 < % ≤ 2.00
2.00 < % ≤ 2.67
2.67 < % ≤ 3.33
N = 30
Xmin = 152.0 kN
Xmax = 462.0 kN
Xμ = 330.8 kN
Ymin = 35.0 kN
Ymax = 175.0 kN
Yμ = 114.9 kN
Y = aX+b
a = 0.425
b = -25.9

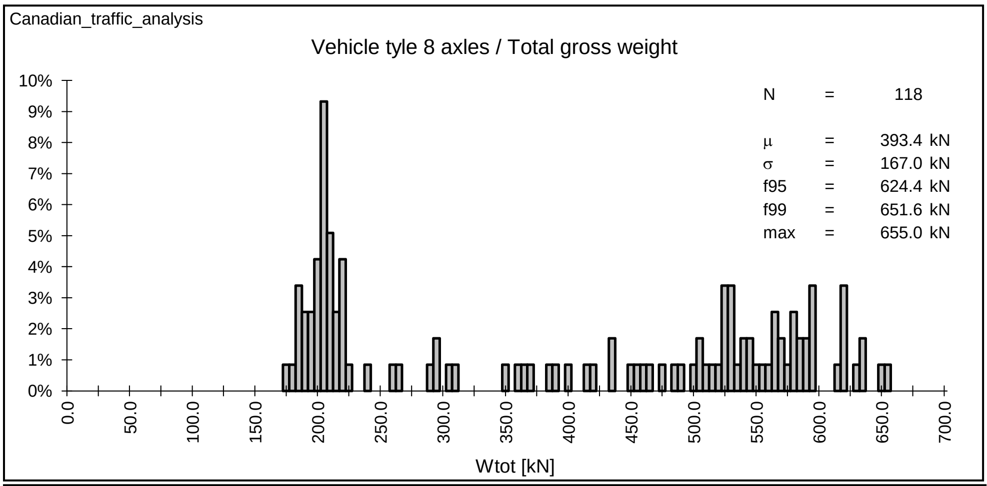

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3-Q5 and Q2
W2 + W3 [kN]
Wtot - W4 - W5 - W7 - W8 [kN]
0.00 < % ≤ 0.67
0.67 < % ≤ 1.33
1.33 < % ≤ 2.00
2.00 < % ≤ 2.67
2.67 < % ≤ 3.33
N = 30
Xmin = 101.0 kN
Xmax = 330.0 kN
Xμ = 216.0 kN
Ymin = 48.0 kN
Ymax = 172.0 kN
Yμ = 105.1 kN
Y = aX+b
a = 0.544
b = -12.3

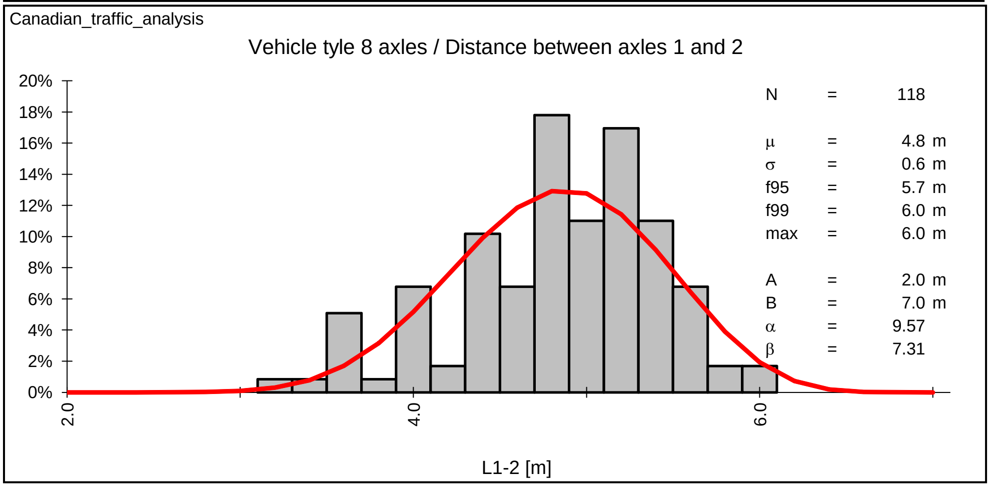

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3-Q5-Q2 and Q4
W6 [kN]
Wtot - W4 - W5 - W7 - W8 - W2 - W3 [kN]
0.00 < % ≤ 1.33
1.33 < % ≤ 2.67
2.67 < % ≤ 4.00
4.00 < % ≤ 5.33
5.33 < % ≤ 6.67
N = 30
Xmin = 51.0 kN
Xmax = 164.0 kN
Xμ = 110.8 kN
Ymin = 0.0 kN
Ymax = 97.0 kN
Yμ = 60.0 kN
Y = aX+b
a = 0.882
b = -37.8

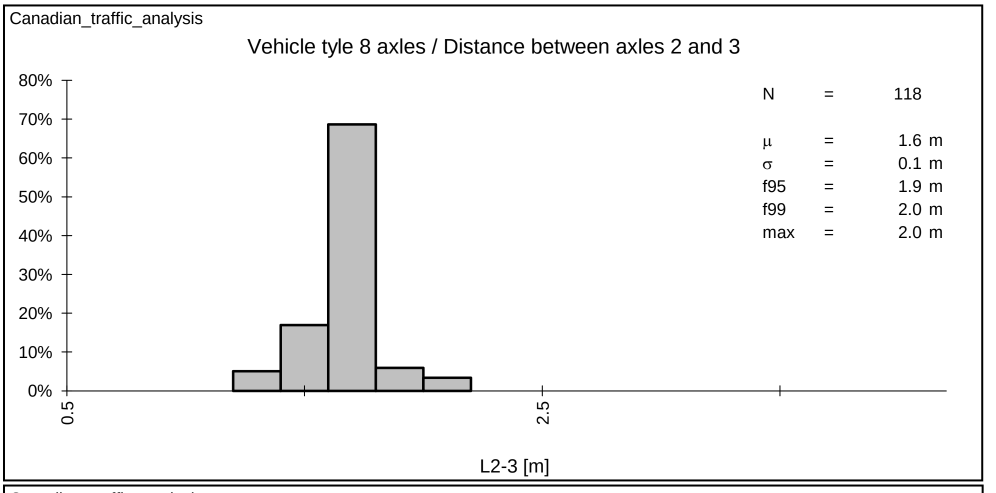

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
W3 [kN]
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 2.00
2.00 < % ≤ 4.00
4.00 < % ≤ 6.00
6.00 < % ≤ 8.00
8.00 < % ≤ 10.00
N = 30
Xmin = 24.0 kN
Xmax = 86.0 kN
Xμ = 52.6 kN
Ymin = 24.0 kN
Ymax = 86.0 kN
Yμ = 52.6 kN

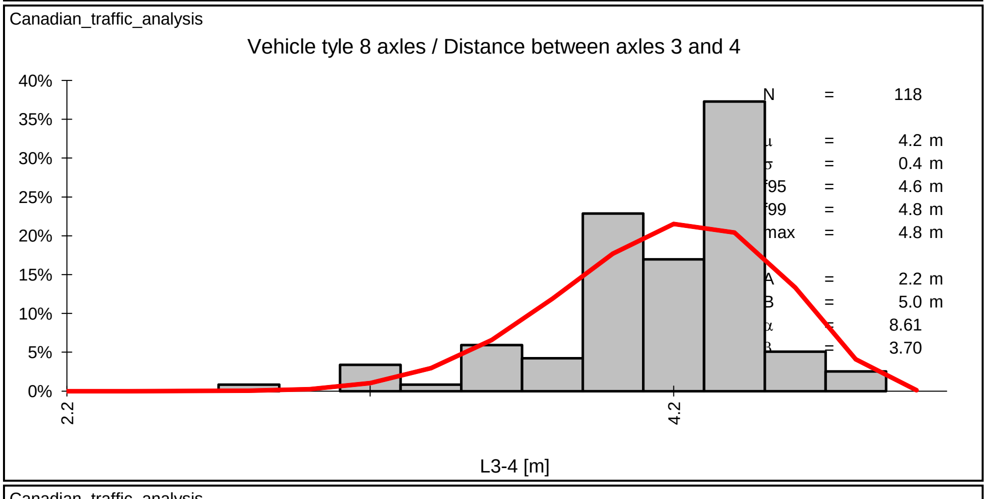

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3
W5 [kN]
W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 2.00
2.00 < % ≤ 4.00
4.00 < % ≤ 6.00
6.00 < % ≤ 8.00
8.00 < % ≤ 10.00
N = 30
Xmin = 0.0 kN
Xmax = 97.0 kN
Xμ = 62.4 kN
Ymin = 15.0 kN
Ymax = 97.0 kN
Yμ = 63.1 kN

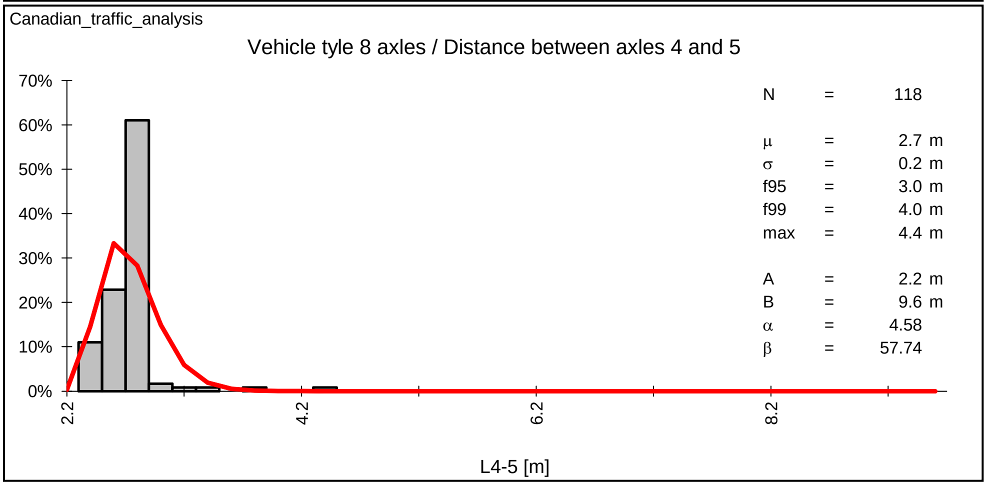

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q5
W8 [kN]
W7 [kN]
0.00 < % ≤ 2.00
2.00 < % ≤ 4.00
4.00 < % ≤ 6.00
6.00 < % ≤ 8.00
8.00 < % ≤ 10.00
N = 30
Xmin = 0.0 kN
Xmax = 87.0 kN
Xμ = 56.1 kN
Ymin = 18.0 kN
Ymax = 88.0 kN
Yμ = 59.0 kN

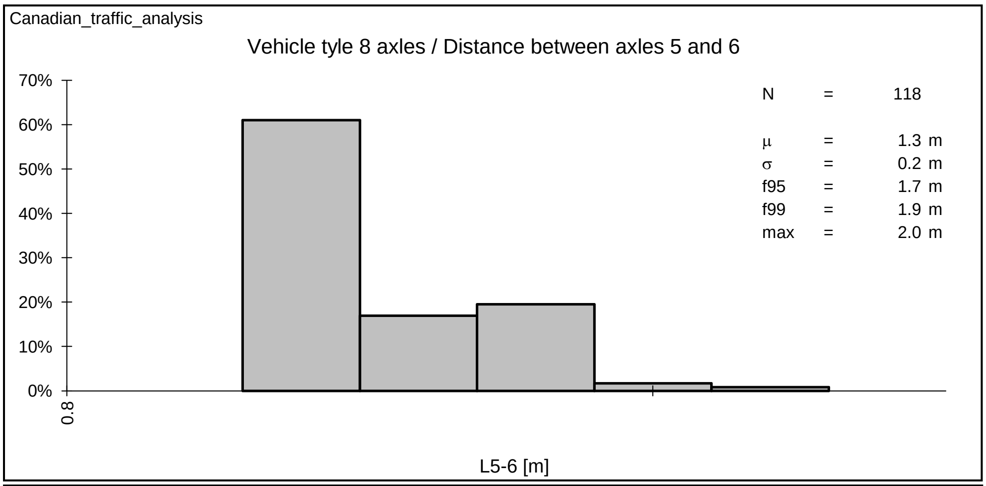

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
Wtot [kN]
N = 118
μ = 393.4 kN
σ = 167.0 kN
f95 = 624.4 kN
f99 = 651.6 kN
max = 655.0 kN

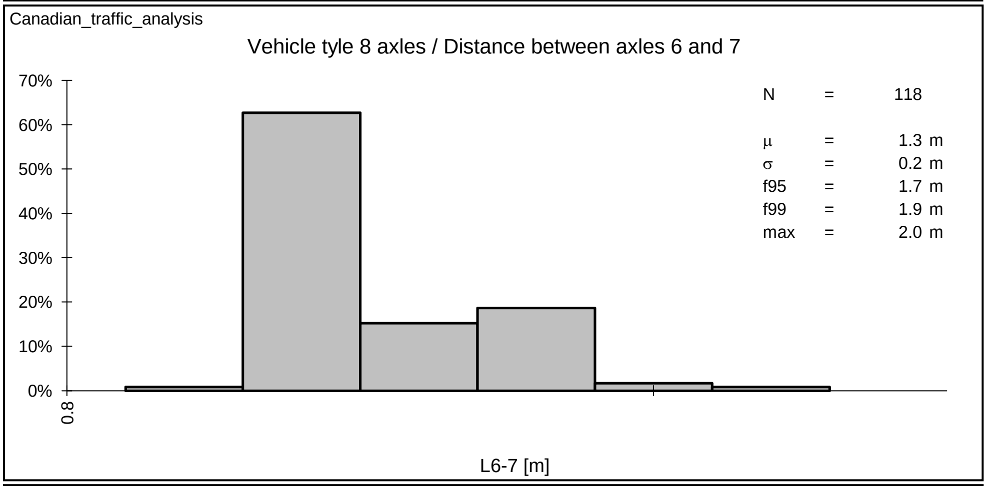

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
L1-2 [m]
N = 118
μ = 4.8 m
σ = 0.6 m
f95 = 5.7 m
f99 = 6.0 m
max = 6.0 m
A = 2.0 m
B = 7.0 m
α = 9.57
β = 7.31

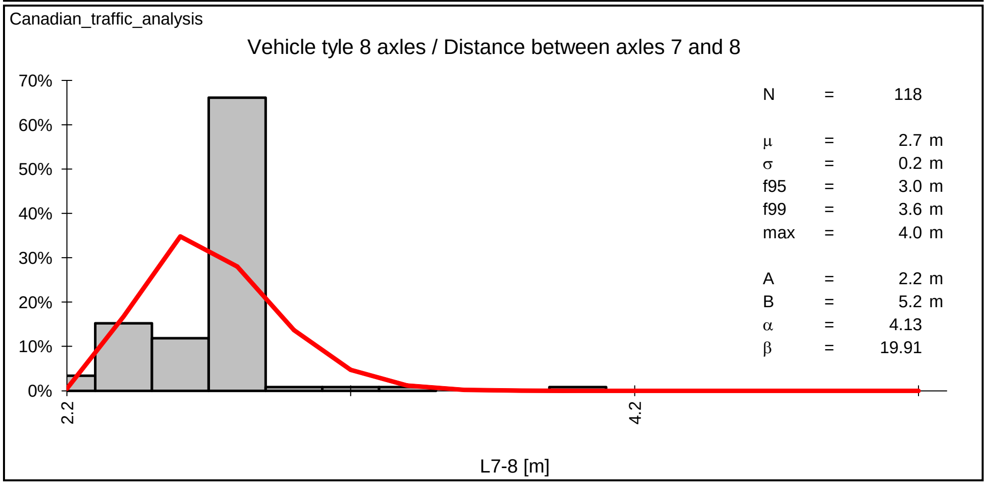

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.5
L2-3 [m]
N = 118
μ = 1.6 m
σ = 0.1 m
f95 = 1.9 m
f99 = 2.0 m
max = 2.0 m

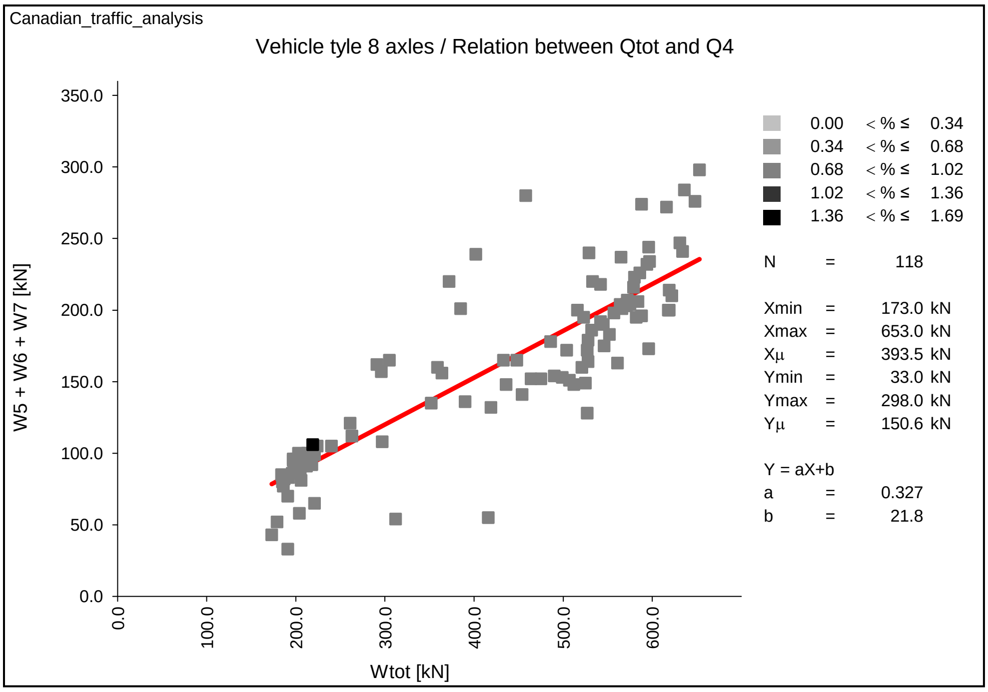

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
L3-4 [m]
N = 118
= 4.2 m
= 0.4 m
= 4.6 m
= 4.8 m
= 4.8 m
= 2.2 m
= 5.0 m
8.61
3.70

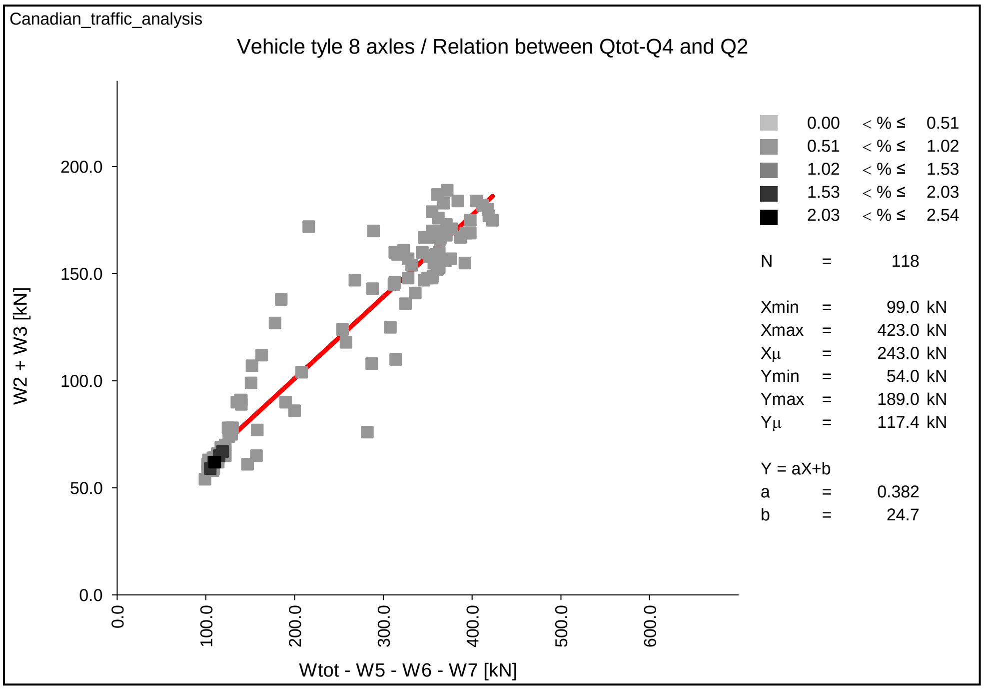

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
70%
60%
50%
40%
30%
20%
10%
0%
2.2
4.2
6.2
8.2
L4-5 [m]
N = 118
μ = 2.7 m
σ = 0.2 m
f95 = 3.0 m
f99 = 4.0 m
max = 4.4 m
A = 2.2 m
B = 9.6 m
α = 4.58
β = 57.74

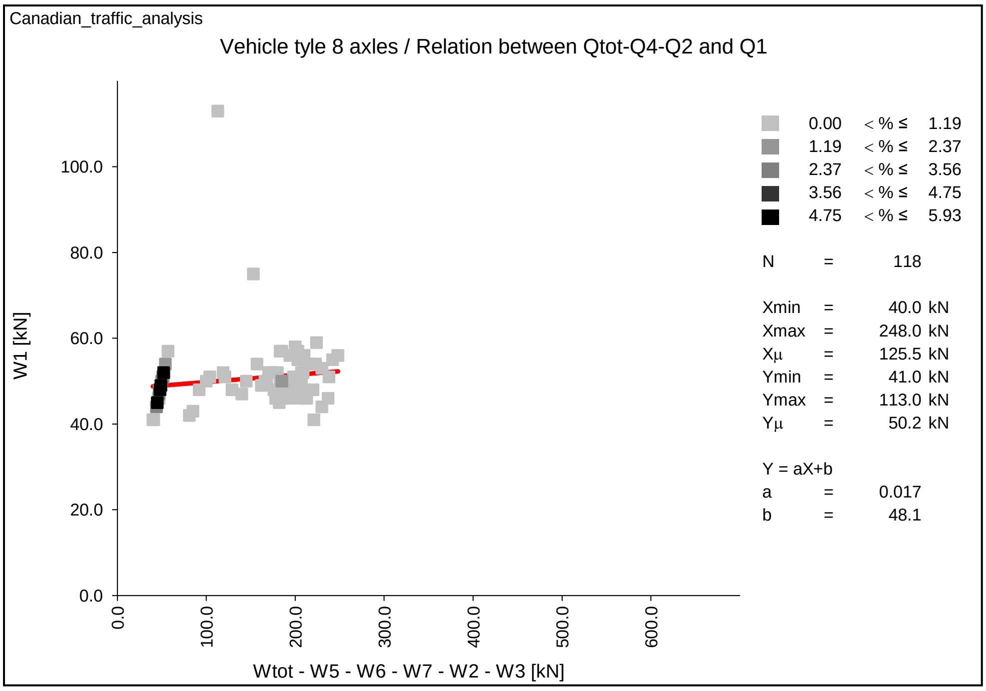

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
70%
60%
50%
40%
30%
20%
10%
0%
0.8
N = 118
μ = 1.3 m
σ = 0.2 m
f95 = 1.7 m
f99 = 1.9 m
max = 2.0 m
L5-6 [m]

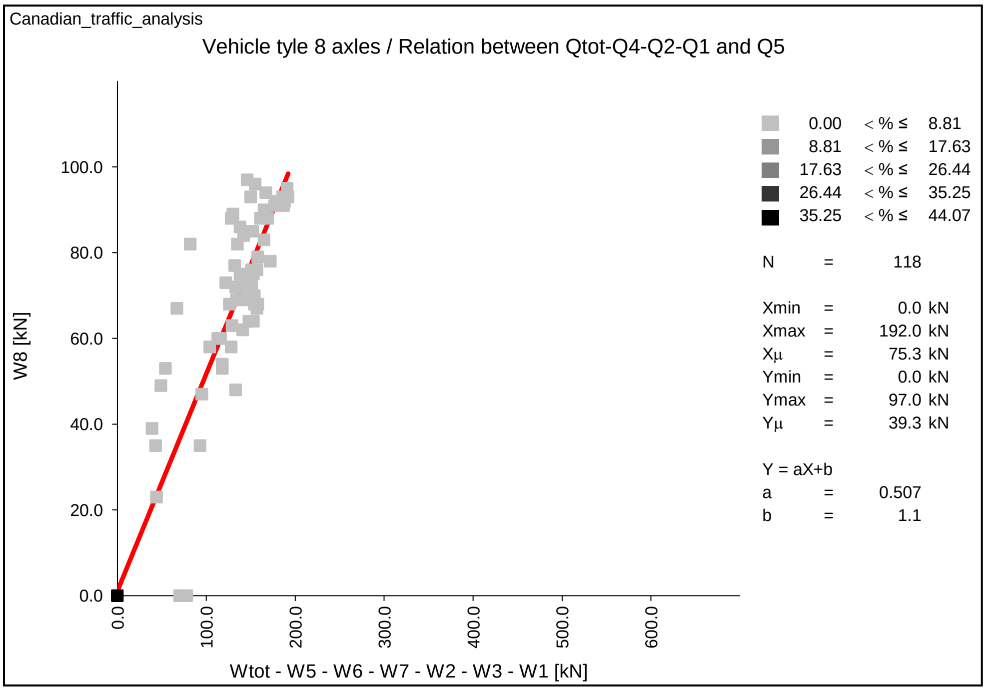

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
70%
60%
50%
40%
30%
20%
10%
0%
0.8
N = 118
μ = 1.3 m
σ = 0.2 m
f95 = 1.7 m
f99 = 1.9 m
max = 2.0 m
L6-7 [m]

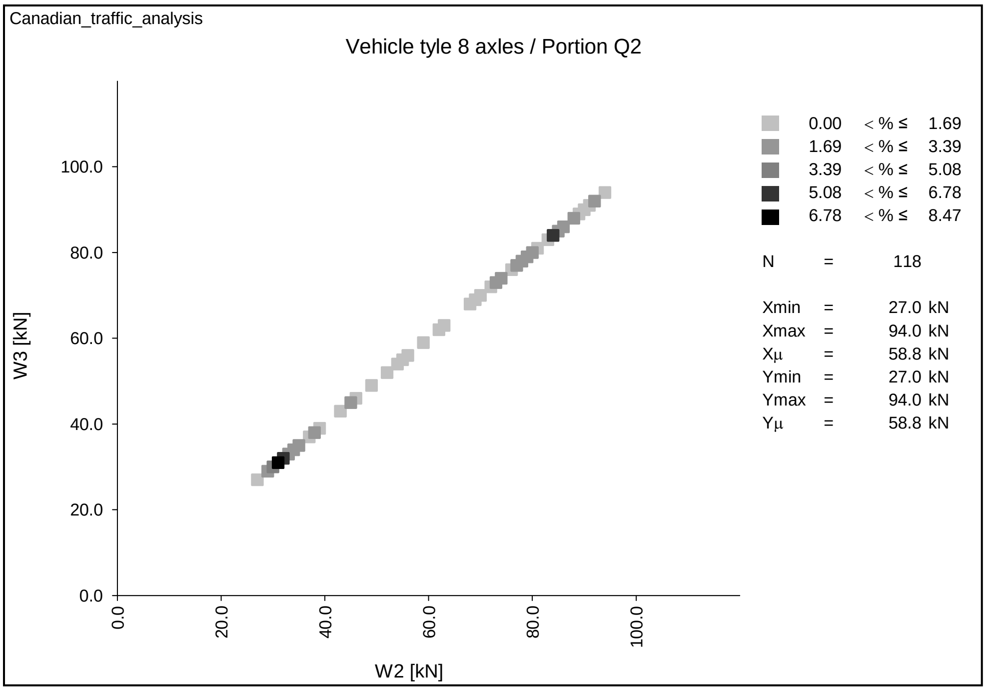

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
70%
60%
50%
40%
30%
20%
10%
0%
2.2
4.2
N = 118
μ = 2.7 m
σ = 0.2 m
f95 = 3.0 m
f99 = 3.6 m
max = 4.0 m
A = 2.2 m
B = 5.2 m
α = 4.13
β = 19.91
L7-8 [m]

