



# TARDEC

---TECHNICAL REPORT---

THE NATION'S LABORATORY FOR ADVANCED AUTOMOTIVE TECHNOLOGY

No. 13631



WINNER OF THE 1994 FEDERAL QUALITY IMPROVEMENT PROTOTYPE AWARD

COMPUTER-BASED DYNAMIC AND FINITE ELEMENT ANALYSIS OF THE JOINT SERVICES IMAGERT PROCESSING SYSTEM (JSIPS) TRAILER; MODIFIED M371A1, 22-1/2-TON, FLATBED, SEMI-TRAILER

SEPTEMBER 1994

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U.S. Army Tank-Automotive Research,  
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Warren, Michigan 48397-5000

# REPORT DOCUMENTATION PAGE

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## **1.0 SUMMARY**

The System Simulation and Technology Division (AMSTA-RY), of the U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC) was tasked by the Product Manager, Trailers to perform a computer-based simulation of the M932A1, 6x6, 5-ton Semitractor, towing a Joint Services Imagery Processing System (JSIPS) trailer. The JSIPS trailer is an M871A1, 22-1/2-ton, flat bed, semitrailer that has been modified by converting the trailer deck and frame into a "gooseneck" configuration. PM, Trailers decided to use computer-based analyses to determine if the structural integrity and/or operational performance of the trailer would be degraded by these modifications. Computer-based analysis is an efficient, timely and cost-effective means of making such determinations.

Dynamic Analysis and Design System (DADS) software was used to create a three-dimensional, rigid-body model of the M932A1/JSIPS trailer system. This model served two purposes. The first was to simulate a series of driving maneuvers to test the stability of the truck/trailer system. The second purpose was to simulate the truck/trailer system encountering severe obstacles in order to induce dynamic forces into the structural members of the trailer frame. These forces, along with accelerations and displacements of various points on the trailer, were used as input for a finite element analysis of the structural integrity of the modified trailer frame. A detailed finite element model of the trailer frame was developed for this purpose.

The results of the analysis indicate that the modifications made to the M871A1 trailer do not degrade the dynamic performance or stability of the M932A1/JSIPS trailer system. The modifications should also not have a detrimental effect on the structural integrity of the system when performing its normal operating mission. However, it is recommended that extreme caution be used if forced to operate this system in a manner beyond its normal requirements.

## **2.0 INTRODUCTION/OBJECTIVE**

### **2.1 Background**

The System Simulation and Technology Division, of the U.S. Army Tank-Automotive Research, Development, and Engineering Center was tasked by the Product Manager, Trailers to perform a computer-based simulation of the M932A1, 6x6, 5-ton Semitractor, towing a Joint Services Imagery Processing System trailer. The JSIPS trailer is an M871A1, 22-1/2-ton, flat bed, Semi-Trailer that has been modified by converting the trailer deck and frame into a "gooseneck" configuration. The gooseneck was added to the trailer in order to raise the kingpin height of the trailer from 50 inches to 60 inches above the ground so that the trailer would be operational with the M931, M931A1, M932, and M932A1 tractors. The simulation included the

development and analysis of a full-scale dynamic model of the M932A1/JSIPS trailer combination and several finite element models of the JSIPS trailer frame. The dynamic model was used to determine if the change in kingpin height on the JSIPS trailer would have any detrimental effect on the stability and performance of the truck/trailer combination. The dynamic model was also used to generate a variety of reaction forces, displacements, and accelerations at the kingpin, support gussets, and trunnion attachment points. The reaction forces at these points were applied to the finite element models. Static-linear finite element analyses were run to determine the over-all structural integrity of the JSIPS semitrailer.

## **2.2 Analysis**

A computer-based dynamic model of the M932A1/JSIPS trailer combination was created using Dynamic Analysis and Design System software. The DADS software is a set of general-purpose computer programs that can be used to model and predict the motion of a variety of vehicle systems. DADS builds a mathematical model of the vehicle system that calculates positions, velocities, and accelerations of the various parts of the system, as well as resultant forces that act within the system.

A finite element model and analysis of the trailer frame was also performed for this project. The finite element method is an analysis technique for solving the differential equations of complex problems. The method has become a valuable tool for modeling structural, mechanical, thermal, and fluid systems. In finite element analysis, a structure is broken down into simple discrete regions, or finite elements. These simple structural elements, which can be beams, shells, or solids, have elastic behavior that can be formulated mathematically. They are then assembled to form the overall structure of the item being analyzed. It is mandatory that the behavior of the model closely exhibits the behavior of the actual physical structure, in order to obtain realistic results and verify the model.

## **3.0 PROCEDURE**

### **3.1 Dynamic Model**

#### **3.1.1 DADS Methodology**

DADS contains a large library of mechanical elements that can be used to build a three-dimensional model of vehicle systems. These include rigid and flexible bodies, joints, constraints, force and torque-producing elements, as well as control and hydraulic elements.

Once a model has been defined from the library of 3-D elements, the data set is processed by the DADS analysis program and the model is mathematically assembled. The equations of motion for the various bodies in the model are

automatically generated and numerically solved. Results of the simulation are the positions, velocities, and accelerations of all bodies in the vehicle system. Also included are various data on any force elements in the model and the internal reaction forces due to any joints or constraints in the model.

A dynamic analysis was performed on the model of the M932A1/JSIPS trailer combination that was created for this project. In a dynamic analysis, the motion of the bodies is calculated from the forces acting upon them and the mass properties of the bodies themselves. These forces include gravity and any external forces specified by the user. The equations of motion are defined in terms of the masses and forces. The resulting second-order differential equations are then integrated numerically using a variable step and order algorithm.

### **3.1.2 M932A1/JSIPS Trailer Computer Model Description**

A DADS, rev. 6.0, format file of the computer-based M932A1/JSIPS trailer model is shown in **Appendix A**. The M932A1 Tractor was modeled as rigid body. The leaf spring suspension was modeled as a series of translational spring damper actuators (TSDA) attaching the tractor body to the front and rear axles. The axle motion was constrained to allow only vertical translation and longitudinal rotation. A user-defined subroutine was used to calculate the individual spring displacements, roll stiffness, and the relative spring displacements in the rear bogey, where two axles share the same leaf spring. The trailer suspension was modeled similarly. The tractor/trailer 5th-wheel/kingpin interface was modeled as three revolute joints in order to limit the allowable pitch, roll, and yaw motion of the trailer at the interface. A user-defined subroutine was used to control the system's steering and velocity. The trailer was modeled as three rigid bodies (front deck, rear left deck, rear right deck) connected together at the gooseneck location with two bracket joints. Bracket joints remove the six degrees-of-freedom of one body relative to another. Using the bracket joints permitted the three rigid bodies to dynamically behave as one, but also permitted the recording of the reaction forces generated at the attachment points during the simulations. These reaction forces, along with those at the kingpin and trunnion attachment points, were used as the input loads for the finite element model of the trailer frame and gussets.

### **3.1.3 Simulations**

TARDEC's Cray 2 super computer was use to run a series of dynamic simulations of the M932A1/JSIPS trailer performing the following:

- 1) Traversing a driver side, 6" bump, at 20 mph.
- 2) Traversing a driver side, 9" bump, at 5 mph.
- 3) Traversing a driver side, 9" bump, at 10 mph.
- 4) Traversing a driver side, 6" pothole, at 5 and 10 mph.



- 5) Traversing a driver side, 9" pothole, at 5 and 10 mph.
- 6) Traversing an alternating, 20% side slope course at 10 and 20 mph.
- 7) Performing a 120 ft X 11 ft, Slalom maneuver at 30 and 40 mph.
- 8) Traversing Belgian block at 20 mph.
- 9) Traversing Perryman Course # 1, unimproved cross-country, at 30 mph.

The cross country/Belgian block simulations were based on the requirements of MIL-M-8090F, Roadability Tests, para 4.5.12, Type V, group D mobility. The truck/trailer combination was simulated at the maximum allowable speeds for these test courses. MIL-M-8090F, TABLE III, requires Type V, group D vehicles to negotiate an 11.5-degree side slope. The combination was simulated running through a much more severe, alternating driver side and curb side, 20-degree side slope course. The slalom maneuver simulations were done to test the stability of the truck/trailer combination.

The bump and pothole simulations were done primarily to generate loading inputs for the finite element structural analysis of the JSIPS trailer gooseneck. The JSIPS trailer was modeled with a payload of 3,000 pounds on the forward portion of the deck and 22,000 pounds on the portion of the deck rearward from the gooseneck. This payload configuration was specified in paragraph 1 of the Purchase Description for the JSIPS trailer modifications.

## **3.2 Finite Element Models**

### **3.2.1 Computer Hardware and Software**

PATRAN is the pre/postprocessing software package used to visually create the finite element models (FEM). PATRAN's postprocessor allows the analyst to view the results of the analysis in graphical form. PATRAN version 3.0 was used on a Silicon Graphics Personal Iris workstation.

ABAQUS is a large-scale, general-purpose finite element analysis program capable of analyzing complex structures. ABAQUS was developed by Hibbitt, Karlsson, & Sorensen, Inc. ABAQUS version 5.2, which resides on TARDEC's Cray-2 Supercomputer, was used for this project.

### **3.2.2 Models**

The finite element model contains all the information needed to run the analysis. The model defines the actual shape and dimensions of the trailer, the materials used and

their properties, and any boundary conditions and force loadings.

A beam finite element model of the entire JSIPS semitrailer frame was created for this project using PATRAN. The entire frame was modeled since the loads were not symmetric and there were no indicated areas of interest. The JSIPS FEM contains 354 elements and 535 nodes, giving 2,549 degrees of freedom (DOF). Two noded B31 beam elements and four/three noded S4R5/STR135 shell elements were used. There are 21 different beam cross-sectional properties which are defined in the ABAQUS 5.2 input file.

Items such as the payload and suspension are not physically modeled but were added to the FEM as mass loads. Also, items such as the spare tire and carrier, mud flaps, and hydraulic lines, which add no structural rigidity to the trailer, were not included in the FEM. A payload of 22,000 pounds was applied to the rear of the trailer and a 3,000-pound payload is over the front portion of the trailer.

### 3.2.3 Material Properties

The JSIPS semi-trailer is constructed primarily of ASTM A572 Grade 50 and ASTM A36 structural steel. The material properties are given in the table below.

<u>Property</u>	<u>ASTM A572</u>	<u>ASTM A36</u>
Young's Modulus	29.0 x 10 <sup>6</sup> psi	29.0 x 10 <sup>6</sup> psi
Density	0.284 lb/in <sup>3</sup>	0.284 lb/in <sup>3</sup>
Poisson's Ratio	0.30	0.30
Yield Strength*	50 ksi	36 ksi
Ultimate Strength*	65 ksi	58 ksi

\* Minimum values listed

These material properties were used in the finite element analysis and the yield strength was used to quantify the results.

## 4.0 RESULTS and DISCUSSION

### 4.1 Dynamic Analysis

**Appendix B** (B-3 through B-15) contains the time history responses of the pitch, roll, and yaw angles of the JSIPS trailer frame for each of the simulations performed. The truck/trailer combination did not show any tendencies toward instability throughout the series of maneuvers simulated, as indicated by the plots. The most severe dynamic reaction of the JSIPS trailer occurred when responding to the 9-inch bump at the speeds of 5 and 10 mph (B-2,B-3). The trailer rolled to a maximum angle of

approximately 9.5° but returned to a stable condition. The side slope course simulations (B-8,B-9) show that the JSIPS trailer, as modeled, can sustain at least a 12.5° roll angle without overturning. The trailer did not show any unstable performance characteristics when performing the pothole (B-4 thru B-7), slalom (B-10,B-11), or cross-country (B-12,B-13) simulations.

Plots B-16 and B-17 show the time history response of the vertical accelerations (g's) into the trailer deck both fore and aft of the gooseneck for the Belgian block course and the Perryman Course #1 simulations respectively. These plots indicate a maximum vertical acceleration of approximately 1.25 g's into the forward deck, and approximately 1.5 g's into the rear deck during the Belgian block simulations. The maximum vertical accelerations for the Perryman 1 course simulations were under 1 g for both the forward and rear decks.

## **4.2 Finite Element Analysis**

Several finite element analyses were run simulating different terrain and driving scenarios. Reaction forces, displacements, and accelerations were obtained from the dynamic simulations. These values, at specified time steps, were used in the static-linear finite element analyses. The time steps were picked based on maximum forces at the gussets or the suspension. For some analyses, multiple time steps were investigated in order to capture the "worst case" loads.

### **4.2.1 Failure Criterion**

The Maximum Distortion Energy criterion was used to quantify the finite element analysis results for this project. According to this criterion, also known as the von Mises criterion, a given structural component is safe, as long as the maximum value of distortion energy per unit volume in that material remains smaller than the distortion energy per unit volume required to cause yield in a tensile test specimen of the same material. For this project, the von Mises stress, which also takes into account the shear effects, was compared to the yield strength of the material.

### **4.2.2 Simulations**

**9-inch bump at 10 mph:** This was considered to be the worst case scenario the JSIPS trailer could possibly witness. The dynamic analysis simulates the truck/trailer going 10 mph while the left tires go over a 9 inch bump. The reaction forces in the gooseneck gusset area were highest at 4.257 seconds into the dynamic run. The reaction forces, accelerations, and displacements at this time step were used in the static finite element analysis. The resultant stresses were greater than the yield strength of the material, indicating plastic deformation. Under this condition, the trailer is unsafe and would fail, however, the extent of failure is unknown. The highest stress occurs in the outside gusset plate.

**9-inch bump at 5 mph:** The 9" bump dynamic simulation was run at a slower speed of 5 mph. A time step of 9.372 seconds was used. The stresses were in the same outside gusset plate location but were lower. The max von Mises stress was 32,900 psi which is below the yield strength of the material.

**6-inch bump at 20 mph:** For this analysis, two time steps were looked at, 2.277 and 2.739 seconds. For the 2.277-second case, the maximum von Mises stress was 45,200 psi and occurred in the outside gusset location. The gusset is constructed of ASTM A572 Grade 50 steel, which has a yield strength of 50 ksi. Figures 1 and 2 depict the color stress plot for this analysis. The second time step was 2.739 seconds. The maximum von Mises stress for this case was 32,900 psi, and occurred at a lateral C-channel crossmember near the suspension. This stress is also below the yield strength of the material, and is considered safe.

**6-inch pothole at 5 mph:** A time step of 8.778 seconds was used for this analysis. The stresses were well below the yield strength of the ASTM A572 material. The maximum von Mises stress was 27,900 psi and was in the outside gusset plate location.

**Belgian Block at 20 mph:** A time step of 7.557 seconds was used for this analysis. The maximum von Mises stress was 28,900 psi and was located in a lateral crossmember near the suspension of the trailer. This stress is well below the yield strength of the material, and is considered safe.

**Perryman-1 at 30 mph:** This analysis simulated a cross-country road with small hills. Two different time steps were investigated. The first was at 2.739 seconds into the dynamic analysis. The FEA results at this time show a maximum von Mises stress of 23,500 psi which is located on the outside gooseneck gusset plate. The second time step used was 5.445 seconds. The maximum stress was 26,200 psi and was located in the main center longitudinal rails, just rearward of the gooseneck. The stresses for both these analyses are below the yield strength of the steel.

## **5.0 CONCLUSIONS and RECOMMENDATIONS**

### **5.1 Dynamic Analysis**

The simulations performed for the dynamic analysis portion of this project were more severe than what the JSIPS trailer is likely to experience in actual use, due to its limited mission and the sensitivity of the electronic equipment it will transport. It should also be noted that the JSIPS trailer was modeled with a payload of 3,000 pounds on the forward portion of the deck and 22,000 pounds on the portion of the deck rearward from the gooseneck. These loads are greater than the payload data

provided by the Army Space Program Office. Based on the analysis performed, the modification of the M871A1 trailer will not have a detrimental effect on the overall stability or dynamic performance of the trailer.

## **5.2 Finite Element Analysis**

The results of this report are based on a trailer in "like new" condition with no rust or other damage. Also, no fatigue analysis or prototype test were performed for this project.

The finite element analyses indicate no problems with the modified M871A1 trailer with one exception. The 9-inch bump at 10 mph simulation produced high stresses in the gooseneck region of the trailer that exceed the yield strength of the material. As mentioned previously, it is not likely that such a severe obstacle would be encountered during the normal mission of the JSIPS trailer. However, it is recommended that extreme caution be used when towing the JSIPS trailer through obstacles of this magnitude. For all other simulations, the stresses were below the material yield strength.

