MOMENTS DUE TO TRUCKS MEASURED ON SELECTED BRIDGES IN THE DETROIT AREA

Report submitted to the Michigan Department of Transportation and the Great Lakes Center for Truck Transportation Research

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1. INTRODUCTION

This Report is a supplement to the Final Report on Truck Loads on Selected Bridges in the Detroit Area, submitted to the Michigan DOT in January 1995. Truck loads were measured on seven bridges using weigh-in-motion equipment (WIM). The cumulative distribution functions of the gross vehicle weight are shown in the Final Report.

The objective of this Report is to present the results of calculations of moments for the measured trucks. The cumulative distribution functions (CDF) of moments are plotted on the normal probability paper.
# TABLE OF CONTENTS

1. Introduction ...................................................................................... 1  
2. Selected Bridges and Measured Trucks .......................................... 2  
3. Gross Vehicle Weights .................................................................... 4  
4. Moments Caused by Trucks ............................................................ 4  
   References ....................................................................................... 12
2. SELECTED BRIDGES AND MEASURED TRUCKS

The selected bridges are listed in Table 1.

Table 1 Selected Bridges.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Michigan</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>WY/I94</td>
<td>S36-82022</td>
<td>Wyoming Road over I-94, Detroit, Wayne County</td>
</tr>
<tr>
<td>I94/M10</td>
<td>S25-82023</td>
<td>I-94 Eastbound to M-10 Northbound (Lodge Highway), Detroit, Wayne County</td>
</tr>
<tr>
<td>US12/I94</td>
<td>S32-82022</td>
<td>US-12 Eastbound ramp to I-94 Eastbound Dearborn, Wayne County</td>
</tr>
<tr>
<td>DA/M10</td>
<td>S15-82112</td>
<td>Davison Ave. Eastbound over M-10 Southbound (Lodge Highway), Detroit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wayne County</td>
</tr>
<tr>
<td>M39/M10</td>
<td>S09-63801</td>
<td>M-39 Southbound ramp over M-10 Northbound (Lodge Highway), Southfield,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oakland County</td>
</tr>
<tr>
<td>I94/I75.</td>
<td>S24-82251</td>
<td>I-94 Westbound over I-75 to I-75 Southbound Detroit, Wayne County</td>
</tr>
<tr>
<td>M153/M39</td>
<td>S01-82081</td>
<td>M-153 Westbound (Ford Road) over M-39 Southbound (Southfield Freeway),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Detroit, Wayne County</td>
</tr>
</tbody>
</table>
The number of trucks measured on each bridge is shown in Table 2.

Table 2. Number of Trucks Weighed.

<table>
<thead>
<tr>
<th>Bridge Location</th>
<th>Truck Type (Number of Axles)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>WY/I94</td>
<td>82</td>
<td>26</td>
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<tr>
<td>I94/M10</td>
<td>385</td>
<td>95</td>
</tr>
<tr>
<td>US12/I94</td>
<td>56</td>
<td>28</td>
</tr>
<tr>
<td>DA/M10</td>
<td>125</td>
<td>45</td>
</tr>
<tr>
<td>M39/M10</td>
<td>350</td>
<td>59</td>
</tr>
<tr>
<td>I94/175</td>
<td>93</td>
<td>19</td>
</tr>
<tr>
<td>M153/M39</td>
<td>94</td>
<td>28</td>
</tr>
</tbody>
</table>
3. GROSS VEHICLE WEIGHTS

The gross vehicle weights (GVW) of the measured trucks vary from site-to-site. A statistical representation of a variable is the cumulative distribution function (CDF). CDF's of GVW for trucks observed on the considered bridges are plotted on the normal probability paper in Fig. 1. The construction and use of the normal probability paper is described in the previous report (Nowak et al. 1994).

The results indicate that I-94/M-10 carries the heaviest trucks. The lowest GVW's are observed on M-153/M-39.
Fig. 1. CDF's of Gross Vehicle Weight for the Considered Bridges.
4. MOMENTS CAUSED BY TRUCKS

The effect of heavy trucks on bridges depends on the span length, gross vehicle weight (GVW) and truck configuration (number of axles and axle spacings). Therefore, load effects were calculated for the measured trucks. In particular, the obtained truck data is used to determine the lane moments. Each truck is run using influence lines and the maximum moment is recorded for spans from 20 through 200 ft.

The obtained moments are divided by HS-20 moment (AASHTO 1992). The cumulative distribution functions (CDF) of moments are determined for various spans. The results are plotted on the normal probability paper. The construction and use of the probability paper is given in Report by Nowak et al (1994).

The CDF's are presented in Fig. 2 and 3 for Wyoming/I-94 truck traffic, Fig. 4 and 5 for I-94/M-10 traffic, Fig. 6 and 7 for US12/I-94 trucks, Fig. 8 and 9 for DA/M-10 trucks, Fig. 10 and 11 for M-39/M-10 trucks, Fig. 12 and 13 for I-94/I-75 trucks, and Fig. 14 and 15 for M-153/M-39 trucks.

The maximum values of moments are observed for I-94/M-10 truck traffic. For spans 90 and 120 ft they are about three times HS-20 truck moments. The minimum moments, under HS-20 moments, are obtained for M-153/M-39.
Fig. 2. WY/I94, Lane Moment Distributions, 20, 30, and 60 ft.

Fig. 3. WY/I94, Lane Moment Distributions, 90, 120, and 200 ft.
Fig. 4. I94/M10, Lane Moment Distributions, 20, 30, and 60 ft.

Fig. 5. I94/M10, Lane Moment Distributions, 90, 120, and 200 ft.
Fig. 6. US12/I94, Lane Moment Distributions, 20, 30, and 60 ft.

Fig. 7. US12/I94, Lane Moment Distributions, 90, 120, and 200 ft.
Fig. 8. DA/M10, Lane Moment Distributions, 20, 30, and 60 ft.

Fig. 9. DA/M10, Lane Moment Distributions, 90, 120, and 200 ft.
Fig. 10. M39/M10, Lane Moment Distributions, 20, 30, and 60 ft.

Fig. 11. M39/M10, Lane Moment Distributions, 90, 120, and 200 ft.
Fig. 12. I94/I75, Lane Moment Distributions, 20, 30, and 60 ft.

Fig. 13. I94/I75, Lane Moment Distributions, 90, 120, and 200 ft.
Fig. 14. M153/M39, Lane Moment Distributions, 20, 30, and 60 ft.

Fig. 15. M153/M39, Lane Moment Distributions, 90, 120, and 200 ft.
REFERENCES