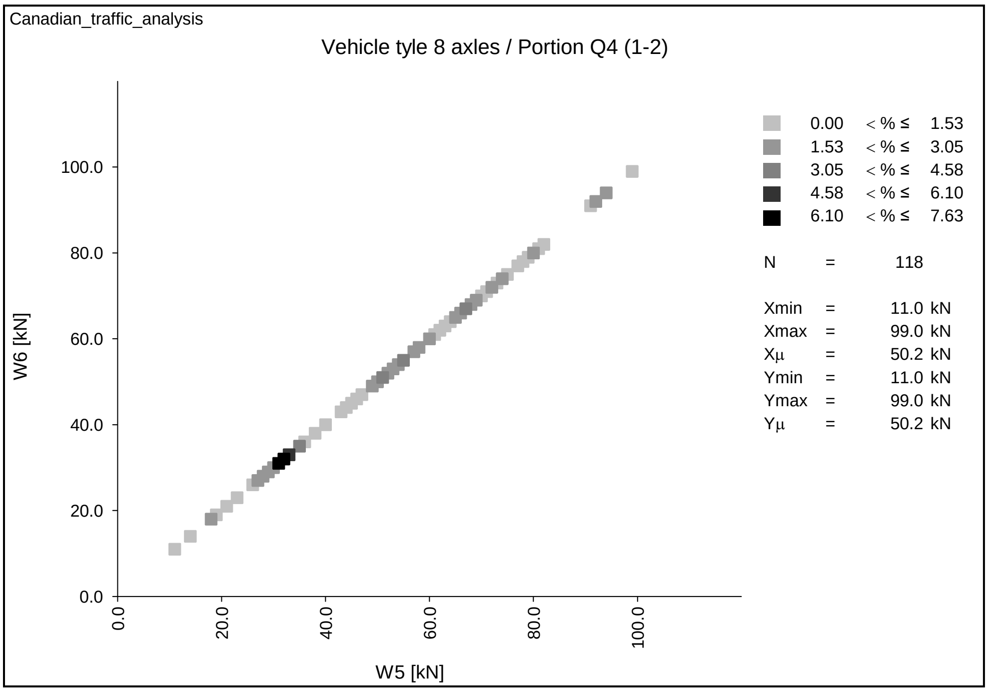

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q4
W5 + W6 + W7 [kN]
Wtot [kN]
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.34
0.34 < % ≤ 0.68
0.68 < % ≤ 1.02
1.02 < % ≤ 1.36
1.36 < % ≤ 1.69
N = 118
Xmin = 173.0 kN
Xmax = 653.0 kN
Xµ = 393.5 kN
Ymin = 33.0 kN
Ymax = 298.0 kN
Yµ = 150.6 kN
Y = aX+b
a = 0.327
b = 21.8

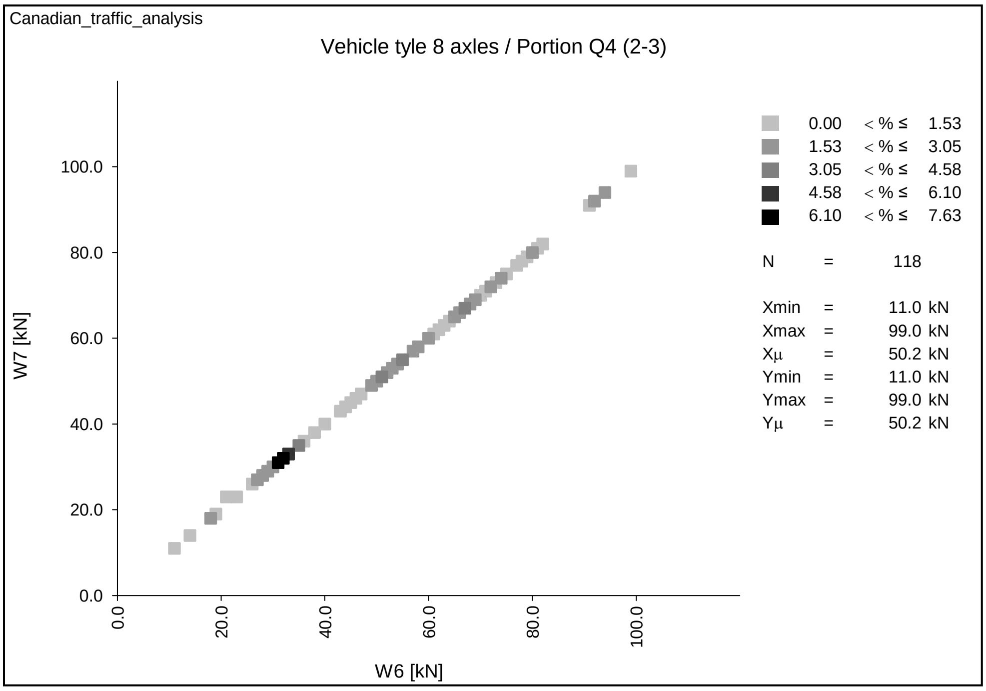

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q4 and Q2
W2 + W3 [kN]
Wtot - W5 - W6 - W7 [kN]
0.0
50.0
100.0
150.0
200.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.51
0.51 < % ≤ 1.02
1.02 < % ≤ 1.53
1.53 < % ≤ 2.03
2.03 < % ≤ 2.54
N = 118
Xmin = 99.0 kN
Xmax = 423.0 kN
Xµ = 243.0 kN
Ymin = 54.0 kN
Ymax = 189.0 kN
Yµ = 117.4 kN
Y = aX+b
a = 0.382
b = 24.7

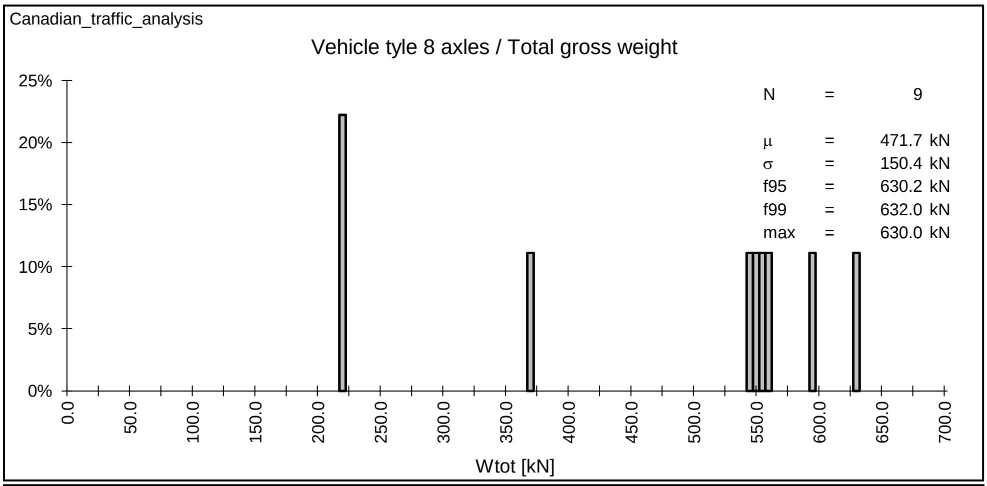

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q4-Q2 and Q1
W1 [kN]
Wtot - W5 - W6 - W7 - W2 - W3 [kN]
0.00 < % ≤ 1.19
1.19 < % ≤ 2.37
2.37 < % ≤ 3.56
3.56 < % ≤ 4.75
4.75 < % ≤ 5.93
N = 118
Xmin = 40.0 kN
Xmax = 248.0 kN
Xµ = 125.5 kN
Ymin = 41.0 kN
Ymax = 113.0 kN
Yµ = 50.2 kN
Y = aX+b
a = 0.017
b = 48.1

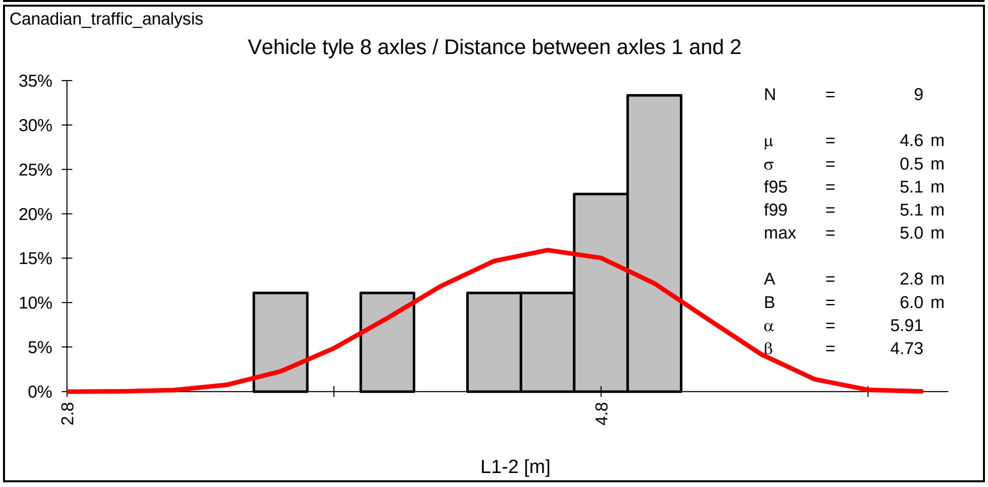

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q4-Q2-Q1 and Q5
W8 [kN]
Wtot - W5 - W6 - W7 - W2 - W3 - W1 [kN]
0.00 < % ≤ 8.81
8.81 < % ≤ 17.63
17.63 < % ≤ 26.44
26.44 < % ≤ 35.25
35.25 < % ≤ 44.07
N = 118
Xmin = 0.0 kN
Xmax = 192.0 kN
Xµ = 75.3 kN
Ymin = 0.0 kN
Ymax = 97.0 kN
Yµ = 39.3 kN
Y = aX+b
a = 0.507
b = 1.1

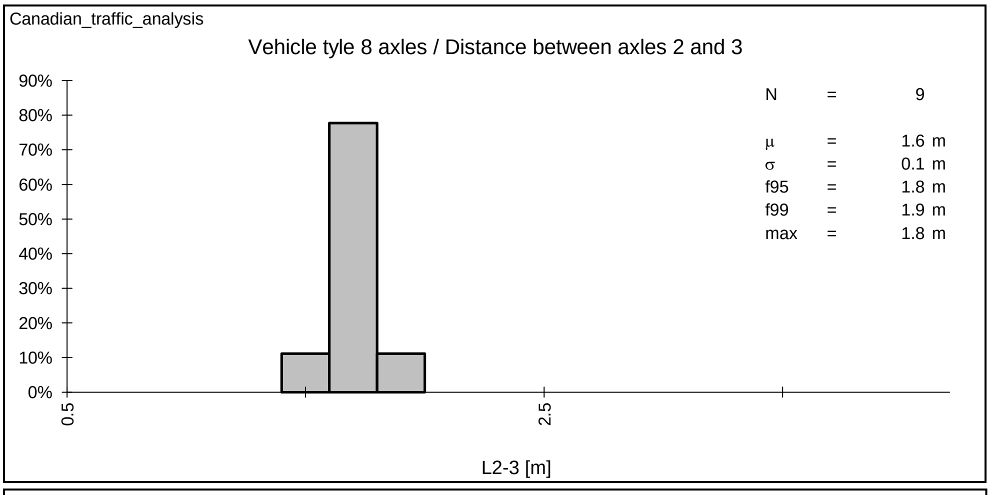

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 1.69
1.69 < % ≤ 3.39
3.39 < % ≤ 5.08
5.08 < % ≤ 6.78
6.78 < % ≤ 8.47
N = 118
Xmin = 27.0 kN
Xmax = 94.0 kN
Xμ = 58.8 kN
Ymin = 27.0 kN
Ymax = 94.0 kN
Yμ = 58.8 kN

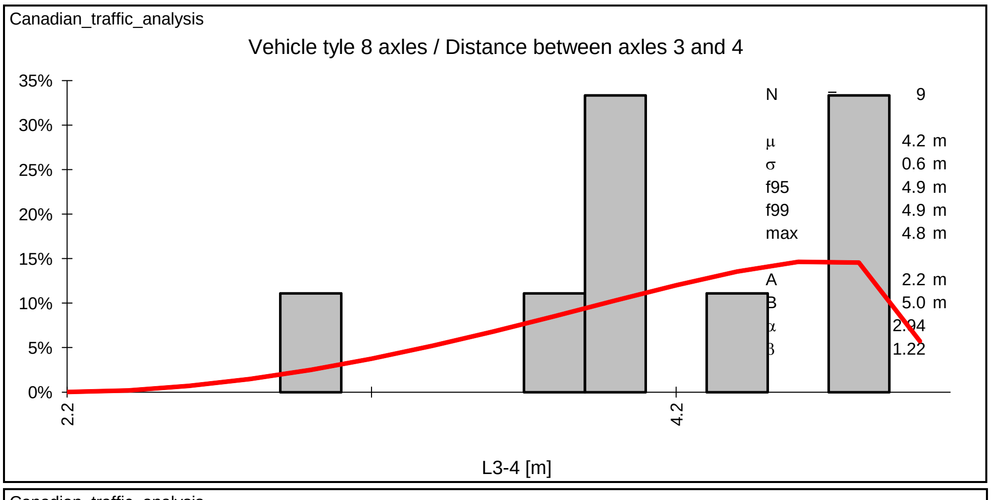

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4 (1-2)
W6 [kN]
W5 [kN]
0.00 < % ≤ 1.53
1.53 < % ≤ 3.05
3.05 < % ≤ 4.58
4.58 < % ≤ 6.10
6.10 < % ≤ 7.63
N = 118
Xmin = 11.0 kN
Xmax = 99.0 kN
Xμ = 50.2 kN
Ymin = 11.0 kN
Ymax = 99.0 kN
Yμ = 50.2 kN

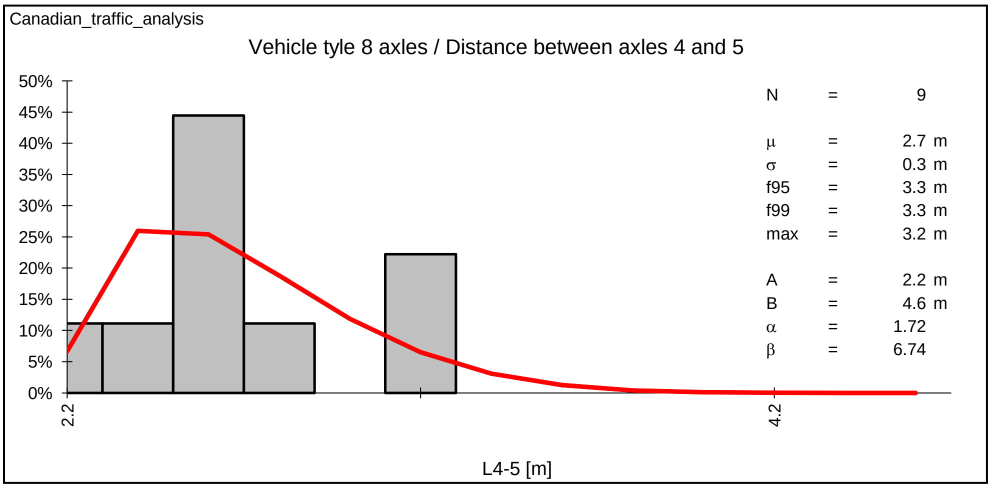

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4 (2-3)
W7 [kN]
W6 [kN]
0.00 < % ≤ 1.53
1.53 < % ≤ 3.05
3.05 < % ≤ 4.58
4.58 < % ≤ 6.10
6.10 < % ≤ 7.63
N = 118
Xmin = 11.0 kN
Xmax = 99.0 kN
Xμ = 50.2 kN
Ymin = 11.0 kN
Ymax = 99.0 kN
Yμ = 50.2 kN

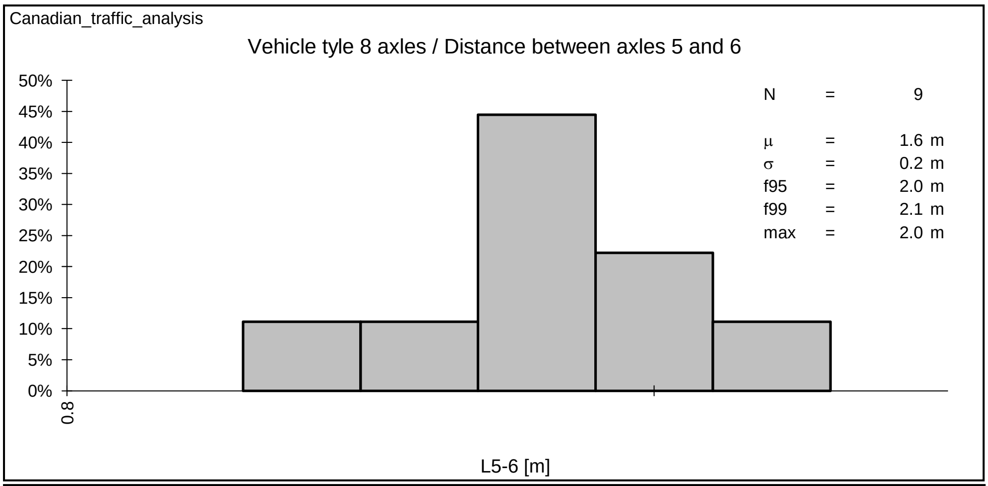

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
Wtot [kN]
N = 9
μ = 471.7 kN
σ = 150.4 kN
f95 = 630.2 kN
f99 = 632.0 kN
max = 630.0 kN

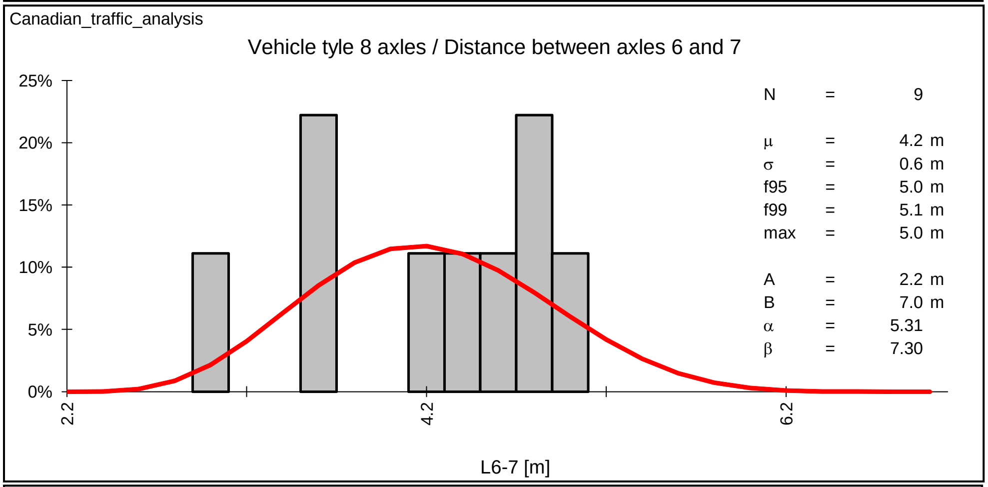

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
L1-2 [m]
N = 9
μ = 4.6 m
σ = 0.5 m
f95 = 5.1 m
f99 = 5.1 m
max = 5.0 m
A = 2.8 m
B = 6.0 m
α = 5.91
β = 4.73

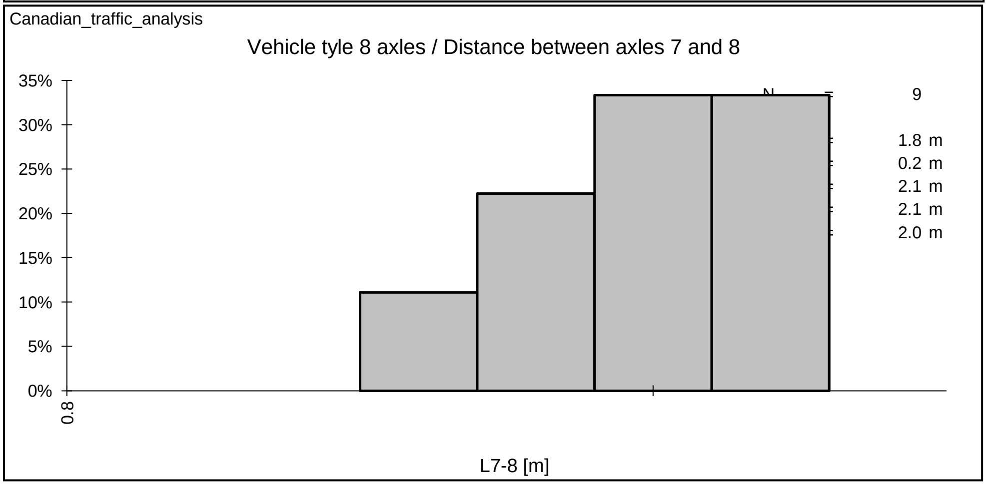

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.5
L2-3 [m]
N = 9
μ = 1.6 m
σ = 0.1 m
f95 = 1.8 m
f99 = 1.9 m
max = 1.8 m

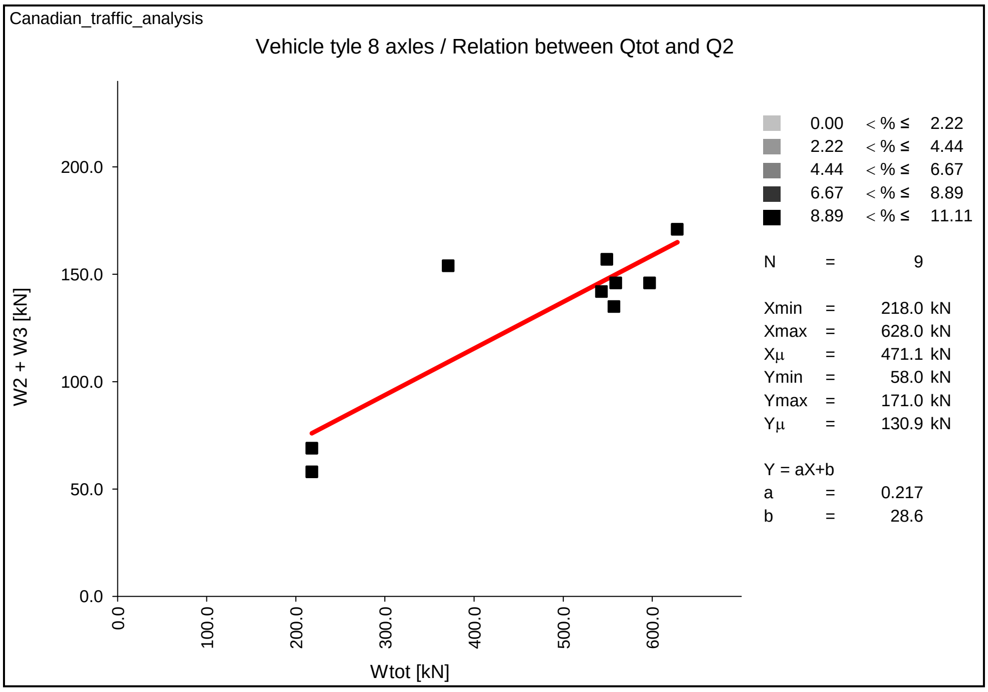

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
L3-4 [m]
N = 9
μ 4.2 m
σ 0.6 m
f95 4.9 m
f99 4.9 m
max 4.8 m
A 2.2 m
B 5.0 m
2.94
1.22

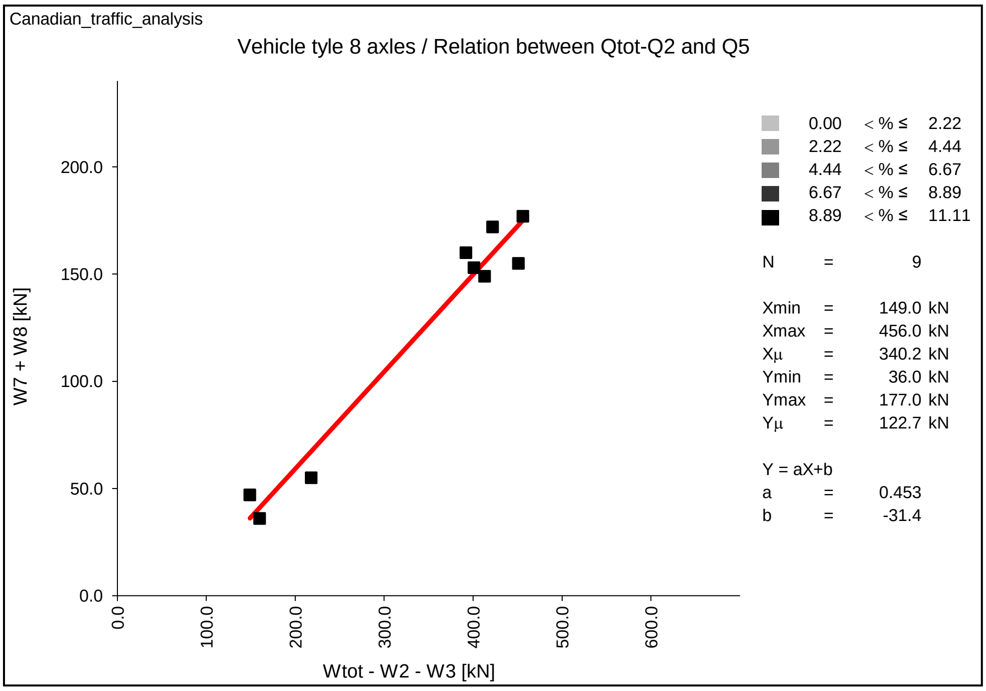

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
L4-5 [m]
N = 9
μ = 2.7 m
σ = 0.3 m
f95 = 3.3 m
f99 = 3.3 m
max = 3.2 m
A = 2.2 m
B = 4.6 m
α = 1.72
β = 6.74

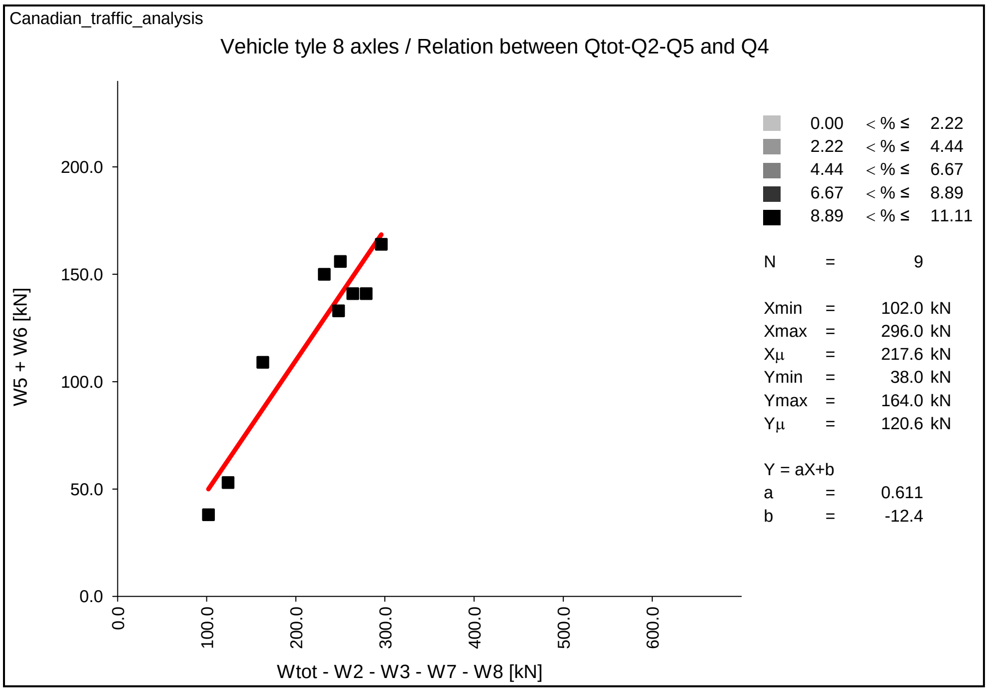

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L5-6 [m]
N = 9
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

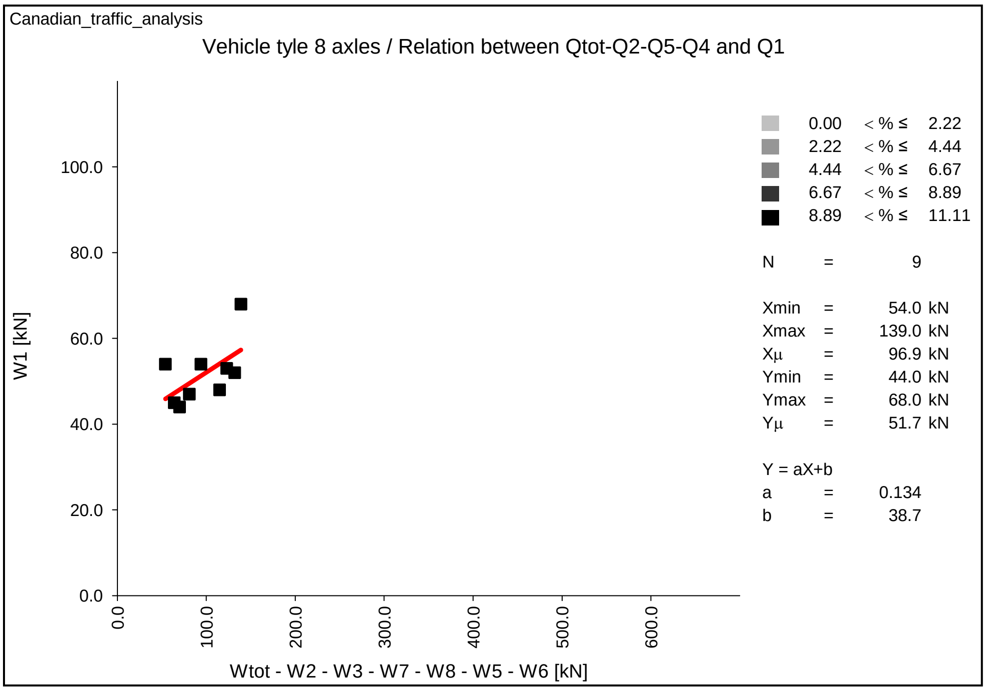

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
25%
20%
15%
10%
5%
0%
2.2
4.2
6.2
L6-7 [m]
N = 9
μ = 4.2 m
σ = 0.6 m
f95 = 5.0 m
f99 = 5.1 m
max = 5.0 m
A = 2.2 m
B = 7.0 m
α = 5.31
β = 7.30