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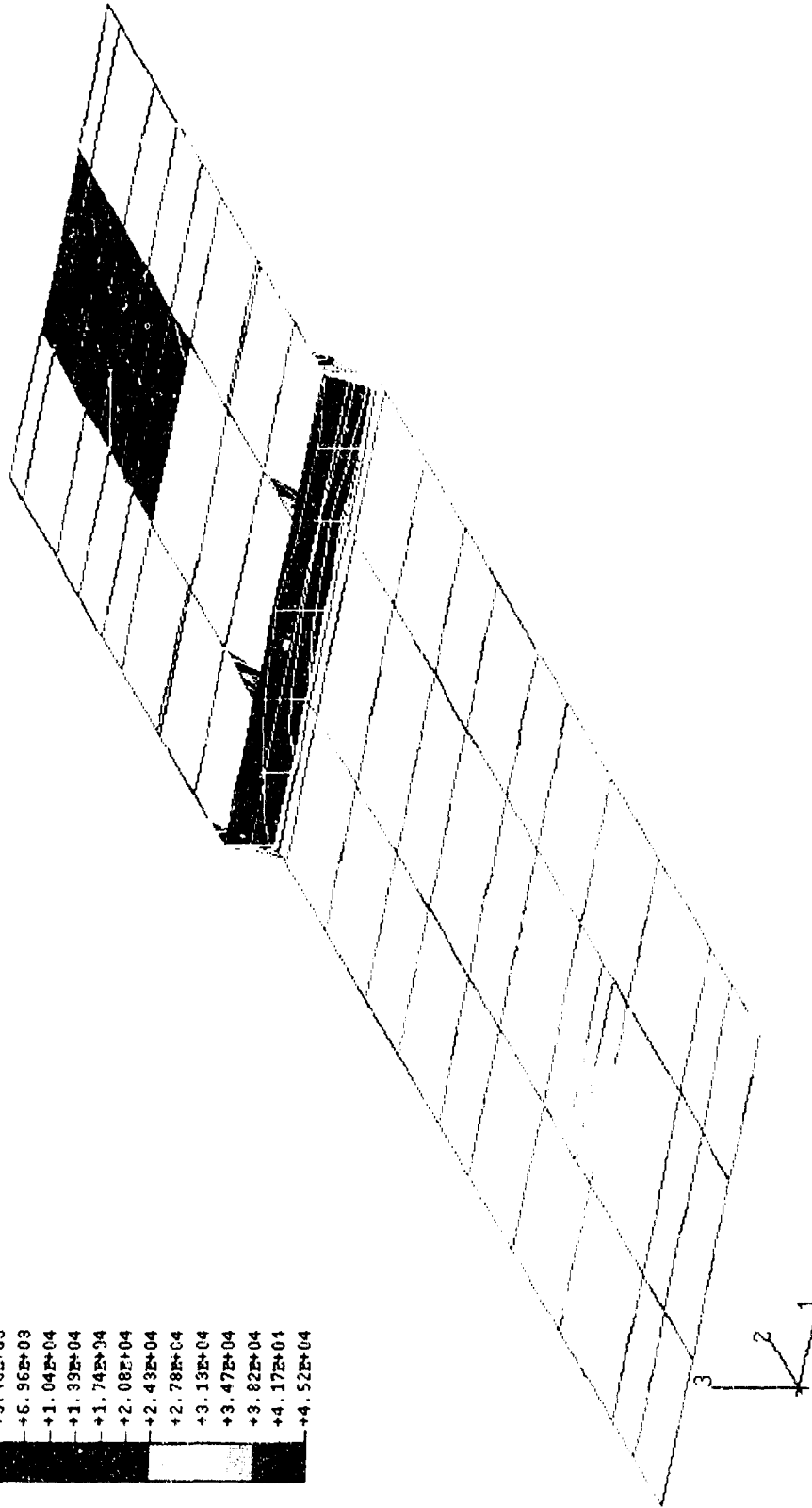
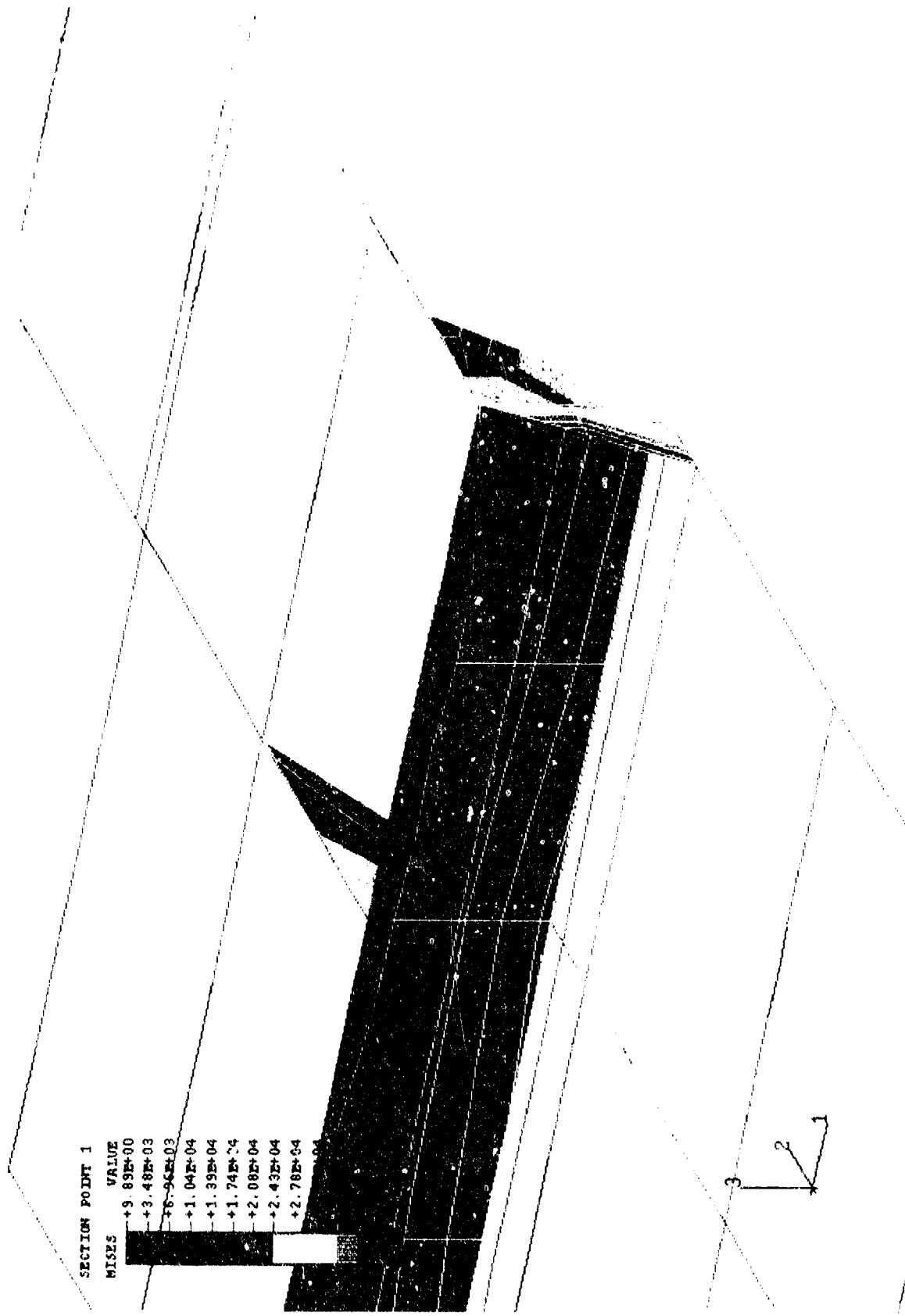


Figure 1. Finite Element Analysis Results for the JSIPS Trailer Frame  
 Simulating a 6" bump at 20 mph at 2.277 seconds  
 von Mises Stresses (psi)

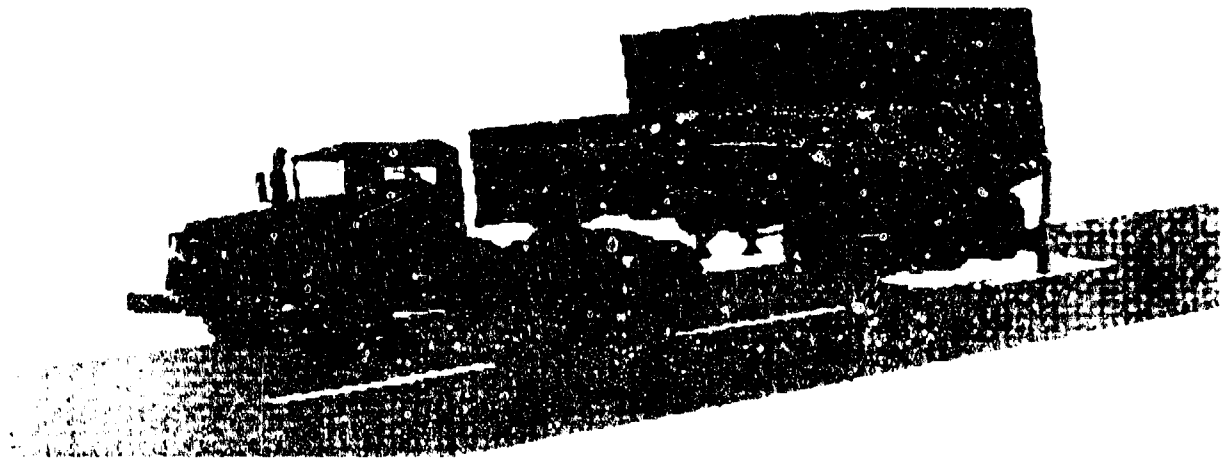


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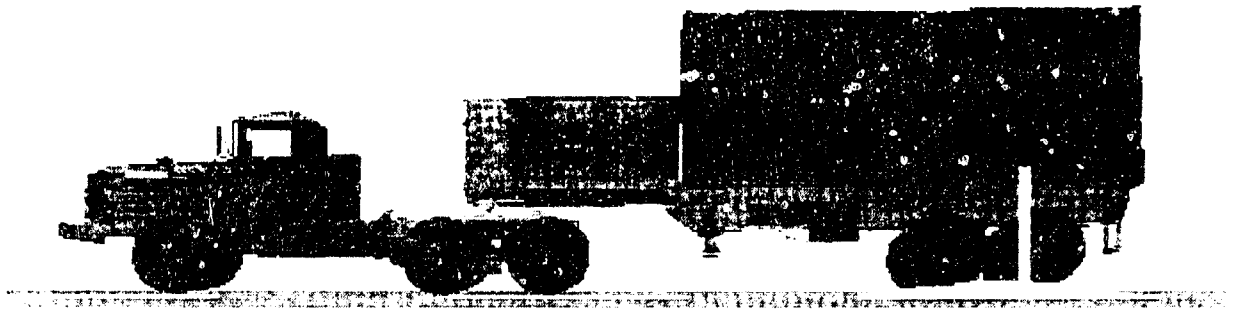
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	+2.43E+04
	+2.78E+04



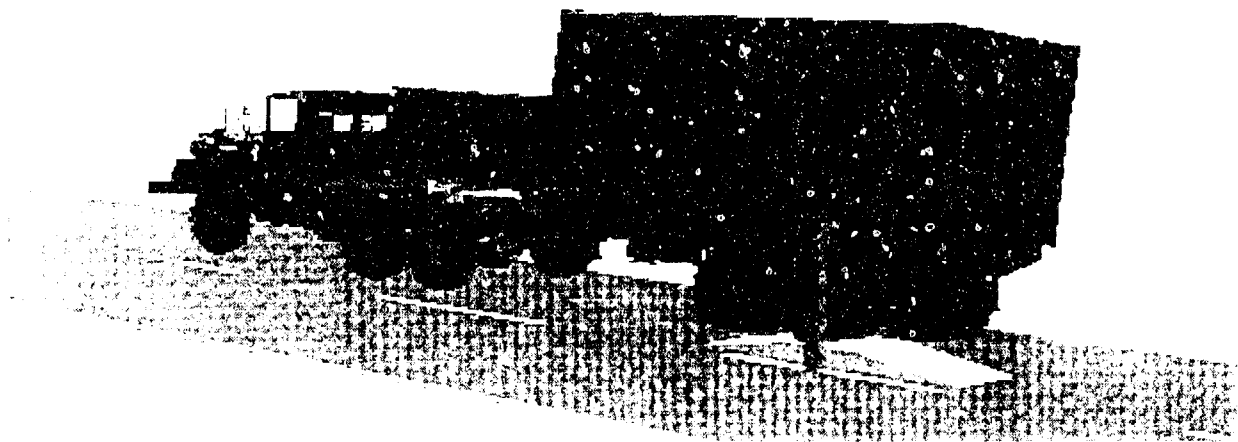
Figure 2. Finite Element Analysis Results for the JSIPS Trailer Frame  
 Simulating a 6" bump at 20 mph at 2.277 seconds  
 von Mises Stresses (psi)  
 (Close-up of Right, Outside Gusset Plate)



Front View



Side View



Rear View

Figure 3. M/3L USIBS Trailer Dynamic Model Simulation:  
Traverse of a Bump at 20 mph





APPENDIX A

DADS Formatted File

```

*****
*****
**** M932A1 5-ton Semi-Tractor ****
**** ****
**** Towing Modified M871 20 ton (JSIPS Trailer) ****
**** ****
**** The Payload consists of 22,000 lbs on the bed and 3,000 lbs on the ****
**** gooseneck. ****
**** ****
**** Mike Pozolo 4/25/94 ****
*****
*****

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```

SYSTEM      INCHES      DYNAMIC      FULL      TRUE GLOBAL      TRUE
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1.0000000000000000  0.00000000000000E+00  10.0000000000000000  0.33000000000000E-01
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DYNAMIC      TRUE      INTERPOLATED      GLOBAL
0.50000000000000E-010.10000000000000E-020.10000000000000E-03

```

```

*****
****          FRONT AXLE
**** Front axle to chassis connection modelled as two distance constraints at
**** leaf spring location. One constraint in center of axle to center of chassis
**** to remove axle rotational degree of freedom. And one constraint extending
**** 100 inches out to the right side to remove lateral degree of freedom.
*****

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\*\*\*\* constraints at leaf spring locations

```

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-16.49000000000000  0.0000000000000000  22.50000000000000
-16.49000000000000  24.25000000000000  40.65000000000000
-16.49000000000000  0.0000000000000000  23.50000000000000
-15.49000000000000  24.25000000000000  39.65000000000000
-15.49000000000000  0.0000000000000000  22.50000000000000
29.70160000000000
DISTANCE  TA1WBR.DC      TCH.BOD      TA1.BOD      0      0
16.49000000000000  24.25000000000000  39.65000000000000
16.49000000000000  0.0000000000000000  22.50000000000000
16.49000000000000  24.25000000000000  40.65000000000000
16.49000000000000  0.0000000000000000  23.50000000000000
17.49000000000000  24.25000000000000  39.65000000000000
17.49000000000000  0.0000000000000000  22.50000000000000
29.70160000000000

```

\*\*\*\* constrains rotation of front axle

