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**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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Report submitted to  
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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.

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## 2. SELECTED BRIDGES AND MEASURED TRUCKS

The selected bridges are listed in Table 1.

Table 1 Selected Bridges.

Symbol	Michigan State ID	Location
WY/I94	S36-82022	Wyoming Road over I-94, Detroit, Wayne County
I94/M10	S25-82023	I-94 Eastbound to M-10 Northbound (Lodge Highway) , Detroit, Wayne County
US12/I94	S32-82022	US-12 Eastbound ramp to I-94 Eastbound Dearborn, Wayne County
DA/M10	S15-82112	Davison Ave. Eastbound over M-10 Southbound (Lodge Highway), Detroit, Wayne County
M39/M10	S09-63801	M-39 Southbound ramp over M-10 Northbound (Lodge Highway), Southfield, Oakland County
I94/I75.	S24-82251	I-94 Westbound over I-75 to I-75 Southbound Detroit, Wayne County
M153/M39	S01-82081	M-153 Westbound (Ford Road) over M- 39 Southbound (Southfield Freeway), Detroit, Wayne County

The number of trucks measured on each bridge is shown in Table 2.

Table 2. Number of Trucks Weighed.

Number of Trucks Weighed											
Gross Vehicle Weight > 10 Kips for 2 Axle Vehicles, Gross Vehicle Weight > 15 Kips for 3 or more Axle Vehicles.											
Bridge Location	Truck Type (Number of Axles)										Total
	2	3	4	5	6	7	8	9	10	11	
WY/I94	82	26	18	107	16	9	14	2	3	20	297
I94/M10	385	95	40	147	70	28	13	8	3	133	924
US12/I94	56	28	18	43	6	6	5	1	3	4	170
DA/M10	125	45	10	34	26	10	6	7	3	6	273
M39/M10	350	59	43	118	11	10	2	2	1	2	598
I94/I75	93	19	27	148	9	7	2	0	0	8	313
M153/M39	94	28	21	18	2	1	0	2	0	1	167