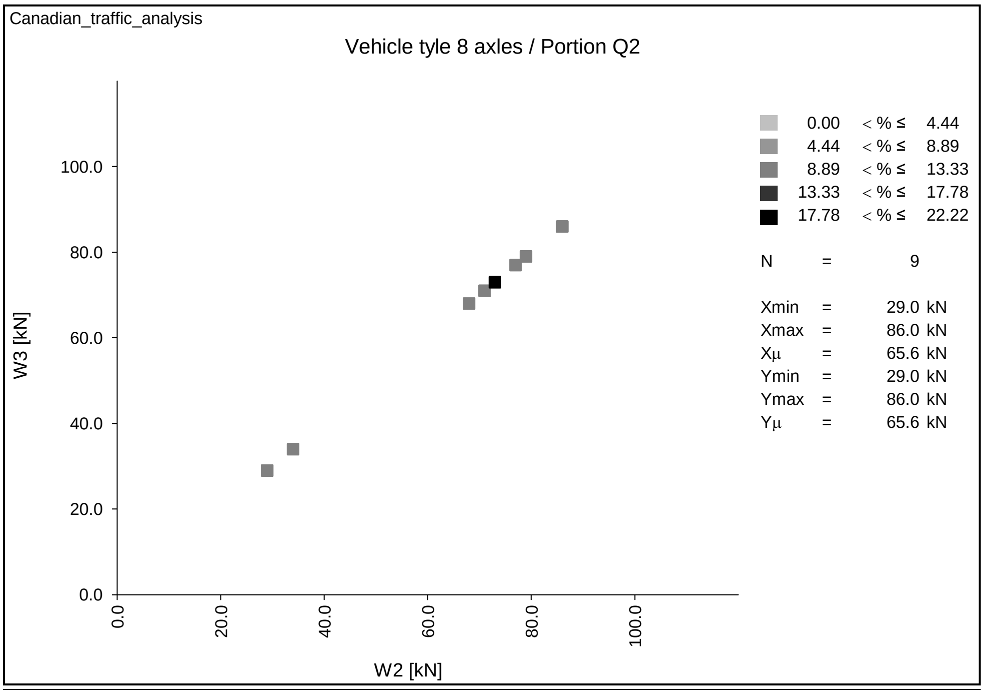

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L7-8 [m]
9
1.8 m
0.2 m
2.1 m
2.1 m
2.0 m

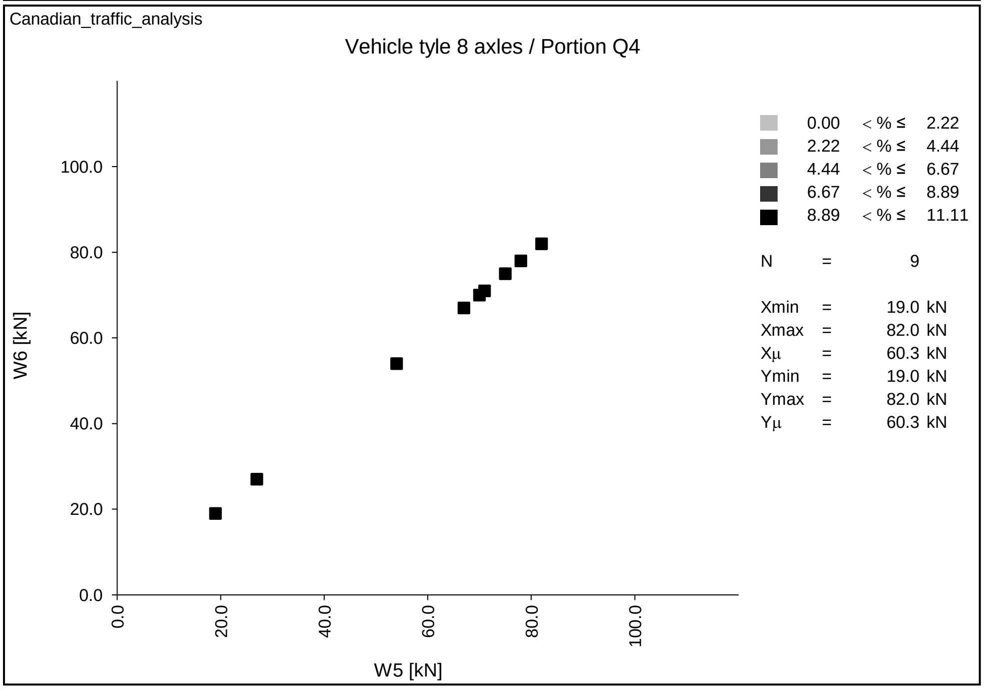

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q2
W2 + W3 [kN]
Wtot [kN]
0.00 < % ≤ 2.22
2.22 < % ≤ 4.44
4.44 < % ≤ 6.67
6.67 < % ≤ 8.89
8.89 < % ≤ 11.11
N = 9
Xmin = 218.0 kN
Xmax = 628.0 kN
Xµ = 471.1 kN
Ymin = 58.0 kN
Ymax = 171.0 kN
Yµ = 130.9 kN
Y = aX+b
a = 0.217
b = 28.6

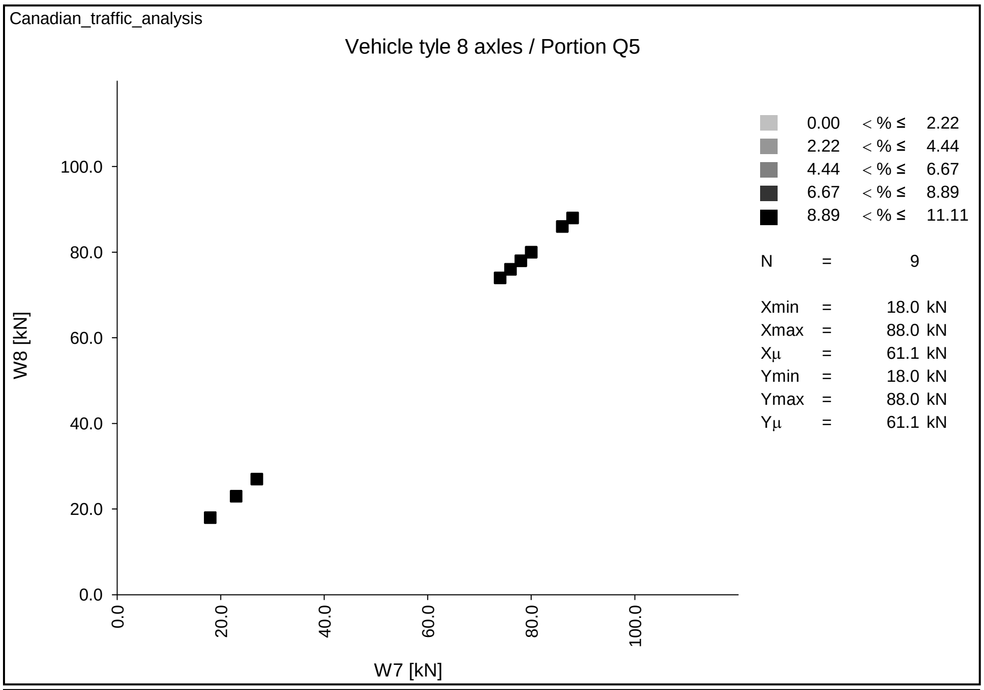

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q2 and Q5
W7 + W8 [kN]
Wtot - W2 - W3 [kN]
0.00 < % ≤ 2.22
2.22 < % ≤ 4.44
4.44 < % ≤ 6.67
6.67 < % ≤ 8.89
8.89 < % ≤ 11.11
N = 9
Xmin = 149.0 kN
Xmax = 456.0 kN
Xµ = 340.2 kN
Ymin = 36.0 kN
Ymax = 177.0 kN
Yµ = 122.7 kN
Y = aX+b
a = 0.453
b = -31.4

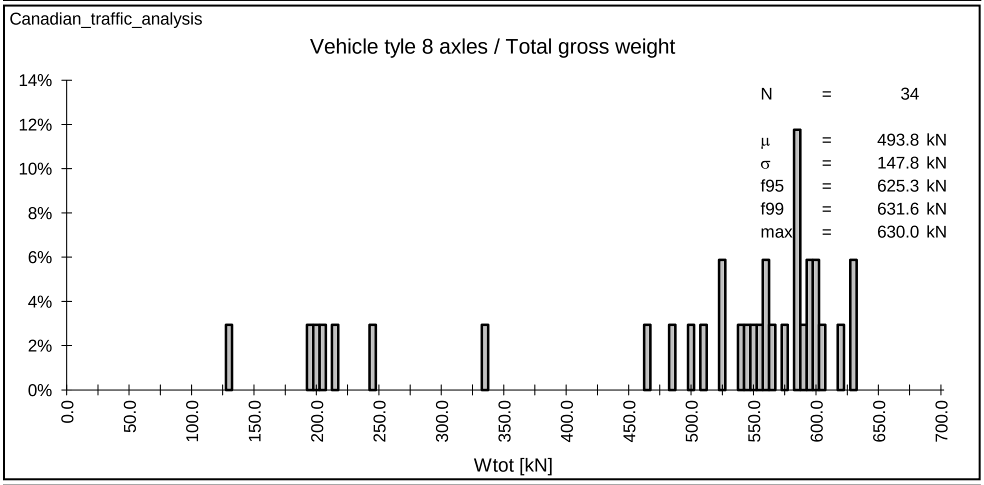

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q2-Q5 and Q4
W5 + W6 [kN]
Wtot - W2 - W3 - W7 - W8 [kN]
0.00 < % ≤ 2.22
2.22 < % ≤ 4.44
4.44 < % ≤ 6.67
6.67 < % ≤ 8.89
8.89 < % ≤ 11.11
N = 9
Xmin = 102.0 kN
Xmax = 296.0 kN
Xμ = 217.6 kN
Ymin = 38.0 kN
Ymax = 164.0 kN
Yμ = 120.6 kN
Y = aX+b
a = 0.611
b = -12.4

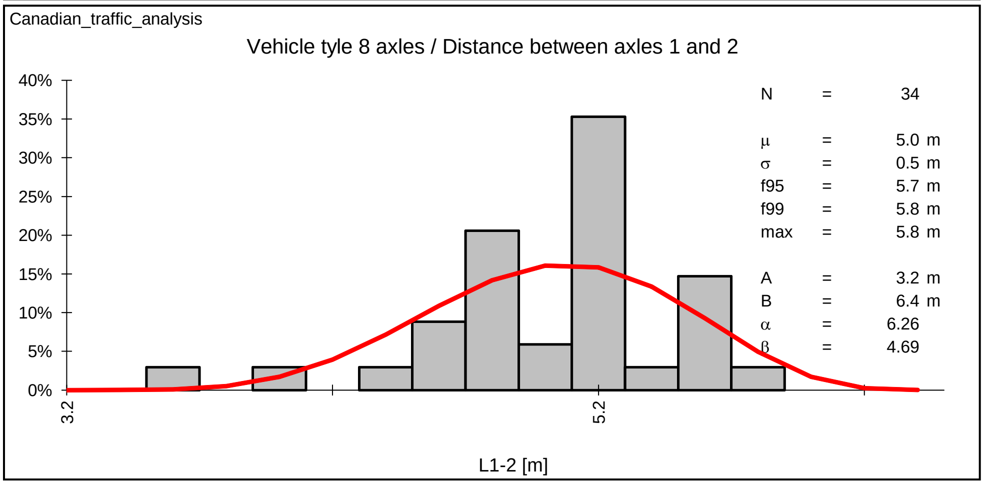

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q2-Q5-Q4 and Q1
W1 [kN]
Wtot - W2 - W3 - W7 - W8 - W5 - W6 [kN]
0.00 < % ≤ 2.22
2.22 < % ≤ 4.44
4.44 < % ≤ 6.67
6.67 < % ≤ 8.89
8.89 < % ≤ 11.11
N = 9
Xmin = 54.0 kN
Xmax = 139.0 kN
Xμ = 96.9 kN
Ymin = 44.0 kN
Ymax = 68.0 kN
Yμ = 51.7 kN
Y = aX+b
a = 0.134
b = 38.7

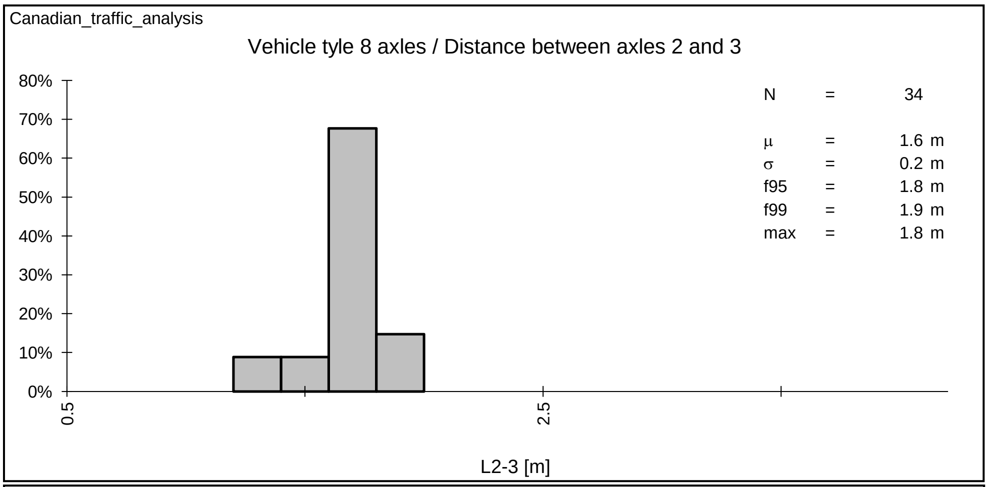

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 4.44
4.44 < % ≤ 8.89
8.89 < % ≤ 13.33
13.33 < % ≤ 17.78
17.78 < % ≤ 22.22
N = 9
Xmin = 29.0 kN
Xmax = 86.0 kN
Xμ = 65.6 kN
Ymin = 29.0 kN
Ymax = 86.0 kN
Yμ = 65.6 kN

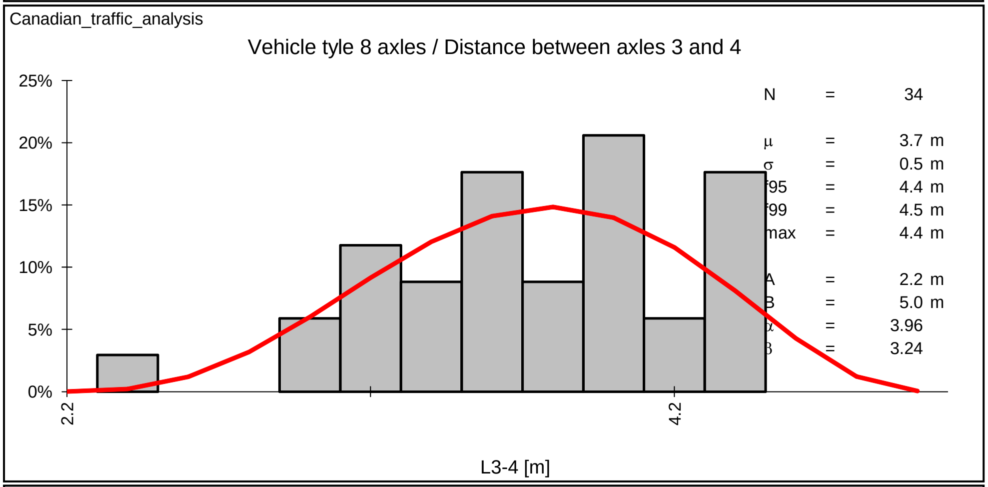

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4
W6 [kN]
W5 [kN]
0.00 < % ≤ 2.22
2.22 < % ≤ 4.44
4.44 < % ≤ 6.67
6.67 < % ≤ 8.89
8.89 < % ≤ 11.11
N = 9
Xmin = 19.0 kN
Xmax = 82.0 kN
Xμ = 60.3 kN
Ymin = 19.0 kN
Ymax = 82.0 kN
Yμ = 60.3 kN

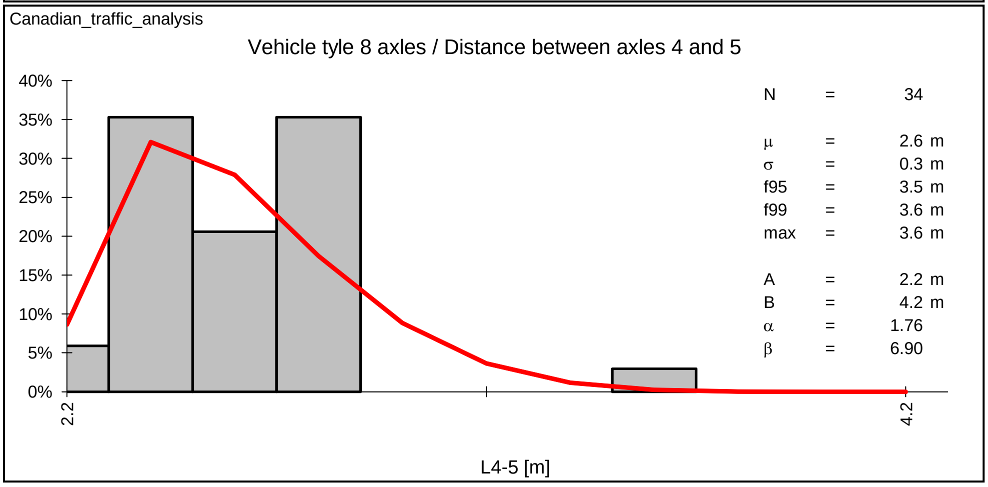

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q5
0.00 < % ≤ 2.22
2.22 < % ≤ 4.44
4.44 < % ≤ 6.67
6.67 < % ≤ 8.89
8.89 < % ≤ 11.11
N = 9
Xmin = 18.0 kN
Xmax = 88.0 kN
Xµ = 61.1 kN
Ymin = 18.0 kN
Ymax = 88.0 kN
Yµ = 61.1 kN
W8 [kN]
W7 [kN]

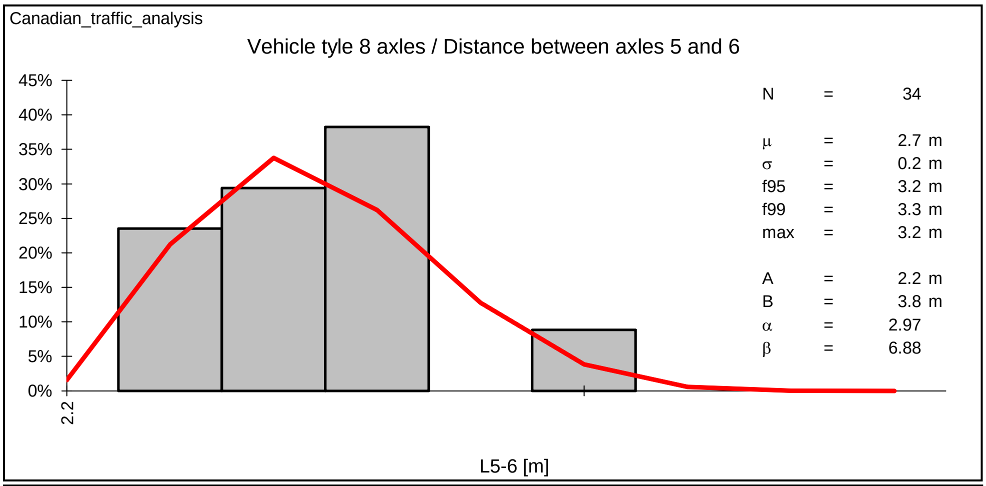

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
N = 34
µ = 493.8 kN
σ = 147.8 kN
f95 = 625.3 kN
f99 = 631.6 kN
max = 630.0 kN
Wtot [kN]

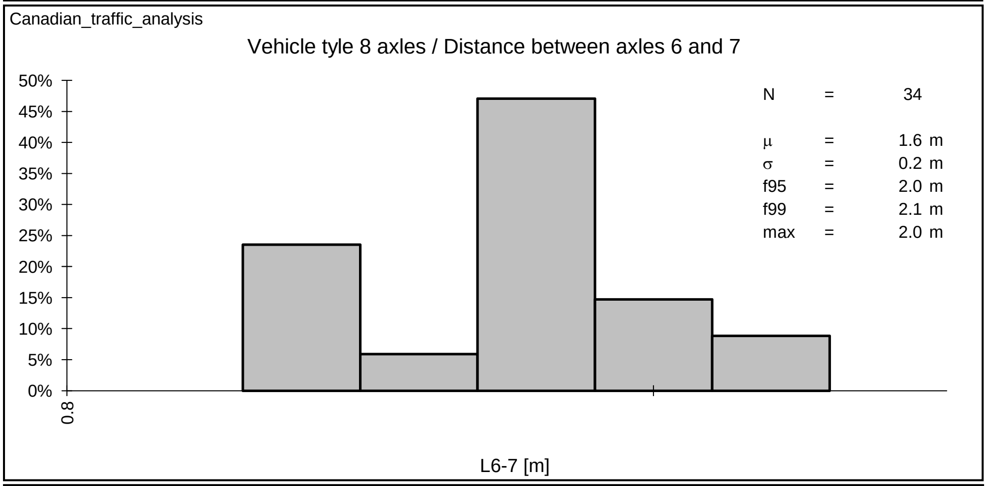

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
N = 34
µ = 5.0 m
σ = 0.5 m
f95 = 5.7 m
f99 = 5.8 m
max = 5.8 m
A = 3.2 m
B = 6.4 m
α = 6.26
β = 4.69
L1-2 [m]

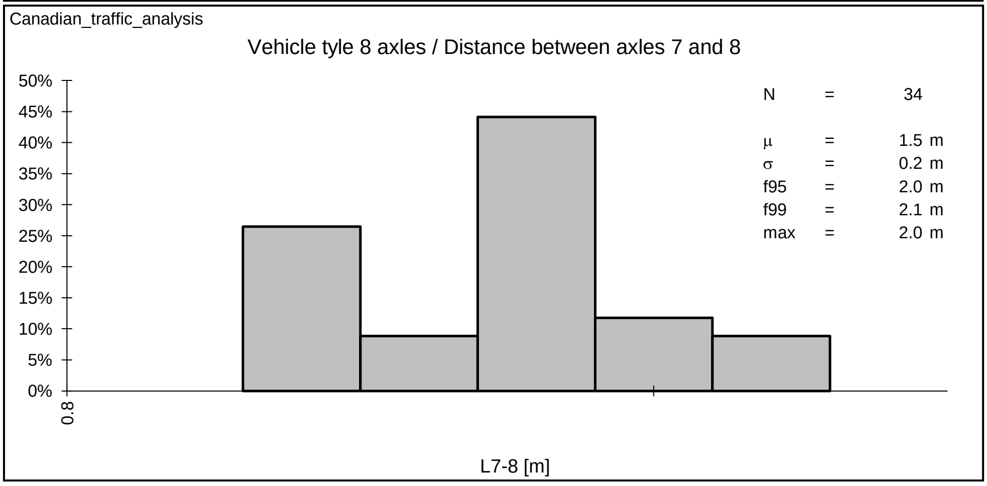

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.5
L2-3 [m]
N = 34
μ = 1.6 m
σ = 0.2 m
f95 = 1.8 m
f99 = 1.9 m
max = 1.8 m

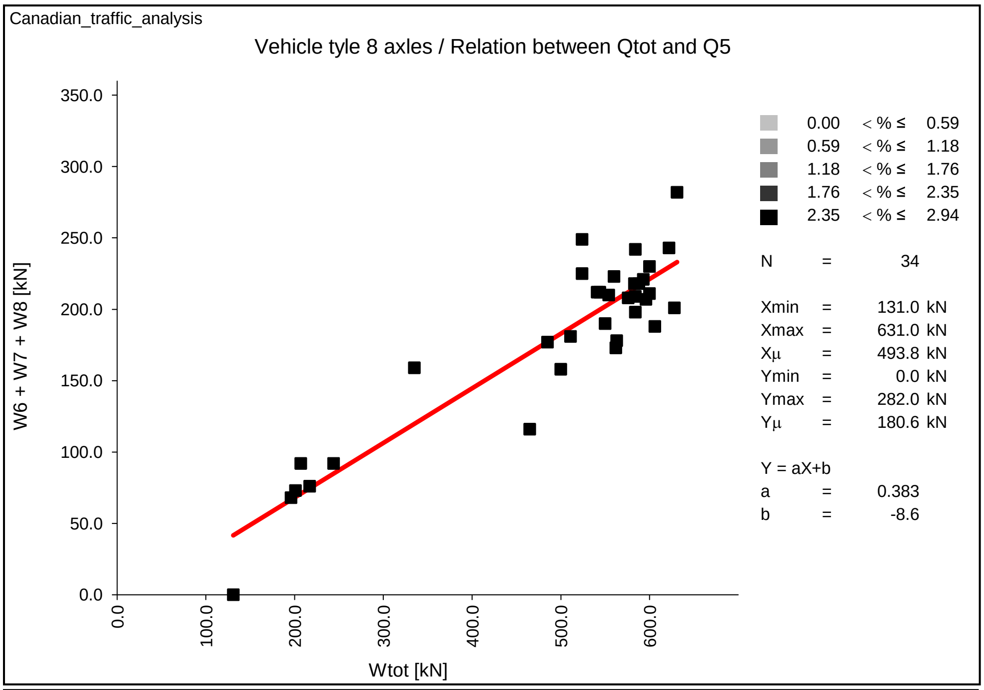

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
25%
20%
15%
10%
5%
0%
2.2
4.2
L3-4 [m]
N = 34
μ = 3.7 m
σ = 0.5 m
f95 = 4.4 m
f99 = 4.5 m
max = 4.4 m
A = 2.2 m
B = 5.0 m
α = 3.96
β = 3.24

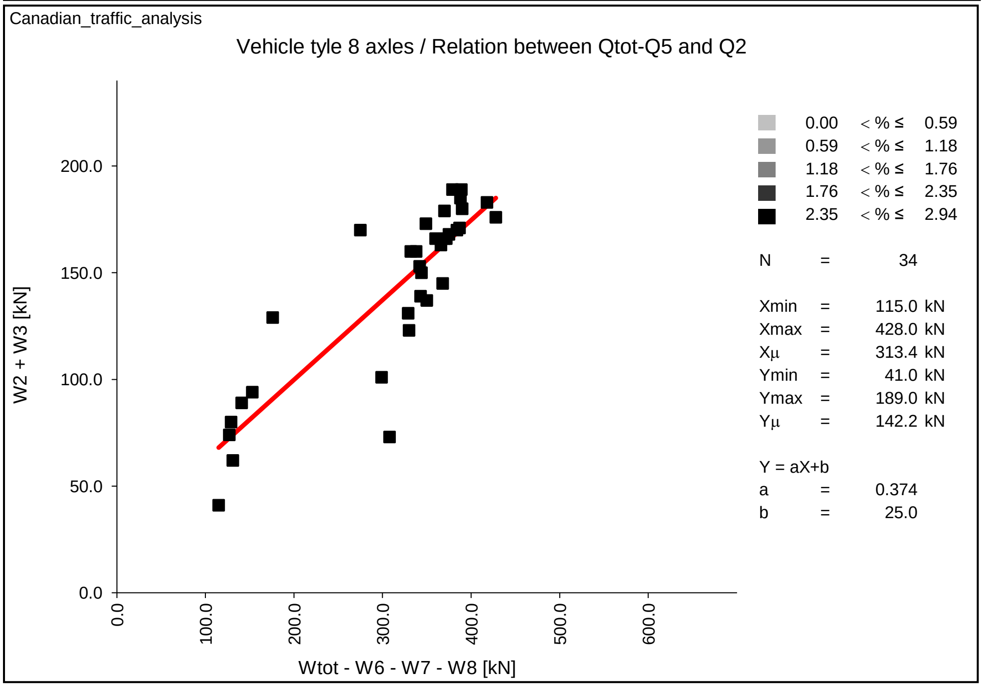

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
L4-5 [m]
N = 34
μ = 2.6 m
σ = 0.3 m
f95 = 3.5 m
f99 = 3.6 m
max = 3.6 m
A = 2.2 m
B = 4.2 m
α = 1.76
β = 6.90

