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"Measurements and interpretation of dynamic loads on bridges".

ECSC-contract nr. 7210-KD/6/604

Final report Haagsche Schouw Bridge
Rheden Bridge

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"Measurements and interpretation of dynamic loads on bridges"
ECSC Contract nr. 7210-KD/6/604
Final report of the "Haagsche Schouw" bridge and the "Rheden" bridge.

0. Summary

This report contains the results of measurements on two Dutch bridges, which intend to get a better insight of the relation between loading and stresses of a bridge structure.
With the knowledge of such a relation it will be possible to predict the fatigue behaviour of highway bridges.

Installed weighbridges and magnetic coils recorded the traffic in terms of axle loads, axle distances, vehicle length, vehicle speed and vehicle intervals. The lorries were classified according to their number of axles in 19 types ofwhich 5 types are dual lorries subdivided into different axle distances.
Installed straingauges on several stringers and a cross girder recorded the stresses in the bridge structure.

Computer programmes were made to arrange the data in a convenient order (statical process) with the help of the laboratory computer.

The relation between the load on the bridgedeck and the stresses in the measuring points has been recorded by measuring the influence planes statically as well as dynamically.

An investigation took place to deduce the traffic from the peak values of the measured stresses on the bridge.

For one bridge the measured and calculated static influence planes are compared together.

Analysis of the data of the measurements showed that:

- there is a lot of difference between the stress pattern of the measured points in one cross section of the bridge due to the lateral distribution of the traffic; therefore in consequence of the lateral distribution the number of axle loads needed to reach an accurate stress distribution is larger than to reach the distribution of axleloads with thesameaccuracy.
- the movable bascule bridge showed a considerable number of cycles after the vehicles left the bridge due to dynamical effects.

1. INTRODUCTION

This report contains the Dutch contribution to a research program of dynamic loads on bridges.
The object of this research is to get a better insight in the behaviour of a bridge due to traffic loading.
Especially the relation between loading and stresses in various components of the structure is of interest.

When such a relation would be known it would become possible to predict the fatigue behaviour of highway bridges.

The results must be applied to a computer simulation; to this end a lot of computer time was spent to gather the output of the experiments into the proper statistical mode.
In the Netherlands two bridges have been chosen which satisfy the following criteria:

- a single carriageway bridge
- a bridge with two lanes only
- a bridge with a simple structural system
- a bridge in a road where the traffic pattern is not disturbed by exits or entrances close to the bridge.

The first bridge on which was measured was one on highway 44 crossing the river "Oude Rijn" at the "Haagsche Schouw".
The traffic measured ran from Amsterdam to the Haque.
The second bridge called the "Rheden Bridge" is situated on highway 12 crossing the river "IJssel" near Arnhem.

This bridge is serving the traffic abroad (Rotterdam-Oberhausen).

For these two bridges 180 hours of measurements have been analysed and as it turned out they contained 96.779 counted axle loads greater than 10 kN.

The mean traffic frequency expressed in axle loads > 10 kN for the "Haagsche Schouw Bridge" was about 195 per hour, measured in 82 hours and 747 per hour for the "Rheden Bridge" in a period of 98 hours.
Most of the measurements took place between 07.00-19.00 hrs.

2. MEASUREMENT OF THE TRAFFIC

To determine the features of the traffic, weighbridges and magnetic coils have been installed in the pavement behind the bridge (see figure 2.1.).

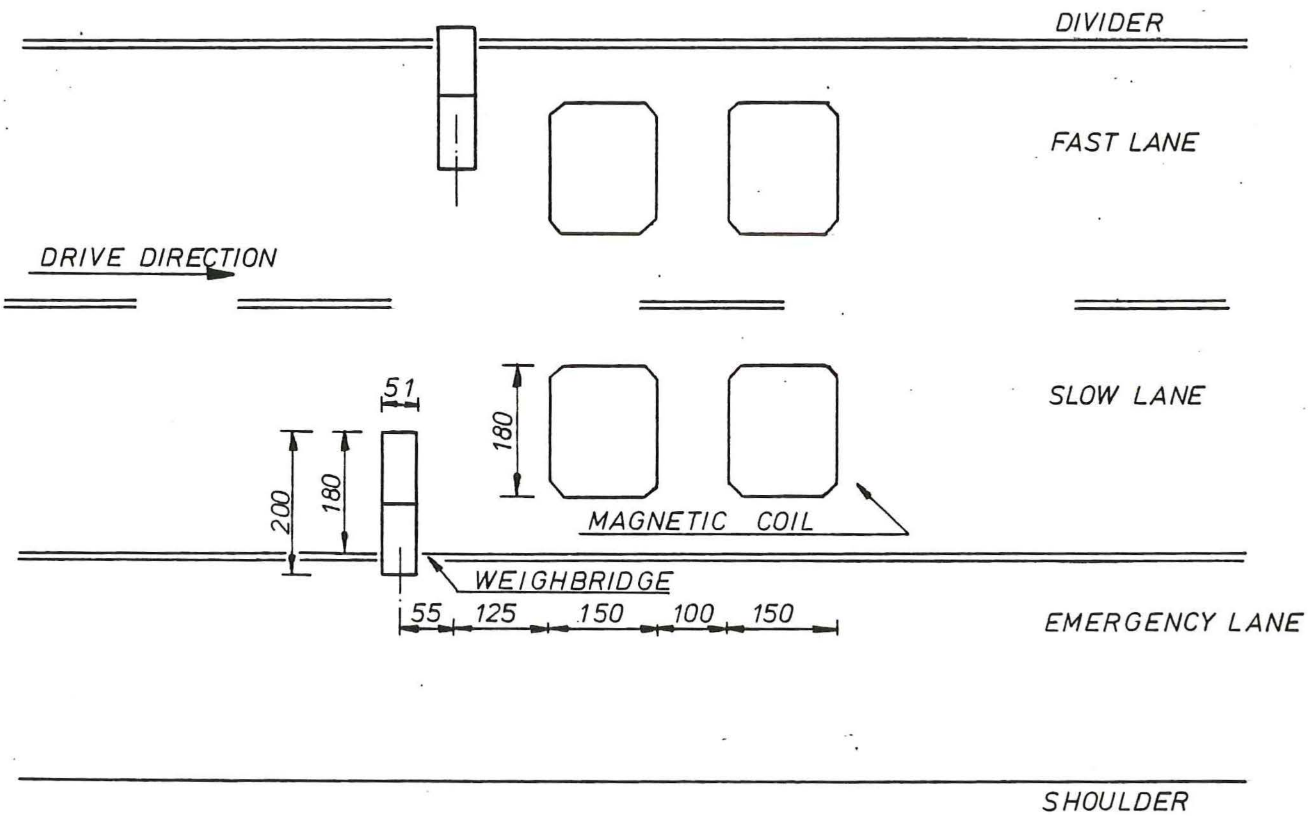


Figure 2.1.

2.1. Magnetic coils (vehicle length, speed and distances between the axles).
When a vehicle passes over the coil the reactance of the coil changes. The speed and length of a vehicle can be determined from the difference in time of passing two subsequent coils and their distance apart.
The distance between two vehicles can be determined from the difference in time of the coil being passed over and the vehicle speed.
The axle distance can be determined from the vehicle speed and the difference in time of touching the weighbridges by the wheels.

2.2. Weighbridges (loads, lateral distribution).
The deflection of a weighplate is proportional to the wheelload exerted. It was measured with straingauges. The traffic distribution in the lateral direction was determined coarsely by detecting loads in the fast and slow lane while a fine determination was made using the measurements of the stresses in the longitudinal stringers of the bridge.

2.3. Data acquisition system
The data aquisition system was based in the Raytheon 704 mini computer. The addition of a highspeed-reader and highspeed punch increased the possibilities e.g. greater data storage. A computerprogramme was made to record the traffic loads and magnetic coil output and to detect the peak values of the measured stresses.
All these quantities were recorded on punchtape.
Other computerprogrammes were made to analyse the signals and to arrange them in a convenient order (statistical process) with the help of the laboratory computer (Hewlett-Packard).

3. DESCRIPTION OF THE MEASURED BRIDGES AND THE LOCATION OF THE MEASURING POINTS

3.1. Description of the "Haagsche Schouw Bridge"

The bridge consists of two parallel indepent movable bascule bridges. The west bridge was chosen for serving the southbound traffic (Amsterdam to the Haque).
The structure consists of two main steel girders and a number of crossgirders with longitudinal stringers on top.
The deck is made of wooden boards with an asphalt top layer.
Figure 3.1.1. shows some dimensions of this bridge.

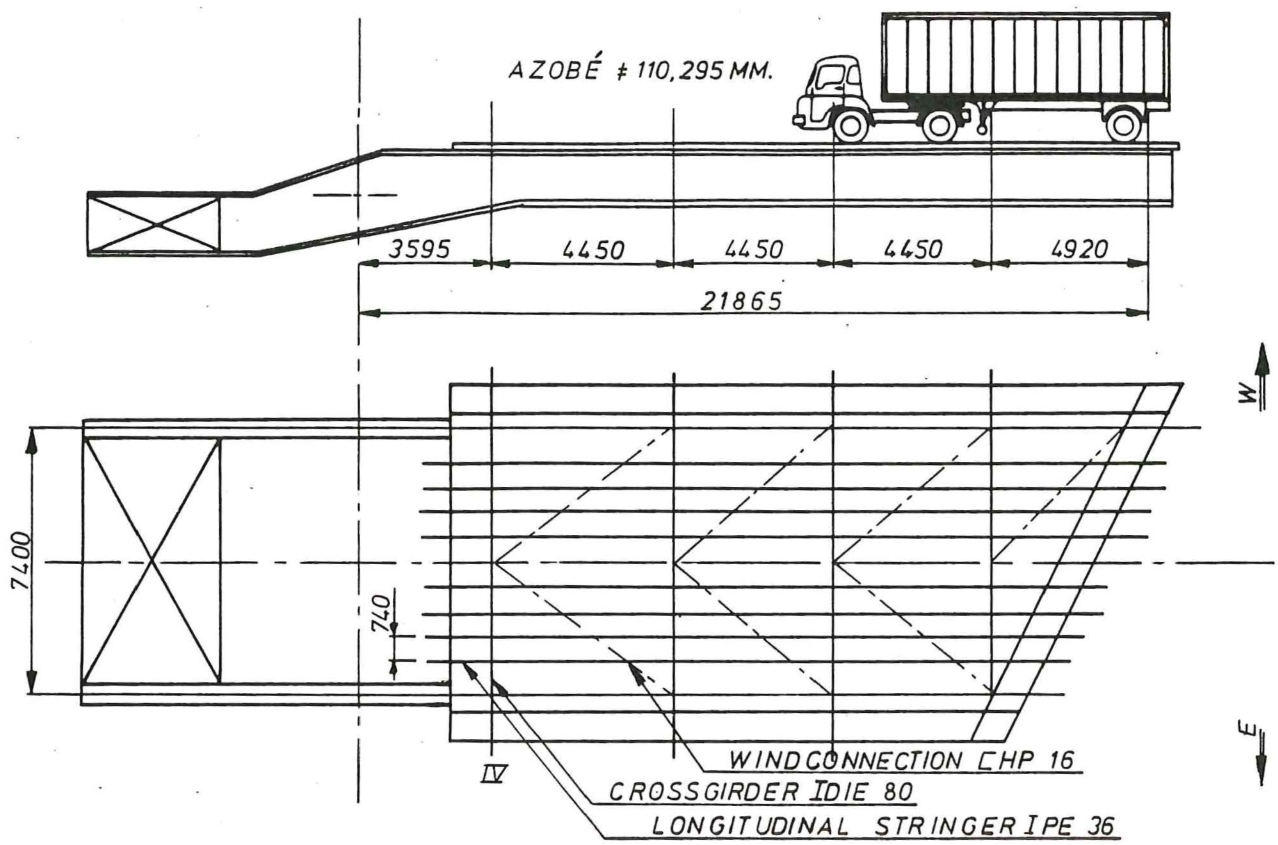


Figure 3.1.1.

3.1.2. Location of the measuring-points on the "Haagsche Schouw Bridge"

In a cross-section, various straingauges were applied in order to get an insight into the distribution of the stresses in that cross-section.
From this it appeared that the stress-plattern in the upper flange was disturbed by secondary effects such as transverse bending of the flanges.
Therefore, at the final measuring points the strain-gauges were only applied on the bottom flanges.
At each measuring point four active straingauges were placed and connected in such a way that the resulting measured quantity is not sensitive to variations in temperature and transverse bending of the girder (complete Wheatstone Bridge).
Figures 3.1.2.1. and 3.1.2.2. give the position of the measuring points.
The numbers 1,2 and 3 on a crossgrider, the numbers 4-21 on various stringers.
It appeared that the analyses of the stresses in points 1-12 gave a lot of problems due to the dynamic response of the bridge.
That is the reason why later on the points 2-3 and 13-21 were measured only.

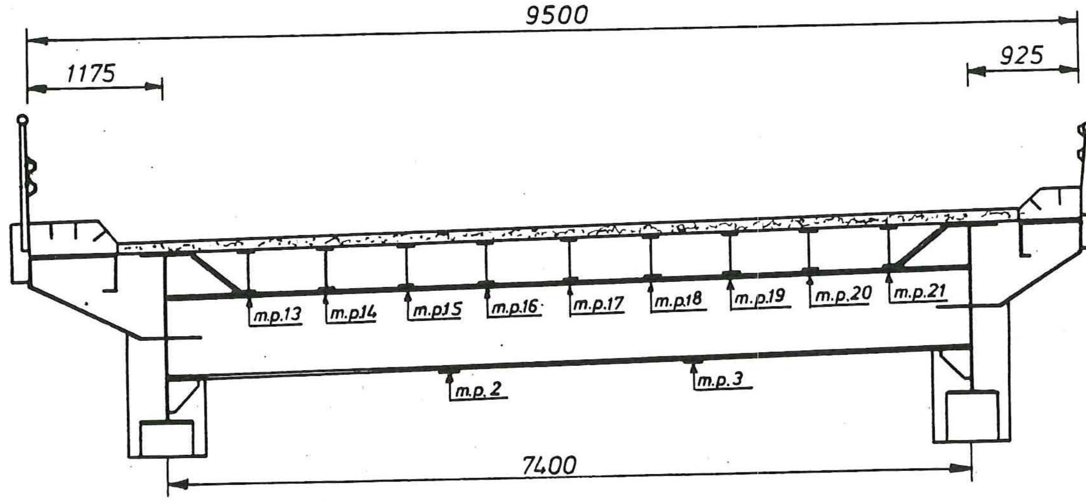


Figure 3.1.2.1.

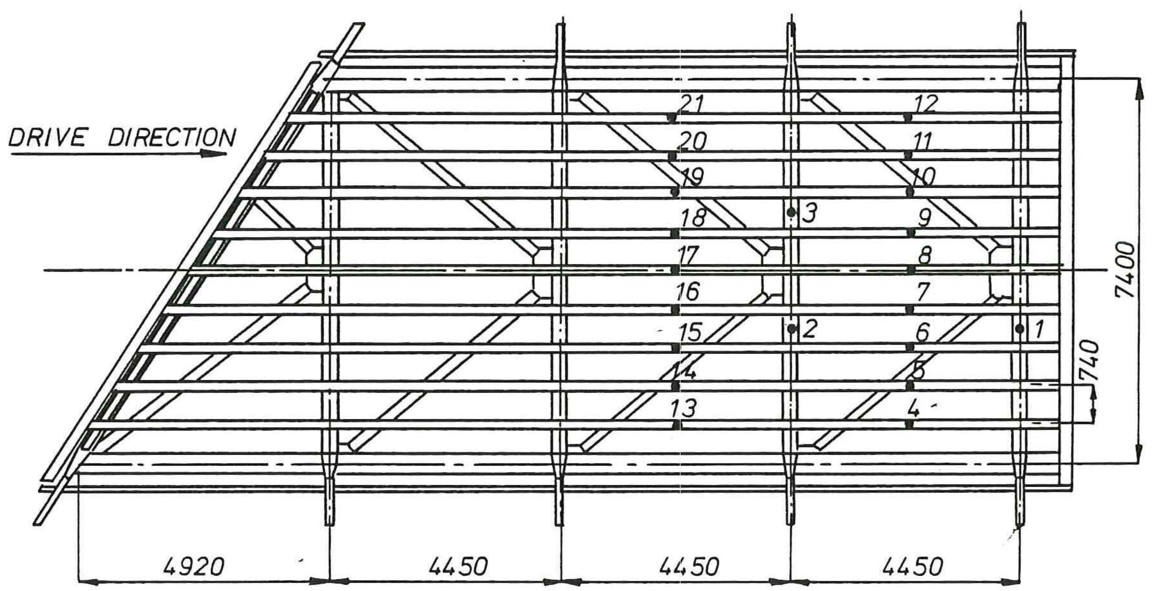


Figure 3.1.2.2.

3.2.1. Description of the "Rheden Bridge"

The bridge consists of two parallel independent bridges. The south bridge was chosen for serving the eastbound traffic (Rotterdam to Oberhausen).

The structure consists of two main steel girders with five spans (45 + 50 + 105 + 50 + 45 = 295 meters) and a number of crossgirders which are welded to the steel deck plate.
The longitudinal stringers are stiffeners of the deck plate which has an asphalt top layer.
Figure 3.2.1.1. shows some dimensions of this bridge.

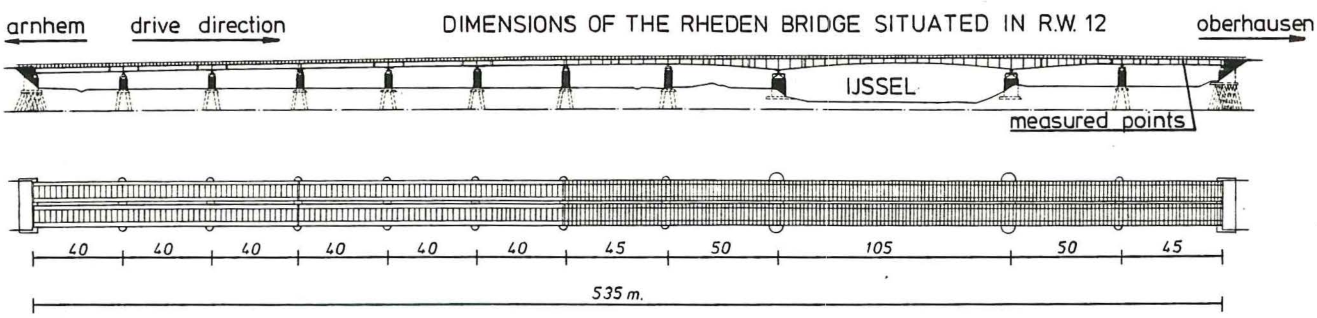


Figure 3.2.1.1.

3.2.2. The location of the measuring points on the "Rheden Bridge"

Just as the measuring points on the "Haagsche Schouw Bridge", the straingauges were attached to the bottomside of the longitudinal stiffeners and one crossgirder.
Figure 3.2.2.1. shows the location of the measuring points.

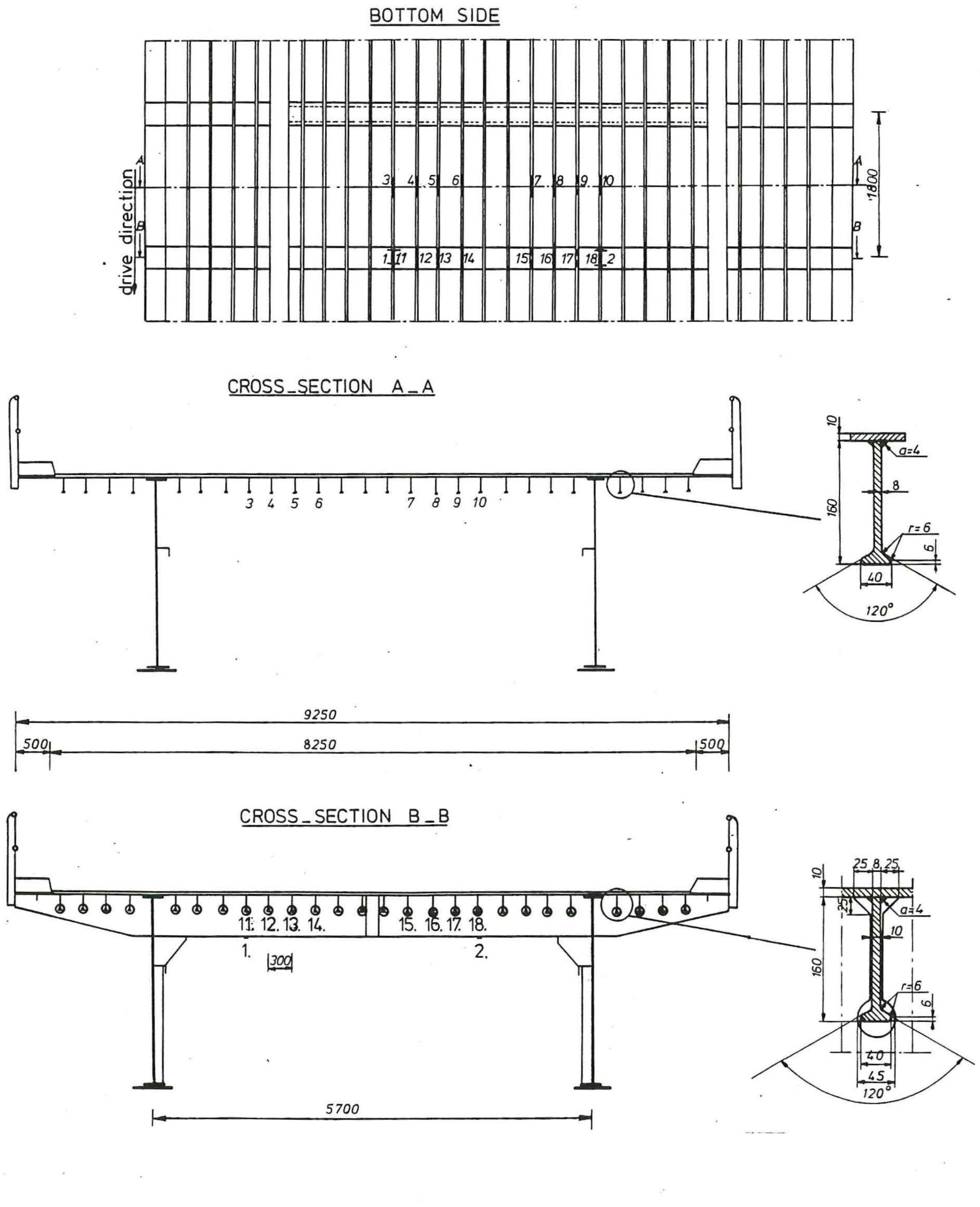

BOTTOM SIDE
drive direction
A
B
3 4 5 6 7 8 9 10
1 11 12 13 14 15 16 17 18 2
1800
CROSS_SECTION A_A
3 4 5 6 7 8 9 10
10
a=4
8
160
r=6
6
40
120°
9250
500
8250
500
CROSS_SECTION B_B
11. 12. 13. 14. 15. 16. 17. 18.
1. 2.
300
25 8 25
10
25
a=4
10
160
r=6
6
40
45
120°
5700

Figure 3.2.2.1.

4.1.1.1. Measured static influence lines

As an example, the influence line of measuring point 13 belonging to track B-B' is given in figure 4.1.1.1.1.

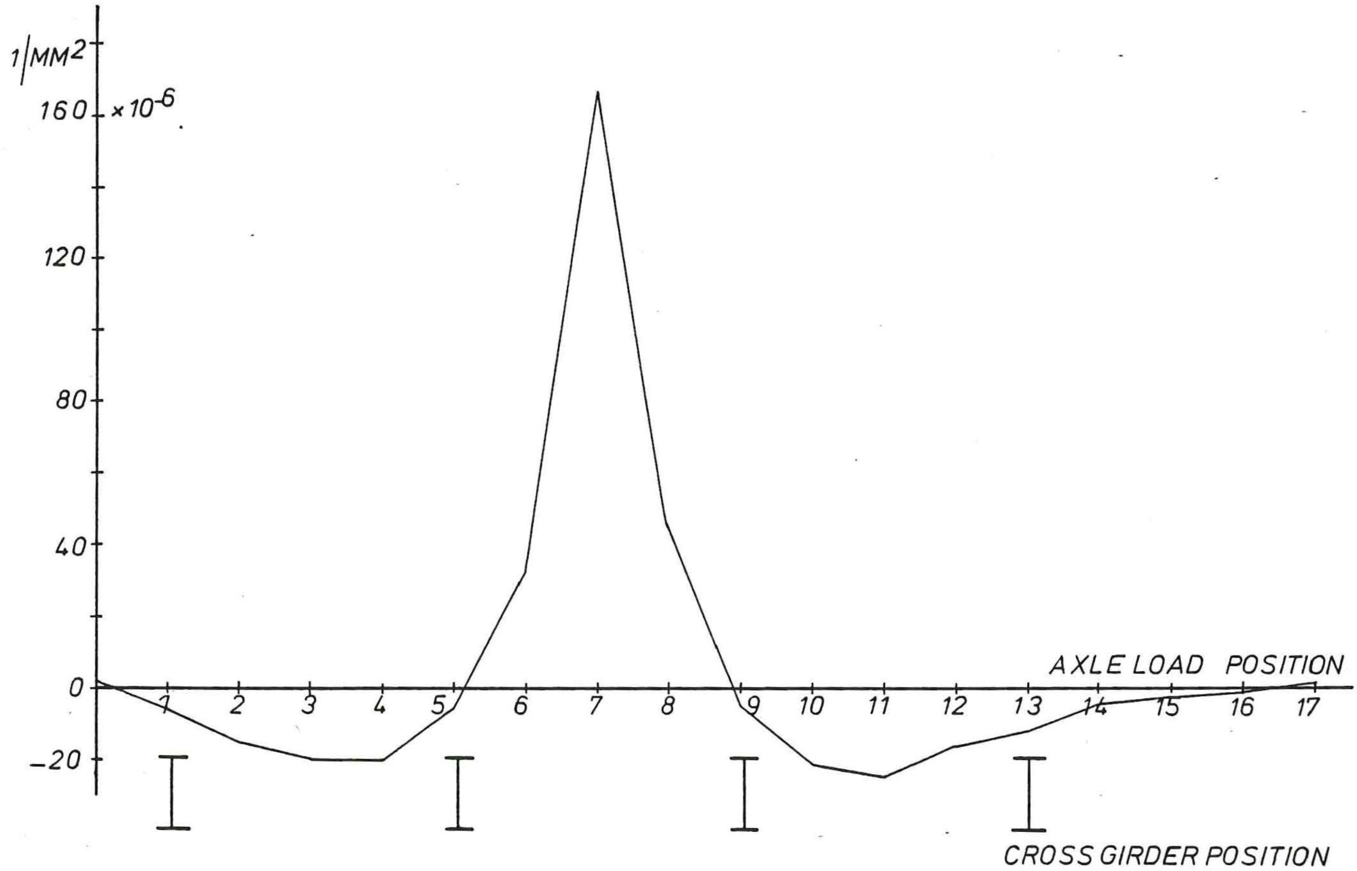


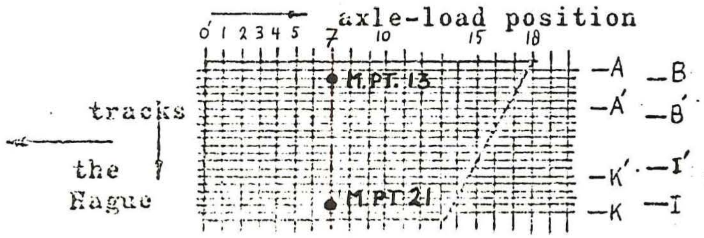
Figure 4.1.1.1.1.

