Report 26-2

DYNAMIC TESTING PROGRAM
OF THE T. & N. O. RAILROAD OVERPASS
EL PASO COUNTY, TEXAS

BY

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Final Report
On
Research Project
Part 2 of 2

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Foreword

In March of 1962 the Texas Highway Department, in co-operation with the Bureau of Public Roads Physical Research Division, planned a study of the T. & N. O. Railroad Overpass on Interstate Highway 10 in El Paso, Texas. This study was formulated to investigate and evaluate the characteristics of the structure under live loading and to compare the results of data obtained with calculated and design values.

Maximum stresses and deflections were measured under static and dynamic loading conditions. Points under investigation on the structure corresponded to the critical points studied during theoretical design. In the comparison of the live load effects it should be remembered that the validity of the theoretical live load stresses is dependent upon the distribution of loads, effects of impact, and the degree of composite action assumed for the theoretical design criteria. Although the theoretical and measured values should be very nearly the same, there are factors that tend to produce a difference in these values. Vibratory action may tend to increase or decrease measured values. This is also true of the physical action of the test truck upon the structure. Sidesway of the truck will affect the load distribution and spring action of the truck suspension system will affect the impact factor. Of particular importance is the surface condition of the bridge deck, which, if rough or uneven will cause a variance in the applied impact to the structure. These items were considered in the evaluation of test runs and in the study of final recorded results.

A simultaneous study was planned on the P. & S. F. Railroad Overpass. This structure, located in downtown El Paso, was showing excessive slab distress in the form of transverse and longitudinal cracking. Spalling of the surface concrete down to the top reinforcement steel was occurring. The study was made to measure beam stresses, deflection, and vibratory behavior under dynamic live load and to determine whether excessive values of these characteristics were contributing to the slab distress. The findings of this study are noted in a companion report.

I. Test Methods and Descriptions

Purpose of Test

In April of 1962 a test program was initiated on the eastbound unit of a twin structure overpass spanning the Ft. Bliss Spur of the T. & N. O. Railroad. This structure is located on Interstate Highway 10 within the city limits of El Paso, Texas and has been opened to traffic since July 1961. The bridge is carrying heavy truck traffic.

Maximum stresses and deflections plus vibration characteristics were measured under static and dynamic loading conditions. The test program was initiated for the purpose of studying these measured values and of comparing data taken with calculated design values.

Bridge Description

The superstructure is a five span continuous I-beam unit (50'-65'-65'-65'-50') with a 52'-0" width roadway. A 6½" concrete slab is supported on seven 33 WF 141 and 33 WF 130 combination steel girders which are spaced on 8'-0" centers. Design loading for the bridge was H20-S16 in accordance with the AASHO Standard Specifications for Highway Bridges, 1953 Edition. Non-composite action was assumed for design, but shear connectors on 24" centers in the positive moment areas were added during construction.

The substructure consists of typical round column bents with concrete caps and spread footings supported by steel piling. Each 2'-6" wide by 3'-3" deep cap is supported on four columns. The alignment of the bridge is on a 43°-27' right forward skew. See Figure 1 for layout.

Test Truck Loading

The test truck was loaded with crushed stone aggregate to approximately an H20-S16 loading. (Fig. 2A) Wheel loads were measured with Department of Public Safety loadometer scales (Fig. 2B) The total weight of loaded truck was 67,400 lbs. Individual wheel loadings and spacings are shown in Fig. 3.

Testing Procedure

A total of 51 points were selected on the structure to provide data for analysis of the bridge behavior. Many of these points required the use of up to five gages to give a complete pattern of stress and deflections. As it was possible to record only 48 gages simultaneously, a number of series of tests were required. For each series of gages a predetermined set of test runs of the truck was made and repeated. Variations in speed, direction, and truck position on the roadway were planned to give the conditions of loading required for the analysis of the bridge.

Station letter designations were assigned to portions of the bridge structure which in turn were designated to be measured in numbered series of test runs. As an example, Station A was recorded in Series I of the test procedure.. Figure 4 shows the station positions and also the position of gages on the beam flanges. Pairs of flange gages were connected in series.

Series I recorded all points at Stations A and B with single point recordings at Stations C, D and F along Beam 4 and one additional end reaction point at the beginning of the bridge.

Series II recorded points of measurement at Stations D, E and F.

Series III recorded points of measurement at Station C, D, E and F plus concrete gages affixed to the bottom of the slab between the beams.

The test runs made by the loaded truck followed predetermined paths along the centerline of the bridge and along lines 16'-0" Left and Right of the centerline (Curb Lanes Fig. 1). These paths of travel were marked on the bridge deck and extended approximately 200 feet beyond each end of the structure. This enabled the truck driver to get positioned correctly before proceeding across the bridge. "Sights" were mounted on the truck to enable the driver to accurately guide the truck along these paths. A small metal arm extended down from the front bumper of the truck low enough to strike and knock over a position marker. This position marker consisted of a row of wooden clothespins clipped at 1" intervals to a two-foot long horizontal bar. This bar was mounted on a short stand and placed on the bridge deck along the path of travel. As the metal arm on the truck passed over the position marker a clothespin was knocked over thus recording the position of the centerline of the truck in relation to the intended path of travel. Figure 5 shows a test run in progress.

Air hoses of the type generally used for traffic counts were stretched across the bridge at the beginning and end of the bridge and at midspan. These air hoses activated an electrical contact switch that was connected to the recording oscillographs in the instrument trailer. As the wheels of the test truck passed over the air hoses, the switch was closed causing a "blip" or event mark to appear on the records. These "blips" or event marks were used as an aid in calculating the speed of the vehicle and also served to indicate placement of the truck at a specified point during each test run.

To determine the probable maximum trace displacement on the records, the test truck was placed stationary at each critical section of the bridge. Amplification for each trace could then be predetermined for each gage. This procedure was for the purpose of presetting amplification to produce satisfactory record scales.

Roughness of the approach slabs and of the bridge deck was measured using a leveling instrument and recording grade shots at two-foot intervals along each path of travel. Grade line deviations along test paths are shown in Fig. 6.

Portable radio units were used to coordinate test runs. The use of these units between the instrument trailer personnel, the truck driver, flagmen, and the personnel on top of the bridge provided coordination of the entire testing program.

Bridge Instrumentation

The test recording instruments used for the project were assembled and operated by the Division of Physical Research, Bureau of Public Roads, Washington, D. C. These instruments were mounted inside a mobile house trailer reconditioned to provide mounting space for the instruments and storage for the necessary supplies. Also included in the trailer was a darkroom for developing the trace records made during the scheduled test runs over the structure.

The strain measuring equipment consisted of two banks of 12 channel amplifiers and three banks of 8 channel amplifiers. Each bank had its own individual power source. Three oscillograph recorders or multi-light beam galvanometers handled 18 active traces each plus base datum lines and event markers. The oscillograph equipment was manufactured by the Consolidated Electrodynamics Corporation of Pasadena, California. Figure 7 is an interior view of the instrument trailer.

Collectively, these instruments measure the effect of change in strain and/or deflection at points on the structure. This change is, in essence, a change in resistance in the active arm of a Wheatstone Bridge. This change in resistance produces a small voltage change in the circuit which is amplified and fed into one of the light beam galvanometers of the recording oscillograph. The movement of this light beam is proportional to the amount of strain induced in a gage and is projected onto a light sensitive paper. When developed this paper furnishes a permanent record of the test run for analysis.

<u>Gage Location</u>

As stated, strain gages and deflectometers were placed at the intersection of beams and station lines. (See Fig. 4)

Gages were mounted 1½" in from the outer edges of the beam flanges unless an obstruction prevented attachment at that point. The gages were placed on the bottom sides of both the top and bottom flanges in the areas of positive moments. In the areas where negative moments were measured, the gages were placed on the bottom of the top flanges and the top of the bottom flanges. Deflectometers were clamped to the bottom flanges of the beams at maximum deflection points. Concrete blocks placed on the ground were used as stationary reference points. Braided wire cable served as the connecting link between the blocks and the deflectometers. (For a general view of flange gages and a deflectometer, see Fig. 8).

Letters, figures, and symbols were used to identify each gage and deflectometer. As an example the designation A4T indicates Station A, Beam 4, and top flange gages.

All gages attached to the beams and to the deflectometers were SR-4 Type A-3 strain gages. The concrete gages were SR-4 Type A-9 gages.

II. Analysis of Data

Test Run Selection

Selection of the particular test runs to be evaluated was influenced by a variety of factors which are worth mentioning at this time. Each test on a specific path of travel and at a certain speed was made by a pair of round trip runs of the test vehicle. Therefore, there were four individual records available for analysis. Two records with the truck following the regular flow of traffic and two records with the truck opposing the regular flow of traffic. Speeds of the truck were calculated using the lines and event markers shown on the oscillograph recording and were compared to the intended speed of the truck during the test run. Those runs most nearly meeting the speed requirements were noted and set aside for further study as to accurate positioning of the truck along the path of travel. The position marker measurements which were recorded after each test run showed whether the truck deviated from the path of travel in a straight pattern or a weaving pattern. A weaving pattern would accentuate sidesway of the load in the test vehicle. (Study of the truck records showing individual wheel loads would also indicate the amount of sidesway.)

Collectively, this careful screening of the records gave a test run that most nearly fulfilled the idealized test run. A "second" choice run was also noted to be used as a check on any particular trace that might seem to be irregular or unexpected, but is not reported on unless used. Figure 9 shows a typical test run oscilligraph trace record.

Data Processing

In order to reduce the trace recordings of the test runs to useful stresses and deflections it was necessary to manually scale these traces to determine the magnitude of deviation from some no-loaded condition. This norm or no-load condition was established for each gage on the test record by operating the oscillograph for a few seconds before the test truck came onto the bridge. A table was set up to record the various scaled values needed to obtain this difference and to calculate the resulting final stress or deflection values. A sample table is shown in Figure 10. A large amount of repetitive calculations were necessary to reduce the original data to its usable form. Possibly the use of a data processing machine would have speeded up the reduction of the data after the manual measurements were completed.

Live Load Stresses and Deflections

For the assimulation of the maximum live load stresses and deflections, the peak values of the record traces were measured with the test vehicle at the critical section that was under study. To be used in a comparison with design stresses and deflections it would be necessary to consider the bridge to be loaded as assumed in the original design.

Data was combined from all three test lanes to provide values of stress and deflection that should be comparable to calculated values based on three lanes loaded with actual test truck loads.

Charts No. 1 thru 4, 9 thru 12, 17 and 18 show accummulative totals of peak stresses or deflections (at the station analyzed) produced by the test truck in the position that gave maximum values for each beam. Charts No. 4 thru 8 and 13 thru 16 show accumulative stresses or deflections (at the station analyzed) produced by the drive wheels of the test truck being located at that station.

With all girder sections being equal, the load distribution is directly proportional to the distribution of bottom gage stresses. However, it is noted that when considering lateral load distribution it is incorrect to use the values attained when measuring peak trace values of a test run. Therefore, for the purposes of measured load distribution comparison with design load distribution (AASHO distribution factor, S/5.5 was used), it is necessary to record separate values at Stations B and E. Investigation of the trace records showed that the maximum stresses and deflections did not occur simultaneously. Therefore, values were obtained when the truck was positioned at the certain critical point under study.

For the comparison to the measured stresses and deflections it was considered practical to list the design values in the text of the Data Analysis rather than to reproduce them on each chart of measured values. These design values are listed below.

CALCULATED DESIGN LIVE LOAD
STRESSES AND DEFLECTIONS
INCLUDING IMPACT

FOR NON-COMPOSITE DESIGN

	Sta. A	Sta. C	Sta. D	Sta. F
Max. Flange Stresses	13950	8780	13320	9580
Max. Defl. (Calc.)	0.83 in.	-	1.33 in.	-
Max. Defl. (Allow)	0.75 in.	-	1.00 in.	-

FOR COMPOSITE DESIGN

	Sta. A	Sta. C	Sta. D	Sta. F
Max. Flange Stresses	10604	6970	11266	7659
Max. Defl. (Calc.)	0.46 in.	-	0.74 in.	-
Max. Defl. (Allow)	0.75 in.	-	1.00 in.	-

Flange Stresses Are Measured in psi.

These listed non-composite stresses and deflections were calculated using the section furnished in original design criteria which assumed non-composite action of the superstructure. It can be seen by comparing the design and measured data that composite action was very evident. Charts No. 43 thru 57 show top and bottom flange stresses for each test run.

It may be assumed that a small part of the composite action is due to friction between the slab and the beams. In addition, a large contribution toward composite action was provided by the introduction of a field change that required shear connectors or lugs to be welded to the tops of the beams. These lugs were placed on 24" centers in the positive moment areas of the structure only. These lugs would tend to prevent slippage between the slab and beams. Lack of actual slippage is not definitely assumed although careful screening of the oscillograph records shows no evidence of sudden or sharp changes in the path of the traces. A sudden or sharp change would show a shift in the neutral axis of the section thus indicating a change in composite action and slippage between the slab and beams.

Of particular interest was the presence of stress reversal action in the stringers of the structure during dynamic loadings. Most pronounced reversals occurred in the curb lane of the end spans of the unit. Maximum reversals were in the order of 43% of the induced stresses in the positive moment area. These reversals were mostly evident as the test vehicle was leaving the structure and could have been aggrevated by the heavy skew and by interaction between spans. Higher speeds tended to produce greater reversals.

SR-4 type A-9 strain gages were applied transversely and longitudinally to the bottom of the slab between the beams and under the curb lane paths to study load transfer in the slab. Although the gages were placed in areas of maximum structure action, it was noted that only localized loads as they passed over the gages were readily recorded. This data showed induced concrete stresses of about 325 psi maximum. The slab gages showed little or no stress until a truck wheel was within three feet of a gage point. This indicates that the ability of the slab to transmit a wheel load to the beams was limited to a 6 foot section of slab centered under the wheel.

Vibration

The study of the natural frequency of the combined actions of a vehicle and a structure are dependent upon a number of variables and constants. The variables are introduced by the moving vehicle which needs to be analyzed as to its mass, placement, direction and speed. The constants are the properties of the structures' mass, stiffness, supports, and length. Introduced together, these factors provide a constantly varying frequency that is tedious and complex to formulate and tabulate and is correct only for the conditions applied at that time. One exception to this would be when the truck characteristics and the structure characteristics vibrate in the same phase or in resonance. Only at intermittent points on the records was this condition noted. Therefore, the investigation of vibration was directed to analysis of the damping characteristics of the bridge and study of the peak double amplitude of vibration produced under live load. These could affect the rideability sensation produced on vehicles passing over the structure. The measurements of these peak double amplitudes are shown in Chart No. 58. They are given in inches for each beam and are shown with the truck following each path of travel and at varying speeds. This measurement was taken at the point where the truck most greatly affected the section under study and appears to be rather large. This is caused by the gage traces being influenced by the normal deflection of the beams under load rather than being measured under an idealized vibrative condition.

As only one end of the structure was instrumented, the damping characteristics of that section only are available for analysis. Another detriment to extensive study was the lack of records showing the full damping action of the structure. Therefore, only the average calculated values of these few runs are given.

For the end span, the average measured duration of vibration after the test truck left the structure and until vibration was no longer measurable was noted to be 3.6 seconds. The average Log Decrement of Damping was noted to be in a range from .064 to .095 and varied according to truck speed and position.

The natural frequency of the end span was approximately 10.0 cycles per second. A loaded frequency of 9.2 cycles per second was measured with difficulty in that it was very hard to find records that had traces showing constant vibration frequency cycles. As noted, this was due to the complex interaction between the structure and the test vehicle. Slightly lower values were noted for interior spans.

Vibration effects transferred between the spans caused an irregular action in the trace movement which could effect the peak stresses and deflections produced by a vehicle crossing the bridge. This action, in form of larger vibration peaks of double amplitude, could fall just as a trace reached its true maximum displacement and would result in a higher stress or deflection than normal. These peaks may fall to either side of the maximum displacement and have a damping effect on the true displacement. This transfer or beating between spans could also have a decided effect on the values of the logarithmic decrement of damping.

III. Summary of Results

1. Accumulated measured values of stress and deflection based on three paths loaded are considerably lower than design values. The design values are based on AASHO load distribution factor which is equivalent to placing 5.1 standard trucks on the structure with equal distribution.

2. Accumulated measured values of stress and deflection based on three paths loaded compare favorably with calculated values. The calculated values are based on actual test truck loads distributed according to assumed distribution patterns. (See 3 below) AASHO impact factors for positive moments were used.

   A. Measured values of positive moment stress compare closely with calculated values.

   B. Measured values of deflection are in general lower than calculated values. This may be attributed to the inherent greater stiffness of a skewed structure due to slab warping. It may also be attributed to the fact that calculated values are based on $n = 10$, whereas stress diagrams indicate an average n of approximately 7.

   C. Measured values of negative moment stress are considerably lower than calculated values. This may be attributed to the low deflections mentioned above and to a small amount of composite action present on the lightly stressed beams. (See Charts 55 through 57). It should be noted that this composite action would probably not occur with three simultaneous truck loads; however, it does affect the accumulated single load values.

3. The following assumed distribution percentages were selected for distributing calculated values plotted on Charts 1 through 18. These percentages were selected to conform in general to measured values and therefore they provide an indication of the measured distribution with three paths loaded.

Beam	1	2	3	4	5	6	7
Positive Moment Span 1	44*	42	34	60	34	42	44
Positive Moment Span 2 @ D	40	46	40	48	40	46	40
Positive Moment Span 2 @ E	65	42	25	36	25	42	65
Negative Moment @ F	Equal						

* % of one truck to the beam

Equal distribution of deflections for accumulated loads gave acceptable correlation in all cases. For deflections due to single truck loads, the calculated deflections were distributed as indicated by the measured deflections. The deflections at both B and E were distributed by percentages obtained from measured values at A and D respectively.

4. Impact effect as indicated by measured stress was erratic and in some cases rather high. This could be due in part to roughness of the riding surface on the approach slab and the bridge deck. See Fig. 6. No other explanation is available for this. In general, impact increased with speed.

5. Measured stresses confirm composite action in the positive moment areas and non-composite action in negative moment areas except as noted in 2 above. (See Charts 43 through 58).

6. The structure exhibited a tendency toward a rapid damping of vibration as shown by a low time lapse to a "rest" condition, a high degree of logarithmic decrement, and a low amplitude of vibration. This high rate of energy dissipation is probably due to greater stiffness caused by composite action.

ACKNOWLEDGMENTS

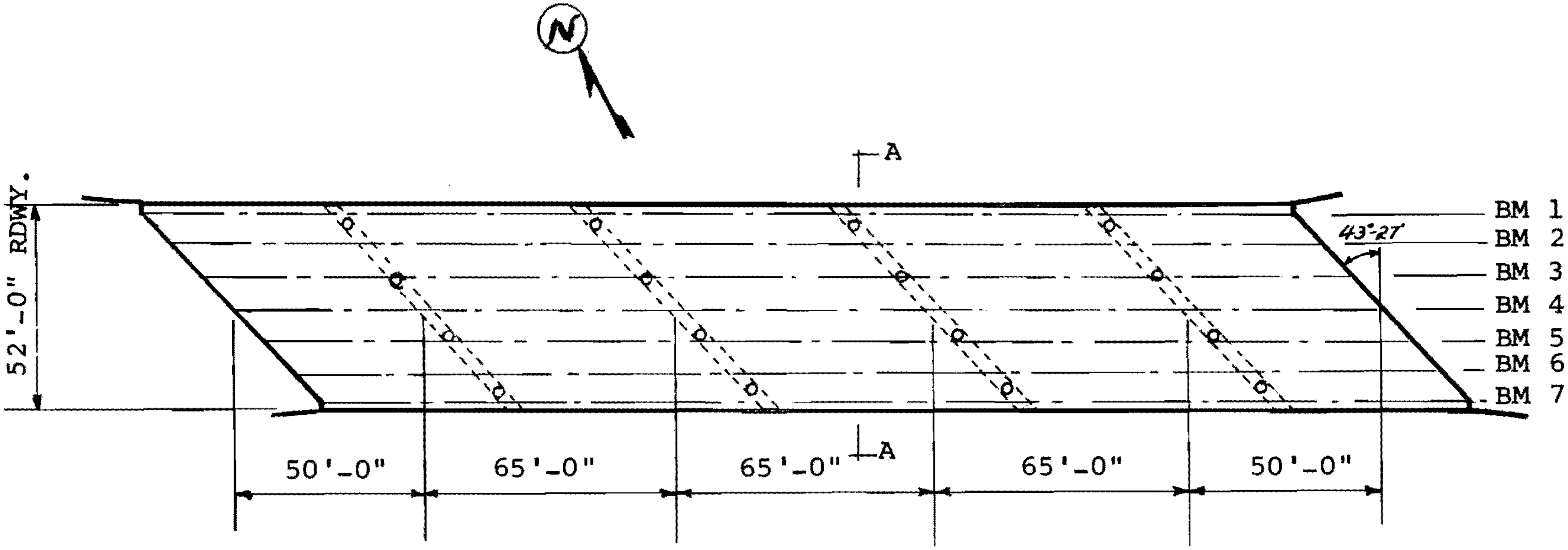
The testing program was a cooperative project of the Department of Commerce, Bureau of Public Roads, and the Bridge Division, Texas Highway Department.

Mr. G. S. Vincent, Bridge Engineer, Division of Physical Research, Bureau of Public Roads, assisted the Texas Highway Department in the initial planning of the testing program.

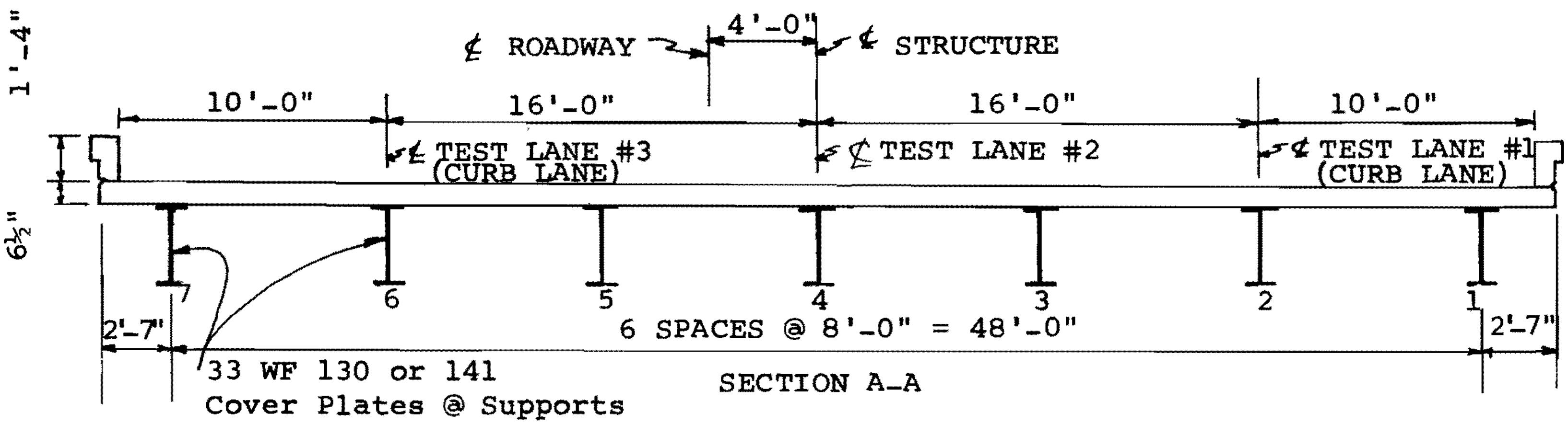
Field supervision of the testing was provided by R. F. Varney, Highway Research Engineer, Bureau of Public Roads, and C. F. Galambos, Highway Research Engineer, Bureau of Public Roads, along with personnel of the Bridge Division, Texas Highway Department.

Work crews and special field equipment were provided by Mr. Ed Mars, District Engineer of District 24, Texas Highway Department.

LIST OF FIGURES



PLAN VIEW OF EASTBOUND BRIDGE



SECTION A-A

FIGURE 1 LAYOUT OF T. & N.O. STRUCTURE

FIGURE 2A LOADING AGGREGATE INTO TEST TRUCK

FIGURE 2B WEIGHING WHEEL LOADS

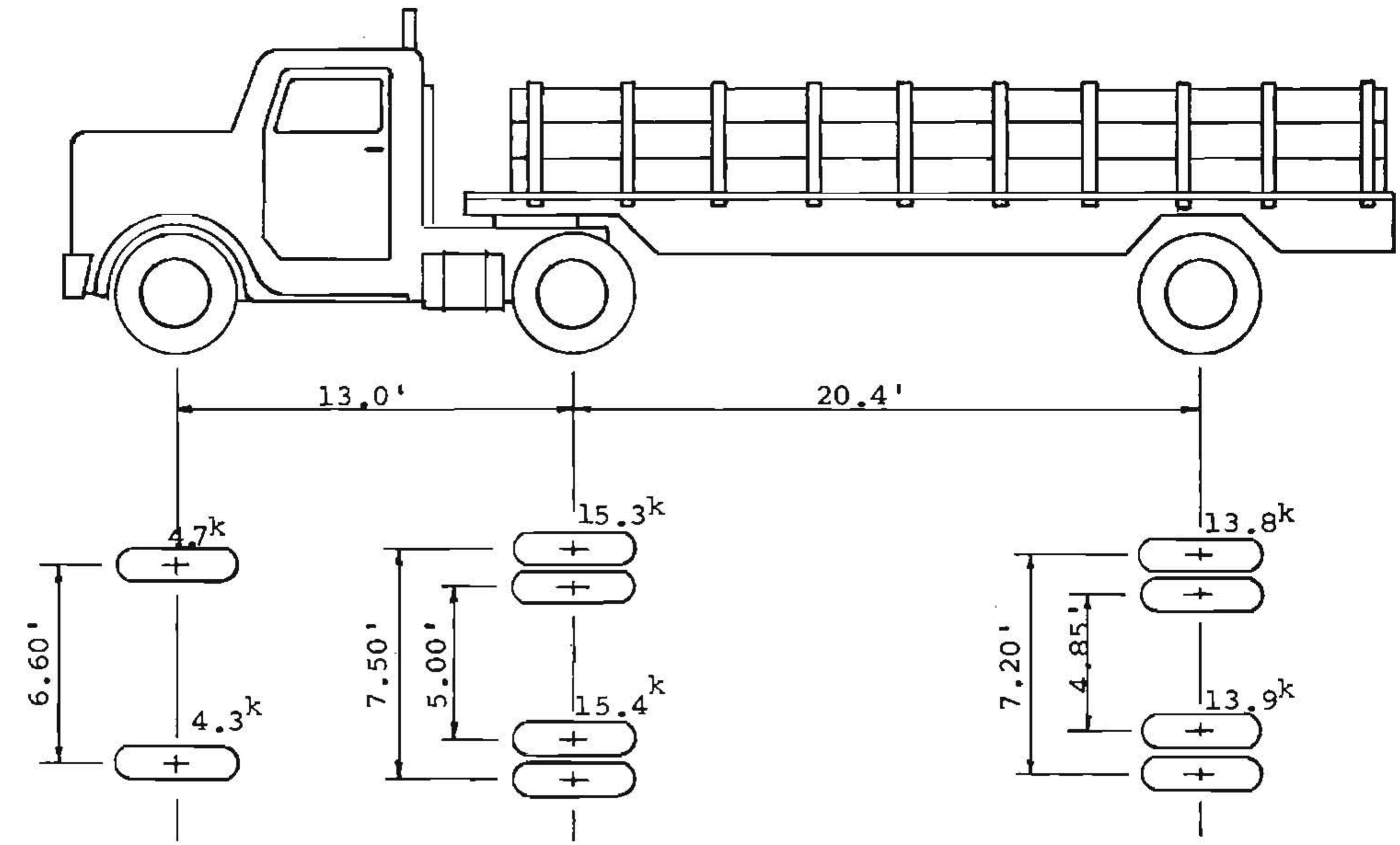
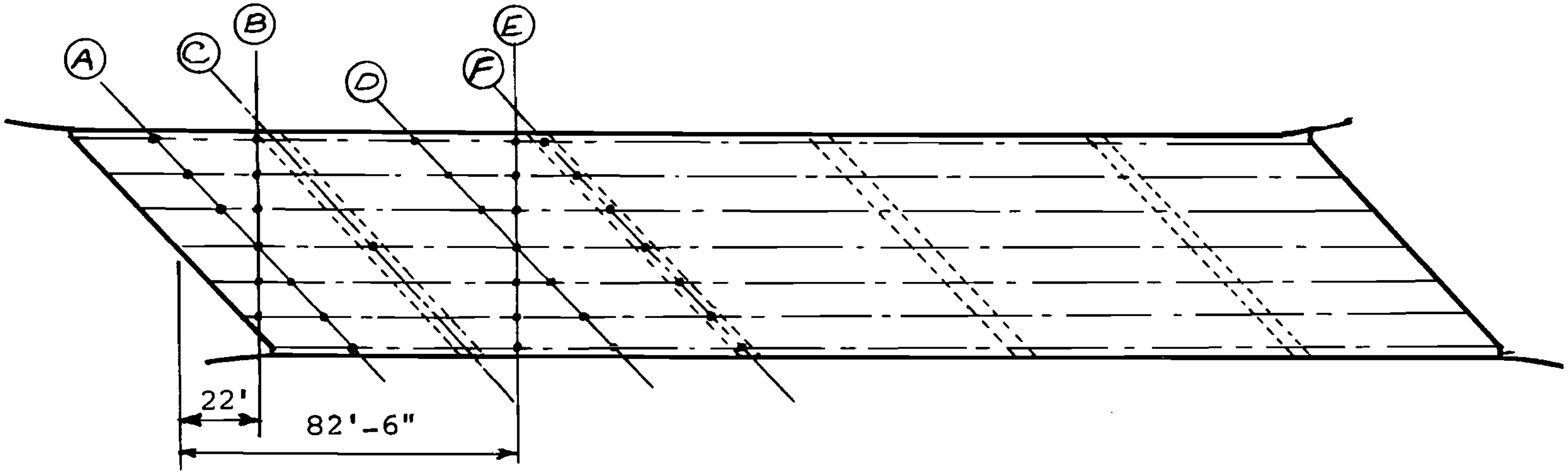
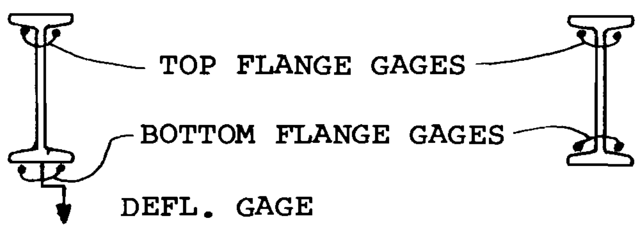