### **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.

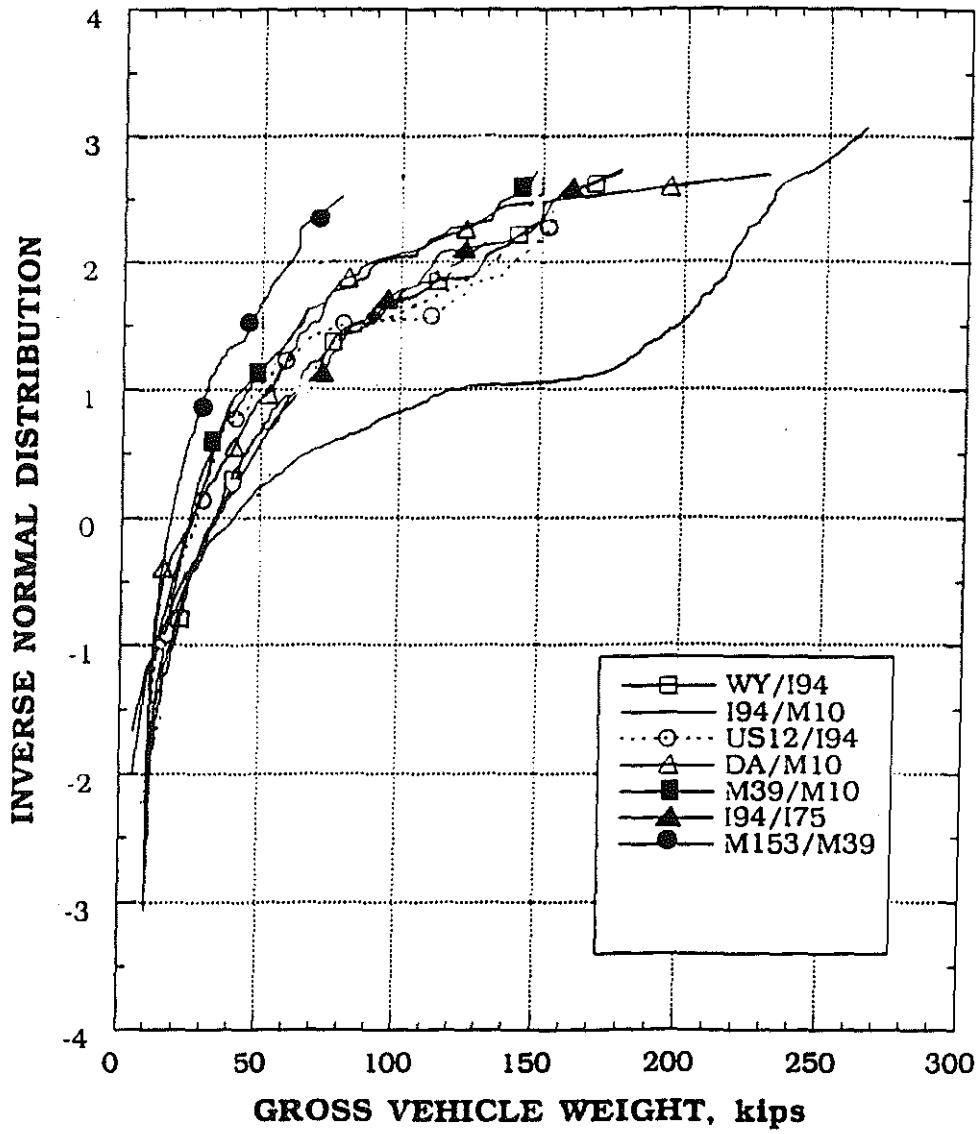


Fig. 1. CDF's of Gross Vehicle Weight for the Considered Bridges.



#### 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.

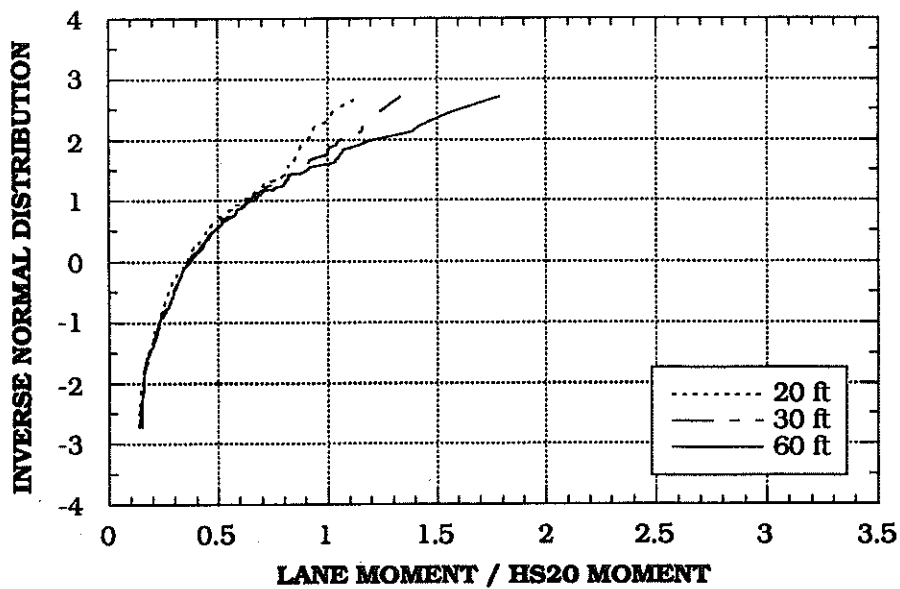


Fig. 2. WY/I94, Lane Moment Distributions, 20, 30, and 60 ft.