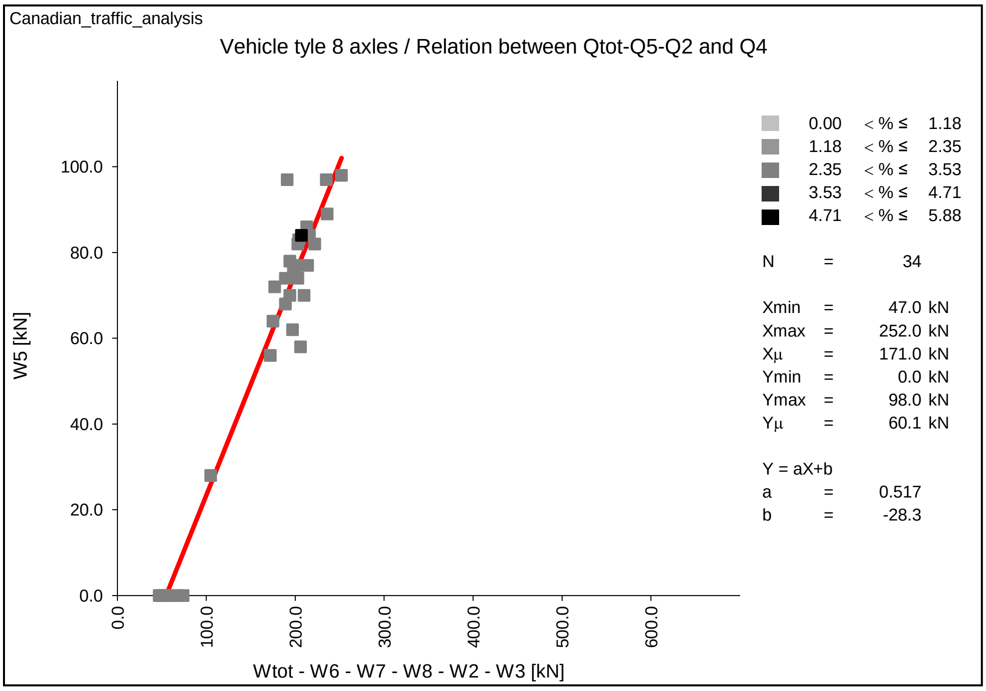

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
L5-6 [m]
N = 34
μ = 2.7 m
σ = 0.2 m
f95 = 3.2 m
f99 = 3.3 m
max = 3.2 m
A = 2.2 m
B = 3.8 m
α = 2.97
β = 6.88

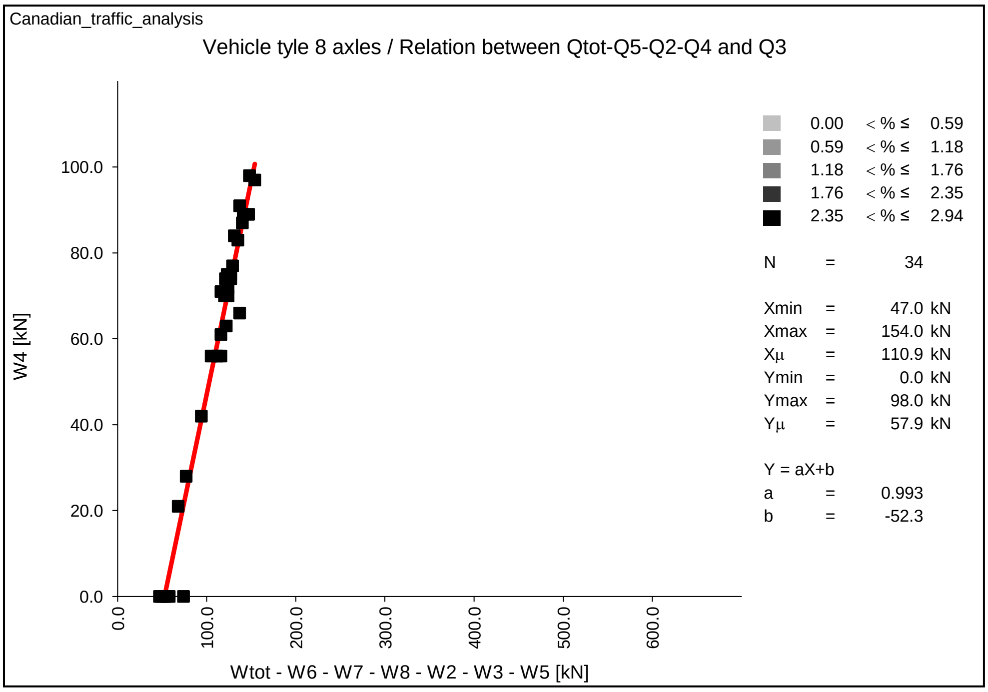

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L6-7 [m]
N = 34
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

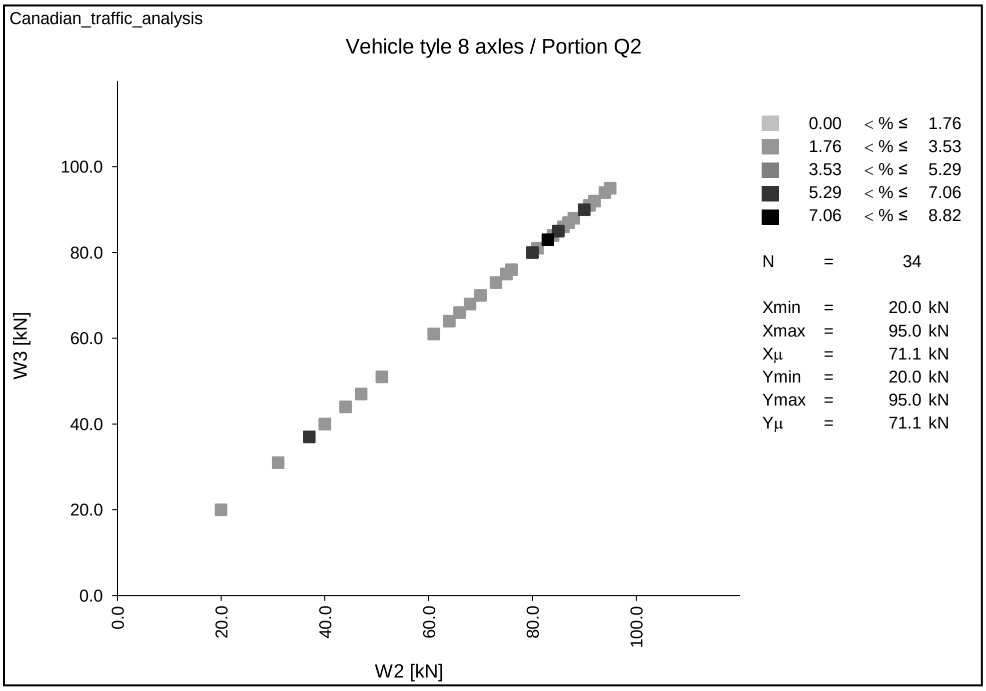

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L7-8 [m]
N = 34
μ = 1.5 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.1 m
max = 2.0 m

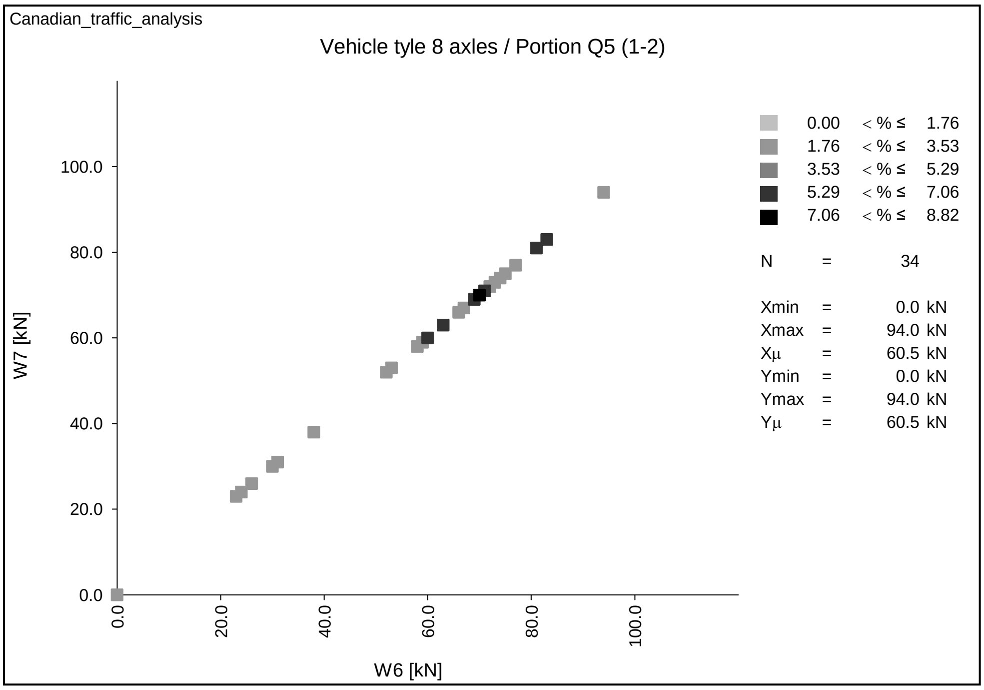

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q5
W6 + W7 + W8 [kN]
Wtot [kN]
0.00 < % ≤ 0.59
0.59 < % ≤ 1.18
1.18 < % ≤ 1.76
1.76 < % ≤ 2.35
2.35 < % ≤ 2.94
N = 34
Xmin = 131.0 kN
Xmax = 631.0 kN
Xμ = 493.8 kN
Ymin = 0.0 kN
Ymax = 282.0 kN
Yμ = 180.6 kN
Y = aX+b
a = 0.383
b = -8.6

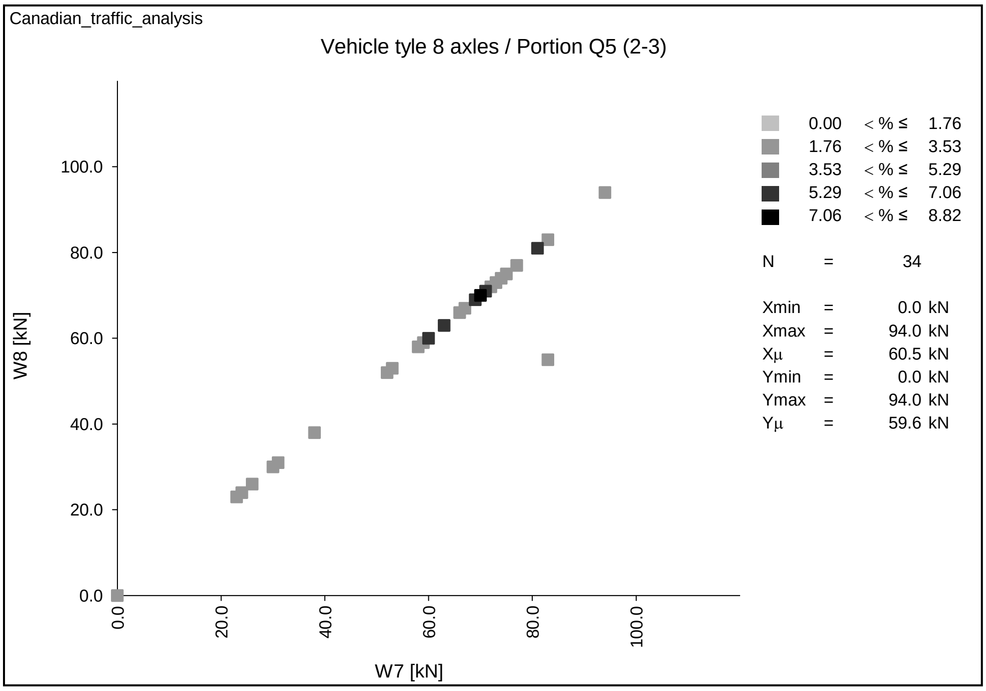

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q5 and Q2
W2 + W3 [kN]
Wtot - W6 - W7 - W8 [kN]
0.00 < % ≤ 0.59
0.59 < % ≤ 1.18
1.18 < % ≤ 1.76
1.76 < % ≤ 2.35
2.35 < % ≤ 2.94
N = 34
Xmin = 115.0 kN
Xmax = 428.0 kN
Xμ = 313.4 kN
Ymin = 41.0 kN
Ymax = 189.0 kN
Yμ = 142.2 kN
Y = aX+b
a = 0.374
b = 25.0

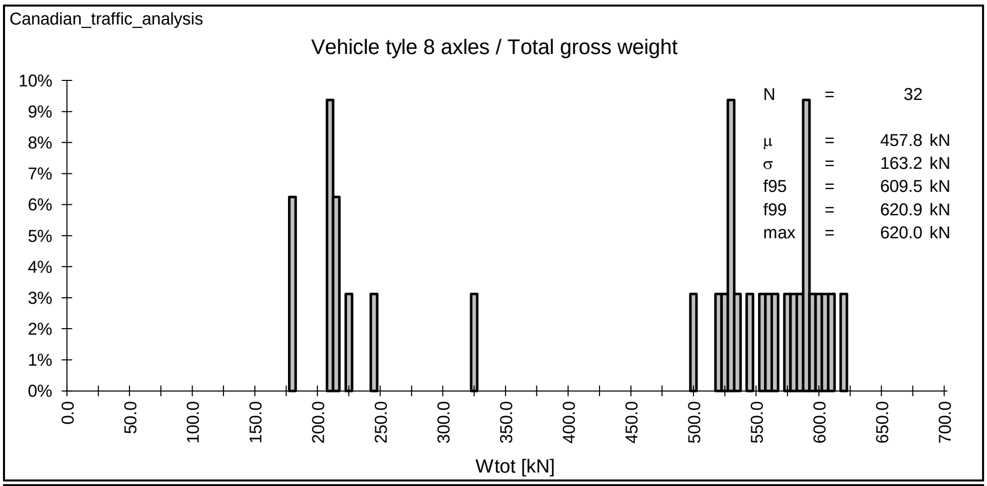

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q5-Q2 and Q4
W5 [kN]
Wtot - W6 - W7 - W8 - W2 - W3 [kN]
0.00 < % ≤ 1.18
1.18 < % ≤ 2.35
2.35 < % ≤ 3.53
3.53 < % ≤ 4.71
4.71 < % ≤ 5.88
N = 34
Xmin = 47.0 kN
Xmax = 252.0 kN
Xµ = 171.0 kN
Ymin = 0.0 kN
Ymax = 98.0 kN
Yµ = 60.1 kN
Y = aX+b
a = 0.517
b = -28.3

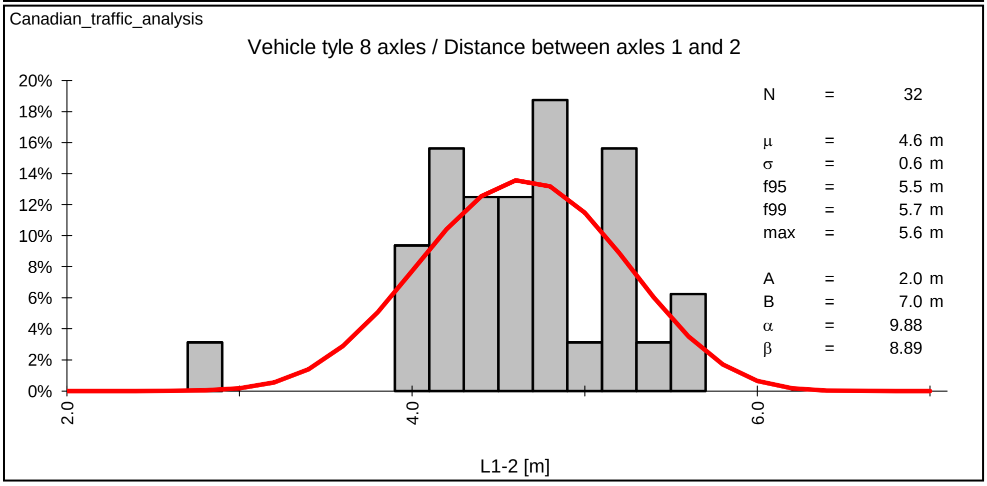

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q5-Q2-Q4 and Q3
W4 [kN]
Wtot - W6 - W7 - W8 - W2 - W3 - W5 [kN]
0.00 < % ≤ 0.59
0.59 < % ≤ 1.18
1.18 < % ≤ 1.76
1.76 < % ≤ 2.35
2.35 < % ≤ 2.94
N = 34
Xmin = 47.0 kN
Xmax = 154.0 kN
Xµ = 110.9 kN
Ymin = 0.0 kN
Ymax = 98.0 kN
Yµ = 57.9 kN
Y = aX+b
a = 0.993
b = -52.3

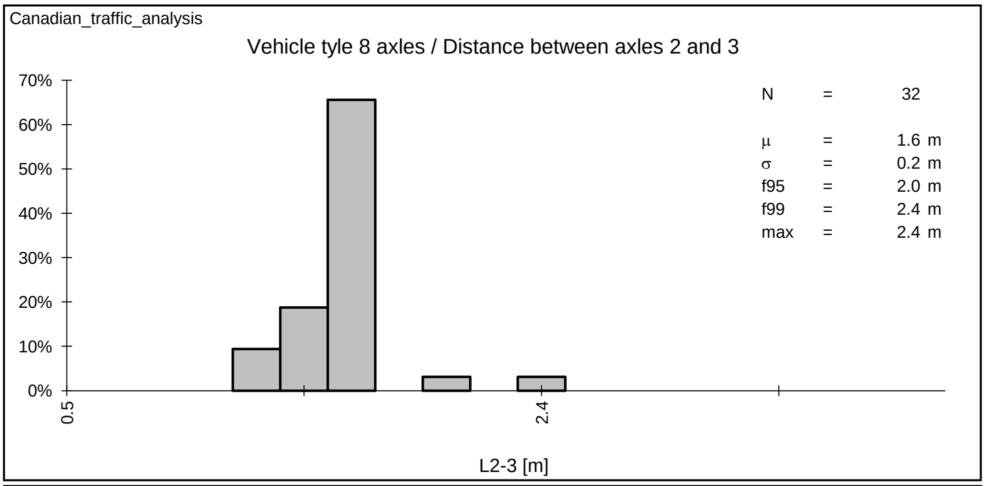

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
W3 [kN]
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 1.76
1.76 < % ≤ 3.53
3.53 < % ≤ 5.29
5.29 < % ≤ 7.06
7.06 < % ≤ 8.82
N = 34
Xmin = 20.0 kN
Xmax = 95.0 kN
Xµ = 71.1 kN
Ymin = 20.0 kN
Ymax = 95.0 kN
Yµ = 71.1 kN

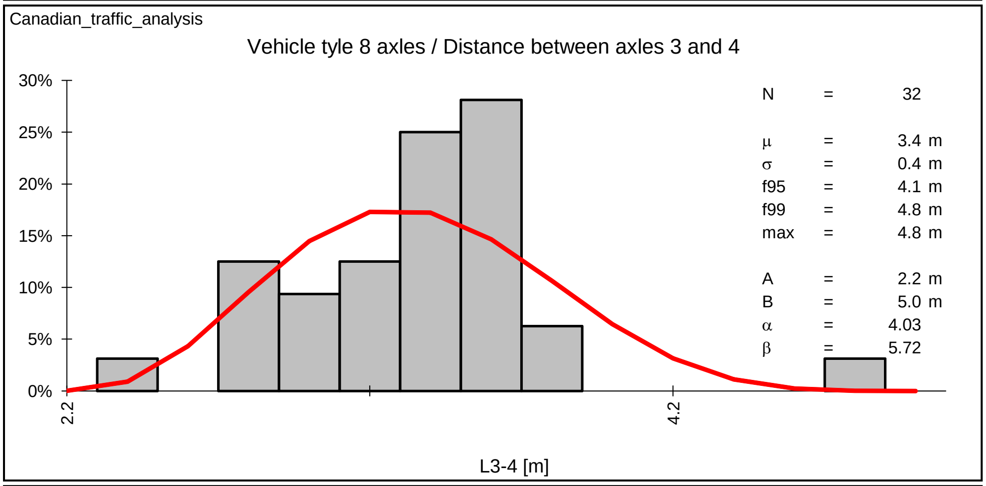

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q5 (1-2)
W7 [kN]
W6 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 1.76
1.76 < % ≤ 3.53
3.53 < % ≤ 5.29
5.29 < % ≤ 7.06
7.06 < % ≤ 8.82
N = 34
Xmin = 0.0 kN
Xmax = 94.0 kN
Xµ = 60.5 kN
Ymin = 0.0 kN
Ymax = 94.0 kN
Yµ = 60.5 kN

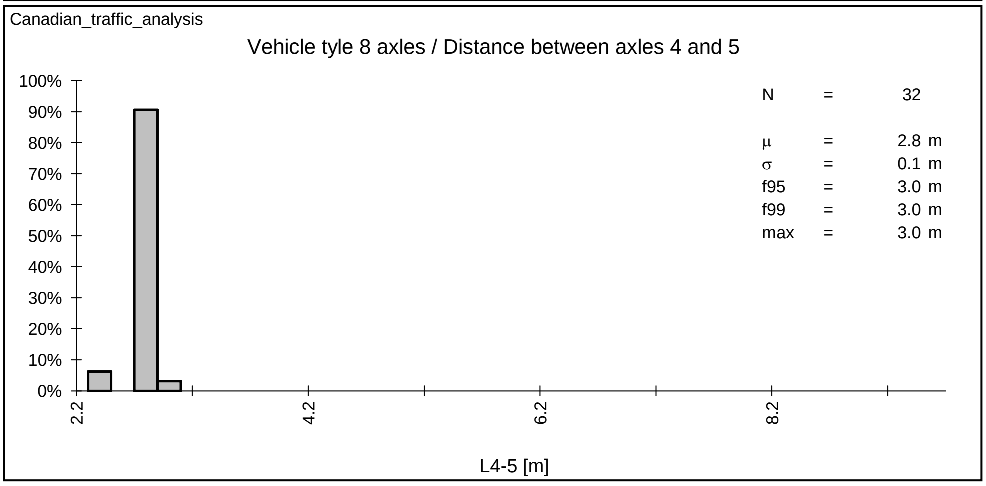

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q5 (2-3)
0.00 < % ≤ 1.76
1.76 < % ≤ 3.53
3.53 < % ≤ 5.29
5.29 < % ≤ 7.06
7.06 < % ≤ 8.82
N = 34
Xmin = 0.0 kN
Xmax = 94.0 kN
Xμ = 60.5 kN
Ymin = 0.0 kN
Ymax = 94.0 kN
Yμ = 59.6 kN
W8 [kN]
W7 [kN]

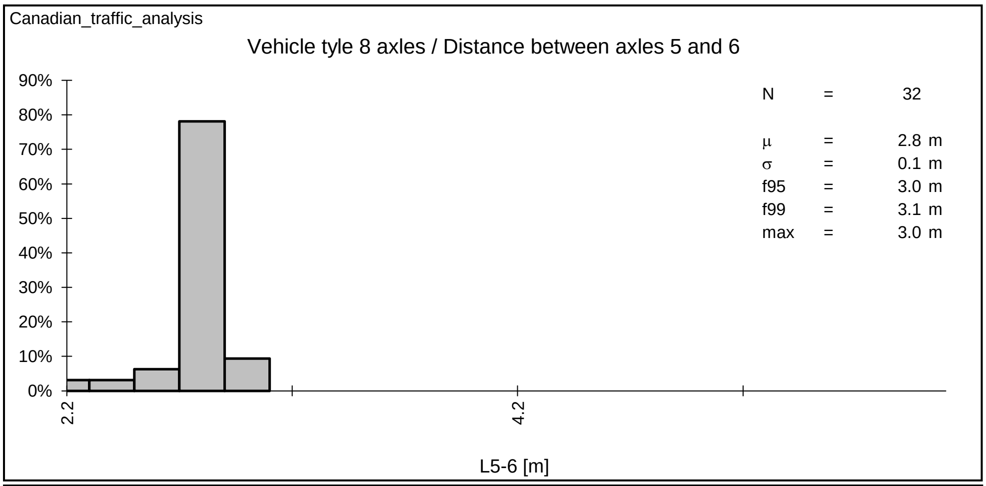

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
N = 32
μ = 457.8 kN
σ = 163.2 kN
f95 = 609.5 kN
f99 = 620.9 kN
max = 620.0 kN
Wtot [kN]

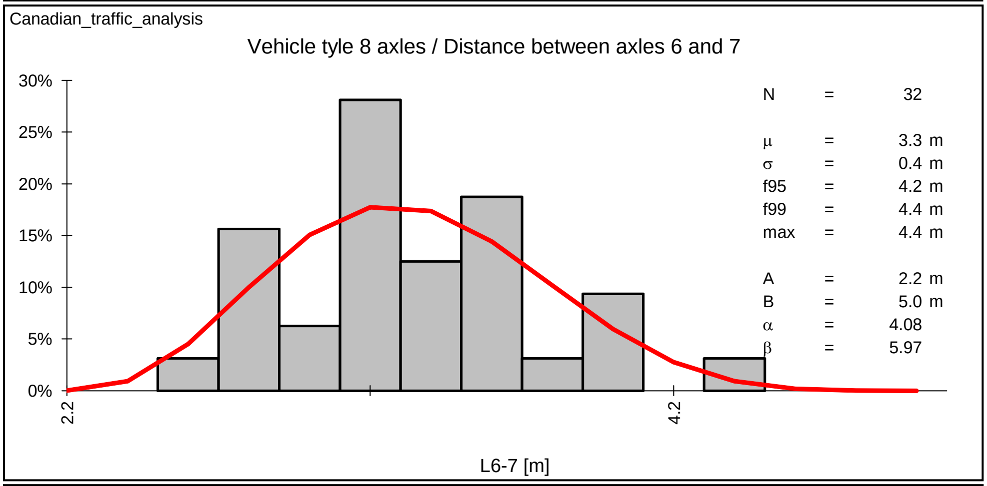

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
N = 32
μ = 4.6 m
σ = 0.6 m
f95 = 5.5 m
f99 = 5.7 m
max = 5.6 m
A = 2.0 m
B = 7.0 m
α = 9.88
β = 8.89
L1-2 [m]

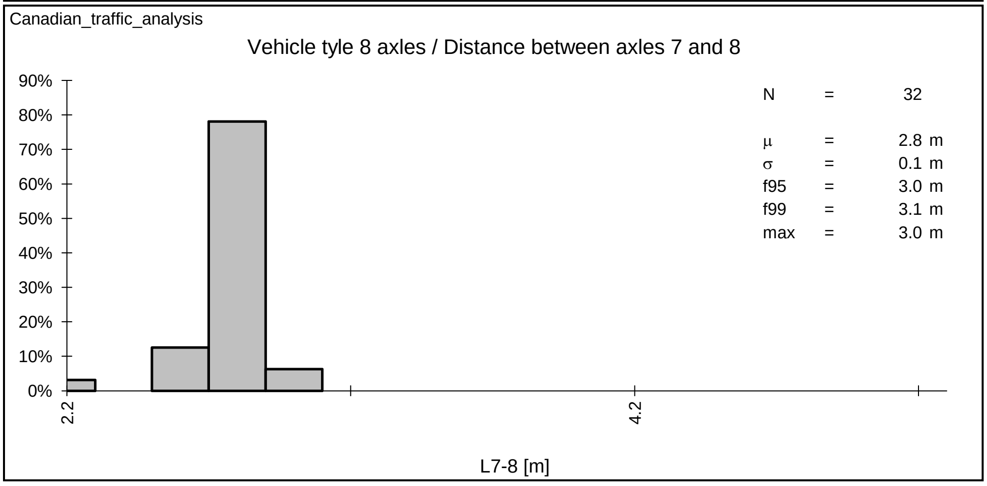

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
N = 32
μ = 1.6 m
σ = 0.2 m
f95 = 2.0 m
f99 = 2.4 m
max = 2.4 m
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.4
L2-3 [m]

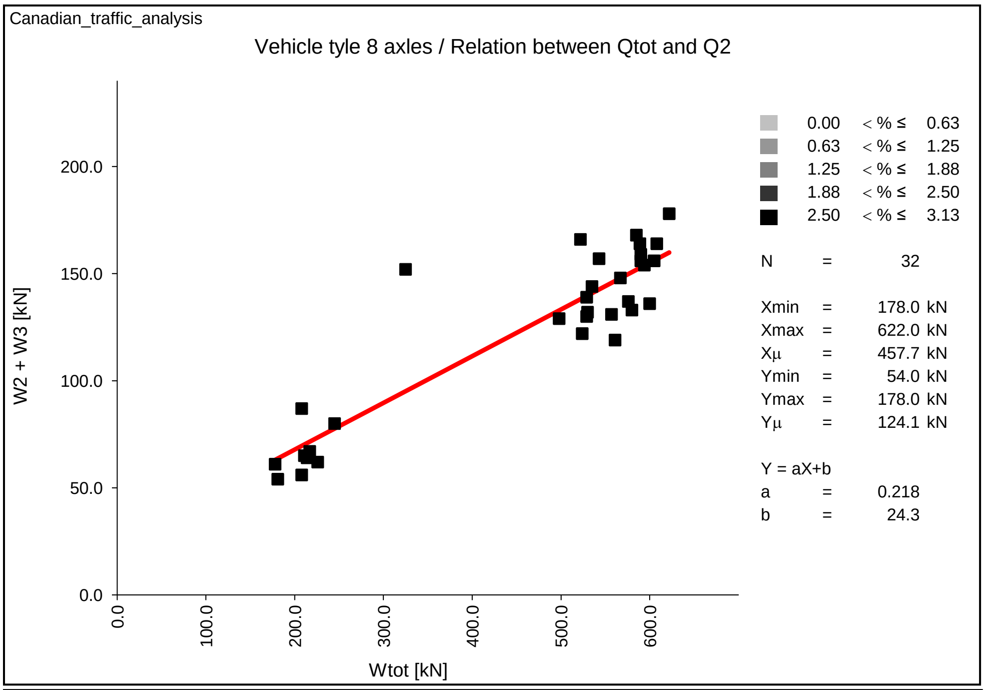

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
N = 32
μ = 3.4 m
σ = 0.4 m
f95 = 4.1 m
f99 = 4.8 m
max = 4.8 m
A = 2.2 m
B = 5.0 m
α = 4.03
β = 5.72
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
L3-4 [m]