```

DISTANCE  TA1TR.DC      TCH.BOD      TA1.BOD      0      0
0.0000000000000000  -24.25000000000000  41.65000000000000
0.0000000000000000  0.0000000000000000  41.65000000000000
0.0000000000000000  -24.25000000000000  42.65000000000000
0.0000000000000000  0.0000000000000000  42.65000000000000
1.0000000000000000  -24.25000000000000  41.65000000000000
1.0000000000000000  0.0000000000000000  41.65000000000000
24.25000000000000

```

\*\*\*\* tractor axle lateral constraint between front axle and chassis

DISTANCE	TA1PB.DC	TCH.BOD	TA1.BOD	0	0
100.0000000000000		0.000000000000000	41.6500000000000		
0.000000000000000		0.000000000000000	41.6500000000000		
100.0000000000000		0.000000000000000	42.6500000000000		
0.000000000000000		0.000000000000000	42.6500000000000		
101.0000000000000		0.000000000000000	41.6500000000000		
1.000000000000000		0.000000000000000	41.6500000000000		
100.0000000000000					

\*\*\* centerlink between front wheel steering knuckles

DISTANCE	TA1CL.DC	TA1LS.BOD	TA1RS.BOD	0	0
-39.0000000000000		-10.4300000000000	16.3100000000000		
39.0000000000000		-10.4300000000000	16.3100000000000		
-39.0000000000000		-10.4300000000000	17.3100000000000		
39.0000000000000		-10.4300000000000	17.3100000000000		
-38.0000000000000		-10.4300000000000	16.3100000000000		
40.0000000000000		-10.4300000000000	16.3100000000000		
78.0000000000000					

\*\*\*\*\*  
 END of FRONT AXLE  
 \*\*\*\*\*

\*\*\*\*\*  
 REAR AXLES  
 \*\*\*\* Rear axle to chassis connection modelled as two distance constraints at  
 \*\*\*\* leaf spring locations. Actual suspension has two lower suspension  
 \*\*\*\* members on each side of leaf spring mount to the center beam.  
 \*\*\*\* It also has a single suspension member above the axle. With this  
 \*\*\*\* suspension configuration, an extra lateral constraint must be added  
 \*\*\*\* to remove the extra lateral degree of freedom.  
 \*\*\*\*\*

\*\*\*\* constraints at leaf spring locations

DISTANCE	TA2WBL.DC	TCH.BOD	TA2.BOD	0	0
-18.6900000000000		-163.6800000000000	12.6700000000000		
-18.6900000000000		-140.0000000000000	13.5600000000000		
-18.6900000000000		-163.6800000000000	13.6700000000000		
-18.6900000000000		-140.0000000000000	14.5600000000000		
-17.6900000000000		-163.6800000000000	12.6700000000000		
-17.6900000000000		-140.0000000000000	13.5600000000000		
23.6967000000000					

DISTANCE	TA3WBL.DC	TCH.BOD	TA3.BOD	0	0
-18.6900000000000		-170.3200000000000	12.6700000000000		
-18.6900000000000		-194.0000000000000	13.5600000000000		
-18.6900000000000		-170.3200000000000	13.6700000000000		
-18.6900000000000		-194.0000000000000	14.5600000000000		
-17.6900000000000		-170.3200000000000	12.6700000000000		
-17.6900000000000		-194.0000000000000	13.5600000000000		
23.6967000000000					

DISTANCE	TA2WBR.DC	TCH.BOD	TA2.BOD	0	0
18.6900000000000		-163.6800000000000	12.6700000000000		
18.6900000000000		-140.0000000000000	13.5600000000000		
18.6900000000000		-163.6800000000000	13.6700000000000		
18.6900000000000		-140.0000000000000	14.5600000000000		
17.6900000000000		-163.6800000000000	12.6700000000000		

17.690000000000	-140.0000000000	13.560000000000		
23.696700000000				
DISTANCE TA3WBR.DC	TCH.BOD	TA3.BOD	0	0
18.690000000000	-170.3200000000	12.670000000000		
18.690000000000	-194.0000000000	13.560000000000		
18.690000000000	-170.3200000000	13.670000000000		
18.690000000000	-194.0000000000	14.560000000000		
17.690000000000	-170.3200000000	12.670000000000		
17.690000000000	-194.0000000000	13.560000000000		
23.696700000000				

\*\*\*\*\* rear suspension arrangement to control lateral motion

DISTANCE TA2TR.DC	TCH.BOD	TA2.POD	0	0
-22.640000000000	-166.0000000000	41.470000000000		
-22.640000000000	-140.0000000000	41.470000000000		
-22.640000000000	-166.0000000000	40.470000000000		
-22.640000000000	-140.0000000000	40.470000000000		
-21.640000000000	-166.0000000000	41.470000000000		
-21.640000000000	-140.0000000000	41.470000000000		
26.000000000000				

DISTANCE TA3TR.DC	TCH.BOD	TA3.BOD	0	0
-22.640000000000	-168.0000000000	41.470000000000		
-22.640000000000	-194.0000000000	41.470000000000		
-22.640000000000	-168.0000000000	40.470000000000		
-22.640000000000	-194.0000000000	40.470000000000		
-21.640000000000	-168.0000000000	41.470000000000		
-21.640000000000	-194.0000000000	41.470000000000		
26.000000000000				

DISTANCE TA2PB.DC	TCH.BOD	TA2.BOD	0	0
100.000000000000	-140.0000000000	40.260000000000		
0.000000000000	-140.0000000000	40.260000000000		
100.000000000000	-140.0000000000	41.260000000000		
0.000000000000	-140.0000000000	41.260000000000		
101.000000000000	-140.0000000000	40.260000000000		
1.000000000000	-140.0000000000	40.260000000000		
100.000000000000				

DISTANCE TA3PB.DC	TCH.BOD	TA3.BOD	0	0
100.000000000000	-194.0000000000	40.260000000000		
0.000000000000	-194.0000000000	40.260000000000		
100.000000000000	-194.0000000000	41.260000000000		
0.000000000000	-194.0000000000	41.260000000000		
101.000000000000	-194.0000000000	40.260000000000		
1.000000000000	-194.0000000000	40.260000000000		
100.000000000000				

\*\*\*\*\* END of REAR AXLES \*\*\*\*\*

\*\*\*\*\* Curves to include bump steer effects ufrcl1.f uses RSDA #1,2 to steering.

RSDA	TA1LSBS.RSDA	TA1LKP.REV		
TSBSL.CUR	NONE	NONE		
0.000000000000	0.000000000000	0.000000000000	0.000000000000	
RSDA	TA1RSBS.RSDA	TA1RKP.REV		
TSBSR.CUR	NONE	NONE		
0.000000000000	0.000000000000	0.000000000000	0.000000000000	

\*\*\*\* M932A1 Super Singles, 14R20, LOAD J, Ply Rating 18, All-Terrain

TIRE	TAIL.TIRE	TAILW.BOD	TAILS.BOD	FULL
TIRELS.CUR	NONE	NONE	NONE	
-39.000000000000	0.000000000000	22.670000000000		
24.450000000000	0.000000000000	8.000000000000		
3500.0000000000	108861.98107486	0.000000000000		
0.800000000000				
TIRE	TA1R.TIRE	TA1RW.BOD	TA1RS.BOD	FULL
TIRELS.CUR	NONE	NONE	NONE	
39.000000000000	0.000000000000	22.670000000000		
24.450000000000	0.000000000000	8.000000000000		
3500.0000000000	108861.98107486	0.000000000000		
0.800000000000				
TIRE	TA2L.TIRE	TA2LW.BOD	TA2.BOD	FULL
TIRELS.CUR	NONE	NONE	NONE	
-40.656250000000	-140.000000000000	22.670000000000		
24.450000000000	0.000000000000	8.000000000000		
3500.0000000000	108861.98107486	0.000000000000		
0.800000000000				
TIRE	TA2R.TIRE	TA2RW.BOD	TA2.BOD	FULL
TIRELS.CUR	NONE	NONE	NONE	
40.656250000000	-140.000000000000	22.670000000000		
24.450000000000	0.000000000000	8.000000000000		
3500.0000000000	108861.98107486	0.000000000000		
0.800000000000				
TIRE	TA3L.TIRE	TA3LW.BOD	TA3.BOD	FULL
TIRELS.CUR	NONE	NONE	NONE	
-40.656250000000	-194.000000000000	22.670000000000		
24.450000000000	0.000000000000	8.000000000000		
3500.0000000000	108861.98107486	0.000000000000		
0.800000000000				
TIRE	TA3R.TIRE	TA3RW.BOD	TA3.BOD	FULL
TIRELS.CUR	NONE	NONE	NONE	
40.656250000000	-194.000000000000	22.670000000000		
24.450000000000	0.000000000000	8.000000000000		
3500.0000000000	108861.98107486	0.000000000000		
0.800000000000				

\*\*\*\* Tractor springs controlled from ufrc10.f  
 \*\*\*\* First group of 6 TSDAs used to measure relative distance between right  
 \*\*\*\* and left spring displacements on common axles and to average the  
 \*\*\*\* displacement of the rear springs which share the same axle.

TSDA	TA1LSPR.TSDA	TCH.BOD	TA1.BOD	0	0
NONE	NONE	NONE	NONE		
-16.490000000000	0.000000000000	122.500000000000			
-16.490000000000	0.000000000000	22.500000000000			
-16.490000000000	0.000000000000	123.450000000000			
-16.490000000000	0.000000000000	23.450000000000			
-15.490000000000	0.000000000000	122.500000000000			
-15.490000000000	0.000000000000	22.500000000000			
0.000000000000	100.000000000000	0.000000000000	0.000000000000		
TSDA	TA2LSPR.TSDA	TCH.BOD	TA2.BOD	0	0
NONE	NONE	NONE	NONE		
-18.690000000000	-140.000000000000	122.500000000000			
-18.690000000000	-140.000000000000	22.500000000000			
-18.690000000000	-140.000000000000	123.450000000000			
-18.690000000000	-140.000000000000	23.450000000000			
-17.690000000000	-140.000000000000	122.500000000000			
-17.690000000000	-140.000000000000	22.500000000000			
0.000000000000	100.000000000000	10.000000000000	0.000000000000		

TSDA	TA1LSPR.TSDA	TCH.BOD	TA3.BOD	0	0
NONE	NONE	NONE	NONE		
-18.6900000000000	-194.000000000000		122.500000000000		
-18.6900000000000	-194.000000000000		22.5000000000000		
-18.6900000000000	-194.000000000000		123.450000000000		
-18.6900000000000	-194.000000000000		23.4500000000000		
-17.6900000000000	-194.000000000000		122.500000000000		
-17.6900000000000	-194.000000000000		22.5000000000000		
0.000000000000000	100.000000000000		10.0000000000000	0.000000000000000	
TSDA	TA1RSPR.TSDA	TCH.BOD	TA1.BOD	0	0
NONE	NONE	NONE	NONE		
16.4900000000000	0.00000000000000		122.500000000000		
16.4900000000000	0.00000000000000		22.5000000000000		
16.4900000000000	0.00000000000000		123.450000000000		
16.4900000000000	0.00000000000000		23.4500000000000		
15.4900000000000	0.00000000000000		122.500000000000		
15.4900000000000	0.00000000000000		22.5000000000000		
0.000000000000000	100.000000000000		0.000000000000000	0.000000000000000	
TSDA	TA2RSPR.TSDA	TCH.BOD	TA2.BOD	0	0
NONE	NONE	NONE	NONE		
18.6900000000000	-140.000000000000		122.500000000000		
18.6900000000000	-140.000000000000		22.5000000000000		
18.6900000000000	-140.000000000000		123.450000000000		
18.6900000000000	-140.000000000000		23.4500000000000		
17.6900000000000	-140.000000000000		122.500000000000		
17.6900000000000	-140.000000000000		22.5000000000000		
0.000000000000000	100.000000000000		10.0000000000000	0.000000000000000	
TSDA	TA3RSPR.TSDA	TCH.BOD	TA3.BOD	0	0
NONE	NONE	NONE	NONE		
18.6900000000000	-194.000000000000		122.500000000000		
18.6900000000000	-194.000000000000		22.5000000000000		
18.6900000000000	-194.000000000000		123.450000000000		
18.6900000000000	-194.000000000000		23.4500000000000		
17.6900000000000	-194.000000000000		122.500000000000		
17.6900000000000	-194.000000000000		22.5000000000000		
0.000000000000000	100.000000000000		10.0000000000000	0.000000000000000	

\*\*\*\* Spring forces applied by second group of 6 TSDAs

TSDA	TA1LSP.TSDA	TCH.BOD	TA1.BOD	0	0
TBSTOP.CUR	NONE	NONE	NONE		
-16.4900000000000	0.00000000000000		122.500000000000		
-16.4900000000000	0.00000000000000		22.5000000000000		
-16.4900000000000	0.00000000000000		123.450000000000		
-16.4900000000000	0.00000000000000		23.4500000000000		
-15.4900000000000	0.00000000000000		122.500000000000		
-15.4900000000000	0.00000000000000		22.5000000000000		
2271.0000000000000	100.000000000000		0.000000000000000	0.000000000000000	
TSDA	TA2LSP.TSDA	TCH.BOD	TA2.BOD	0	0
TBSTOP.CUR	NONE	NONE	NONE		
-18.6900000000000	-140.000000000000		122.500000000000		
-18.6900000000000	-140.000000000000		22.5000000000000		
-18.6900000000000	-140.000000000000		123.450000000000		
-18.6900000000000	-140.000000000000		23.4500000000000		
-17.6900000000000	-140.000000000000		122.500000000000		
-17.6900000000000	-140.000000000000		22.5000000000000		
5983.0000000000000	100.000000000000		10.0000000000000	0.000000000000000	
TSDA	TA3LSP.TSDA	TCH.BOD	TA3.BOD	0	0
TBSTOP.CUR	NONE	NONE	NONE		
-18.6900000000000	-194.000000000000		122.500000000000		

-18.690000000000	-194.000000000000	22.500000000000		
-18.690000000000	-194.000000000000	123.450000000000		
-18.690000000000	-194.000000000000	23.450000000000		
-17.690000000000	-194.000000000000	122.500000000000		
-17.690000000000	-194.000000000000	22.500000000000		
5983.000000000000	100.000000000000	10.000000000000	0.000000000000	
TSDA	TA1RSP.TSDA	TCH.BOD	TA1.BOD	0 0
TBSTOP.CUR	NONE	NONE		
16.490000000000	0.000000000000	122.500000000000		
16.490000000000	0.000000000000	22.500000000000		
16.490000000000	0.000000000000	123.450000000000		
16.490000000000	0.000000000000	23.450000000000		
15.490000000000	0.000000000000	122.500000000000		
15.490000000000	0.000000000000	22.500000000000		
2271.000000000000	100.000000000000	0.000000000000	0.000000000000	
TSDA	TA2RSP.TSDA	TCH.BOD	TA2.BOD	0 0
TBSTOP.CUR	NONE	NONE		
18.690000000000	-140.000000000000	122.500000000000		
18.690000000000	-140.000000000000	22.500000000000		
18.690000000000	-140.000000000000	123.450000000000		
18.690000000000	-140.000000000000	23.450000000000		
17.690000000000	-140.000000000000	122.500000000000		
17.690000000000	-140.000000000000	22.500000000000		
5983.000000000000	100.000000000000	10.000000000000	0.000000000000	
TSDA	TA3RSP.TSDA	TCH.BOD	TA3.BOD	0 0
TBSTOP.CUR	NONE	NONE		
18.690000000000	-194.000000000000	122.500000000000		
18.690000000000	-194.000000000000	22.500000000000		
18.690000000000	-194.000000000000	123.450000000000		
18.690000000000	-194.000000000000	23.450000000000		
17.690000000000	-194.000000000000	122.500000000000		
17.690000000000	-194.000000000000	22.500000000000		
5983.000000000000	100.000000000000	10.000000000000	0.000000000000	

REVOLUTE	TA1LKP.REV	TA1.BOD	TA1LS.BOD	0 0
-39.000000000000	0.000000000000		22.670000000000	
-39.000000000000	0.000000000000		22.670000000000	
-39.000000000000	0.000000000000		23.670000000000	
-39.000000000000	0.000000000000		23.670000000000	
-38.000000000000	0.000000000000		22.670000000000	
-38.000000000000	0.000000000000		22.670000000000	
REVOLUTE	TA1RKP.REV	TA1.BOD	TA1RS.BOD	0 0
39.000000000000	0.000000000000		22.670000000000	
39.000000000000	0.000000000000		22.670000000000	
39.000000000000	0.000000000000		23.670000000000	
39.000000000000	0.000000000000		23.670000000000	
40.000000000000	0.000000000000		22.670000000000	
40.000000000000	0.000000000000		22.670000000000	

\*\*\*\* tractor axle to wheel revolute joints

REVOLUTE	TA1LW.REV	TA1LS.BOD	TA1LW.BOD	0 0
-39.000000000000	0.000000000000		22.670000000000	
-39.000000000000	0.000000000000		22.670000000000	
-38.000000000000	0.000000000000		22.670000000000	
-38.000000000000	0.000000000000		22.670000000000	
-39.000000000000	0.000000000000		23.670000000000	
-39.000000000000	0.000000000000		23.670000000000	
REVOLUTE	TA1RW.REV	TA1RS.BOD	TA1RW.BOD	0 0



39.000000000000	0.000000000000	22.670000000000		
39.000000000000	0.000000000000	22.670000000000		
40.000000000000	0.000000000000	22.670000000000		
40.000000000000	0.000000000000	22.670000000000		
39.000000000000	0.000000000000	23.670000000000		
39.000000000000	0.000000000000	23.670000000000		
REVOLUTE TA2LW.REV	TA2.BOD	TA2LW.BOD	0	0
-39.000000000000	-140.000000000000	22.670000000000		
-39.000000000000	-140.000000000000	22.670000000000		
-38.000000000000	-140.000000000000	22.670000000000		
-38.000000000000	-140.000000000000	22.670000000000		
-39.000000000000	-140.000000000000	23.670000000000		
-39.000000000000	-140.000000000000	23.670000000000		
REVOLUTE TA2RW.REV	TA2.BOD	TA2RW.BOD	0	0
39.000000000000	-140.000000000000	22.670000000000		
39.000000000000	-140.000000000000	22.670000000000		
40.000000000000	-140.000000000000	22.670000000000		
40.000000000000	-140.000000000000	22.670000000000		
39.000000000000	-140.000000000000	23.670000000000		
39.000000000000	-140.000000000000	23.670000000000		
REVOLUTE TA3LW.REV	TA3.BOD	TA3LW.BOD	0	0
-39.000000000000	-194.000000000000	22.670000000000		
-39.000000000000	-194.000000000000	22.670000000000		
-38.000000000000	-194.000000000000	22.670000000000		
-38.000000000000	-194.000000000000	22.670000000000		
-39.000000000000	-194.000000000000	23.670000000000		
-39.000000000000	-194.000000000000	23.670000000000		
REVOLUTE TA3RW.REV	TA3.BOD	TA3RW.BOD	0	0
39.000000000000	-194.000000000000	22.670000000000		
39.000000000000	-194.000000000000	22.670000000000		
40.000000000000	-194.000000000000	22.670000000000		
40.000000000000	-194.000000000000	22.670000000000		
39.000000000000	-194.000000000000	23.670000000000		
39.000000000000	-194.000000000000	23.670000000000		

\*\*\*\* model of the 5th wheel hitch point

REVOLUTE HITCH_1	HITCH1.BOD	TCH.BOD	0	0
0.000000000000	-162.810000000000	47.620000000000		
0.000000000000	-162.810000000000	47.620000000000		
1.000000000000	-162.810000000000	47.620000000000		
1.000000000000	-162.810000000000	47.620000000000		
0.000000000000	-162.810000000000	48.620000000000		
0.000000000000	-162.810000000000	48.620000000000		
REVOLUTE HITCH_2	HITCH1.BOD	HITCH2.BOD	0	0
0.000000000000	-162.810000000000	57.187500000000		
0.000000000000	-162.810000000000	57.187500000000		
0.000000000000	-161.810000000000	57.187500000000		
0.000000000000	-161.810000000000	57.187500000000		
1.000000000000	-162.810000000000	57.187500000000		
1.000000000000	-162.810000000000	57.187500000000		
REVOLUTE HITCH_3	HITCH2.BOD	F_DECK.BOD	0	0
0.000000000000	-162.810000000000	57.187500000000		
0.000000000000	-162.810000000000	57.187500000000		
0.000000000000	-162.810000000000	58.187500000000		
0.000000000000	-162.810000000000	58.187500000000		
1.000000000000	-162.810000000000	57.187500000000		
1.000000000000	-162.810000000000	57.187500000000		

RSDA HITCH\_ROLL HITCH\_2

BLOCKS_IN	NONE	NONE	
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000

\*\*\*\* tractor body # 1 Path control frcl1.f uses the body location to find path

BODY	TCH.BOD	POSITIVE	PARAMETERSFALSEFALSEFALSE
NONE	NONE	NONE	NONE
NONE	NONE	NONE	NONE
0.0000000000000000	-117.500000000000		37.700000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
29.46620000000000	175998.39510000		15889.746100000 175998.39510000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000

\*\*\*\* tractor axles

BODY	TA1.BOD	POSITIVE	PARAMETERSFALSEFALSEFALSE
NONE	NONE	NONE	NONE
NONE	NONE	NONE	NONE
0.0000000000000000	0.0000000000000000		22.670000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
6.7614000000000000	3600.000000000000		2400.000000000000 3600.000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000

BODY	TA2.BOD	POSITIVE	PARAMETERSFALSEFALSEFALSE
NONE	NONE	NONE	NONE
NONE	NONE	NONE	NONE
0.0000000000000000	-140.000000000000		22.670000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
7.0120000000000000	3600.000000000000		2400.000000000000 2400.000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000

BODY	TA3.BOD	POSITIVE	PARAMETERSFALSEFALSEFALSE
NONE	NONE	NONE	NONE
NONE	NONE	NONE	NONE
0.0000000000000000	-194.000000000000		22.670000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
7.2710000000000000	3600.000000000000		2400.000000000000 2400.000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000

\*\*\*\* steering knuckles

BODY	TAILS.BOD	POSITIVE	PARAMETERSFALSEFALSEFALSE
NONE	NONE	NONE	NONE
NONE	NONE	NONE	NONE
-19.00000000000000	0.0000000000000000		22.670000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.1000000000000000	1.0000000000000000		1.0000000000000000 1.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000
0.0000000000000000	0.0000000000000000		0.0000000000000000

BODY	TAILS.BOD	POSITIVE	PARAMETERSFALSEFALSEFALSE
NONE	NONE	NONE	NONE
NONE	NONE	NONE	NONE
19.00000000000000	0.0000000000000000		22.670000000000



0.0000000000000000 0.0000000000000000 0.0000000000000000  
 0.0000000000000000 0.0000000000000000 0.0000000000000000

\*\*\*\* 5th wheel hitch bodies

BODY	HITCH1.BOD	POSITIVE	PARAMETERS	FALSE	FALSE	FALSE
NONE	NONE	NONE	NONE			
NONE	NONE	NONE	NONE			
0.0000000000000000	-162.810000000000	47.620000000000				
0.0000000000000000	0.0000000000000000	0.0000000000000000				
0.2600000000000000	1.0000000000000000	1.0000000000000000				1.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000				
0.0000000000000000	0.0000000000000000	0.0000000000000000				
0.0000000000000000	0.0000000000000000	0.0000000000000000				
0.0000000000000000	0.0000000000000000	0.0000000000000000				
BODY	HITCH2.BOD	POSITIVE	PARAMETERS	FALSE	FALSE	FALSE
NONE	NONE	NONE	NONE			
NONE	NONE	NONE	NONE			
0.0000000000000000	-162.810000000000	57.187500000000				
0.0000000000000000	0.0000000000000000	0.0000000000000000				
0.2600000000000000	1.0000000000000000	1.0000000000000000				1.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000				
0.0000000000000000	0.0000000000000000	0.0000000000000000				
0.0000000000000000	0.0000000000000000	0.0000000000000000				

\*\*\*\* Intial conditions on tractor

INITIAL	TCHO.IC	TCH.BOD	NONE		
NONE	ORIENTATION	0			
0.0000000000000000	0.0000000000000000	0.0000000000000000			0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000			
0.0000000000000000	0.0000000000000000	0.0000000000000000			
INITIAL	TCHX.IC	TCH.BOD	NONE		
NONE	X	0			
0.0000000000000000	0.0000000000000000	0.0000000000000000			0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000			
0.0000000000000000	0.0000000000000000	0.0000000000000000			
INITIAL	TCHY.IC	TCH.BOD	NONE		
NONE	Y	0			
0.0000000000000000	352.000000000000	0.0000000000000000			0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000			
0.0000000000000000	0.0000000000000000	0.0000000000000000			
INITIAL	TCHZ.IC	TCH.BOD	NONE		
NONE	Z	0			
0.0000000000000000	0.0000000000000000	0.0000000000000000			0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000			
0.0000000000000000	0.0000000000000000	0.0000000000000000			
INITIAL	TA1Z.IC	TA1.BOD	NONE		
NONE	Z	0			
0.0000000000000000	0.0000000000000000	0.0000000000000000			0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000			
0.0000000000000000	0.0000000000000000	0.0000000000000000			
INITIAL	TA2Z.IC	TA2.BOD	NONE		
NONE	Z	0			
0.0000000000000000	0.0000000000000000	0.0000000000000000			0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000			
0.0000000000000000	0.0000000000000000	0.0000000000000000			
INITIAL	TA3Z.IC	TA3.BOD	NONE		
NONE	Z	0			
0.0000000000000000	0.0000000000000000	0.0000000000000000			0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000			
0.0000000000000000	0.0000000000000000	0.0000000000000000			