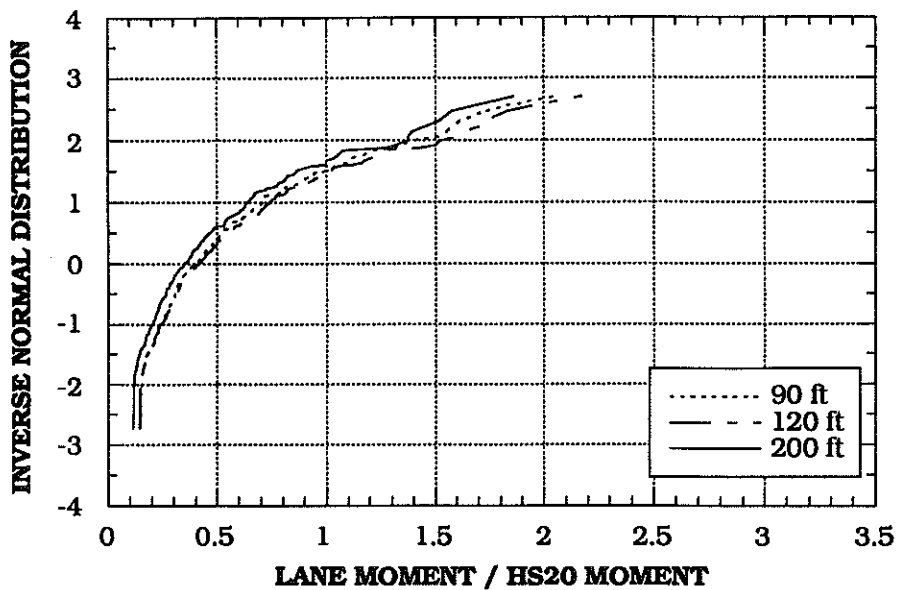


Fig. 3. WY/I94, Lane Moment Distributions, 90, 120, and 200 ft.

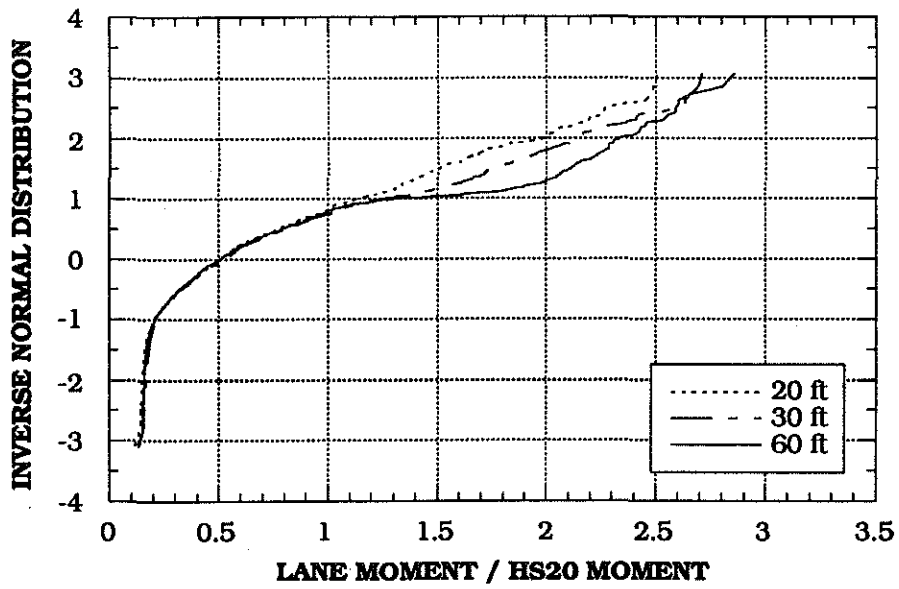


Fig. 4. I94/M10, Lane Moment Distributions, 20, 30, and 60 ft.