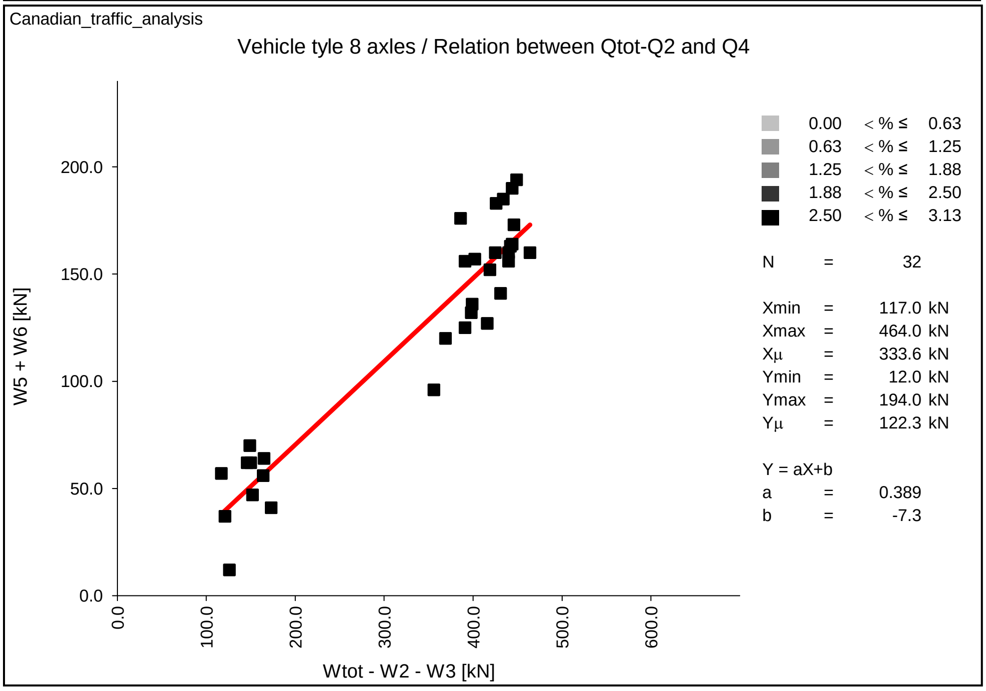

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
N = 32
μ = 2.8 m
σ = 0.1 m
f95 = 3.0 m
f99 = 3.0 m
max = 3.0 m
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.2
4.2
6.2
8.2
L4-5 [m]

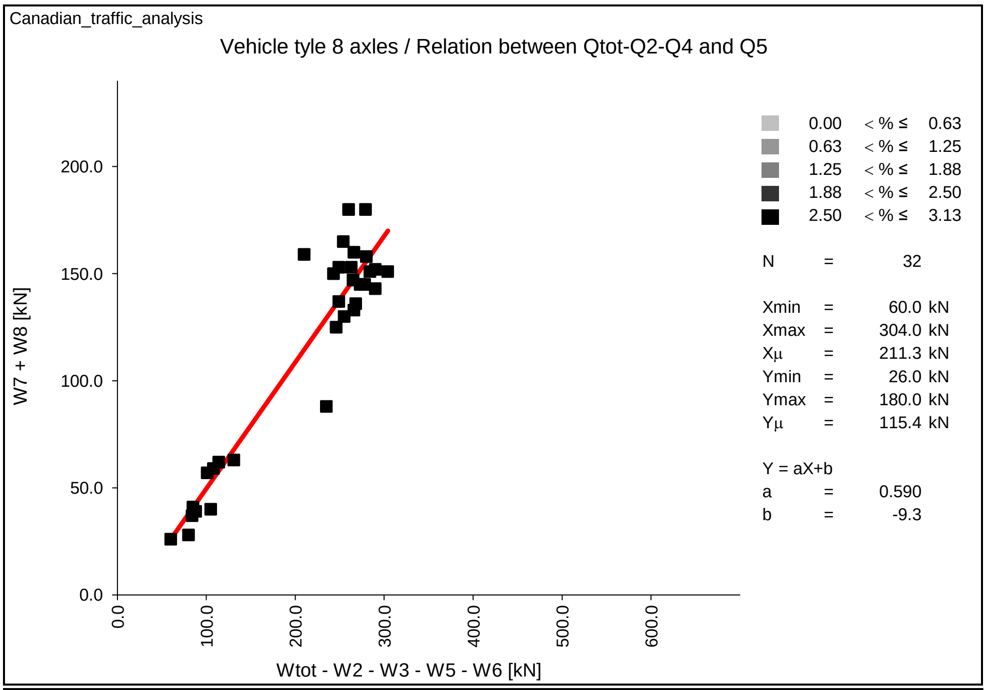

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.2
4.2
L5-6 [m]
N = 32
μ = 2.8 m
σ = 0.1 m
f95 = 3.0 m
f99 = 3.1 m
max = 3.0 m

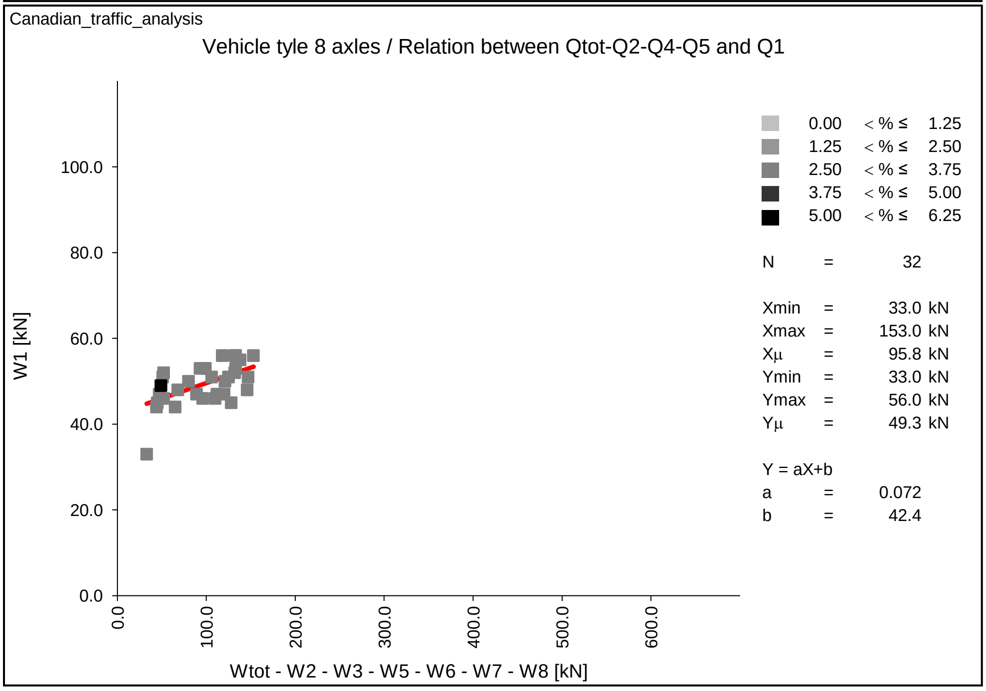

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
L6-7 [m]
N = 32
μ = 3.3 m
σ = 0.4 m
f95 = 4.2 m
f99 = 4.4 m
max = 4.4 m
A = 2.2 m
B = 5.0 m
α = 4.08
β = 5.97

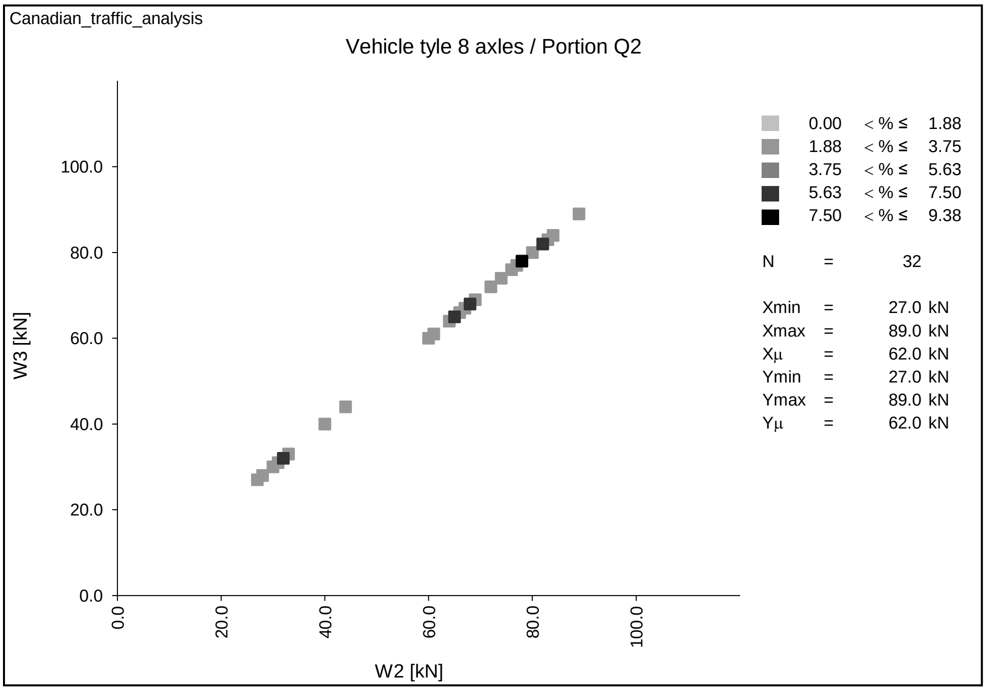

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.2
4.2
L7-8 [m]
N = 32
μ = 2.8 m
σ = 0.1 m
f95 = 3.0 m
f99 = 3.1 m
max = 3.0 m

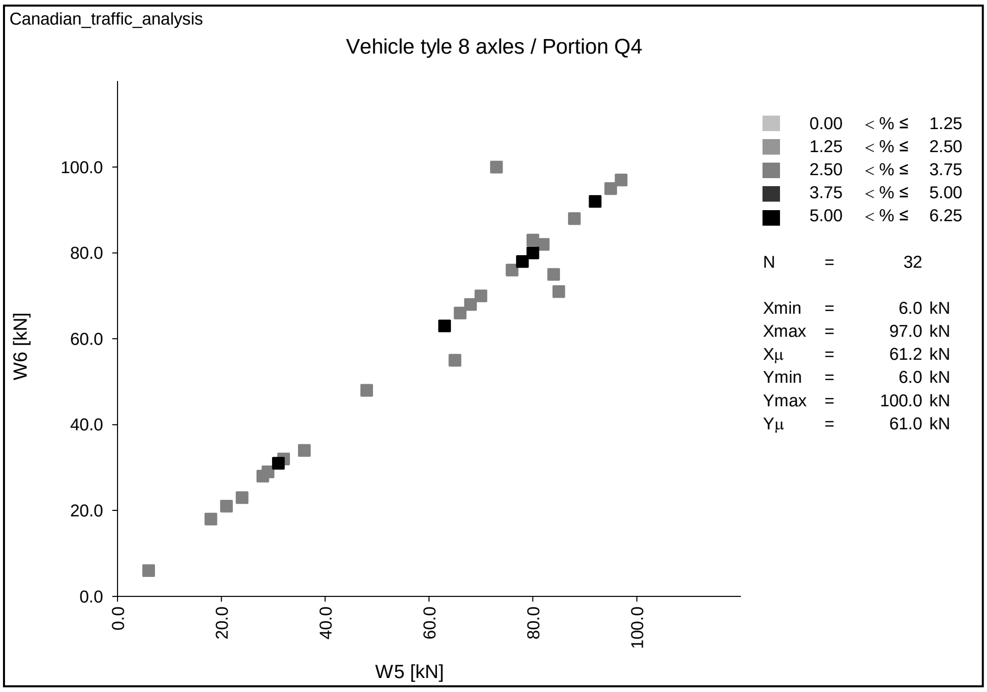

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q2
W2 + W3 [kN]
Wtot [kN]
0.00 < % ≤ 0.63
0.63 < % ≤ 1.25
1.25 < % ≤ 1.88
1.88 < % ≤ 2.50
2.50 < % ≤ 3.13
N = 32
Xmin = 178.0 kN
Xmax = 622.0 kN
Xμ = 457.7 kN
Ymin = 54.0 kN
Ymax = 178.0 kN
Yμ = 124.1 kN
Y = aX+b
a = 0.218
b = 24.3

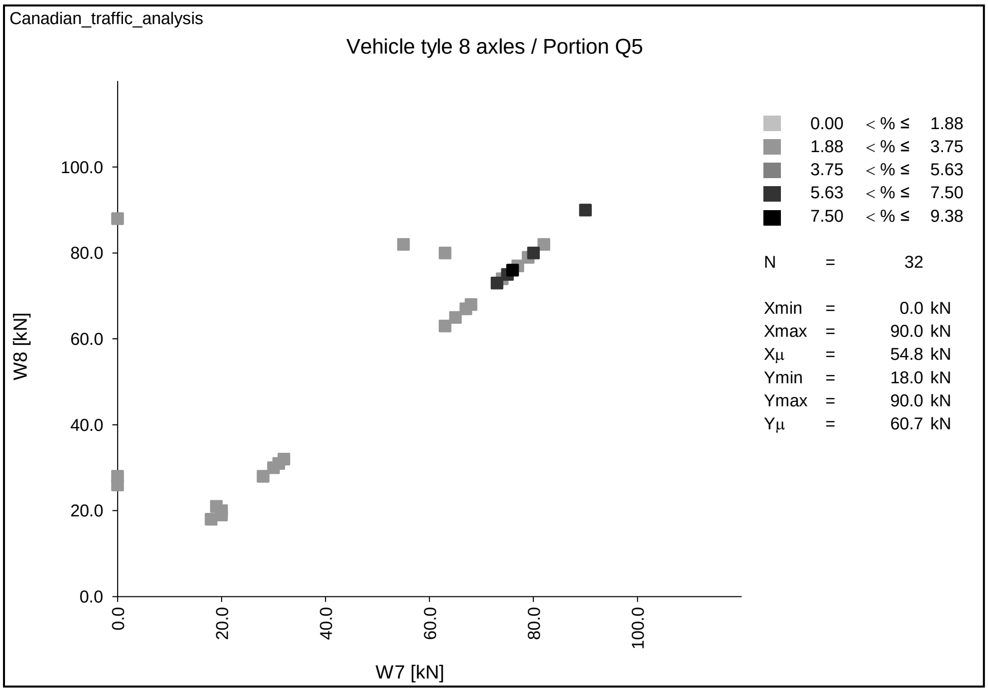

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q2 and Q4
W5 + W6 [kN]
Wtot - W2 - W3 [kN]
0.00 < % ≤ 0.63
0.63 < % ≤ 1.25
1.25 < % ≤ 1.88
1.88 < % ≤ 2.50
2.50 < % ≤ 3.13
N = 32
Xmin = 117.0 kN
Xmax = 464.0 kN
Xμ = 333.6 kN
Ymin = 12.0 kN
Ymax = 194.0 kN
Yμ = 122.3 kN
Y = aX+b
a = 0.389
b = -7.3

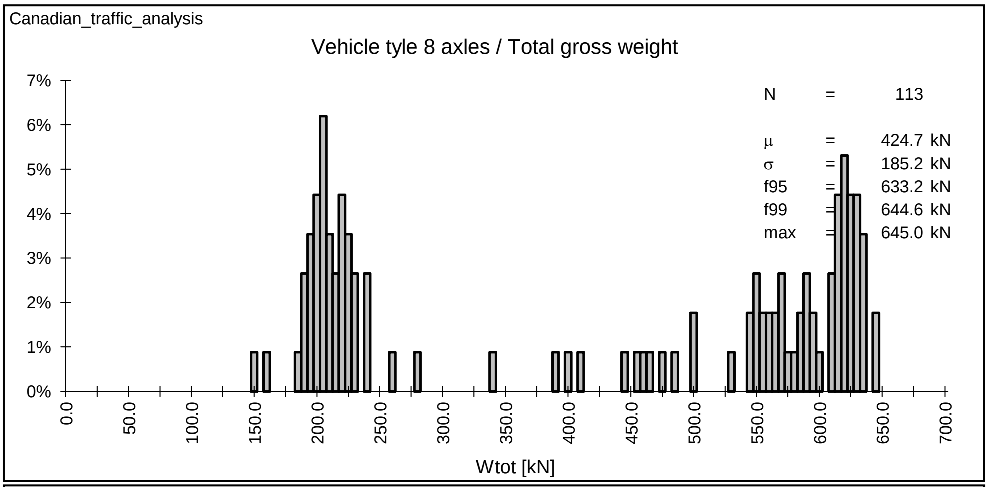

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q2-Q4 and Q5
W7 + W8 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot - W2 - W3 - W5 - W6 [kN]
0.00 < % ≤ 0.63
0.63 < % ≤ 1.25
1.25 < % ≤ 1.88
1.88 < % ≤ 2.50
2.50 < % ≤ 3.13
N = 32
Xmin = 60.0 kN
Xmax = 304.0 kN
Xμ = 211.3 kN
Ymin = 26.0 kN
Ymax = 180.0 kN
Yμ = 115.4 kN
Y = aX+b
a = 0.590
b = -9.3

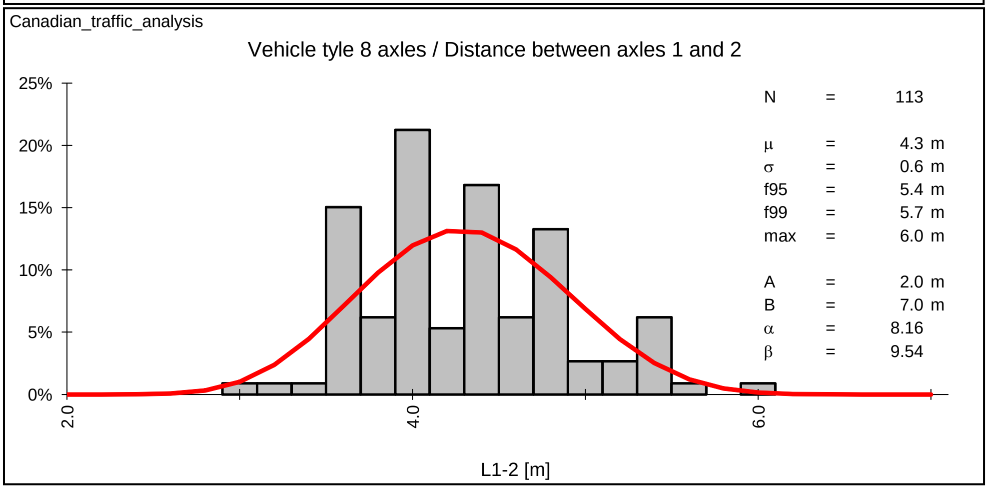

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q2-Q4-Q5 and Q1
W1 [kN]
100.0
80.0
60.0
40.0
20.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot - W2 - W3 - W5 - W6 - W7 - W8 [kN]
0.00 < % ≤ 1.25
1.25 < % ≤ 2.50
2.50 < % ≤ 3.75
3.75 < % ≤ 5.00
5.00 < % ≤ 6.25
N = 32
Xmin = 33.0 kN
Xmax = 153.0 kN
Xμ = 95.8 kN
Ymin = 33.0 kN
Ymax = 56.0 kN
Yμ = 49.3 kN
Y = aX+b
a = 0.072
b = 42.4

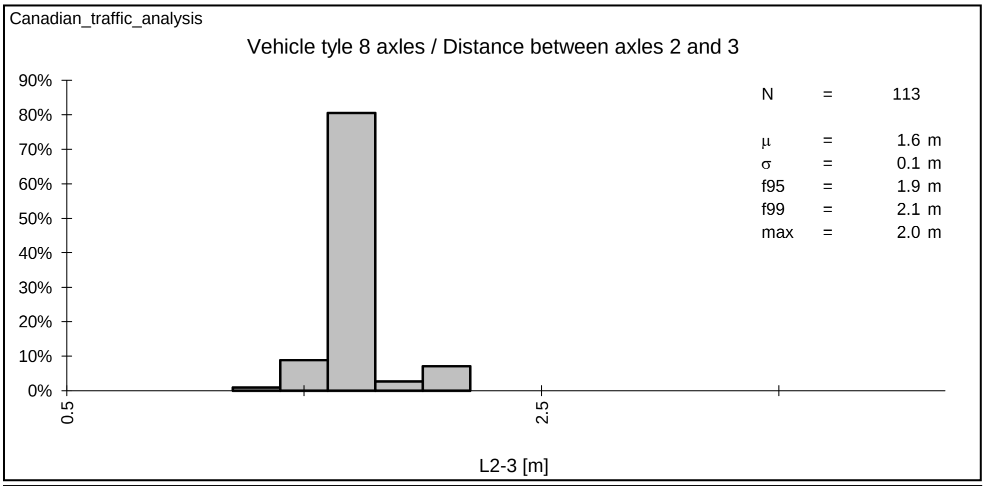

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
0.00 < % ≤ 1.88
1.88 < % ≤ 3.75
3.75 < % ≤ 5.63
5.63 < % ≤ 7.50
7.50 < % ≤ 9.38
N = 32
Xmin = 27.0 kN
Xmax = 89.0 kN
Xμ = 62.0 kN
Ymin = 27.0 kN
Ymax = 89.0 kN
Yμ = 62.0 kN
W3 [kN]
W2 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

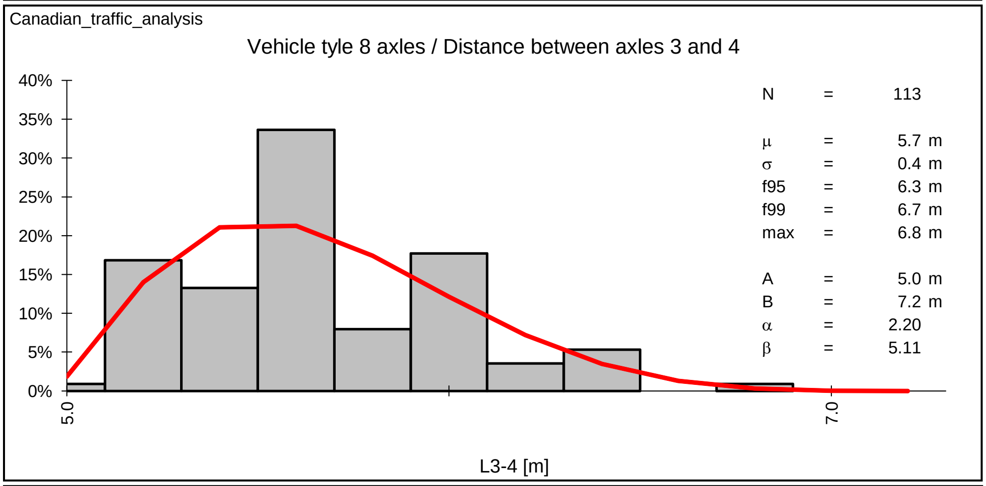

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4
0.00 < % ≤ 1.25
1.25 < % ≤ 2.50
2.50 < % ≤ 3.75
3.75 < % ≤ 5.00
5.00 < % ≤ 6.25
N = 32
Xmin = 6.0 kN
Xmax = 97.0 kN
Xμ = 61.2 kN
Ymin = 6.0 kN
Ymax = 100.0 kN
Yμ = 61.0 kN
W6 [kN]
W5 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

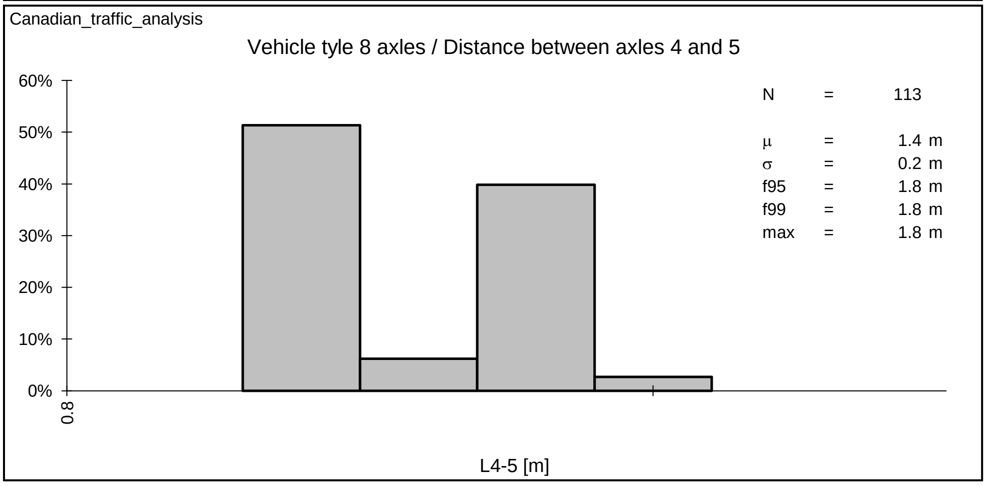

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q5
W8 [kN]
W7 [kN]
0.00 < % ≤ 1.88
1.88 < % ≤ 3.75
3.75 < % ≤ 5.63
5.63 < % ≤ 7.50
7.50 < % ≤ 9.38
N = 32
Xmin = 0.0 kN
Xmax = 90.0 kN
Xμ = 54.8 kN
Ymin = 18.0 kN
Ymax = 90.0 kN
Yμ = 60.7 kN

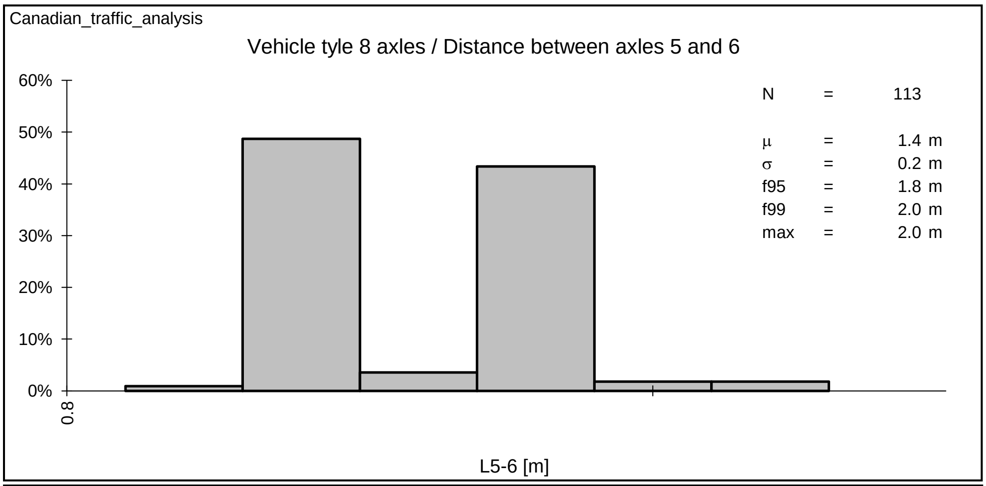

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
Wtot [kN]
N = 113
μ = 424.7 kN
σ = 185.2 kN
f95 = 633.2 kN
f99 = 644.6 kN
max = 645.0 kN

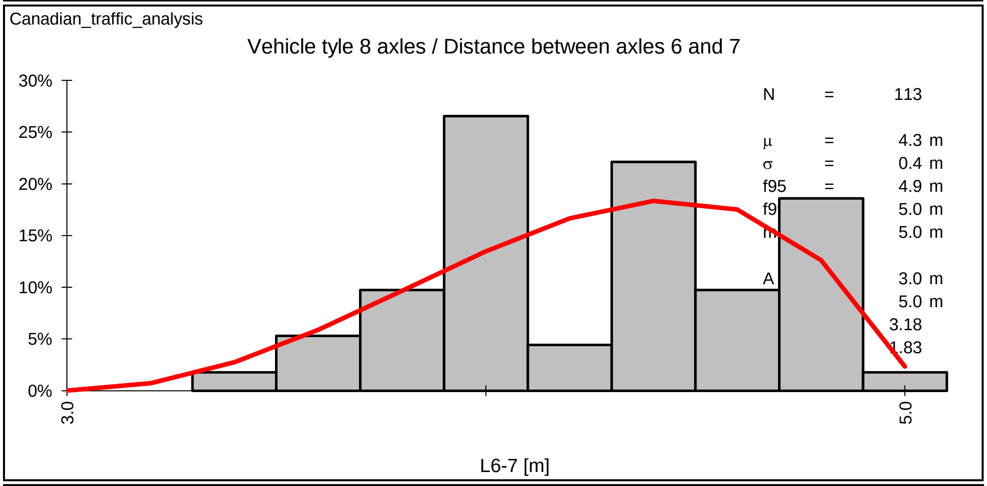

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
L1-2 [m]
N = 113
μ = 4.3 m
σ = 0.6 m
f95 = 5.4 m
f99 = 5.7 m
max = 6.0 m
A = 2.0 m
B = 7.0 m
α = 8.16
β = 9.54