FIGURE 3 WHEEL LOADS AND SPACINGS

FIGURE 4 POSITIONS OF DATA MEASURING STATIONS





GAGE POSITIONS AT STATIONS A,B,D,&E

GAGE POSITIONS AT STATIONS C & F

FIGURE 5 TYPICAL TEST RUN OF TRUCK

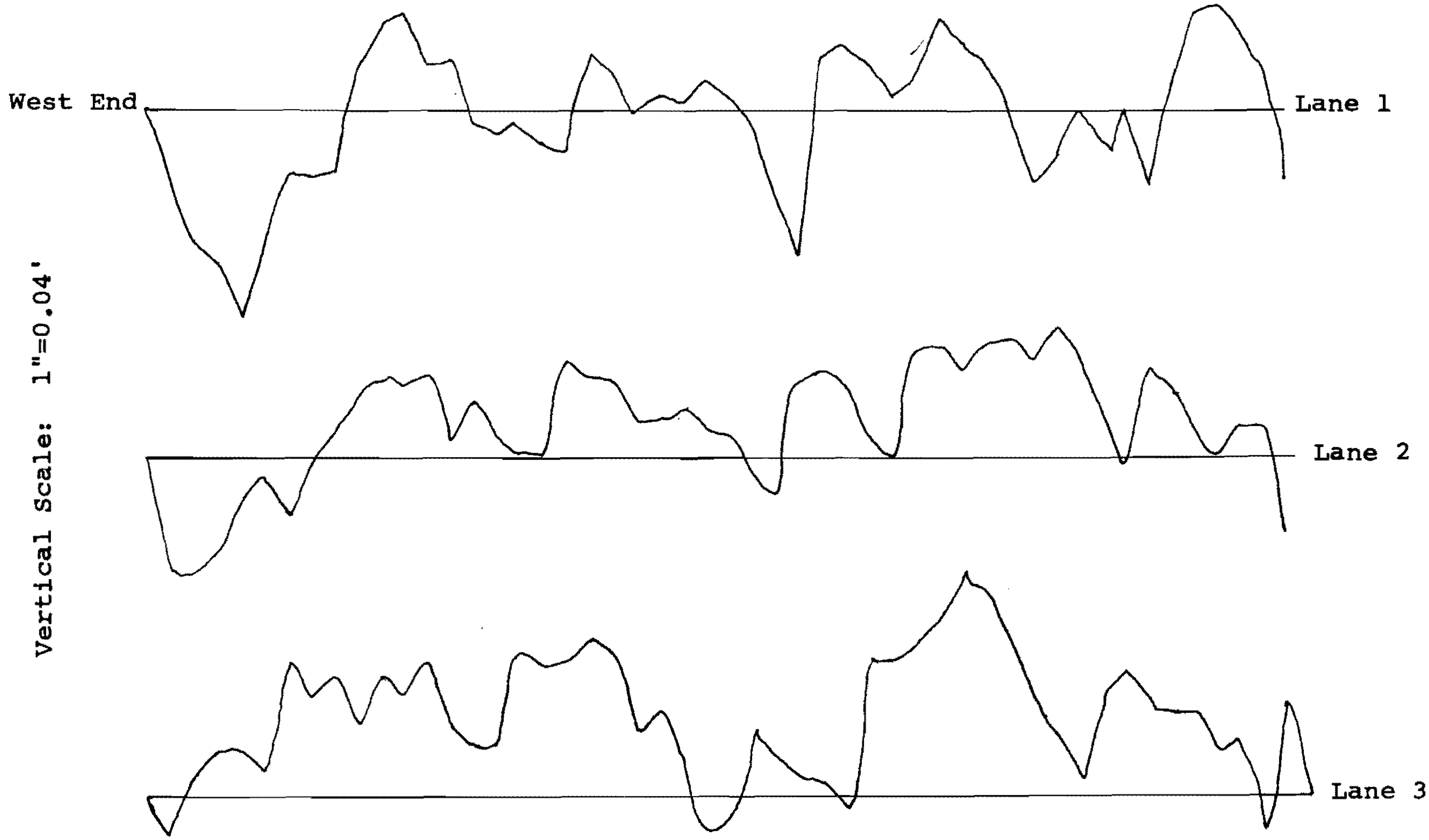


FIGURE 6

PLOTS OF BRIDGE PROFILES ALONG TEST PATHS

(DEVIATIONS FROM VERTICAL CURVE)

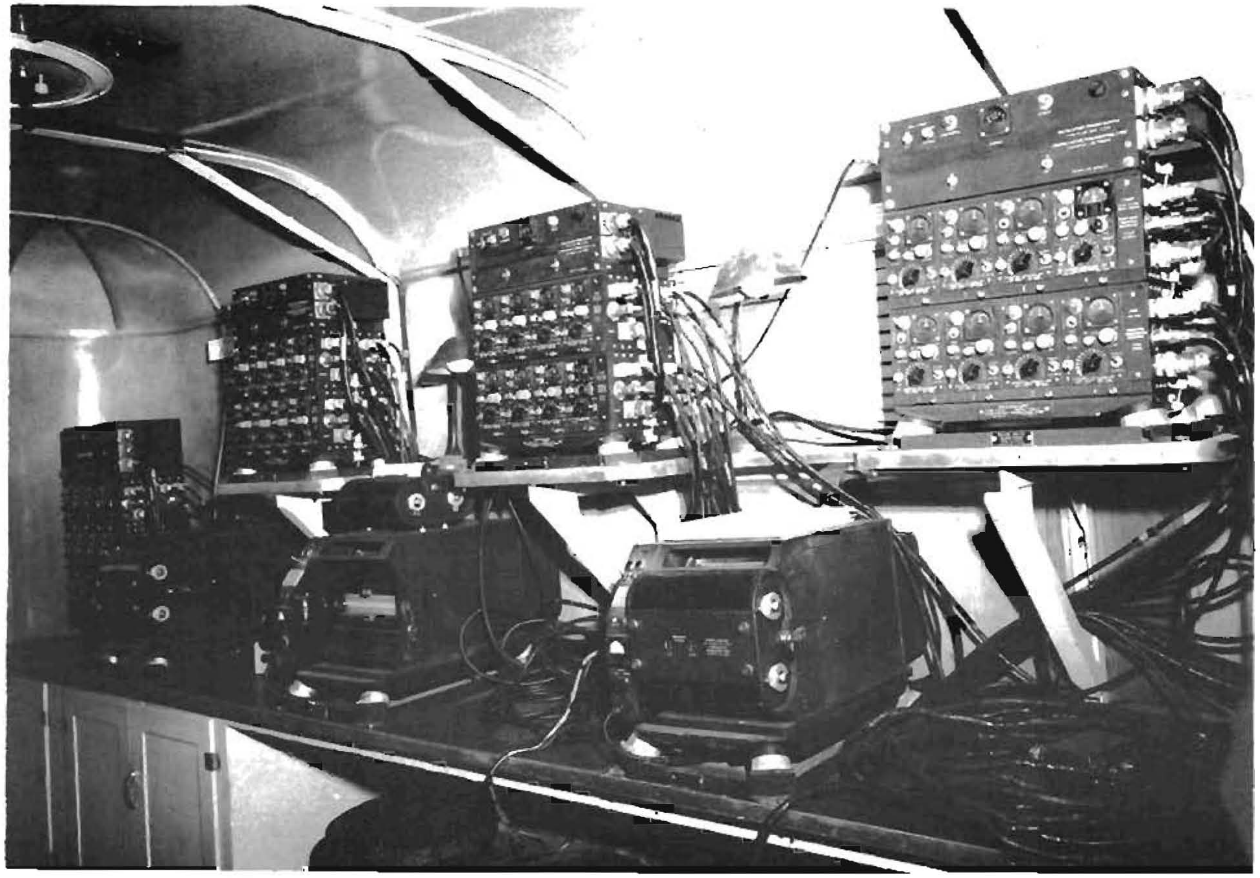


FIGURE 7 STRAIN MEASURING INSTRUMENTS IN TRAILER

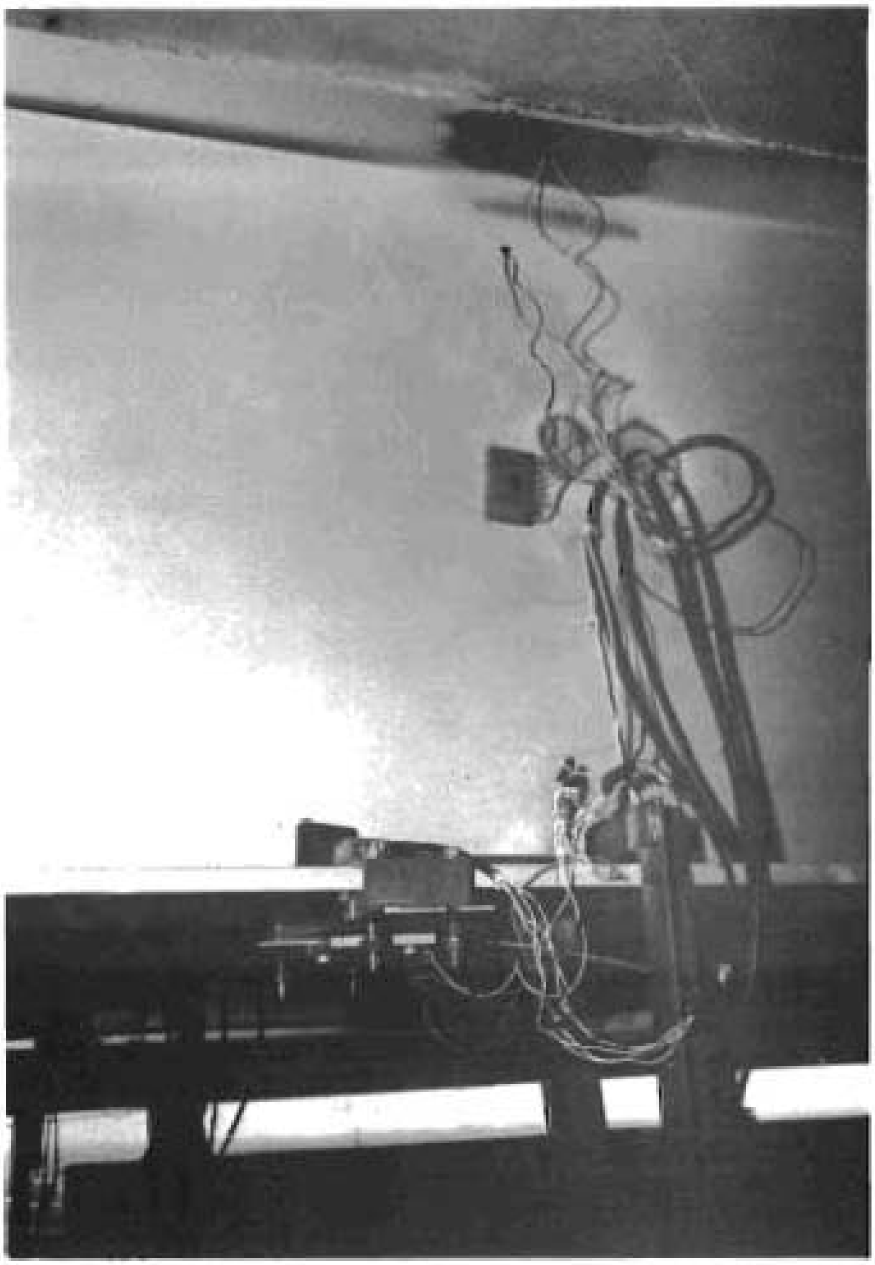


FIGURE 8 TYPICAL PLACEMENT OF FLANGE GAGES AND DEFLECTOMETERS

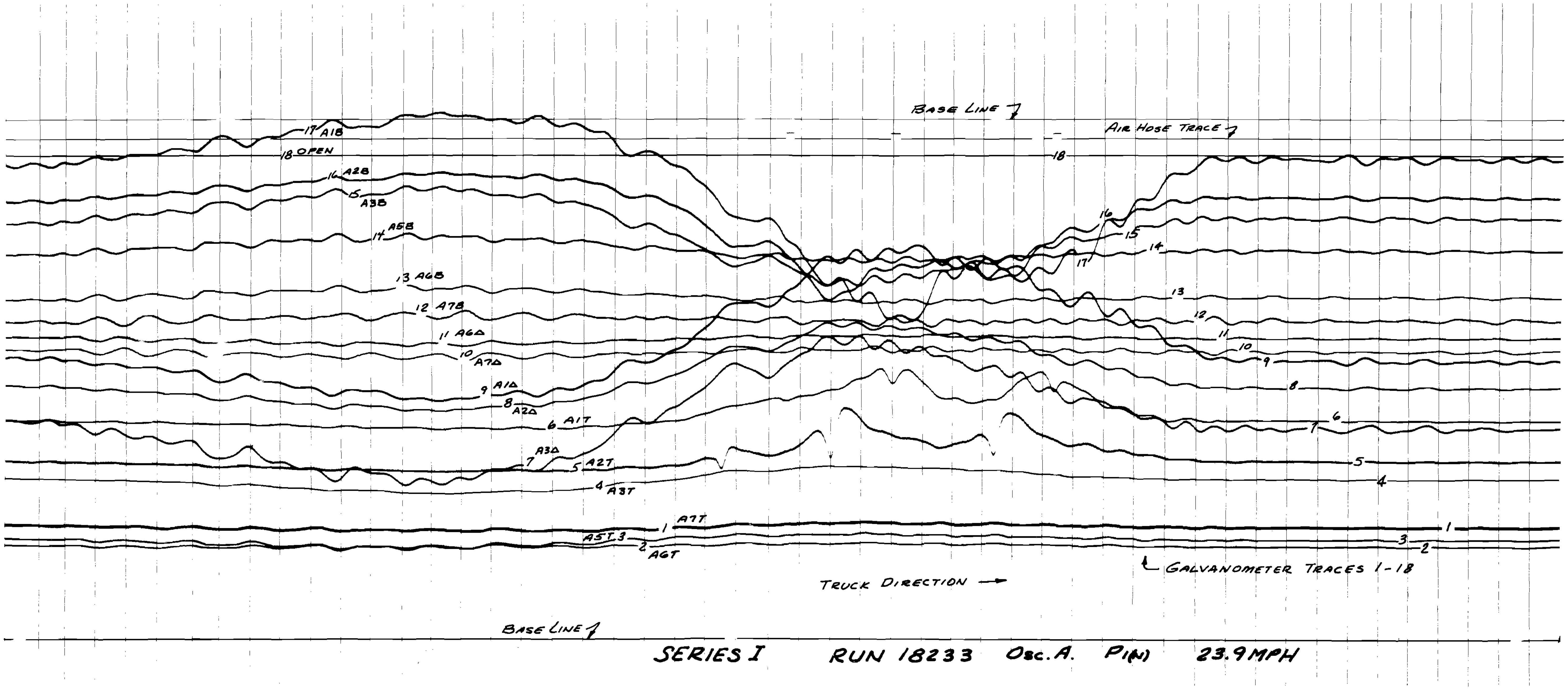


FIGURE 9 TYPICAL TRACE RECORDING OF TEST RUN

OSC.A.-RECORD NO. 18213-PATH 1 (NORMAL)-SERIES 1
T.&N.O. RR OVERPASS - 25 MPH

Galv. No	Gage Position	Base To Mean Trace	Base To Peak Trace	Diff.	Stress Factor or Defl.Factor	Stress(psi) or Defl.(In.)
6	A1T	2.15	2.53	+0.38	515.0	+ 195.70 psi
17	A1B	4.68	3.40	-1.28	2026.8	-2954.30 psi
9	A1Δ	2.71	3.86	+1.05	0.1135	+ 0.1192 in.
5	A2T	2.10	2.57	+0.47	512.9	+ 241.06 psi
16	A2B	4.42	3.04	-1.38	2813.3	-3882.35 psi
8	A2Δ	2.37	3.03	+0.66	0.1234	+ 0.0820 in.
4	A3T	2.18	2.28	+0.10	490.4	+ 49.04 psi
15	A3B	4.18	3.45	-0.73	1753.4	-1279.98 psi
7	A3Δ	1.95	2.94	+0.99	0.0475	+ 0.0470 in.
3	A5T	1.37	1.40	+0.03	551.1	+ 16.53 psi
14	A5B	3.98	3.90	-0.08	1821.2	- 145.70 psi
-	A5Δ	ON OSC. B	-	-	-	-
2	A6T	1.29	1.31	+0.02	440.9	+ 8.81 psi
13	A6B	3.35	3.48	+0.13	1690.5	+ 219.77 psi
11	A6Δ	2.93	2.97	+0.04	0.1226	+ 0.0049 in.
1	A7T	0.56	0.61	+0.05	430.4	+ 21.52 psi
12	A7B	3.25	3.17	-0.08	1698.1	- 135.85 psi
10	A7Δ	2.82	2.83	+0.01	6.1082	+ 0.0011 in.

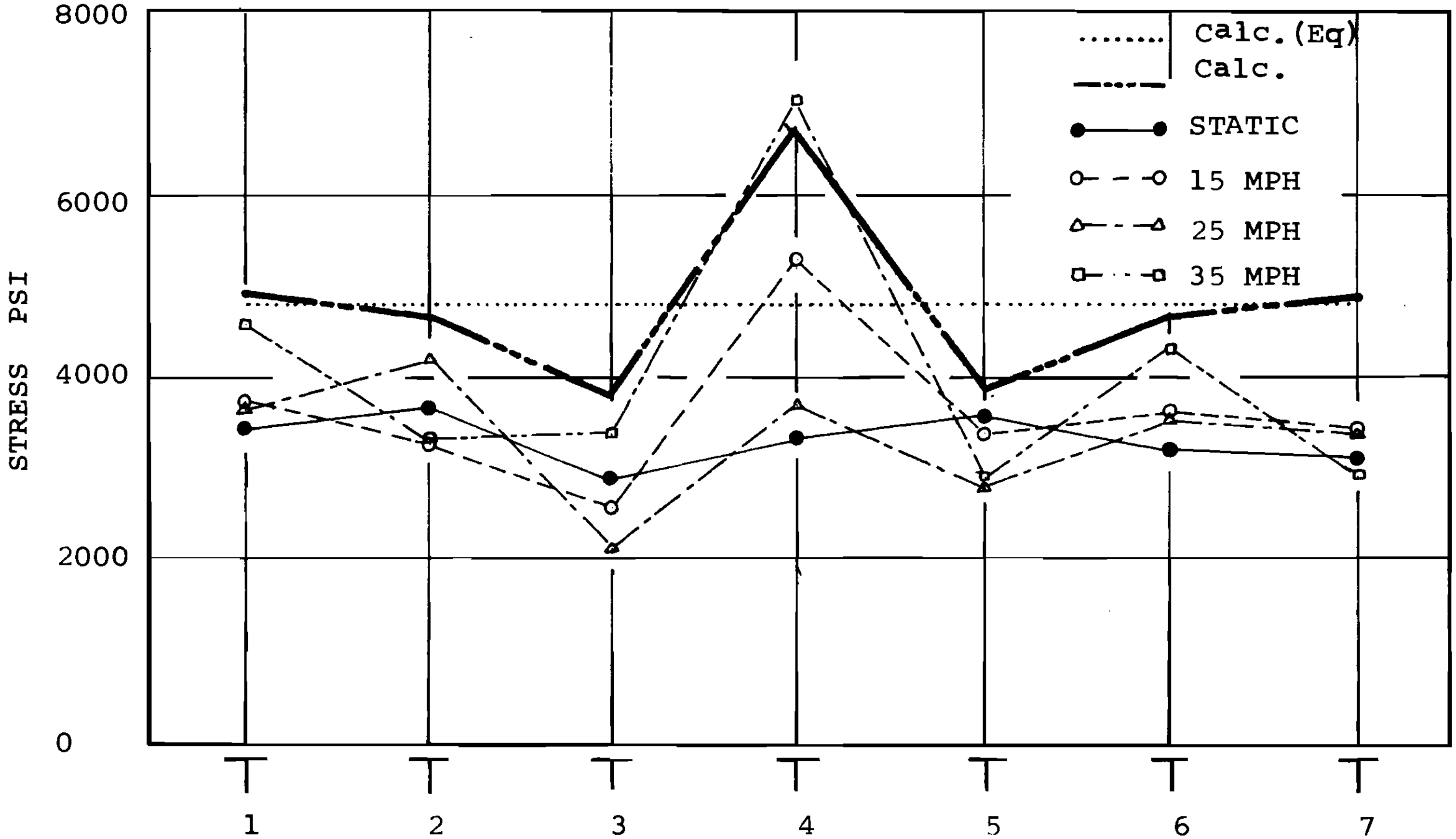
Top Or Bottom Flange, Deflection

Beam Number

Station

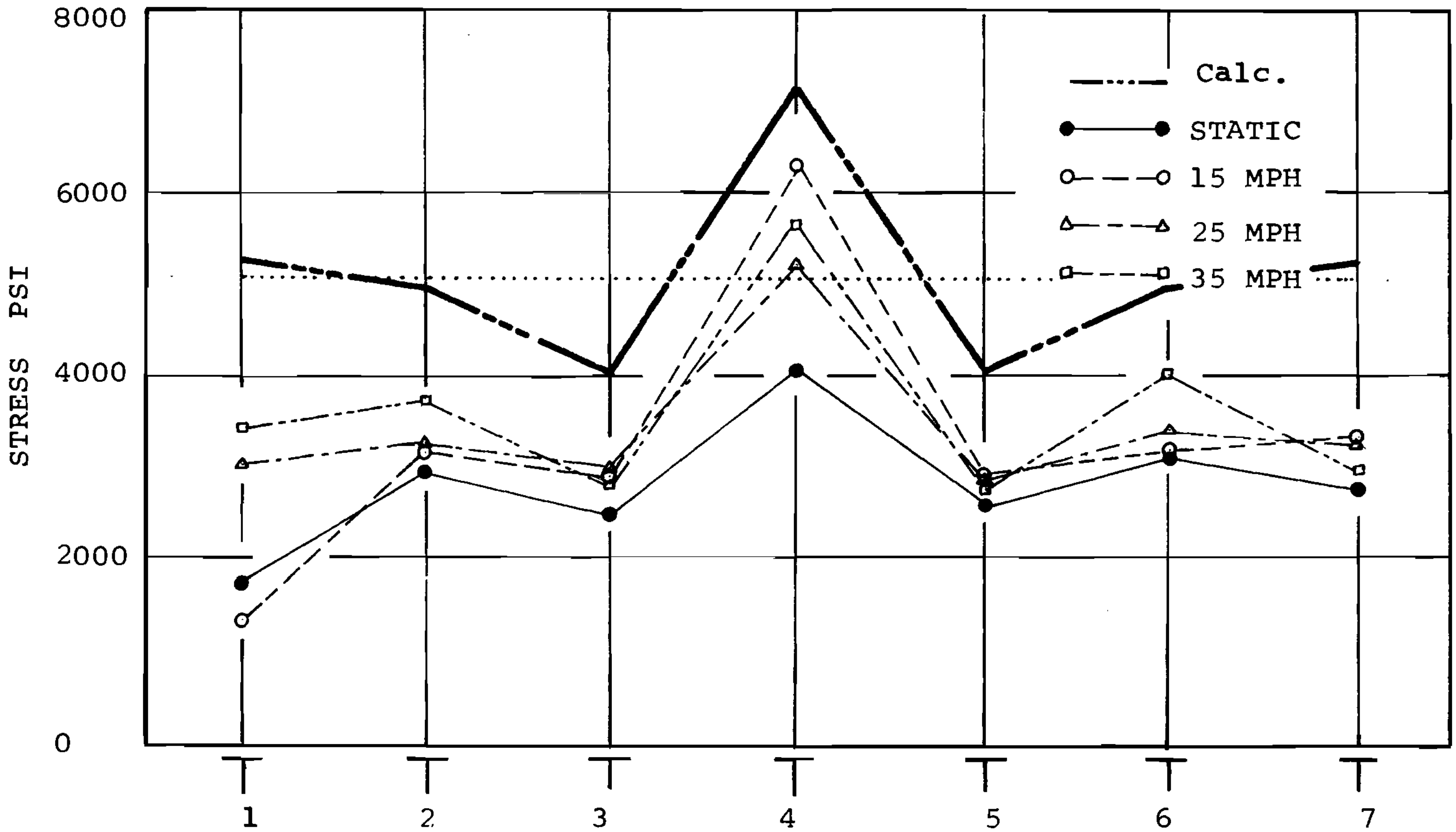
FIGURE 10 SAMPLE RECORD OF TABULATING TRACE MEASUREMENTS

DATA CHARTS



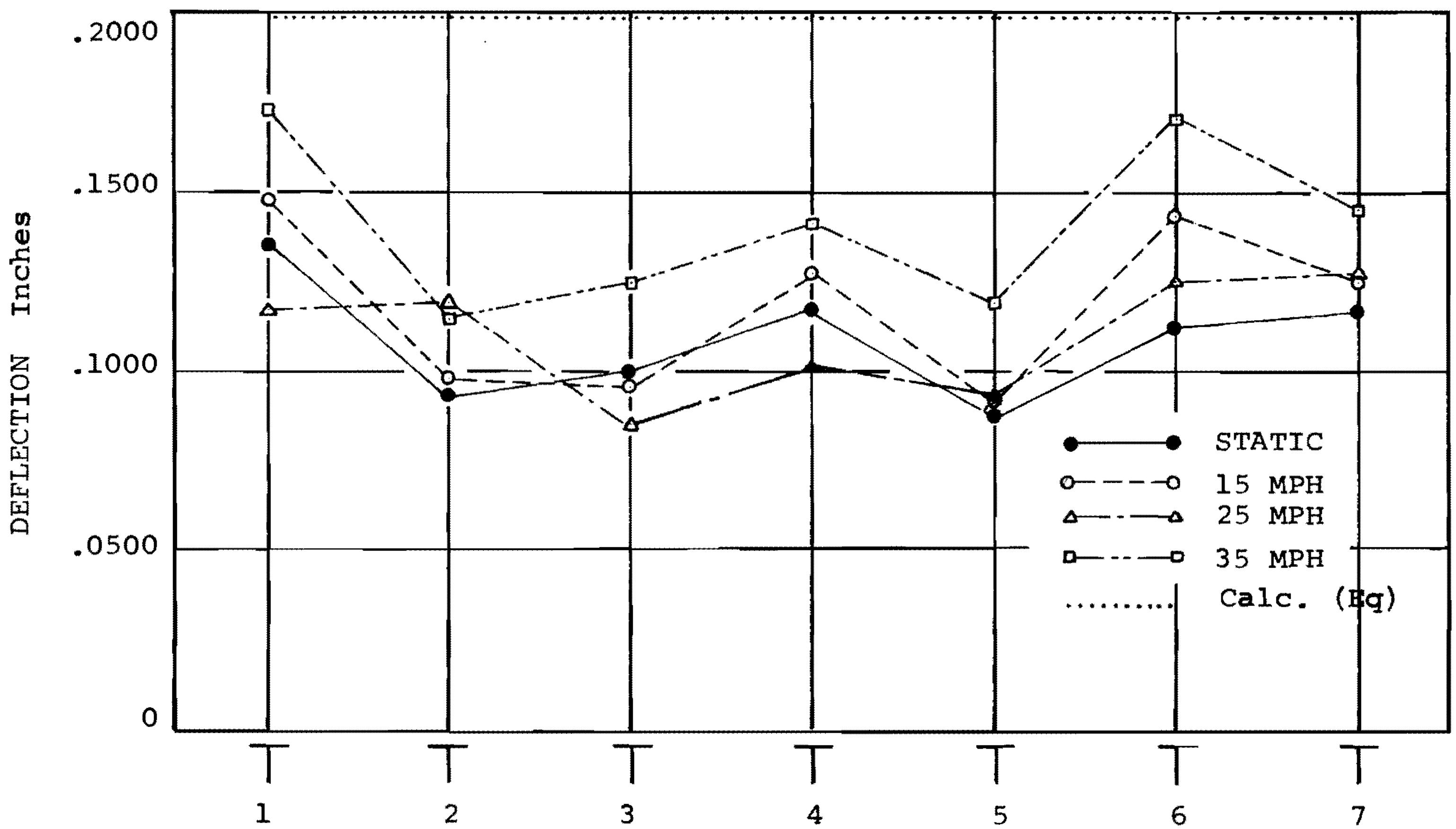
PEAK LIVE LOAD STRESSES AT STATION A
T & NO RR O'PASS
ACCUM. BOTT. FLANGE STRESSES 3 LANES LOADED
TRUCK NORMAL TO FLOW OF TRAFFIC