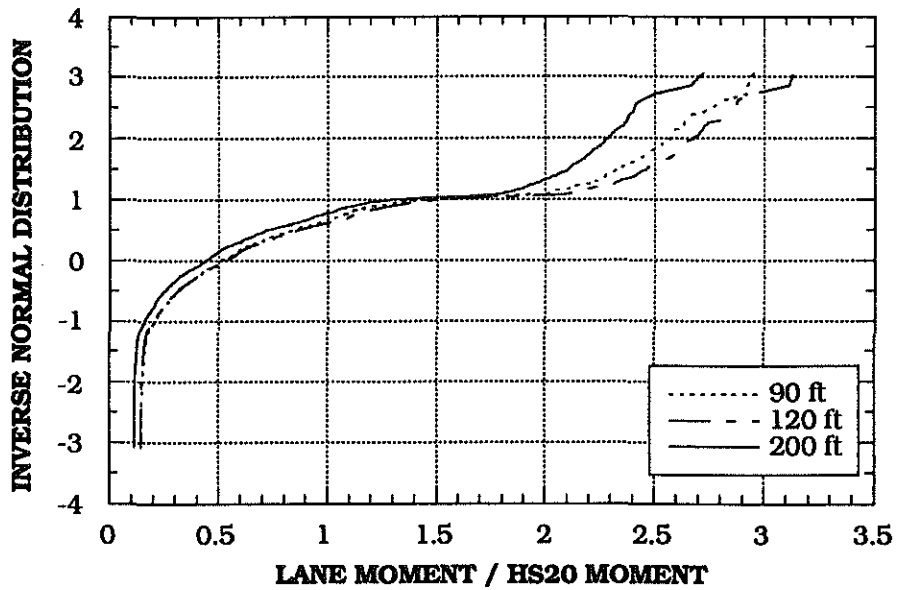


Fig. 5. I94/M10, Lane Moment Distributions, 90, 120, and 200 ft.

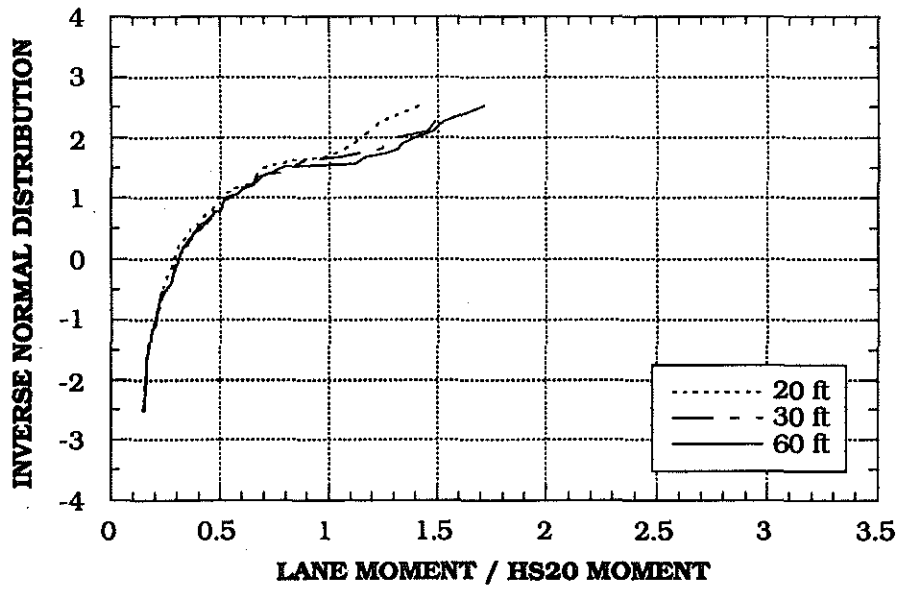


Fig. 6. US12/I94, Lane Moment Distributions, 20, 30, and 60 ft.