As was to be expected the influence becomes largest if the axle load is found in the crosssection which corresponds to point 13.

In the table on page 13 an example is given of all measured influence factors for point 13 and 21.
Points 13 and 21 are symmetric with respect to the longitudinal axis of symmetry.
This is approximately expressed in the values.

INFLUENCE-FACTORS   MEASURING-POINT 13 and 21

TRACKS	AXLE-LOAD POSITION 0'	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
A-A'	-1	-6	-16	-26	-20	-6	28	106	36	-4	-20	-21	-18	-11	-4	-2	0	1	
B-B'	1	-6	-15	-20	-20	-7	32	166	45	-3	-21	-25	-17	-12	-5	-2	-1	1	
C-C'	0	-7	-15	-19	-26	-6	34	132	46	-2	-21	-25	-18	-10	-3	-1	0	0	
D-D'	-1	-6	-13	-17	-15	-3	33	65	37	2	-18	-23	-15	-10	-4	-1	0	0	
E-E'	-1	-6	-10	-14	-12	-1	23	30	25	2	-13	-17	-12	-8	-4	-1	0	0	13
G-G'	-3	-2	-1	0	2	1	1	0	0	0	0	-1	-2	-2	-2	-1	-	-	
H-H'	-2	-2	-2	-1	1	1	0	0	1	1	1	-1	-2	-3	-2	0	-	-	
I-I'	-2	-2	-1	0	1	1	1	1	1	1	0	-1	-1	-3	-2	0	-	-	
K-K'	-2	-1	-1	0	0	0	1	1	1	1	0	-1	-2	-2	-1	-1	-	-	
A-A'	-2	-2	-1	-1	0	0	1	1	1	1	0	0	0	-1	0	0	0	0	
B-B'	-2	-1	0	1	1	0	0	1	1	2	2	1	1	1	-1	0	1	0	
C-C'	-4	-3	-1	-1	0	0	0	0	0	1	1	0	-1	-1	-1	0	1	1	
D-D'	-4	-2	-1	0	1	0	0	0	1	2	1	0	0	-2	-1	0	1	1	
E-E'	-3	-3	-1	-1	0	1	0	1	1	2	3	2	1	1	1	3	4	4	21
G-G'	-4	-8	-12	-15	-19	-7	25	57	31	1	-12	-9	-5	0	3	4	-	-	
H-H'	0	-7	-13	-20	-19	-6	30	115	46	2	-14	-7	-12	-4	0	-1	-	-	
I-I'	2	-4	-11	-15	-15	-1	30	171	45	1	-14	-5	-14	-4	1	-3	-	-	
K-K'	10	8	-3	-9	-6	7	39	116	42	5	-9	-12	-7	0	4	3	-	-	



Stress= axle-load(N) x influence-factor x $10^{-6}(^1/mm^2)$=----$^N/mm^2$

← drive direction(right)

→ Amsterdam

← drive direction(left)

HAAGSCHE SCHOUWBRUG
INFLUENCE FACTORS

4.1.1.2. Measured dynamic influence lines

To get an indication of the dynamic effect a lorry has been driven with different speeds in tracks B-B' and I-I'.
The results are presented in figure 4.1.1.2.1. as ratios between the dynamic influence factors and the static influence factors.
An universal ratio cannot be given.

Another influence of dynamic loads is that the number of cycles is larger than the number of cycles that can be calculated with the help of static influence factors.
This effect is shown in figure 4.1.1.2.2. where the analogue recording of several measuring points are presented and the position of a lorry is indicated with photographs.
A considerable number of cycles with a respectable magnitude occur after the vehicle has left the bridge.

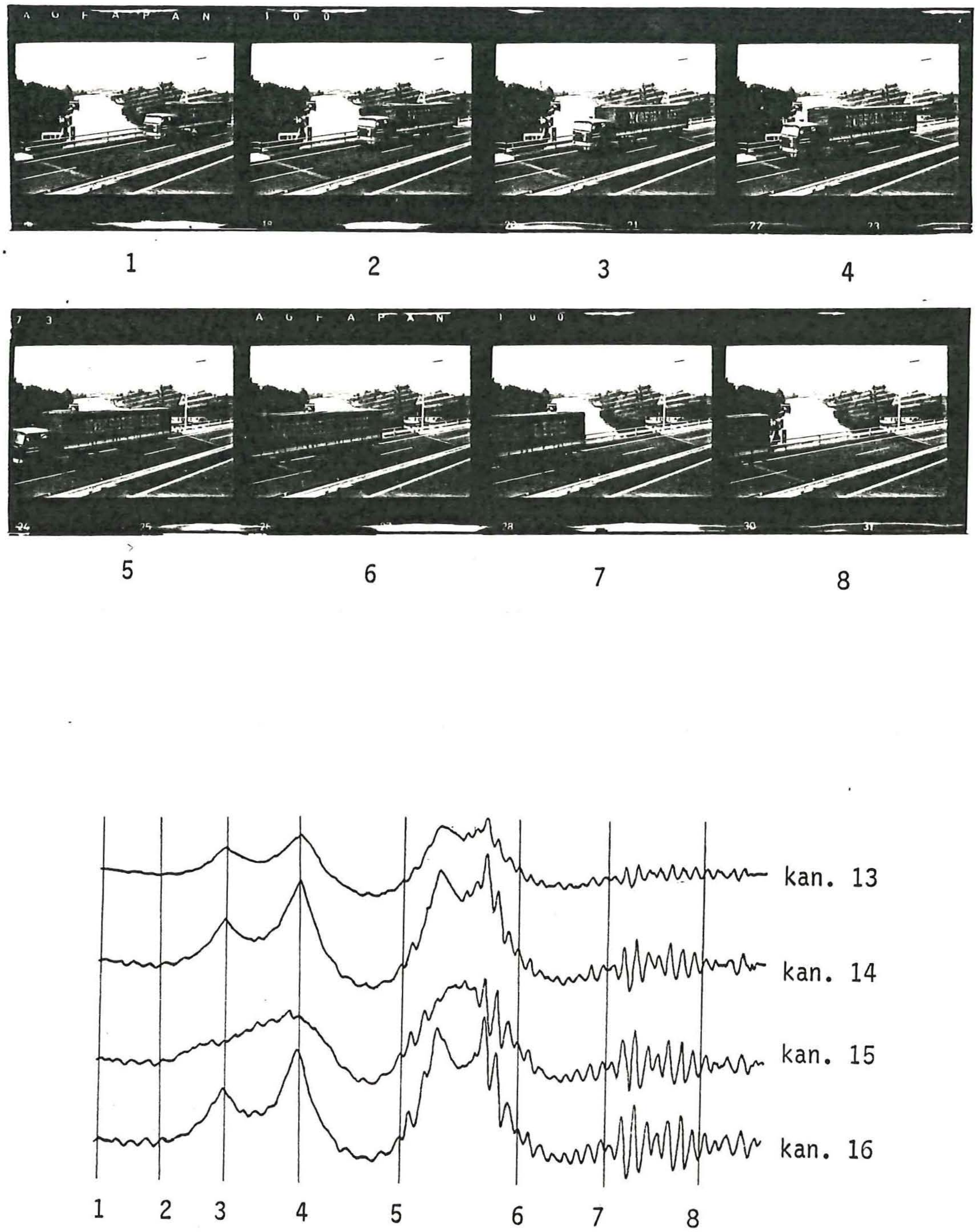


Figure 4.1.1.2.1.

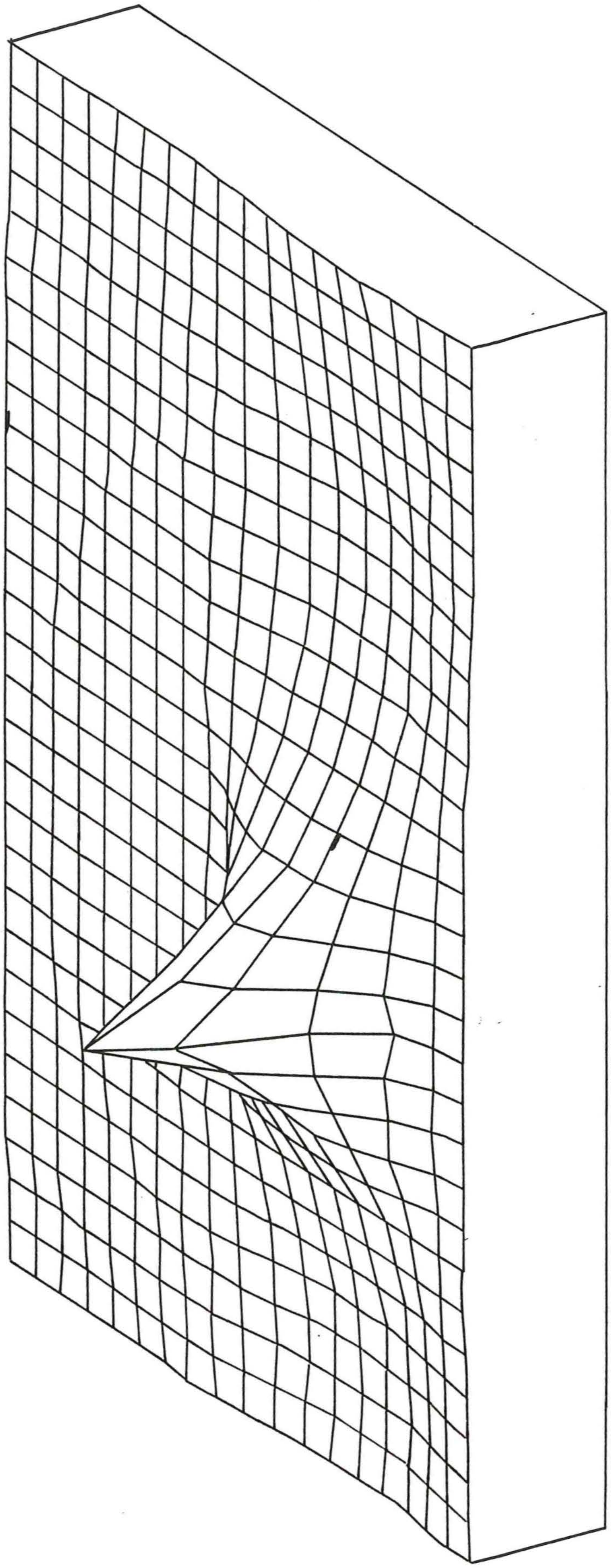


Figure 4.1.1.3.

Influence surface measuring point 13

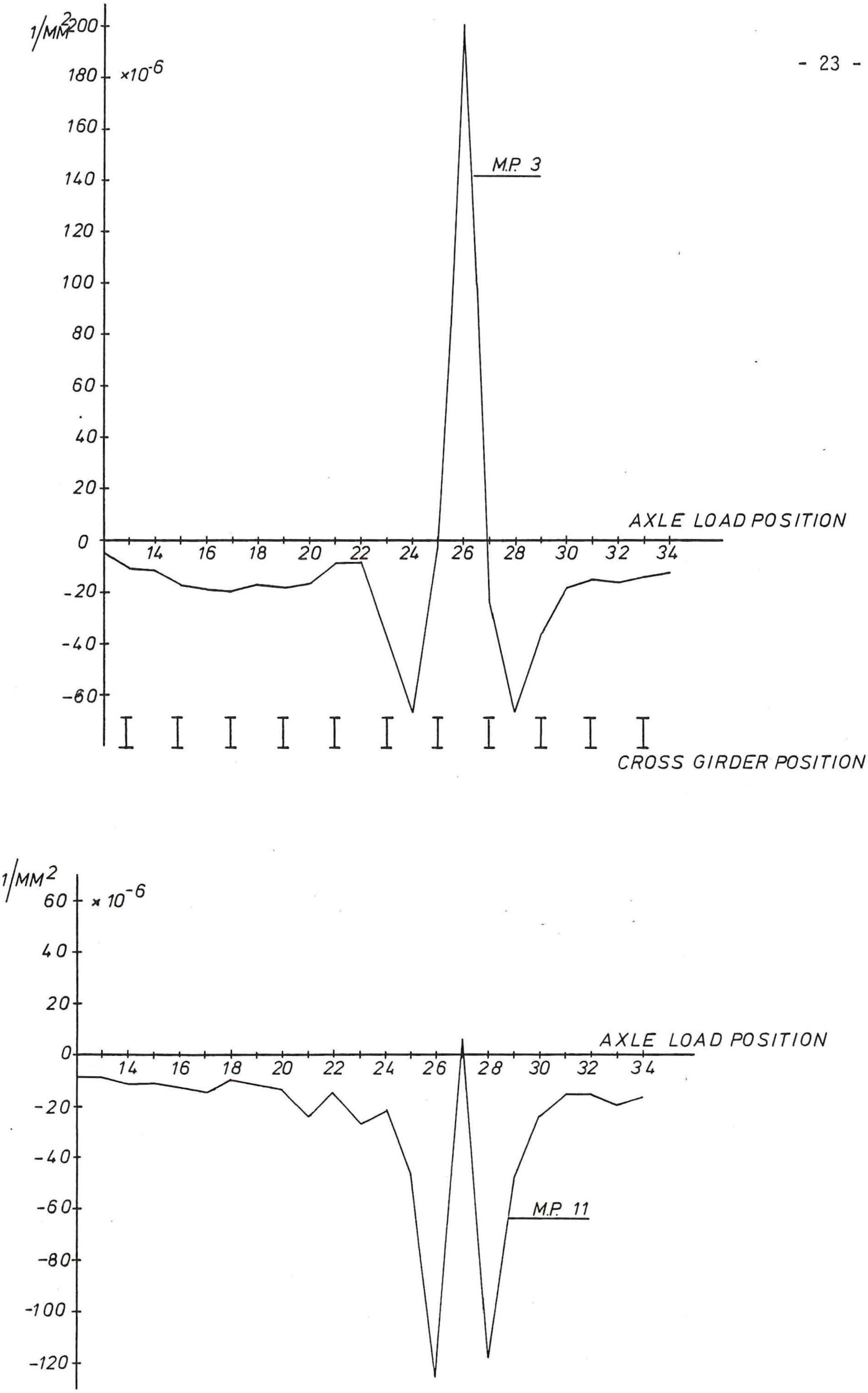


Figure 4.1.2.1.1.

4.2. The processing of the traffic data

4.2.1. Type classification of vehicles

To arrange the traffic data in a convenient order, the vehicles are grouped into types according to their number of axles as given in figure 4.2.1.1.

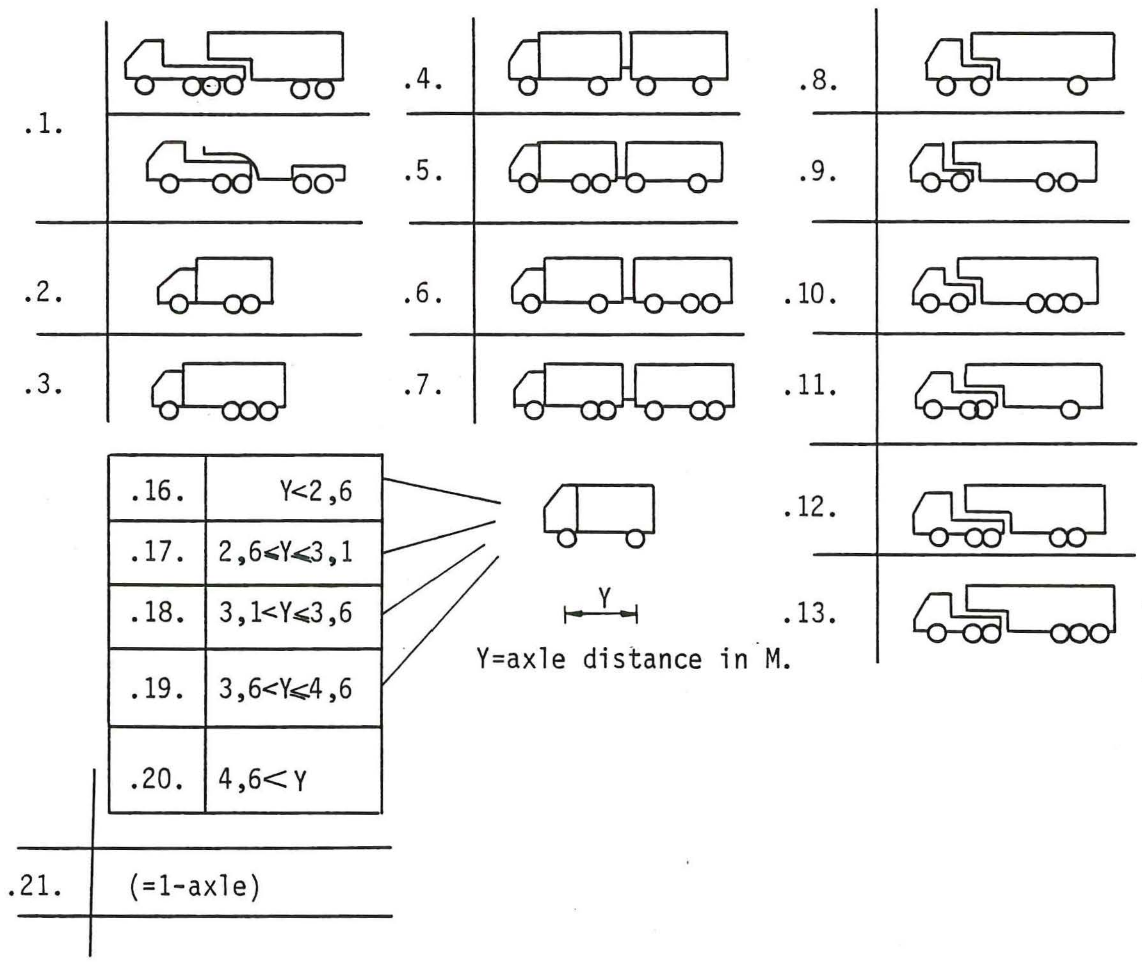


Figure 4.2.1.1.

In group 1 all vehicles are placed, which do not belong to other groups. All vehicles with two axles but with different axled distances are classified in groups 16 up to and including 20.
In group 21, all two axle vehicles are placed which have only one axle greater than 8 kN.

4.2.2. Axle loads

All axle loads are denoted by two numbers.
The first one of which represents the class the vehicle belongs to.
The second indicates the number of the wheel counting from the front of the vehicle to its rear see figure 4.2.2.1.
When the latter number is a zero obviously it is not a wheel-number but the figure to which this number pertains is the average of axle loads of the specified type.

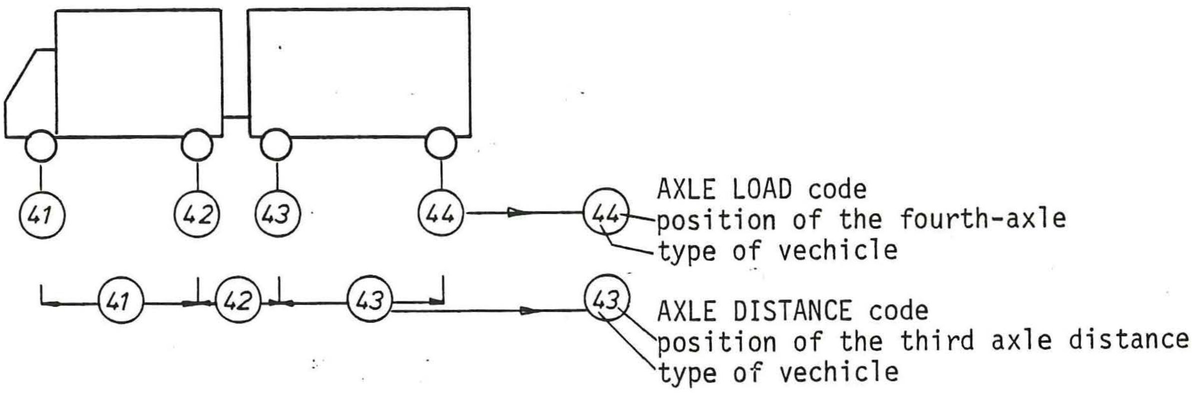


Figure 4.2.2.1.

4.2.2.1. Frequency distributions of axle loads

The numbers of axle loads of a specific type and magnitude are tabulated as given in figure 6.1.2.1.1. on page 32 . The table is given for one of the lanes. At the bottomlines of the columns, the sum of the vehicles of a specific type and the mean and standard deviation of the columns are given. A sum of all measured axles in this particular lane with a specific class of magnitude is given in the column headed "sum".

4.2.2.2. Cumulative relative frequency curves

Cumulative relative frequency curves are plotted for axle-loads greater than or equal to 10 kN for both lanes. Figure 6.1.1.1. on page 28 gives an example. The loads are occumulated from the largest class to the class of 10-12 kN and divided by the total value.

4.2.3. Axle distances

The axle distances determined as stated in section 4.2.2. are grouped both into classes according to their magnitude and to their location between the axles as given in figure 4.2.2.1. on page 25 .

4.2.3.1. Frequency distribution of axle distances

With a method analogous to the one used for the load-data the axle distances are treated (see figure 6.1.2.3.2. on page 36).

5. THE PROCESSING OF MEASURED STRESS DATA

5.1. The results of the measurements of the stresses are both level counted and rainflow counted.
For the description of these methods see |1|.
Only the levels crossed in upward direction are counted including the values caused by the cars of which axle loads were not counted (< 8 kN).

5.1.1. Frequency tables of level crossings

The level crossing counts are gathered in frequency tables see figure 6.1.3.1.1. on page 40 .

5.1.2. Modified relative frequency curves of level crossings

The level crossings counts are divided by the number of axle loads larger or equal to 10 kN which passed over the bridge.
The results are plotted in modified relative frequency curves.
Usually, of course, a relative frequency is defined as the frequency of the individual divided by the sum of all frequences.
Since this definition was not used here,the word modified is inserted.
This may lead to function values greater or lower than 1.

5.2. Frequency tables of rainflow counts

The rainflow counts are gathered in frequency tables see figure 6.1.3.2.2. on page 41 .

5.2.2. Modified cumulative relative frequency curves of rainflow counts

The rainflow counts are accumulated from the largest class to the lowest class. The results are divided by the number of axle-loads larger or equal to 10 kN which passed over the bridge.
See figure 6.1.3.6. on page 43 .
The results are plotted in modified relative frequency curves of rainflow counts.

6. RESULTS

6.1. Results of measurements on the "Haagsche Schouw Bridge"

6.1.1. The cumulative relative frequency curves of the axle loads in both lanes

Figure 6.1.1.1. shows the results of the measured axle loads in the slow lane and the fast lane during 81.79 hours.
In this period 14.443 axle loads ≥ 10 kN in the slow lane and 1476 axle loads ≥ 10 kN in the fast lane have been registered.
From this figure it is clear that there is a lot of difference between the traffic distribution in the slow lane and the fast lane.

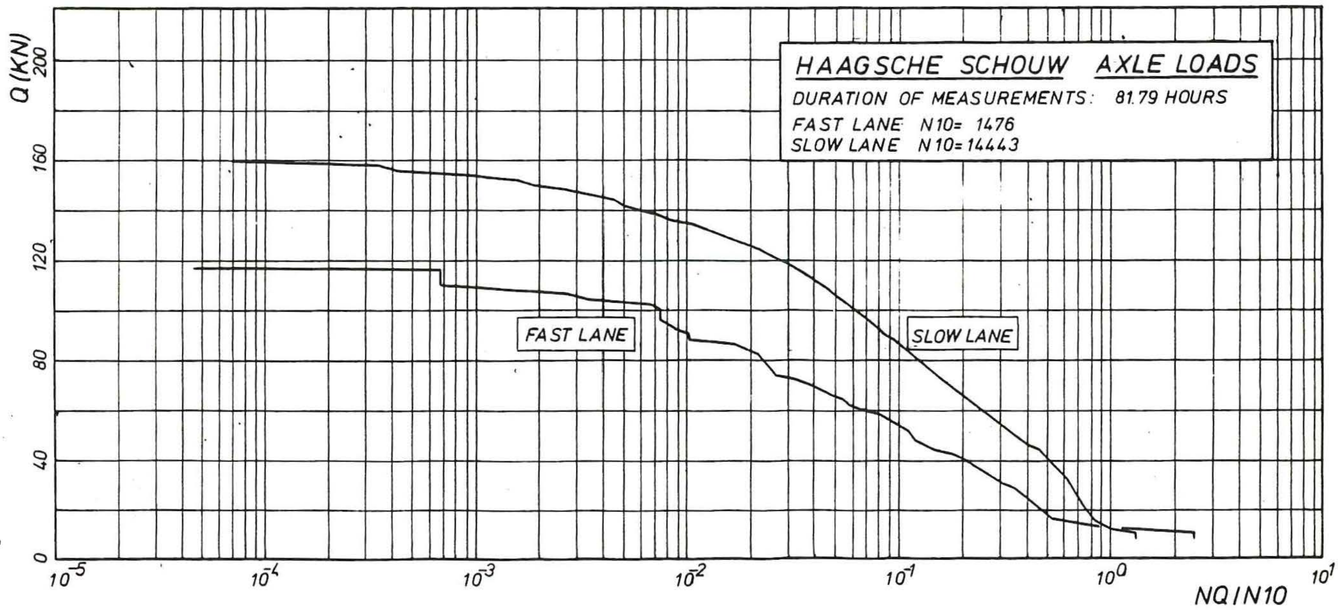


Figure 6.1.1.1.