```

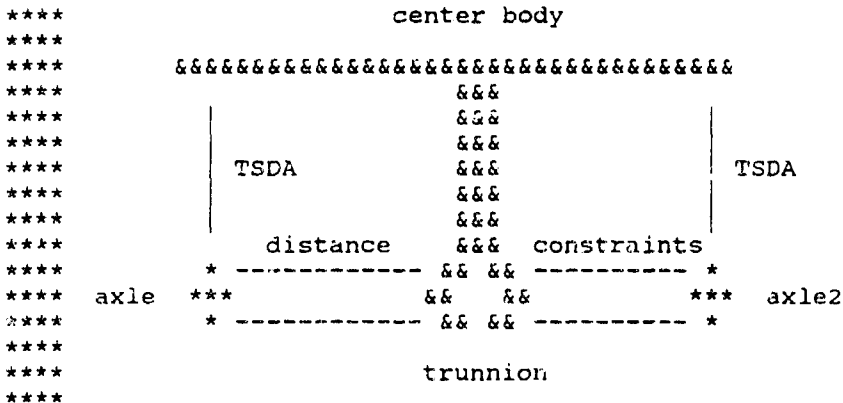
0.00000000000000    0.00000000000000    0.00000000000000
*****
*****
***** JSIPS TRAILER; Modified M871 *****
*****
*****

```