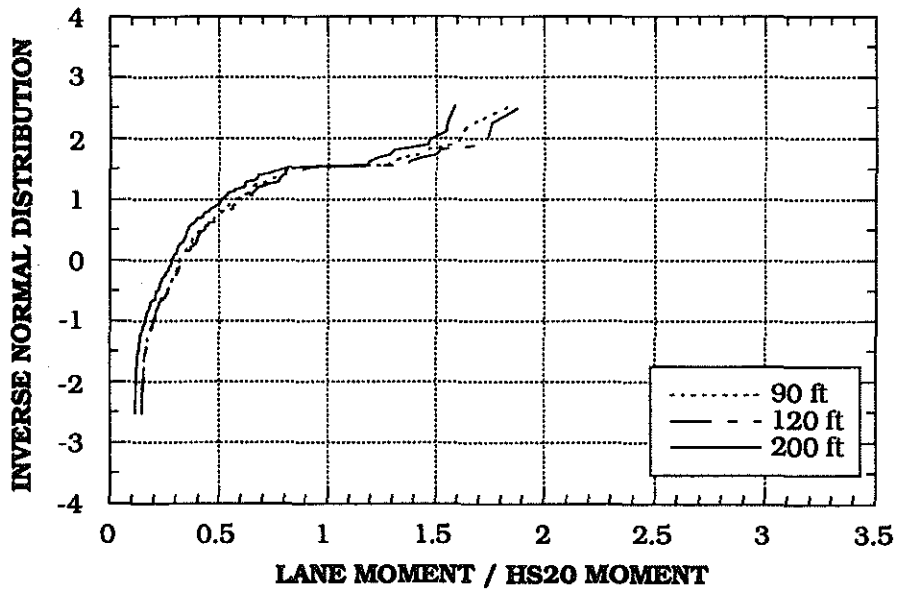


Fig. 7. US12/I94, Lane Moment Distributions, 90, 120, and 200 ft.

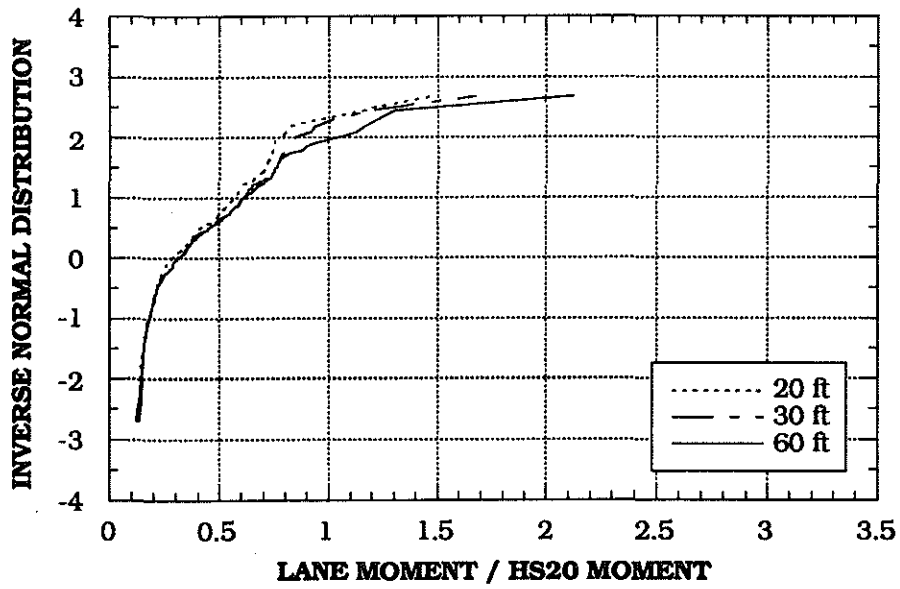


Fig. 8. DA/M10, Lane Moment Distributions, 20, 30, and 60 ft.

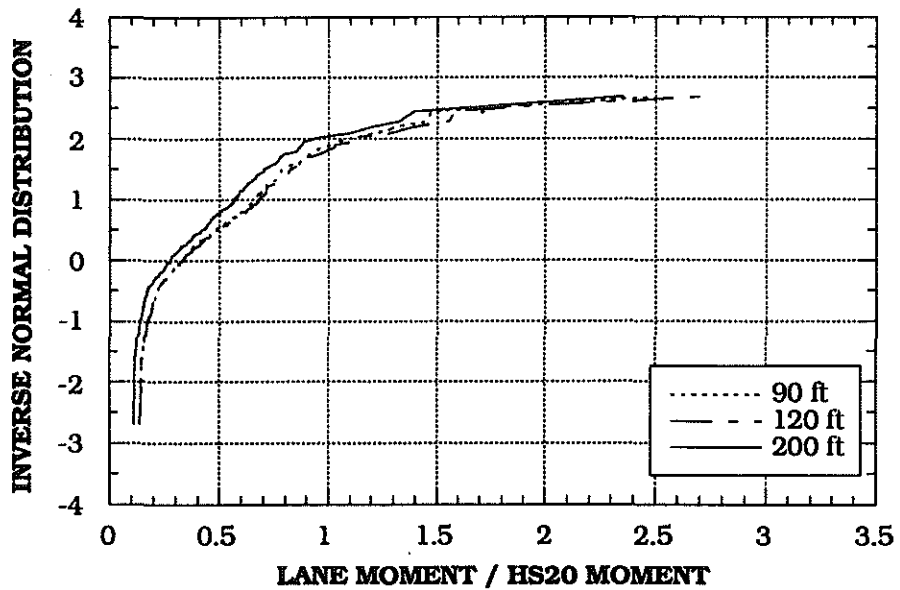


Fig. 9. DA/M10, Lane Moment Distributions, 90, 120, and 200 ft.