This period of 81.79 hours is subdivided into 13 shorter periods to investigate the difference between the results of the slow lane and fast lane.
It appears that 6036 axle loads ≥ 10 kN are enough to record the cumulative relative frequency curves of the axle loads in the slow lane.
To obtain this curve with sufficient accuracy for the fast lane on the other hand, it shows that this curve - calculated after measuring 1476 axle loads ≥ 10 kN in 81.79 hours- is hardly enough to extend this graph for a longer period (see figure 6.1.1.2. and 6.1.1.3.).

Although in principle one would expect the fast lane curve to coincide with the slow lane curve, such a result is impossible to obtain in a finite measuring time.

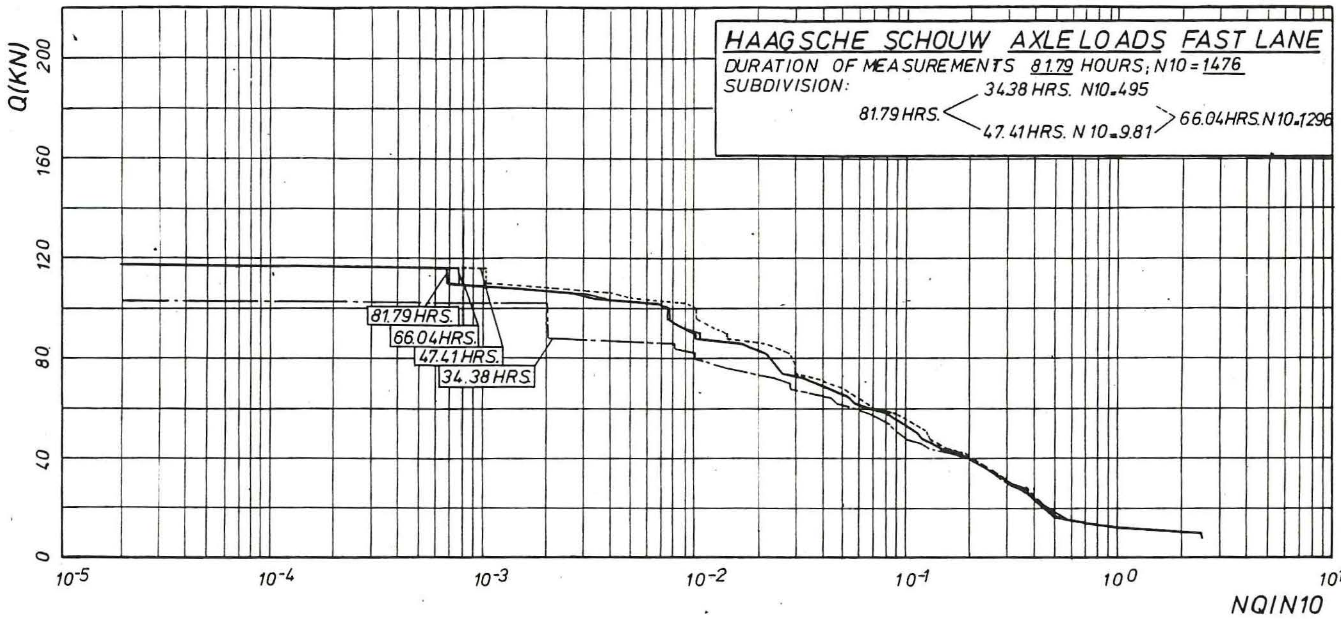


Figure 6.1.1.2.

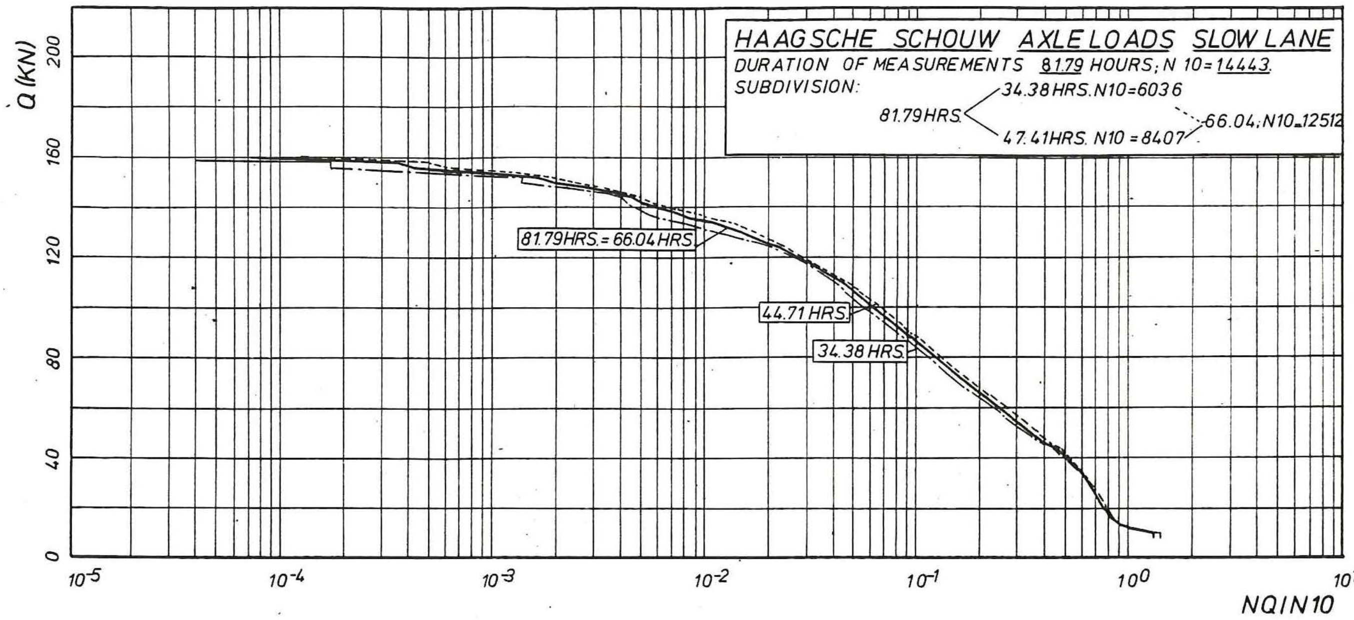


Figure 6.1.1.3.

6.1.2. Frequency distribution of axle loads and axle distances both after 81.79 hours

6.1.2.1. Relation between load and type of vehicle

From the frequency distribution of axle loads it appears that the axle loads of the dual lorries goes up with the size of the axle distance.
This can be seen from the table of figure 6.1.2.1.1. but also from figure 6.1.2.1.2. on page 32 and page 33.
The latter shows, the mean, the maximum and the minimum values of the axle loads per type as obtained from the frequency distribution tables.

From the table in figure 6.1.2.1.1. it is clear that the distributions in general are not symmetrical. On one hand this may be due to the small ammount of data.
On the other hand there is a lower limit to the measuring device which prevents small values to occur.

6.1.2.2. Distribution of the type of vehicles

This distribution is given in figure 6.1.2.2.1. on page 34 .
One reads that 15,7% of all traffic has axle loads > 8 kN; and that 81,66% of this percentage are dual lorries.

6.1.2.3. Mean values of axle loads and axle distances per type

These values are gathered in figure 6.1.2.3.1. on page 35 .

6.1.3. Vehicle intervals

The measured values are gathered in figure 6.1.3.2. on page 37 .

6.1.4. Lateral distribution after various periods

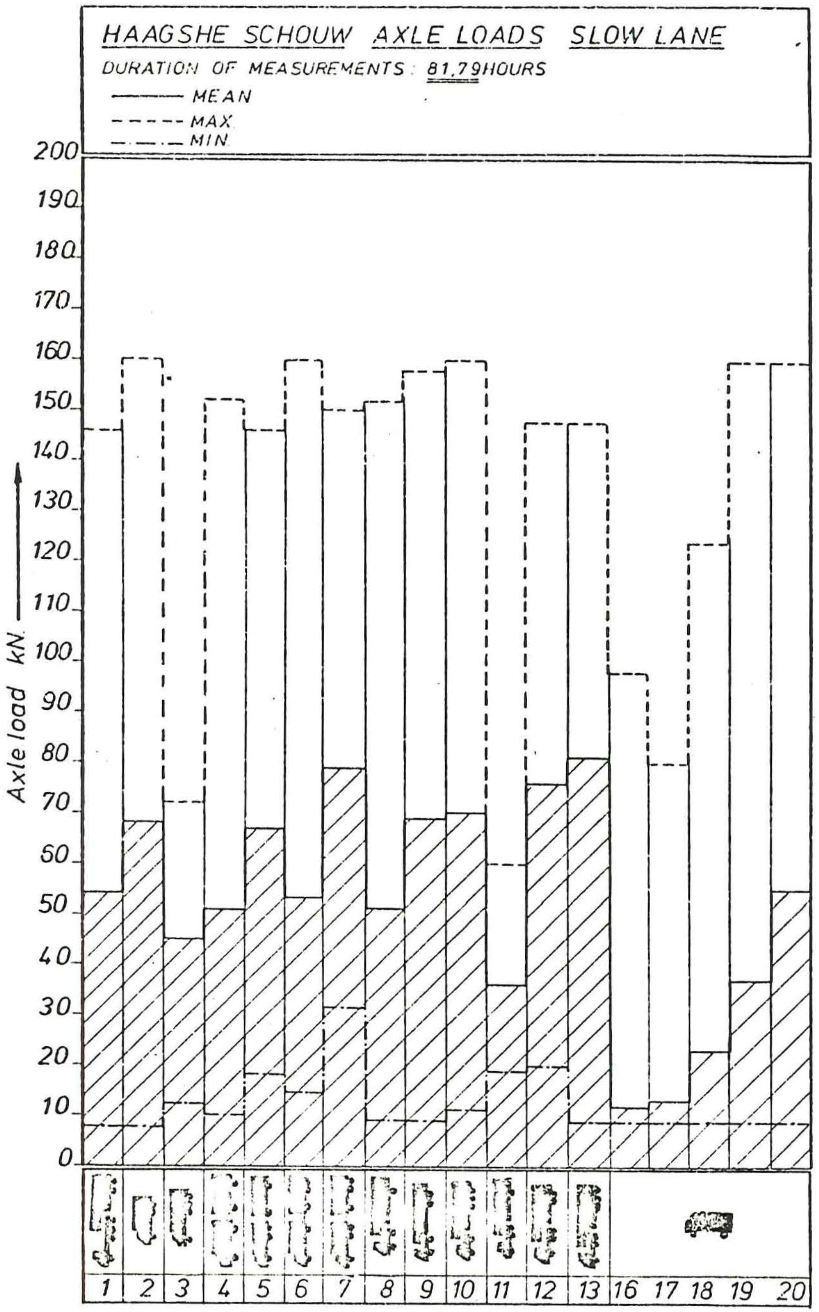
The measured values are gathered in figure 6.1.4.1. on page 38 .
It can be read that 56-60% of the traffic runs in track C-C'.
See figure 6.1.4.2. on page 38 .

HISTOGRAMS OF AXLE-LOADS OF TYPES 13,16-20 AND 1-AXLES OF THE FOLLOWING MEASUREMENTS IN THE SLOW LANE

CODENUMBER: 6024 NUMBER: 3507 DATE: 11088

AXLE CODE: AXLELOAD KN- KN	130	131	132	133	134	135	136	160	161	162	170	171	172	180	181	182	190	191	192	200	201	202	1-AX	SUM
0- 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2- 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4- 6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6- 8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
8- 10	.	.	.	.	.	1.	.	176.	243.	297.	446.	551.	665.	19.	37.	88.	4.	8.	11.	6.	10.	10.	2217.	4189.
10- 12	.	.	.	.	.	.	.	207.	130.	96.	398.	308.	235.	99.	90.	70.	11.	13.	13.	11.	7.	8.	435.	1447.
12- 14	.	.	.	.	1.	1.	.	50.	59.	51.	162.	165.	117.	86.	125.	62.	16.	30.	18.	1.	4.	2.	96.	753.
14- 16	.	.	.	.	1.	.	.	26.	30.	15.	65.	82.	55.	83.	114.	53.	36.	55.	25.	4.	4.	2.	23.	490.
16- 18	.	.	.	.	.	.	.	7.	10.	5.	45.	37.	33.	87.	95.	68.	37.	61.	33.	2.	6.	3.	7.	373.
18- 20	.	.	.	.	.	.	.	4.	3.	6.	29.	24.	23.	75.	59.	66.	31.	61.	33.	4.	8.	4.	3.	329.
20- 22	.	.	.	.	.	.	.	1.	1.	1.	18.	8.	13.	51.	43.	58.	41.	55.	23.	6.	16.	6.	.	259.
22- 24	.	.	.	.	.	.	.	1.	.	1.	10.	11.	19.	46.	37.	48.	40.	65.	37.	3.	7.	5.	3.	275.
24- 26	.	.	.	.	.	.	.	1.	1.	.	8.	12.	10.	31.	33.	32.	56.	57.	41.	4.	19.	6.	1.	271.
26- 28	.	.	.	.	.	.	.	2.	.	.	12.	5.	14.	21.	19.	23.	53.	49.	44.	10.	26.	2.	.	253.
28- 30	.	.	.	1.	.	.	.	.	.	.	6.	5.	8.	24.	17.	23.	53.	61.	46.	16.	38.	14.	3.	285.
30- 32	.	.	.	.	.	1.	.	.	.	.	4.	1.	5.	28.	15.	27.	52.	74.	47.	25.	47.	12.	2.	352.
32- 34	.	.	1.	.	2.	.	.	.	.	1.	3.	4.	1.	15.	10.	19.	67.	42.	42.	18.	34.	13.	1.	278.
34- 36	1.	.	.	.	1.	1.	.	1.	.	.	3.	3.	1.	12.	9.	15.	53.	45.	52.	23.	65.	17.	4.	350.
36- 38	.	.	.	.	.	.	1.	1.	.	1.	1.	2.	3.	12.	11.	18.	46.	55.	35.	36.	57.	23.	2.	336.
38- 40	3.	.	1.	1.	.	1.	.	.	.	.	3.	1.	4.	14.	7.	14.	52.	35.	43.	49.	78.	23.	3.	325.
40- 42	1.	.	.	.	.	.	1.	.	.	.	3.	.	4.	15.	2.	15.	54.	29.	50.	41.	71.	33.	1.	322.
42- 44	.	.	.	1.	.	.	2.	.	.	1.	2.	2.	7.	11.	8.	12.	34.	65.	74.	50.	205.	74.	2.	697.
44- 46	.	.	1.	1.	.	1.	.	.	.	.	2.	1.	1.	6.	2.	3.	37.	27.	27.	42.	90.	36.	.	309.
46- 48	.	.	1.	1.	.	.	1.	.	.	.	.	.	.	5.	5.	6.	33.	36.	30.	68.	96.	31.	1.	328.
48- 50	.	2.	.	.	.	.	.	.	.	.	.	1.	1.	4.	11.	3.	27.	13.	21.	69.	89.	41.	.	321.
50- 52	.	.	.	.	.	.	.	.	.	.	.	.	.	3.	5.	4.	13.	9.	22.	87.	61.	40.	.	252.
52- 54	.	1.	1.	.	.	.	1.	.	.	.	.	.	.	2.	2.	3.	15.	13.	21.	83.	68.	40.	.	254.
54- 56	.	2.	.	1.	.	1.	.	.	.	.	1.	.	1.	1.	1.	4.	18.	12.	18.	76.	46.	45.	2.	242.
56- 58	.	7.	.	1.	1.	1.	.	.	.	.	1.	.	.	1.	.	1.	19.	7.	16.	80.	36.	52.	1.	237.
58- 60	.	1.	.	1.	.	1.	.	.	.	.	.	.	.	1.	2.	2.	16.	5.	19.	88.	24.	61.	2.	207.
60- 62	1.	.	.	.	.	1.	.	.	.	1.	1.	.	.	1.	1.	1.	11.	5.	12.	59.	21.	55.	2.	194.
62- 64	.	3.	.	1.	.	2.	1.	.	.	1.	.	.	.	.	1.	2.	9.	3.	13.	55.	18.	57.	1.	216.
64- 66	.	4.	.	.	.	1.	.	.	.	1.	.	.	.	1.	.	.	12.	2.	10.	62.	17.	54.	1.	173.
66- 68	1.	2.	.	.	1.	1.	.	.	.	.	.	.	.	.	1.	4.	10.	2.	13.	45.	12.	61.	1.	184.
68- 70	.	3.	.	.	1.	1.	1.	.	.	.	.	.	1.	1.	1.	.	6.	3.	9.	32.	11.	47.	5.	158.
70- 72	.	3.	.	2.	1.	.	.	.	.	.	.	.	.	1.	.	2.	8.	1.	8.	24.	6.	38.	1.	135.
72- 74	1.	1.	.	2.	.	.	.	.	.	.	.	.	1.	.	.	.	3.	2.	6.	30.	9.	30.	2.	124.
74- 76	.	1.	.	1.	1.	.	.	.	.	.	.	.	.	.	.	1.	3.	.	6.	13.	3.	36.	.	111.
76- 78	.	.	.	.	2.	.	.	.	.	.	.	.	.	2.	.	1.	2.	.	11.	14.	7.	31.	.	106.
78- 80	2.	.	2.	.	2.	.	.	.	.	.	.	.	1.	.	.	.	5.	.	9.	10.	5.	40.	1.	106.
80- 82	3.	.	.	.	1.	1.	1.	1.	.	.	.	.	.	.	.	.	3.	.	3.	9.	2.	34.	1.	90.
82- 84	1.	.	2.	1.	.	2.	.	.	.	.	.	.	.	.	.	.	2.	.	6.	8.	1.	20.	1.	71.
84- 86	.	1.	.	1.	2.	.	.	.	.	.	.	.	.	1.	.	1.	5.	.	6.	9.	.	26.	1.	78.
86- 88	2.	1.	2.	5.	2.	1.	.	.	.	.	.	.	.	2.	.	1.	2.	.	10.	10.	.	36.	.	122.
88- 90	1.	.	4.	1.	1.	.	.	.	.	.	.	.	.	1.	.	1.	.	.	6.	5.	2.	17.	1.	59.
90- 92	3.	.	.	2.	1.	1.	.	.	.	.	.	.	.	.	.	.	.	.	1.	8.	.	17.	1.	58.
92- 94	3.	.	3.	2.	1.	3.	1.	.	.	.	.	.	.	1.	.	.	.	.	5.	7.	.	12.	2.	58.
94- 96	3.	.	2.	1.	.	.	1.	.	.	.	.	.	.	.	.	1.	1.	.	2.	6.	.	11.	.	63.
96- 98	1.	.	.	3.	2.	1.	.	.	1.	.	.	.	.	.	.	.	1.	.	.	6.	.	13.	.	66.
98- 100	2.	.	.	.	.	1.	2.	.	.	.	.	.	.	.	.	.	.	.	2.	4.	.	5.	.	47.
100- 102	.	.	1.	1.	1.	1.	.	.	.	.	.	.	.	.	.	.	1.	.	1.	2.	.	6.	1.	47.
102- 104	1.	.	1.	.	1.	1.	.	.	.	.	.	.	.	.	.	1.	1.	.	4.	3.	.	5.	.	59.
104- 106	1.	.	2.	1.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.	.	36.
106- 108	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.	1.	.	5.	.	38.
108- 110	.	.	1.	.	3.	.	1.	.	.	.	.	.	.	.	.	1.	.	.	1.	.	.	4.	.	52.
110- 112	.	.	1.	.	.	2.	3.	.	.	.	.	.	.	.	.	1.	1.	.	.	.	.	8.	.	47.
112- 114	.	.	3.	.	.	.	1.	.	.	.	.	.	.	.	.	1.	.	.	2.	1.	.	7.	.	41.
114- 116	.	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.	.	38.
116- 118	1.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	1.	.	.	3.	.	.	3.	.	40.
118- 120	.	.	1.	.	1.	1.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	3.	.	33.
120- 122	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	4.	.	24.
122- 124	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	.	.	.	6.	.	36.
124- 126	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	1.	1.	.	3.	.	33.
126- 128	.	.	.	.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5.	.	27.
128- 130	.	.	.	.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	3.	.	26.
130- 132	.	.	.	.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	22.
132- 134	.	.	.	.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	7.	.	36.
134- 136	.	.	.	.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	13.
136- 138	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	20.
138- 140	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13.
140- 142	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6.
142- 144	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	12.
144- 146	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	1.	.	13.
146- 148	.	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11.
148- 150	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.
150- 152	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8.
152- 154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	7.
154- 156	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.
156- 158	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.
158- 160	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	1.	.	1.
SUM:	32							478			1223			763			1000			1326			2831	8759/ 16708
MEAN:	82.	65.	90.	78.	82.	77.	101.	12.	12.	12.	13.	13.	13.	23.	20.	24.	38.	32.	42.	55.	45.	65.	11.	36.
ST. DEV:	215.	90.	233.	204.	296.	303.	334.	43.	46.	52.	54.	45.	66.	119.	99.	151.	159.	122.	142.	.	.	.	.	. *0. 1

Figure 6.1.2.1.1.



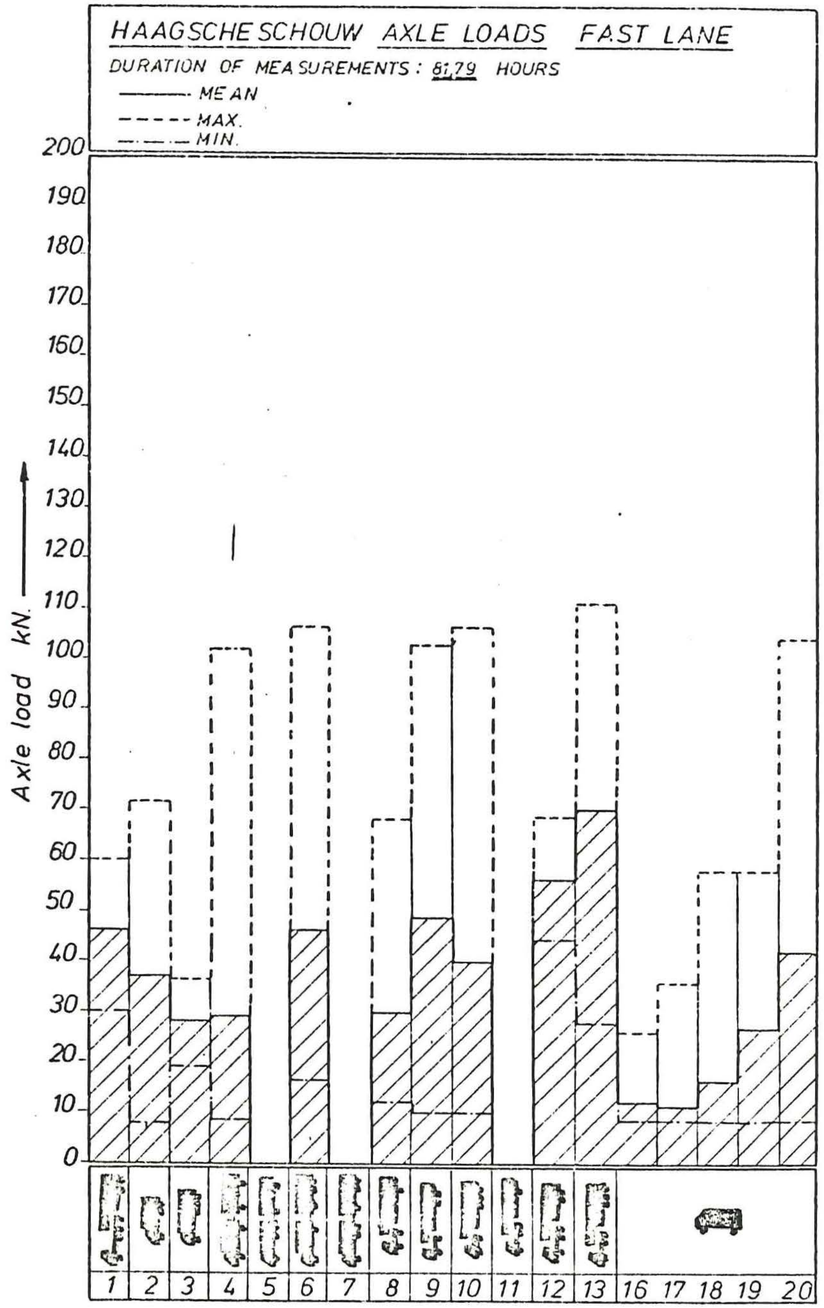
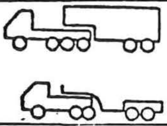
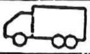
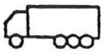
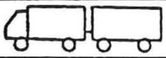
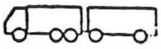
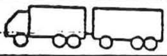
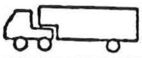
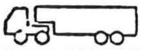
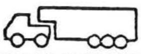
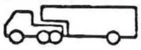
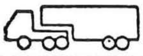
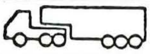


Figure 6.1.2.1.2.