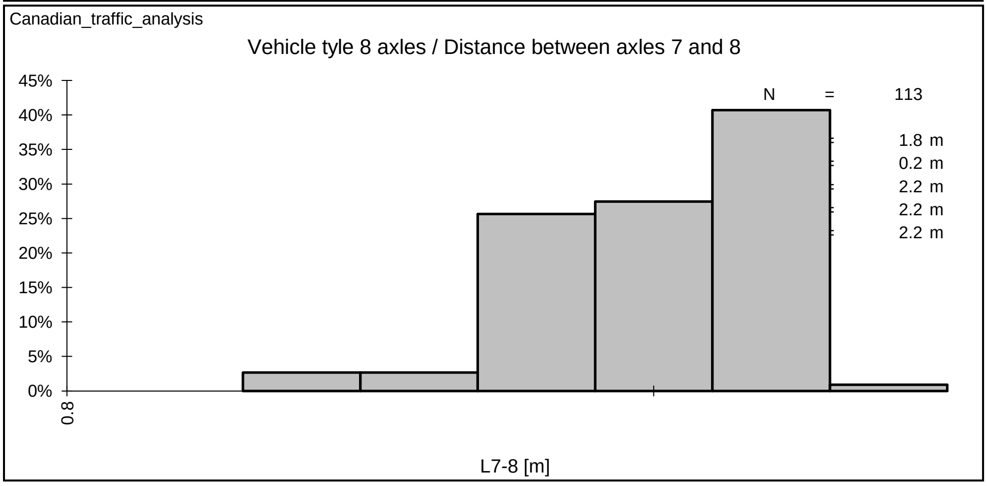

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.5
L2-3 [m]
N = 113
μ = 1.6 m
σ = 0.1 m
f95 = 1.9 m
f99 = 2.1 m
max = 2.0 m

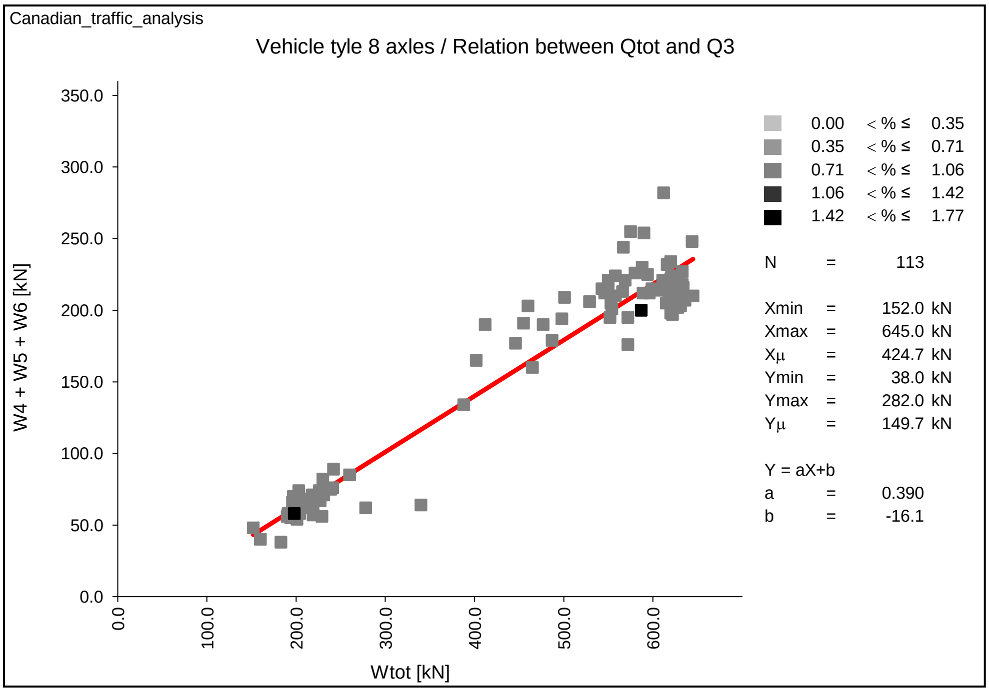

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
40%
35%
30%
25%
20%
15%
10%
5%
0%
5.0
7.0
L3-4 [m]
N = 113
μ = 5.7 m
σ = 0.4 m
f95 = 6.3 m
f99 = 6.7 m
max = 6.8 m
A = 5.0 m
B = 7.2 m
α = 2.20
β = 5.11

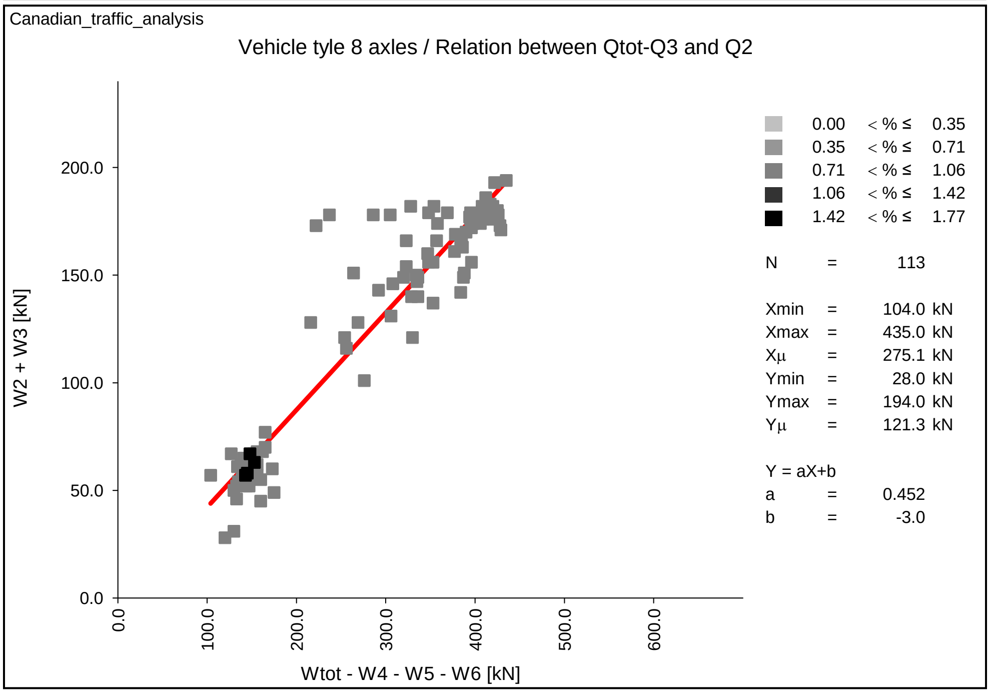

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
60%
50%
40%
30%
20%
10%
0%
0.8
L4-5 [m]
N = 113
μ = 1.4 m
σ = 0.2 m
f95 = 1.8 m
f99 = 1.8 m
max = 1.8 m

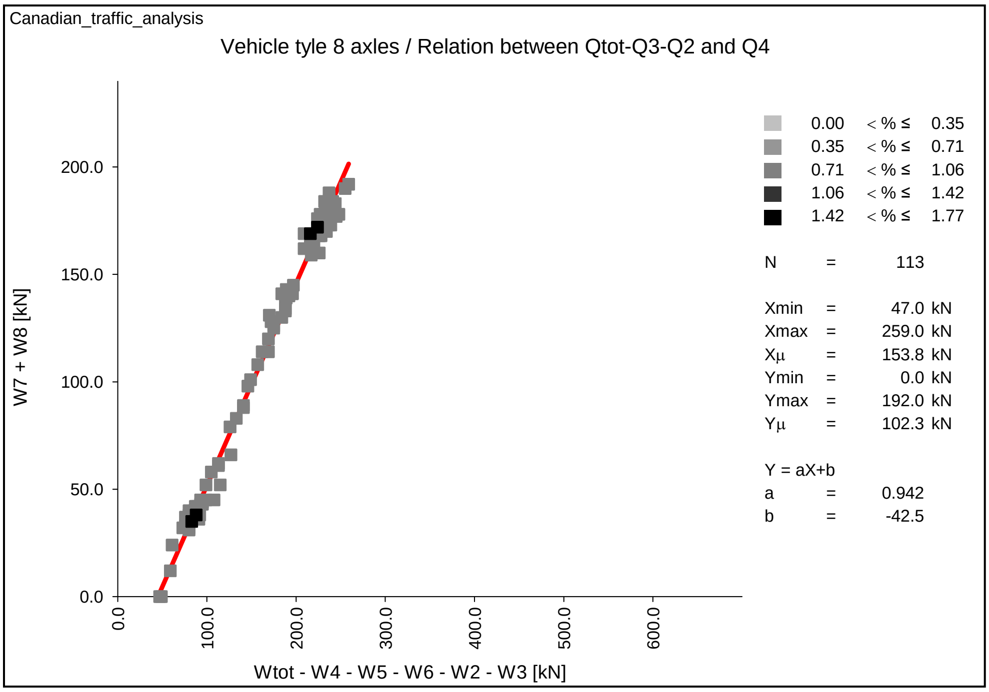

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
N = 113
μ = 1.4 m
σ = 0.2 m
f95 = 1.8 m
f99 = 2.0 m
max = 2.0 m
60%
50%
40%
30%
20%
10%
0%
0.8
L5-6 [m]

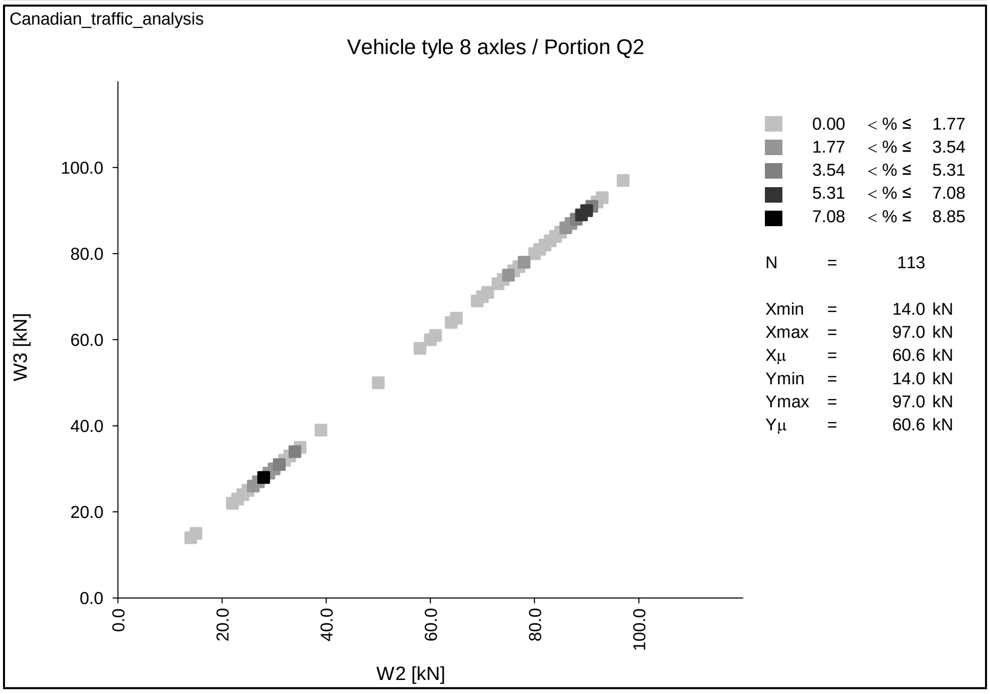

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
N = 113
μ = 4.3 m
σ = 0.4 m
f95 = 4.9 m
5.0 m
5.0 m
3.0 m
5.0 m
3.18
1.83
30%
25%
20%
15%
10%
5%
0%
3.0
5.0
L6-7 [m]

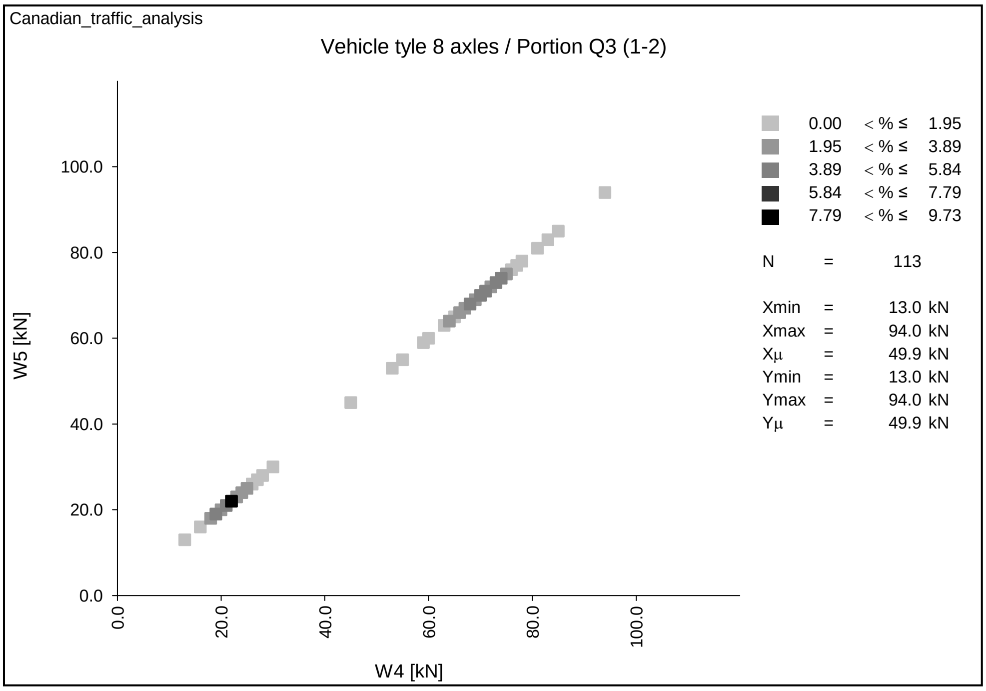

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
N = 113
1.8 m
0.2 m
2.2 m
2.2 m
2.2 m
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L7-8 [m]

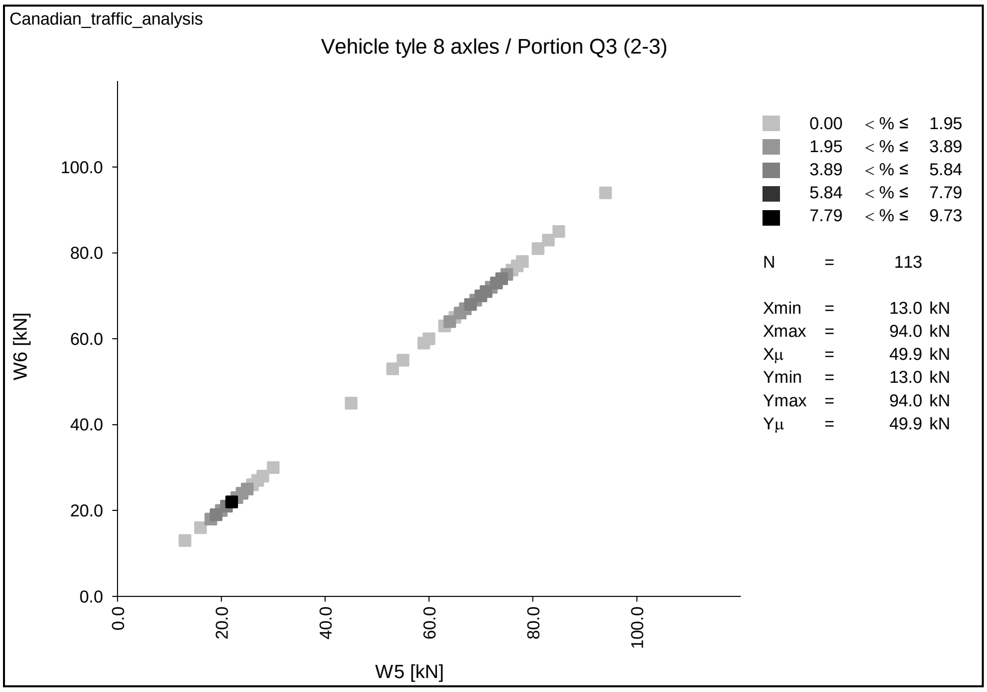

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q3
W4 + W5 + W6 [kN]
Wtot [kN]
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.35
0.35 < % ≤ 0.71
0.71 < % ≤ 1.06
1.06 < % ≤ 1.42
1.42 < % ≤ 1.77
N = 113
Xmin = 152.0 kN
Xmax = 645.0 kN
Xμ = 424.7 kN
Ymin = 38.0 kN
Ymax = 282.0 kN
Yμ = 149.7 kN
Y = aX+b
a = 0.390
b = -16.1

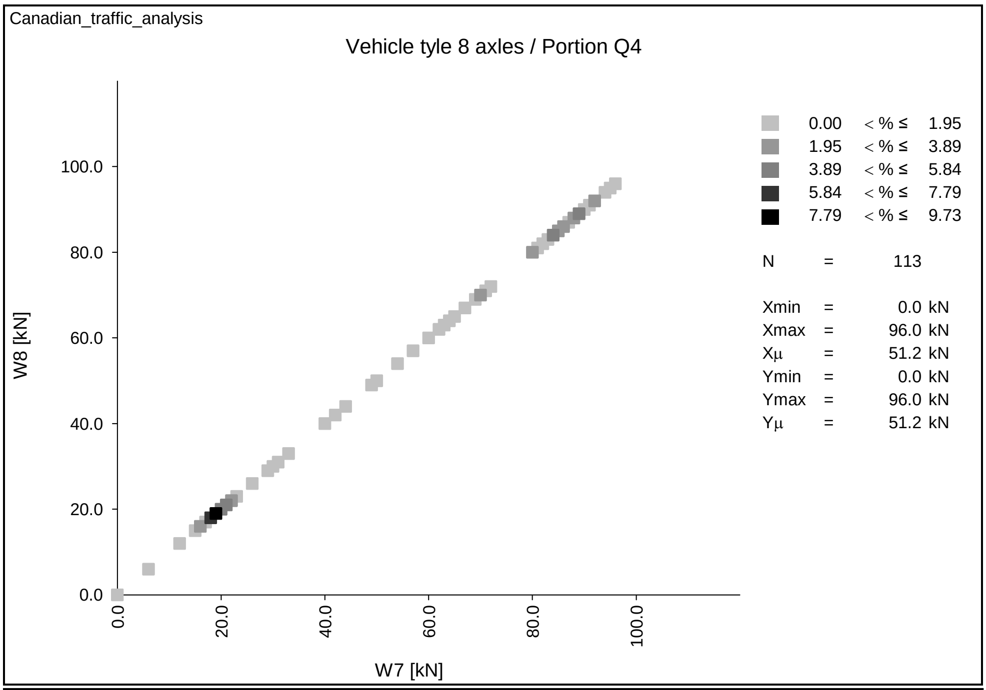

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3 and Q2
W2 + W3 [kN]
Wtot - W4 - W5 - W6 [kN]
0.0
50.0
100.0
150.0
200.0
100.0
200.0
300.0
400.0
500.0
600.0
0.00 < % ≤ 0.35
0.35 < % ≤ 0.71
0.71 < % ≤ 1.06
1.06 < % ≤ 1.42
1.42 < % ≤ 1.77
N = 113
Xmin = 104.0 kN
Xmax = 435.0 kN
Xμ = 275.1 kN
Ymin = 28.0 kN
Ymax = 194.0 kN
Yμ = 121.3 kN
Y = aX+b
a = 0.452
b = -3.0

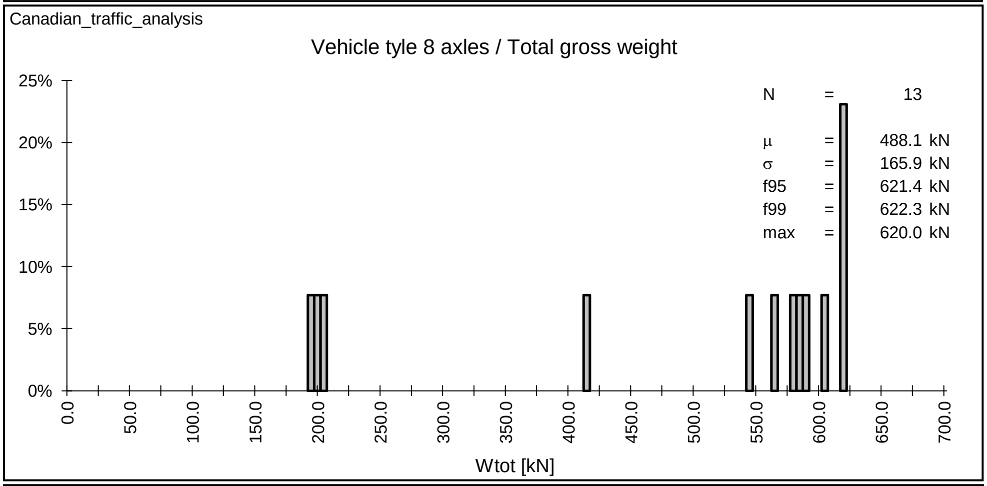

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3-Q2 and Q4
0.00 < % ≤ 0.35
0.35 < % ≤ 0.71
0.71 < % ≤ 1.06
1.06 < % ≤ 1.42
1.42 < % ≤ 1.77
N = 113
Xmin = 47.0 kN
Xmax = 259.0 kN
Xμ = 153.8 kN
Ymin = 0.0 kN
Ymax = 192.0 kN
Yμ = 102.3 kN
Y = aX+b
a = 0.942
b = -42.5
W7 + W8 [kN]
Wtot - W4 - W5 - W6 - W2 - W3 [kN]

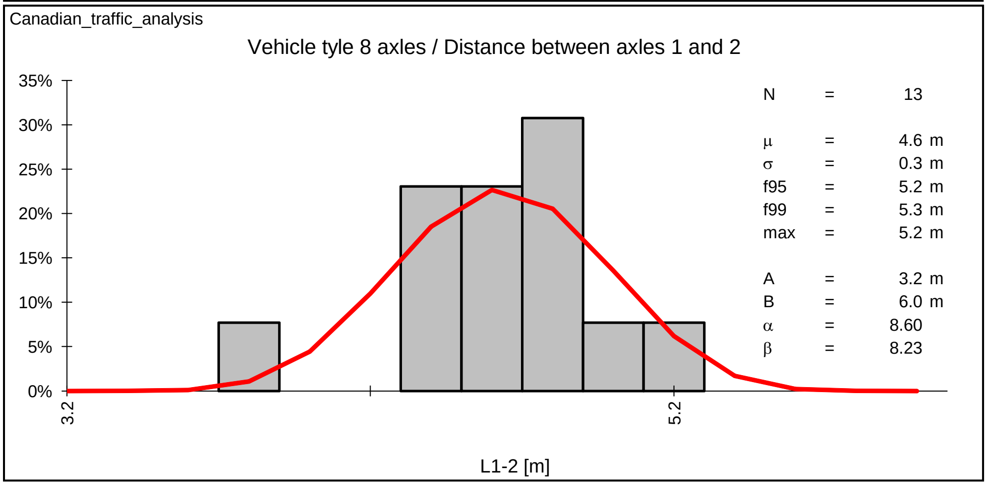

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
0.00 < % ≤ 1.77
1.77 < % ≤ 3.54
3.54 < % ≤ 5.31
5.31 < % ≤ 7.08
7.08 < % ≤ 8.85
N = 113
Xmin = 14.0 kN
Xmax = 97.0 kN
Xμ = 60.6 kN
Ymin = 14.0 kN
Ymax = 97.0 kN
Yμ = 60.6 kN
W3 [kN]
W2 [kN]

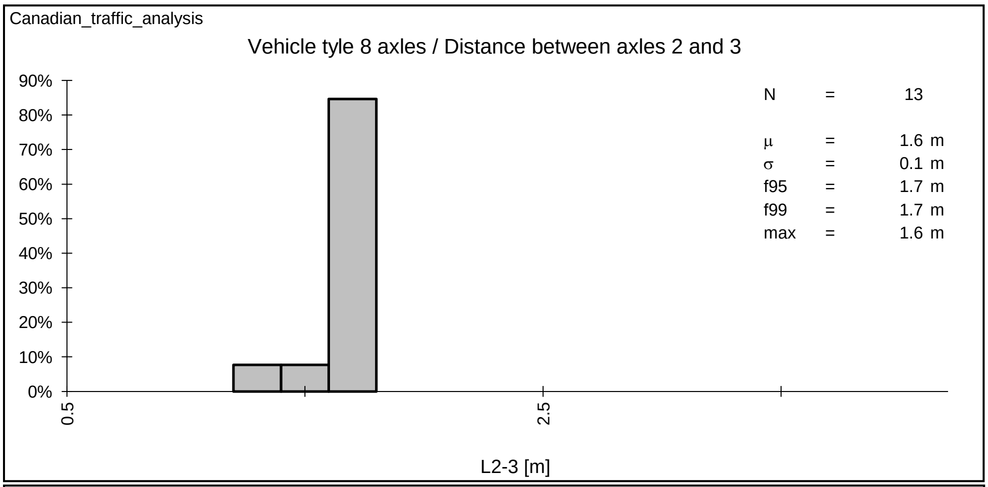

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3 (1-2)
0.00 < % ≤ 1.95
1.95 < % ≤ 3.89
3.89 < % ≤ 5.84
5.84 < % ≤ 7.79
7.79 < % ≤ 9.73
N = 113
Xmin = 13.0 kN
Xmax = 94.0 kN
Xμ = 49.9 kN
Ymin = 13.0 kN
Ymax = 94.0 kN
Yμ = 49.9 kN
W5 [kN]
W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

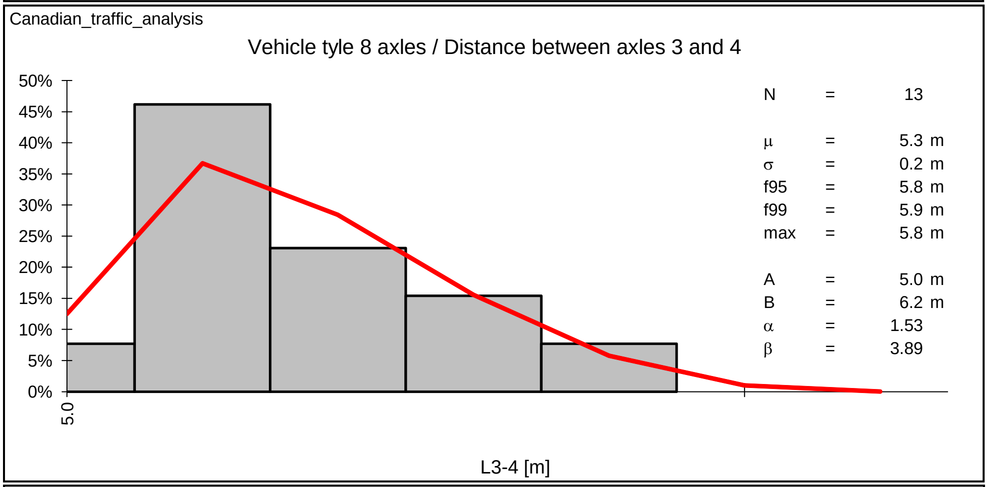

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3 (2-3)
0.00 < % ≤ 1.95
1.95 < % ≤ 3.89
3.89 < % ≤ 5.84
5.84 < % ≤ 7.79
7.79 < % ≤ 9.73
N = 113
Xmin = 13.0 kN
Xmax = 94.0 kN
Xμ = 49.9 kN
Ymin = 13.0 kN
Ymax = 94.0 kN
Yμ = 49.9 kN
W6 [kN]
W5 [kN]
0.0
20.0
40.0
60.0
80.0
100.0

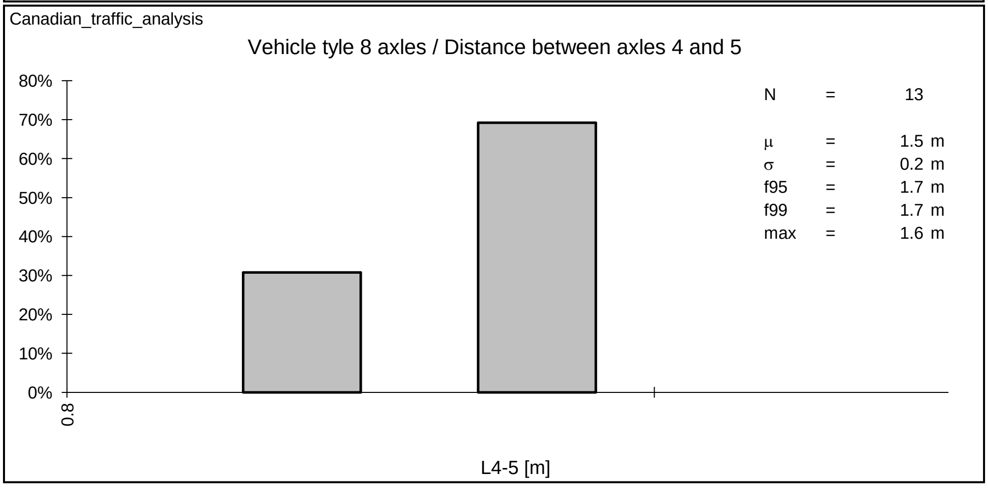

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4
0.00 < % ≤ 1.95
1.95 < % ≤ 3.89
3.89 < % ≤ 5.84
5.84 < % ≤ 7.79
7.79 < % ≤ 9.73
N = 113
Xmin = 0.0 kN
Xmax = 96.0 kN
Xμ = 51.2 kN
Ymin = 0.0 kN
Ymax = 96.0 kN
Yμ = 51.2 kN
W8 [kN]
W7 [kN]