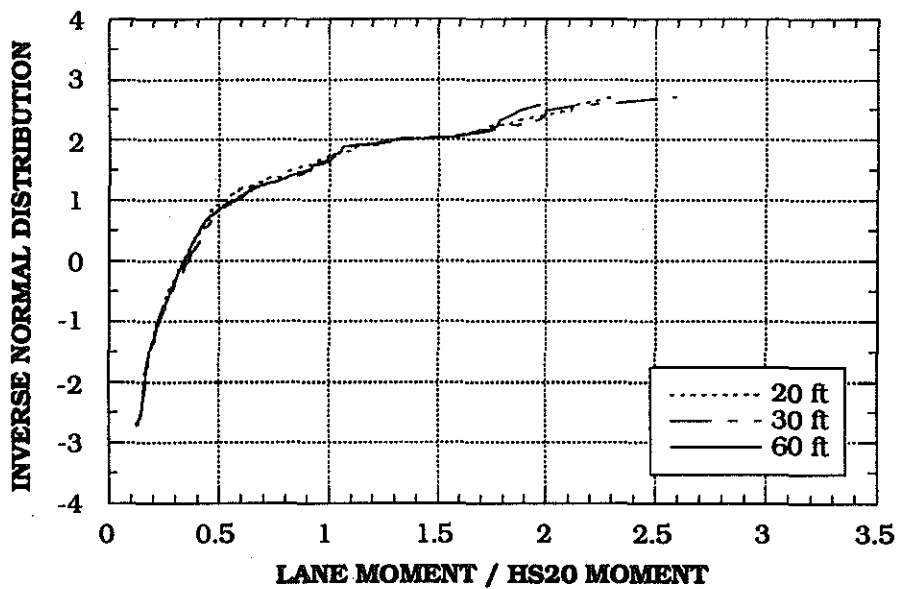


Fig. 10. M39/M10, Lane Moment Distributions, 20, 30, and 60 ft.

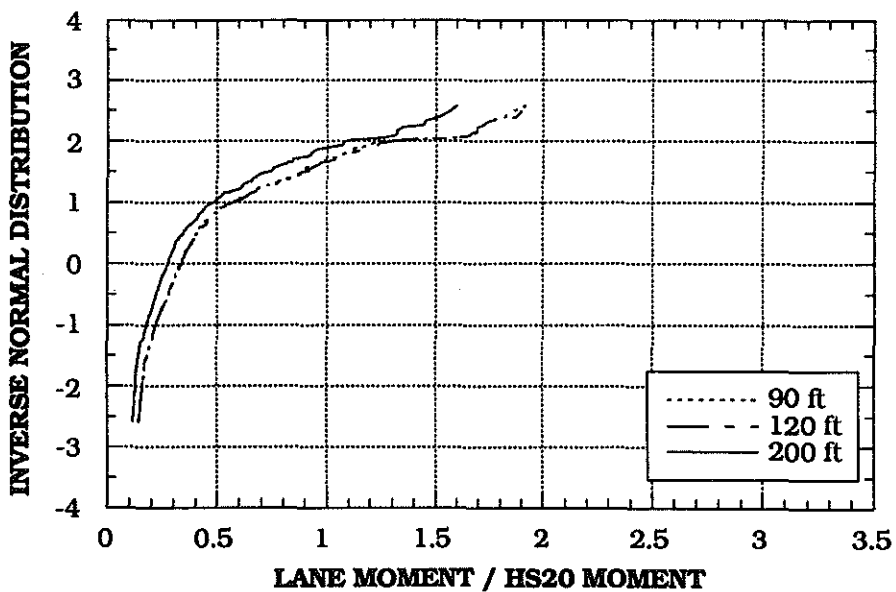


Fig. 11. M39/M10, Lane Moment Distributions, 90, 120, and 200 ft.