CHART NO. 1



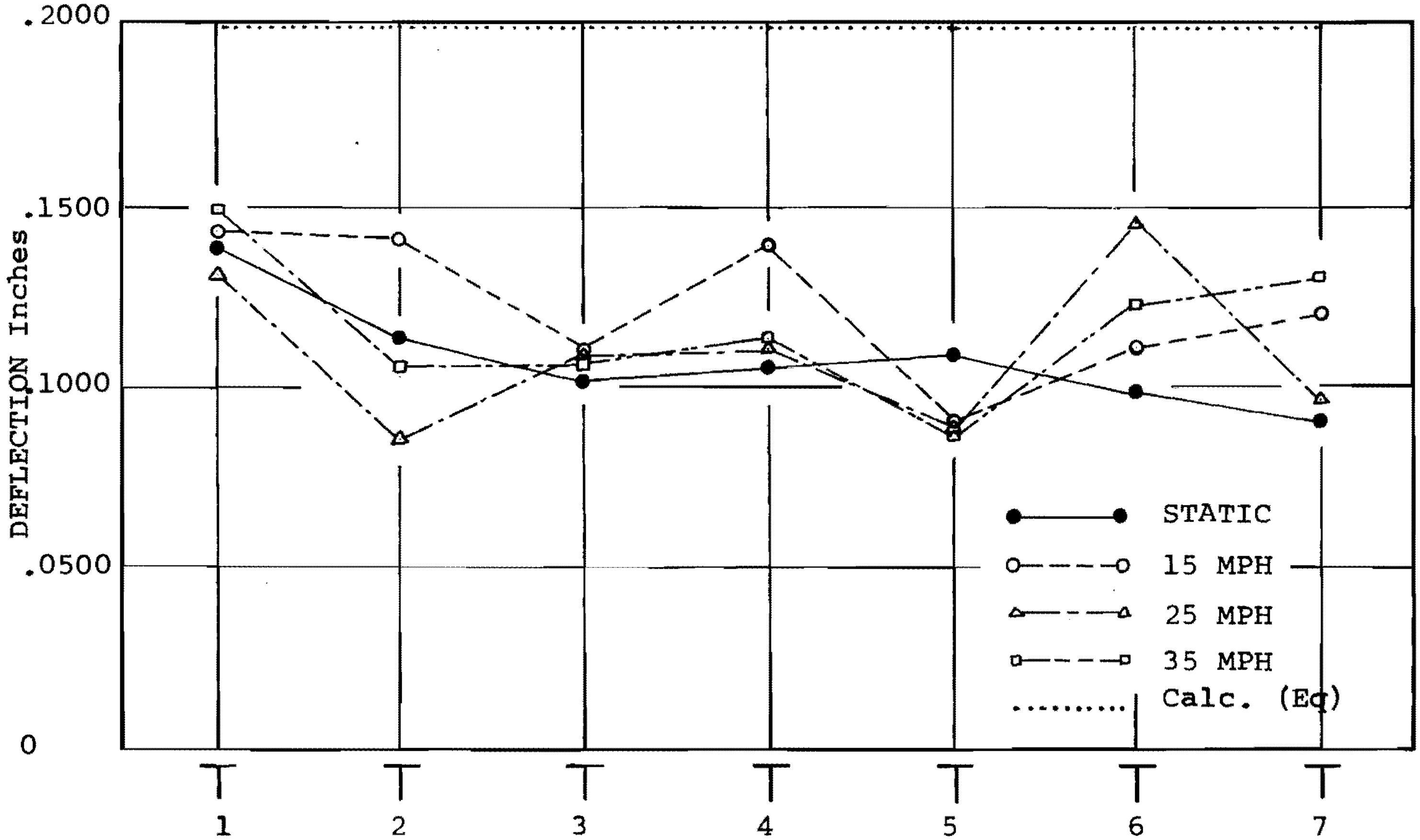
PEAK LIVE LOAD STRESSES AT STATION A
T & NO RR O'PASS
ACCUM. BOTT. FLANGE STRESSES 3 LANES LOADED
TRUCK OPP. TO FLOW OF TRAFFIC

CHART NO. 2



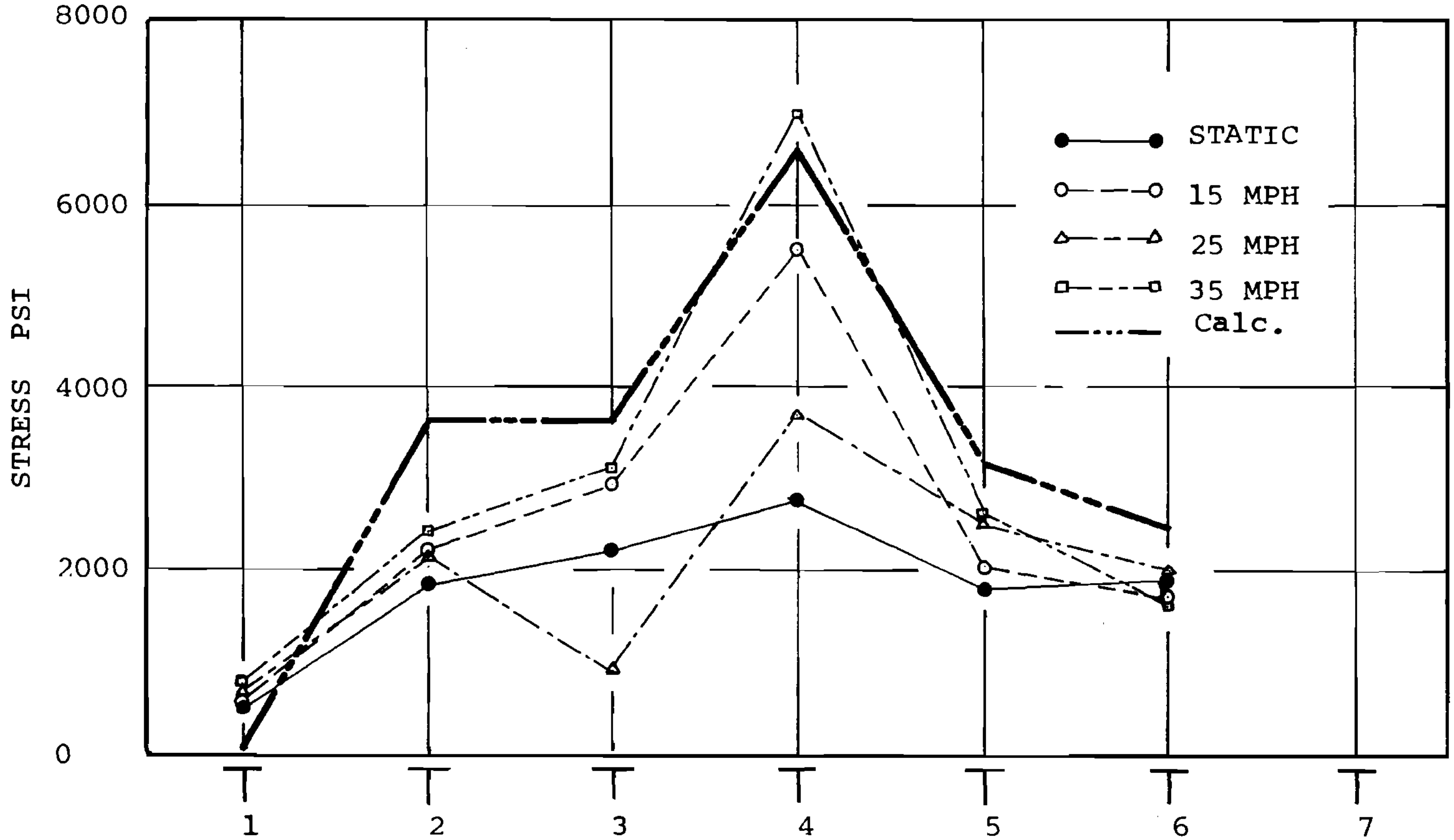
PEAK LIVE LOAD DEFLECTION AT STATION A
T & NO RR O'PASS 3 LANES LOADED
ACCUM. DEFL. NORMAL TO FLOW OF TRAFFIC

CHART NO. 3



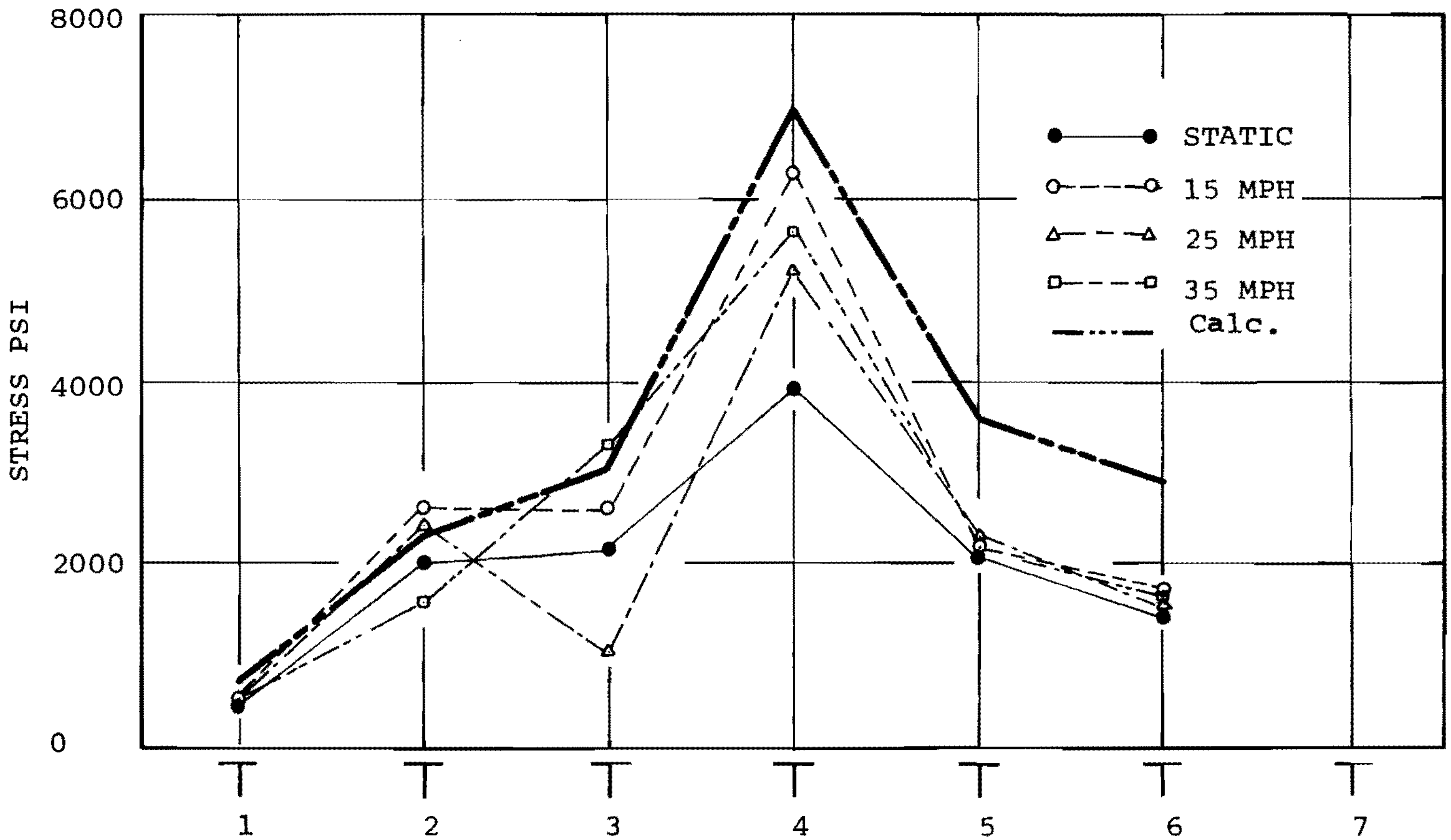
PEAK LIVE LOAD DEFLECTION AT STATION A
T & NO RR O'PASS 3 LANES LOADED
ACCUM. DEFL. OPPOSITE TO FLOW OF TRAFFIC

CHART NO. 4



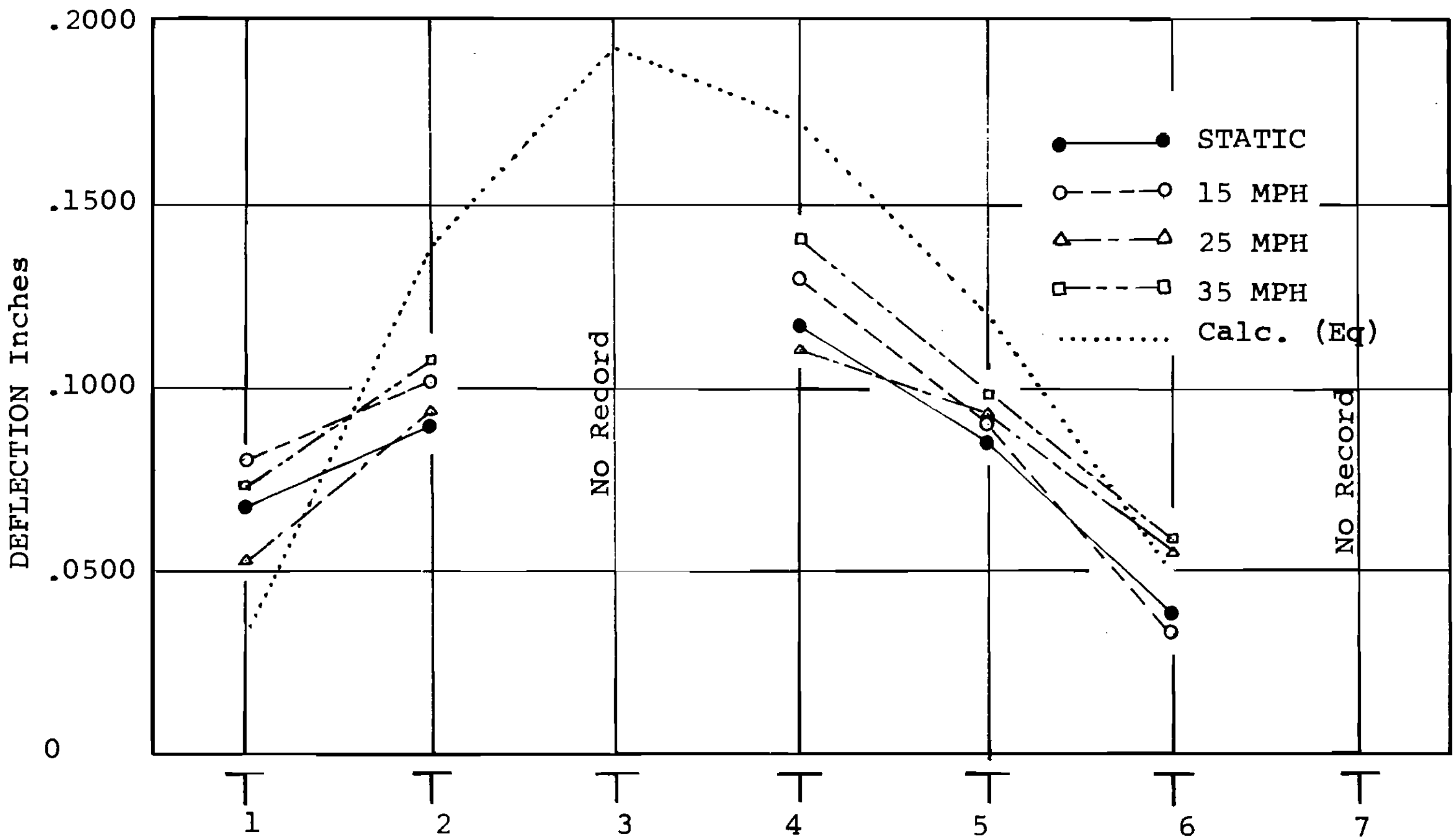
LIVE LOAD STRESS DISTRIBUTION
T & NO RR O'PASS DRIVE AXLE AT STATION B
ACCUM. BOTT. FLANGE STRESSES 3 LANES LOADED
TRUCK NORMAL TO FLOW OF TRAFFIC

CHART NO. 5



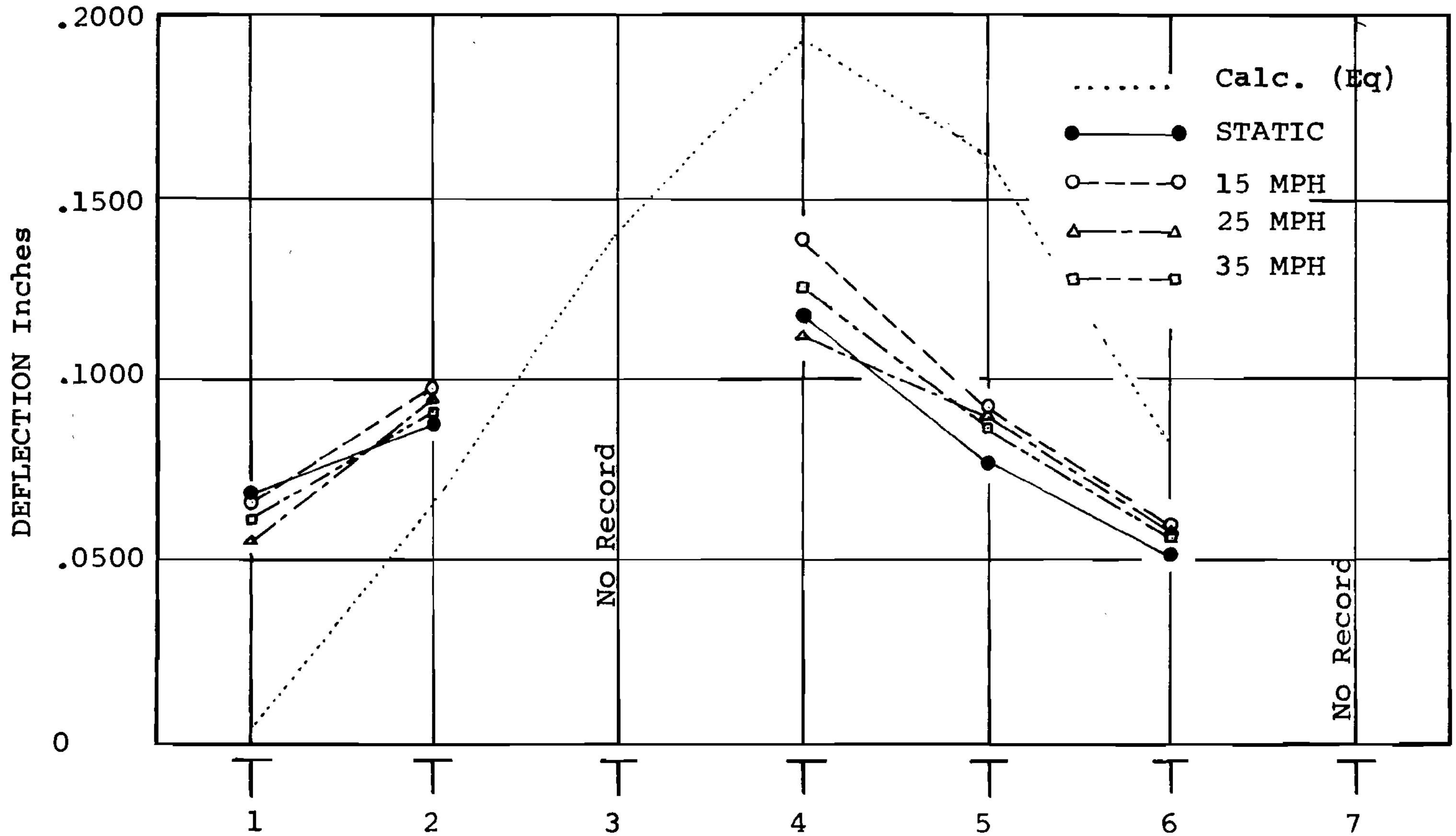
LIVE LOAD STRESS DISTRIBUTION
T & NO RR O'PASS DRIVER AXLE AT STATION B
ACCUM. BOTT. FLANGE STRESSES 3 LANES LOADED
TRUCK OPP. TO FLOW OF TRAFFIC

CHART NO. 6



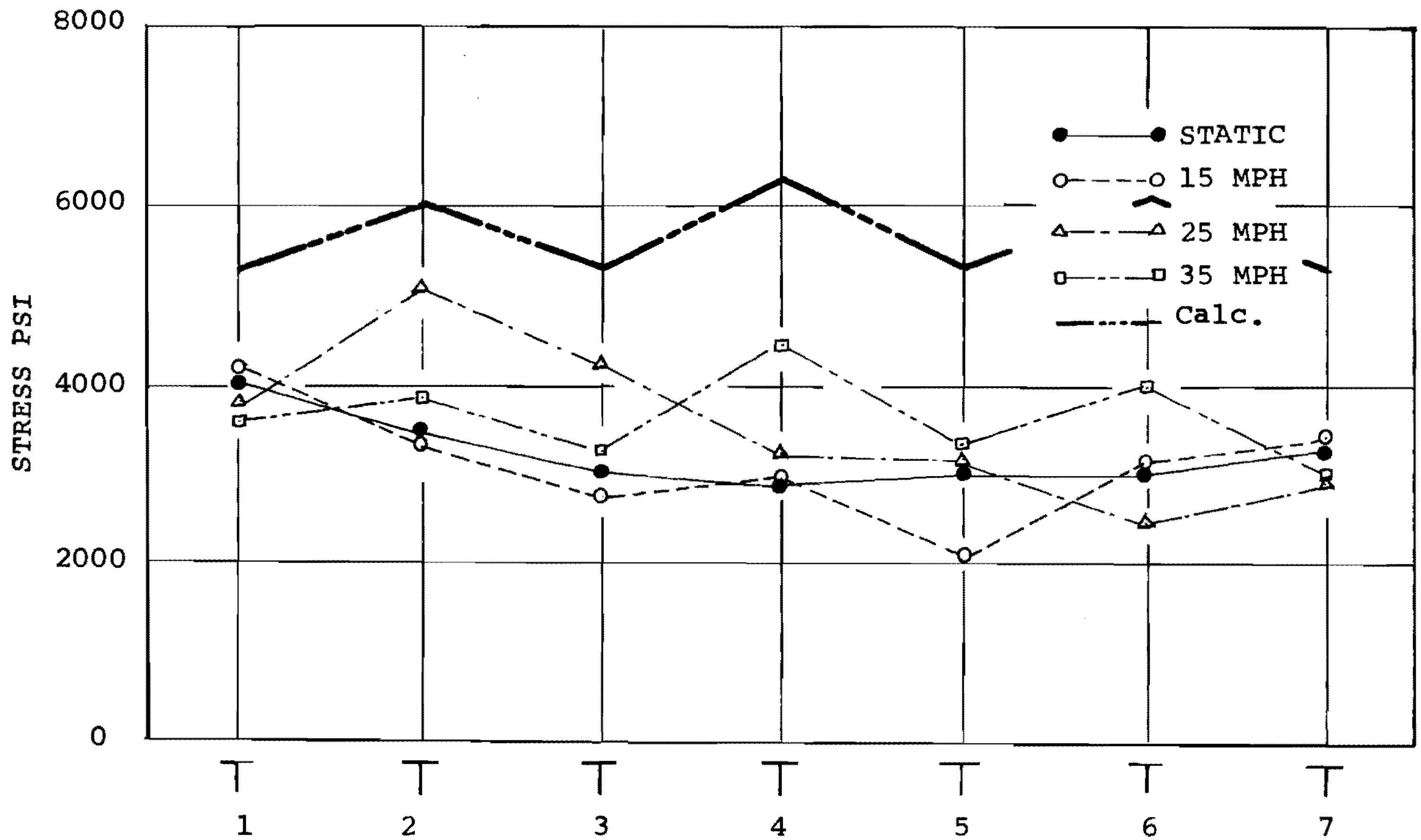
LIVE LOAD DEFLECTION DRIVER AXLE AT STATION B
T & NO RR O'PASS 3 LANES LOADED
ACCUM. DEFL. NORMAL TO FLOW OF TRAFFIC

CHART NO. 7



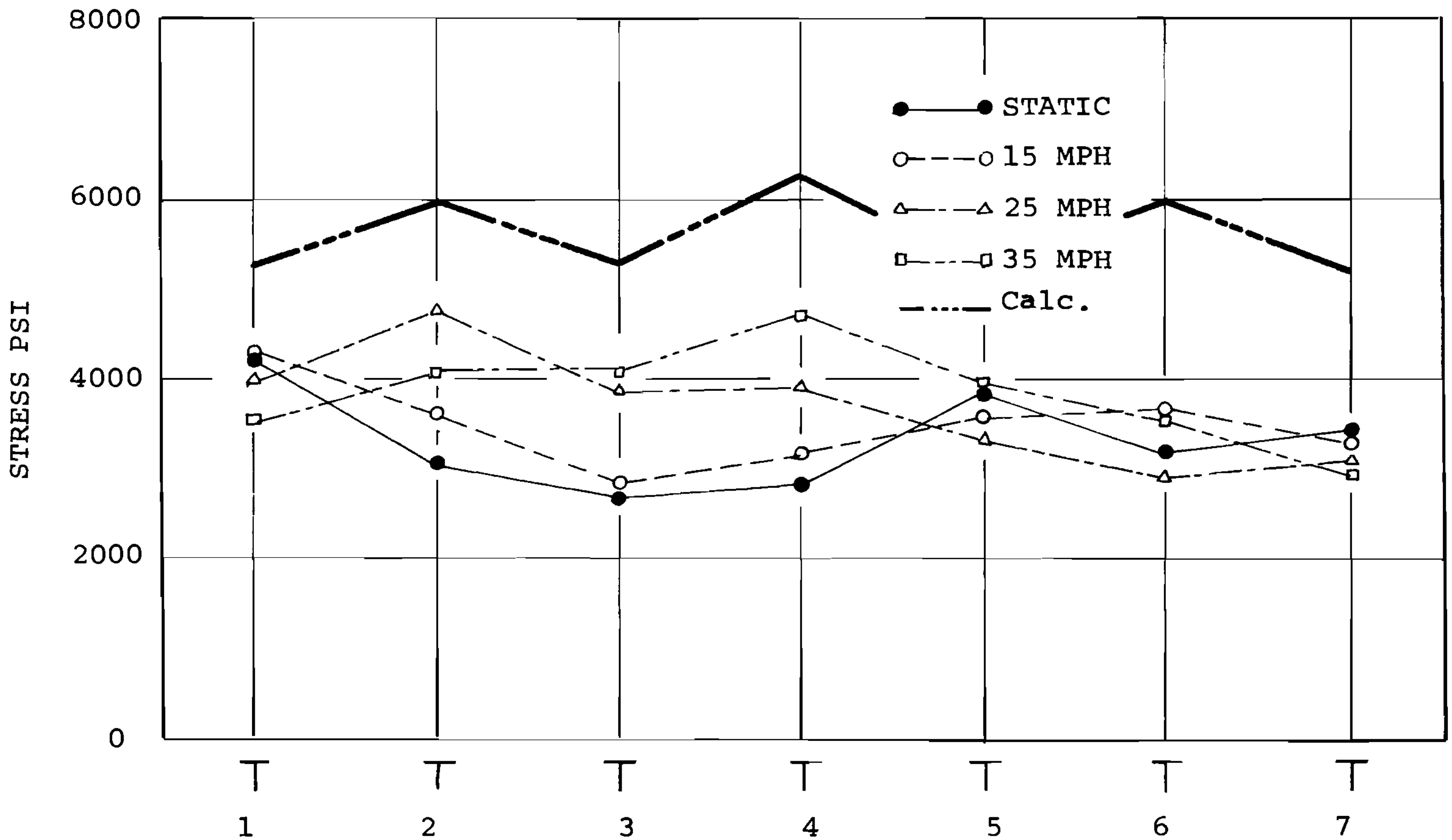
LIVE LOAD DEFLECTION DRIVER AXLE AT STATION B
T & NO RR O'PASS 3 LANES LOADED
ACCUM. DEFL. OPPOSITE TO FLOW OF TRAFFIC