COUNTED VEHICLES TYPES 1-20 ("Haagsche Schouw Bridge")						
Vehicle types	Measurement 101-3507 : hours 81.79					
	Fast lane		Slow lane		Sum	
	number	%	number	%	number	%
.1. 	1	0.11	49	0.72	50	0.65
.2. 	10	1.12	295	4.36	305	3.98
.3. 	1	0.11	9	0.13	10	0.13
.4. 	16	1.79	245	3.62	261	3.41
.5. 			24	0.35	24	0.31
.6. 	5	0.56	47	0.70	52	0.68
.7. 			3	0.04	3	0.04
.8. 	7	0.78	211	3.12	218	2.85
.9. 	22	2.46	314	4.64	336	4.39
.10. 	7	0.78	73	1.08	80	1.05
.11. 			4	0.06	4	0.05
.12. 	1	0.11	23	0.34	24	0.31
.13. 	2	0.22	35	0.52	37	0.48
.16.  Y<2.6	84	9.40	517	7.65	601	7.85
.17. 2.6≤Y<3.1	394	44.07	1313	19.42	1707	22.30
.18. 3.1<Y≤3.6	134	15.00	885	13.09	1019	13.31
.19. 3.6<Y≤4.6	73	8.17	1163	17.20	1236	16.15
.20. 4.6<Y	137	15.32	1551	22.94	1688	22.05

} 81.66% (types .16.–.20., Sum %)

COUNTED VEHICLES TYPES 1-21 ("Haagsche Schouw Bridge")						
.21. 1-AXLES	1711	65.63	3076	31.27	4787	38.48
.1 t/m 20.	894	34.31	6761	68.73	7655	61.53
1 t/m 21	2605		9837		12442	

15,7%

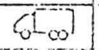
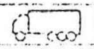
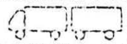
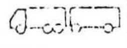
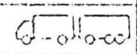
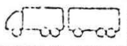
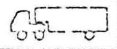
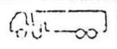
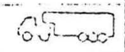
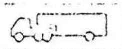
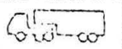
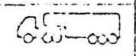
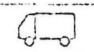
Total numbers of cars measured in 81,79 houres : 79.210

Figure 6.1.2.2.1.

Figure 6.1.2.3.1.

HAAGSCHE SCHOUW BRIDGE

AXLE LOADS AND AXLE DISTANCES PER TYPE DURING MEASUREMENTS OF 82 HOURS

Types	slow lane													fast lane											
	Counted vehicles	Mean axle load per axle kN						Mean axle distance per axle M					Counted vehicles	Mean axle load per axle kN						Mean axle distance per axle M				
		A1	A2	A3	A4	A5	A6	A1	A2	A3	A4	A5		A1	A2	A3	A4	A5	A6	A1	A2	A3	A4	A5
	295	60	78	67				3.8	1.3				10	41	42	27				3.8	1.1			
	9	55	53	32	40			3.9	1.3	1.2			1	30	20	36	26			4.2	1.2	1.2		
	245	51	69	43	42			4.7	5.4	4.4			16	32	42	20	21			4.7	5.6	4.5		
	24	64	82	57	68	64		4.4	1.7	4.5	5.3													
	47	57	78	47	43	43		4.9	4.9	4.4	1.4		5	50	64	42	38	40		4.6	4.6	4.2	1.4	
	3	67	124	72	89	59	66	4.4	1.4	4.6	4.3	1.7												
	211	40	55	57				3.1	6.0				7	28	29	33				3.5	6.7			
	314	57	86	64	67			3.3	5.9	1.7			22	44	61	45	47			3.2	6.2	1.8		
	73	61	101	62	64	64		3.3	5.4	1.2	1.4		7	51	59	26	32	33		3.3	5.3	1.3	1.3	
	4	48	29	30	34			2.8	1.4	5.7														
	23	63	90	64	73	90		2.9	1.3	5.2	1.9		1	58	68	58	46	46		2.9	1.3	4.4	1.2	
	35	64	89	77	80	76	99	3.1	1.3	4.8	1.3	1.8	2	52	87	64	51	59	109	3.2	1.3	4.5	1.2	1.6
	5429	12 ——→					64	3.8					822	11 ——→					48	3.4				

Sum type 1 : 50

Sum type 21 : 4787

Total numbers of lorries : 7655

HISTOGRAMS OF AXLE-DISTANCES OF TYPES 9 - 13 AND 16 - 20 OF THE FOLLOWING MEASUREMENTS IN THE SLOW LANE

CODENUMBER: 6026 NUMBER: 3507 DATE: 11088

AXLE-DIST. CODE: AXLE-DISTANCES IN M.	91	92	93	101	102	103	104	111	112	113	121	122	123	124	131	132	133	134	135	16-20	
.1- .2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
.2- .3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	
.3- .4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	
.4- .5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
.5- .6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
.6- .7	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
.7- .8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	
.8- .9	.	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	2.	
.9- 1.0	.	.	1.	.	.	2.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	
1.0- 1.1	.	.	6.	.	.	7.	6.	.	.	.	.	.	.	.	.	1.	.	.	.	.	
1.1- 1.2	.	.	11.	.	.	11.	7.	.	.	.	.	1.	.	.	.	.	.	2.	1.	1.	
1.2- 1.3	.	.	28.	.	.	16.	17.	.	.	.	.	4.	.	.	.	10.	.	19.	3.	.	
1.3- 1.4	.	.	44.	.	.	26.	18.	.	1.	.	.	9.	.	1.	.	18.	.	7.	4.	.	
1.4- 1.5	.	.	16.	.	.	5.	6.	.	.	.	.	7.	.	1.	.	5.	.	2.	3.	.	
1.5- 1.6	.	.	3.	.	.	.	2.	.	1.	.	.	2.	.	.	.	1.	.	1.	.	.	
1.6- 1.7	.	.	4.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	
1.7- 1.8	.	.	1.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.	
1.8- 1.9	.	.	10.	.	.	.	.	.	.	.	.	.	.	1.	.	.	.	.	1.	.	
1.9- 2.0	.	.	56.	.	.	1.	5.	.	.	.	.	.	.	7.	.	.	.	2.	7.	5.	
2.0- 2.1	.	.	82.	.	.	2.	6.	.	.	.	.	.	.	8.	.	.	.	2.	9.	5.	
2.1- 2.2	.	.	51.	.	.	1.	3.	.	.	.	.	.	.	5.	.	.	.	.	7.	6.	
2.2- 2.3	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	35.	
2.3- 2.4	.	.	.	.	.	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	128.	
2.4- 2.5	.	.	.	1.	.	.	.	.	.	.	1.	.	1.	.	.	.	.	.	.	160.	
2.5- 2.6	5.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170.	
2.6- 2.7	8.	.	.	.	.	.	.	.	.	.	1.	.	1.	.	4.	.	.	.	.	155.	
2.7- 2.8	18.	.	.	.	.	.	.	.	.	.	1.	.	1.	.	3.	.	.	.	.	294.	
2.8- 2.9	7.	.	.	1.	.	.	.	2.	.	.	8.	.	.	.	1.	.	.	.	.	322.	
2.9- 3.0	13.	.	.	3.	.	.	.	.	.	.	5.	.	.	.	5.	.	.	.	.	298.	
3.0- 3.1	11.	.	.	6.	.	.	.	.	.	.	1.	.	.	.	5.	.	.	.	.	244.	
3.1- 3.2	20.	.	.	9.	.	.	.	.	.	.	2.	.	.	.	4.	.	.	.	.	132.	
3.2- 3.3	42.	1.	.	7.	.	.	.	.	.	.	1.	.	1.	.	5.	.	.	.	.	133.	
3.3- 3.4	70.	.	.	12.	.	.	.	.	.	.	.	.	1.	.	4.	.	.	.	.	160.	
3.4- 3.5	58.	1.	.	13.	.	.	.	.	.	.	1.	.	.	.	2.	.	.	.	.	262.	
3.5- 3.6	26.	.	.	10.	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	198.	
3.6- 3.7	7.	1.	.	3.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	115.	
3.7- 3.8	9.	1.	.	3.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	85.	
3.8- 3.9	5.	2.	.	1.	.	.	.	.	.	.	1.	.	.	.	.	.	1.	.	.	110.	
3.9- 4.0	2.	6.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	113.	
4.0- 4.1	.	1.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	119.	
4.1- 4.2	2.	2.	.	2.	1.	.	.	.	.	.	.	.	.	.	1.	.	1.	.	.	174.	
4.2- 4.3	4.	2.	.	2.	1.	.	.	.	.	.	.	.	.	.	1.	.	2.	.	.	165.	
4.3- 4.4	.	5.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	87.	
4.4- 4.5	1.	4.	.	.	4.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	95.	
4.5- 4.6	.	6.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	100.	
4.6- 4.7	1.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	108.	
4.7- 4.8	.	4.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	7.	.	.	125.	
4.8- 4.9	1.	5.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	4.	.	.	135.	
4.9- 5.0	2.	2.	.	.	4.	.	.	.	.	.	.	.	1.	.	.	.	5.	.	.	104.	
5.0- 5.1	.	3.	.	.	1.	.	.	.	.	.	.	.	1.	.	.	.	5.	.	.	89.	
5.1- 5.2	.	4.	.	.	4.	.	.	.	.	.	.	.	1.	.	.	.	3.	.	.	110.	
5.2- 5.3	.	6.	.	.	7.	.	.	.	.	.	.	.	1.	.	.	.	2.	.	.	108.	
5.3- 5.4	.	5.	.	.	7.	.	.	.	.	.	.	.	1.	.	.	.	1.	.	.	81.	
5.4- 5.5	.	8.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	51.	
5.5- 5.6	.	10.	.	.	3.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	94.	
5.6- 5.7	.	15.	.	.	9.	.	.	.	.	.	.	.	1.	.	.	.	.	.	.	95.	
5.7- 5.8	.	7.	.	.	3.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	67.	
5.8- 5.9	.	8.	.	.	3.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	72.	
5.9- 6.0	.	16.	.	.	7.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	101.	
6.0- 6.1	.	13.	.	.	3.	.	.	.	.	.	.	.	4.	.	.	.	.	.	.	109.	
6.1- 6.2	.	16.	.	.	3.	.	.	.	.	.	.	.	6.	.	.	.	.	.	.	36.	
6.2- 6.3	.	30.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	24.	
6.3- 6.4	.	23.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10.	
6.4- 6.5	.	19.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5.	
6.5- 6.6	.	14.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.	
6.6- 6.7	.	14.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.	
6.7- 6.8	.	17.	.	.	.	.	.	.	.	.	.	.	1.	.	.	.	.	.	.	5.	
6.8- 6.9	.	10.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.	
6.9- 7.0	.	7.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.	
7.0- 7.1	.	10.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.	
7.1- 7.2	.	5.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.	
7.2- 7.3	.	2.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	
7.3- 7.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
7.4- 7.5	.	2.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	
7.5- 7.6	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	.	.	.	.	.	
7.6- 7.7	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
7.7- 7.8	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
7.8- 7.9	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
7.9- 8.0	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	
8.0- 8.1	.	1.	.	.	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	1.	
MEAN:	33.	59.	17.	33.	54.	12.	14.	28.	14.	57.	29.	13.	52.	19.	31.	13.	48.	13.	18.	38.	*0.1
STANDARD DEV:	.	.	.	31.	60.	24.	33.	.	14.	318.	31.	10.	141.	20.	36.	9.	38.	24.	35.	.	*0.01

Figure 6.1.3.1.

VECHICLE SPACING "Haagsche Schouw Bridge"								
Vehicle intervals	Number of measurements / measured period							
	3201-3293 10,74 hrs.		2301-3507 47,31 hrs.		1001-3507 66,04 hrs.		101-3507 81,79 hrs.	
M - M	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow
0 - 5				2		3	0	3
5 - 10	2	1	3	3	3	10	3	10
10 - 15	1	3	3	19	4	37	4	38
15 - 20	1	1	2	9	2	18	2	22
20 - 25	2	3	2	20	2	32	2	32
25 - 30		5	2	23	2	38	2	44
30 - 35		2	2	19	2	30	2	36
35 - 40		2	1	11	1	21	1	26
40 - 45		10	2	25	2	39	2	43
45 - 50		10		33		40	0	40
50 - 55	1	3	1	22	2	35	2	38
55 - 60		2	1	18	1	31	1	38
60 - 65		1	1	17	1	26	1	30
65 - 70		5		25		39	0	43
70 - 75		2		19	1	27	1	28
75 - 80		4	1	15	1	27	1	28
80 - 85	1	4	1	20	3	28	3	29
85 - 90		6	2	28	2	39	2	43
90 - 95		6	1	18	1	29	1	35
95 - 100		7	1	33	2	40	2	42
100 - 105	5		26		26	7	26	8
105 - 110		1		18		25	0	29
110 - 115		4		16		29	0	31
115 - 120		3		16		22	0	25
120 - 125		3	2	19	2	32	2	35
125 - 130		7	1	26	1	34	1	36
130 - 135		4		12		24		28
135 - 140		4	1	26	1	36	1	38
140 - 145	1	3	1	18	2	22	2	24
145 <	102	691	575	3444	755	5076	855	5822

Figure 6.1.3.2.

Lateral distribution of the "Haagsche Schouw Bridge"				
Track	m.p.	10.74 hrs.	47.31 hrs.	66.04hrs.
A-A'	15	4.45%	4.76	4.67
B-B'	13	0.89%	1.47	1.21
C-C'	16	59.96%	55.93	57.73
D-D'	14	13.17%	11.94	12.29
E-E'	17	8.90%	8.31	8.81
G-G'	20	2.31%	4.76	4.19
H-H'	18	9.08%	7.65	7.12
I-I'	21	1.25%	5.18	3.99

Figure 6.1.4.1.

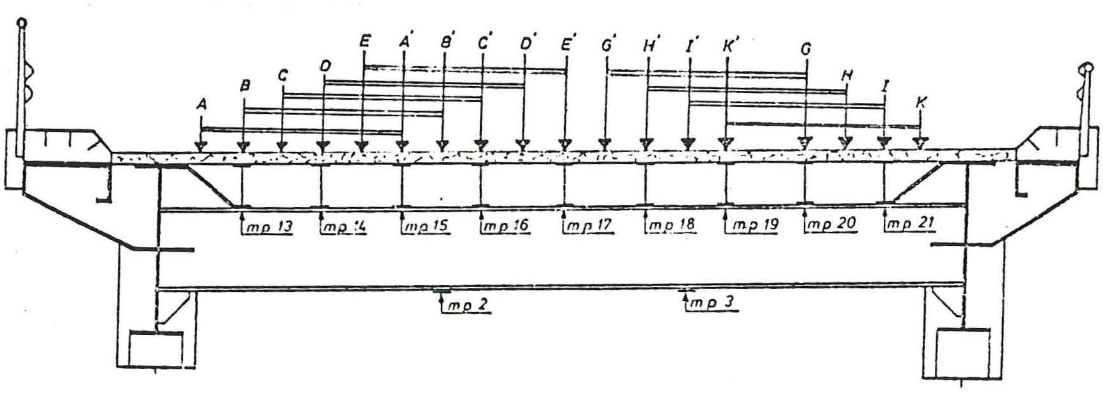


Figure 6.1.4.2.

6.1.3. Measured stresses during 66 hours

The results of level crossings and rainflow counts recorded during a period of 66 hours are given in figure 6.1.3.1. and 6.1.3.2. on pages 40 and 41.

Just as the axle loads the results are plotted in frequency curves. Figure 6.1.3.3. on page 41 shows the modified relative frequency curve of level crossings of the measuring points 2 and 3 on a crossgirder and figure 6.1.3.4. on page 42 the measuring points on the longitudinal stringers in one crosssection of the bridge.
The modified cumulative relative frequency curves of rainflow counts of mp 2 and 3 are given in figure 6.1.3.5. on page 42 and these curves of the measuring points on the longitudinal stringers in figure 6.1.3.6.

From figure 6.1.3.3. on page 41 and 6.1.3.5. on page 42 it appears there is a lot of difference between the stress pattern of mp 3 in the fast lane and mp 2 in the slow lane.

The same phenomena occur by the measuring points on the longitudinal stringers situated in one cross-section of the bridge.
In figure 6.1.3.4. on page 42 it is clearly seen that the stress distribution in measured cross-section differs markedly.
The stresses which are exerted in several points, especially where the traffic is not frequent, are not only smaller but also occur less than in the points where most of the heavy traffic runs.
Even in the slow lane there is much deviation.
So it is to be expected that a simulation can give a realistic result if the lateral distribution will be taken into account.

Another important effect associated with the lateral distribution is the number of axle loads it takes to reach the final stress distribution.
In general a slightly longer time is taken in the case of the axle-loads (c.f. 1).

M. POINT : LEVEL N/MM2	2	3	13	14	15	16	17	18	20	21
42.6- 41.0	.	.	.	1.	.	.	.	.	.	.
41.0- 39.4	3.	.	.	1.	.	1.	.	.	.	.
39.4- 37.8	5.	.	.	2.	.	1.	2.	.	.	.
37.8- 36.3	5.	.	.	2.	.	1.	2.	.	.	1.
36.3- 34.7	6.	.	.	2.	.	2.	3.	.	.	1.
34.7- 33.1	7.	.	.	5.	2.	10.	7.	.	.	1.
33.1- 31.5	11.	.	.	12.	6.	21.	12.	3.	.	1.
31.5- 30.0	11.	.	.	30.	15.	44.	18.	6.	.	1.
30.0- 28.4	14.	.	.	63.	21.	86.	26.	11.	.	1.
28.4- 26.8	23.	.	.	118.	38.	150.	33.	13.	2.	1.
26.8- 25.2	43.	.	1.	192.	65.	247.	43.	16.	4.	2.
25.2- 23.7	84.	4.	7.	280.	115.	390.	71.	22.	5.	5.
23.7- 22.1	138.	10.	15.	406.	175.	522.	95.	27.	13.	5.
22.1- 20.5	261.	19.	29.	533.	277.	682.	127.	38.	17.	5.
20.5- 18.9	434.	32.	63.	661.	404.	862.	178.	49.	28.	7.
18.9- 17.3	607.	50.	128.	787.	549.	1047.	254.	77.	32.	12.
17.3- 15.8	831.	82.	217.	982.	700.	1214.	357.	93.	40.	15.
15.8- 14.2	1062.	157.	330.	1169.	884.	1483.	506.	126.	41.	21.
14.2- 12.6	1389.	268.	457.	1453.	1085.	1873.	749.	189.	63.	33.
12.6- 11.0	1671.	496.	644.	1876.	1349.	2447.	1050.	287.	90.	55.
11.0- 9.5	2004.	867.	959.	2520.	1735.	3397.	1490.	442.	130.	91.
9.5- 7.9	2713.	1514.	1454.	3487.	2486.	4788.	2258.	763.	196.	137.
7.9- 6.3	4349.	2477.	2285.	4915.	4024.	6852.	3716.	1397.	334.	224.
6.3- 4.7	6914.	4523.	3512.	7011.	7409.	10084.	6784.	2919.	650.	324.
4.7- 3.2	10644.	9412.	5375.	11602.	13846.	16091.	13152.	7668.	2617.	458.
3.2- 1.6	16333.	18509.	11370.	27849.	33680.	39585.	29855.	25655.	17558.	2857.
1.6- .0	26249.	31937.	17816.	44885.	56355.	63498.	56008.	48515.	27725.	9045.
.0- -1.6	23390.	29100.	17489.	43758.	55720.	61782.	54426.	47252.	26868.	9006.
-1.6- -3.2	14802.	16150.	8938.	22188.	26769.	27660.	31997.	25072.	6779.	2725.
-3.2- -4.7	3394.	2951.	1740.	5842.	8606.	8558.	7938.	4514.	429.	53.
-4.7- -6.3	747.	683.	489.	1495.	2451.	2351.	2131.	777.	42.	14.
-6.3- -7.9	249.	80.	158.	474.	656.	590.	489.	138.	5.	2.
-7.9- -9.5	147.	7.	60.	113.	160.	139.	114.	19.	1.	1.
-9.5- -11.0	90.	1.	17.	16.	29.	27.	20.	1.	1.	1.
-11.0- -12.6	101.	1.	2.	2.	1.	12.	8.	1.	1.	1.
-12.6- -14.2	87.	1.	1.	1.	.	10.	6.	1.	1.	1.
-14.2- -15.8	64.	1.	1.	1.	.	10.	6.	1.	1.	1.
-15.8- -17.3	17.	1.	1.	1.	.	10.	6.	1.	1.	1.
-17.3- -18.9	3.	1.	1.	1.	.	10.	6.	1.	1.	1.
-18.9- -20.5	3.	1.	1.	1.	.	10.	6.	1.	1.	1.
-20.5- -22.1	4.	1.	1.	1.	.	10.	6.	1.	1.	1.
-22.1- -23.7	3.	1.	1.	1.	.	10.	6.	1.	1.	1.
-23.7- -25.2	1.	1.	1.	1.	.	10.	6.	1.	1.	1.
-25.2- -26.8	.	1.	1.	1.	.	10.	6.	1.	1.	1.
-26.8- -28.4	.	.	.	.	.	2.	.	.	.	.
-28.4- -30.0	.	.	.	.	.	.	.	.	.	.
-30.0- -31.5	.	.	.	.	.	.	.	.	.	.
-31.5- -33.1	.	.	.	.	.	.	.	.	.	.
-33.1- -34.7	.	.	.	.	.	.	.	.	.	.
-34.7- -36.3	.	.		.	.	.	.	.	.	.
-36.3- -37.8	.	.		.	.	.	.	.	.	.
-37.8- -39.4	.	.		.	.	.	.	.	.	.
-39.4- -41.0	.	.		.	.	.	.	.	.	.
-41.0- -42.6	.	.		.	.	.	.	.	.	
-42.6- -44.2	.	.								
-44.2- -45.7	.	.								
-45.7- -47.3	.	.								
-47.3- -48.9	.	.								
-48.9- -50.5	.	.								
-50.5- -52.0	.	.								
-52.0- -53.6	.	.								
-53.6- -55.2	.	.		.	.	.	.	.	.	
-55.2- -56.8	.	.	.	.	.	.	.	.	.	.

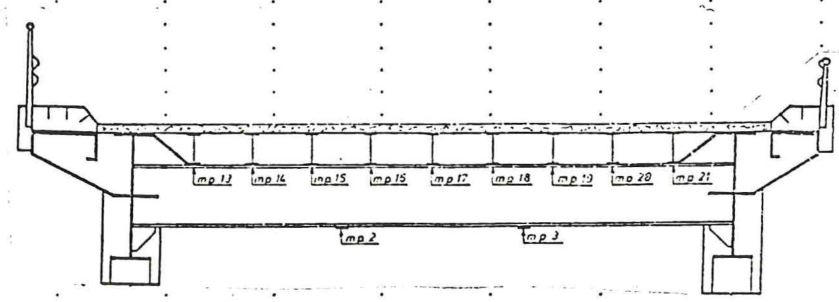


Figure 6.1.3 1.

M. POINT: RANGE N/MM2		2	3	13	14	15	16	17	18	20	21
0-	2.0	25609.	27762.	15437.	39864.	50415.	58068.	46409.	41730.	29401.	12835.
2.0-	4.0	20653.	21573.	11656.	27575.	31640.	34420.	34278.	31596.	19559.	4987.
4.0-	6.0	11958.	13051.	5240.	14333.	18562.	19141.	19510.	16669.	5617.	597.
6.0-	8.0	3274.	3371.	2005.	4933.	6418.	7038.	6689.	4189.	727.	159.
.8.0-	10.0	2339.	2123.	1764.	3765.	5625.	6495.	5268.	2567.	320.	160.
10.0-	12.0	701.	525.	666.	1445.	1943.	2404.	1712.	668.	87.	63.
12.0-	14.0	473.	356.	591.	1414.	1531.	2168.	1315.	416.	85.	66.
14.0-	16.0	148.	126.	267.	561.	513.	844.	430.	152.	32.	24.
16.0-	18.0	150.	127.	314.	599.	433.	776.	345.	80.	26.	15.
18.0-	20.0	128.	47.	135.	288.	194.	338.	143.	42.	12.	8.
20.0-	22.0	164.	37.	171.	346.	214.	388.	155.	45.	12.	9.
22.0-	24.0	78.	14.	78.	174.	132.	244.	54.	20.	11.	2.
24.0-	26.0	103.	16.	77.	198.	151.	235.	78.	22.	8.	2.
26.0-	28.0	38.	3.	28.	128.	86.	145.	31.	9.	5.	4.
28.0-	30.0	37.	6.	16.	170.	92.	167.	33.	12.	11.	5.
30.0-	32.0	6.	1.	7.	105.	47.	103.	14.	5.	4.	.
32.0-	34.0	9.	.	1.	100.	49.	110.	20.	7.	.	.
34.0-	36.0	4.	.	.	51.	13.	50.	9.	4.	.	.
36.0-	38.0	1.	.	1.	55.	11.	48.	7.	5.	.	1.
38.0-	40.0	.	.	1.	8.	9.	20.	4.	2.	.	1.
40.0-	42.0	1.	.	.	10.	5.	10.	7.	.	.	.
42.0-	44.0	2.	.	.	3.	2.	3.	2.	.	.	.
44.0-	46.0	.	1.	.	.	.	.	3.	.	.	.
46.0-	48.0	1.	.	.	1.	.	.	1.	.	.	.
48.0-	50.0	.	.	.	.	.	2.	.	.	.	.
50.0-	52.0	.	.	.	1.	.	1.	.	.	.	.
52.0-	54.0	.	.	.	1.	.	1.	.	.	.	.
54.0-	56.0	.	.	.	.	.	.	.	.	.	.
56.0-	58.0	.	.	.	.	.	.	.	.	.	.
58.0-	60.0	12.	6.	2.	6.	2.	13.	12.	8.	.	3.