```

**** Rear suspension is a walking beam style with no torque rods, only the
**** spring resists brake torques
**** Each side of the suspension is modeled as axles connected to a center
**** body. This body in turn is connected to the chassis by revolute joints
**** at the axle trunnion. This is an approximation of trying to simulate
**** the behavior of the leaf spring.

```



\*\*\*\*\*

\*\*\* trailer lateral constraint for axles

DISTANCE	TFAXLE_LAT	RR_DECK.BOD	TFAXLE		
500.000000000000	-401.810000000000	20.500000000000		0	0
0.00000000000000	-401.810000000000	20.500000000000			
500.000000000000	-400.810000000000	20.500000000000			
0.00000000000000	-400.810000000000	20.500000000000			
500.000000000000	-401.810000000000	21.500000000000			
0.00000000000000	-401.810000000000	21.500000000000			
500.000000000000					
DISTANCE	TRAXLE_LAT	RR_DECK.BOD	TRAXLE		
500.000000000000	-452.810000000000	20.500000000000		0	0
0.00000000000000	-452.810000000000	20.500000000000			
500.000000000000	-451.810000000000	20.500000000000			
0.00000000000000	-451.810000000000	20.500000000000			
500.000000000000	-452.810000000000	21.500000000000			
0.00000000000000	-452.810000000000	21.500000000000			
500.000000000000					

\*\*\*\* trailer front axle constraints

DISTANCE	DIST_RF_L	RR_DECK.BOD	TFAXLE		
18.295000000000	-427.060000000000	34.221600000000		0	0
18.295000000000	-401.810000000000	23.161200000000			
19.295000000000	-427.060000000000	34.221600000000			
19.295000000000	-401.810000000000	23.161200000000			

18.295000000000	-427.06000000000	35.000000000000		
18.295000000000	-401.81000000000	35.000000000000		
27.566200000000				
DISTANCE	DIST_LR_L	RL_DECK.BOD	TFAXLE	0 0
-18.295000000000	-427.06000000000	34.221600000000		
-18.295000000000	-401.81000000000	23.161200000000		
-17.295000000000	-427.06000000000	34.221600000000		
-17.295000000000	-401.81000000000	23.161200000000		
-18.295000000000	-427.06000000000	35.000000000000		
-18.295000000000	-401.81000000000	35.000000000000		
27.566200000000				

DISTANCE	DIST_RF_U	RR_DECK.BOD	TFAXLE	0 0
0.000000000000	-427.06000000000	29.221600000000		
0.000000000000	-401.81000000000	17.738800000000		
1.000000000000	-427.06000000000	29.221600000000		
1.000000000000	-401.81000000000	17.738800000000		
0.000000000000	-427.06000000000	30.000000000000		
0.000000000000	-401.81000000000	30.000000000000		
27.738400000000				

\*\*\* trailer rear axle constraints

DISTANCE	DIST_RR_L	RR_DECK.BOD	TRAXLE	0 0
18.295000000000	-427.56000000000	34.221600000000		
18.295000000000	-452.56000000000	23.161200000000		
19.295000000000	-427.56000000000	34.221600000000		
19.295000000000	-452.56000000000	23.161200000000		
18.295000000000	-427.56000000000	35.000000000000		
18.295000000000	-452.56000000000	35.000000000000		
27.337381882000				

DISTANCE	DIST_LR_L	RL_DECK.BOD	TRAXLE	0 0
-18.295000000000	-427.56000000000	34.221600000000		
-18.295000000000	-452.56000000000	23.161200000000		
-17.295000000000	-427.56000000000	34.221600000000		
-17.295000000000	-452.56000000000	23.161200000000		
-18.295000000000	-427.56000000000	35.000000000000		
-18.295000000000	-452.56000000000	35.000000000000		
27.337381882000				

DISTANCE	DIST_RR_U	RR_DECK.BOD	TRAXLE	0 0
0.000000000000	-427.56000000000	29.221600000000		
0.000000000000	-452.56000000000	17.738800000000		
1.000000000000	-427.56000000000	29.221600000000		
1.000000000000	-452.56000000000	17.738800000000		
0.000000000000	-427.56000000000	30.000000000000		
0.000000000000	-452.56000000000	30.000000000000		
27.510992272900				

\*\*\* trailer tires

TIRE	RFTIRE	RFWHL	RR_DECK.BOD	FULL
NONE		NONE	NONE	
37.000000000000		-401.81000000000	20.502000000000	
21.200000000000		0.000000000000	10.000000000000	
5000.0000000000		859436.69269624	0.000000000000	
0.800000000000				
TIRE	RRTIRE	RRWHL	RR_DECK.BOD	FULL
NONE		NONE	NONE	
37.000000000000		-452.81000000000	20.502000000000	

21.200000000000	0.000000000000	10.000000000000		
5000.0000000000	859436.69269624	0.000000000000		
0.800000000000				
TIRE LFTIRE	LFWHL	RL_DECK.BOD		FULL
NONE	NONE	NONE		
-37.000000000000	-401.810000000000	20.502000000000		
21.200000000000	0.000000000000	10.000000000000		
5000.0000000000	859436.69269624	0.000000000000		
0.800000000000				
TIRE LRTIRE	LRWHL	RL_DECK.BOD		FULL
NONE	NONE	NONE		
-37.000000000000	-452.810000000000	20.502000000000		
21.200000000000	0.000000000000	10.000000000000		
5000.0000000000	859436.69269624	0.000000000000		
0.800000000000				

\*\*\*\* trailer leafsprings

TSDA	RF_SPRING	TFAXLE	R_SPRING	0	0
BSTOP	NONE	NONE			
21.505000000000	-401.810000000000	20.500000000000			
21.505000000000	-401.810000000000	31.270000000000			
22.505000000000	-401.810000000000	20.500000000000			
22.505000000000	-401.810000000000	31.270000000000			
21.505000000000	-401.810000000000	22.270000000000			
21.505000000000	-401.810000000000	32.270000000000			
8772.0000000000	11.000000000000	20.000000000000	0.000000000000		
TSDA	RR_SPRING	TRAXLE	R_SPRING	0	0
BSTOP	NONE	NONE			
21.505000000000	-452.810000000000	20.500000000000			
21.505000000000	-452.810000000000	31.270000000000			
22.505000000000	-452.810000000000	20.500000000000			
22.505000000000	-452.810000000000	31.270000000000			
21.505000000000	-452.810000000000	22.270000000000			
21.505000000000	-452.810000000000	32.270000000000			
8772.0000000000	11.000000000000	20.000000000000	0.000000000000		
TSDA	LF_SPRING	TFAXLE	L_SPRING	0	0
BSTOP	NONE	NONE			
-21.505000000000	-401.810000000000	20.500000000000			
-21.505000000000	-401.810000000000	31.270000000000			
-22.505000000000	-401.810000000000	20.500000000000			
-22.505000000000	-401.810000000000	31.270000000000			
-21.505000000000	-401.810000000000	22.270000000000			
-21.505000000000	-401.810000000000	32.270000000000			
8772.0000000000	11.000000000000	20.000000000000	0.000000000000		
TSDA	LR_SPRING	TRAXLE	L_SPRING	0	0
BSTOP	NONE	NONE			
-21.505000000000	-452.810000000000	20.500000000000			