CHART NO. 8



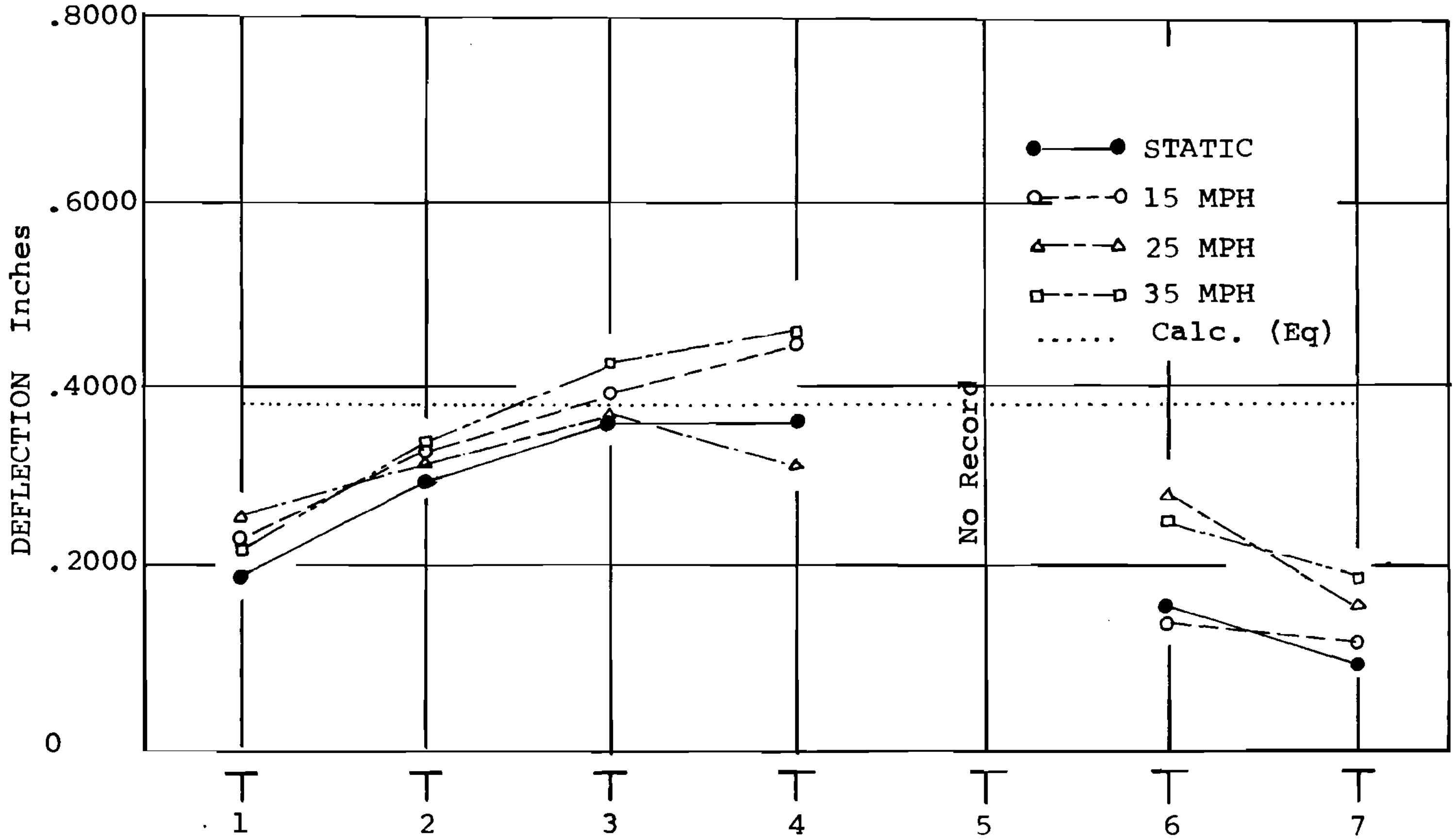
PEAK LIVE LOAD STRESSES AT STATION D
T & NO RR O'PASS
ACCUM. BOTT. FLANGE STRESSES 3 LANES LOADED
TRUCK NORMAL TO FLOW OF TRAFFIC

CHART NO. 9



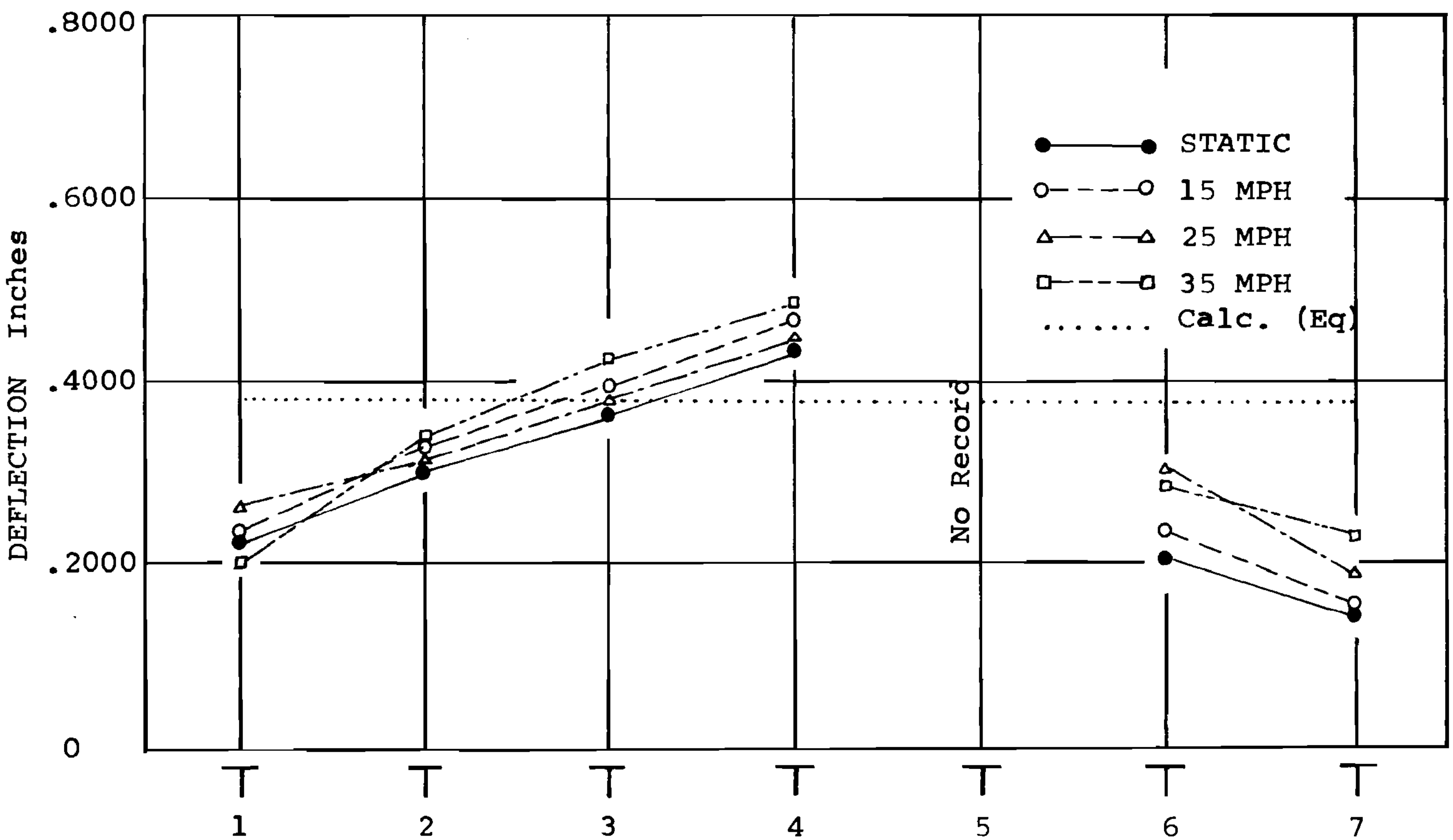
PEAK LIVE LOAD STRESSES AT STATION D
T & NO RR O'PASS
ACCUM. BOTT. FLANGE STRESSES 3 LANES LOADED
TRUCK OPP. TO FLOW OF TRAFFIC

CHART NO. 10



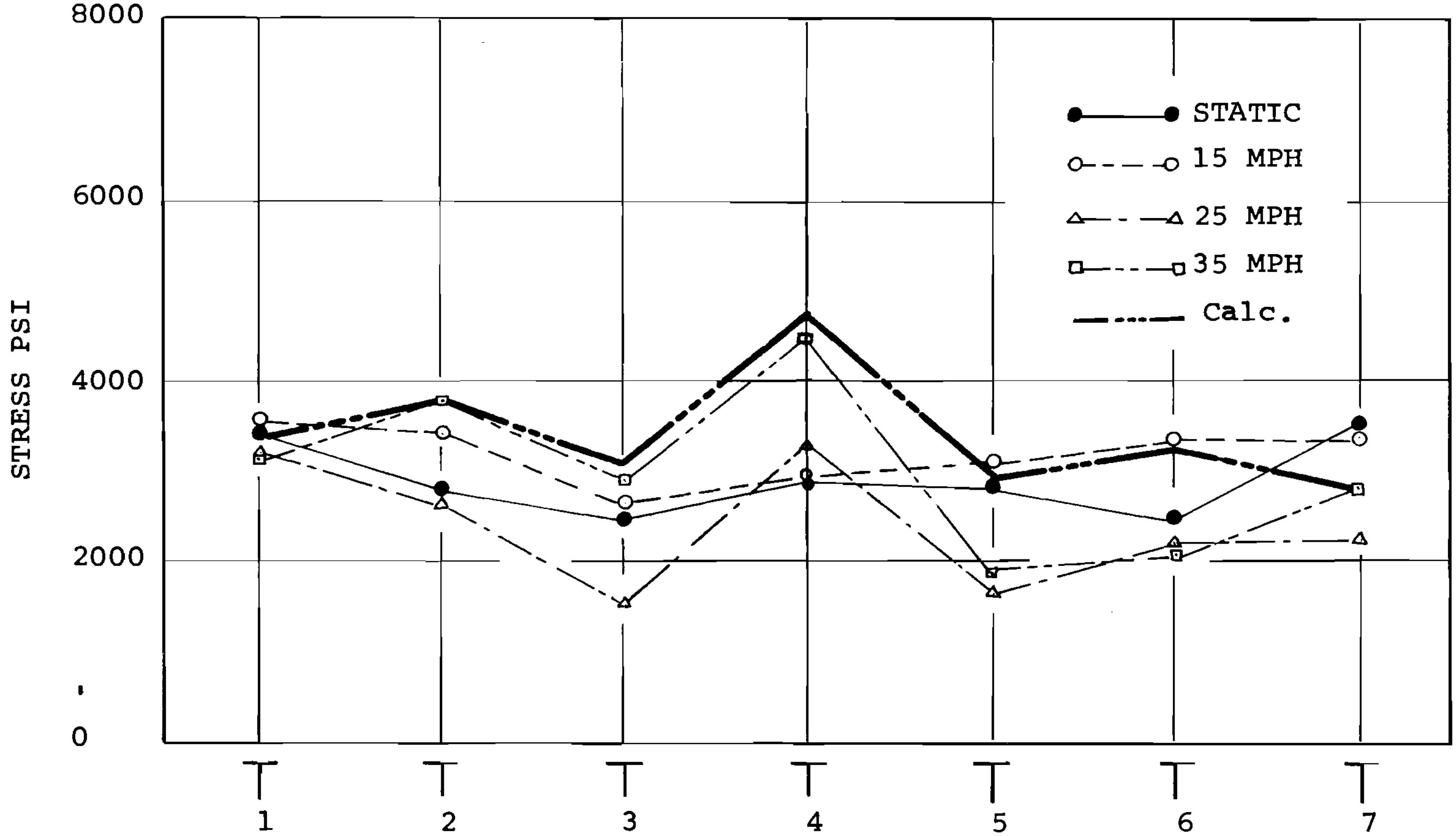
PEAK LIVE LOAD DEFLECTION AT STATION D
T. & N.O. RR O'PASS 3 LANES LOADED
ACCUM. DEFL. NORMAL TO FLOW OF TRAFFIC

CHART NO. 11



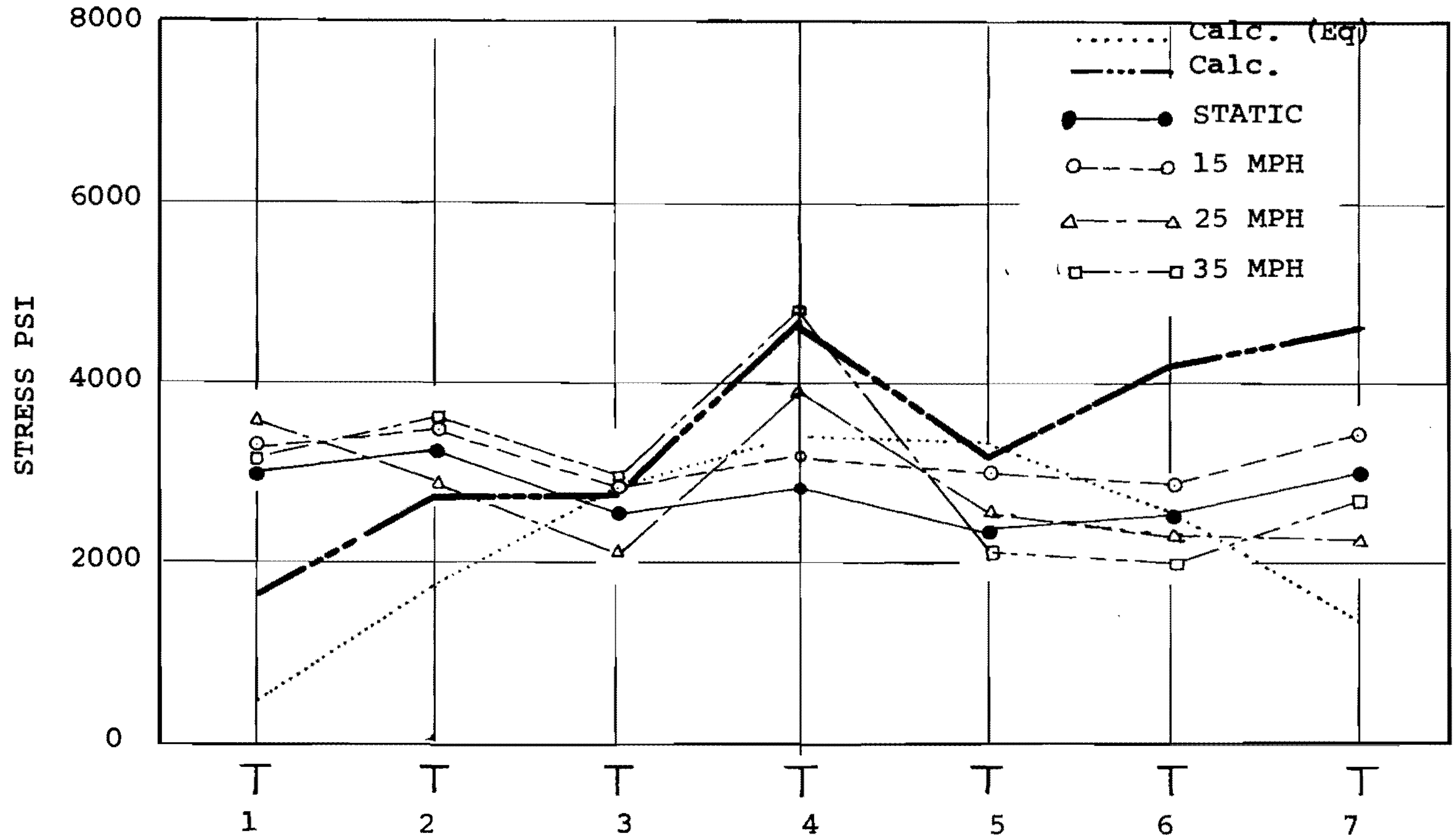
PEAK LIVE LOAD DEFLECTION AT STATION D
T. & N.O. RR O'PASS 3 LANES LOADED
ACCUM. DEFL. OPP. TO FLOW OF TRAFFIC

CHART NO. 12



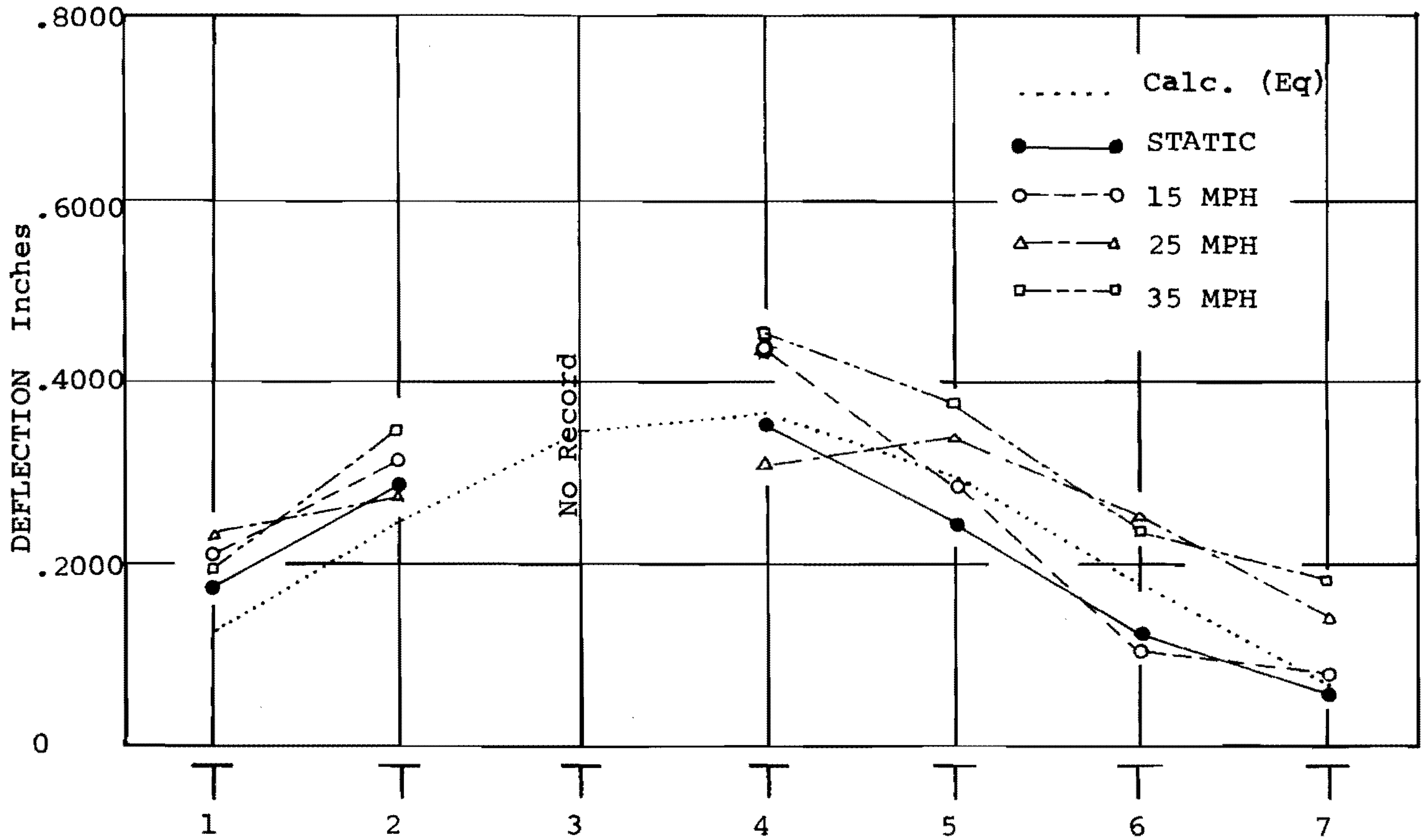
LIVE LOAD STRESSES
T & NO RR O'PASS DRIVER AXLE AT STATION E
ACCUM. BOTT. FLANGE STRESSES 3 LANES LOADED
TRUCK NORMAL TO FLOW OF TRAFFIC

CHART NO. 13



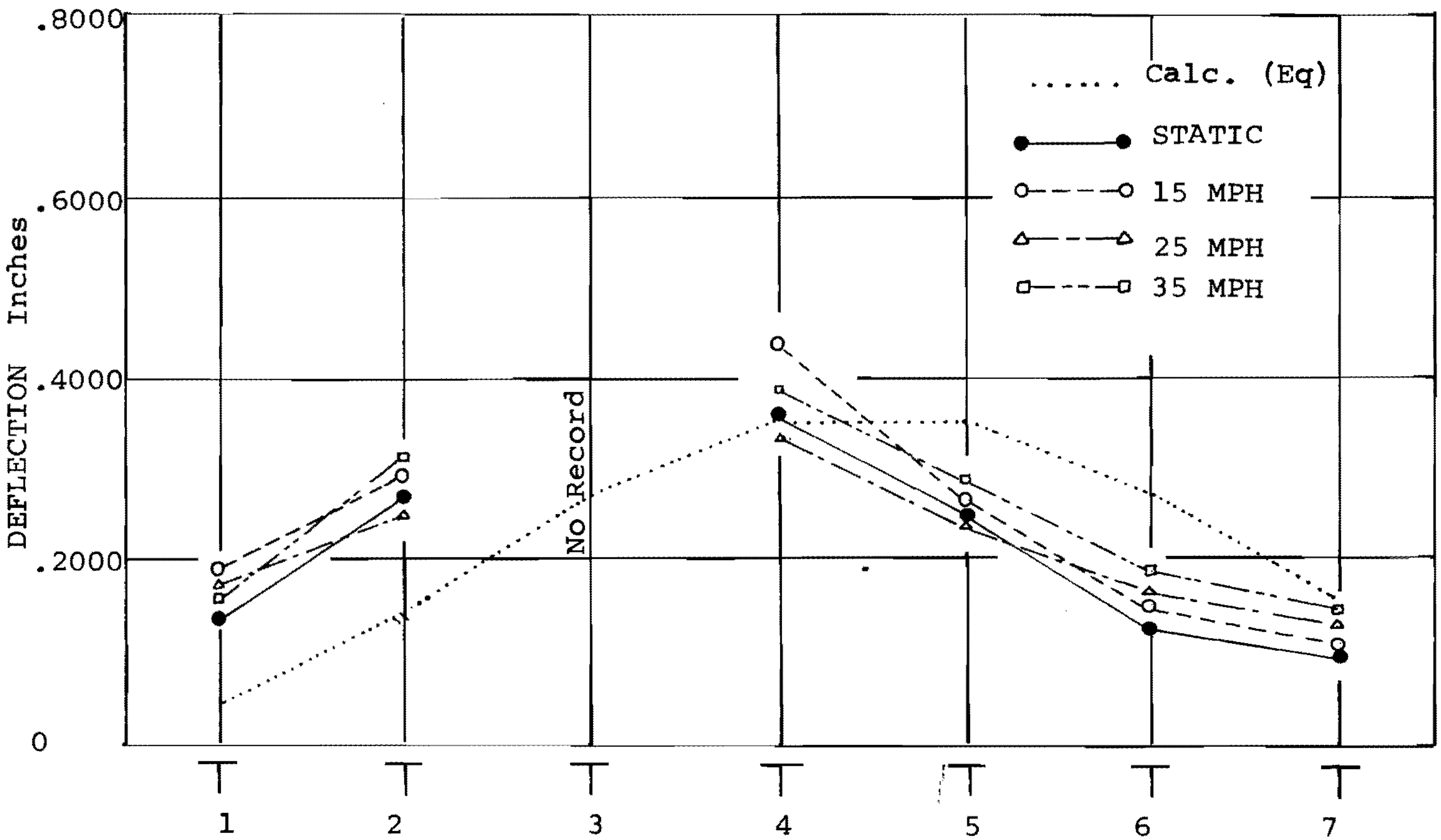
LIVE LOAD STRESSES
T & NO RR O'PASS DRIVER AXLE AT STATION E
ACCUM. BOTT. FLANGE STRESSES 3 LANES LOADED
TRUCK OPP. TO FLOW OF TRAFFIC

CHART NO. 14



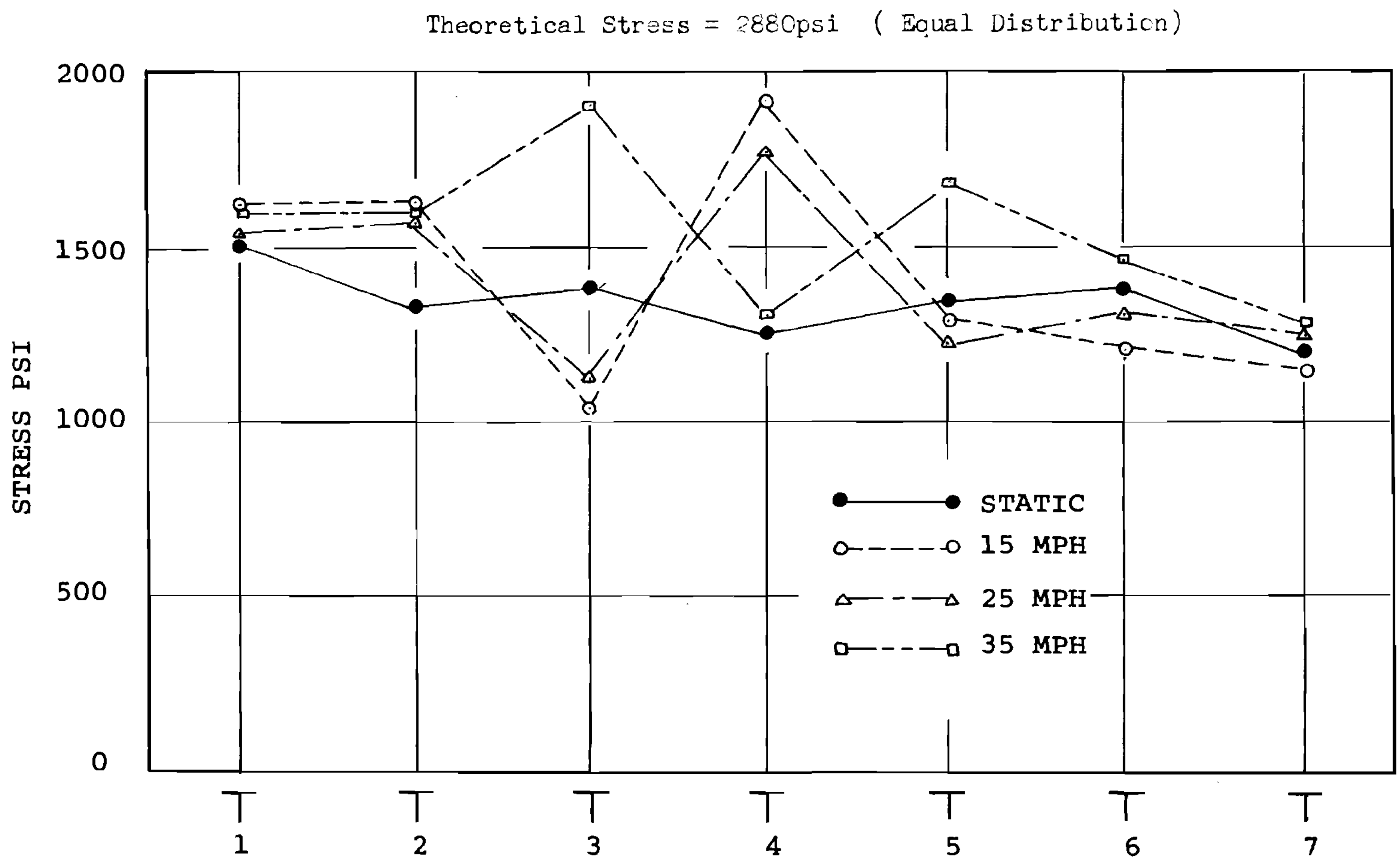
LIVE LOAD DEFLECTION DRIVER AXLE AT STATION E
T & NO RR O'PASS 3 LANES LOADED
ACCU. DEFL. NORMAL TO FLOW OF TRAFFIC