Figure 6.1.3.2.

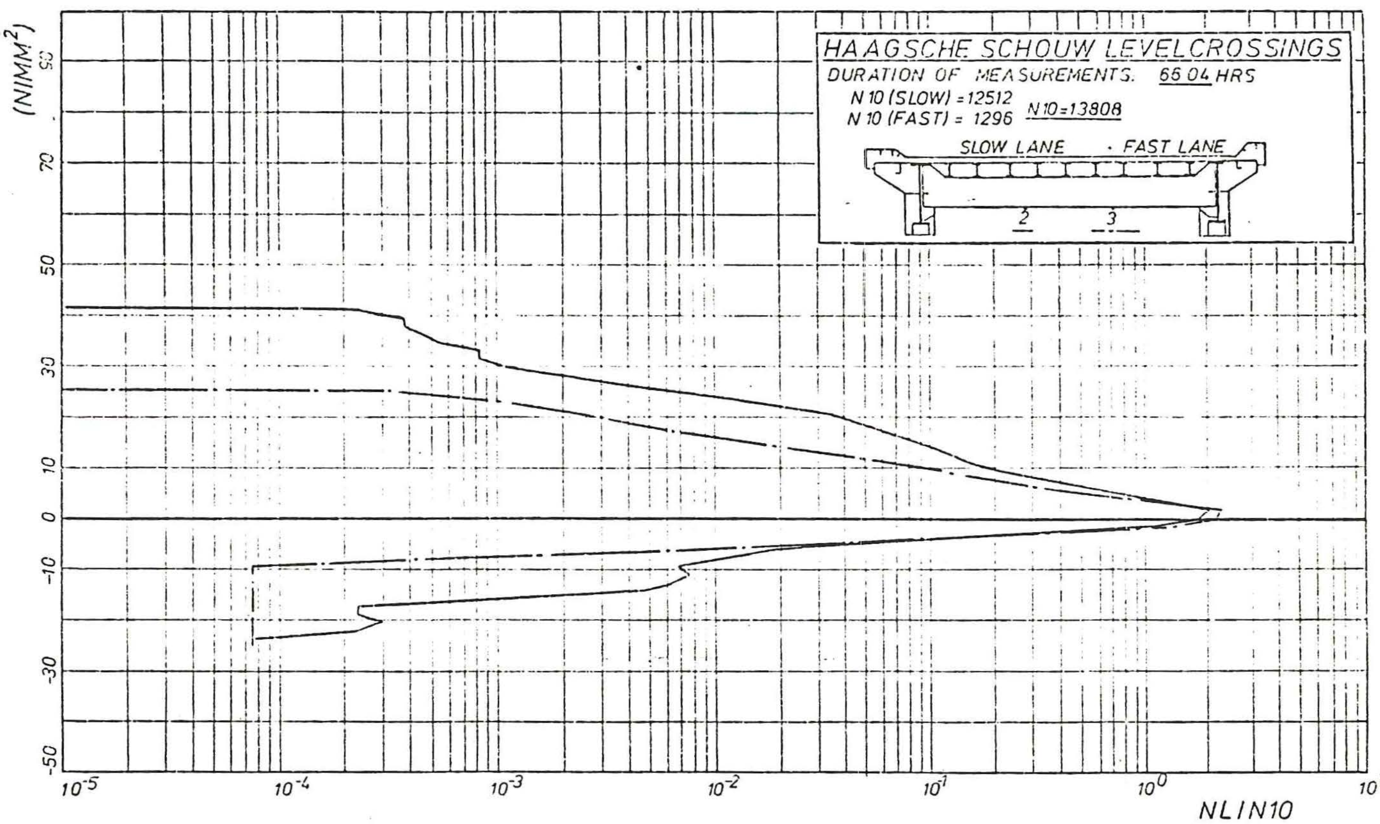


Figure 6.1.3.3.

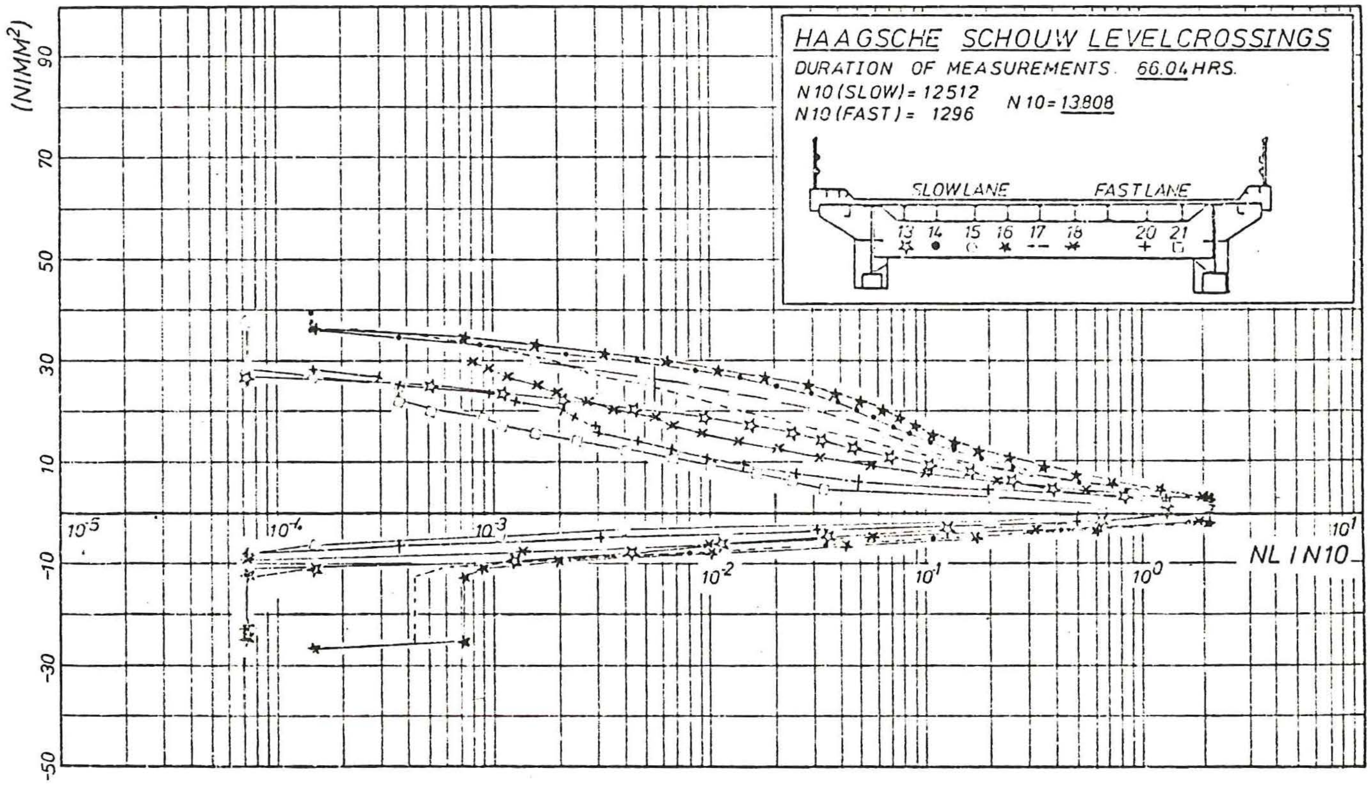


Figure 6.1.3.4.

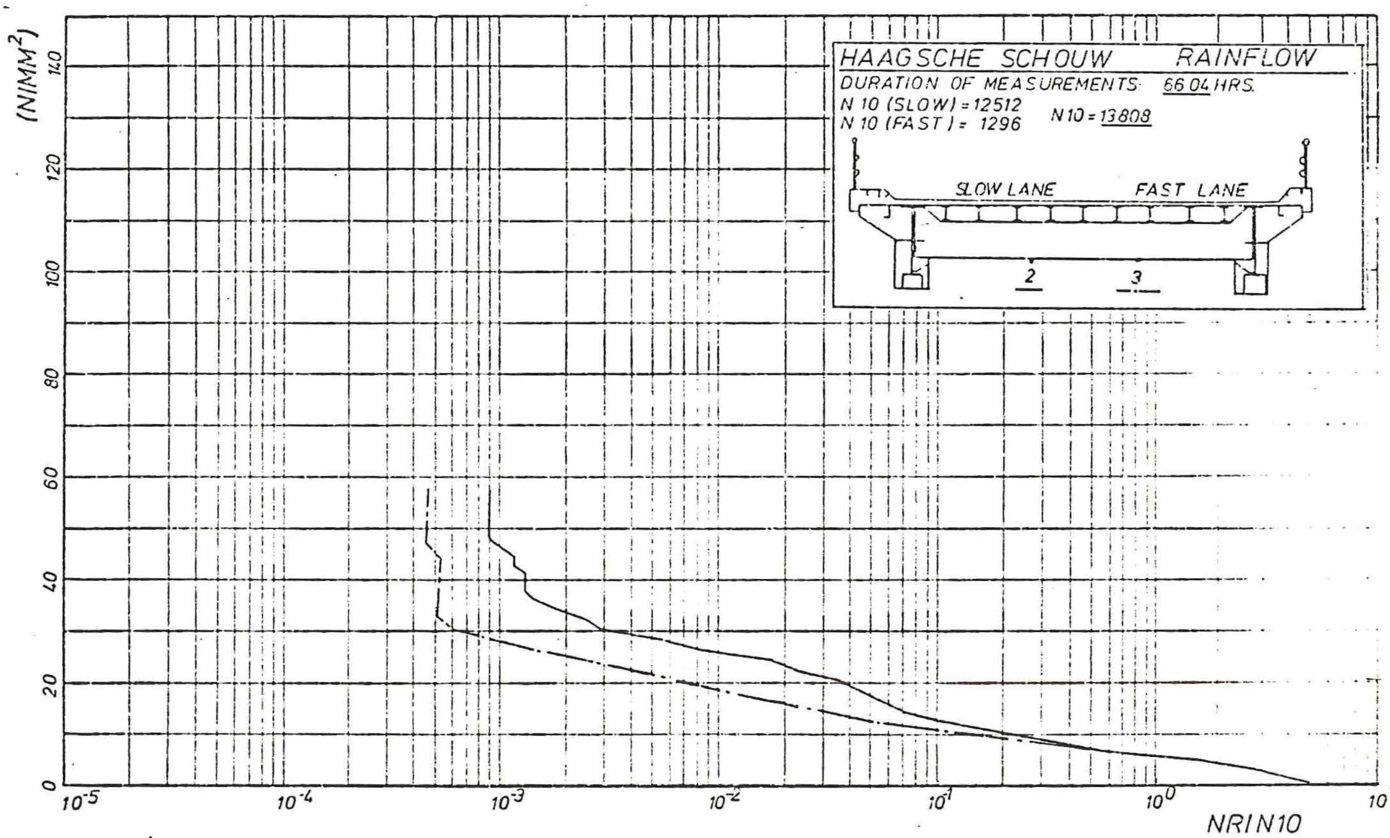


Figure 6.1.3.5.

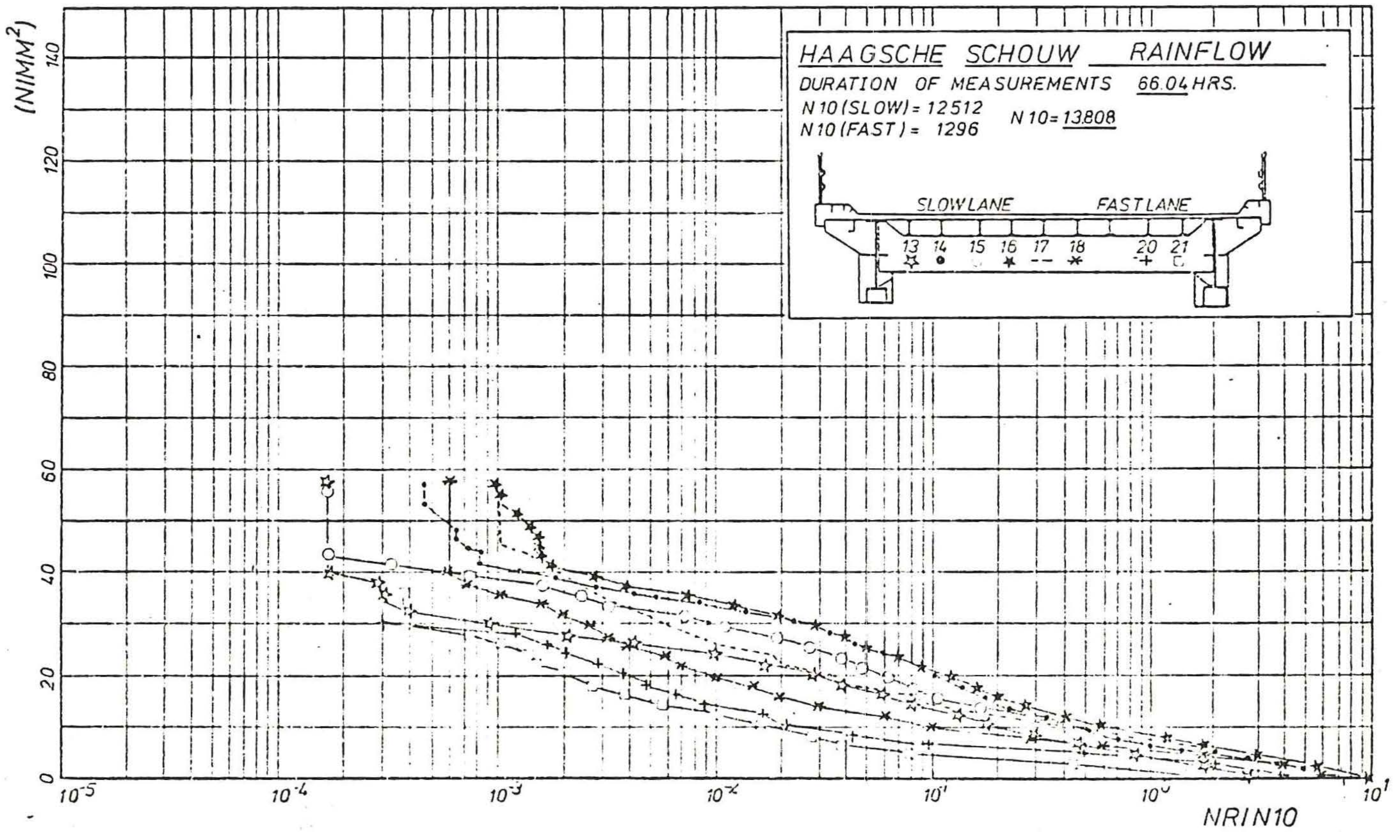

HAAGSCHE SCHOUW RAINFLOW
DURATION OF MEASUREMENTS 66.04 HRS.
N 10 (SLOW) = 12512
N 10 (FAST) = 1296
N 10 = 13808
SLOW LANE
FAST LANE
13 14 15 16 17 18 20 21
(N/MM²)
140
120
100
80
60
40
20
0
10⁻⁵
10⁻⁴
10⁻³
10⁻²
10⁻¹
10⁰
10¹
NR/N10

Figure 6.1.3.6.

6.1.4. Comparison between the computed and measured level crossings and rainflow counts during a period of 4.25 hours

The axle loads counted in the period of 4.25 hours and the influence lines associated with a measuring point are put together to calculate the theoretical level crossings and rainflow counts.

The cumulative relative distribution curves of the measured axle loads in the fast lane as well as the slow lane are given in figure 6.1.4.1.

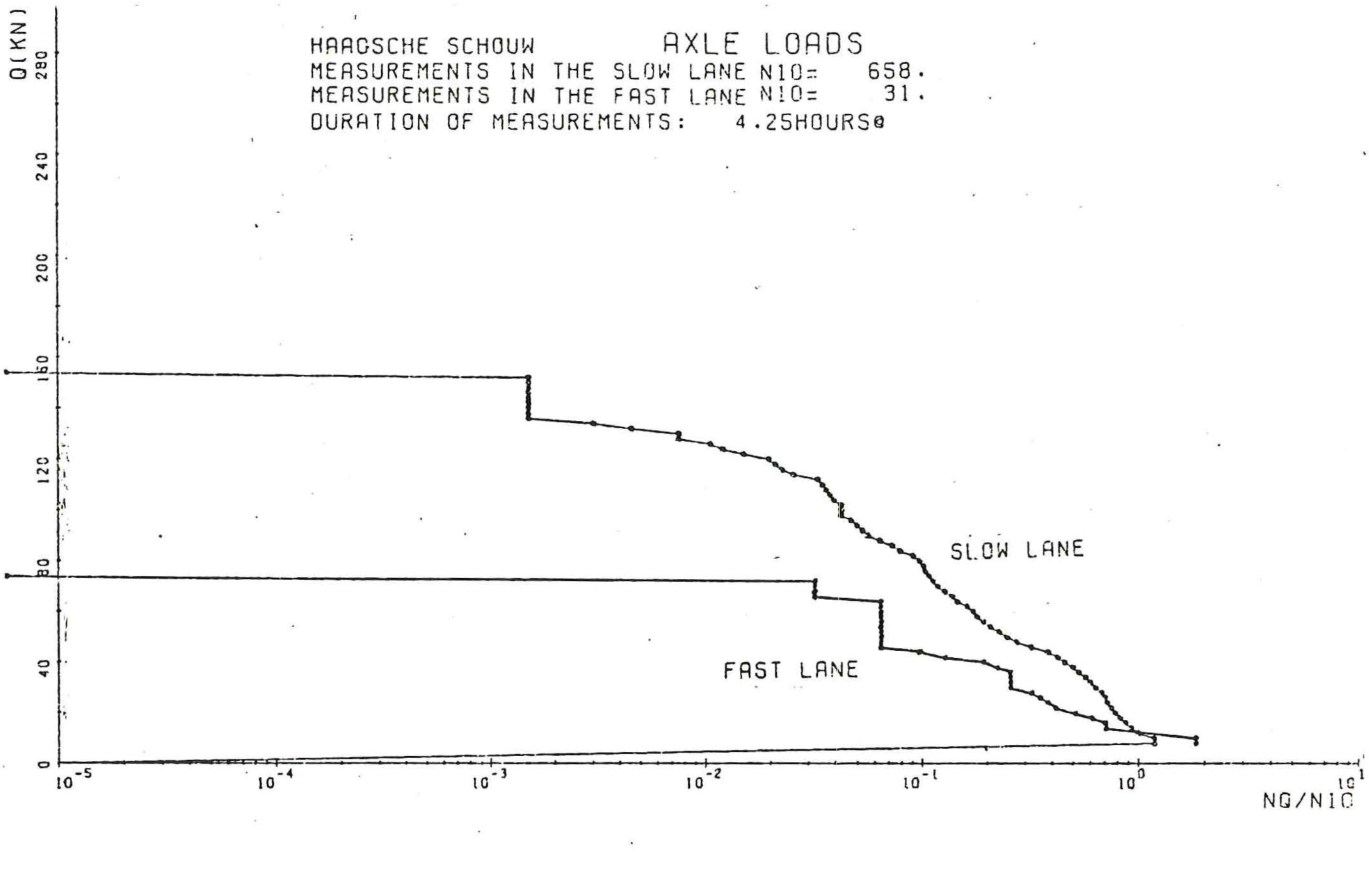


Figure 6.1.4.1.

The results of level crossings and rainflow counts measured during 4.25 hours are given in figure 6.1.4.2. and 6.1.4.4. on pages 46 and 47.
The theoretical level crossings and rainflow counts for this period are given in figure 6.1.4.6. and 6.1.4.7. on pages 46 and 47.

Both measured and calculated values are plotted in modified cumulative relative distribution curves per measuring point see for example mp 14.
As was already pointed out in section 4.1.1.2. the dynamical effects may be important.
So it does not come as a surprise that emperical values do not coincide with this statical calculation.

6.2. Results of measurements on the "Rheden Bridge"

Due to the road works the results of this bridge had to be split up into three main periods.

- Group A : Traffic in both fast lane and slow lane
  - Axle loads: 61,73 hrs. F.l. 7964 S.l. 38141
  - Straingauges: 1-10 : 44,91 hrs
    1,2 11-18 : 8,86 hrs
    1-6 11-14 : 7.96 hrs

- Group B : Traffic in the slow lane only
  - Axle loads: 22,81 hrs. S.l. 21873
  - Straingauges: 1-6, 11-14 : 19,96 hrs
    1-10 : 2,85 hrs

- Group C : Traffic in the fast lane only
  - Axle loads: 13,27 hrs : F.l. 11674
  - Straingauges: 1-10 : 10,17 hrs
    1,2,7-10,15-18: 3,10 hrs

All data corresponding to these periods have been analysed, but not all of them are reported here.
In the total measured period of 97.81 hours 79.860 axle loads greater than or equal to 10 kN have been analysed.

6.2.1. Measured traffic during 61,73 hours (Group A)

6.2.1.1. The cumulative relative frequency curves of the axle loads

Figure 6.2.1.1.1. shows the results of the measured axle loads in the slow lane and the fast lane during 61.73 hours.

In this period 38.141 axle loads > 10 kN in the slow lane and 7964 axle loads > 10 kN in the fast lane have been registered.
From this figure it is clear that there is a lot of difference between the traffic distribution in the slow lane and the fast lane.
But it appears that the maximum load in both lanes is the same.

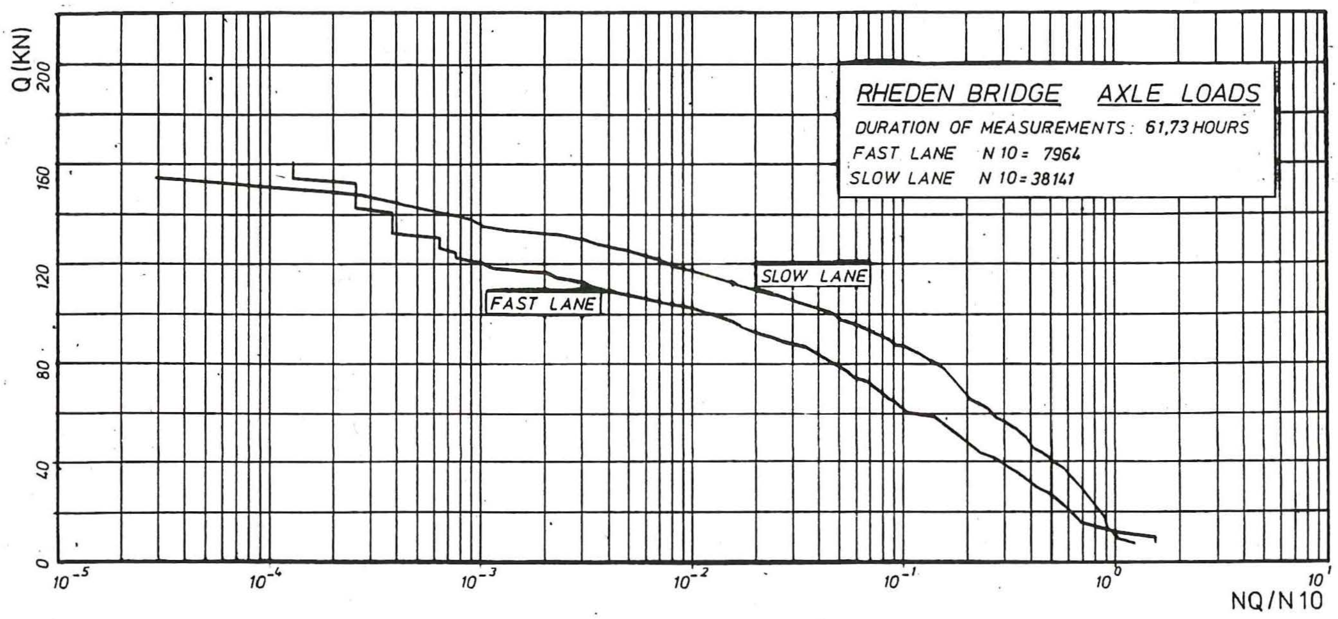


Figure 6.2.1.1.1.

This period of 61.73 hours is subdivided into 18 shorter periods to investigate the difference between the results of the slow lane and fast lane.
See figure 6.2.1.1.2. - 6.2.1.1.4. on page 51 and 52.
It seems that about 3500 axle loads > 10 kN are enough to record the cumulative relative frequency curves of the axle loads in the slow lane.

For the fast lane on the other hand it shows that this curve calculated after measuring 5800 axle loads > 10 kN in 44,91 hrs - is hardly enough to extend this graph for a longer period.

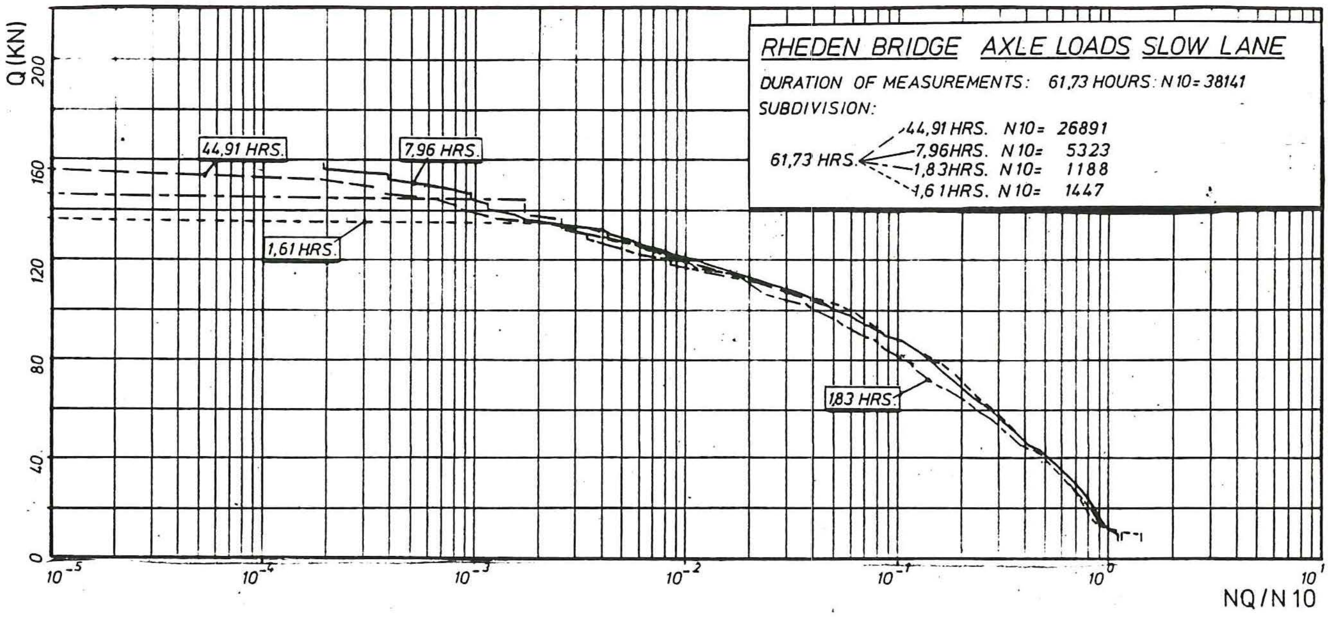


Figure 6.2.1.1.2.