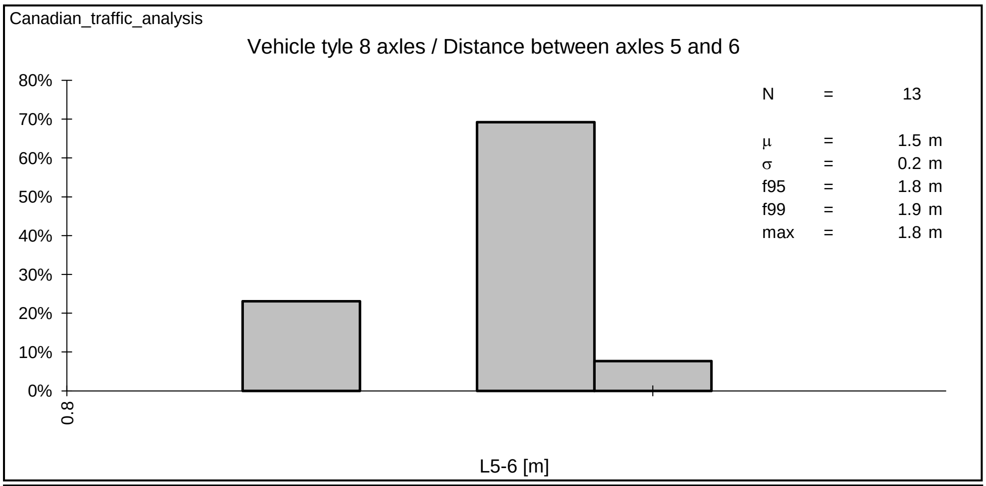

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
N = 13
μ = 488.1 kN
σ = 165.9 kN
f95 = 621.4 kN
f99 = 622.3 kN
max = 620.0 kN
Wtot [kN]

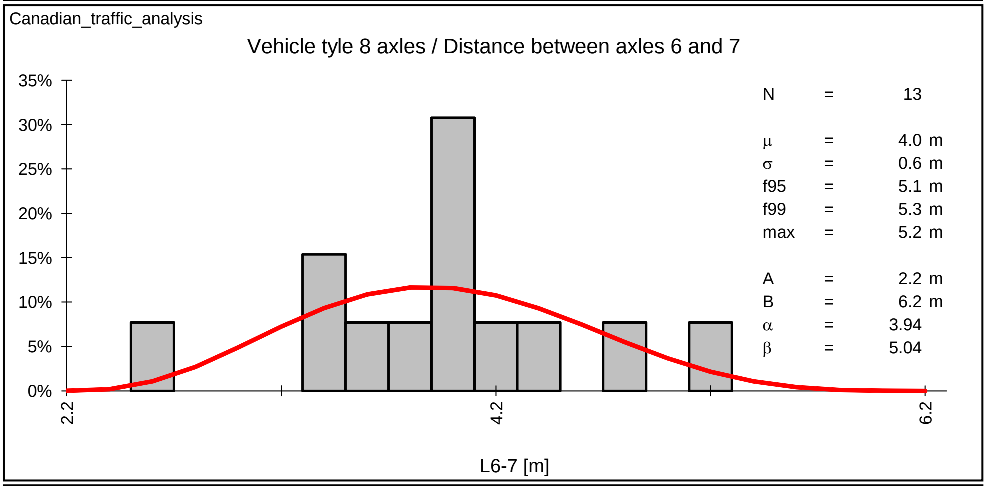

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
N = 13
μ = 4.6 m
σ = 0.3 m
f95 = 5.2 m
f99 = 5.3 m
max = 5.2 m
A = 3.2 m
B = 6.0 m
α = 8.60
β = 8.23
L1-2 [m]

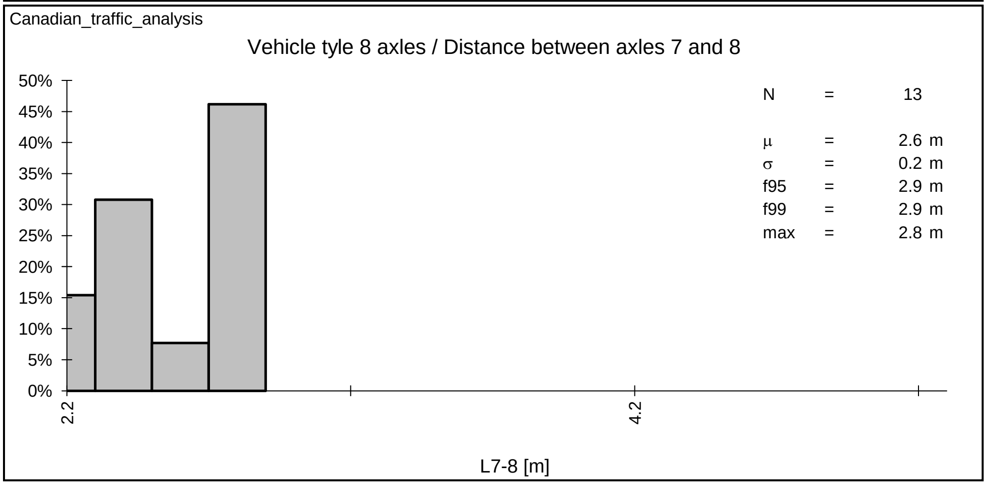

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.5
L2-3 [m]
N = 13
μ = 1.6 m
σ = 0.1 m
f95 = 1.7 m
f99 = 1.7 m
max = 1.6 m

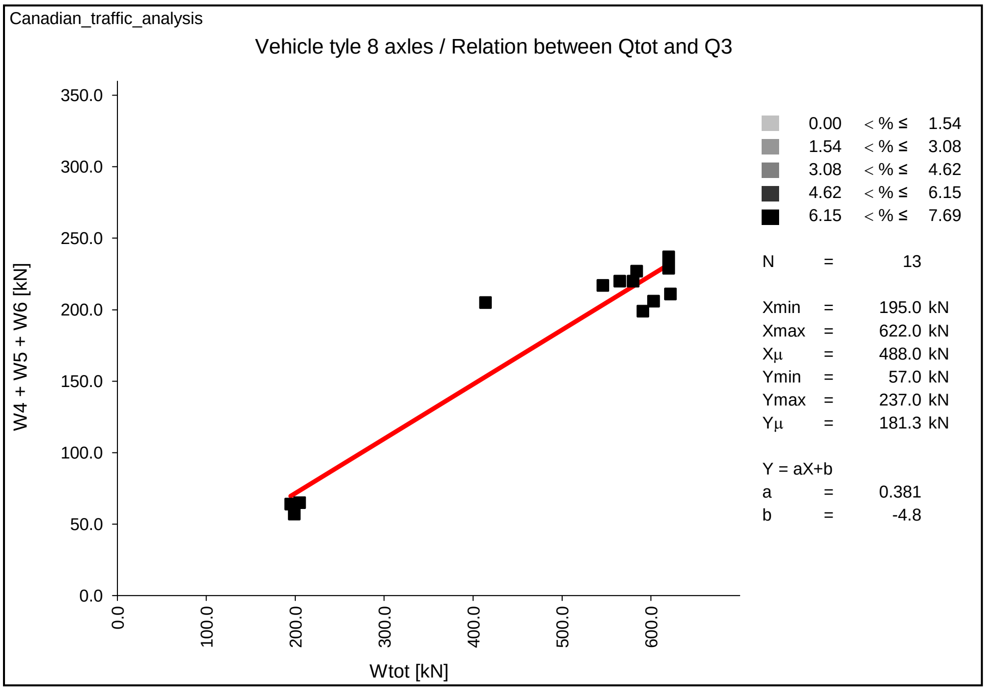

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
5.0
L3-4 [m]
N = 13
μ = 5.3 m
σ = 0.2 m
f95 = 5.8 m
f99 = 5.9 m
max = 5.8 m
A = 5.0 m
B = 6.2 m
α = 1.53
β = 3.89

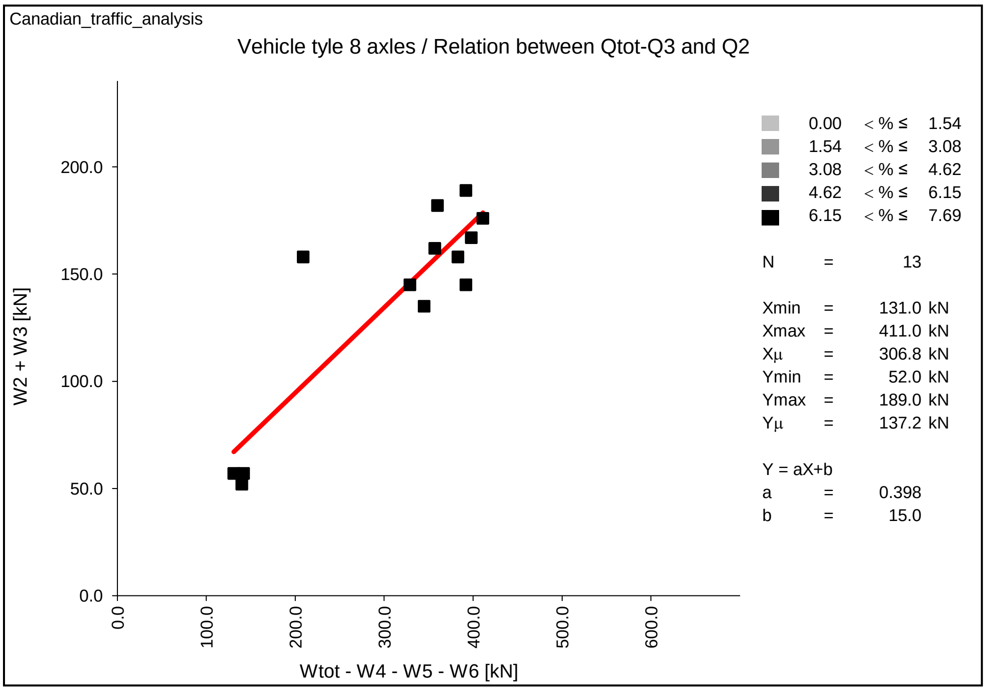

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L4-5 [m]
N = 13
μ = 1.5 m
σ = 0.2 m
f95 = 1.7 m
f99 = 1.7 m
max = 1.6 m

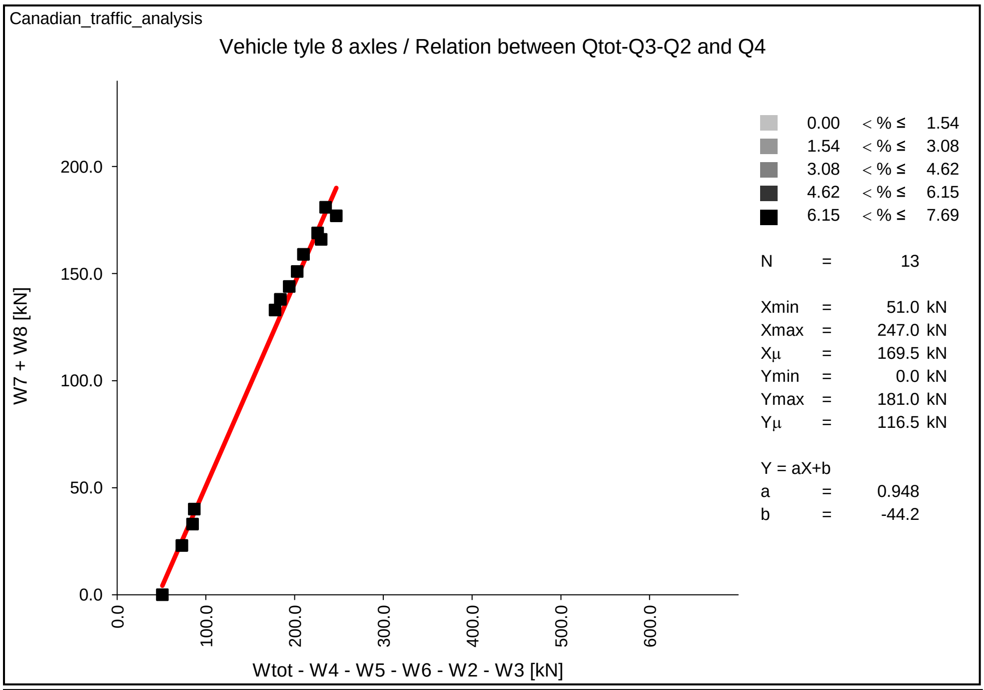

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L5-6 [m]
N = 13
μ = 1.5 m
σ = 0.2 m
f95 = 1.8 m
f99 = 1.9 m
max = 1.8 m

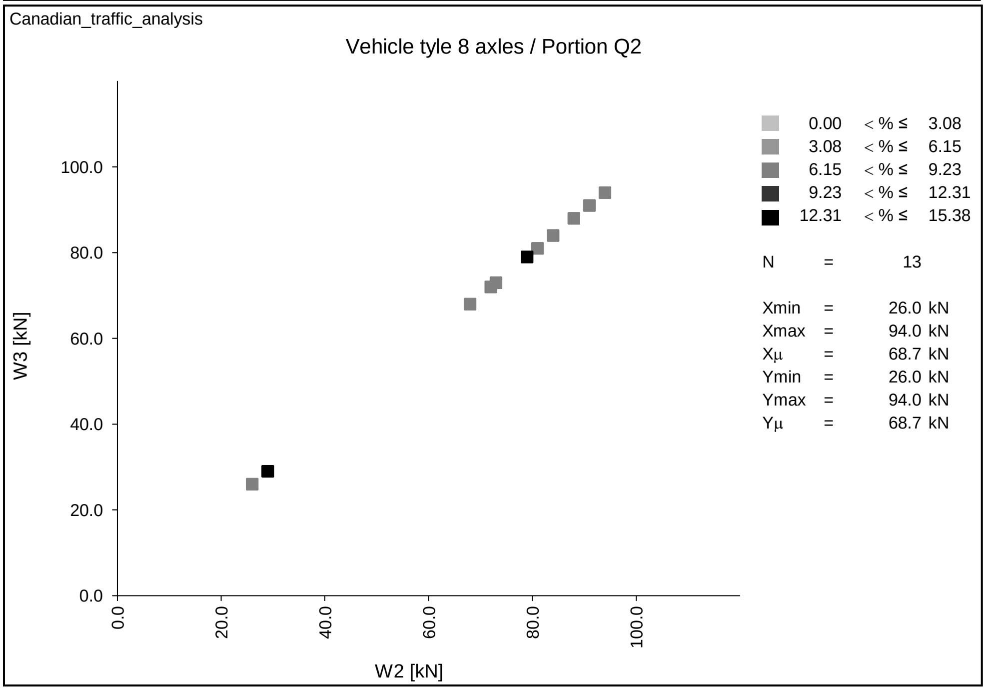

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
6.2
L6-7 [m]
N = 13
μ = 4.0 m
σ = 0.6 m
f95 = 5.1 m
f99 = 5.3 m
max = 5.2 m
A = 2.2 m
B = 6.2 m
α = 3.94
β = 5.04

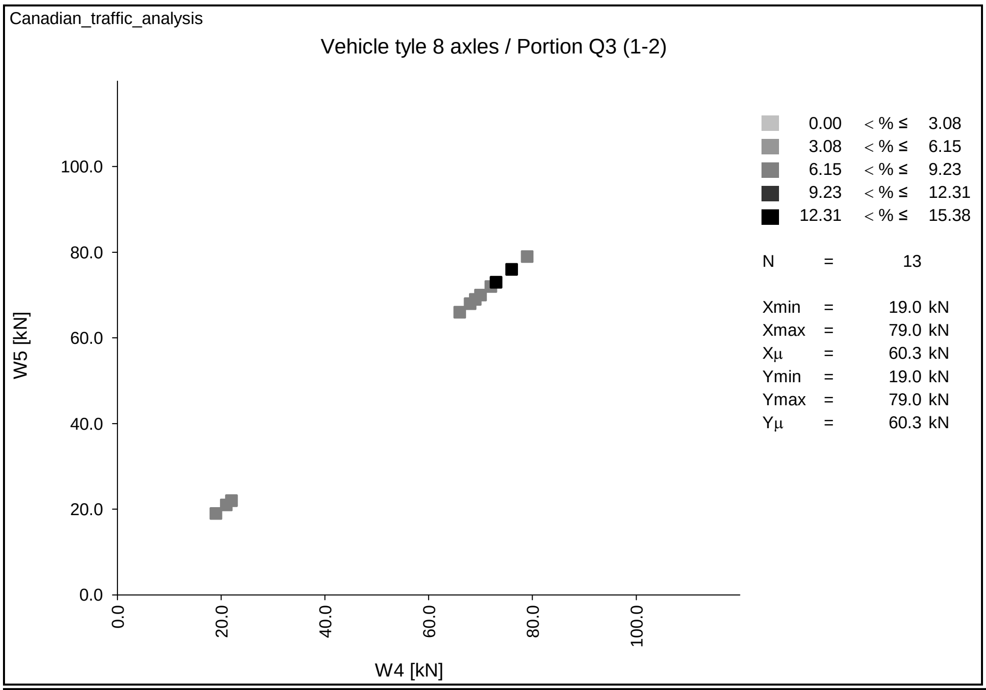

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2.2
4.2
L7-8 [m]
N = 13
μ = 2.6 m
σ = 0.2 m
f95 = 2.9 m
f99 = 2.9 m
max = 2.8 m

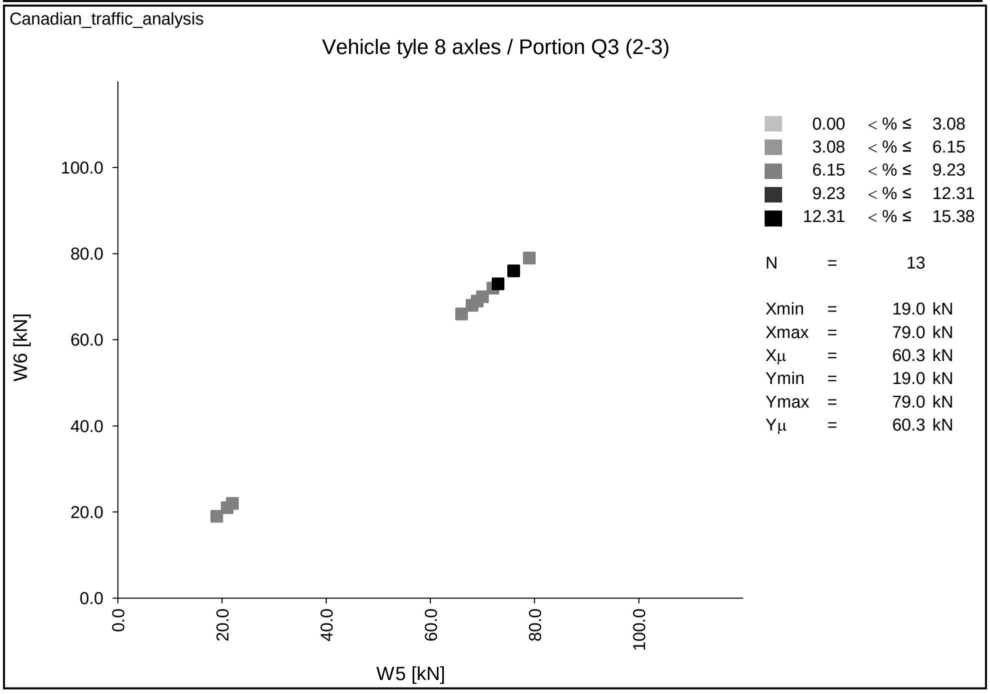

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q3
W4 + W5 + W6 [kN]
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot [kN]
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 195.0 kN
Xmax = 622.0 kN
Xµ = 488.0 kN
Ymin = 57.0 kN
Ymax = 237.0 kN
Yµ = 181.3 kN
Y = aX+b
a = 0.381
b = -4.8

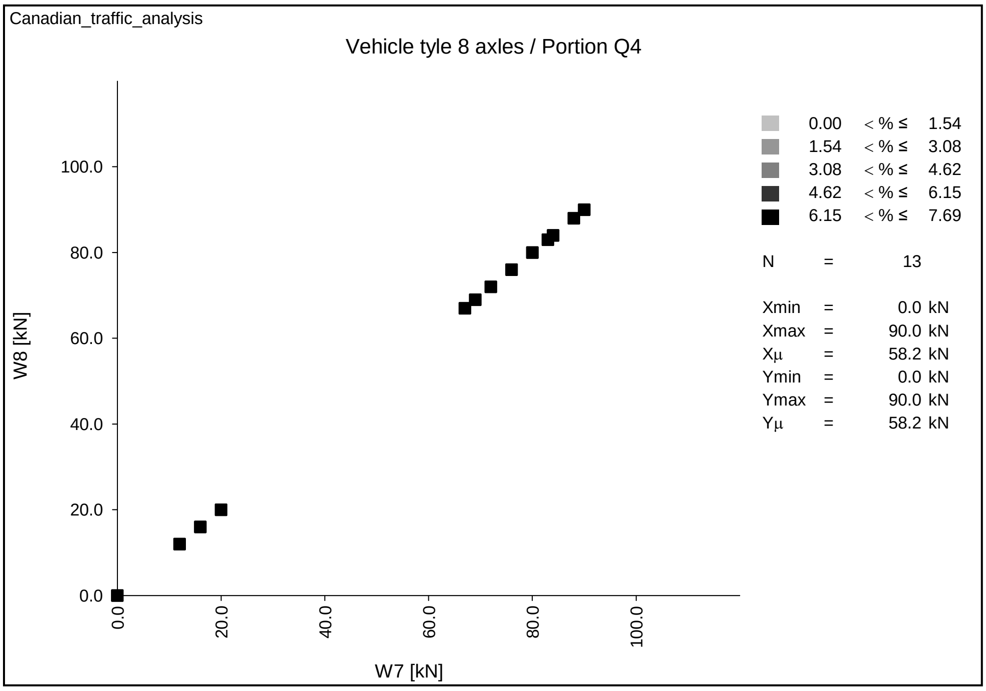

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3 and Q2
W2 + W3 [kN]
200.0
150.0
100.0
50.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Wtot - W4 - W5 - W6 [kN]
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 131.0 kN
Xmax = 411.0 kN
Xµ = 306.8 kN
Ymin = 52.0 kN
Ymax = 189.0 kN
Yµ = 137.2 kN
Y = aX+b
a = 0.398
b = 15.0

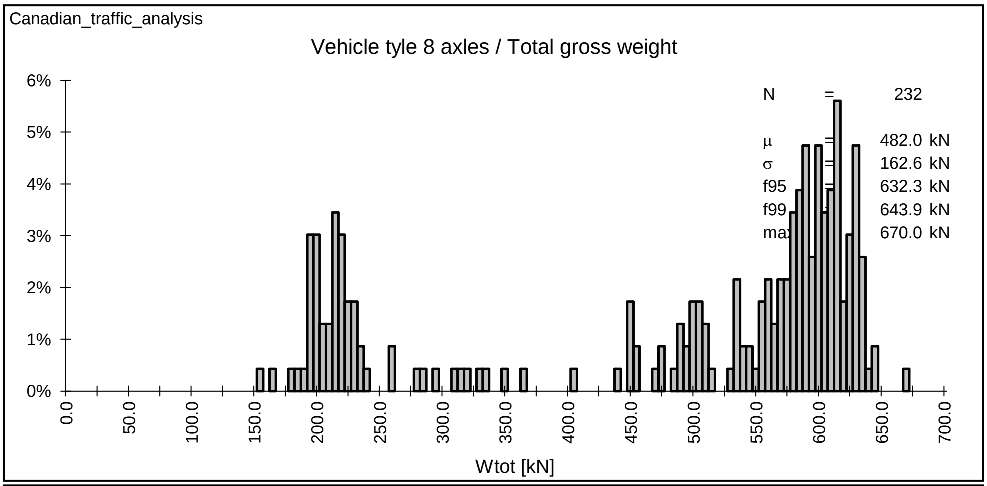

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3-Q2 and Q4
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 51.0 kN
Xmax = 247.0 kN
Xμ = 169.5 kN
Ymin = 0.0 kN
Ymax = 181.0 kN
Yμ = 116.5 kN
Y = aX+b
a = 0.948
b = -44.2
W7 + W8 [kN]
Wtot - W4 - W5 - W6 - W2 - W3 [kN]

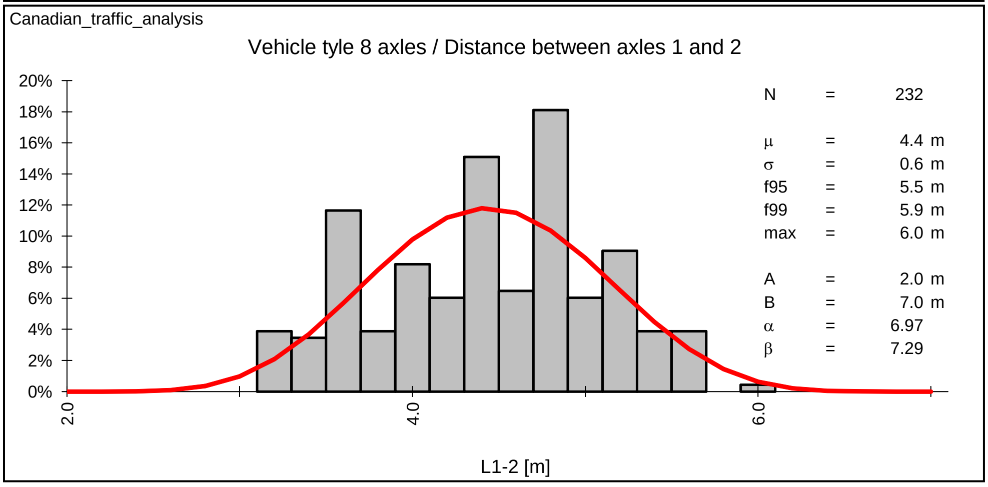

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
0.00 < % ≤ 3.08
3.08 < % ≤ 6.15
6.15 < % ≤ 9.23
9.23 < % ≤ 12.31
12.31 < % ≤ 15.38
N = 13
Xmin = 26.0 kN
Xmax = 94.0 kN
Xμ = 68.7 kN
Ymin = 26.0 kN
Ymax = 94.0 kN
Yμ = 68.7 kN
W3 [kN]
W2 [kN]

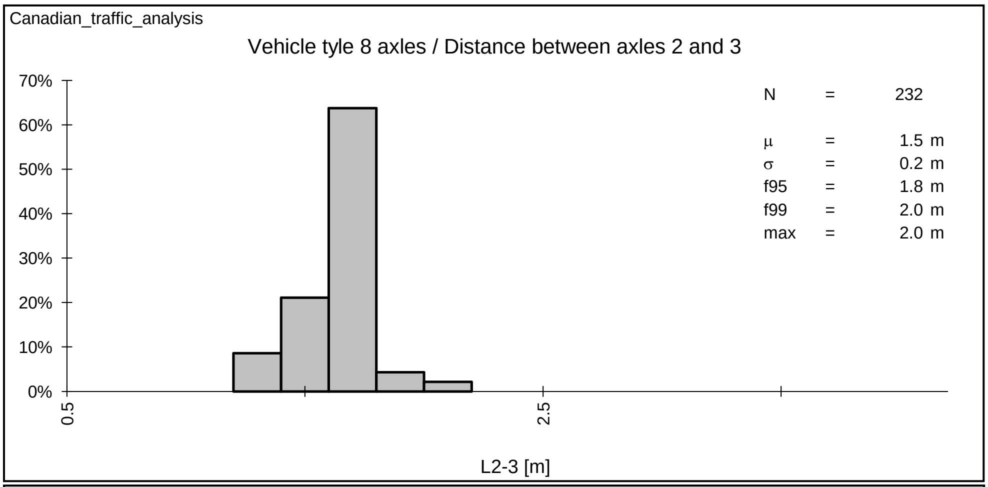

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3 (1-2)
W5 [kN]
W4 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 3.08
3.08 < % ≤ 6.15
6.15 < % ≤ 9.23
9.23 < % ≤ 12.31
12.31 < % ≤ 15.38
N = 13
Xmin = 19.0 kN
Xmax = 79.0 kN
Xμ = 60.3 kN
Ymin = 19.0 kN
Ymax = 79.0 kN
Yμ = 60.3 kN