CHART NO. 15



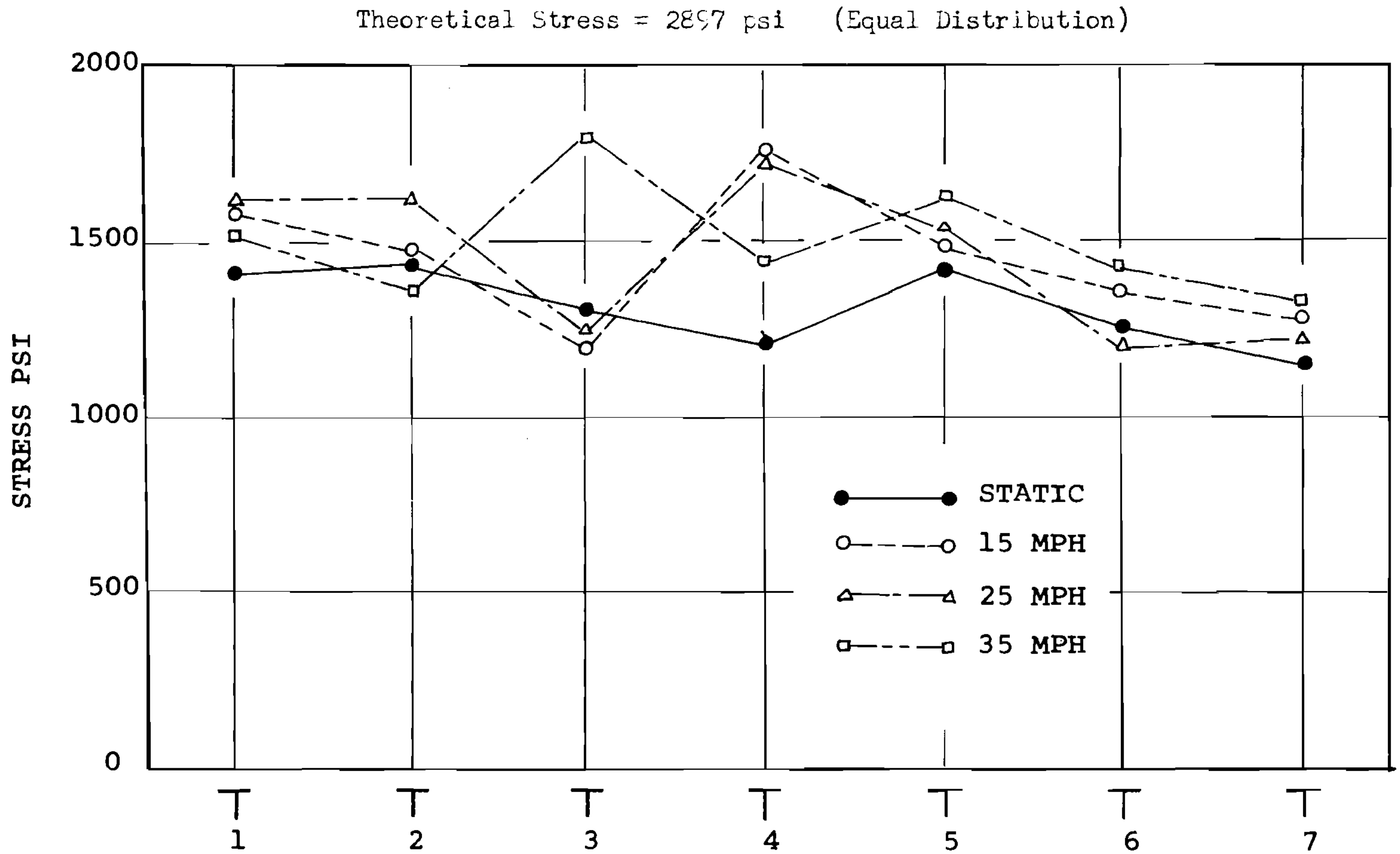
LIVE LOAD DEFLECTION DRIVER AXLE AT STATION E
T & NO RR O'PASS 3 LANES LOADED
ACCUM. DEFL. OPP. TO FLOW OF TRAFFIC

CHART NO. 16



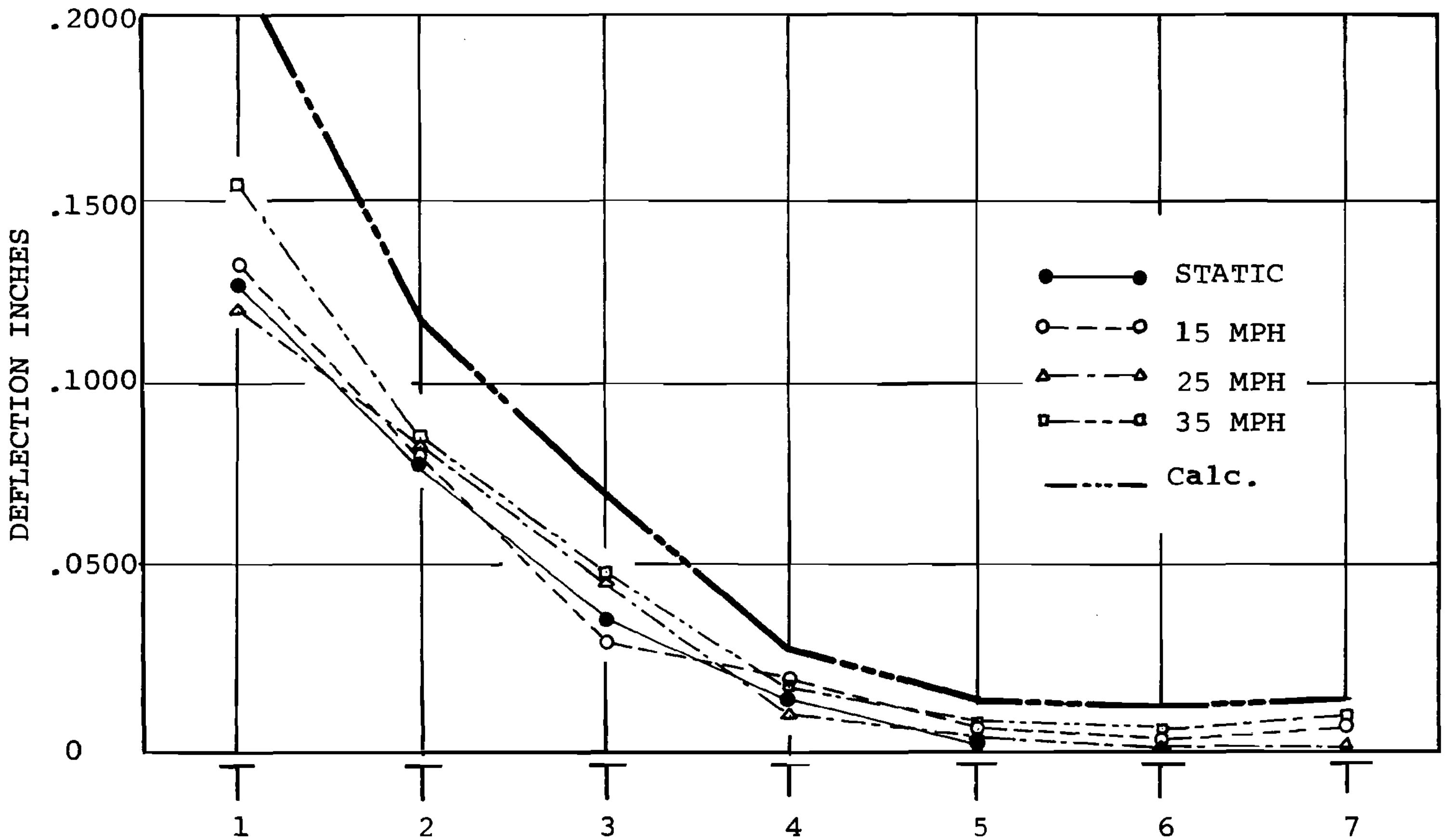
PEAK LIVE LOAD STRESSES AT STATION F
T & NO RR O'PASS
ACCUM. TOP FLANGE STRESSES 3 LANES LOADED
TRUCK NORMAL TO FLOW OF TRAFFIC

CHART NO. 17



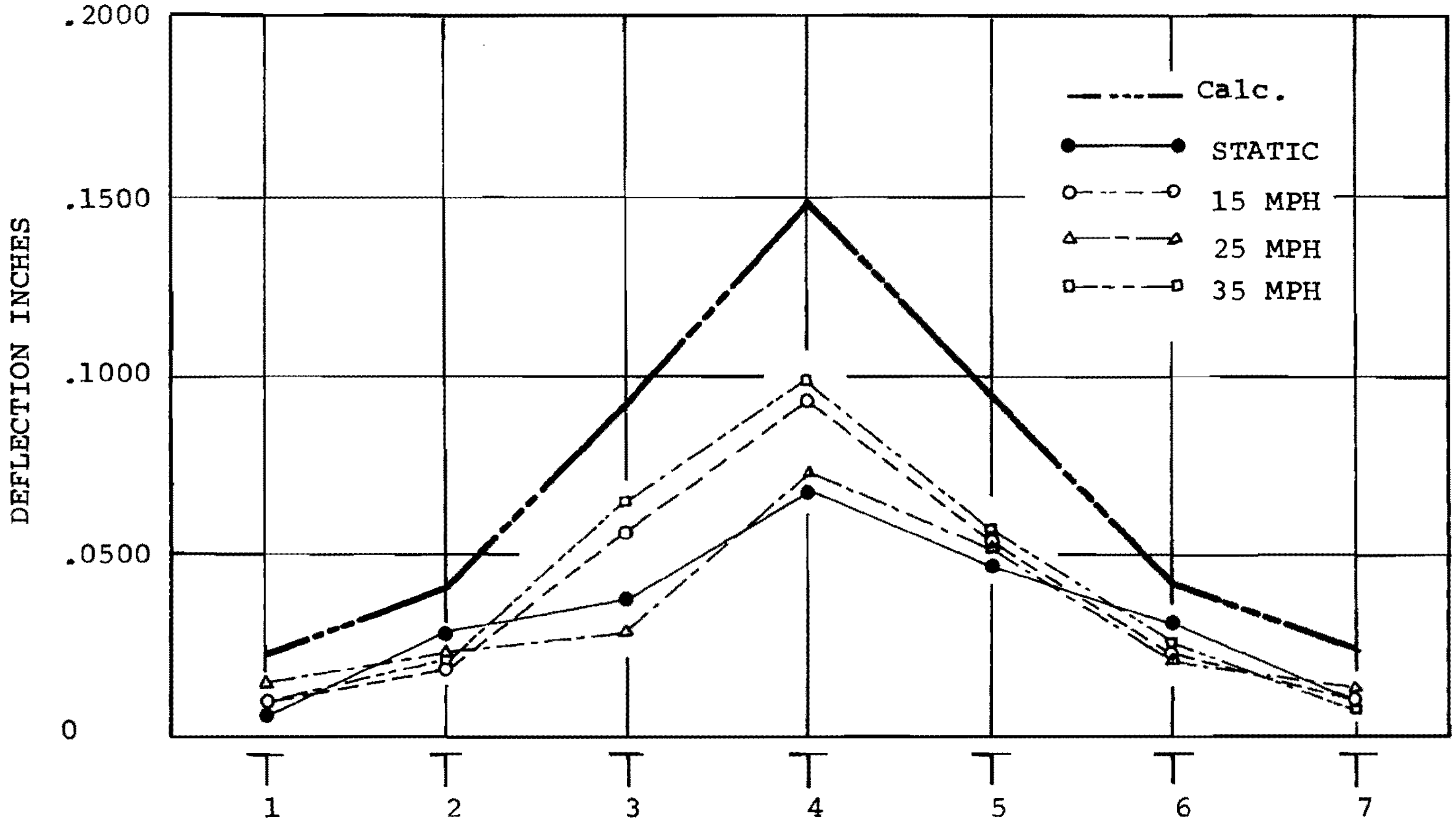
PEAK LIVE LOAD STRESSES AT STATION F
T & NO RR O'PASS
ACCUM. TOP FLANGE STRESSES 3 LANES LOADED
TRUCK OPP. TO FLOW OF TRAFFIC

CHART NO. 18



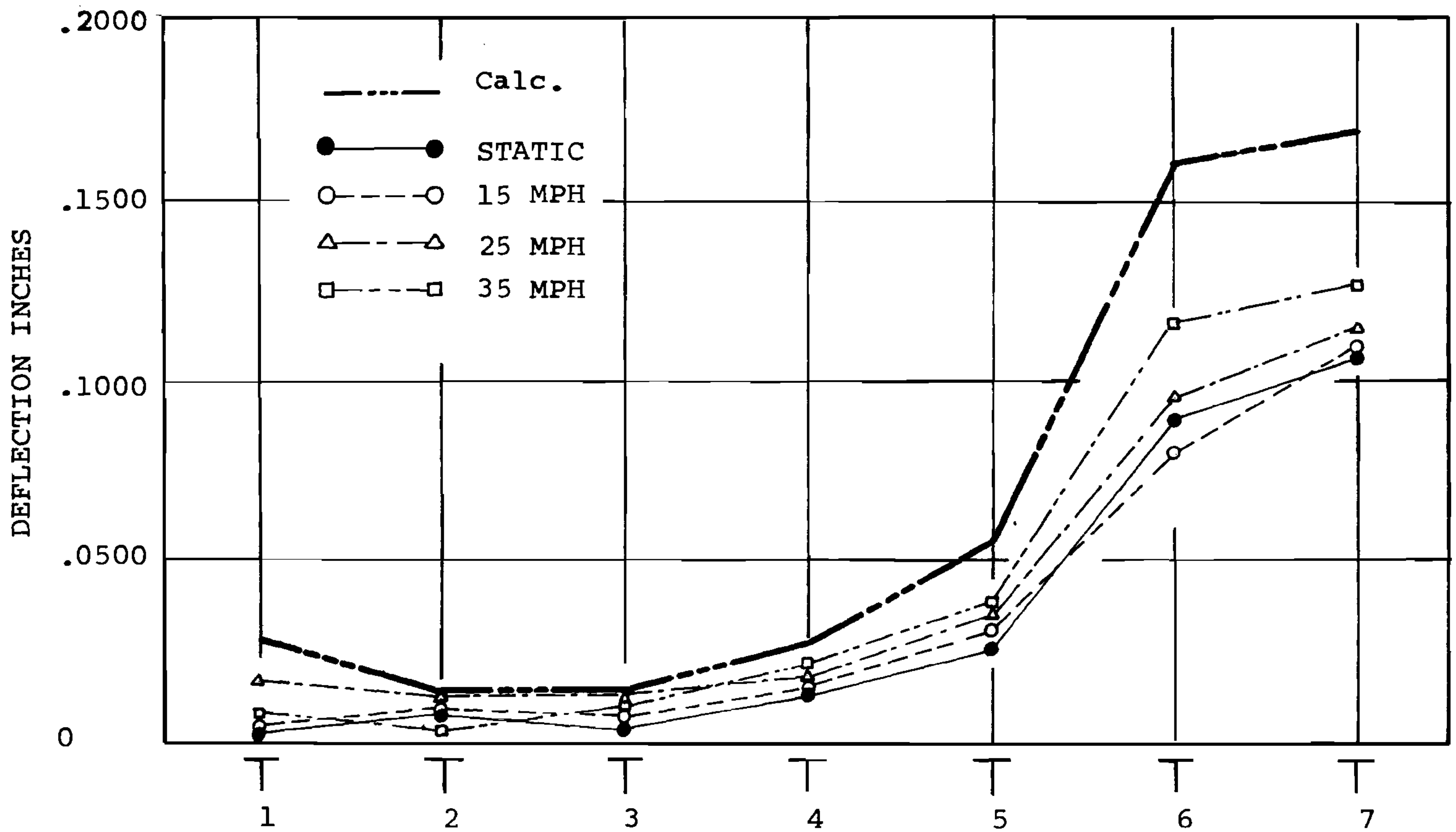
PEAK LIVE LOAD DEFLECTION AT STATION A
T & NO RR O'PASS
DEFL. NORMAL TO FLOW OF TRAFFIC ON PATH 1

CHART NO. 19



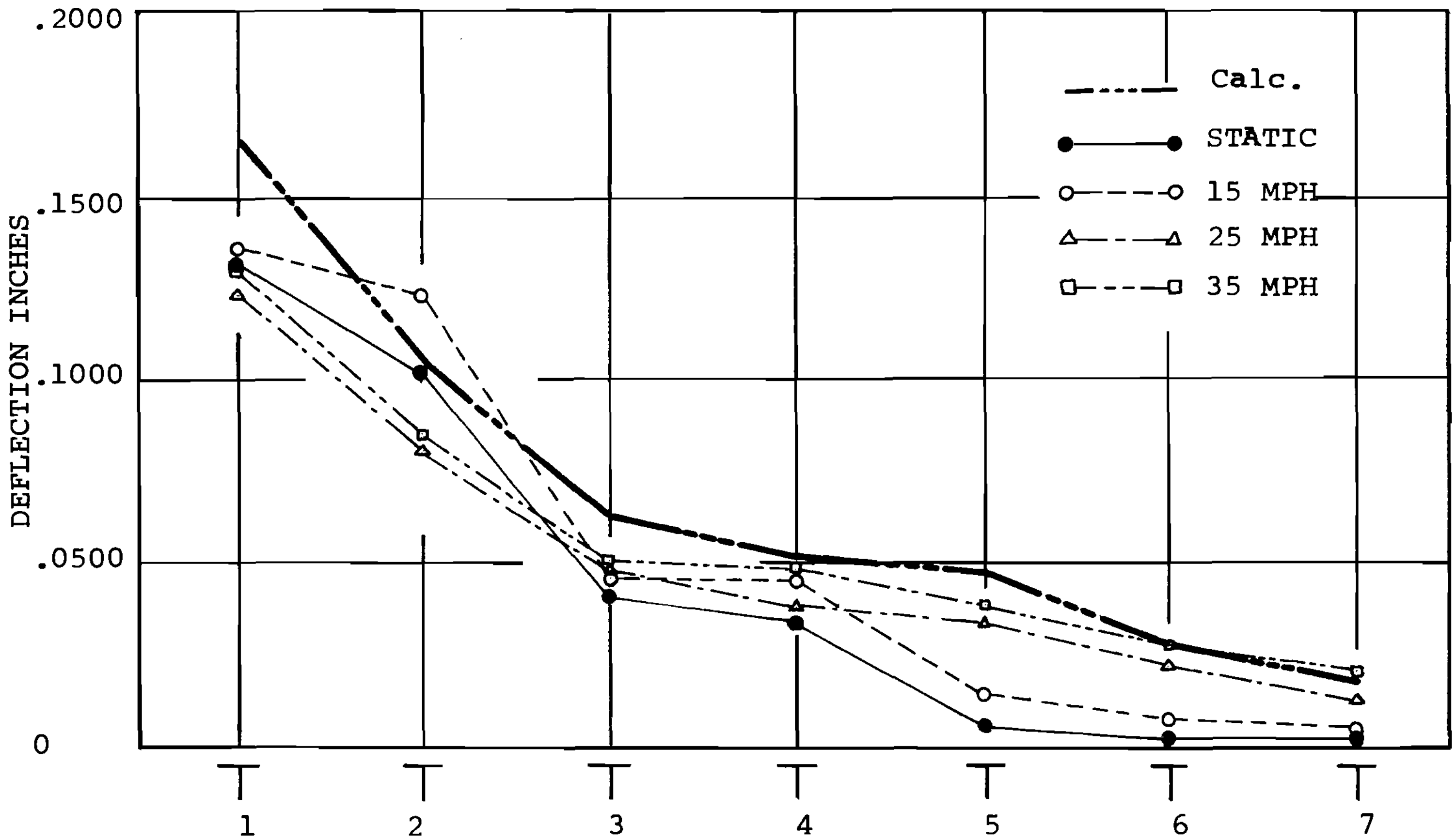
PEAK LIVE LOAD DEFLECTION AT STATION A
T & NO RR O'PASS
DEFL. NORMAL TO FLOW OF TRAFFIC ON PATH 2

CHART NO. 20



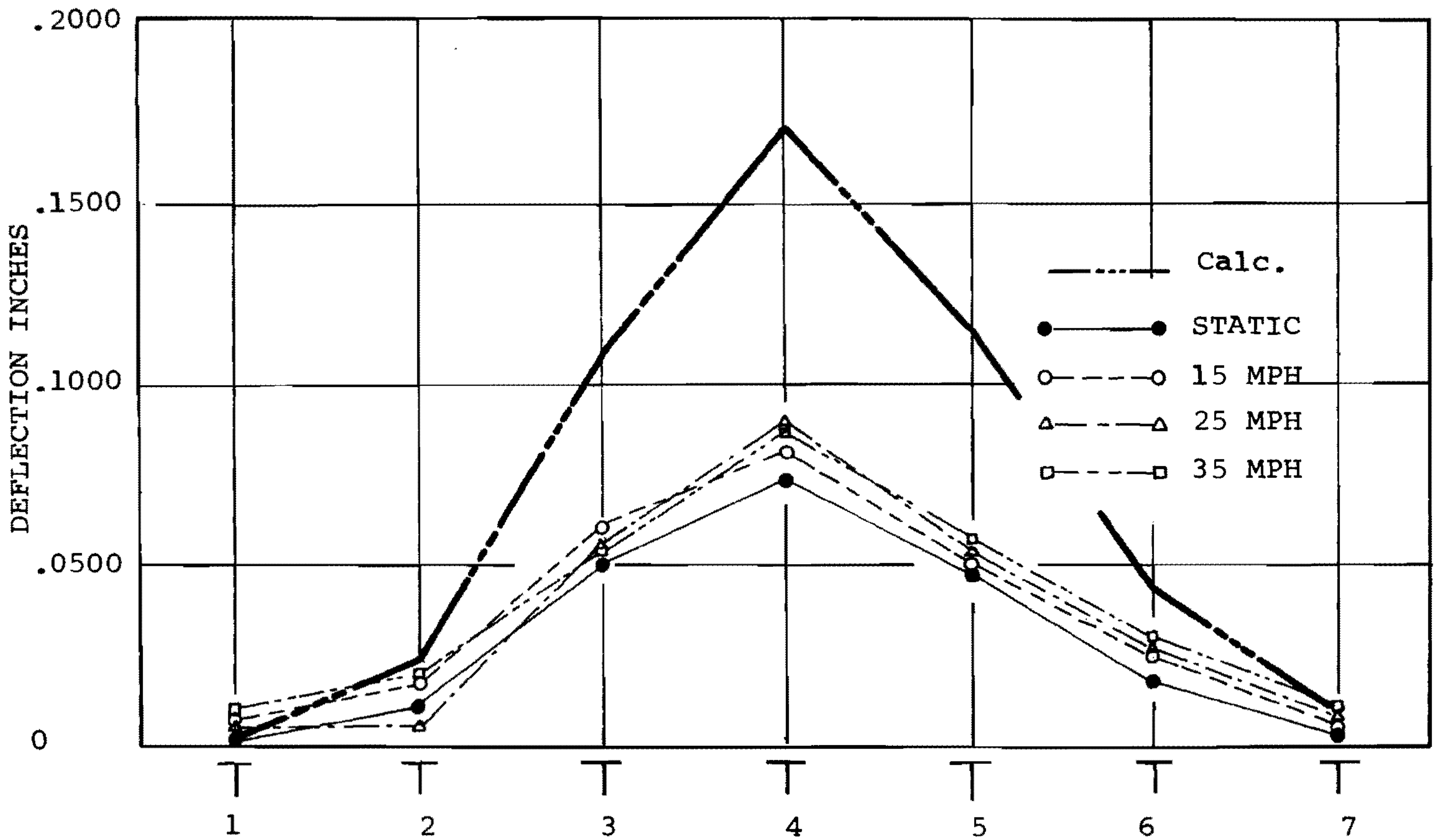
PEAK LIVE LOAD DEFLECTION AT STATION A
T & NO RR O'PASS
DEFL. NORMAL TO FLOW OF TRAFFIC ON PATH 3

CHART NO. 21



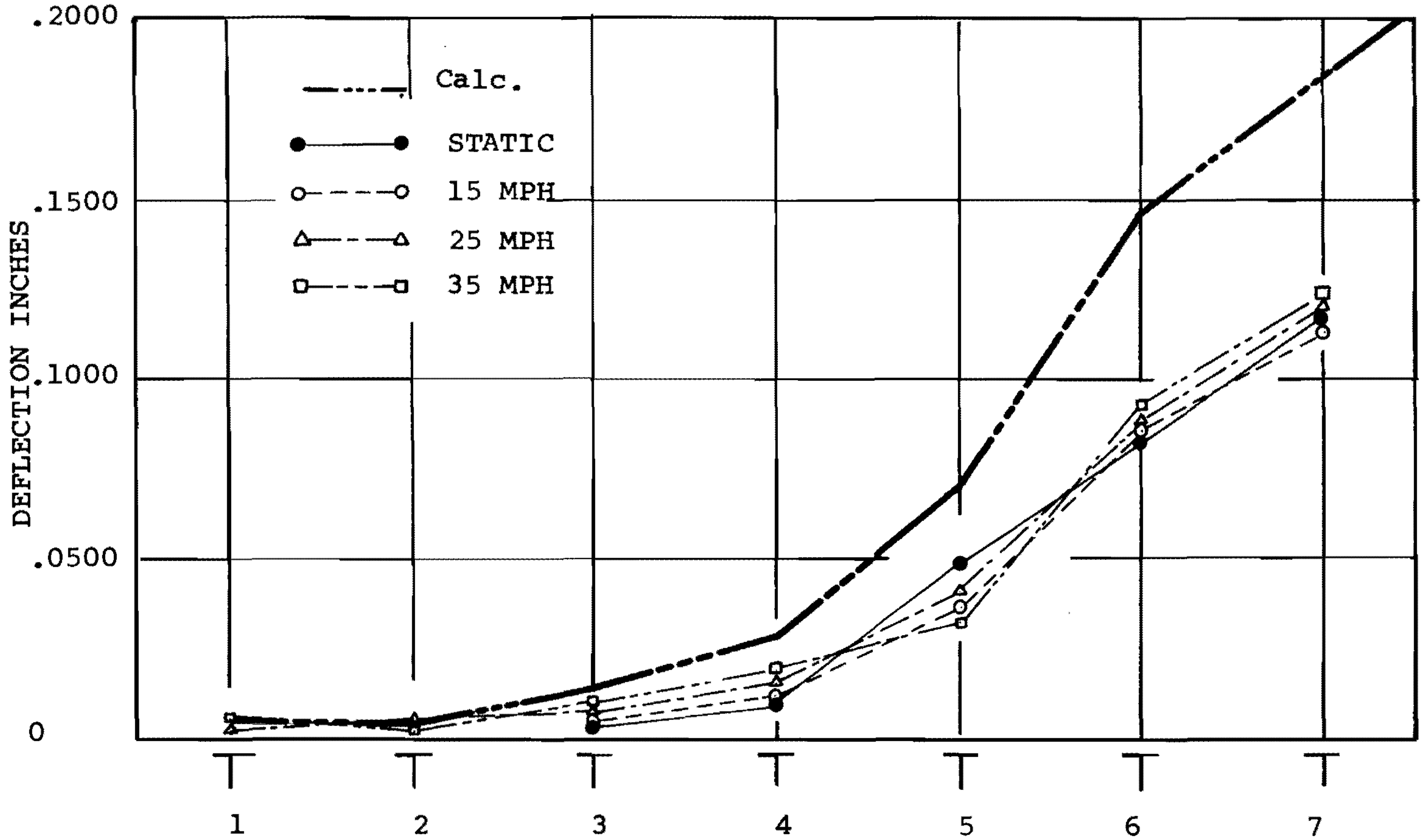
PEAK LIVE LOAD DEFLECTION AT STATION A
T & NO RR O'PASS
DEFL. OPPOSITE TO FLOW OF TRAFFIC ON PATH 1