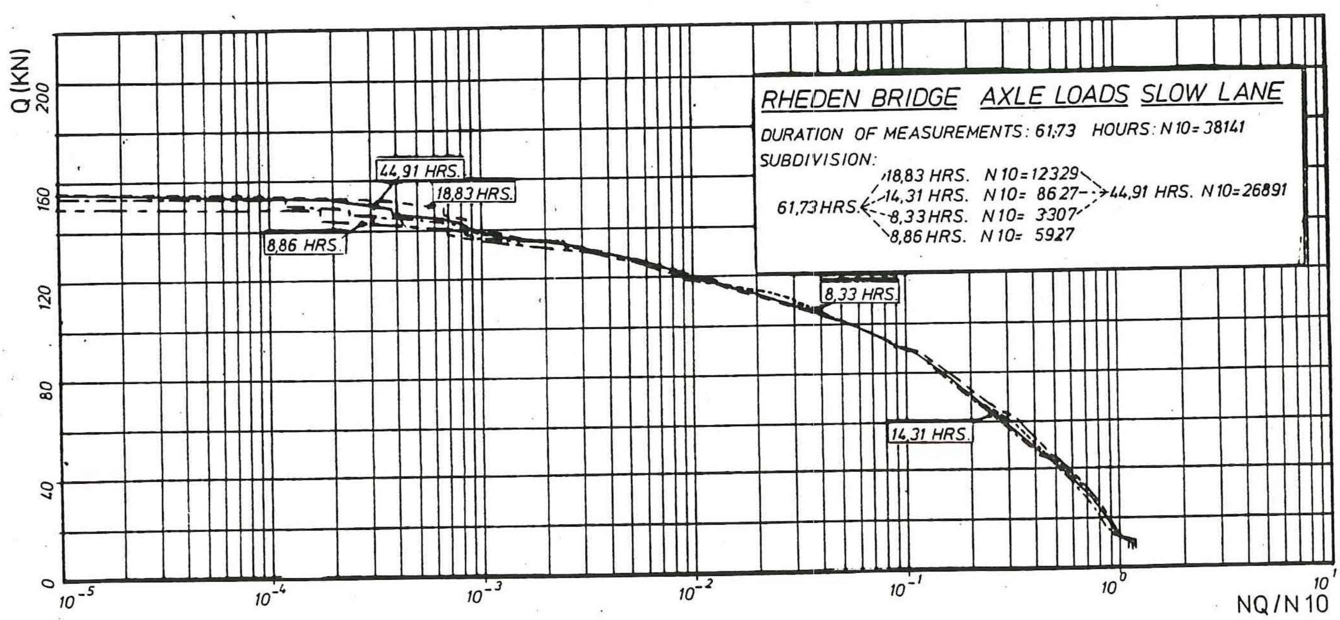


Figure 6.2.1.1.3.

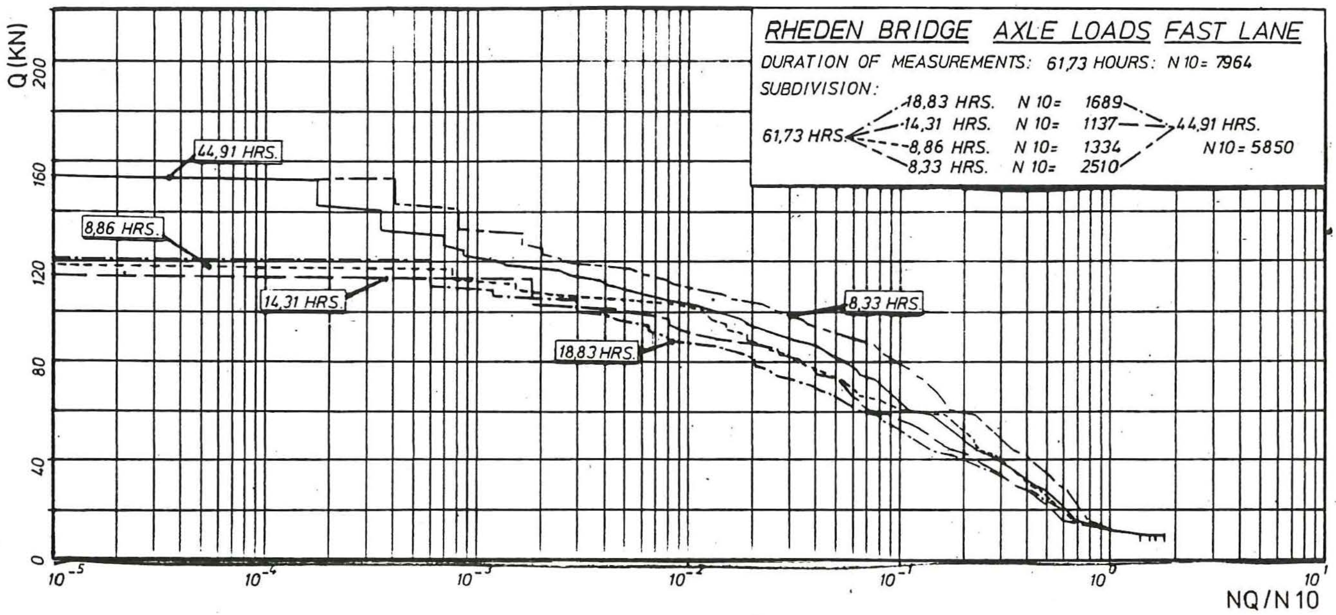


Figure 6.2.1.1.4.

6.2.1.2. Frequency distribution of axle loads and axle distances

6.2.1.2.1. Relation between load and type of vehicle

Anologous to the Haagsche Schouw Bridge it appears from the frequency distribution of axle loads that the axle loads of the dual lorries go up with the size of the axle distance.
This can been seen from the table of figure 6.2.1.2.1.1. on page 54 but also from figure 6.2.1.2.1.2. on page 55 .
The latter shows, the mean, the maximum and the minimum values of the axle loads per type as obtained from the frequency distribution tables.

From the table in figure 6.2.1.2.1.1. it is clear that the distributions in general are not symmetrical.
On one hand this may be due to the small amounts of data.
On the other hand there is a lower limit to the measuring device which prevents small values to occur.

6.2.1.2.2. Distribution of the vehicle types over the traffic

This distribution is given in figure 6.2.1.2.2.1. on page 56.
One reads that 26% of all traffic has axle loads > 8 kN; and that 56,85% of this percentage are dual lorries.

6.2.1.2.3. Mean values of axle loads and axle distances per type

This values are gathered in figure 6.2.1.2.3.1. on page 57.

6.2.1.3. Vehicle intervals

The measured values are gathered in figure 6.2.1.3.1. on page 58 .

6.2.1.4. Lateral distribution after various periods

The measured values are gathered in figure 6.2.1.4.1. on page 59 .
It can be read that 55% of the traffic runs in the same track see figure 6.2.1.4.2.

ISTOGRAMS OF AXLE-LOADS OF TYPES 13,16-20 AND 1-AXLES OF THE FOLLOWING MEASUREMENTS IN THE SLOW LANE

ODENUMBER: 6012 NUMBER: 7215 DATE: 8118

XLE CODE: XLELOAD KN-	KN	130	131	132	133	134	135	136	160	161	162	170	171	172	180	181	182	190	191	192	200	201	202	1-AX	SUM
0-	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2-	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4-	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6-	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
8-	10	.	.	3.	2.	4.	3.	3.	285.	375.	489.	370.	475.	609.	24.	67.	90.	8.	20.	34.	7.	13.	13.	2434.	4994.
10-	12	1.	.	4.	.	4.	1.	.	338.	251.	176.	449.	369.	768.	119.	136.	103.	38.	63.	51.	12.	8.	11.	771.	2542.
12-	14	.	1.	2.	1.	8.	.	.	97.	88.	65.	157.	138.	102.	132.	153.	91.	78.	94.	58.	6.	9.	10.	172.	1365.
14-	16	.	.	2.	1.	16.	9.	1.	26.	39.	18.	54.	69.	46.	102.	101.	75.	83.	127.	83.	8.	18.	8.	44.	1091.
16-	18	.	.	2.	1.	17.	7.	3.	12.	12.	11.	23.	29.	26.	69.	71.	55.	98.	149.	82.	11.	24.	18.	12.	1048.
18-	20	1.	.	4.	2.	17.	12.	10.	3.	7.	4.	25.	10.	16.	46.	36.	55.	98.	116.	97.	24.	41.	30.	5.	1033.
20-	22	5.	.	2.	6.	6.	17.	18.	1.	3.	3.	11.	10.	15.	45.	21.	41.	113.	94.	117.	35.	74.	39.	3.	1104.
22-	24	12.	.	9.	5.	3.	15.	10.	1.	4.	2.	10.	8.	9.	32.	21.	38.	107.	118.	82.	47.	99.	49.	4.	1178.
24-	26	16.	.	7.	6.	3.	8.	13.	2.	1.	2.	5.	10.	10.	26.	19.	33.	98.	121.	91.	82.	132.	68.	6.	1216.
26-	28	16.	.	13.	16.	3.	3.	3.	4.	1.	2.	9.	14.	7.	23.	21.	24.	116.	121.	84.	94.	124.	78.	7.	1246.
28-	30	9.	.	7.	9.	2.	1.	5.	1.	.	3.	11.	22.	9.	20.	21.	17.	100.	94.	72.	117.	123.	90.	2.	1229.
30-	32	7.	2.	8.	12.	.	1.	3.	.	.	3.	9.	15.	9.	22.	18.	21.	72.	102.	88.	109.	124.	92.	2.	1254.
32-	34	4.	2.	6.	5.	1.	1.	2.	1.	1.	1.	10.	15.	7.	17.	23.	15.	83.	72.	68.	118.	125.	122.	4.	1226.
34-	36	5.	3.	4.	3.	1.	2.	1.	9.	1.	1.	18.	3.	6.	17.	22.	11.	85.	75.	57.	126.	119.	83.	10.	1185.
36-	38	1.	7.	3.	2.	3.	.	2.	1.	1.	.	8.	10.	8.	12.	22.	14.	79.	72.	60.	123.	127.	87.	2.	1160.
38-	40	2.	9.	1.	1.	1.	1.	1.	.	1.	1.	12.	8.	9.	19.	27.	17.	67.	70.	58.	111.	125.	92.	6.	1135.
40-	42	.	13.	.	3.	3.	.	4.	2.	1.	.	4.	3.	8.	16.	29.	9.	49.	68.	43.	100.	104.	91.	1.	1095.
42-	44	1.	22.	4.	2.	2.	2.	.	2.	1.	2.	6.	4.	11.	23.	38.	23.	44.	95.	91.	108.	163.	133.	6.	1882.
44-	46	.	7.	1.	3.	1.	4.	.	.	.	.	2.	.	4.	15.	13.	12.	31.	34.	29.	66.	74.	43.	.	808.
46-	48	3.	13.	1.	2.	.	2.	1.	.	.	.	1.	2.	7.	7.	11.	7.	27.	33.	34.	79.	71.	62.	1.	846.
48-	50	.	13.	2.	1.	1.	.	2.	2.	1.	.	3.	1.	1.	7.	3.	9.	26.	35.	26.	68.	57.	49.	1.	829.
50-	52	1.	9.	2.	.	.	1.	2.	3.	.	.	.	.	2.	11.	1.	11.	36.	28.	19.	68.	38.	54.	.	776.
52-	54	2.	6.	2.	3.	.	.	1.	.	3.	.	2.	.	1.	4.	4.	9.	25.	16.	22.	61.	34.	47.	3.	726.
54-	56	1.	9.	3.	1.	1.	2.	.	1.	.	.	.	.	2:	5.	.	1.	30.	15.	19.	44.	28.	53.	.	685.
56-	58	.	7.	.	3.	1.	1.	2.	.	3.	.	1.	.	.	6.	2.	3.	17.	15.	22.	38.	35.	40.	1.	688.
58-	60	.	8.	4.	2.	1.	1.	1.	.	1.	.	2.	.	2.	10.	1.	6.	25.	15.	21.	40.	17.	41.	.	732.
60-	62	3.	3.	4.	2.	3.	1.	.	.	5.	5.	6.	2.	1.	6.	1.	5.	26.	4.	12.	42.	18.	38.	20.	814.
62-	64	7.	6.	2.	6.	1.	3.	1.	3.	2.	2.	3.	.	.	6.	3.	6.	19.	3.	29.	36.	9.	37.	3.	624.
64-	66	3.	3.	1.	3.	2.	1.	2.	1.	1.	.	2.	.	.	6.	2.	4.	25.	5.	9.	33.	9.	31.	4.	582.
66-	68	1.	4.	3.	3.	1.	2.	1.	1.	.	1.	.	.	3.	2.	.	3.	15.	2.	14.	17.	7.	32.	1.	507.
68-	70	5.	4.	3.	.	5.	4.	1.	1.	1.	3.	3.	.	.	4.	1.	2.	12.	1.	14.	16.	3.	24.	26.	482.
70-	72	5.	2.	2	.	3.	7.	2.	1.	.	2.	.	.	2.	10.	.	5.	10.	.	15.	21.	1.	30.	.	421.
72-	74	4.	.	3.	3.	3.	2.	1.	1.	.	.	.	.	1.	3.	.	2.	19.	1.	11.	19.	1.	18.	2.	408.
74-	76	4.	1.	2.	4.	2.	2.	4.	.	3.	2.	.	.	.	9.	.	7.	22.	.	13.	14.	3.	20.	.	394.
76-	78	2.	.	3.	5.	5.	3.	2.	2.	.	.	.	.	2.	5.	.	3.	8.	.	13.	11.	.	19.	.	421.
78-	80	7.	.	3.	1.	2.	1.	1.	1.	.	1.	.	.	2.	1.	.	8.	8.	.	15.	10.	.	23.	.	379.
80-	82	3.	.	3.	2.	4.	3.	.	.	.	.	.	.	.	3.	.	4.	13.	1.	11.	7.	.	17.	.	354.
82-	84	3.	.	3.	3.	1.	1.	3.	.	.	.	1.	.	1.	3.	.	5.	11.	.	15.	6.	.	20.	.	331.
84-	86	5.	.	3.	3.	.	2.	2.	.	.	.	.	.	3.	.	.	3.	15.	.	11.	5.	.	19.	.	340.
86-	88	3.	.	4.	5.	4.	10.	6.	.	.	1.	.	.	2.	.	.	4.	7.	.	19.	5.	2.	26.	.	619.
88-	90	3.	.	3.	5.	3.	.	3.	1.	.	.	.	.	3.	1.	.	.	9.	.	14.	4.	.	17.	.	294.
90-	92	5.	.	3.	7.	3.	3.	3.	.	.	.	.	.	.	.	.	3.	8.	.	11.	5.	.	7.	1.	333.
92-	94	2.	.	3.	6.	4.	2.	6.	.	.	.	.	.	.	.	.	3.	8.	.	4.	4.	.	8.	.	290.
94-	96	1.	.	1.	2.	4.	1.	2.	.	.	2.	.	1.	.	.	.	2.	5.	1.	17.	.	.	10.	.	285.
96-	98	1.	.	2.	1.	.	2.	2.	.	.	.	.	.	1.	.	.	6.	2.	.	12.	.	.	8.	.	262.
98-	100	.	.	3.	1.	2.	2.	3.	.	1.	.	.	.	1.	.	.	6.	4.	.	9.	1.	.	5.	.	251.
100-	102	.	.	2.	2.	3.	.	2.	1.	.	2.	1.	.	.	.	.	3.	.	.	10.	.	.	8.	.	233.
102-	104	.	.	1.	.	1.	3.	3.	.	.	.	.	.	.	.	.	4.	1.	.	7.	.	.	5.	.	210.
104-	106	1.	.	.	2.	.	2.	3.	.	.	.	.	.	1.	.	.	1.	.	.	7.	1.	.	6.	.	183.
106-	108	.	.	.	1.	2.	.	4.	.	1.	.	.	.	.	.	.	2.	.	.	7.	.	.	3.	.	166.
108-	110	.	.	1.	.	2.	2.	4.	.	.	.	.	.	.	.	.	1.	.	.	6.	.	.	3.	.	129.
110-	112	.	.	.	.	1.	1.	2.	.	.	.	.	.	.	.	.	1.	.	.	7.	.	.	4.	.	145.
112-	114	.	.	.	1.	.	.	2.	.	.	.	.	.	.	.	.	.	.	.	4.	.	.	2.	.	91.
114-	116	.	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	2.	.	.	8.	.	.	3.	.	93.
116-	118	.	.	.	.	.	1.	1.	.	.	.	.	.	.	.	.	1.	.	.	6.	.	.	3.	.	67.
118-	120	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	6.	.	.	2.	.	57.
120-	122	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	1.	.	.	2.	.	46.
122-	124	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	.	.	.	2.	.	.	2.	.	43.
124-	126	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6.	.	.	1.	.	38.
126-	128	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5.	.	.	1.	.	37.
128-	130	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.	.	.	.	.	24.
130-	132	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10.	.	.	.	.	29.
132-	134	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6.	.	.	1.	.	33.
134-	136	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.	.	.	.	.	8.
136-	138	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.	.	.	.	.	6.
138-	140	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	.	.	4.
140-	142	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6.
142-	144	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	7.
144-	146	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.
146-	148	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5.
148-	150	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.
150-	152	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	.	.	4.
152-	154	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.
154-	156	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
156-	158	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	1.
158-	160	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.	.	.
SUM:		$$							804			1218			888			1860		1959				3554	16516/ 43131
MEAN		51.	51.	51.	53	48.	50.	56.	14.	13	13	15	14.	15.	36.	22.	29.	36.	30.	42.	43.	37.	48.	12.	39.
ST DEV		257	115	265	276.	336	323	345	96	47.	110	98.	74	128	171.	123.	234.	194.	36.	156.	.	.	.	.	. *0.1

Figure 6.2.1.2.1.1.

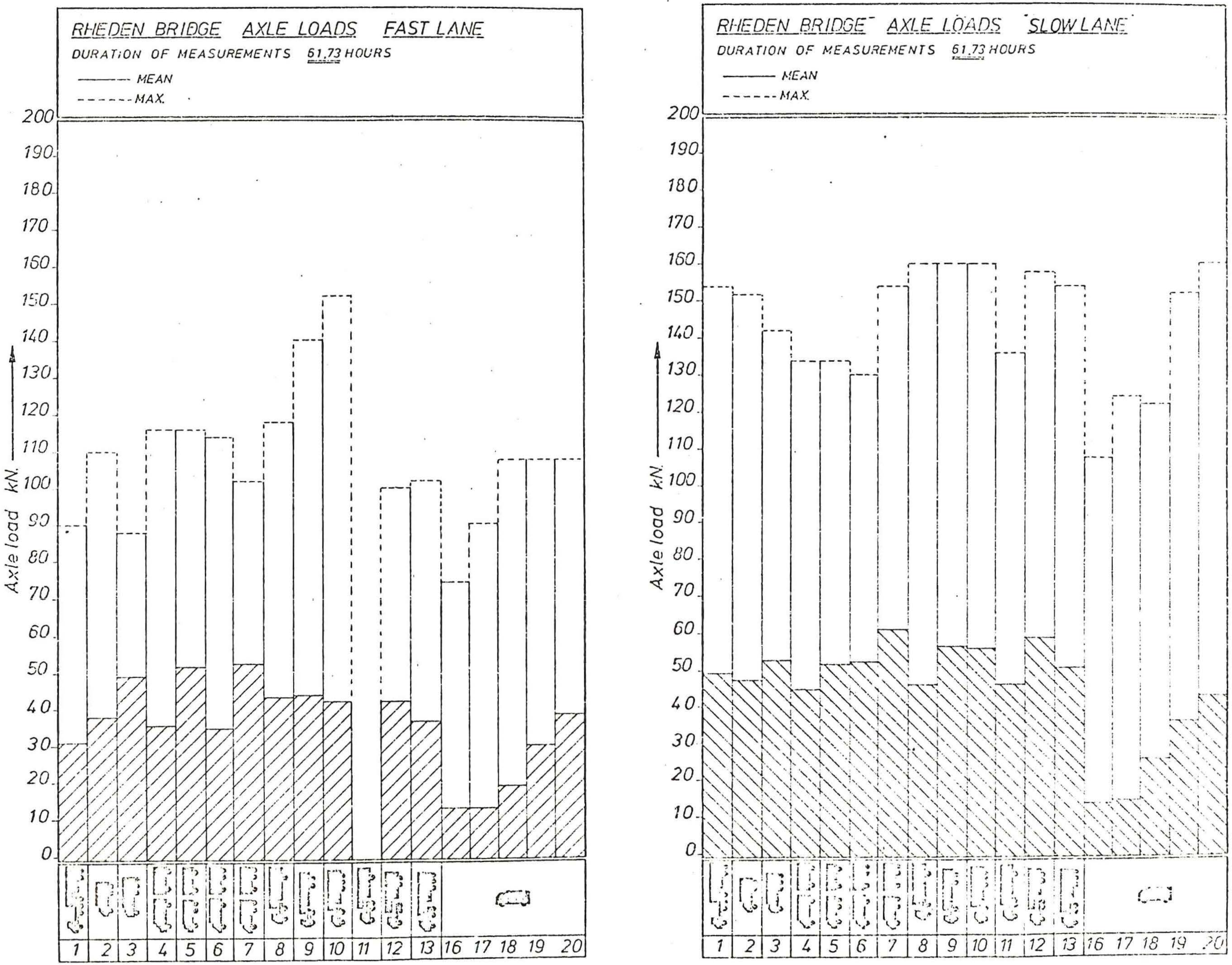


Figure 6.2.1.2.1.2.

COUNTED VEHICLES TYPES 1 - 20 ("Rheden Bridge")							
Vehicle types	Measurement 61,73 . hours						
	Fast lane		Slow lane		Sum		
	number	%	number	%	number	%	
.1.	58	1,62	318	2,45	376	2,27	
.2.	116	3,24	790	6,09	906	5,48	
.3.	4	0,11	19	0,15	23	0,14	
.4.	135	3,77	984	7,59	1119	6,76	
.5.	24	0,67	187	1,44	211	1,28	
.6.	63	1,76	494	3,81	557	3,37	
.7.	16	0,45	141	1,09	157	0,95	
.8.	71	1,98	526	4,06	597	3,61	
.9.	249	6,95	1528	11,79	1777	10,74	
.10.	158	4,41	892	6,88	1050	6,35	
.11.			27	0,21	27	0,16	
.12.	18	0,5	152	1,17	170	1,03	
.13.	16	0,45	155	1,2	171	1,03	
.16. Y<2.6	713	19,91	804	6,2	1517	9,17	
.17. 2.6≤Y<3.1	851	23,76	1218	9,4	2069	12,51	
.18. 3.1<Y≤3.6	286	7,98	888	6,85	1174	7,1	56,85%
.19. 3.6<Y≤4.6	388	10,83	1880	14,5	2268	13,71	
.20. 4.6<Y	416	11,61	1959	15,11	2375	14,36	

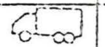
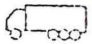
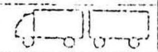
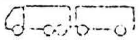
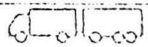
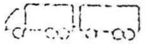
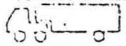
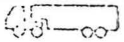
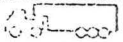
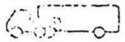
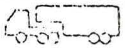
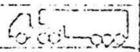
COUNTED VEHICLES TYPES 1 - 21 ("Rheden Bridge")							
.21. 1-AXLES	3059	46,06	3554	21,52	6613	28,56	
.1 t/m 20.	3582	53,94	12962	78,48	16544	71,44	
1 t/m 21	6641		16516		23157		26 %

Total numbers of cars measured in 61,73 hours : 89.126

Figure 6.2.1.2.2.1.