-21.505000000000	-452.810000000000	31.270000000000			
-22.505000000000	-452.810000000000	20.500000000000			
-22.505000000000	-452.810000000000	31.270000000000			
-21.505000000000	-452.810000000000	22.270000000000			
-21.505000000000	-452.810000000000	32.270000000000			
8772.0000000000	11.000000000000	20.000000000000	0.000000000000		

\*\*\*\* springs between the L\_SPRING & R\_SPRING and M871

TSDA	RF_SPRINGDAMP	RR_DECK.BOD	R_SPRING	0	0
BSTOP	NONE	NONE			
21.505000000000	-401.810000000000	20.500000000000			



21.505000000000	-401.8100000000	31.270000000000		
22.505000000000	-401.8100000000	20.500000000000		
22.505000000000	-401.8100000000	31.270000000000		
21.505000000000	-401.8100000000	22.270000000000		
21.505000000000	-401.8100000000	32.270000000000		
20.000000000000	11.000000000000	10.000000000000	0.0000000000000000C	
TSDA	RR_SPRINGDAMP	RR_DECK.BOD	R_SPRING	0 0
BSTOP	NONE	NONE		
21.505000000000	-452.8100000000	20.500000000000		
21.505000000000	-452.8100000000	31.270000000000		
22.505000000000	-452.8100000000	20.500000000000		
22.505000000000	-452.8100000000	31.270000000000		
21.505000000000	-452.8100000000	22.270000000000		
21.505000000000	-452.8100000000	32.270000000000		
20.000000000000	11.000000000000	10.000000000000	0.0000000000000000	
TSDA	LF_SPRINGDAMP	RL_DECK.BOD	L_SPRING	0 0
BSTOP	NONE	NONE		
-21.505000000000	-401.8100000000	20.500000000000		
-21.505000000000	-401.8100000000	31.270000000000		
-22.505000000000	-401.8100000000	20.500000000000		
-22.505000000000	-401.8100000000	31.270000000000		
-21.505000000000	-401.8100000000	22.270000000000		
-21.505000000000	-401.8100000000	32.270000000000		
20.000000000000	11.000000000000	10.000000000000	0.0000000000000000	
TSDA	LR_SPRINGDAMP	RL_DECK.BOD	L_SPRING	0 0
BSTOP	NONE	NONE		
-21.505000000000	-452.8100000000	20.500000000000		
-21.505000000000	-452.8100000000	31.270000000000		
-22.505000000000	-452.8100000000	20.500000000000		
-22.505000000000	-452.8100000000	31.270000000000		
-21.505000000000	-452.8100000000	22.270000000000		
-21.505000000000	-452.8100000000	32.270000000000		
20.000000000000	11.000000000000	10.000000000000	0.0000000000000000	

\*\*\*\* payload bracketed to frame to allow for ease of movement of payload

BRACKET	PAYLOAD_1.BRACK	PAYLOAD1.BOD	F_DECK.BOD	0 0
0.000000000000	-191.5600000000	65.500000000000		
0.000000000000	-191.5600000000	65.500000000000		
0.000000000000	-191.5600000000	66.500000000000		
0.000000000000	-191.5600000000	66.500000000000		
1.000000000000	-191.5600000000	65.500000000000		
1.000000000000	-191.5600000000	65.500000000000		
BRACKET	PAYLOAD_2.BRACK	PAYLOAD2.BOD	FR DECK.BOD	0 0
24.000000000000	-343.7000000000	55.000000000000		
24.000000000000	-343.7000000000	55.000000000000		
24.000000000000	-343.7000000000	56.000000000000		
24.000000000000	-343.7000000000	56.000000000000		
25.000000000000	-343.7000000000	55.000000000000		
25.000000000000	-343.7000000000	55.000000000000		
BRACKET	PAYLOAD_3.BRACK	PAYLOAD3.BOD	RL DECK.BOD	0 0
-24.000000000000	-343.7000000000	55.000000000000		
-24.000000000000	-343.7000000000	55.000000000000		
-24.000000000000	-343.7000000000	56.000000000000		
-24.000000000000	-343.7000000000	56.000000000000		
-23.000000000000	-343.7000000000	55.000000000000		
-23.000000000000	-343.7000000000	55.000000000000		

\*\*\* Bracket Joints used to generate reaction forces at gussets for  
 \*\*\* FEA.

BRACKET	L_GUS.BRACK	RL_DECK.BOD	F_DECK.BOD	0	0
-48.000000000000	-252.310000000000	55.000000000000			
-48.000000000000	-252.310000000000	55.000000000000			
-48.000000000000	-252.310000000000	56.000000000000			
-48.000000000000	-252.310000000000	56.000000000000			
-47.000000000000	-252.310000000000	55.000000000000			
-47.000000000000	-252.310000000000	55.000000000000			
BRACKET	R_GUS.BRACK	RR_DECK.BOD	F_DECK.BOD	0	0
48.000000000000	-252.310000000000	55.000000000000			
48.000000000000	-252.310000000000	55.000000000000			
48.000000000000	-252.310000000000	56.000000000000			
48.000000000000	-252.310000000000	56.000000000000			
49.000000000000	-252.310000000000	55.000000000000			
49.000000000000	-252.310000000000	55.000000000000			

\*\*\*\* joints which attach center body (leaf spring) to trailer chassis

REVOLUTE	RTRUNNION	RR_DECK.BOD	R_SPRING	0	0
21.505000000000	-426.810000000000	33.049100000000			
21.505000000000	-426.810000000000	33.049100000000			
22.505000000000	-426.810000000000	33.049100000000			
22.505000000000	-426.810000000000	33.049100000000			
21.505000000000	-426.810000000000	34.049100000000			
21.505000000000	-426.810000000000	34.049100000000			
REVOLUTE	LTRUNNION	RL_DECK.BOD	L_SPRING	0	0
-21.505000000000	-426.810000000000	33.049100000000			
-21.505000000000	-426.810000000000	33.049100000000			
-22.505000000000	-426.810000000000	33.049100000000			
-22.505000000000	-426.810000000000	33.049100000000			
-21.505000000000	-426.810000000000	34.049100000000			
-21.505000000000	-426.810000000000	34.049100000000			

\*\*\*\* trailer wheel hubs revolute joints

REVOLUTE	RF_REV	RFWHL	TFAXLE	0	0
37.000000000000	-401.810000000000	20.500000000000			
37.000000000000	-401.810000000000	20.500000000000			
38.000000000000	-401.810000000000	20.500000000000			
38.000000000000	-401.810000000000	20.500000000000			
37.000000000000	-401.810000000000	21.500000000000			
37.000000000000	-401.810000000000	21.500000000000			
REVOLUTE	RR_REV	RRWHL	TRAXLE	0	0
37.000000000000	-452.810000000000	20.500000000000			
37.000000000000	-452.810000000000	20.500000000000			
38.000000000000	-452.810000000000	20.500000000000			
38.000000000000	-452.810000000000	20.500000000000			
37.000000000000	-452.810000000000	21.500000000000			
37.000000000000	-452.810000000000	21.500000000000			
REVOLUTE	LF_REV	LFWHL	TFAXLE	0	0
-37.000000000000	-401.810000000000	20.500000000000			
-37.000000000000	-401.810000000000	20.500000000000			
-38.000000000000	-401.810000000000	20.500000000000			
-38.000000000000	-401.810000000000	20.500000000000			
-37.000000000000	-401.810000000000	21.500000000000			