CHART NO. 22



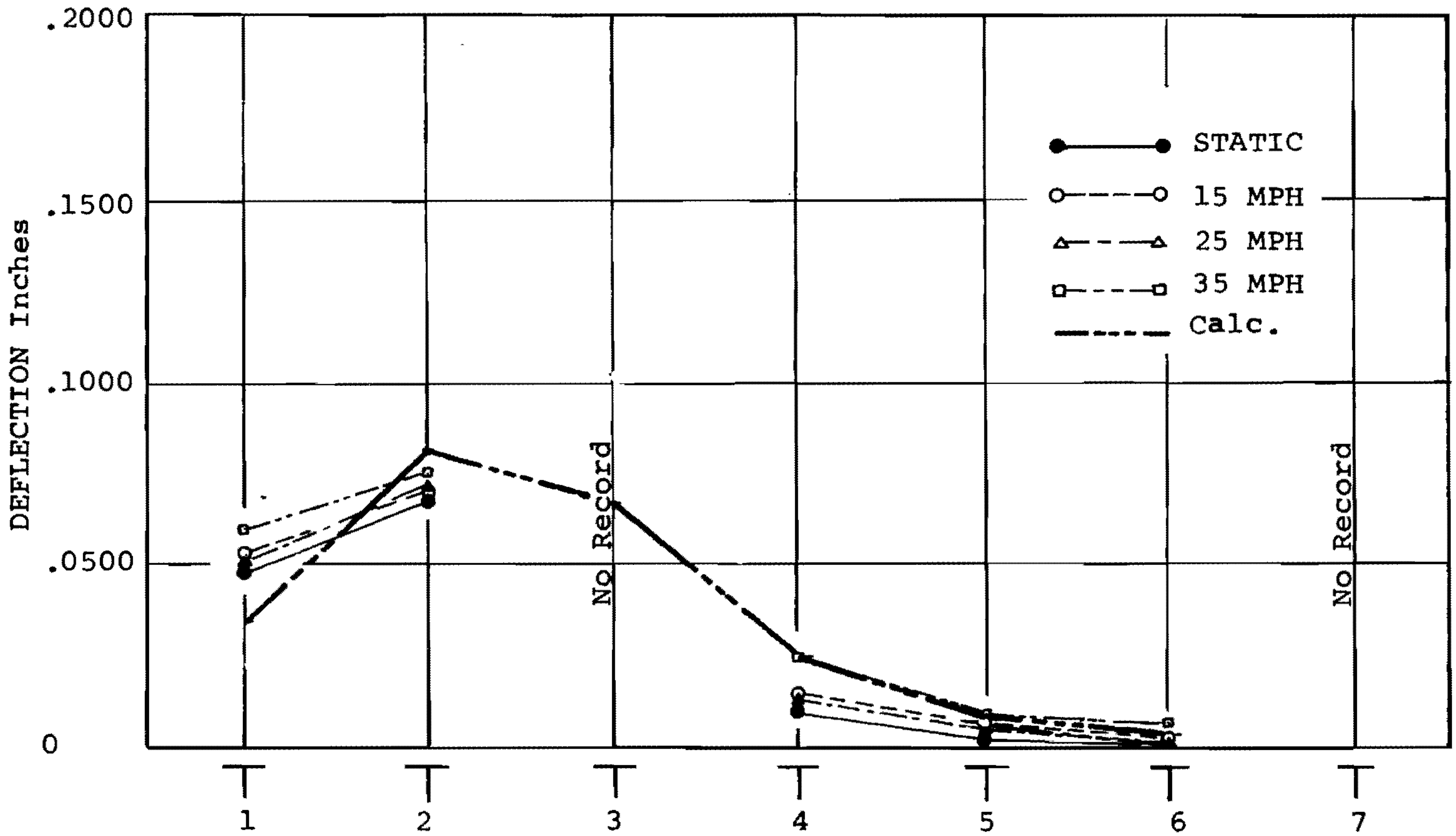
PEAK LIVE LOAD DEFLECTION AT STATION A
T & NO RR O'PASS
DEFL. OPPOSITE TO FLOW OF TRAFFIC ON PATH 2

CHART NO. 23



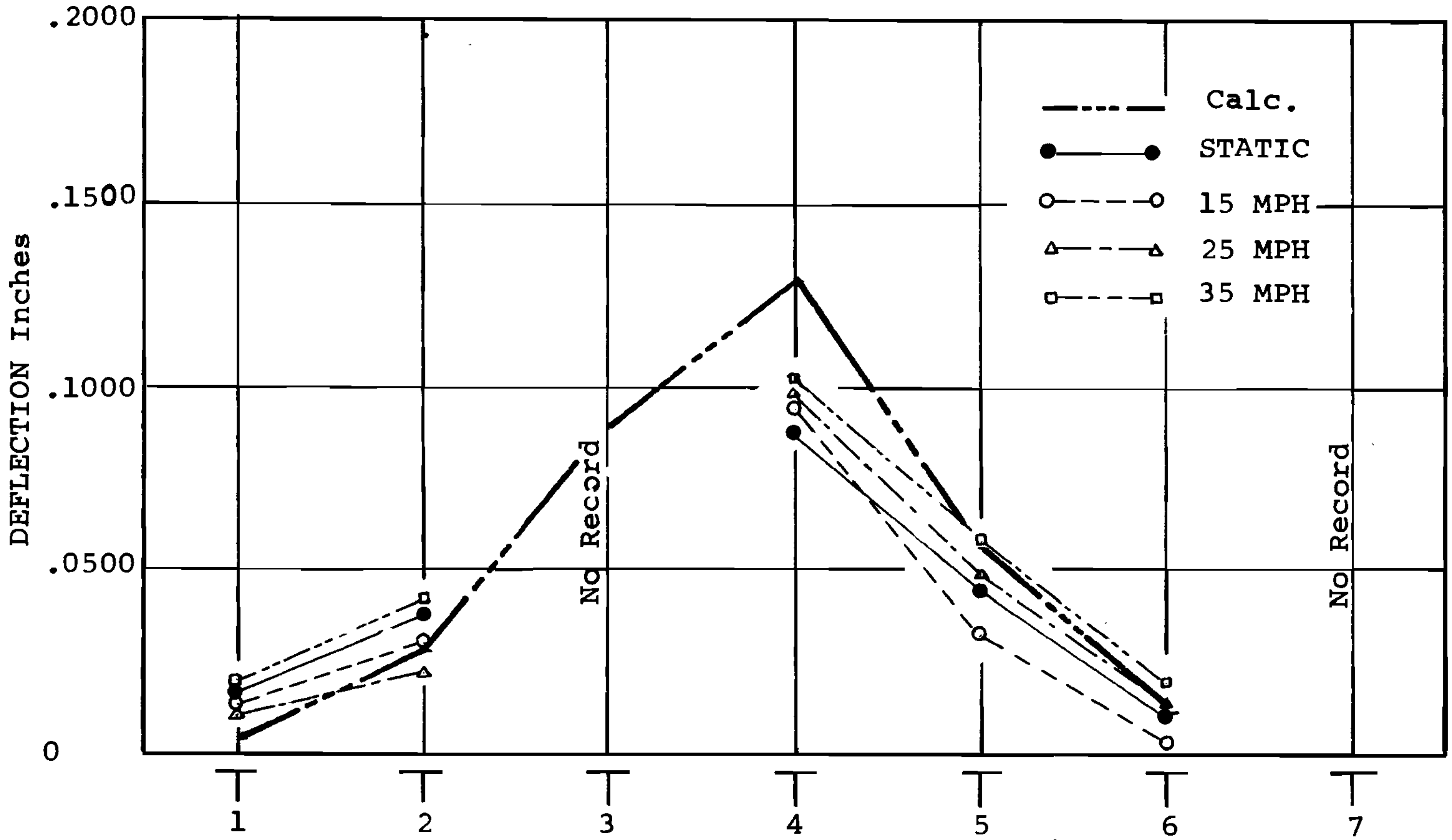
PEAK LIVE LOAD DEFLECTION AT STATION A
T & NO RR O'PASS
DEFL. OPPOSITE TO FLOW OF TRAFFIC ON PATH 3

CHART NO. 24



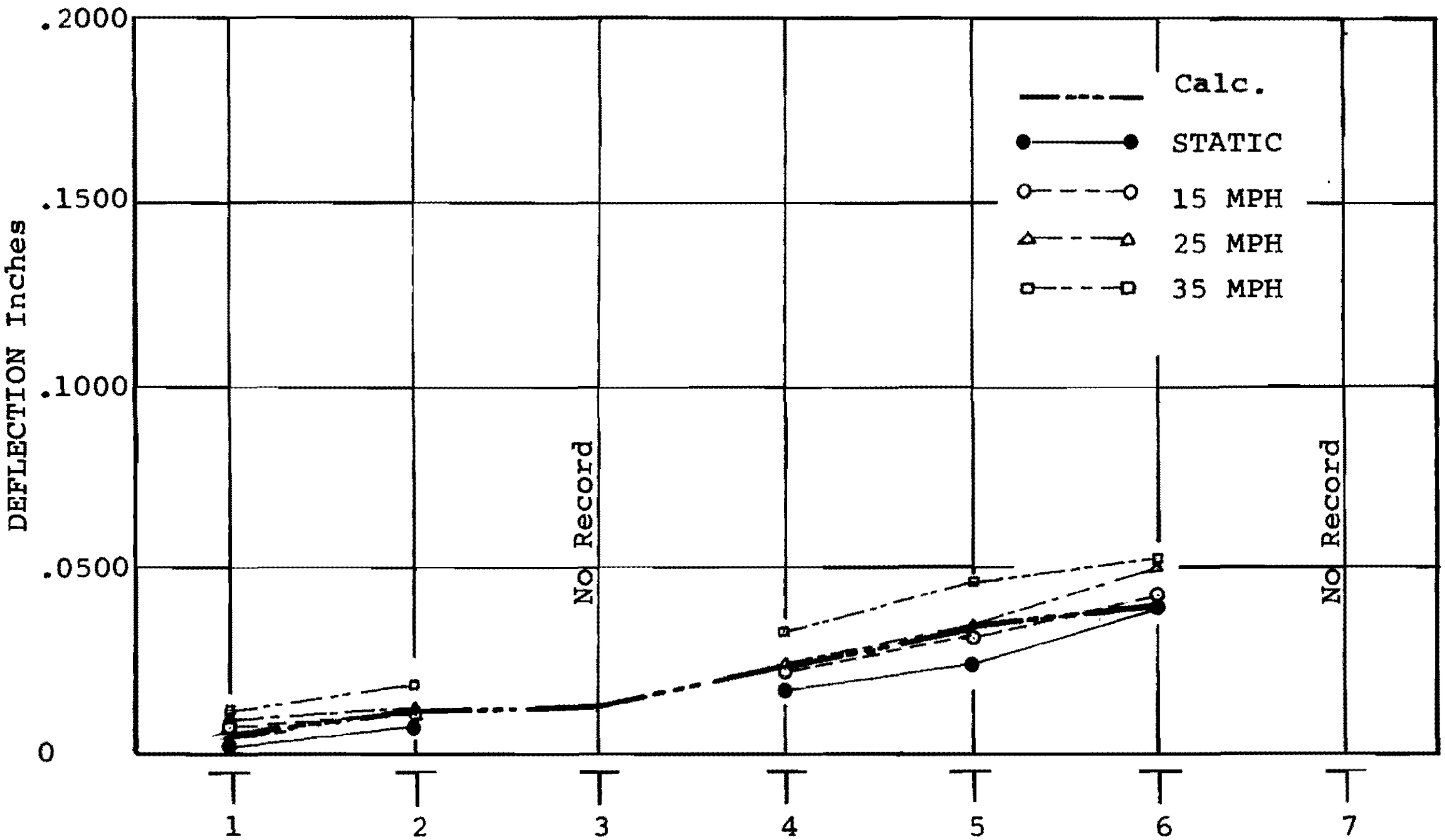
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION B
TRUCK NORMAL TO FLOW OF TRAFFIC ON PATH 1

CHART NO. 25



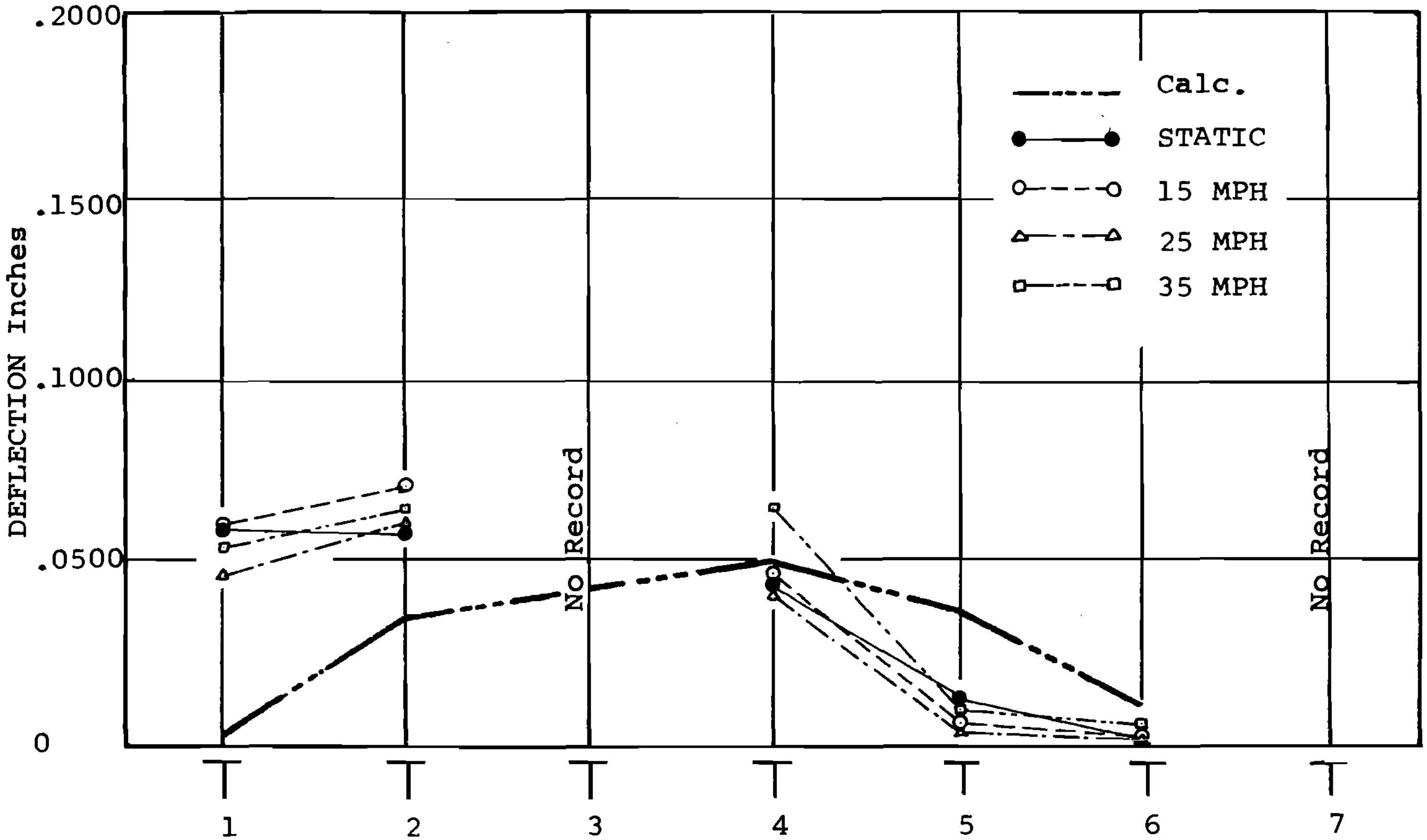
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION B
TRUCK NORMAL TO FLOW OF TRAFFIC ON PATH 2

CHART NO. 26



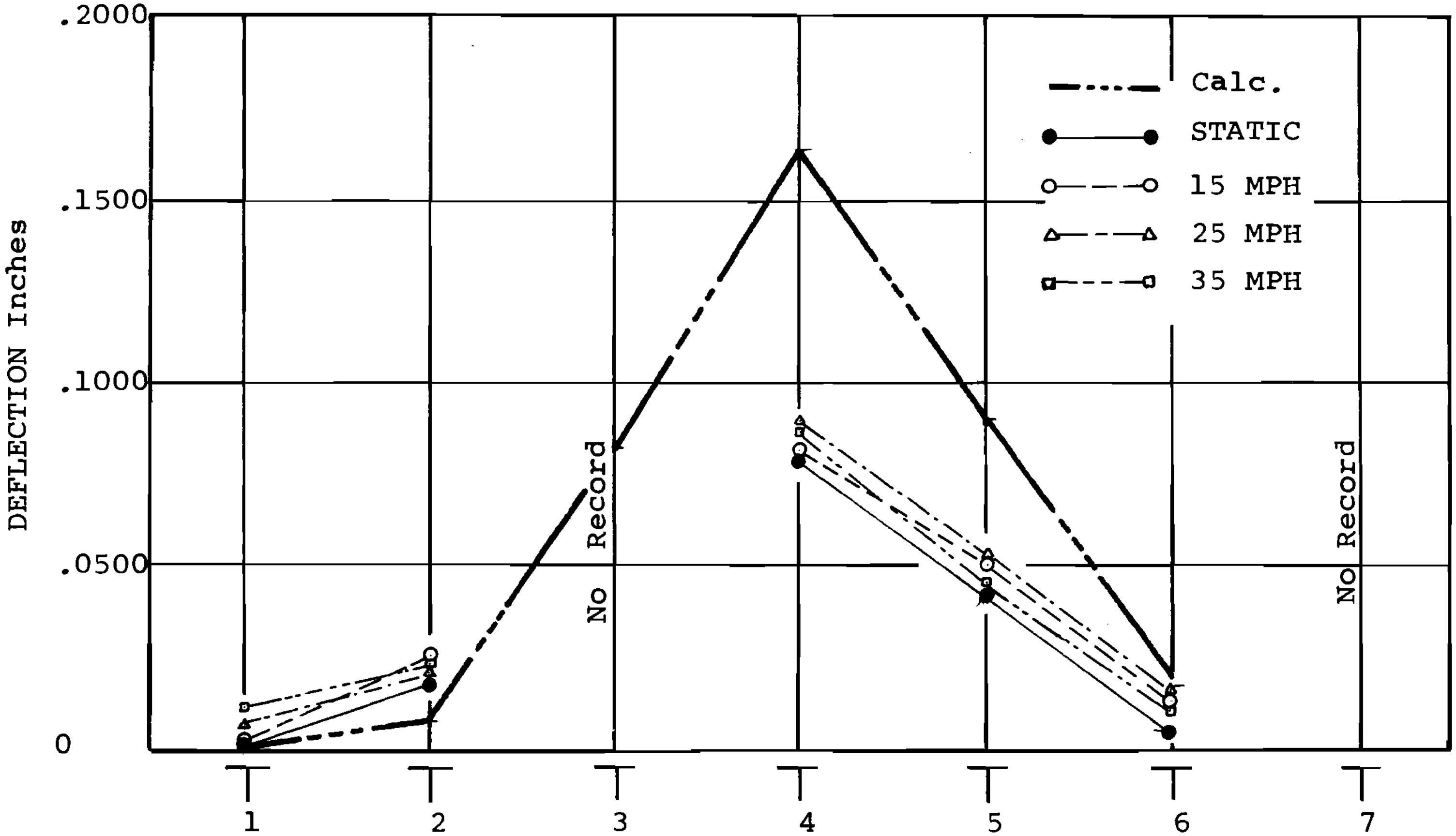
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION B
TRUCK NORMAL TO FLOW OF TRAFFIC ON PATH 3

CHART NO. 27



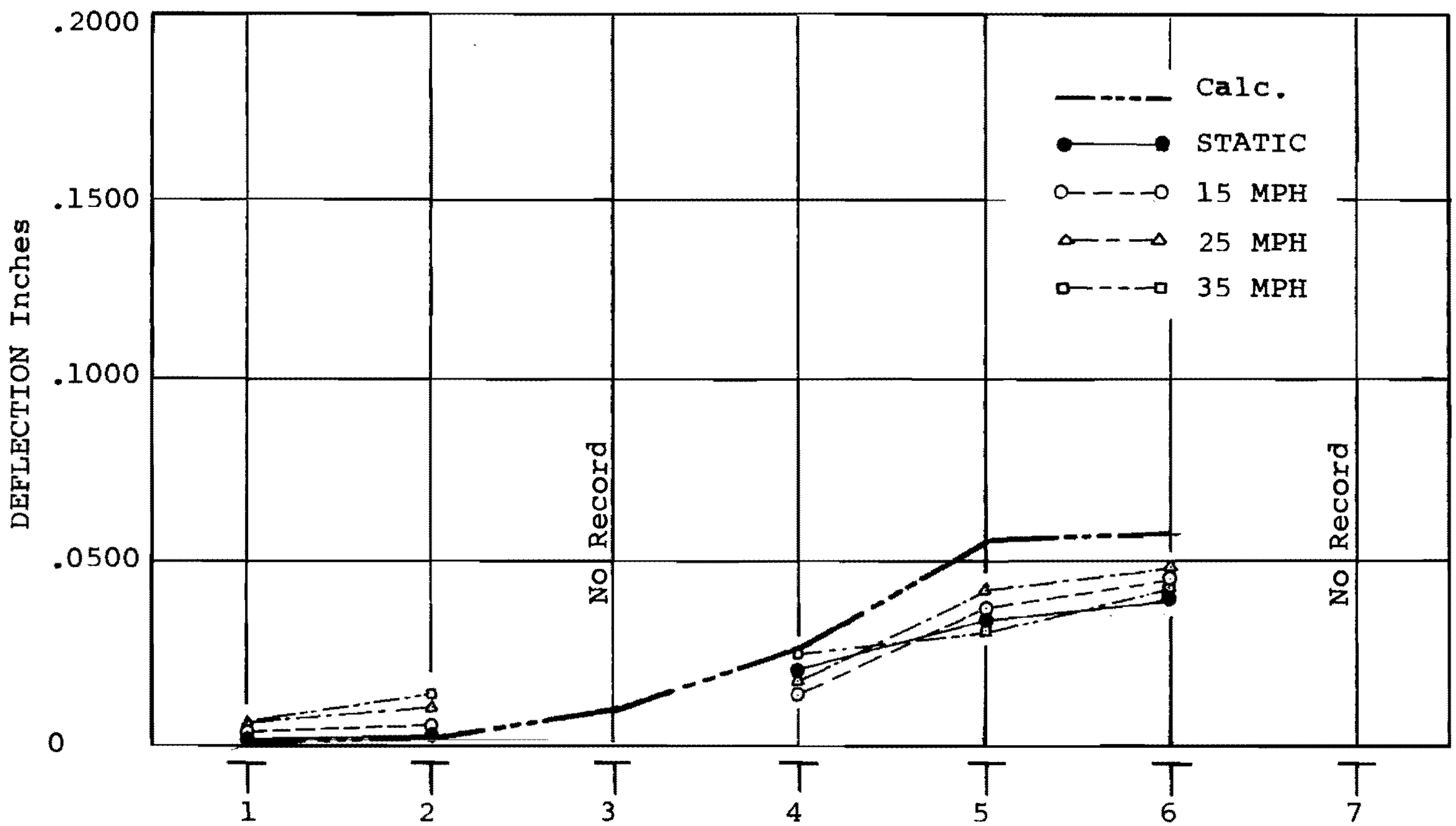
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION B
TRUCK OPPOSITE TO FLOW OF TRAFFIC ON PATH 1

CHART NO. 28



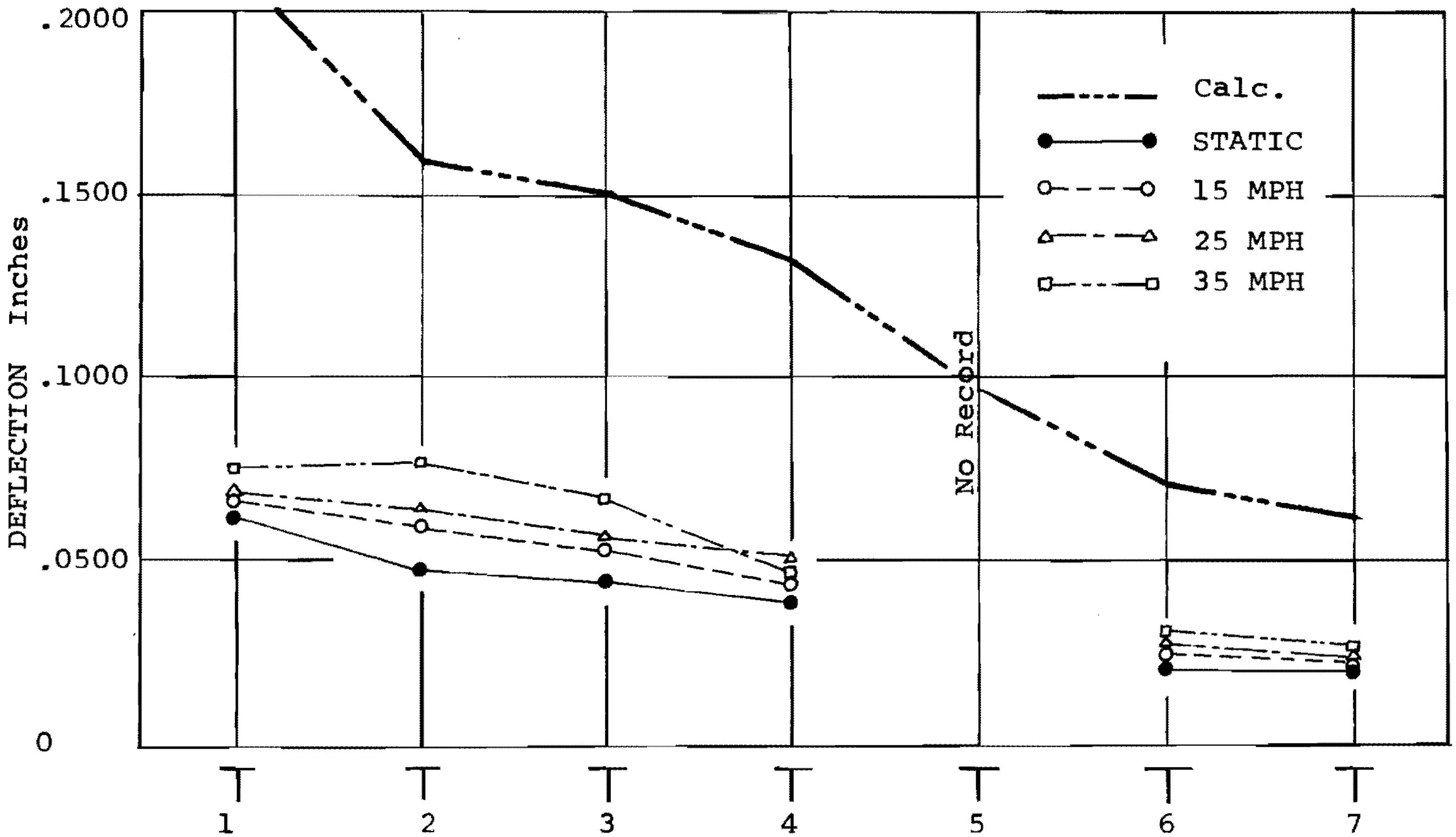
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION B
TRUCK OPPOSITE TO FLOW OF TRAFFIC ON PATH 2

CHART NO. 29



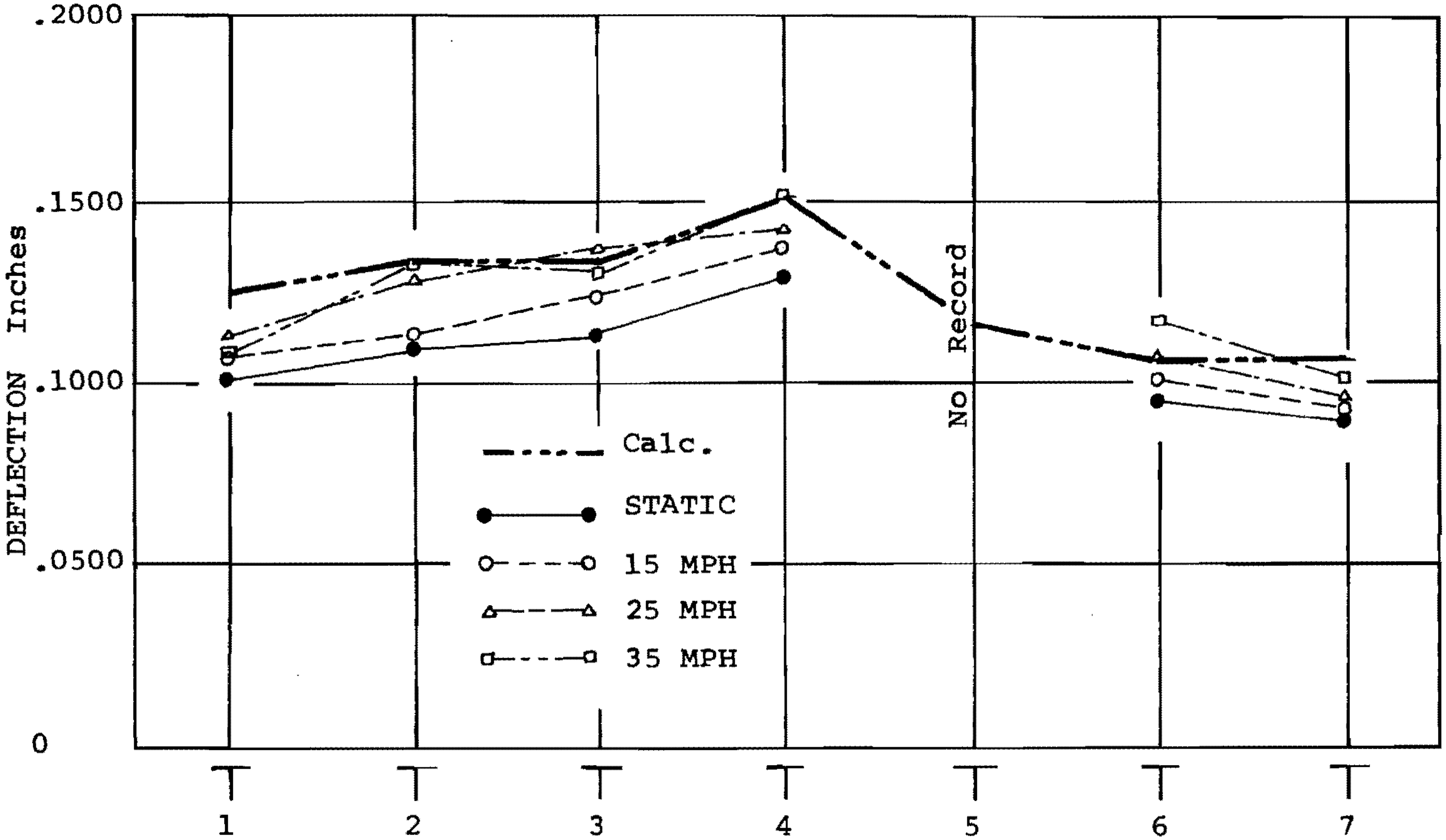
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION B
TRUCK OPPOSITE TO FLOW OF TRAFFIC ON PATH 3