RHEDEN BRIDGE

AXLE LOADS AND AXLE DISTANCES PER TYPE DURING MEASUREMENTS OF 62 HOURS

Types	slow lane													fast lane											
	Counted vehicles	Mean axle load per axle kN						Mean axle distance per axle M					Counted vehicles	Mean axle load per axle kN						Mean axle distance per axle M				
		A1	A2	A3	A4	A5	A6	A1	A2	A3	A4	A5		A1	A2	A3	A4	A5	A6	A1	A2	A3	A4	A5
	790	43	48	49				3.7	1.3				116	36	46	34				3.4	1.1			
	19	48	56	57	58			4.0	1.0	0.8			4	51	41	54	46			3.9	0.8	1.2		
	984	43	57	40	38			4.8	5.3	4.7			135	37	50	30	28			4.8	5.1	4.7		
	187	54	66	52	61	60		4.5	1.3	4.8	4.9		24	48	63	47	53	47		4.4	1.3	4.7	4.7	
	494	51	71	50	43	44		4.9	4.7	4.4	1.3		63	40	50	31	27	26		4.6	4.6	4.3	1.3	
	141	59	80	51	69	56	49	4.3	1.2	4.2	4.1	1.4	16	49	69	50	57	53	42	4.2	1.2	4.2	3.9	1.3
	526	38	50	51				3.2	6.0				71	35	48	45				3.2	6.1			
	1528	48	68	53	59			3.4	6.0	1.8			249	40	53	38	41			3.3	5.8	1.8		
	892	51	76	50	50	53		3.5	5.3	1.3	1.4		158	43	60	34	36	36		3.4	5.1	1.3	1.3	
	27	46	43	41	52			2.9	1.2	6.1														
	152	50	55	55	65	71		3.0	1.3	5.4	1.9		18	42	37	39	42	47		2.8	1.2	5.3	1.9	
	155	51	51	53	48	50	56	2.9	1.3	4.0	1.3	1.4	16	44	37	40	32	32	44	2.8	1.5	4.0	1.1	1.5
	6749	13 → 48						3.9					2654	12 → 45						3.3				

Sum type 1 : 376

Sum type21 : 6613

Total numbers of lorries : 16.544

Figure 6.2.1.2.3.1.

VECHICLE SPACING "Rheden Bridge"				
Vehicle Intervals	Fast Lane		Slow Lane	
M - M	number	%	number	%
0 - 5	12	0,37	19	0,17
5 - 10	48	1,49	98	0,88
10 - 15	70	2,17	195	1,75
15 - 20	62	1,92	245	2,20
20 - 25	65	2,02	250	2,24
25 - 30	81	2,51	282	2,53
30 - 35	49	1,52	255	2,29
35 - 40	65	2,02	274	2,46
40 - 45	46	1,43	228	2,05
45 - 50	33	1,02	199	1,79
50 - 55	30	0,93	205	1,84
55 - 60	32	0,99	199	1,79
60 - 65	37	1,15	181	1,62
65 - 70	36	1,12	164	1,47
70 - 75	48	1,49	148	1,33
75 - 80	23	0,71	165	1,48
80 - 85	33	1,02	137	1,23
85 - 90	26	0,81	140	1,26
90 - 95	23	0,71	154	1,38
95 - 100	31	0,95	148	1,33
100 - 105	17	0,53	136	1,22
105 - 110	29	0,90	116	1,04
110 - 115	17	0,53	128	1,15
115 - 120	16	0,50	133	1,19
120 - 125	19	0,59	110	0,99
125 - 130	20	0,62	114	1,02
130 - 135	22	0,68	111	1,00
135 - 140	21	0,65	98	0,88
140 - 145	14	0,43	93	0,83
145 <	2200	68,22	6417	57,59

Figure 6.2.1.3.1.

LATERAL DISTRIBUTION OF THE TRAFFIC "Rheden Bridge"						
Track	44,91 hrs.	18,83 hrs.	14,31 hrs.	8,33 hrs.	1,83 hrs.	1,61 hrs.
A - A'	1,3 %	1,5 %	1,1 %	0,9 %	0,7 %	2,4 %
B - B'	13,6 %	16,5 %	9,5 %	13,3 %	9,7 %	16,7 %
C - C'	55,0 %	56,5 %	59,0 %	43,5 %	57,6 %	51,6 %
D - D'	22,0 %	21,2 %	23,9 %	22,3 %	22,2 %	14,3 %
H - H'	2,7 %	0,7 %	1,4 %	10,3 %	2,1 %	4,0 %
I - I'	2,4 %	1,3 %	1,1 %	6,1 %	6,3 %	6,4 %
J - J'	1,3 %	1,3 %	1,5 %	1,0 %	1,4 %	0,8 %
K - K'	1,9 %	1,1 %	2,6 %	2,7 %		4,0 %

Figure 6.2.1.4.1.

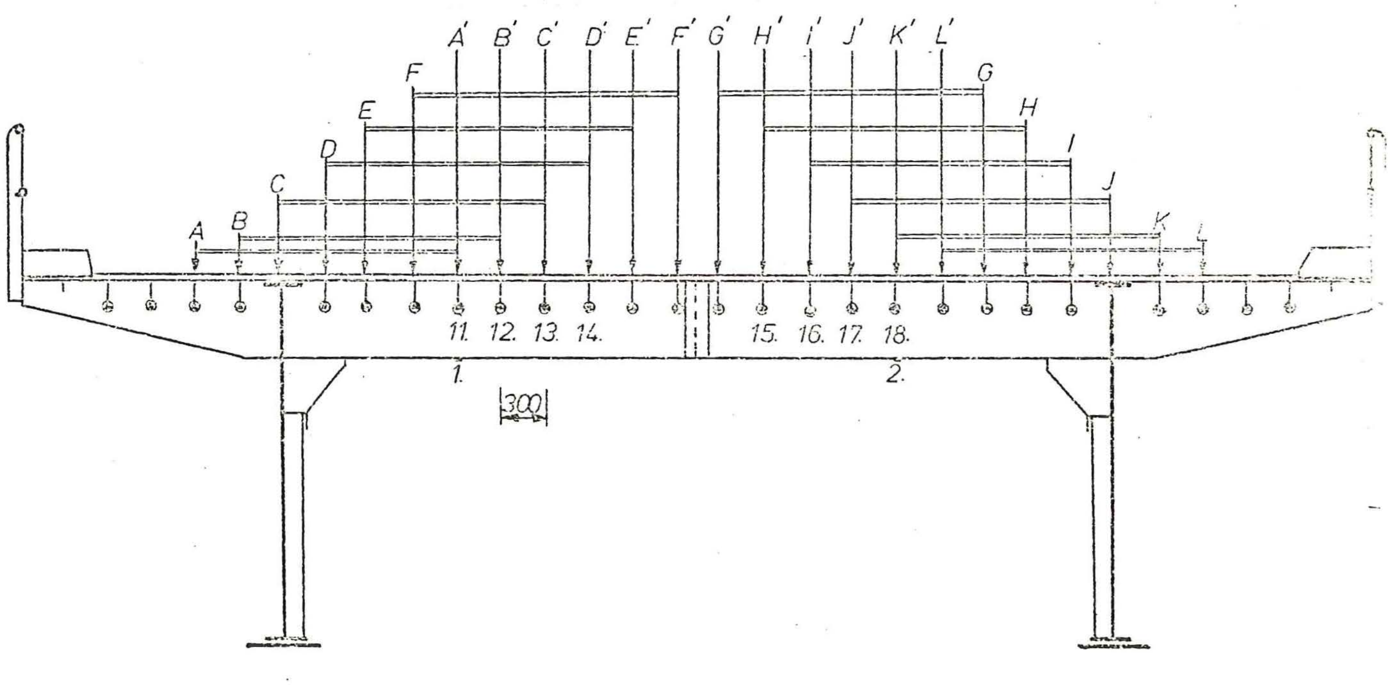


Figure 6.2.1.4.2.

6.2.2. Measured stresses during 44.91 hours Group A

The results of level crossings and rainflow counts record during a period of 45 hours are given in figure 6.2.2.1. on page 61 and figure 6.2.2.2. on page 62.
Just like the axle loads the results are plotted in frequency curves.
Figure 6.2.2.3. on page 63 shows the modified relative frequency curve of level crossings of the measuring points 1 and 2 on a cross girder and figure 6.2.2.4. on page 64 the same curves of measuring points on the longitudinal stringers of one cross section of the bridge.
The modified cumulative relative frequency curves of rainflow counts of mp 1 and 2 are given in figure 6.2.2.5. on page 65 and the same curves of the measuring points on the longitudinal stringers in figure 6.2.2.6. on page 66.

From figure 6.2.2.3. on page 63 and figure 6.2.2.5. on page 65 it appears that there is a lot of difference between the stress pattern of mp 2 on the fast lane and mp 1 in the slow lane.

The same phenomena occur at the measuring points on the longitudinal stringers located in one cross-section of the bridge.
In figure 6.2.2.4. on page 64 it is clearly seen that the stress distribution in the measured cross section differs markedly.
The stresses which are exerted in these points, where the traffic is not frequent, are not only smaller but also occur less than the points where most of the heavy traffic runs.
Even in the slow lane there is much deviation.

So it is to be expected that a simulation can give a realistic result if the lateral distribution will be taken in account.

SUM OF THE RAINFLOW COUNTS OF THE FOLLOWING MEASUREMENTS

CODENUMBER: 8001 NUMBER: 5413 DATE : 5108
CODENUMBER: 8000 NUMBER: 4811 DATE : 28098
CODENUMBER: 8001 NUMBER: 4603 DATE : 26098
CODENUMBER: 8000 NUMBER: 5110 DATE : 4108
CODENUMBER: 8001 NUMBER: 6205 DATE : 20108

M. POINT: RANGE N/MM2	1	2	3	4	5	6	7	8	9	10
. 0- 2. 0	7184.	9649.	19870.	23278.	19750.	14287.	18205.	24371.	32498.	21468.
2. 0- 4. 0	8290.	8437.	22695.	30555.	28823.	18391.	18137.	23917.	31028.	20750.
4. 0- 6. 0	7857.	5049.	13848.	17479.	18162.	13410.	10847.	11993.	12725.	8046.
6. 0- 8. 0	3156.	1855.	5024.	6313.	5459.	5488.	3882.	3252.	3070.	2189.
8. 0- 10. 0	3291.	1396.	5145.	6632.	5392.	5974.	2996.	2620.	2522.	1632.
10. 0- 12. 0	1522.	448.	2411.	3539.	2897.	3069.	1141.	1028.	867.	568.
12. 0- 14. 0	1707.	321.	2615.	4249.	3789.	4089.	1078.	985.	942.	458.
14. 0- 16. 0	781.	129.	1167.	2377.	2410.	2373.	439.	503.	489.	207.
16. 0- 18. 0	735.	140.	1326.	3126.	3296.	3304.	533.	620.	584.	271.
18. 0- 20. 0	313.	61.	628.	1696.	2189.	1982.	294.	330.	360.	100.
20. 0- 22. 0	237.	84.	730.	2175.	2815.	2840.	407.	515.	401.	127.
22. 0- 24. 0	46.	38.	396.	1285.	1796.	1649.	234.	279.	257.	71.
24. 0- 26. 0	36.	34.	402.	1682.	2556.	2333.	269.	345.	231.	120.
26. 0- 28. 0	19.	60.	224.	979.	1580.	1262.	195.	198.	144.	102.
28. 0- 30. 0	61.	149.	308.	1375.	2288.	1954.	296.	254.	175.	196.
30. 0- 32. 0	24.	88.	161.	896.	1451.	1130.	196.	153.	101.	100.
32. 0- 34. 0	35.	94.	175.	1058.	1995.	1484.	205.	241.	100.	124.
34. 0- 36. 0	20.	41.	104.	631.	1322.	976.	126.	120.	63.	28.
36. 0- 38. 0	23.	38.	135.	969.	1857.	1194.	181.	166.	103.	46.
38. 0- 40. 0	15.	21.	75.	523.	1185.	660.	94.	88.	43.	34.
40. 0- 42. 0	17.	13.	78.	779.	1609.	896.	102.	110.	66.	44
42. 0- 44. 0	14.	17.	40.	427.	953.	528.	49.	65.	36.	13.
44. 0- 46. 0	11.	13.	49.	538.	1341.	734.	76.	89.	44.	29.
46. 0- 48. 0	3.	14.	29.	362.	800.	371.	48.	58.	29.	13.
48. 0- 50. 0	5.	14.	43.	479.	1146.	550.	43.	60.	50.	13.
50. 0- 52. 0	.	1.	19.	269.	648.	285.	39.	34.	22.	8.
52. 0- 54. 0	1.	5.	26.	364.	870.	389.	55.	38.	27.	12.
54. 0- 56. 0	.	2.	11.	198.	542.	214.	26.	20.	13.	2.
56. 0- 58. 0	2.	.	13.	234.	680.	290.	46.	29.	14.	5.
58. 0- 60. 0	2.	.	6.	125.	375.	139.	23.	18.	8.	2.
60. 0- 62. 0	2.	.	4.	151.	483.	191.	21.	17.	5.	3.
62. 0- 64. 0	.	.	3.	78.	270.	86.	12.	5.	3.	2.
64. 0- 66. 0	.	1.	4.	83.	349.	95.	7.	13.	7.	4.
66. 0- 68. 0	.	.	2.	40.	151.	44.	4.	6.	3.	1.
68. 0- 70. 0	.	.	1.	36.	198.	58.	4.	12.	3.	2.
70. 0- 72. 0	.	.	.	20.	91.	23.	1.	4.	2.	.
72. 0- 74. 0	6.	.	.	28.	111.	31.	.	4.	4.	
74. 0- 76. 0	.	2.	.	14.	56.	15.	1.	.	.	.
76. 0- 78. 0	2.	.	.	8.	63.	16.	1.	.	.	
78. 0- 80. 0	4.	2.	3.	16.	129.	65.	3.	6.	6.	

Figure 6.2.2.1.

N/MM2	1	2	M. POINT : LEVEL N/MM2	3	4	5	6	7	8	9	10
61.5- 59.9											
59.9- 58.3	3.	1.	-61.5- -59.9	.	.	.	.	1.	6.	4	
58.3- 56.8	4.	1.	-59.9- -58.3	1.	.	.	.	1.	6.	4.	2.
56.8- 55.2	4.	1.	-58.3- -56.8	1.	.	.	.	1.	6.	4.	2.
55.2- 53.6	4.	1.	-56.8- -55.2	1.	.	.	.	2.	6.	4.	3.
53.6- 52.0	4.	1.	-55.2- -53.6	1.	.	.	.	2.	6.	4.	3.
52.0- 50.5	5.	1.	-53.6- -52.0	1.	.	1.	.	2.	6.	4.	3.
50.5- 48.9	4.	1.	-52.0- -50.5	2.	.	1.	.	2.	6.	5.	3.
48.9- 47.3	4.	1.	-50.5- -48.9	2.	.	1.	.	2.	6.	5.	4.
47.3- 45.7	3.	1.	-48.9- -47.3	2.	.	1.	.	2.	6.	5.	4.
45.7- 44.2	4.	1.	-47.3- -45.7	2.	.	1.	.	2.	6.	5.	4.
44.2- 42.6	5.	2.	-45.7- -44.2	2.	.	1.	.	2.	6.	5.	5.
42.6- 41.0	5.	2.	-44.2- -42.6	2.	.	1.	.	2.	7.	7.	6.
41.0- 39.4	5.	2.	-42.6- -41.0	2.	.	2.	.	2.	8.	8.	6.
39.4- 37.8	5.	2.	-41.0- -39.4	2.	.	2.	.	2.	8.	10.	6.
37.8- 36.3	5.	2.	-39.4- -37.8	2.	.	2.	.	2.	9.	10.	6.
36.3- 34.7	5.	3.	-37.8- -36.3	2.	.	2.	.	2.	9.	9.	6.
34.7- 33.1	5.	3.	-36.3- -34.7	2.	.	2.	.	2.	10.	9.	7.
33.1- 31.5	5.	6.	-34.7- -33.1	2.	.	2.	.	2.	10.	10.	7.
31.5- 30.0	7.	12.	-33.1- -31.5	3.	.	2.	.	2.	10.	13.	7.
30.0- 28.4	8.	16.	-31.5- -30.0	3.	.	2.	.	2.	10.	14.	7.
28.4- 26.8	12.	18.	-30.0- -28.4	4.	.	2.	.	3.	10.	14.	7.
26.8- 25.2	19.	22.	-28.4- -26.8	5.	.	2.	.	3.	10.	13.	7.
25.2- 23.7	26.	23.	-26.8- -25.2	6.	.	5.	.	3.	11.	14.	8.
23.7- 22.1	37.	36.	-25.2- -23.7	7.	.	6.	.	3.	11.	14.	9.
22.1- 20.5	62.	55.	-23.7- -22.1	9.	2.	9.	.	3.	12.	17.	9.
20.5- 18.9	98.	92.	-22.1- -20.5	11.	3.	19.	2.	4.	13.	20.	9.
18.9- 17.3	207.	138.	-20.5- -18.9	14.	14.	37.	7.	5.	17.	24.	10.
17.3- 15.8	387.	192.	-18.9- -17.3	19.	57.	130.	19.	14.	21.	30.	10.
15.8- 14.2	709.	275.	-17.3- -15.8	43.	198.	386.	57.	22.	34.	33.	12.
14.2- 12.6	1126.	366.	-15.8- -14.2	125.	514.	912.	216.	62.	62.	60.	21.
12.6- 11.0	1781.	472.	-14.2- -12.6	306.	1220.	1958.	605.	129.	122.	116.	51.
11.0- 9.5	2618.	628.	-12.6- -11.0	905.	2483.	3417.	1614.	275.	216.	219.	110.
9.5- 7.9	3692.	915.	-11.0- -9.5	2130.	4166.	5092.	3160.	609.	439.	410.	241.
7.9- 6.3	4888.	1477.	-9.5- -7.9	3868.	5927.	7280.	5136.	1350.	859.	733.	446.
6.3- 4.7	6624.	2649.	-7.9- -6.3	6081.	8530.	10615.	8030.	2862.	1894.	1560.	945.
4.7- 3.2	9630.	4783.	-6.3- -4.7	9597.	12786.	15413.	12559.	5974.	4325.	3680.	2345.
3.2- 1.6	13648.	7420.	-4.7- -3.2	15833.	19667.	22397.	19746.	11399.	9056.	8357.	5896.
1.6- .0	16081.	11442.	-3.2- -1.6	24927.	27998.	29330.	27747.	19803.	16749.	16445.	11987.
.0- -1.6	15268.	12431.	-1.6- .0	35049	47476	50350	38945	27255.	30825.	38218	25613.
-1.6- -3.2	11359.	10758.	.0- 1.6	34816	55062	57104	43739	26298	33355	41054	26299.
-3.2- -4.7	256.	431.	1.6- 3.2	25369.	50485.	53430.	39443	16150.	25115.	32718.	19645.
-4.7- -6.3	113.	307.	3.2- 4.7	11456.	32367.	38999.	29585.	7082.	11273.	11338.	5393.
-6.3- -7.9	113.	301.	4.7- 6.3	5726.	19896.	27669.	22273.	3596.	4728.	3905.	1784.
-7.9- -9.5	113.	297.	6.3- 7.9	3946.	15771.	23410.	18865.	2657.	3193.	2563.	1186.
-9.5- -11.0	113.	287.	7.9- 9.5	2965.	13816.	21803.	17008.	2288.	2702.	2103.	931.
-11.0- -12.6	113.	286.	9.5- 11.0	2321.	12246.	20606.	15455.	1996.	2393.	1769.	779.
-12.6- -14.2	113.	284.	11.0- 12.6	1828.	10860.	19380.	14052.	1773.	2094.	1480.	673.
-14.2- -15.8	113.	282.	12.6- 14.2	1457.	9658.	18098.	12739.	1595.	1844.	1261.	605.
-15.8- -17.3	113.	279.	14.2- 15.8	1178.	8578.	16915.	11478.	1452.	1655.	1049.	546.
-17.3- -18.9	113.	278.	15.8- 17.3	982.	7629.	15787.	10239.	1303.	1469.	884.	497.
-18.9- -20.5	112.	277.	17.3- 18.9	825.	6816.	14675.	9189.	1186.	1282.	734.	467.
-20.5- -22.1	112.	276.	18.9- 20.5	687.	6054.	13651.	8163.	1073.	1110.	609.	420.
-22.1- -23.7	111.	276.	20.5- 22.1	574.	5382.	12544.	7283.	960.	988.	533	376.
-23.7- -25.2	111.	276.	22.1- 23.7	494.	4691.	11542.	6473.	863.	878.	436.	344.
-25.2- -26.8	110.	276.	23.7- 25.2	432.	4147.	10564.	5769.	796.	769.	374.	325.
-26.8- -28.4	110.	276.	25.2- 26.8	377.	3648.	9622.	5141.	717.	671.	323.	316.
-28.4- -30.0	9.	13.	26.8- 28.4	284.	3140.	8696.	4423.	537.	569.	264.	209.
-30.0- -31.5	9.	2.	28.4- 30.0	223.	2702.	7762.	3804.	440.	477.	215.	142.
-31.5- -33.1	8.	2.	30.0- 31.5	164.	2304.	6831.	3223.	352.	384.	176.	79.
-33.1- -34.7	8.	2.	31.5- 33.1	129.	1956.	5959.	2757.	295.	329.	151.	63.
-34.7- -36.3	8.	2.	33.1- 34.7	106.	1643.	5132.	2370.	247.	274.	128.	48.
-36.3- -37.8	8.	2.	34.7- 36.3	92.	1384.	4391.	2011.	212.	230.	107.	41.
-37.8- -39.4	8.	1.	36.3- 37.8	80.	1125.	3726.	1683.	182.	193.	81.	34.
-39.4- -41.0	7.	1.	37.8- 39.4	68.	920.	3152.	1394.	148.	156.	65.	25.
-41.0- -42.6	7.	1.	39.4- 41.0	47.	745.	2586.	1155.	122.	130.	52.	22.
-42.6- -44.2	7.	1.	41.0- 42.6	32.	596.	2125.	951.	101.	110.	40.	19.
-44.2- -45.7	7.	1.	42.6- 44.2	24.	473.	1786.	757.	79.	94.	30.	13.
-45.7- -47.3	7.	1.	44.2- 45.7	14.	369.	1432.	608.	56.	84.	23.	9.
-47.3- -48.9	6.	1.	45.7- 47.3	13.	283.	1154.	481.	41.	68.	21.	8.
-48.9- -50.5	6.	1.	47.3- 48.9	12.	208.	941.	372.	31.	57.	14.	6.
-50.5- -52.0	5.	1.	48.9- 50.5	7.	153.	734.	299.	18.	49.	10.	3.
-52.0- -53.6	5.	1.	50.5- 52.0	5.	111.	545.	204.	11.	43.	8.	2.
-53.6- -55.2	5.	1.	52.0- 53.6	3.	86.	424.	163.	5.	36.	5.	1.
-55.2- -56.8	5.	1.	53.6- 55.2	2.	63.	339.	127.	5.	34.	3.	1.
-56.8- -58.3	5.	1.	55.2- 56.8	1.	43.	262.	106.	4.	28.	2.	.
-58.3- -59.9	5.	1.	56.8- 58.3	1.	33.	208.	81.	2.	24.	2.	.
-59.9- -61.5	5.	1.	58.3- 59.9	1.	23.	159.	68.	2.	22.	2.	.
-61.5- -63.1	5.	1.	59.9- 61.5	1.	19.	109.	52.	2.	22.	2.	.
-63.1- -64.7	5.	1.	61.5- 63.1	1.	13.	81.	46.	2.	21.	2.	.
-64.7- -66.2	5.	1.	63.1- 64.7	1.	9.	69.	39.	2.	21.	2.	.
-66.2- -67.8	5.	1.	64.7- 66.2	1.	4.	47.	33.	2.	20.	1.	.
-67.8- -69.4	5.	1.	66.2- 67.8	1.	3.	32.	24.	2.	20.	1.	.
-69.4- -71.0	1.	1.	67.8- 69.4	1.	3.	21.	20.	1.	16.	1.	.
-71.0- -72.5	.	1.	69.4- 71.0	1.	2.	16.	17.	1.	17.	1.	.
-72.5- -74.1	.	1.	71.0- 72.5	1.	1.	9.	13.	1.	15.	1.	.
-74.1- -75.7	.	1.	72.5- 74.1	1.	1.	6.	13.	1.	11.	1.	.
-75.7- -77.3	.	1.	74.1- 75.7	1.	1.	5.	12.	1.	8.	1.	.
-77.3- -78.8	.	1.	75.7- 77.3	1.	1.	5.	10.	1.	5.	1.	.
-78.8- -80.4	.	1.	77.3- 78.8	.	1.	3.	2.	1.	4.	1.	.
-80.4- -82.0	.	.	78.8- 80.4	.	1.	3.	1.	.	2.	1.	.
-82.0- -83.6	.	.	80.4- 82.0	.	.	.	.	.	.	.	.
-83.6- -85.2	.	.	82.0- 83.6	.					.	.	.
-85.2- -86.7	.	.	83.6- 85.2	.					.	.	.
-86.7- -88.3	.	.	85.2- 86.7	.					.	.	.
			86.7- 88.3	.	.	.	.	.	.	.	.

figure 6.2.2.2.