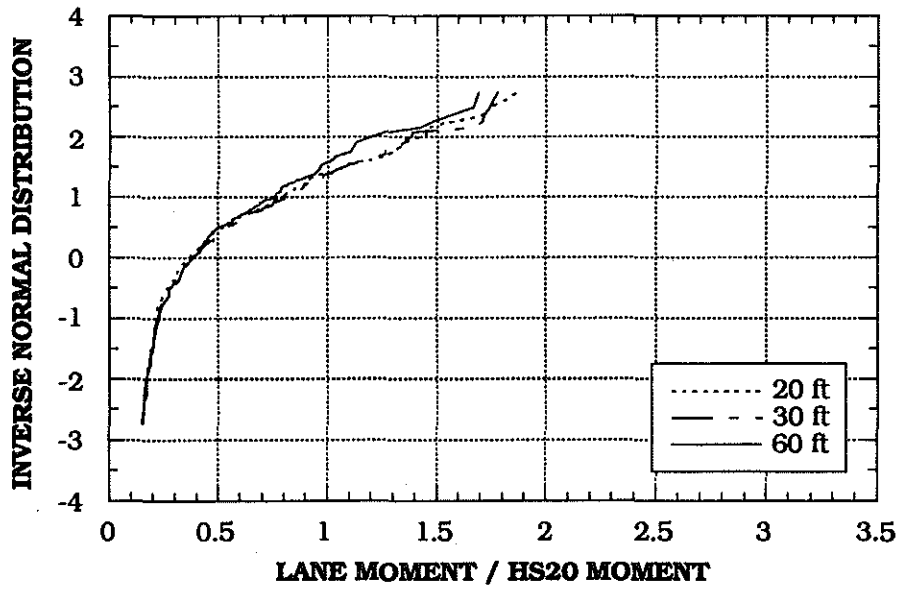


Fig. 12. I94/I75, Lane Moment Distributions, 20, 30, and 60 ft.

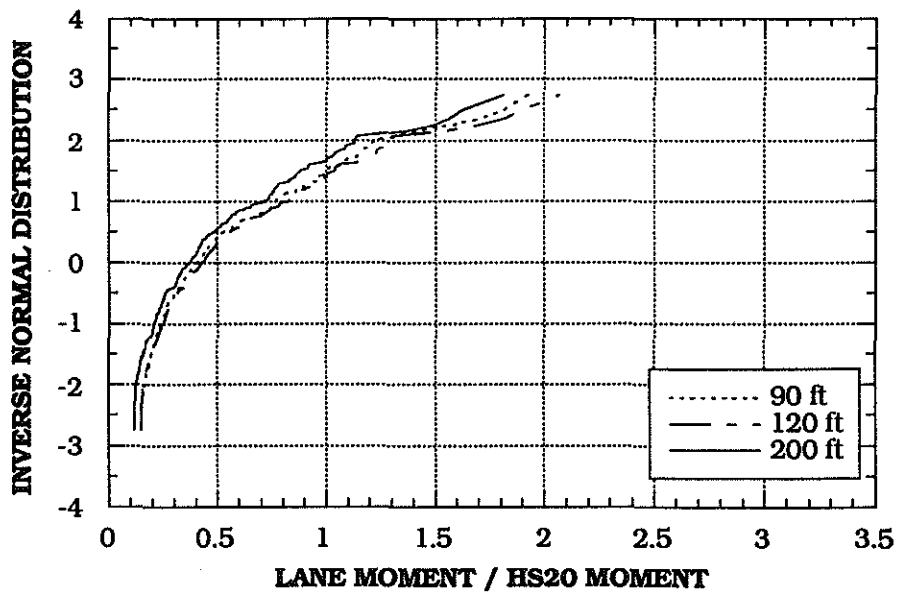


Fig. 13. I94/I75, Lane Moment Distributions, 90, 120, and 200 ft.