CHART NO. 30



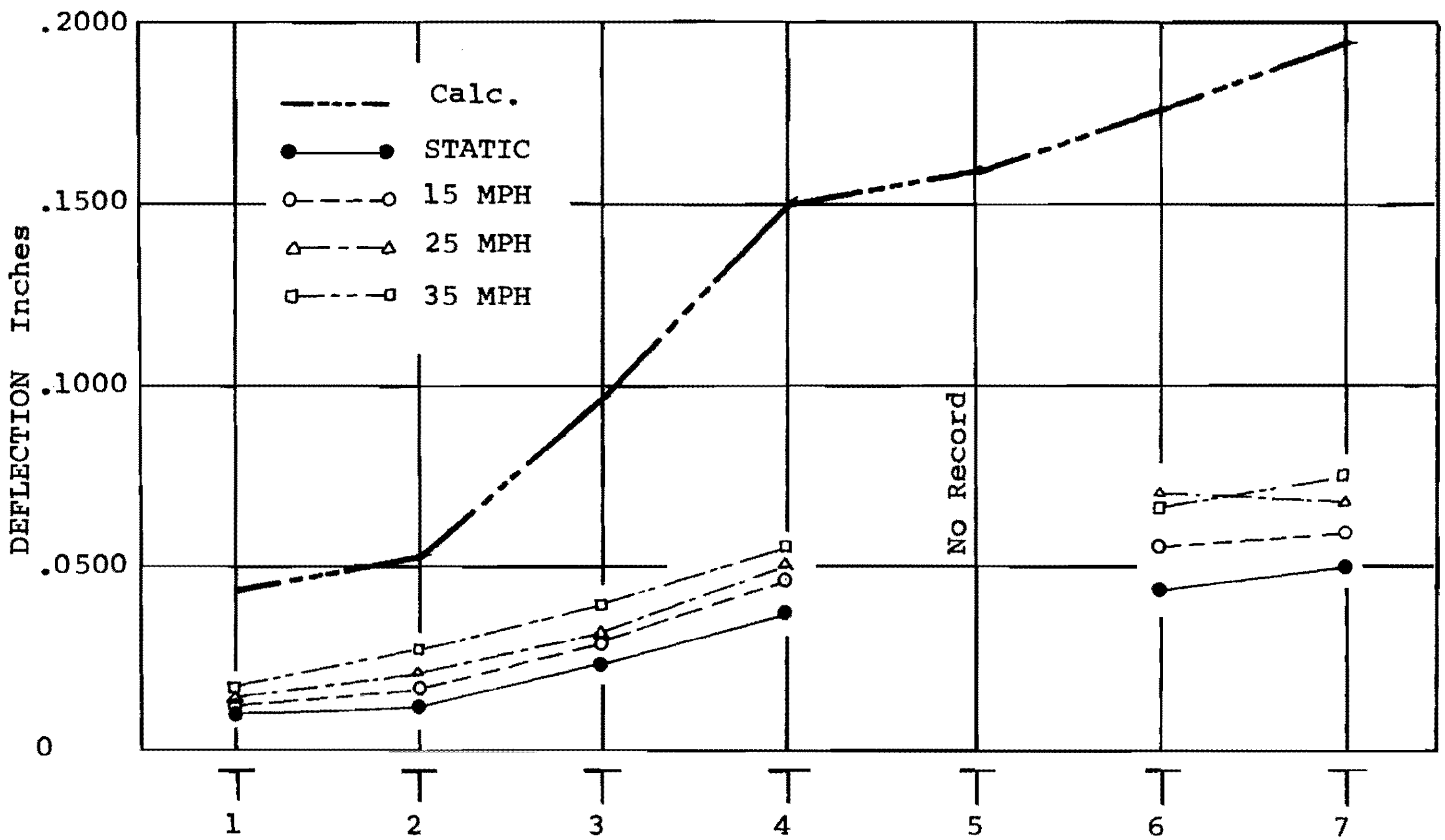
PEAK LIVE LOAD DEFLECTION AT STATION D
T.& N.O. RR O'PASS
TRUCK NORMAL TO FLOW OF TRAFFIC ON PATH 1

CHART NO. 31



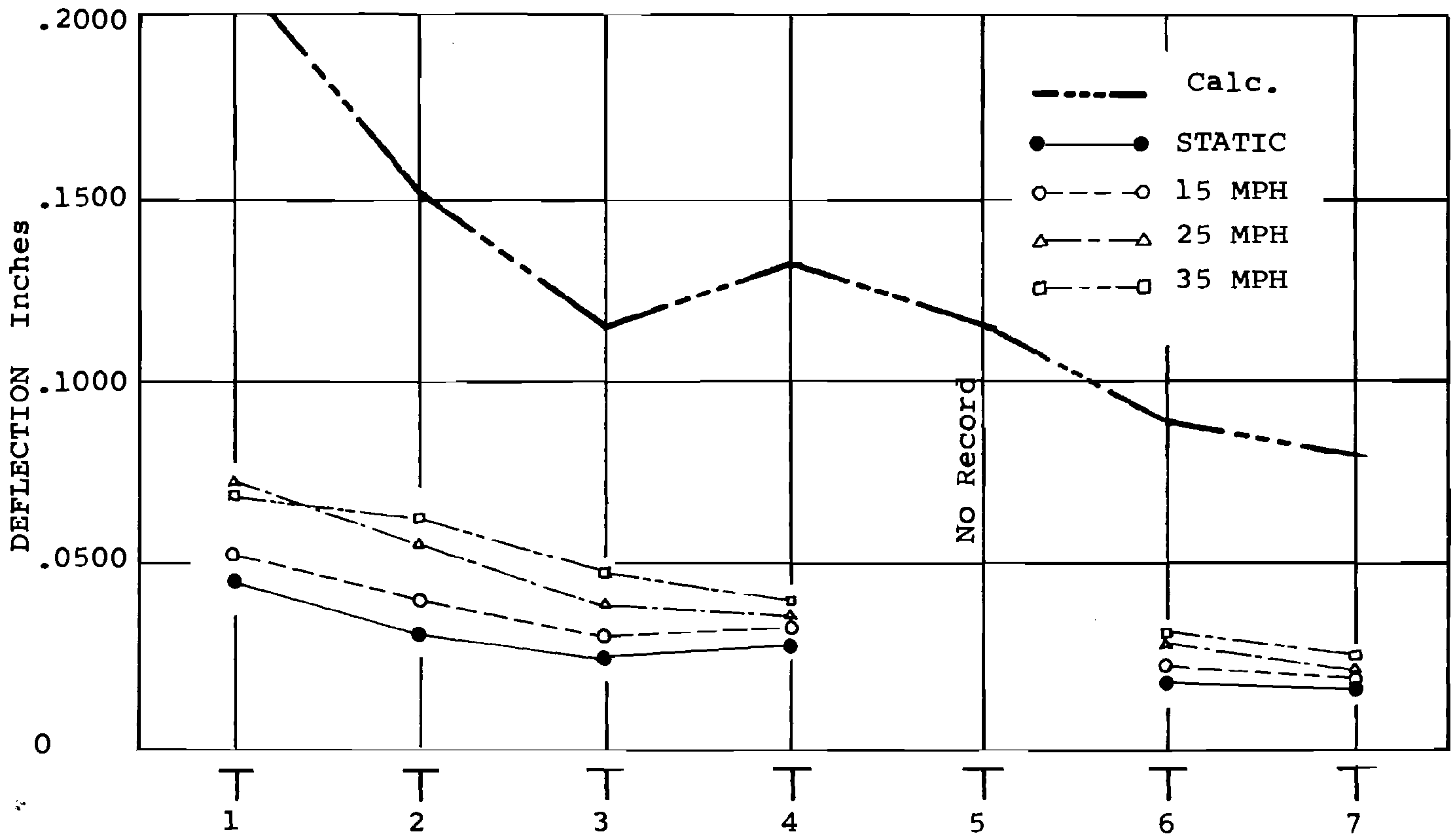
PEAK LIVE LOAD DEFLECTION AT STATION D
T. & N.O. RR O'PASS
TRUCK NORMAL TO FLOW OF TRAFFIC ON PATH 2

CHART NO. 32



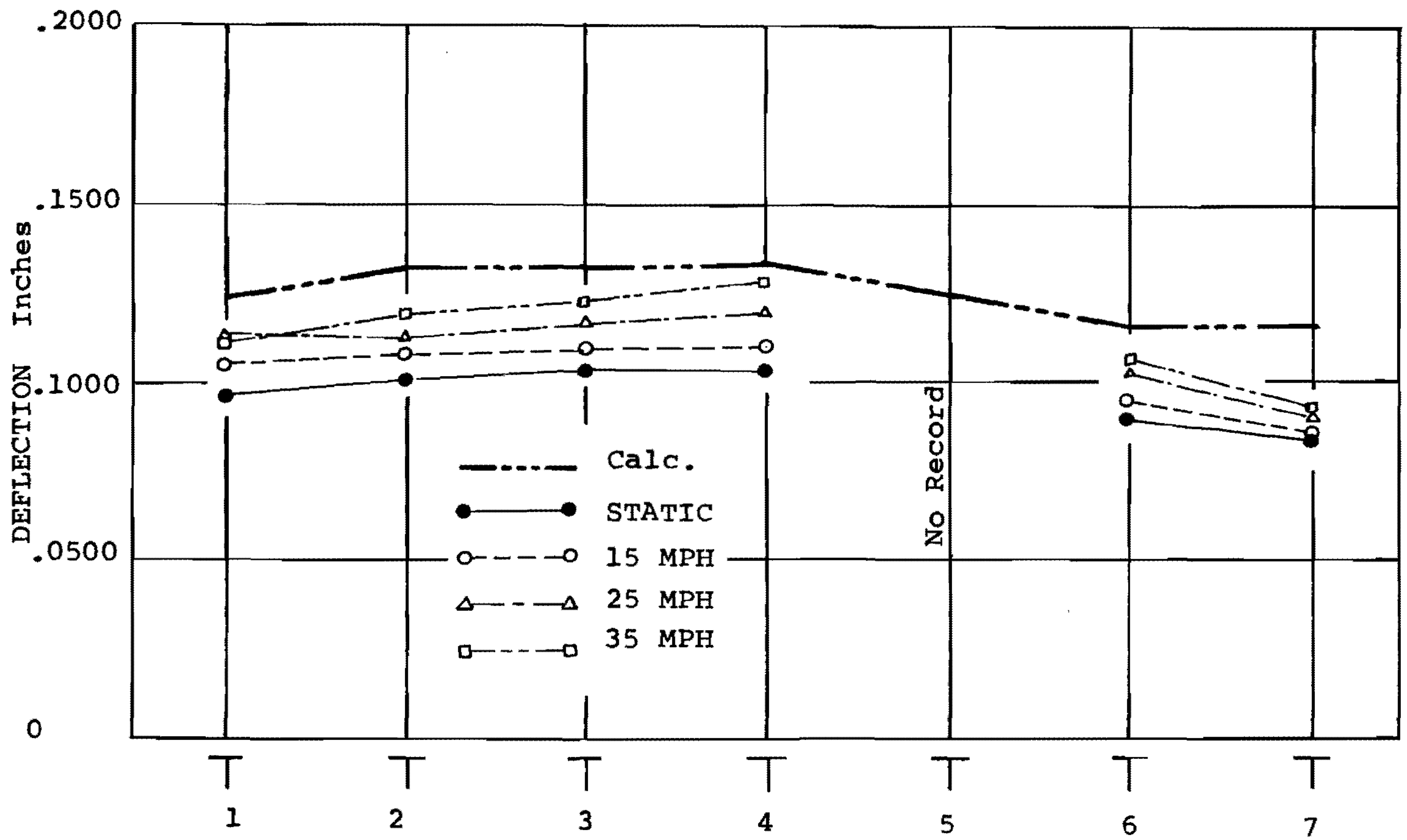
PEAK LIVE LOAD DEFLECTION AT STATION D
T. & N.O. RR O'PASS
TRUCK NORMAL TO FLOW OF TRAFFIC ON PATH 3

CHART NO. 33



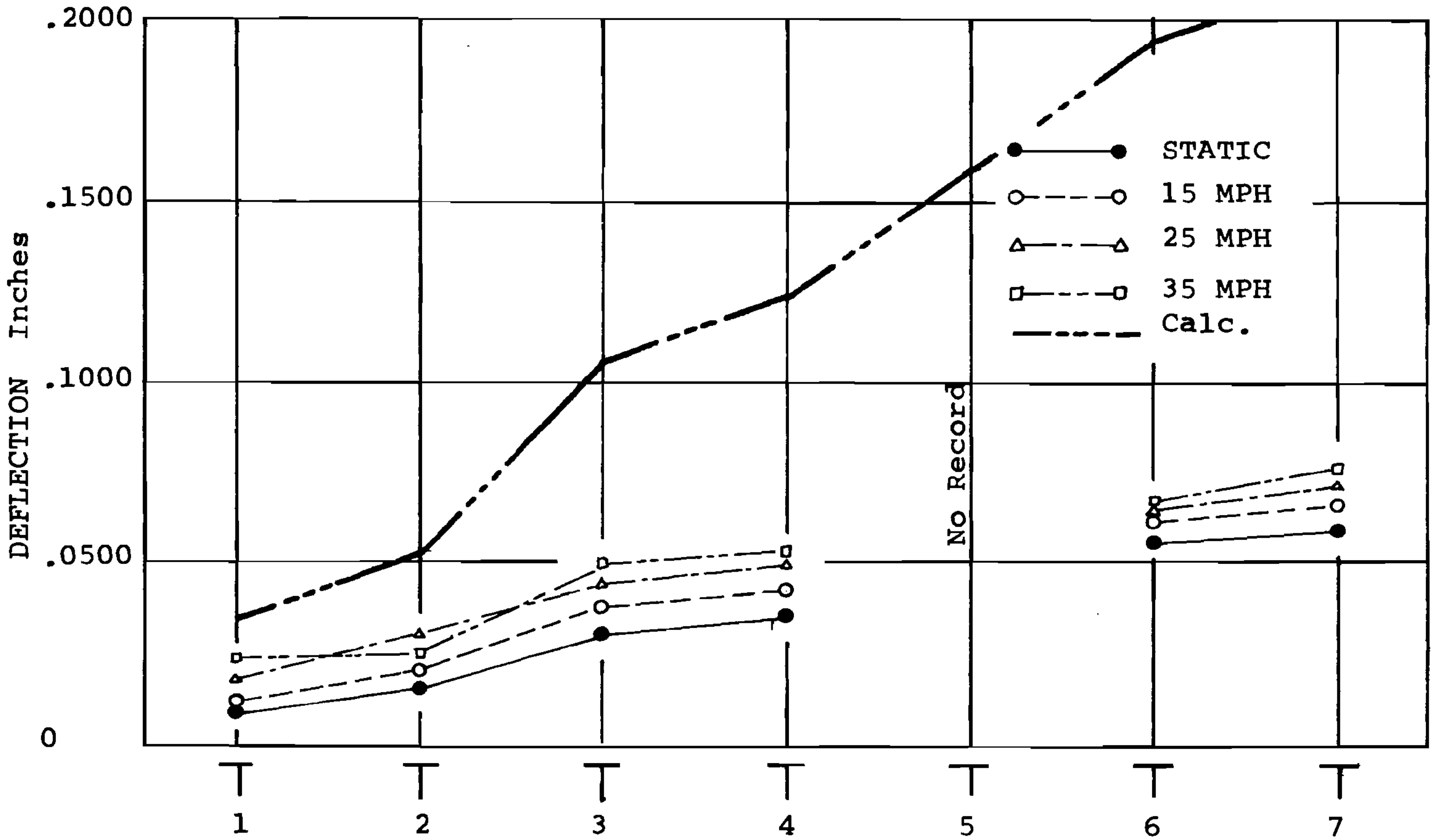
PEAK LIVE LOAD DEFLECTION AT STATION D
T. & N. O. RR O'PASS
TRUCK OPP. TO FLOW OF TRAFFIC ON PATH 1

CHART NO. 34



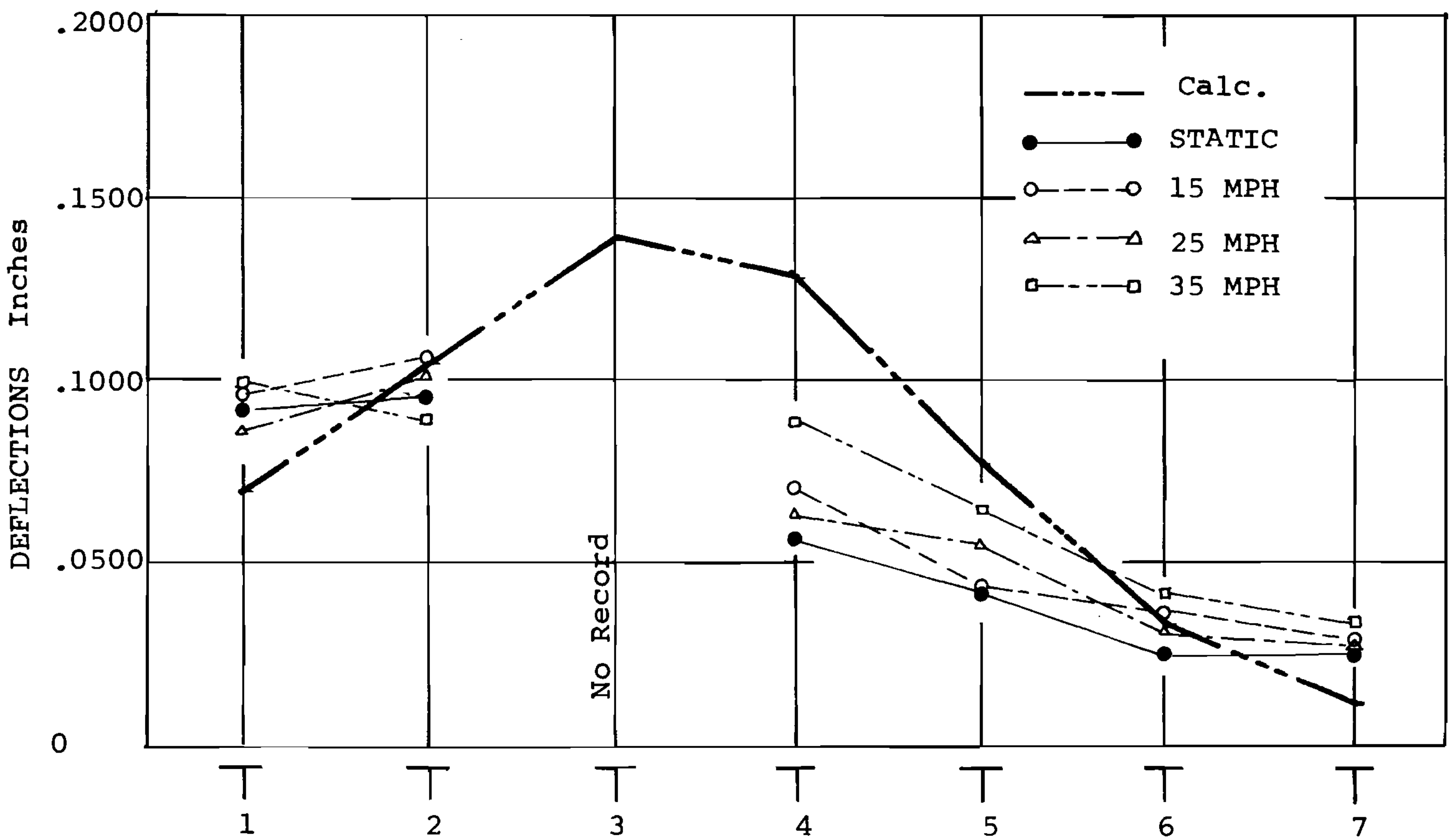
PEAK LIVE LOAD DEFLECTION AT STATION D
T. & N.O. RR O'PASS
TRUCK OPP. TO FLOW OF TRAFFIC ON PATH 2

CHART NO. 35



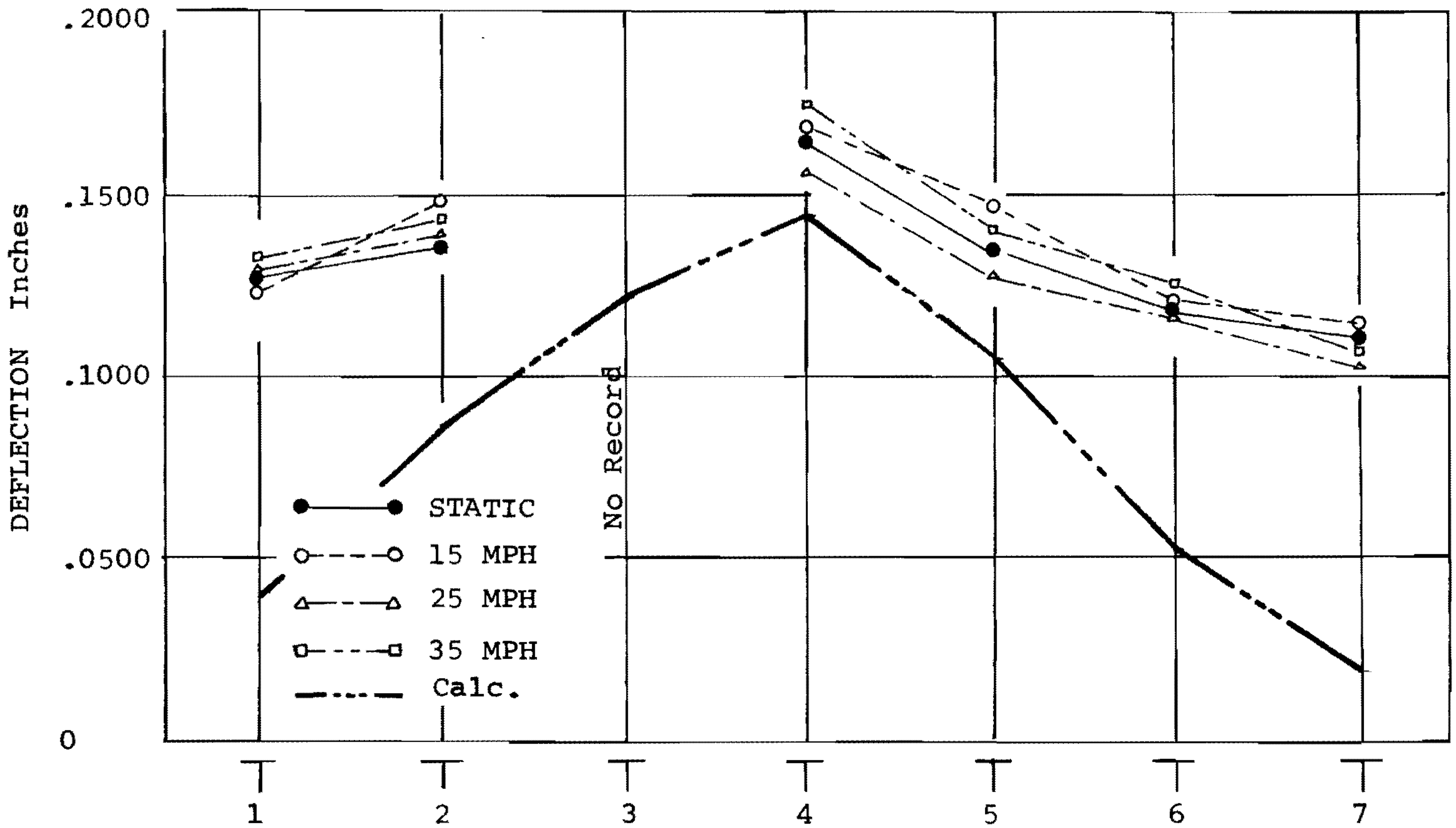
PEAK LIVE LOAD DEFLECTION AT STATION D
T. & N. O. RR O'PASS
TRUCK OPP. TO FLOW OF TRAFFIC ON PATH 3

CHART NO. 36



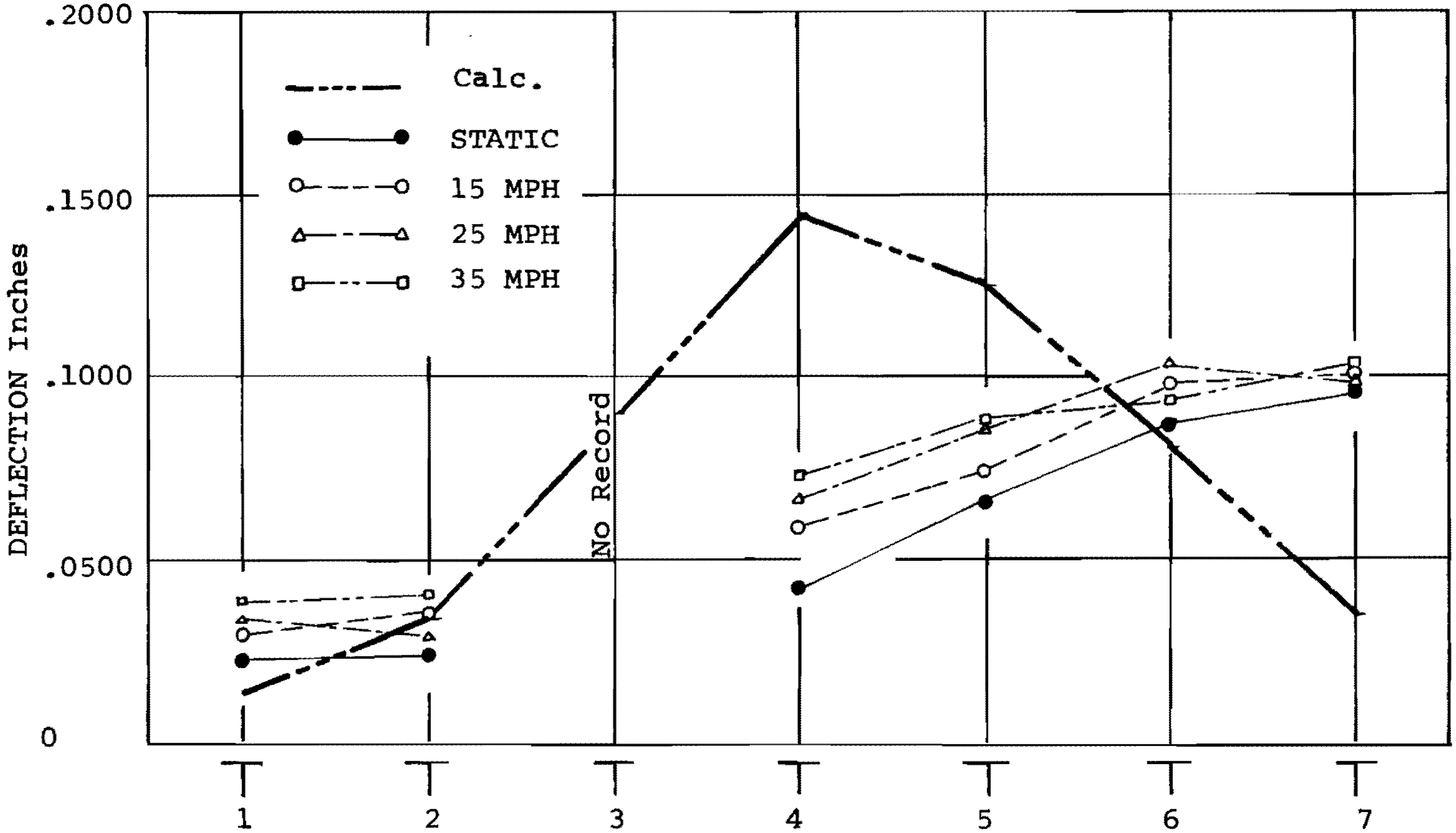
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION E
TRUCK NORMAL TO FLOW OF TRAFFIC ON PATH 1