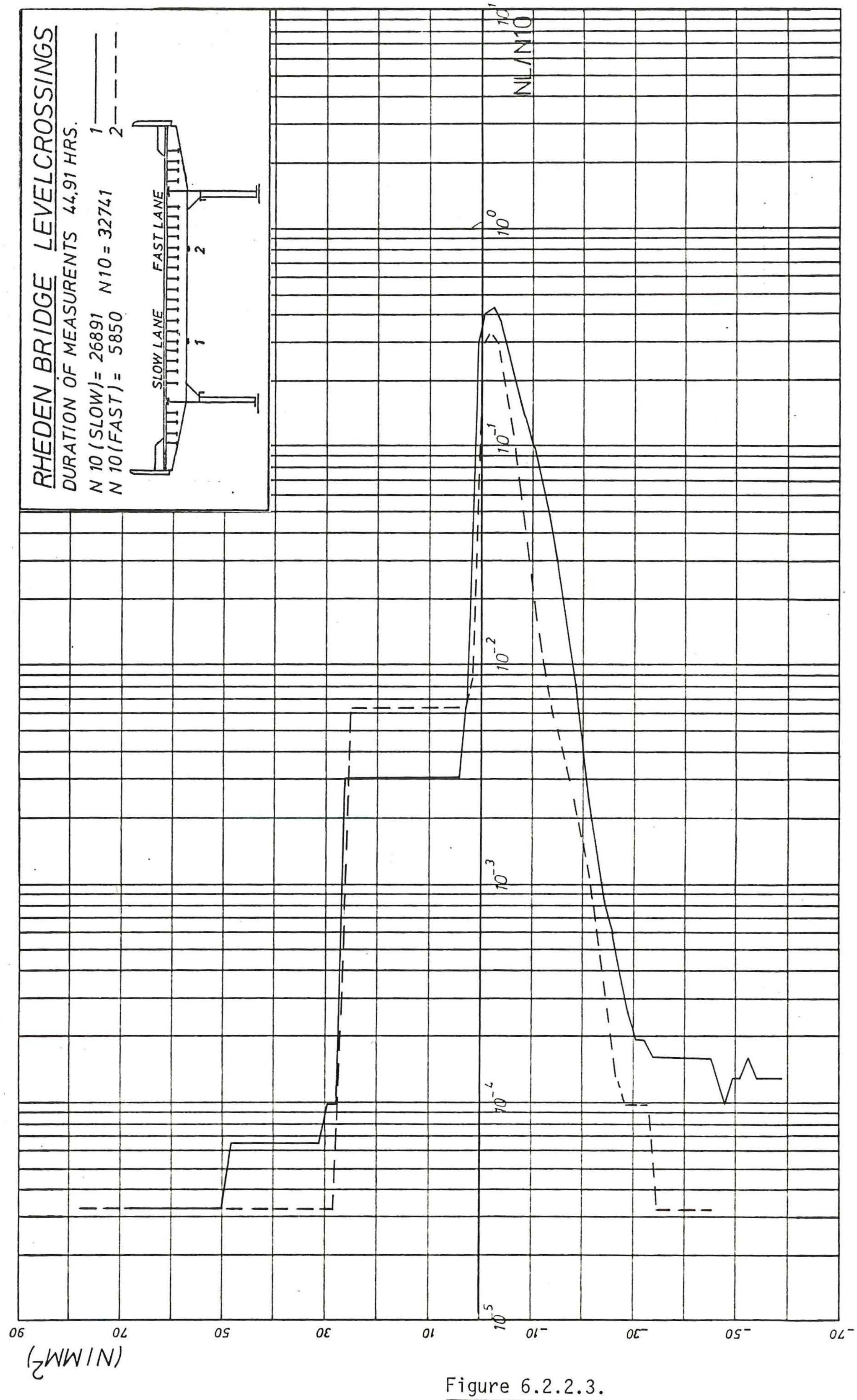
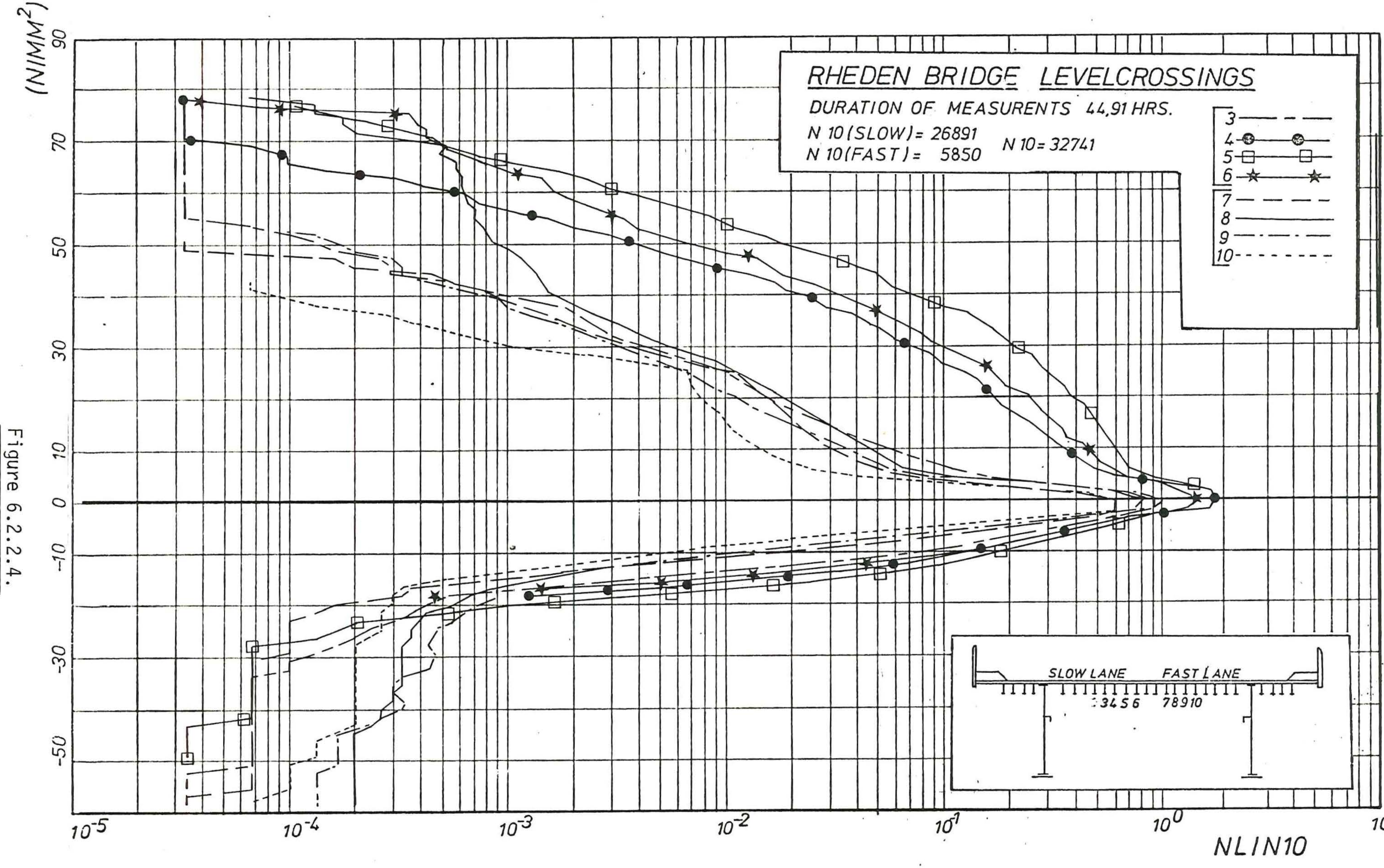
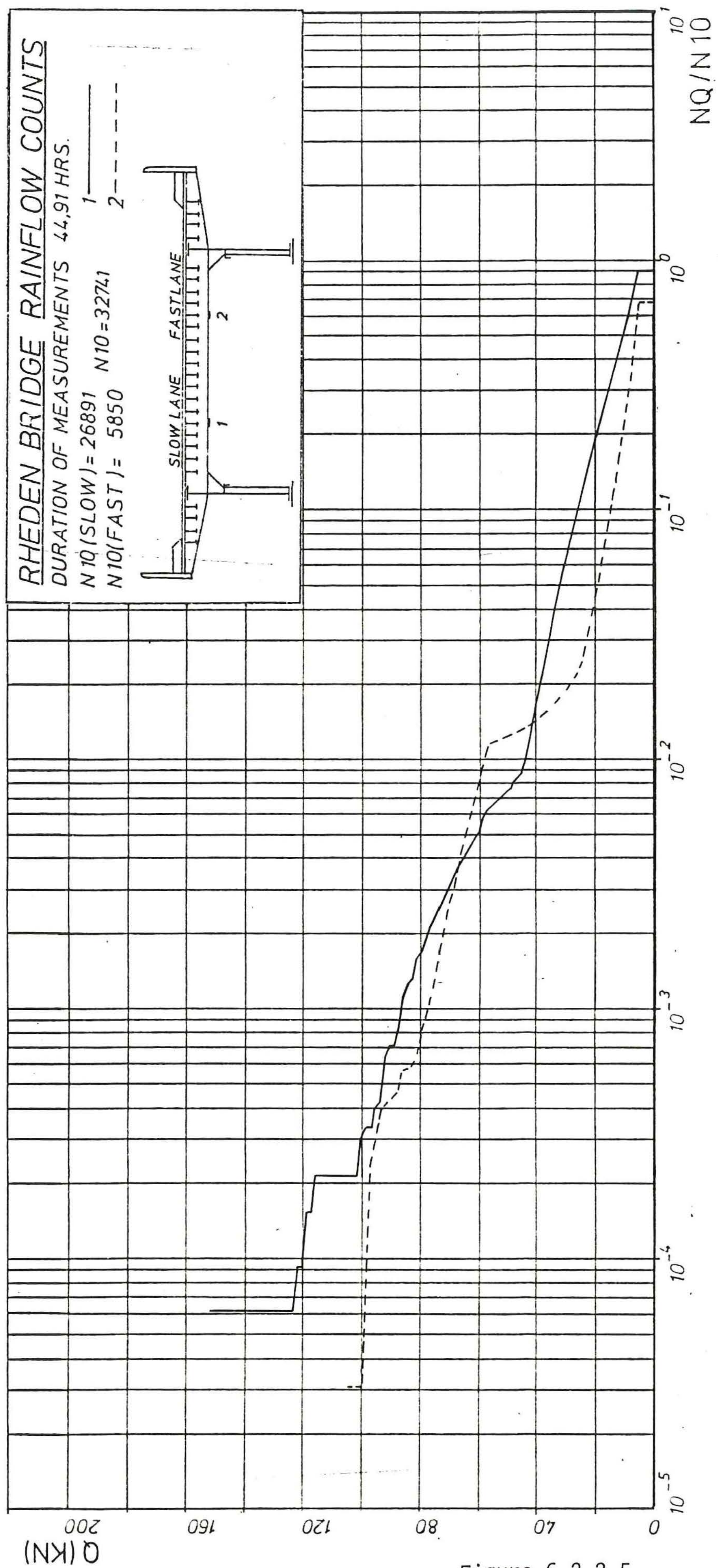

RHEDEN BRIDGE LEVELCROSSINGS
DURATION OF MEASURENTS 44,91 HRS.
N 10 (SLOW) = 26891 N10 = 32741
N 10 (FAST) = 5850
1
2
SLOW LANE
FAST LANE
NL/N10
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
90
70
50
30
10
-10
-30
-50
-70
(N/MM²)

Figure 6.2.2.3.



RHEDEN BRIDGE LEVELCROSSINGS
DURATION OF MEASURENTS 44,91 HRS.
N 10 (SLOW) = 26891
N 10 (FAST) = 5850
N 10 = 32741
3
4
5
6
7
8
9
10
SLOW LANE
FAST LANE
34 5 6
78 9 10
(N/MM²)
90
70
50
30
10
0
-10
-30
-50
10^-5
10^-4
10^-3
10^-2
10^-1
10^0
10^1
NLIN10

Figure 6.2.2.4.



RHEDEN BRIDGE RAINFLOW COUNTS
DURATION OF MEASUREMENTS 44,91 HRS.
N10(SLOW) = 26891 N10 = 32741
N10(FAST) = 5850
1 ———
2 - - - -
SLOW LANE
FASTLANE
1
2
NQ/N10
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
Q (KN)
0
40
80
120
160
200

Figure 6.2.2.5.

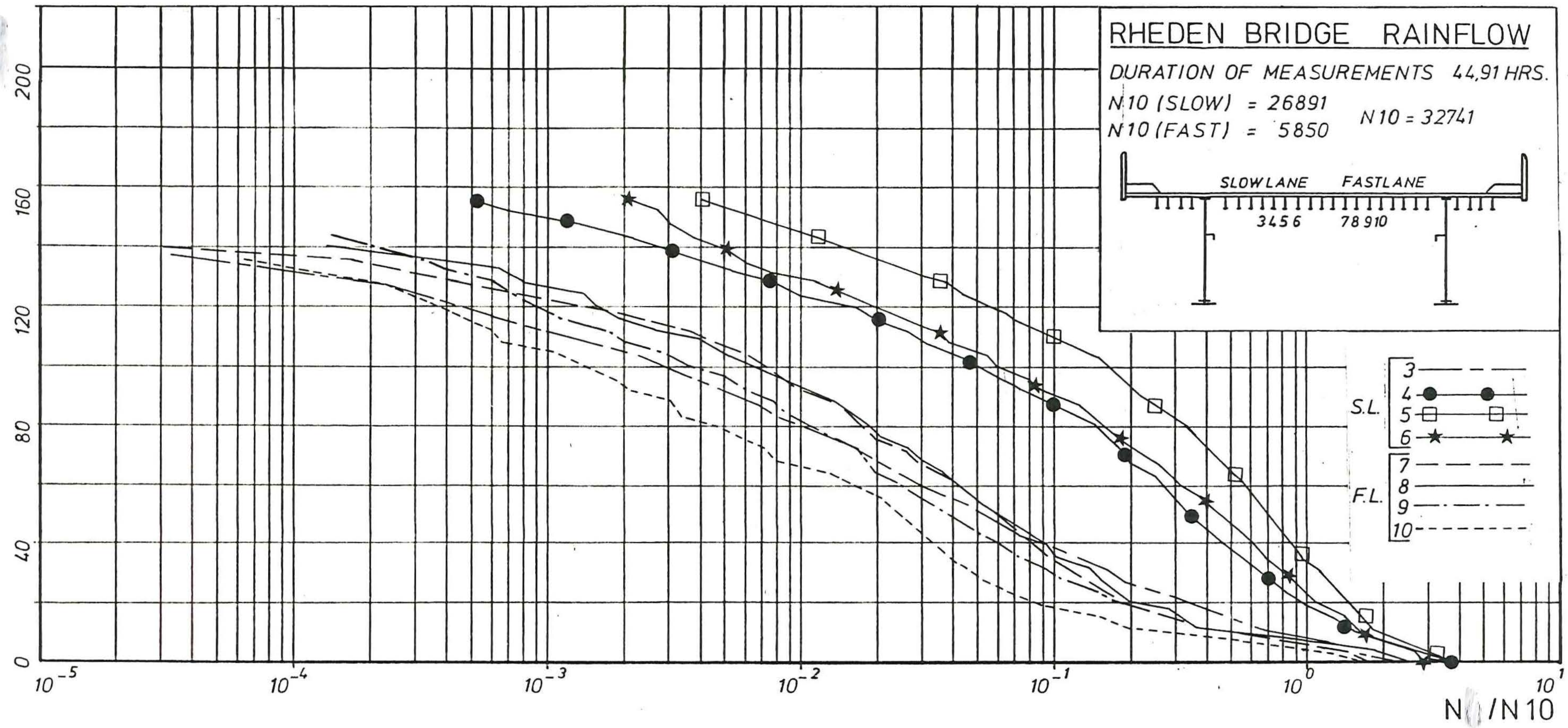

RHEDEN BRIDGE RAINFLOW
DURATION OF MEASUREMENTS 44,91 HRS.
N10 (SLOW) = 26891
N10 (FAST) = 5850
N10 = 32741
SLOWLANE
FASTLANE
3456
78910
S.L.
3
4
5
6
F.L.
7
8
9
10
0
40
80
120
160
200
10^-5
10^-4
10^-3
10^-2
10^-1
10^0
10^1
N /N10

Figure 6.2.2.6.

7. COMPARISON BETWEEN THE TWO BRIDGES INCLUDING CONCLUSIONS

7.1. Measured traffic

The cumulative relative frequency curves of the measured axle loads of both bridges are given in figure 7.1.1.

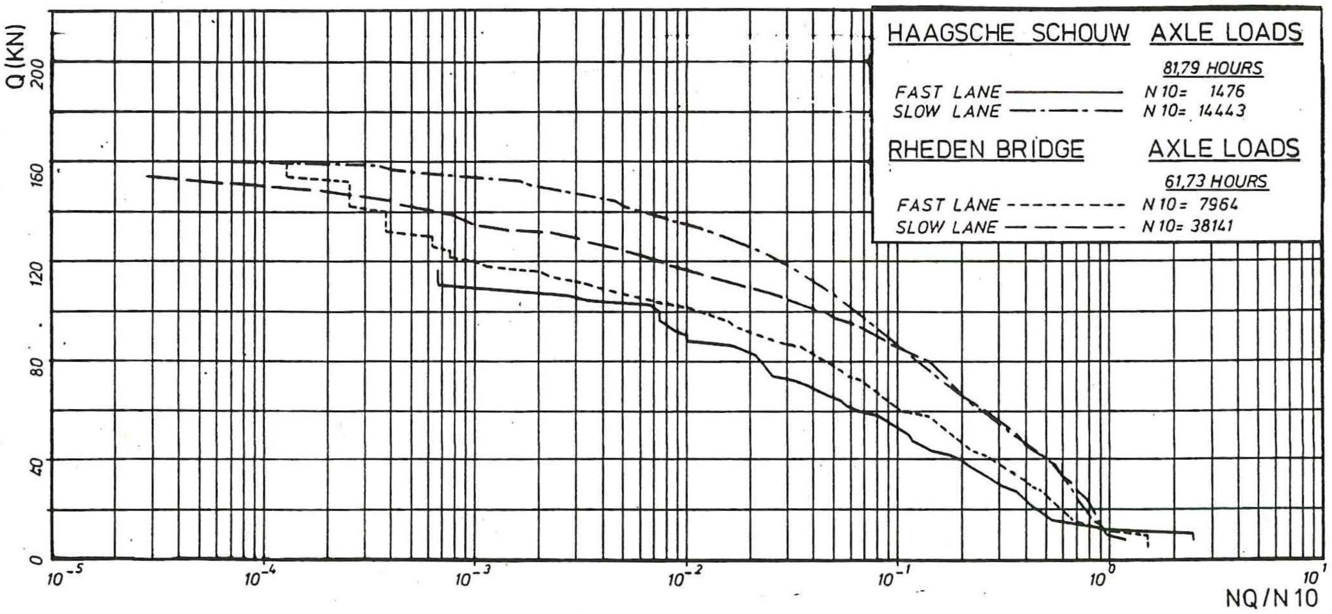


Figure 7.1.1.

In the first place it is seen that the difference between the curves of both lanes of the "Rheden" Bridge is smaller than the difference between the curves of the "Haagsche Schouw Bridge".
In the second place it is remarkeble, that the slow lane curve of the "Rheden Bridge" is lower than the one of the "Haagsche Schouw Bridge".

This difference can be explained if one compares the mean axle load per type of the two bridge (see figure 7.1.2.).

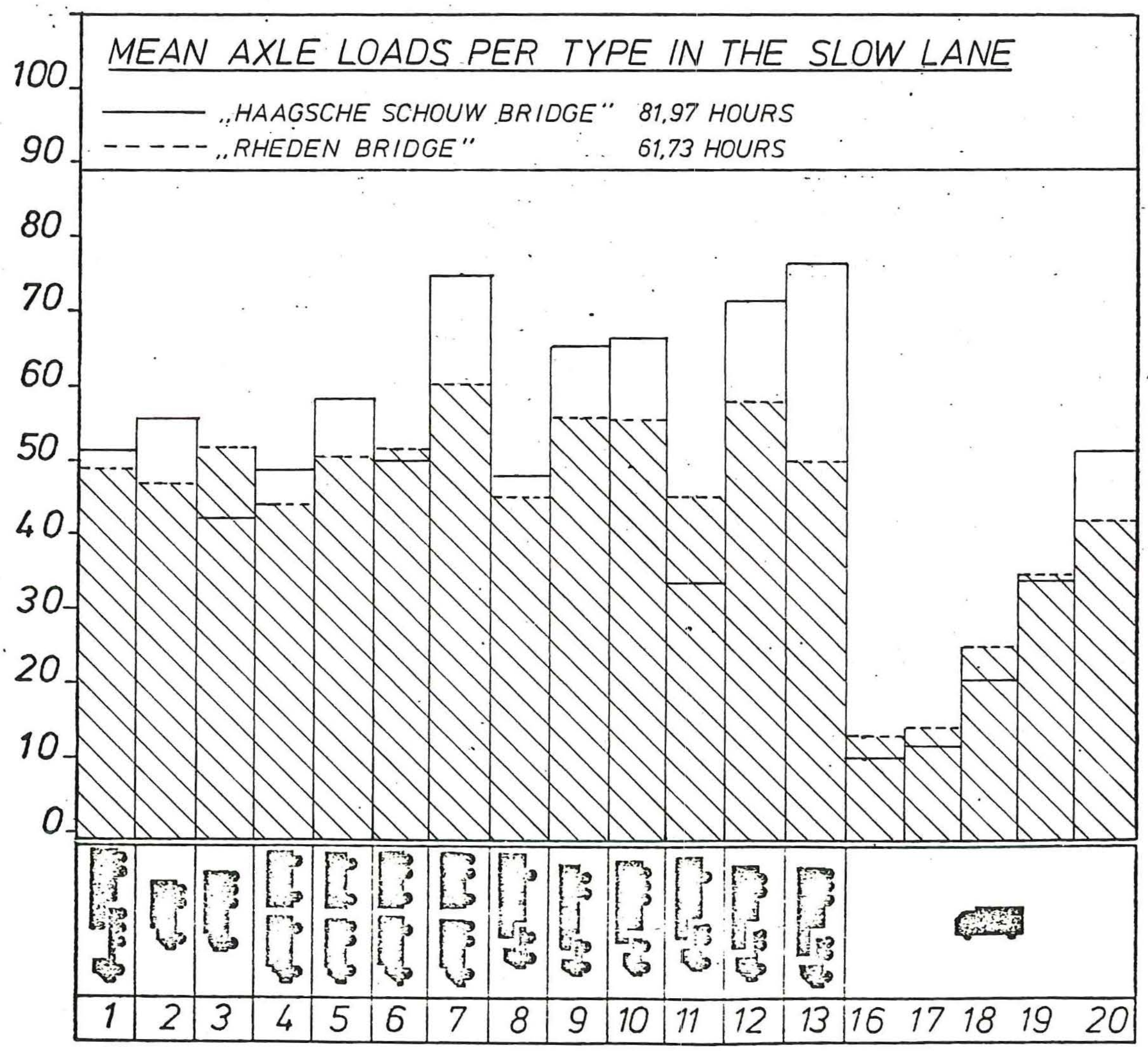


Figure 7.1.2.

It appears that the mean axle load per type in the slow lane of the "Rheden Bridge" is smaller than the corresponding value of the "Haagsche Schouw Bridge".
This phenomenon is probably caused by the higher frequency of the international traffic on the "Rheden Bridge".

Measurements showed that 15,7% of the traffic loads on the "Haagsche Schouw Bridge" is caused by vehicles with axle loads greater than 8 kN and that 82% of the lorries were dual lorries. The same percentages for the "Rheden Bridge" are 26% and 60%.

From the frequency distributions of the axle loads of both bridges it appeared that the axle loads of the dual lorries go up with the size of the axle distances.

For both bridges it holds that 55-60% of all traffic runs in the same track.

Generally the vehicle intervals of lorries on the "Haagsche Schouw Bridge" are greater than 145 meters (= 90%).
For the "Rheden Bridge" this percentage is about 58%.

In order to construct the cumulative relative frequency curve of the axle loads the table below shows the demand of time necessary.

	Haagsche Schouw Bridge		Rheden Bridge	
	hours	number of axleloads	hours	number of axleloads
Slow lane	81,79	14443 (sufficient)	61,73	38141 (sufficient)
Fast lane		1476 (not sufficient)		7964 (not sufficient)

7.2. Measured stresses

The stresses in several points of one cross section of the construction of both bridges differs markedly.
Especially where the traffic is not frequent, they are not only smaller but also occur less than in the measuring points where most of the heavy traffic runs.
Even in the slow lanes there is much deviation.
So it is to be expected that a simulation can give a realistic result if the lateral distribution will be taken in account.
Another important effect associated with the lateral distribution is the number of axle loads it takes to reach the final stress distribution.
Measurement and calculations on the "Haagsche Schouw Bridge" showed that the dynamic effects of this bridge are very important.
In general a slightly longer time is taken than in the case of the axle loads.

7.3. Measured and calculated influence lines

For the "Haagsche Schouw Bridge" it appeared that the influence lines of points which are symmetric with respect to the longitudinal axis of symmetriy are nearly the same.
An universal ratio between the dynamic influence factors and the static influence factors on the "Haagsche Schouw Bridge" cannot be given.
Another influence of the dynamic loads of the "Haagsche Schouw Bridge" showed that the number of cycles is larger than the number of cycles that can be calculated with the help of static influence lines.
A limited investigation with computed static influence lines for the "Haagsche Schouw Bridge" showed that the calculated stresses were about 30% higher than the measured values.
Measuring static influence lines of the "Rheden Bridges" it appeared that the influence of a static load for a point at mid-span of the stiffener is larger than the influence for a point on the spot of the cross girder.

8. DISCUSSION

The research done so far leaves some questions un answered. They mainly fall into two categories. One categorie is related to the loading of the bridge. The other deals with the transfer of a particular loading pattern into stresses in various parts of the construction.
From what was presented in section 6.1.4. it is obvious that the calculation methods do not lead to a satisfactory description of the experiments. It is to be expected that more sophisticated computer-programmes produce a better result.
Such programmes are available, but there are two reasons why they have not been used.
The first reason is that so far no one has had the time to run them. If anyone would be would be able to compute dynamical effects.
The second reason is that for a computer programme to produce output that fits the experiments, one needs better input.
In order to accomplish this a more detailed picture of the interaction between parts is required.
At the moment handling this typ of information is a costly affair.
As was printed out in section 3 only a few parts of the bridges have been considered.
In sight into the mechanism of the transfer of dynamical loads into stresses that occur in the main girders is not available.
Further experiments are necessary.
The lateral distribution of the running traffic turns out to be of major importance.
Until now this effect has hardly been investigated.
Two questions must be asnwerd:

- to what degree are fatique components in accurate when the lateral load distribution is not accounted for
- what factors may be of influence on the lateral traffic distribution.

Another matter related to the loads of the bridges is the charactor of the traffic.
As is obvious from section quite difference in both the lateral distribution an the vehicle spacing presented itself as a function of the character of the traffic.
It is by all means clear that this point needs more attention to.

A small investigation has been performed whether the axle loads can been deduced from the measured stresses in the stringers.
This investigation is worth to be continued with the gathered results.

9. REFERENCE

(1) Final Report "Haagsche Schouw Bridge" 6-79-5.
"Measurements and interpretation of dynamic loads on bridges".
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(2) Final Report "Rheden Bridge" 6-79-6.
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