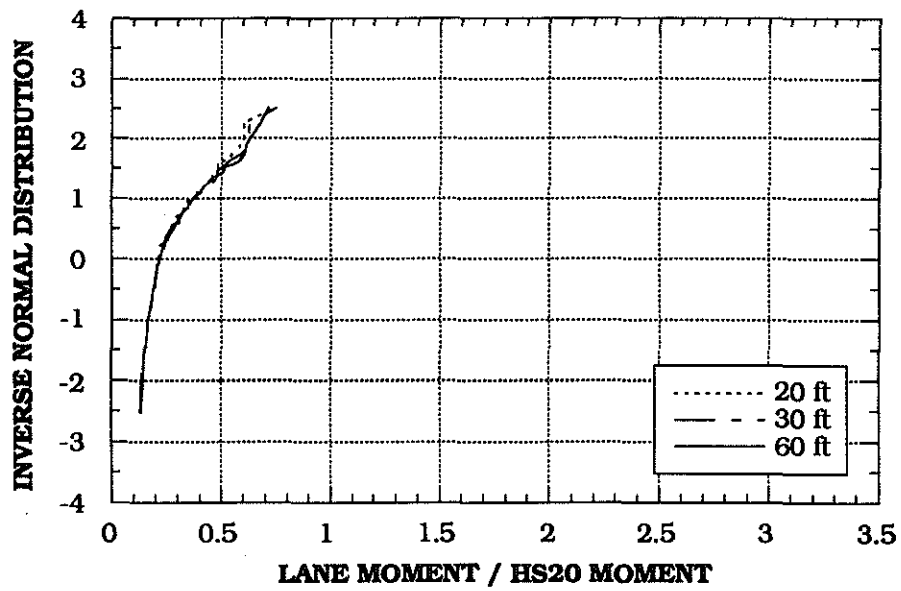


Fig. 14. M153/M39, Lane Moment Distributions, 20, 30, and 60 ft.

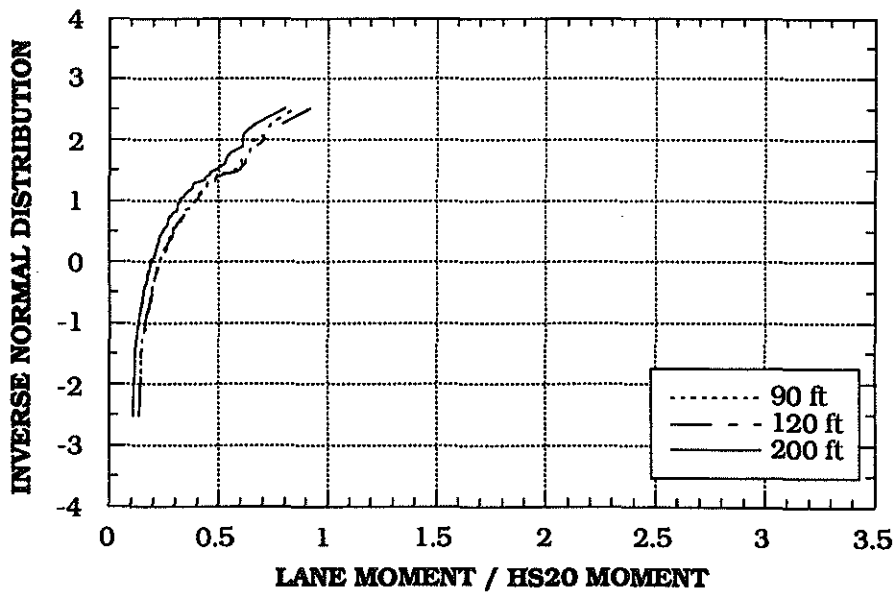


Fig. 15. M153/M39, Lane Moment Distributions, 90, 120, and 200 ft.



**REFERENCES**

Nowak, A.S., Kim, S-J., Laman, J.A., Saraf, V., Park, C-H. and Sokolik, A., 1995, "Truck Loads on Selected Bridges in the Detroit Area", Final Report submitted to Michigan DOT, Department of Civil and Environmental Engineering, University of Michigan, Ann Arbor, MI 48109-2125.

Nowak, A.S., Laman, J.A. and Nassif, H., 1994, "Effect of Truck Loads on Bridges", Final Report submitted to Michigan DOT, Department of Civil and Environmental Engineering, University of Michigan, Ann Arbor, MI 48109-2125.