-37.000000000000	-401.810000000000	21.500000000000			
REVOLUTE	LR_REV	LRWHL	TRAXLE	0	0
-37.000000000000	-452.810000000000	20.500000000000			
-37.000000000000	-452.810000000000	20.500000000000			
-38.000000000000	-452.810000000000	20.500000000000			

-38.000000000000	--452.81000000000	20.500000000000
-37.000000000000	--452.81000000000	21.500000000000
-37.000000000000	--452.81000000000	21.500000000000

\*\*\*\* trailer chassis

BODY	F_DECK.BOD	POSITIVE	PARAMETERS	FALSE	FALSE	FALSE
NONE	NONE	NONE	NONE			
NONE	NONE	NONE	NONE			
0.00000000000000	-191.560000000000		62.750000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
6.95519200000000	7484.000000000000		5359.000000000000		12808.0000000000	
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
BODY	RL_DECK.BOD	POSITIVE	PARAMETERS	FALSE	FALSE	FALSE
NONE	NONE	NONE	NONE			
NONE	NONE	NONE	NONE			
-24.00000000000000	-343.700000000000		50.000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
13.91038400000000	69413.1050000000		2786.000000000000		71968.0000000000	
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
BODY	RR_DECK.BOD	POSITIVE	PARAMETERS	FALSE	FALSE	FALSE
NONE	NONE	NONE	NONE			
NONE	NONE	NONE	NONE			
24.00000000000000	-343.700000000000		50.000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
13.91038400000000	69413.1050000000		2786.000000000000		71968.0000000000	
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			

\*\*\*\* trailer axles

BODY	TFAXLE	POSITIVE	PARAMETERS	FALSE	FALSE	FALSE
NONE	NONE	NONE	NONE			
NONE	NONE	NONE	NONE			
0.00000000000000	-401.810000000000		20.500000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
1.90670000000000	64.92000000000000		1564.000000000000		1564.0000000000	
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
BODY	TRAXLE	POSITIVE	PARAMETERS	FALSE	FALSE	FALSE
NONE	NONE	NONE	NONE			
NONE	NONE	NONE	NONE			
0.00000000000000	-452.810000000000		20.500000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
1.90670000000000	64.92000000000000		1564.000000000000		1564.0000000000	
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			
0.00000000000000	0.00000000000000		0.00000000000000			

\*\*\*\* trailer wheel hubs

BODY	RFWHL	POSITIVE	PARAMETERS	FALSE	FALSE	FALSE
NONE	NONE	NONE	NONE			
NONE	NONE	NONE	NONE			

37.0000000000000	-401.81000000000	20.50000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.3900000000000	44.00000000000	24.50000000000	24.50000000000
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
BODY RRWHL	POSITIVE	PARAMETERSFALSEFALSEFALSE	
NONE	NONE	NONE	
NONE	NONE	NONE	
37.0000000000000	-452.81000000000	20.50000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.3900000000000	44.00000000000	24.50000000000	24.50000000000
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
BODY LFWHL	POSITIVE	PARAMETERSFALSEFALSEFALSE	
NONE	NONE	NONE	
NONE	NONE	NONE	
-37.0000000000000	-401.81000000000	20.50000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.3900000000000	44.00000000000	24.50000000000	24.50000000000
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
BODY LRWHL	POSITIVE	PARAMETERSFALSEFALSEFALSE	
NONE	NONE	NONE	
NONE	NONE	NONE	
-37.0000000000000	-452.81000000000	20.50000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.3900000000000	44.00000000000	24.50000000000	24.50000000000
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	

\*\*\* center body to simulate leafspring coupling between axles

BODY R_SPRING	POSITIVE	PARAMETERSFALSEFALSEFALSE	
NONE	NONE	NONE	
NONE	NONE	NONE	
21.5050000000000	-426.81000000000	28.92520000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.5200000000000	25.00000000000	1.00000000000	25.00000000000
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
BODY L_SPRING	POSITIVE	PARAMETERSFALSEFALSEFALSE	
NONE	NONE	NONE	
NONE	NONE	NONE	
-21.5050000000000	-426.81000000000	28.92520000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.5200000000000	25.00000000000	1.00000000000	25.00000000000
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	
0.0000000000000	0.0000000000000	0.0000000000000	

\*\*\* trailer payload: Front and Rear differ. \*\*\*

BODY PAYLOAD1.BOD	POSITIVE	PARAMETERSFALSEFALSEFALSE	
NONE	NONE	NONE	
NONE	NONE	NONE	
0.0000000000000	-191.56000000000	84.00000000000	

0.0000000000000000	0.0000000000000000	0.0000000000000000	
7.77121541809000	59007.8100000000	44762.2000000000	85865.1300000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	
0.0000000000000000	0.0000000000000000	0.0000000000000000	
0.0000000000000000	0.0000000000000000	0.0000000000000000	
BODY	PAYLOAD2.BOD	POSITIVE	PARAMETERSFALSEFALSEFALSE
NONE	NONE	NONE	NONE
NONE	NONE	NONE	NONE
-24.00000000000000	-343.700000000000	96.00000000000000	
0.0000000000000000	0.0000000000000000	0.0000000000000000	
28.4944565330000	165581.0000000000	43767.0000000000	165581.0000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	
0.0000000000000000	0.0000000000000000	0.0000000000000000	
0.0000000000000000	0.0000000000000000	0.0000000000000000	
BODY	PAYLOAD3.BOD	POSITIVE	PARAMETERSFALSEFALSEFALSE
NONE	NONE	NONE	NONE
NONE	NONE	NONE	NONE
24.00000000000000	-343.700000000000	96.00000000000000	
0.0000000000000000	0.0000000000000000	0.0000000000000000	
28.4944565330000	165581.0000000000	43767.0000000000	165581.0000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	
0.0000000000000000	0.0000000000000000	0.0000000000000000	
0.0000000000000000	0.0000000000000000	0.0000000000000000	

\*\*\*\* trailer initial conditions

INITIAL	F_DECKO.INIT	TFAXLE	NONE	
NONE	ORIENTATION		0	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
INITIAL	TFAXLE-Z.IC	TFAXLE	NONE	
NONE	Z		0	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
INITIAL	TFAXLE-E2.IC	TFAXLE	NONE	
NONE	E2		0	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
INITIAL	TRAXLE-Z.IC	TRAXLE	NONE	
NONE	Z		0	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
INITIAL	TRAXLE-E2.IC	TRAXLE	NONE	