CHART NO. 37



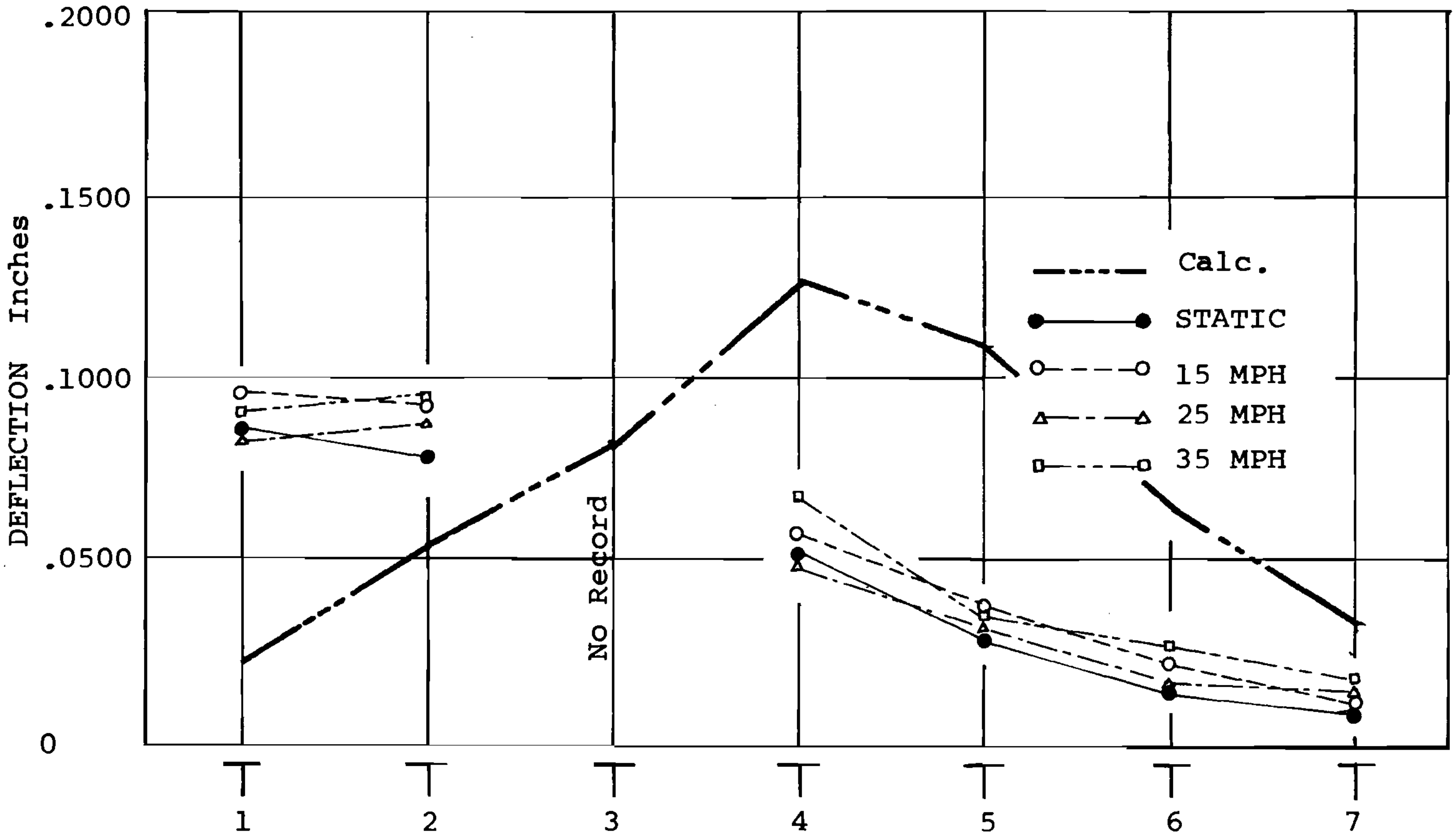
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION E
TRUCK NORMAL TO FLOW OF TRAFFIC ON PATH 2

CHART NO. 38



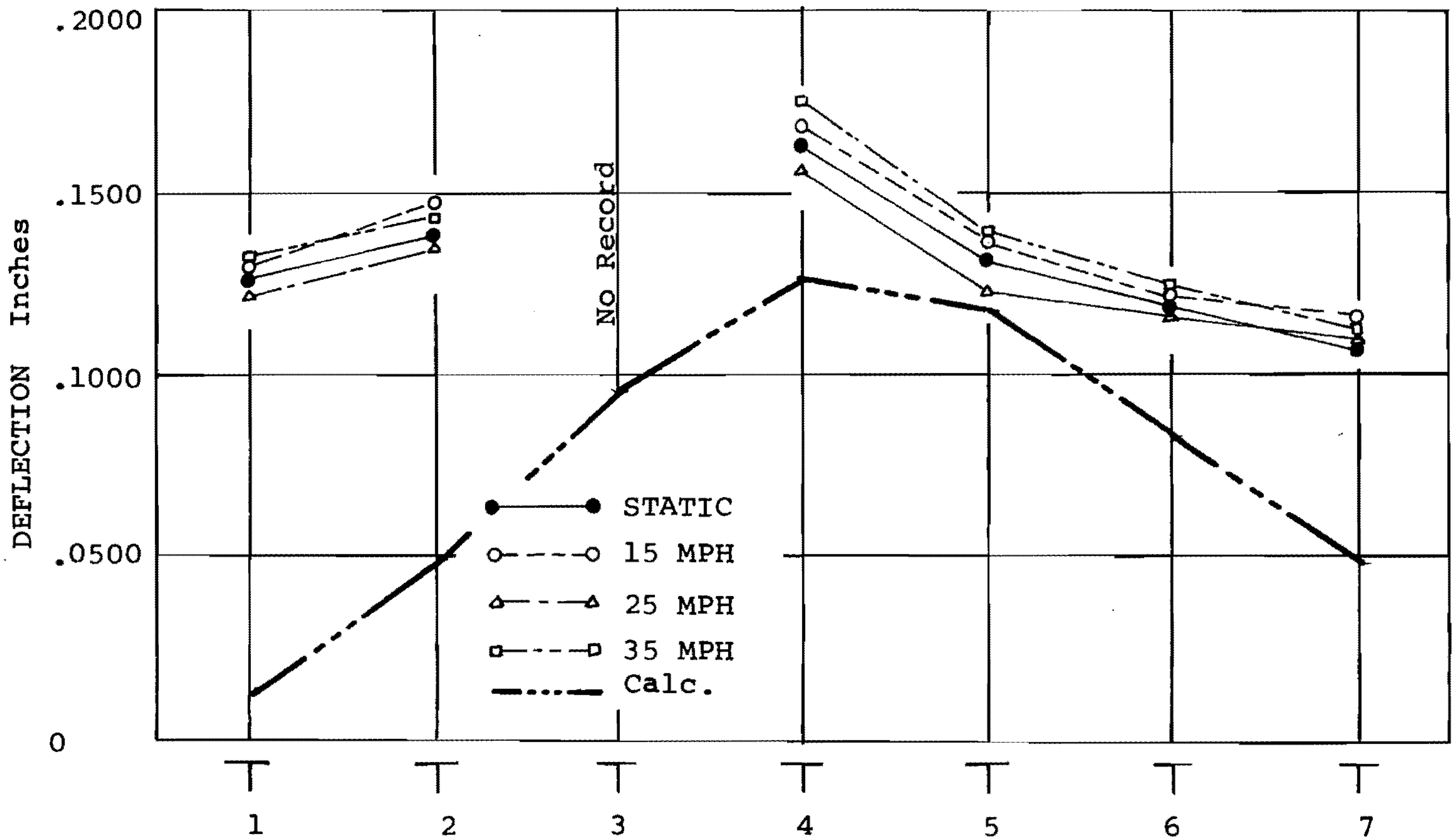
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION E
TRUCK NORMAL TO FLOW OF TRAFFIC ON PATH 3

CHART NO. 39



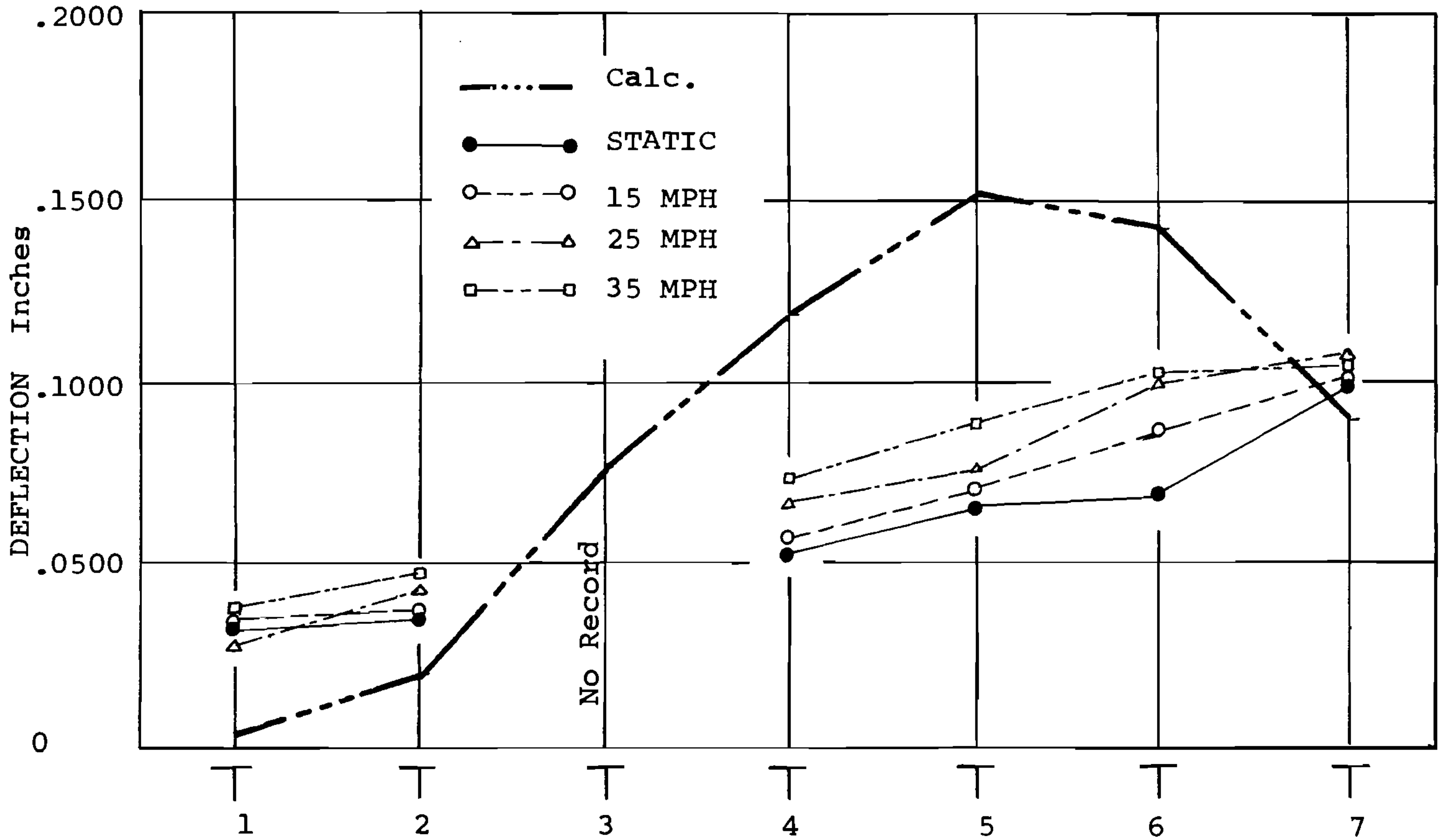
LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION E
TRUCK OPP. TO FLOW OF TRAFFIC ON PATH 1

CHART NO. 40



LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION E
TRUCK OPP. TO FLOW OF TRAFFIC ON PATH 2

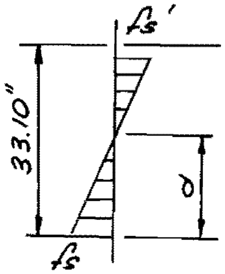
CHART NO. 41



LIVE LOAD DEFLECTION
T & NO RR O'PASS DRIVER AXLE AT STATION E
TRUCK OPP. TO FLOW OF TRAFFIC ON PATH 3

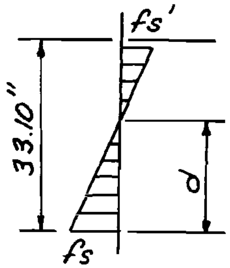
CHART NO. 42

	Beam No.	1	2	3	4	5	6	7
	fs'	253.4	452.7	58.9	34.0	60.6	8.8	12.9
15 MPH	fs	3445.6	2700.8	1174.8	622.0	218.5	118.3	152.8
	d	30.83"	28.8"	31.5"	31.3"	26.1"	30.8"	30.5"
	fs'	195.7	241.1	49.0	67.9	16.5	8.81	21.5
25 MPH	fs	2954.3	3882.4	1279.9	299.5	145.7	219.8	135.8
	d	31.0"	31.1"	31.8"	26.9"	29.7"	23.6"	30.5"
	fs'	314.5	256.1	78.5	34.0	55.1	17.6	30.1
35 MPH	fs	3891.5	2588.2	1279.9	760.3	145.7	321.2	169.8
	d	30.6"	30.1"	31.1"	31.6"	24.0	31.8"	28.1"



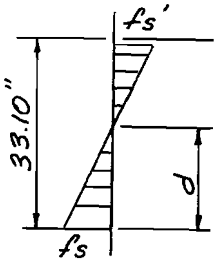
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION A - PATH 1 NORMAL
CHART NO. 43

	Beam No.	1	2	3	4	5	6	7
	fs'	41.2	30.8	186.4	34.0	418.8	61.7	21.5
15 MPH	fs	263.5	534.5	1367.7	4377.2	2021.5	608.6	237.7
	d	28.6"	31.2"	29.1"	32.8"	27.4"	30.0"	30.3"
	fs'	51.2	46.2	29.4	34.0	170.8	61.7	64.5
25 MPH	fs	405.4	590.8	1560.5	3686.1	1548.0	514.8	152.8
	d	29.4"	30.3"	32.4"	32.7"	29.9"	29.5"	23.3"
	fs'	10.3	20.3	73.6	50.9	264.5	54.3	17.2
35 MPH	fs	364.8	675.2	1770.9	4837.9	1566.2	591.7	118.9
	d	32.1"	32.1"	31.8"	32.7"	28.3"	30.3"	28.9"



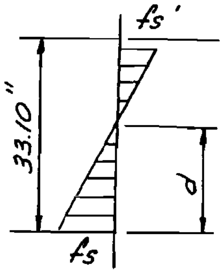
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION A – PATH 2 NORMAL
CHART NO. 44

	Beam No.	1	2	3	4	5	6	7
	fs'	-	-	-	34.0	374.8	387.9	223.8
15 MPH	fs	-	-	-	483.8	1129.1	2873.9	3005.6
	d	-	-	-	30.9"	24.8"	29.2"	30.8"
	fs'	-	-	-	34.0	148.8	454.1	210.9
25 MPH	fs	-	-	-	299.5	1092.7	2704.8	3158.8
	d	-	-	-	29.7"	29.1"	28.3"	31.0"
	fs'	-	-	9.8	50.9	319.6	478.1	317.8
35 MPH	fs	-	-	175.3	575.3	1110.9	3381.0	3598.1
	d	-	-	28.2"	30.4"	25.7"	27.3"	30.4"



TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION A - PATH 3 NORMAL
CHART NO. 45

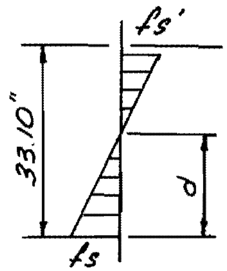
	Beam No.	1	2	3	4	5	6	7
	fs'	718.1	555.9	44.7	Same as at Station A Beam 4	9.9	20.4	-
15 MPH	fs	309.5	1687.7	879.1		211.2	90.4	-
	d	9.9"*	24.8"	31.4"		31.6"	27.0"	-
	fs'	536.6	530.5	39.1		4.9	15.3	-
25 MPH	fs	367.3	1466.9	152.1		193.6	83.9	-
	d	12.0"*	24.3"	26.3"		32.2"	27.9"	-
	fs'	849.7	642.7	39.1		4.9	25.5	-
35 MPH	fs	367.3	1577.3	895.9		211.2	41.9	-
	d	9.9"*	23.5"	31.7"		32.3"	20.5"	-



*@ Sta. B, Beam No. 1 falls in the non-composite negative moment area.

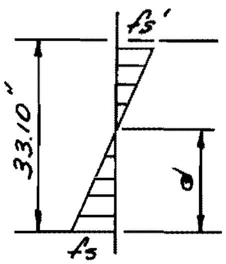
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION B - PATH 1 NORMAL
CHART NO. 46

	Beam No.	1	2	3	4	5	6	7
	fs'	35.9	156.3	145.2	Same As At Station A Beam 4	104.8	137.5	-
15 MPH	fs	115.9	473.2	1656.7		1478.2	377.5	-
	d	25.2"	24.8"	30.4"		30.9"	24.3"	-
	fs'	47.9	104.2	111.7		79.8	127.3	-
25 MPH	fs	154.7	552.1	591.7		1619.0	377.5	-
	d	25.3"	27.9"	27.8"		31.5"	24.7"	-
	fs'	23.9	86.9	396.5		84.8	106.9	-
35 MPH	fs	115.9	488.9	1572.2		1390.2	405.5	-
	d	27.4	28.1	26.4"		31.1"	26.1"	-



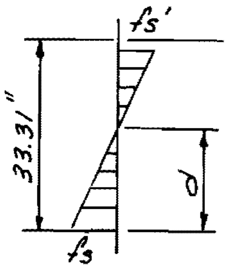
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION B - PATH 2 NORMAL
CHART NO. 47

	Beam No.	1	2	3	4	5	6	7
	fs'	35.9	17.4	33.5	Same As At Station A Beam 4	4.9	458.3	–
15 MPH	fs	135.3	47.3	371.5		510.3	1244.4	–
	d	26.2"	24.2"	30.3"		32.7"	24.2"	–
	fs'	59.8	–	83.8"		9.9	529.6	–
25 MPH	fs	115.9	–	169.1		633.5	1579.9	–
	d	21.8"	–	22.1"		32.5"	24.7"	–
	fs'	–	–	55.9		4.9	499.0	–
35 MPH	fs	–	–	152.1		563.1	1314.3	–
	d	–	–	24.2"		32.8"	23.9"	–



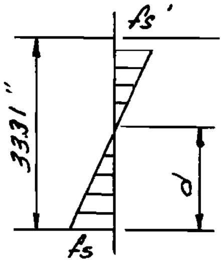
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION B – PATH 3 NORMAL
CHART NO. 48

	Beam No.	1	2	3	4	5	6	7
	fs'	355.4	463.4	59.1	27.7	42.5	9.3	8.8
15 MPH	fs	3615.0	2791.3	1195.3	663.4	208.6	124.1	118.3
	d	30.3"	28.6"	31.7"	31.9	27.6"	30.9"	31.0"
	fs'	327.9	241.1	56.7	78.4	22.0	10.4	15.4
25 MPH	fs	3170.8	3761.4	2076.2	693.8	236.8	219.8	50.9
	d	30.1"	31.3"	32.4"	29.9"	30.4"	31.7"	25.6"
	fs'	226.6	282.7	58.9	110.7	49.6	22.1	31.1
35 MPH	fs	2959.1	3010.2	1192.3	832.5	668.1	135.2	169.8
	d	30.9"	30.5"	31.7"	29.4"	31.0"	28.7"	28.2"



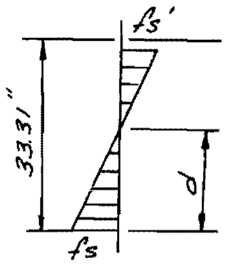
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION D - PATH 1 NORMAL
CHART NO. 49

	Beam No.	1	2	3	4	5	6	7
	fs'	46.4	36.9	188.5	225.9	402.3	61.7	25.8
15 MPH	fs	263.9	506.4	1437.8	1634.1	937.5	540.9	186.8
	d	28.3"	31.0"	29.9"	29.3"	23.3"	29.8"	29.3"
	fs'	55.3	46.2	189.5	193.7	163.9	64.5	21.5
25 MPH	fs	590.8	1402.7	2021.1	1898.1	1693.1	557.8	152.8
	d	30.4"	32.2"	30.4"	30.2"	30.2"	29.8"	29.2"
	fs'	53.4	37.3	173.2	641.1	194.3	57.3	17.2
35 MPH	fs	364.8	562.7	1455.3	3083.8	1602.7	473.3	254.7
	d	29.0"	31.2"	29.8"	27.8"	29.7"	29.7"	31.0"



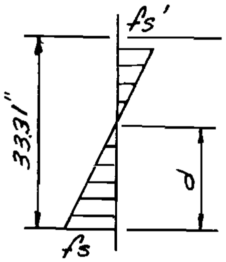
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION D - PATH 2 NORMAL
CHART NO. 50

	Beam No.	1	2	3	4	5	6	7
	fs'	–	–	19.6	55.3	374.8	387.9	223.8
15 MPH	fs	–	–	87.8	627.5	928.8	2485.0	3090.5
	d	–	–	27.2"	30.6"	23.7"	28.8"	31.1"
	fs'	–	–	27.9	67.9	141.3	454.1	245.3
25 MPH	fs	–	–	127.3	619.5	1213.6	1639.1	2654.1
	d	–	–	27.4"	30.0"	29.8"	29.1	30.5"
	fs'	–	9.8	50.9	64.1	243.1	319.6	206.6
35 MPH	fs	–	298.1	575.9	558.8	983.5	3394.9	2547.2
	d	–	32.2"	30.6"	29.8"	26.7"	30.4"	30.8"



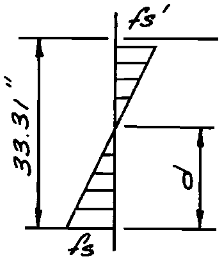
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION D – PATH 3 NORMAL
CHART NO. 51

		Beam No. 1	2	3	4	5	6	7
	fs'	589.3	403.8	54.1	Same As At Station D Beam 4	59.1	9.3	7.3
15 MPH	fs	3312.1	2519.9	983.2		893.4	208.6	118.3
	d	28.3"	28.7"	31.5"		31.2"	31.8"	31.4"
	fs'	601.7	546.1	44.6		21.7	16.1	-
25 MPH	fs	2988.1	2016.7	239.5		183.6	177.8	-
	d	27.8"	26.2"	28.1"		29.7"	30.5"	-
	fs'	593.4	676.5	51.6		19.2	9.8	-
35 MPH	fs	2876.3	3010.1	899.5		536.2	193.8	-
	d	27.6"	27.2"	31.5"		31.9"	31.7"	-

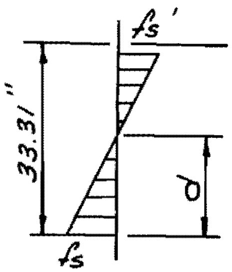


TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION E - PATH 1 NORMAL
CHART NO. 52

	Beam No.	1	2	3	4	5	6	7
	fs'	20.8	91.9	312.6		398.5	111.3	31.2
15 MPH	fs	197.3	613.1	1547.5		1131.8	535.7	197.4
	d	30.1"	28.9"	27.7"		24.7"	28.6"	28.8"
	fs'	41.3	43.4	197.8		256.7	98.1	20.7
25 MPH	fs	176.3	593.9	1137.2	Same As At Station D Beam 4	1342.2	476.8	203.6
	d	26.9"	31.0"	28.4"		27.9"	27.6"	30.2"
	fs'	36.7	39.8	225.8		191.3	107.1	17.8
35 MPH	fs	232.2	476.1	1342.9		1231.7	591.7	294.6
	d	28.8"	30.7"	28.5"		28.8"	28.2"	31.4"



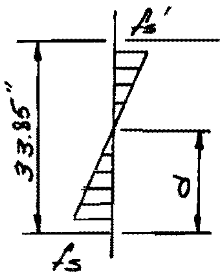
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION E - PATH 2 NORMAL
CHART NO. 53



	Beam No.	1	2	3	4	5	6	7
	fs'	–	9.8	20.2	Same As At Station D Beam 4	368.4	312.1	201.8
15 MPH	fs	–	201.5	93.6		1019.6	2561.3	3002.3
	d	–	31.6"	27.4"		24.5"	29.7"	31.2"
	fs'	–	–	25.4		153.6	398.9	237.4
25 MPH	fs	–	–	135.7		1159.1	1598.2	1993.5
	d	–	–	28.1"		29.4"	26.7"	29.8"
	fs'	–	11.2	36.9		217.6	293.4	206.6
35 MPH	fs	–	301.7	565.4		603.2	1476.3	2452.7
	d	–	32.1"	31.3"		24.5"	27.8"	30.7"

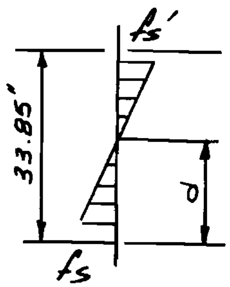
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION E – PATH 3 NORMAL
CHART NO. 54

	Beam No.	1	2	3	4	5	6	7
15 MPH	fs'	1482.3	1382.7	344.7	200.9	82.0	30.4	20.8
	fs	1491.4	1486.6	367.1	146.1	101.5	59.8	108.4
	d	16.5"	17.2"	17.1"	13.9"	18.3"	21.9	27.8"
25 MPH	fs'	1396.4	1301.2	365.8	200.9	73.5	35.4	15.3
	fs	1407.3	1398.7	407.9	196.1	109.7	61.1	100.1
	d	16.7"	17.1"	17.4"	16.4"	19.8"	20.9"	28.8"
35 MPH	fs'	1501.4	1401.3	356.2	189.7	93.0	34.5	18.9
	fs	1536.7	1497.6	401.6	156.7	115.9	73.2	98.4
	d	16.8"	17.1"	17.6"	15.0"	18.4"	22.5"	27.8"



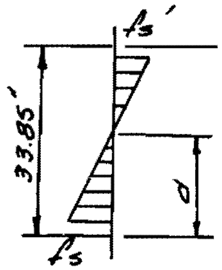
TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION F - PATH 1 NORMAL
CHART NO. 55

	Beam No.	1	2	3	4	5	6	7
	fs'	119.3	194.3	634.2	1348.2	962.5	170.1	83.5
15 MPH	fs	136.1	391.8	1004.7	1915.3	1143.7	239.3	92.9
	d	17.6"	22.2"	20.3"	19.5"	18.0"	19.4"	17.4"
	fs'	101.7	209.4	681.5	1276.8	879.7	158.2	76.4
25 MPH	fs	121.6	426.7	1110.7	1164.7	1031.4	210.9	89.1
	d	18.1"	22.2"	20.6"	15.8"	17.8"	18.9"	17.9"
	fs'	97.3	341.8	875.9	1179.8	746.7	187.3	121.6
35 MPH	fs	131.4	751.2	1142.3	1453.2	1213.4	382.1	142.7
	d	19.1"	22.7"	18.7"	14.5"	20.5"	22.3"	17.9"



TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION F - PATH 2 NORMAL
CHART NO. 56

	Beam No.	1	2	3	4	5	6	7
	fs'	31.4	56.7	61.7	285.5	251.6	1062.9	1043.2
15 MPH	fs	76.2	57.6	57.9	162.3	631.2	957.1	1378.5
	d	23.9"	17.1"	16.4"	12.3"	24.2"	16.0"	19.3"
	fs'	39.8	64.3	73.4	279.5	261.1	1123.8	1149.7
25 MPH	fs	79.1	59.8	69.1	176.3	653.2	1012.6	1403.5
	d	22.5"	16.3"	16.4"	13.1"	24.2"	16.0"	18.6"
	fs'	29.5	59.3	81.3	306.7	342.8	1248.9	1135.5
35 MPH	fs	68.3	64.2	79.4	298.1	674.3	1172.5	1400.1
	d	23.6"	17.6"	16.8"	16.7"	22.5"	16.4"	18.6"



TOP AND BOTTOM FLANGE STRESSES
WITH LOCATION OF NEUTRAL AXIS,
STATION F - PATH 3 NORMAL
CHART NO. 57

PEAK DOUBLE VERTICAL AMPLITUDE, INCHES
MEASURED FROM DEFLECTION GAGE TRACES

50' END SPAN

		Bm 1	Bm 2	Bm 3	Bm 4	Bm 5	Bm 6	Bm 7
	15 MPH	.29	.35	.19	.27		.02	–
PATH 1	25 MPH	.32	.31	.17	.11		.07	.01
NORMAL	35 MPH	.28	.29	.21	.07		.11	.08
	15 MPH	.02	.15	.23	.26		.10	.12
PATH 2	25 MPH	.07	.08	.25	.32	NO RECORD	.18	.08
NORMAL	35 MPH	.13	.11	.29	.27		.15	.05
	15 MPH	.05	.10	.13	.19		.28	.25
PATH 3	25 MPH	.17	.08	.17	.31		.25	.30
NORMAL	35 MPH	.09	.14	.15	.28		.19	.32

65' INTERIOR SPAN

		Bm 1	Bm 2	Bm 3	Bm 4	Bm 5	Bm 6	Bm 7
	15 MPH	.35	.33	.24	.19		.11	.07
PATH 1	25 MPH	.29	.40	.19	.21		.13	.10
NORMAL	35 MPH	.31	.37	.23	.12		.09	.11
	15 MPH	.05	.18	.29	.28		.16	.08
PATH 2	25 MPH	.11	.13	.27	.34	NO RECORD	.15	.11
NORMAL	35 MPH	.02	.09	.33	.31		.19	.09
	15 MPH	.05	.11	.15	.18		.27	.31
PATH 3	25 MPH	–	.09	.13	.27		.29	.29
NORMAL	35 MPH	.07	.12	.16	.31		.24	.35

CHART NO. 58