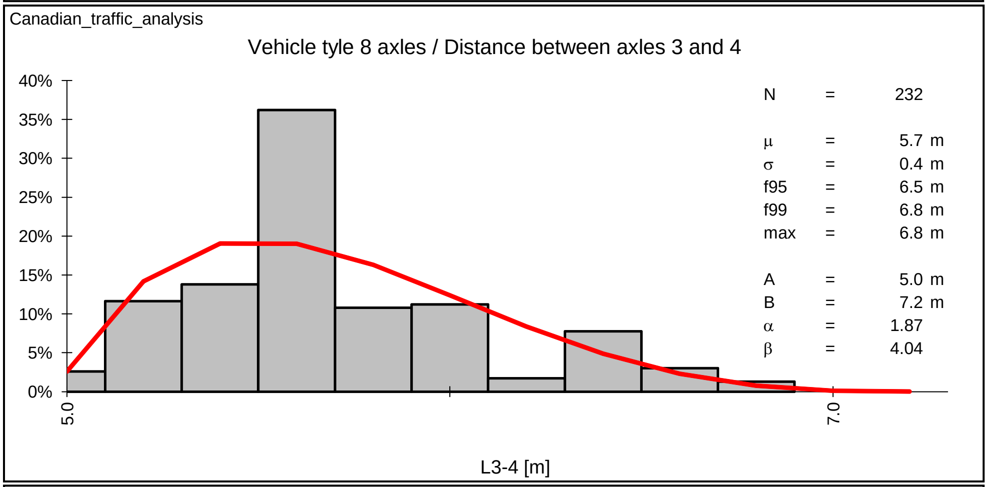

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3 (2-3)
W6 [kN]
W5 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 3.08
3.08 < % ≤ 6.15
6.15 < % ≤ 9.23
9.23 < % ≤ 12.31
12.31 < % ≤ 15.38
N = 13
Xmin = 19.0 kN
Xmax = 79.0 kN
Xμ = 60.3 kN
Ymin = 19.0 kN
Ymax = 79.0 kN
Yμ = 60.3 kN

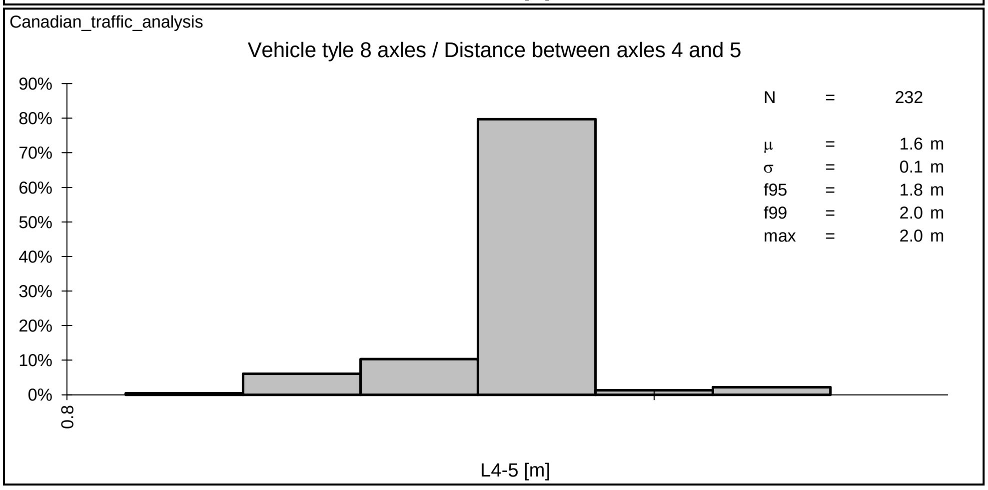

Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4
W8 [kN]
W7 [kN]
0.00 < % ≤ 1.54
1.54 < % ≤ 3.08
3.08 < % ≤ 4.62
4.62 < % ≤ 6.15
6.15 < % ≤ 7.69
N = 13
Xmin = 0.0 kN
Xmax = 90.0 kN
Xμ = 58.2 kN
Ymin = 0.0 kN
Ymax = 90.0 kN
Yμ = 58.2 kN

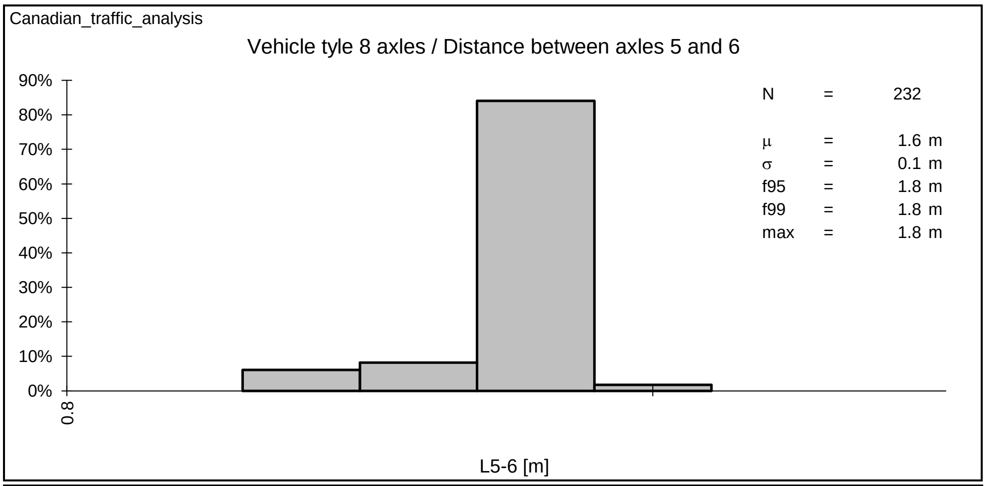

Canadian_traffic_analysis
Vehicle tyle 8 axles / Total gross weight
Wtot [kN]
N = 232
μ = 482.0 kN
σ = 162.6 kN
f95 = 632.3 kN
f99 = 643.9 kN
max = 670.0 kN

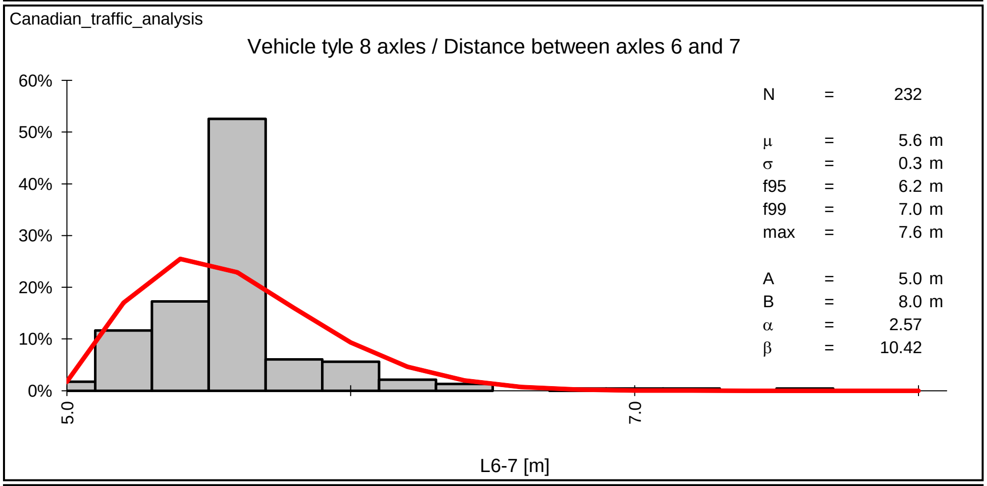

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 1 and 2
L1-2 [m]
N = 232
μ = 4.4 m
σ = 0.6 m
f95 = 5.5 m
f99 = 5.9 m
max = 6.0 m
A = 2.0 m
B = 7.0 m
α = 6.97
β = 7.29

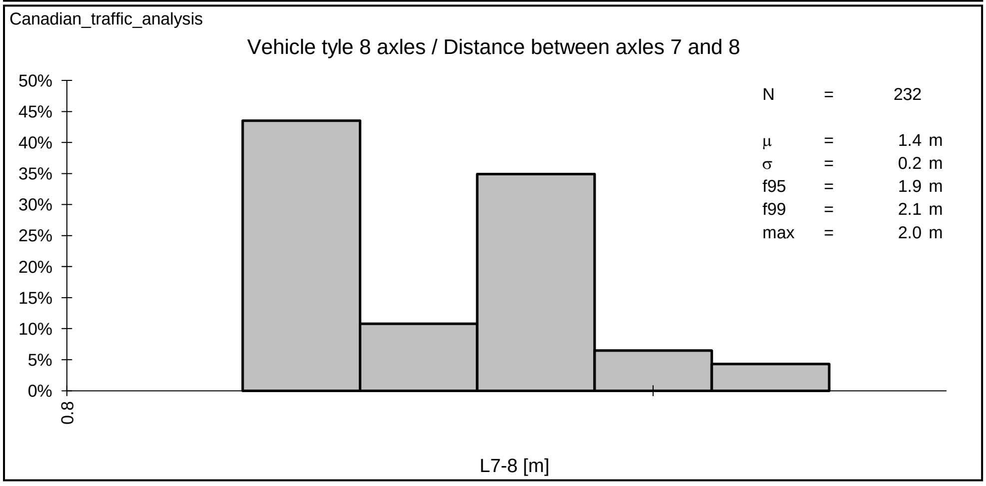

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 2 and 3
70%
60%
50%
40%
30%
20%
10%
0%
0.5
2.5
L2-3 [m]
N = 232
μ = 1.5 m
σ = 0.2 m
f95 = 1.8 m
f99 = 2.0 m
max = 2.0 m

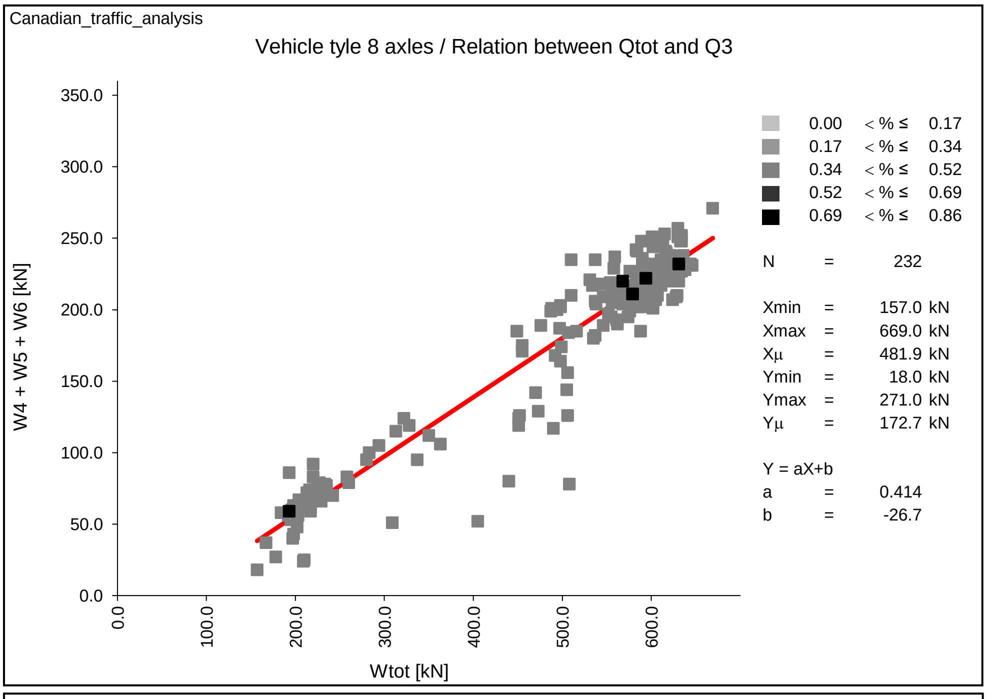

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 3 and 4
40%
35%
30%
25%
20%
15%
10%
5%
0%
5.0
7.0
L3-4 [m]
N = 232
μ = 5.7 m
σ = 0.4 m
f95 = 6.5 m
f99 = 6.8 m
max = 6.8 m
A = 5.0 m
B = 7.2 m
α = 1.87
β = 4.04

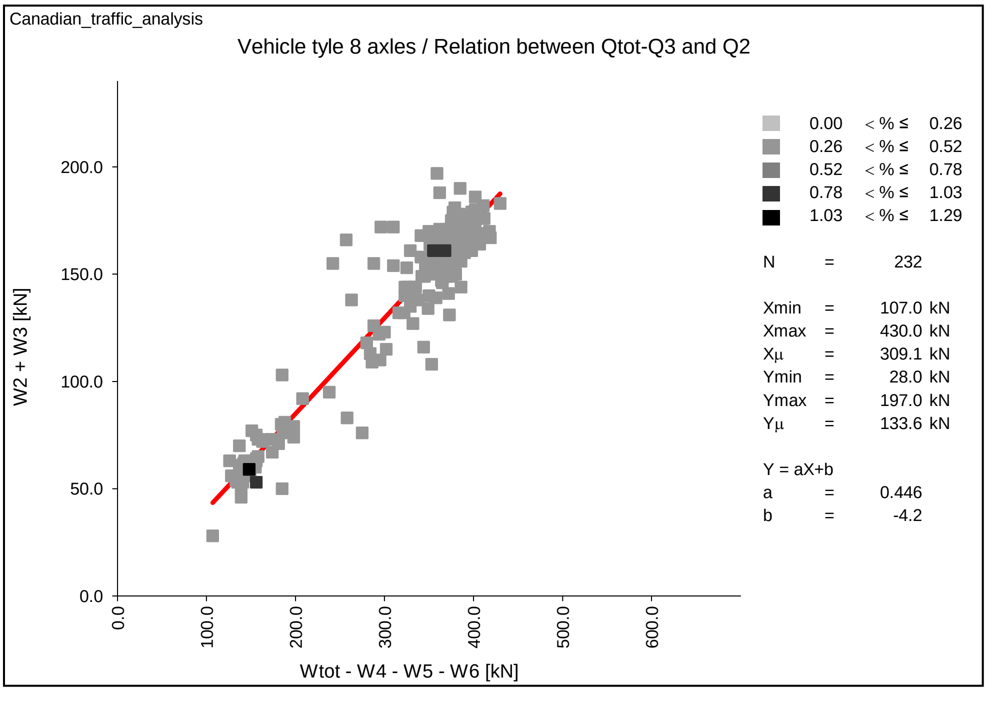

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 4 and 5
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L4-5 [m]
N = 232
μ = 1.6 m
σ = 0.1 m
f95 = 1.8 m
f99 = 2.0 m
max = 2.0 m

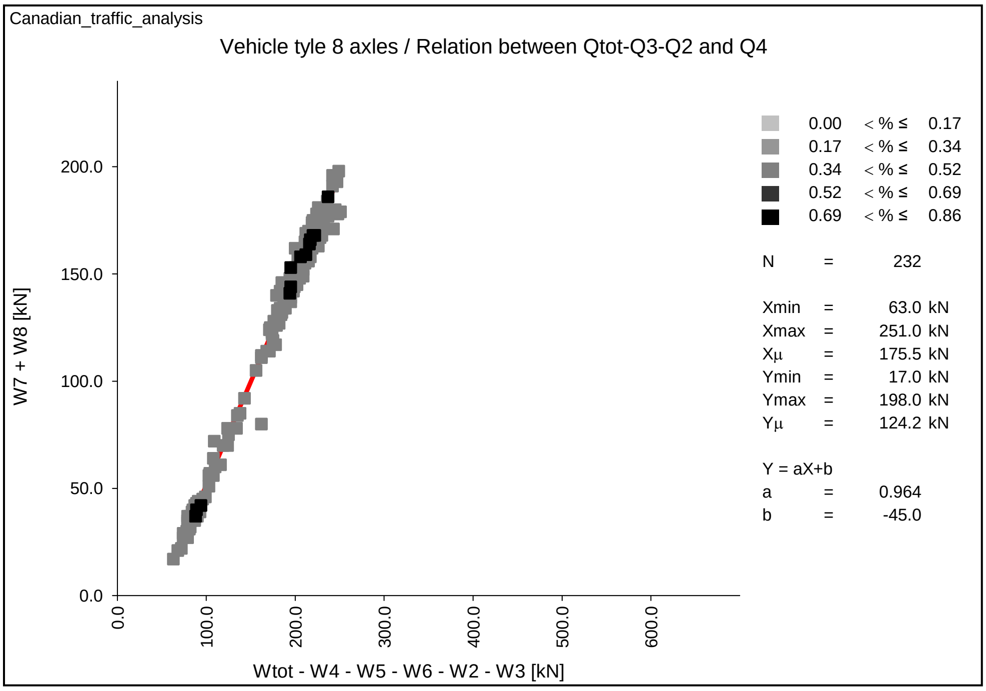

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 5 and 6
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.8
L5-6 [m]
N = 232
μ = 1.6 m
σ = 0.1 m
f95 = 1.8 m
f99 = 1.8 m
max = 1.8 m

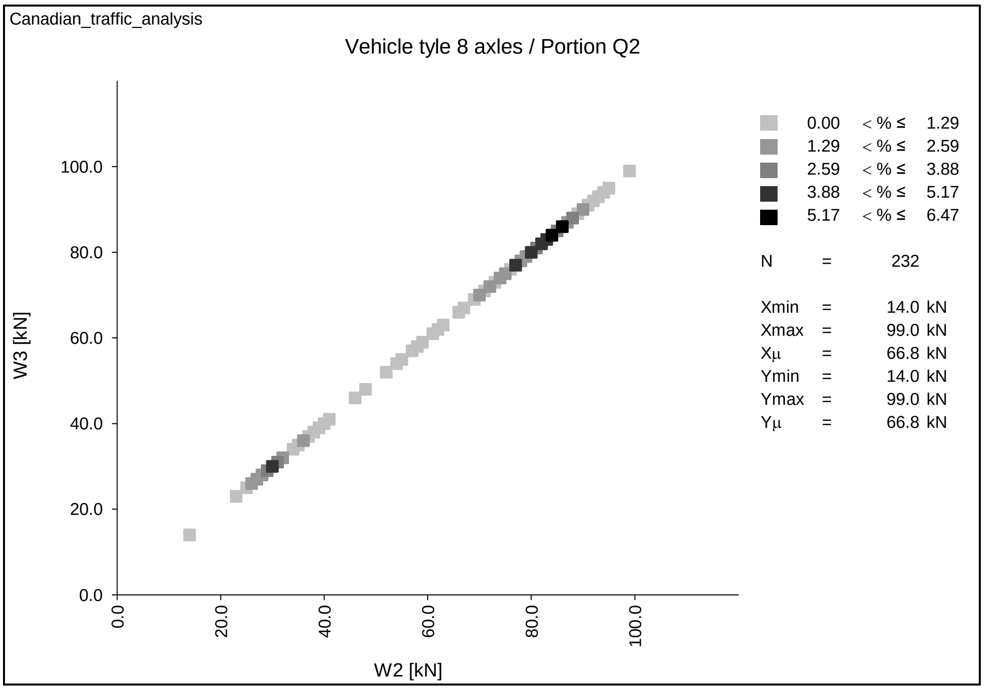

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 6 and 7
60%
50%
40%
30%
20%
10%
0%
5.0
7.0
L6-7 [m]
N = 232
μ = 5.6 m
σ = 0.3 m
f95 = 6.2 m
f99 = 7.0 m
max = 7.6 m
A = 5.0 m
B = 8.0 m
α = 2.57
β = 10.42

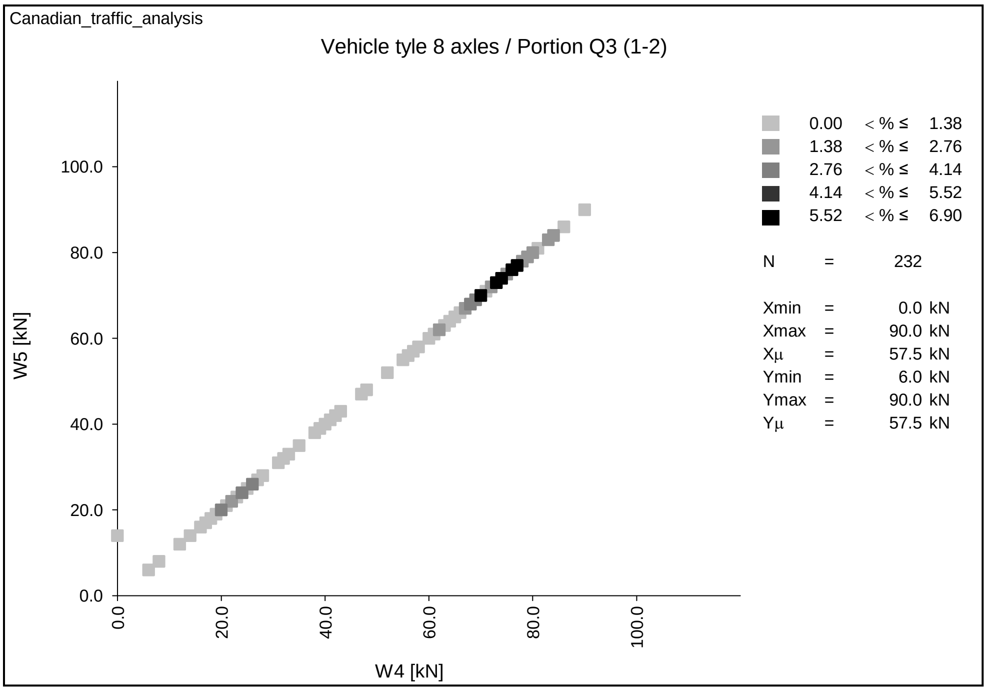

Canadian_traffic_analysis
Vehicle tyle 8 axles / Distance between axles 7 and 8
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.8
L7-8 [m]
N = 232
μ = 1.4 m
σ = 0.2 m
f95 = 1.9 m
f99 = 2.1 m
max = 2.0 m

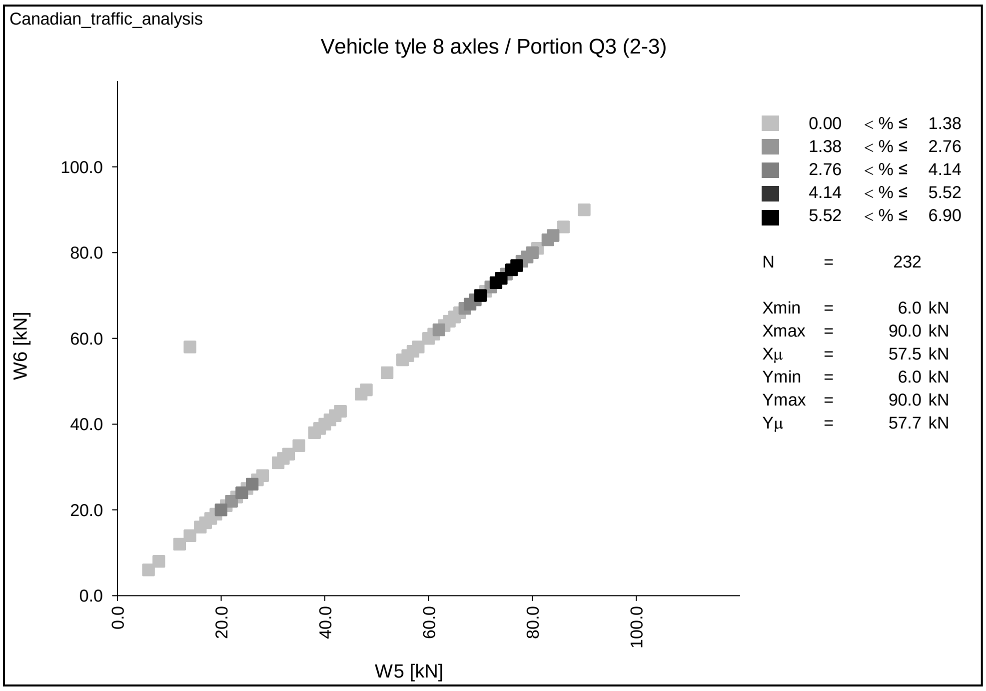

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot and Q3
W4 + W5 + W6 [kN]
Wtot [kN]
0.00 < % ≤ 0.17
0.17 < % ≤ 0.34
0.34 < % ≤ 0.52
0.52 < % ≤ 0.69
0.69 < % ≤ 0.86
N = 232
Xmin = 157.0 kN
Xmax = 669.0 kN
Xµ = 481.9 kN
Ymin = 18.0 kN
Ymax = 271.0 kN
Yµ = 172.7 kN
Y = aX+b
a = 0.414
b = -26.7

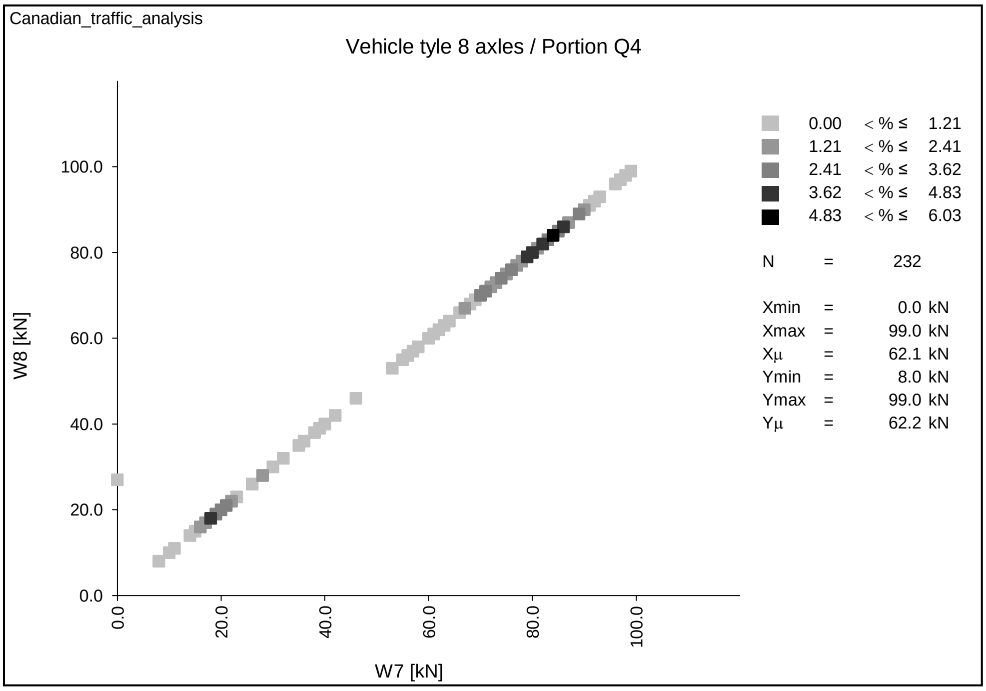

Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3 and Q2
W2 + W3 [kN]
Wtot - W4 - W5 - W6 [kN]
0.00 < % ≤ 0.26
0.26 < % ≤ 0.52
0.52 < % ≤ 0.78
0.78 < % ≤ 1.03
1.03 < % ≤ 1.29
N = 232
Xmin = 107.0 kN
Xmax = 430.0 kN
Xµ = 309.1 kN
Ymin = 28.0 kN
Ymax = 197.0 kN
Yµ = 133.6 kN
Y = aX+b
a = 0.446
b = -4.2


Canadian_traffic_analysis
Vehicle tyle 8 axles / Relation between Qtot-Q3-Q2 and Q4
W7 + W8 [kN]
Wtot - W4 - W5 - W6 - W2 - W3 [kN]
0.00 < % ≤ 0.17
0.17 < % ≤ 0.34
0.34 < % ≤ 0.52
0.52 < % ≤ 0.69
0.69 < % ≤ 0.86
N = 232
Xmin = 63.0 kN
Xmax = 251.0 kN
Xµ = 175.5 kN
Ymin = 17.0 kN
Ymax = 198.0 kN
Yµ = 124.2 kN
Y = aX+b
a = 0.964
b = -45.0


Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q2
W3 [kN]
W2 [kN]
0.00 < % ≤ 1.29
1.29 < % ≤ 2.59
2.59 < % ≤ 3.88
3.88 < % ≤ 5.17
5.17 < % ≤ 6.47
N = 232
Xmin = 14.0 kN
Xmax = 99.0 kN
Xµ = 66.8 kN
Ymin = 14.0 kN
Ymax = 99.0 kN
Yµ = 66.8 kN


Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3 (1-2)
W5 [kN]
W4 [kN]
0.00 < % ≤ 1.38
1.38 < % ≤ 2.76
2.76 < % ≤ 4.14
4.14 < % ≤ 5.52
5.52 < % ≤ 6.90
N = 232
Xmin = 0.0 kN
Xmax = 90.0 kN
Xμ = 57.5 kN
Ymin = 6.0 kN
Ymax = 90.0 kN
Yμ = 57.5 kN


Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q3 (2-3)
W6 [kN]
W5 [kN]
0.00 < % ≤ 1.38
1.38 < % ≤ 2.76
2.76 < % ≤ 4.14
4.14 < % ≤ 5.52
5.52 < % ≤ 6.90
N = 232
Xmin = 6.0 kN
Xmax = 90.0 kN
Xμ = 57.5 kN
Ymin = 6.0 kN
Ymax = 90.0 kN
Yμ = 57.7 kN



Canadian_traffic_analysis
Vehicle tyle 8 axles / Portion Q4
W8 [kN]
W7 [kN]
0.0
20.0
40.0
60.0
80.0
100.0
0.00 < % ≤ 1.21
1.21 < % ≤ 2.41
2.41 < % ≤ 3.62
3.62 < % ≤ 4.83
4.83 < % ≤ 6.03
N = 232
Xmin = 0.0 kN
Xmax = 99.0 kN
Xµ = 62.1 kN
Ymin = 8.0 kN
Ymax = 99.0 kN
Yµ = 62.2 kN