NONE	E2		0	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
INITIAL	LFWHL-E1.IC	LFWHL	NONE	
NONE	E1		0	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
INITIAL	RFWHL-E1.IC	RFWHL	NONE	
NONE	E1		0	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000
0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000	0.0000000000000000

0.00000000000000	0.00000000000000	0.00000000000000	
INITIAL LRWHL-E1.IC	LRWHL	NONE	
NONE	E1	0	
0.00000000000000	0.00000000000000	0.00000000000000	0.00000000000000
0.00000000000000	0.00000000000000	0.00000000000000	
0.00000000000000	0.00000000000000	0.00000000000000	
INITIAL RRWHL-E1.IC	RRWHL	NONE	
NONE	E1	0	
0.00000000000000	0.00000000000000	0.00000000000000	0.00000000000000
0.00000000000000	0.00000000000000	0.00000000000000	
0.00000000000000	0.00000000000000	0.00000000000000	
ROAD ROAD	NONE	0.00000000000000	
0.00000000000000	0.00000000000000	0.00000000000000	0.00000000000000
0.00000000000000	0.00000000000000	0.00000000000000	0.00000000000000
201.000000000000	20.000000000000	0.50000000000000	3.00000000000000

\*\*\*\* tractor tire lateral stiffness curve

CURVE	TIRELS.CUR	PAIRED.XY	13	1
0.12500000000000	0.50000000000000	E-020.10000000000000	E-01	1.00000000000000
0.00000000000000	0.00000000000000	CUBIC		
0.00000000000000	0.00000000000000	4.00000000000000		0.50000000000000
10.000000000000	0.70000000000000	15.00000000000000		0.80000000000000
20.000000000000	0.90000000000000	30.00000000000000		0.85000000000000
40.000000000000	0.82000000000000	50.00000000000000		0.80000000000000
60.000000000000	0.78000000000000	70.00000000000000		0.75000000000000
80.000000000000	0.73000000000000	90.00000000000000		0.70000000000000
100.000000000000	0.65000000000000			

\*\*\*\* bump steer curves

CURVE	TSBSL.CUR	PAIRED.XY	13	3
0.00000000000000	50000.0000000000	0.17500000000000	E-01	1.00000000000000
0.00000000000000	0.00000000000000	LINEAR		
38.000000000000	0.00000000000000	38.40000000000000		0.00000000000000
38.600000000000	0.00000000000000	38.70000000000000		0.00000000000000
38.800000000000	600.000000000000	38.90000000000000		1800.000000000000
39.000000000000	3700.000000000000	39.10000000000000		6500.000000000000
39.200000000000	10150.000000000000	39.30000000000000		15000.000000000000
39.400000000000	20000.000000000000	39.60000000000000		30000.000000000000
40.000000000000	50000.000000000000			

CURVE	TSBSR.CUR	PAIRED.XY	13	4
50000.0000000000	0.00000000000000	0.17500000000000	E-01	1.00000000000000
0.00000000000000	0.00000000000000	LINEAR		
-31.000000000000	-50000.000000000000	-30.60000000000000		-30000.000000000000
-30.400000000000	-20000.000000000000	-30.30000000000000		-15000.000000000000
-30.200000000000	-10150.000000000000	-30.10000000000000		-6500.000000000000
-30.000000000000	-3700.000000000000	-29.90000000000000		-1800.000000000000
-29.800000000000	-600.000000000000	-29.70000000000000		0.00000000000000
-29.600000000000	0.00000000000000	-29.40000000000000		0.00000000000000
-29.000000000000	0.00000000000000			

CURVE	TBSTOP.CUR	PAIRED.XY	2	6
50000.0000000000	50000.0000000000	1.00000000000000		1.00000000000000
0.00000000000000	0.00000000000000	LINEAR		
-3.00000000000000	0.00000000000000	3.00000000000000		0.00000000000000

\*\*\*\* trailer bump stop curve

CURVE	BSTOP	PAIRED.XY	4	10
17544.0000000000	17544.0000000000	1.00000000000000		1.00000000000000
0.00000000000000	0.00000000000000	LINEAR		
0.00000000000000	-9500.000000000000	0.50000000000000		9400.000000000000
1.00000000000000	17800.000000000000	1.50000000000000		25600.000000000000

CURVE	BSTOP2	PAIRED.XY	3	10
0.0000000000000000	5000.0000000000	1.00000000000000		1.00000000000000
0.0000000000000000	0.00000000000000	LINEAR		
-10.00000000000000	0.00000000000000	5.00000000000000		0.00000000000000
15.00000000000000	75000.0000000000			

\*\*\*\* hitch roll curves \*\*\*\*

CURVE	BLOCKS_OUT	PAIRED.XY	7	10
0.0000000000000000	5000.0000000000	1.00000000000000		1.00000000000000
0.0000000000000000	0.00000000000000	LINEAR		
-0.1745000000000000	-100000.0000000000	-0.12220000000000		0.00000000000000
-0.0698000000000000	0.00000000000000	0.00000000000000		0.00000000000000
0.0698000000000000	0.00000000000000	0.12220000000000		0.00000000000000
0.1745000000000000	100000.0000000000			

CURVE	BLOCKS_IN	PAIRED.XY	2	10
100000000.000000	100000000.000000	1.00000000000000		1.00000000000000
0.0000000000000000	0.00000000000000	LINEAR		
-10.00000000000000	-100000000.000000	10.00000000000000		100000000.000000

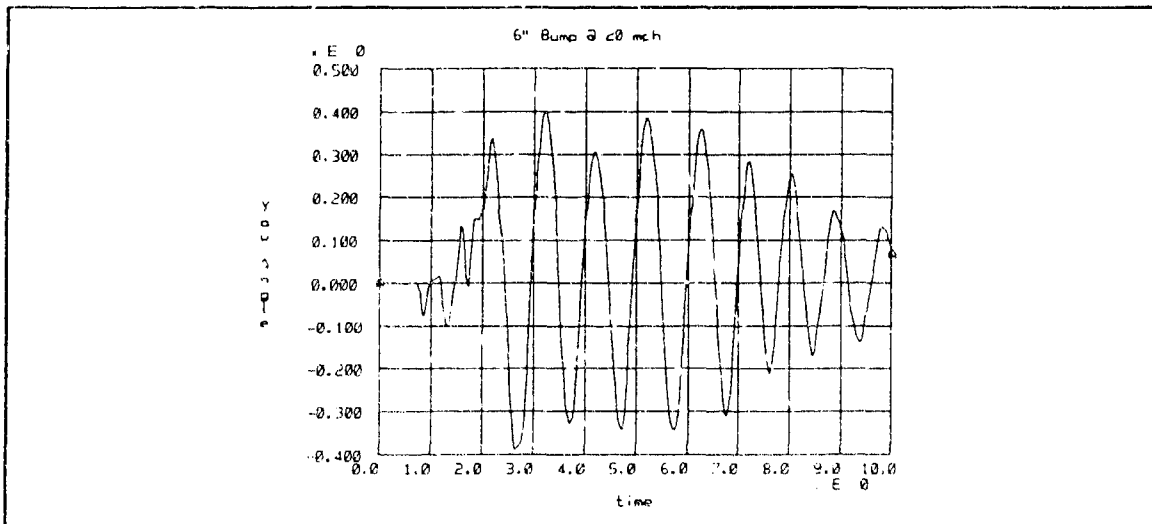
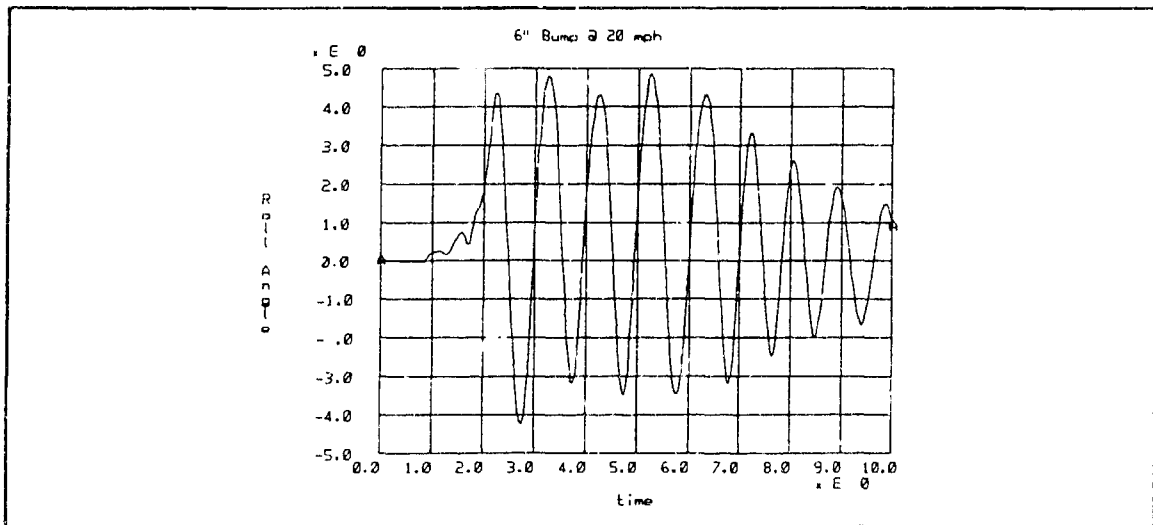
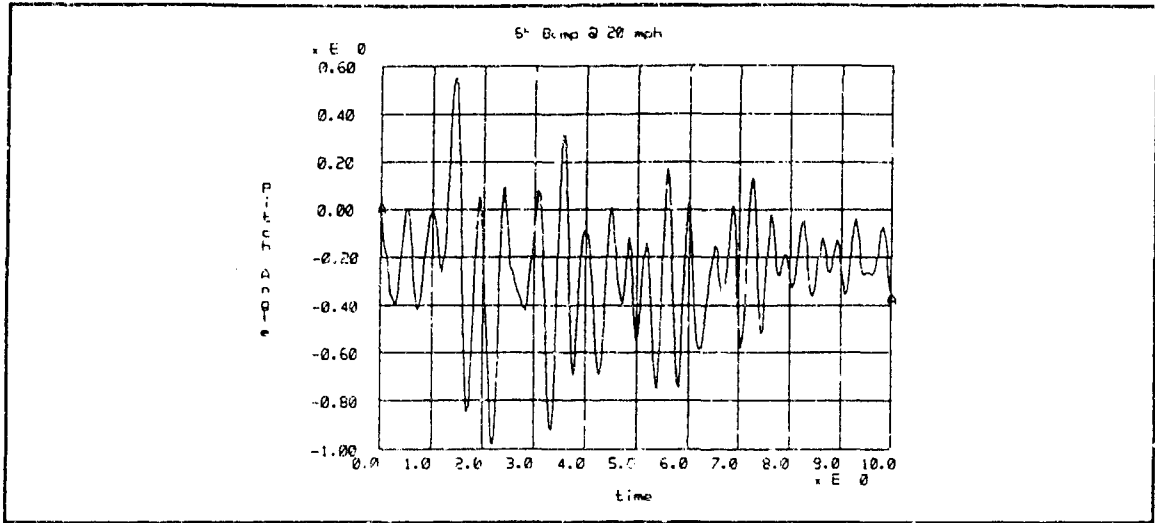
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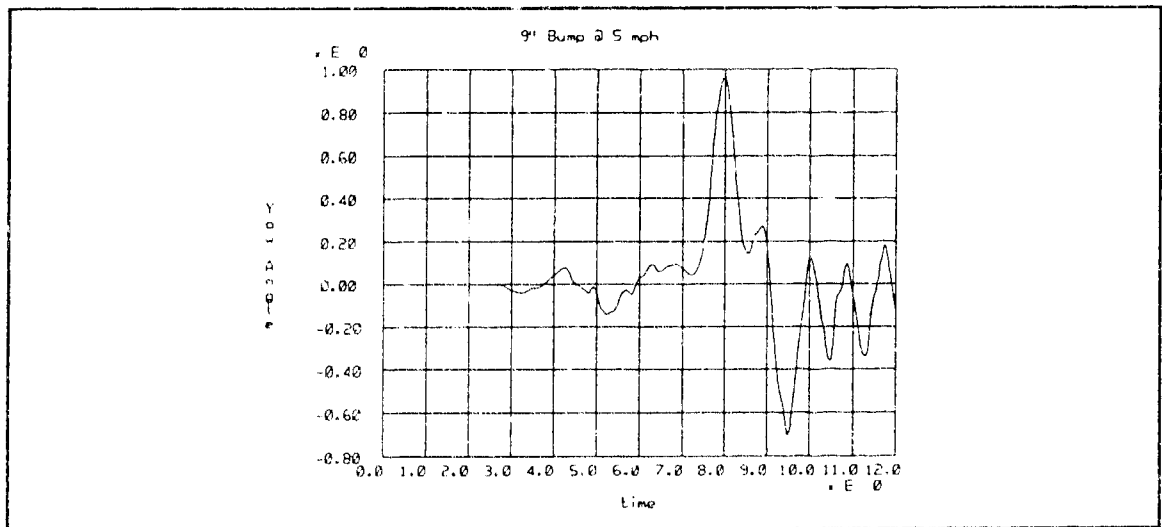
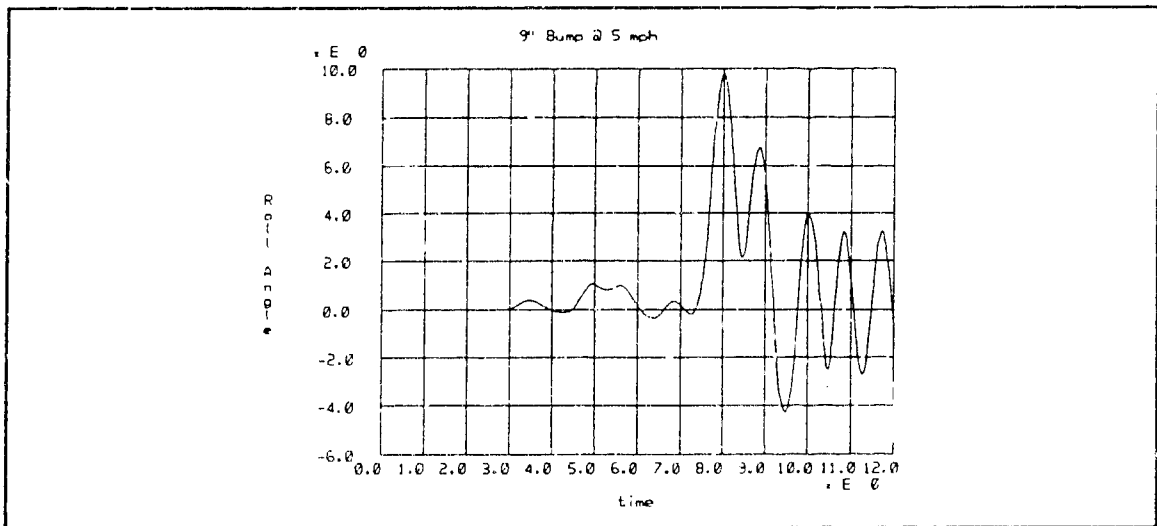
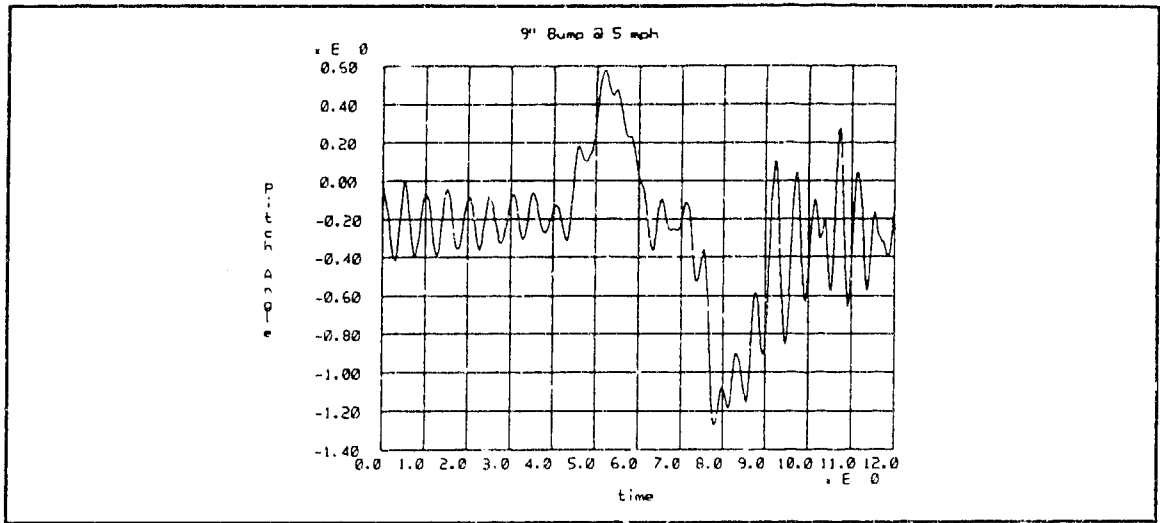
## APPENDIX B

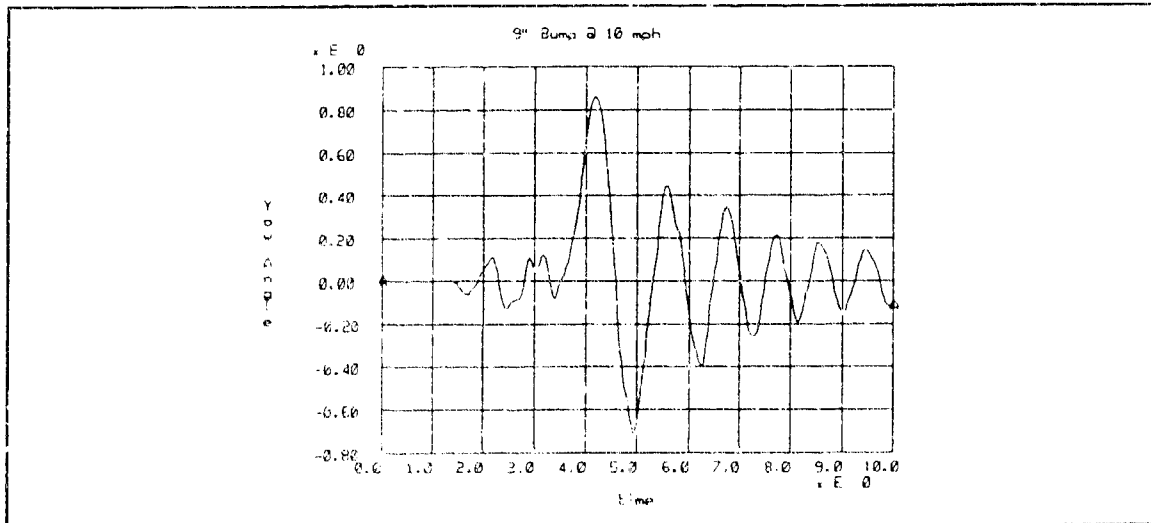
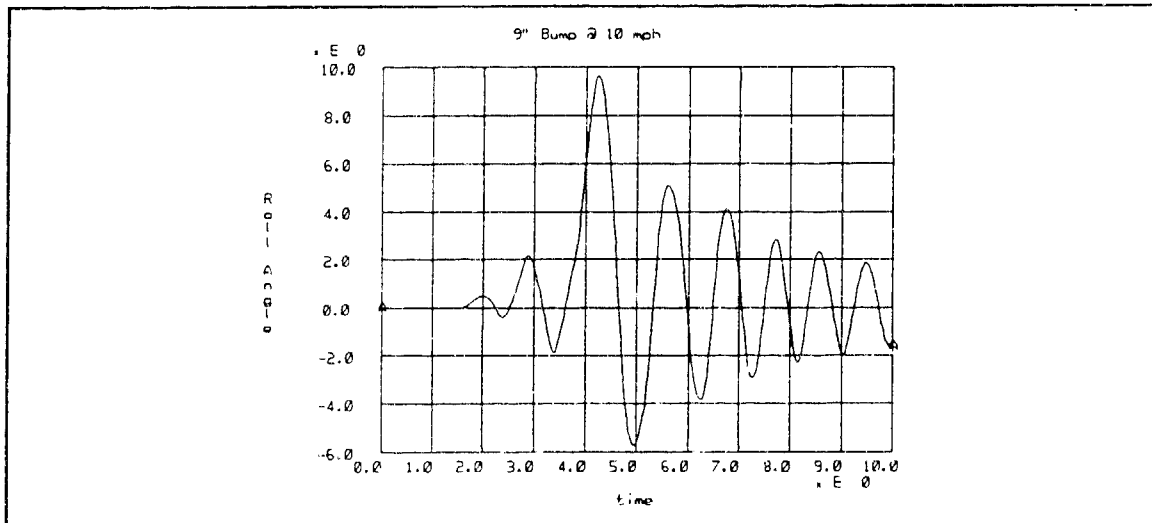
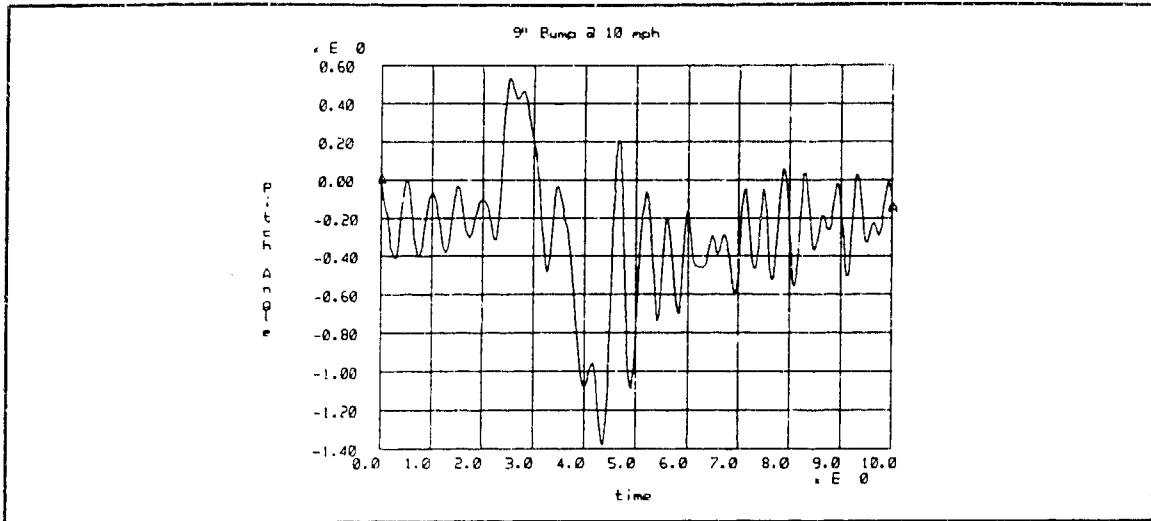
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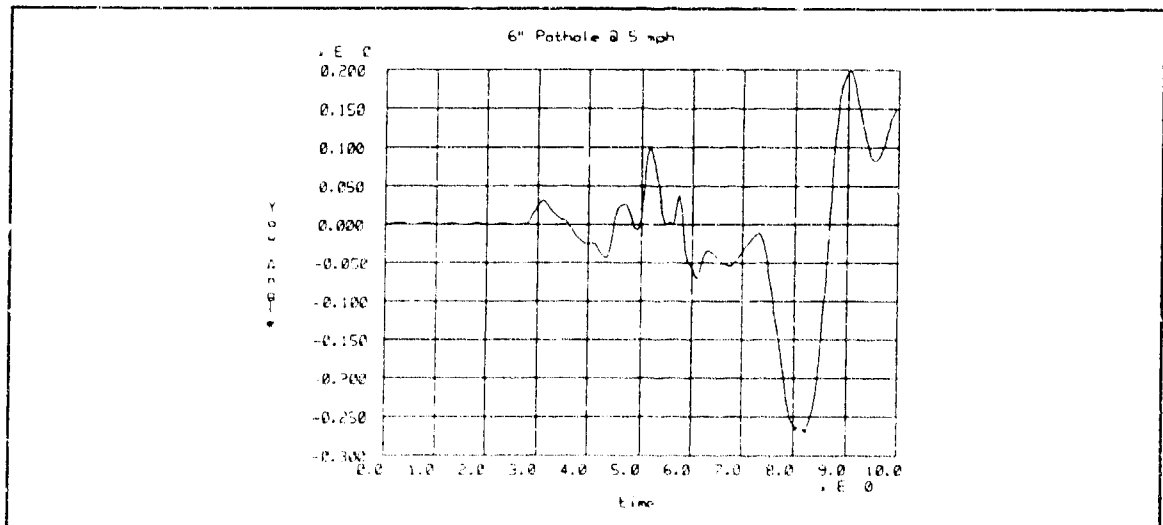
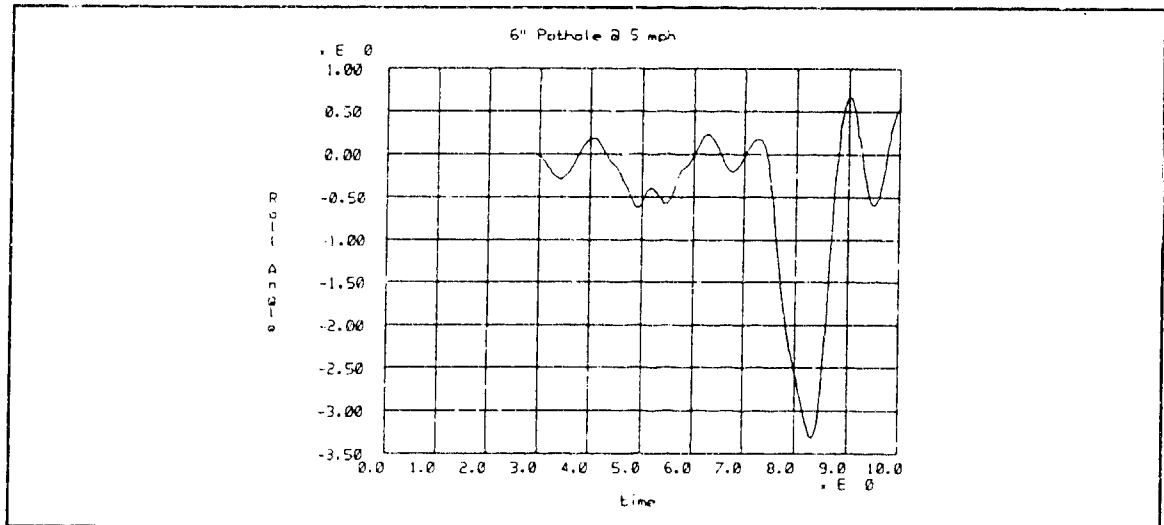
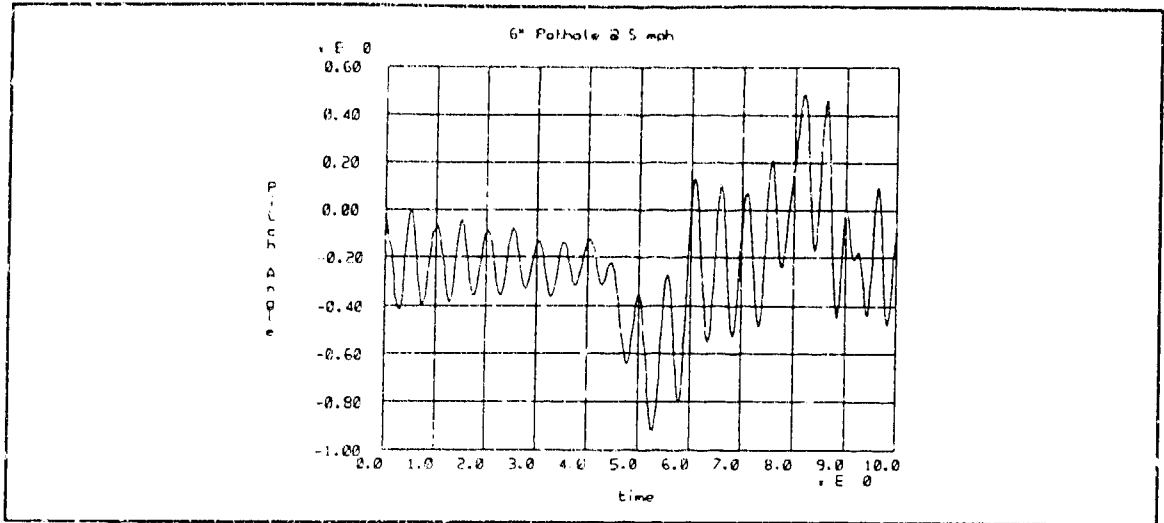


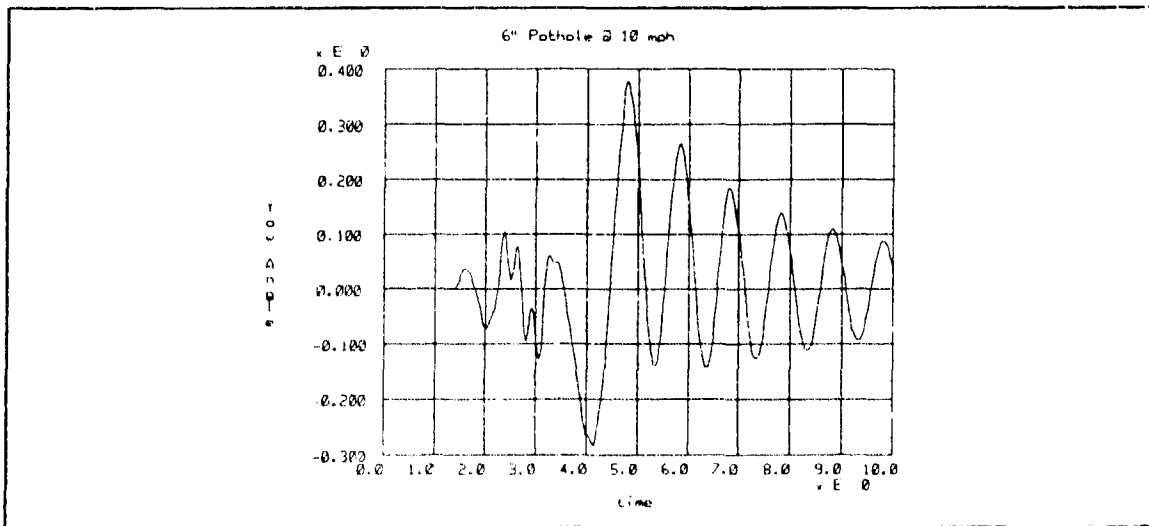
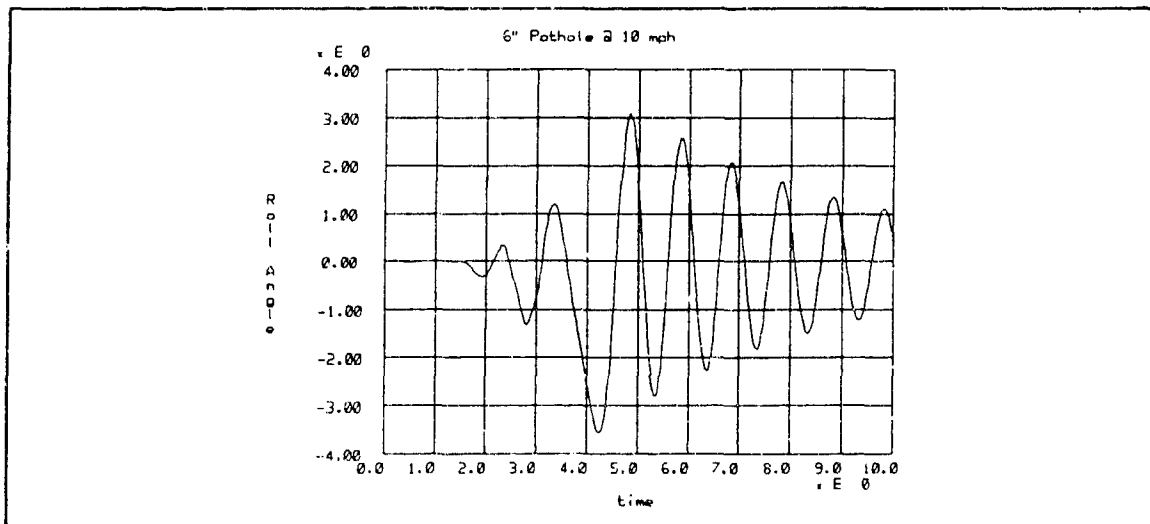
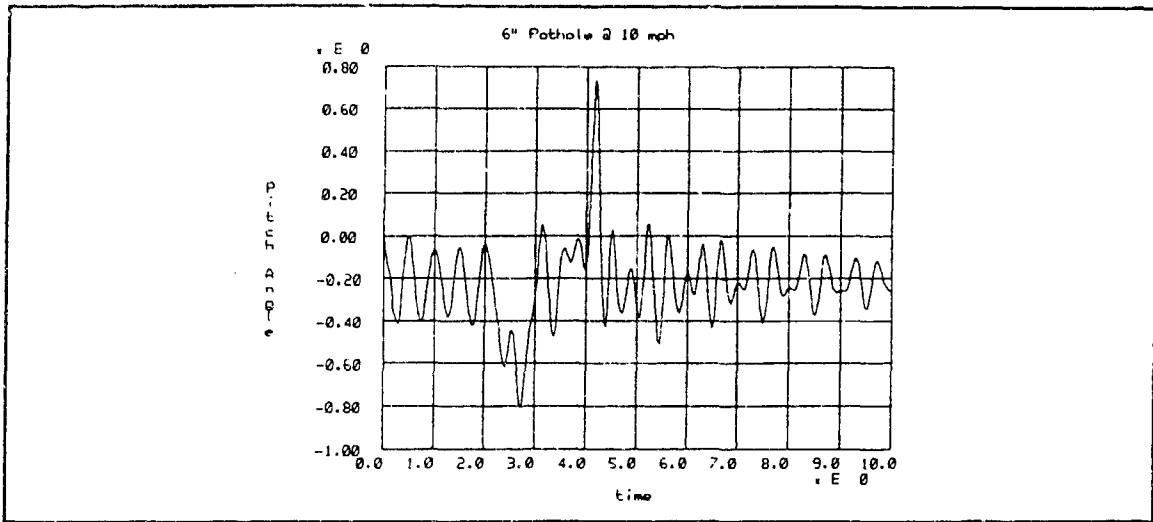


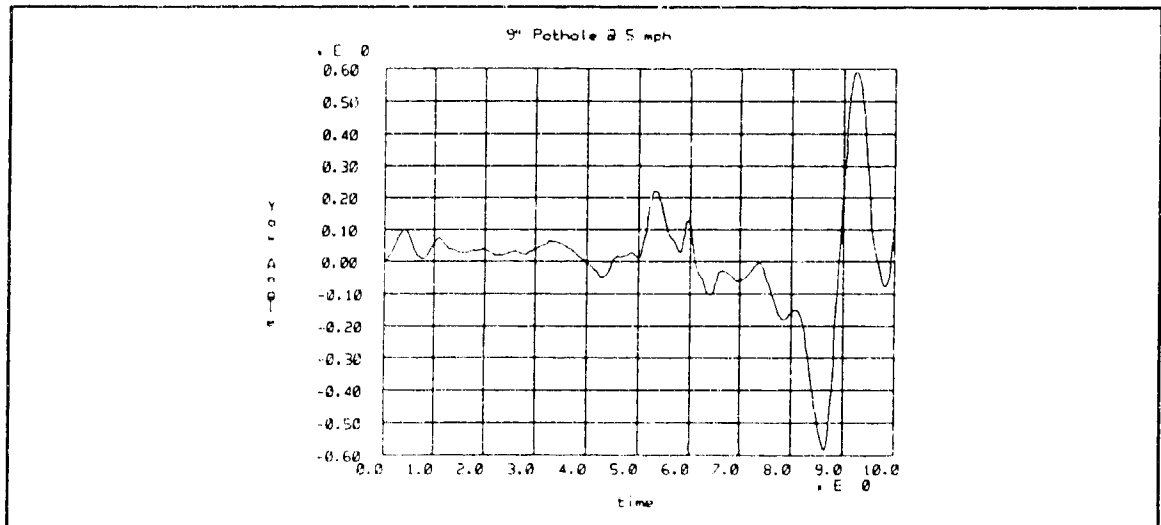
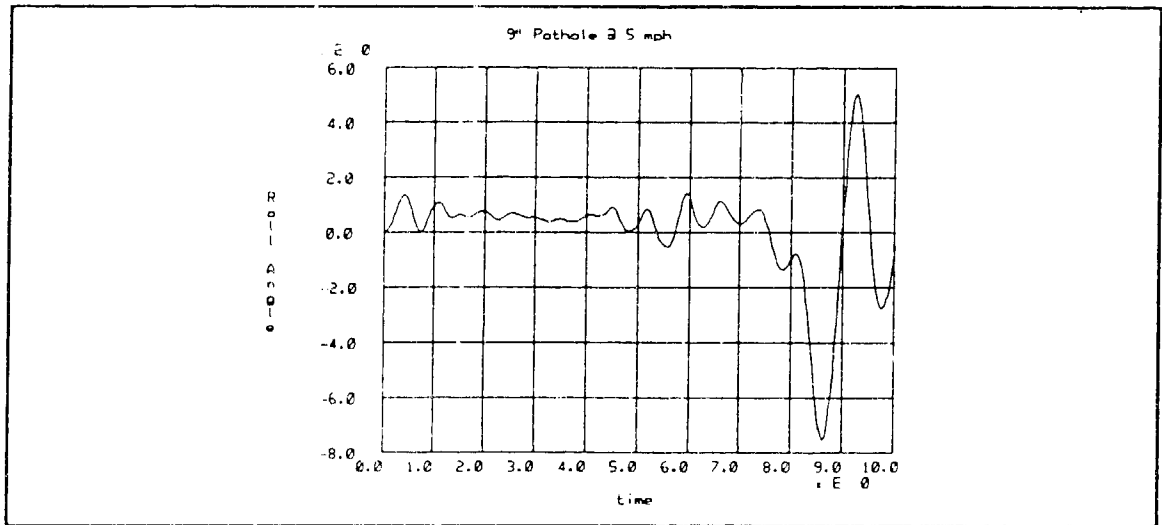
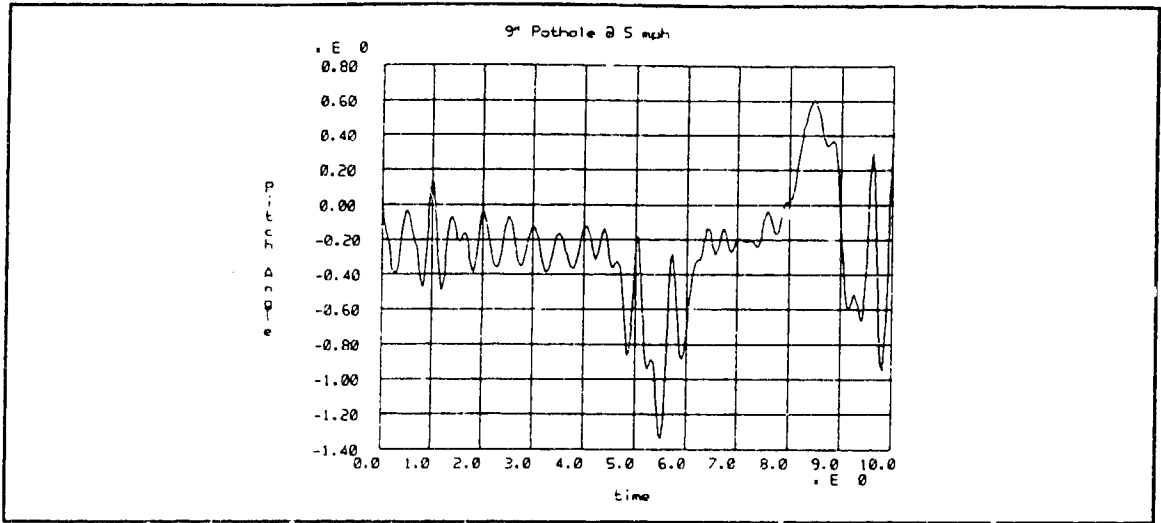


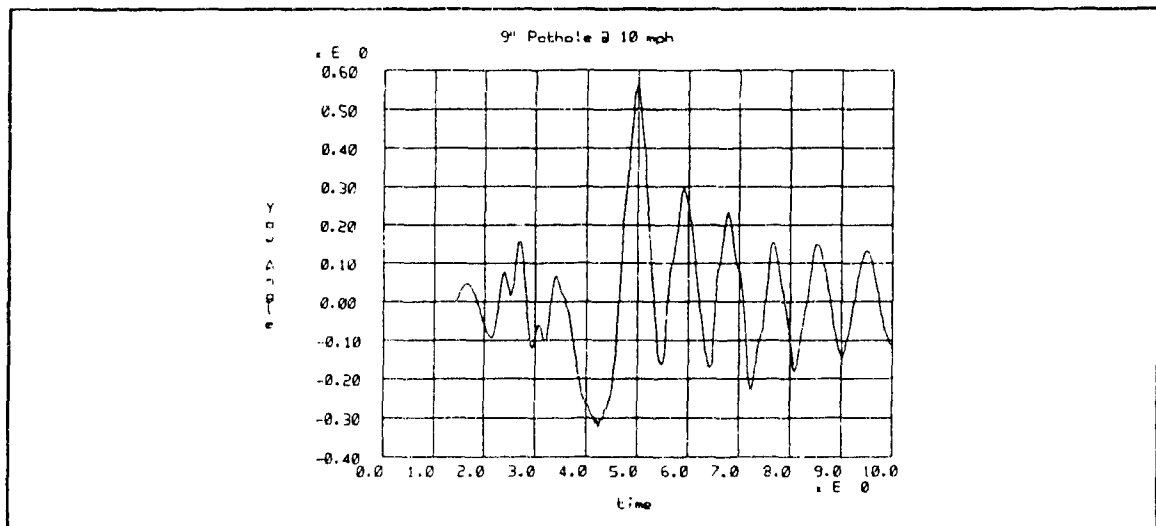
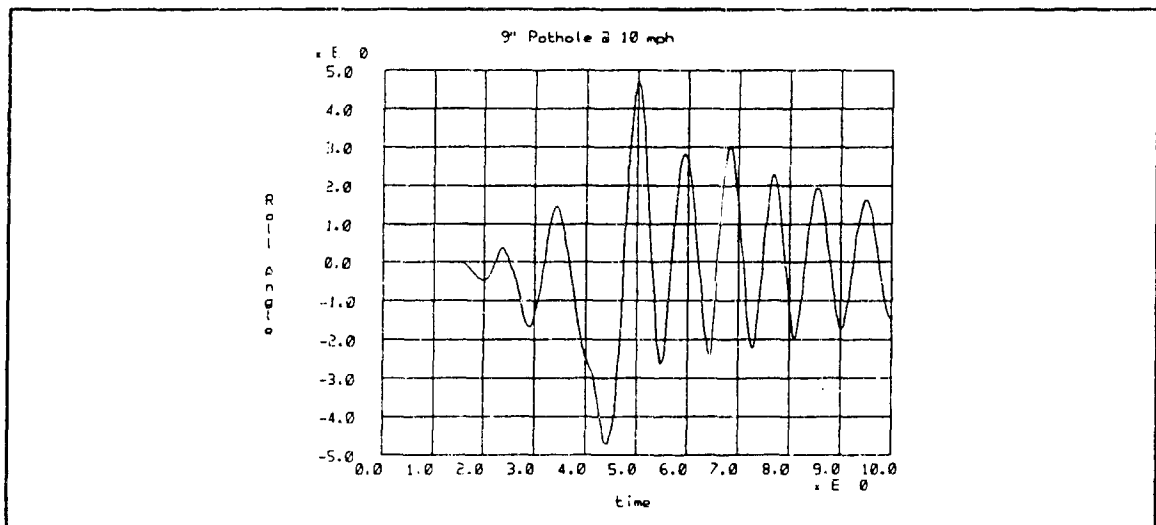
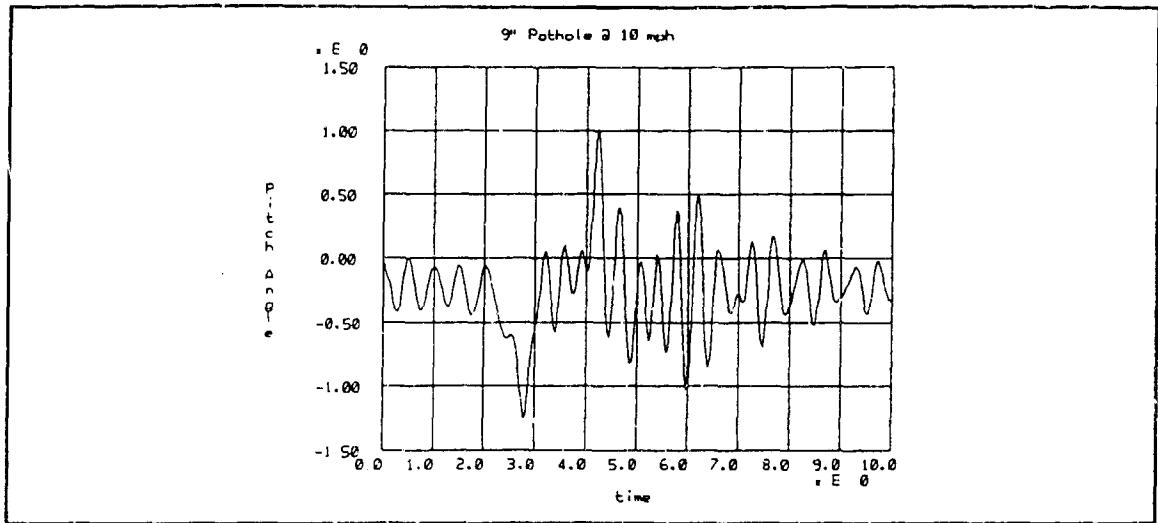




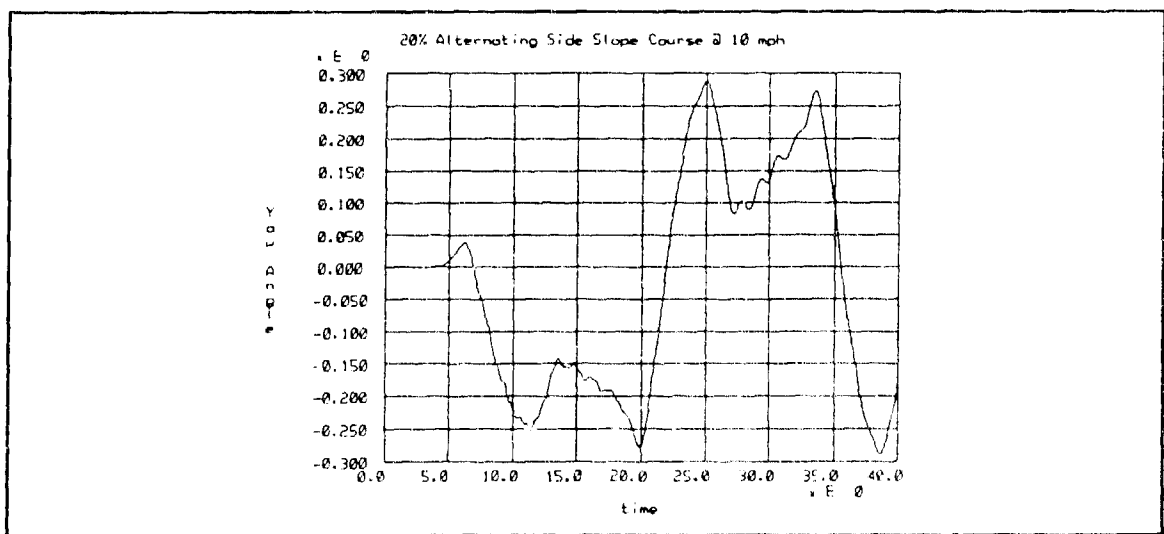
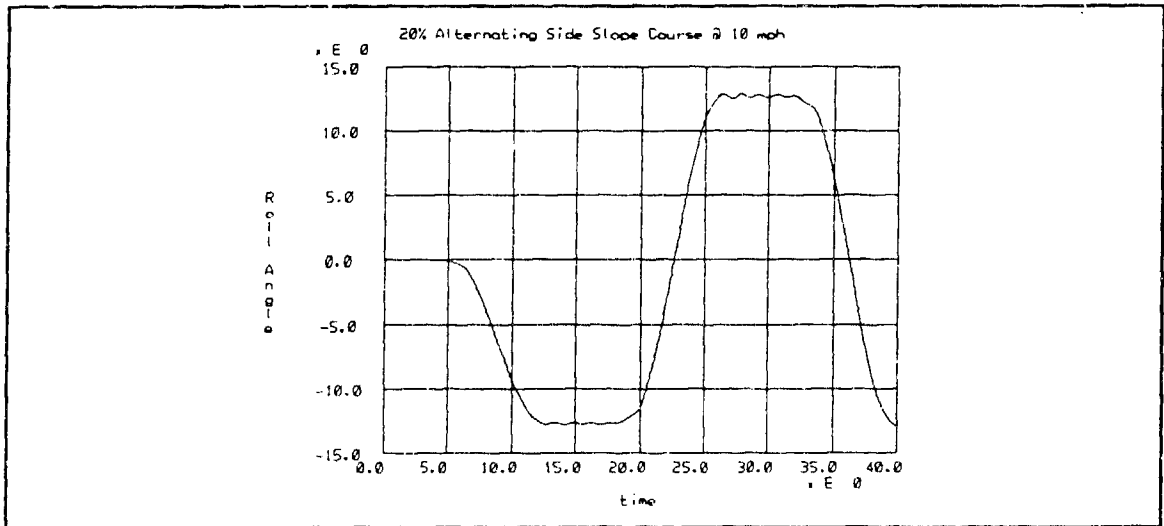
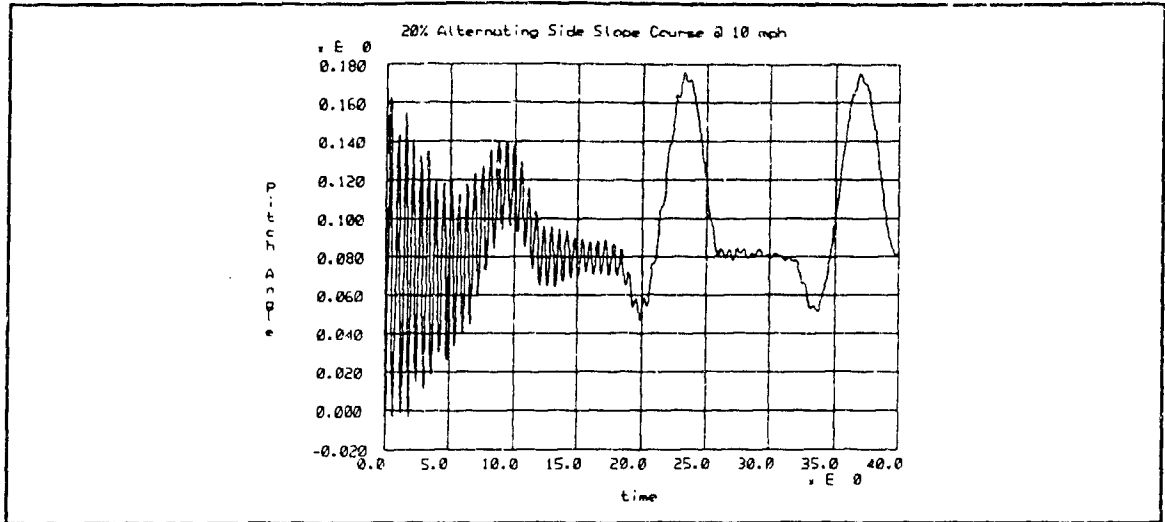


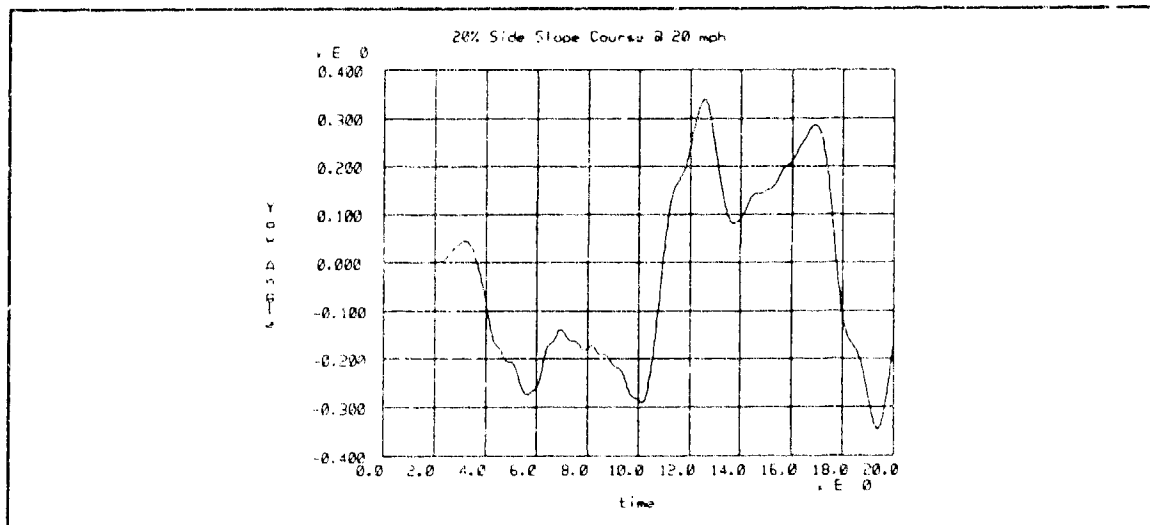
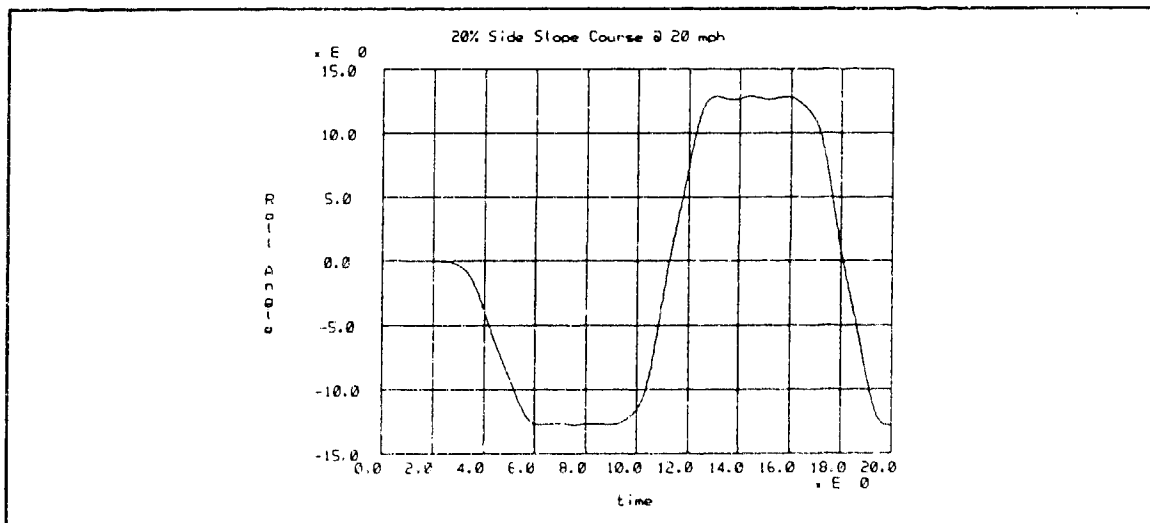
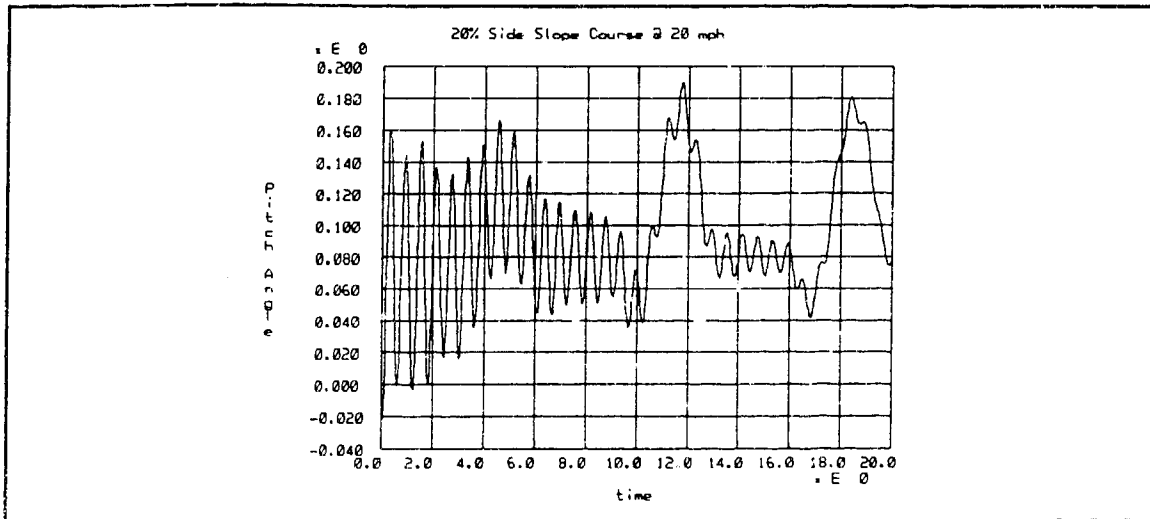


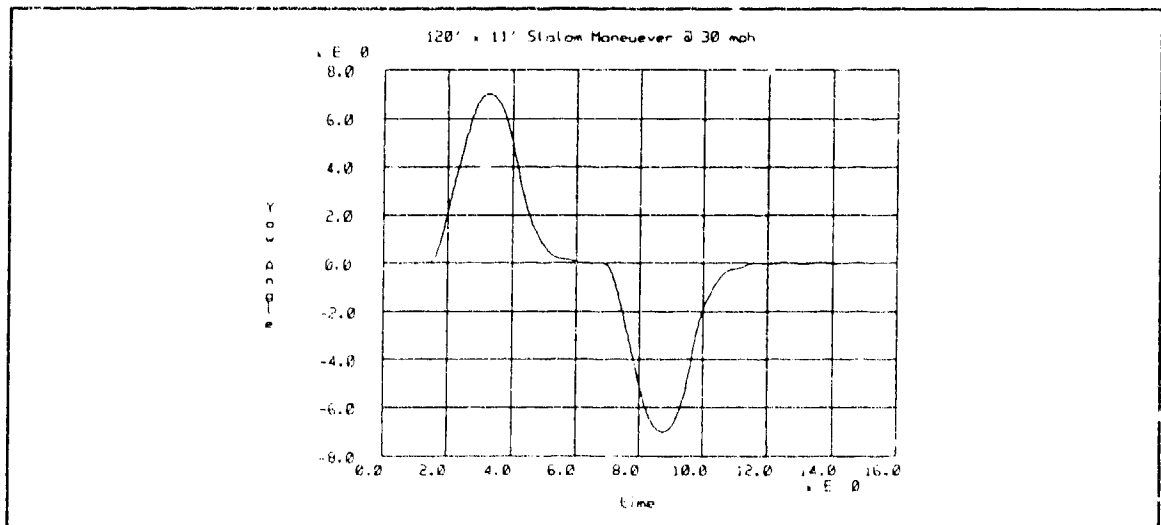
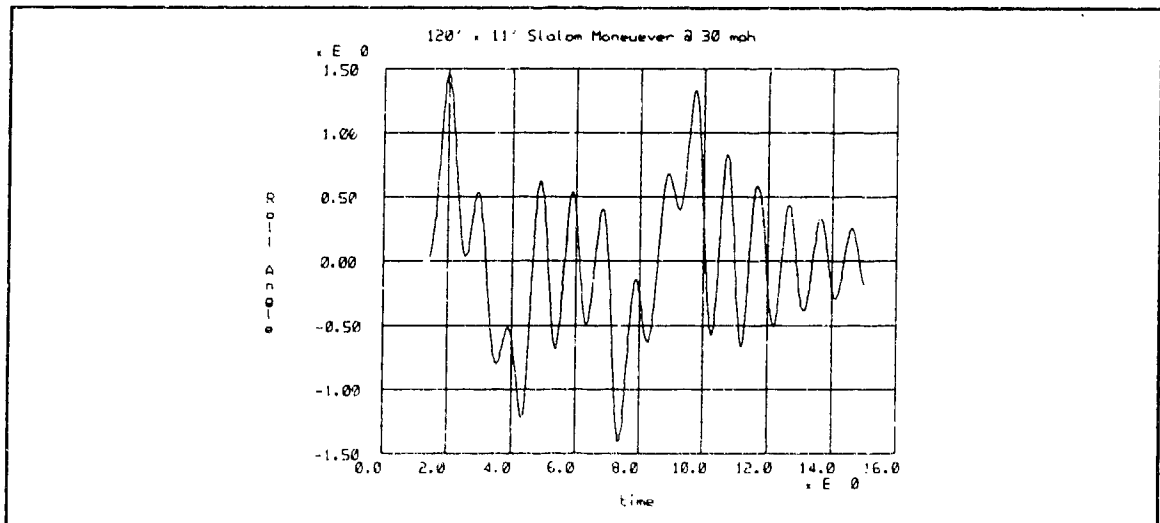
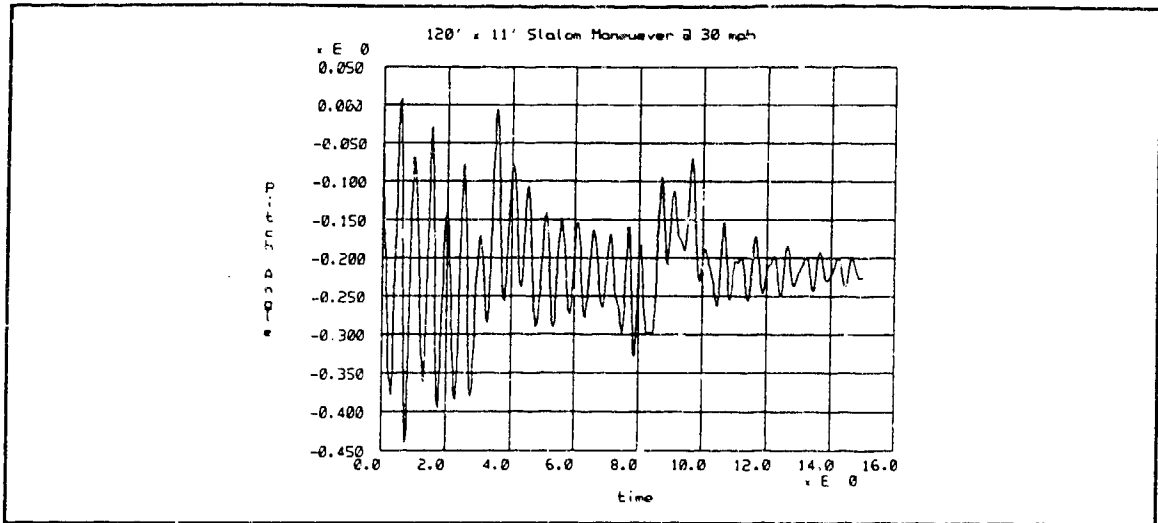


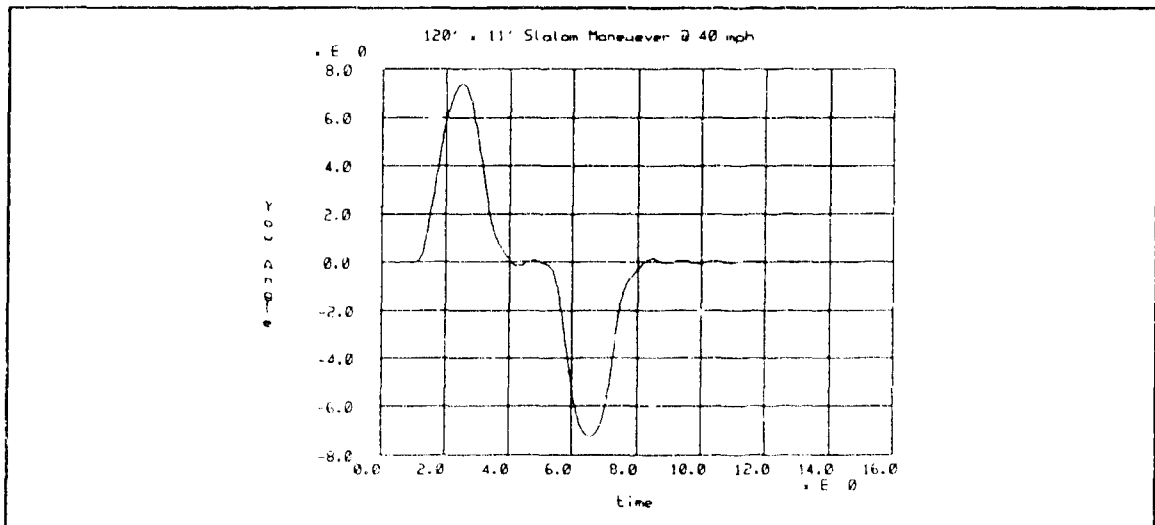
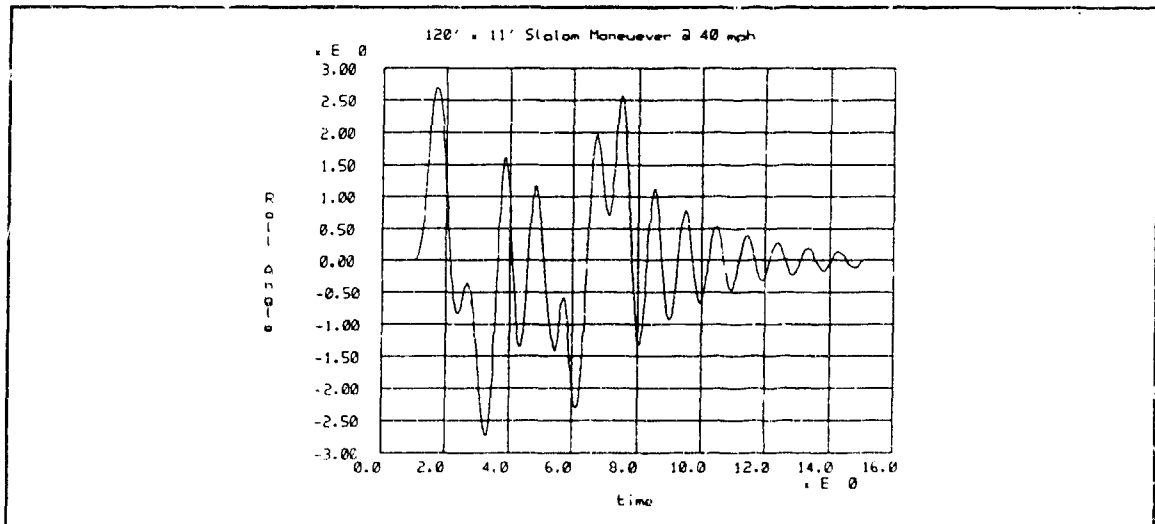
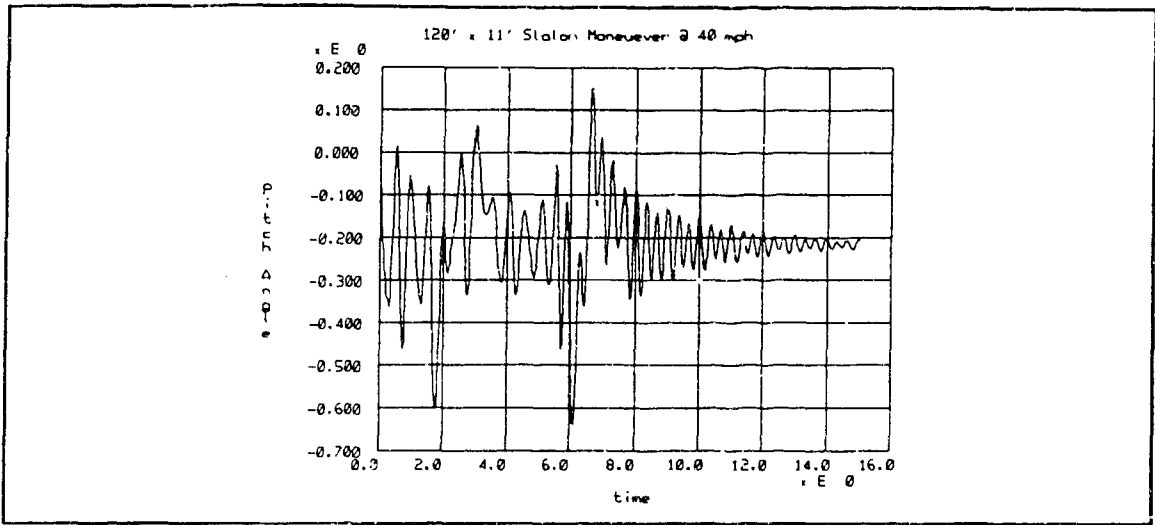


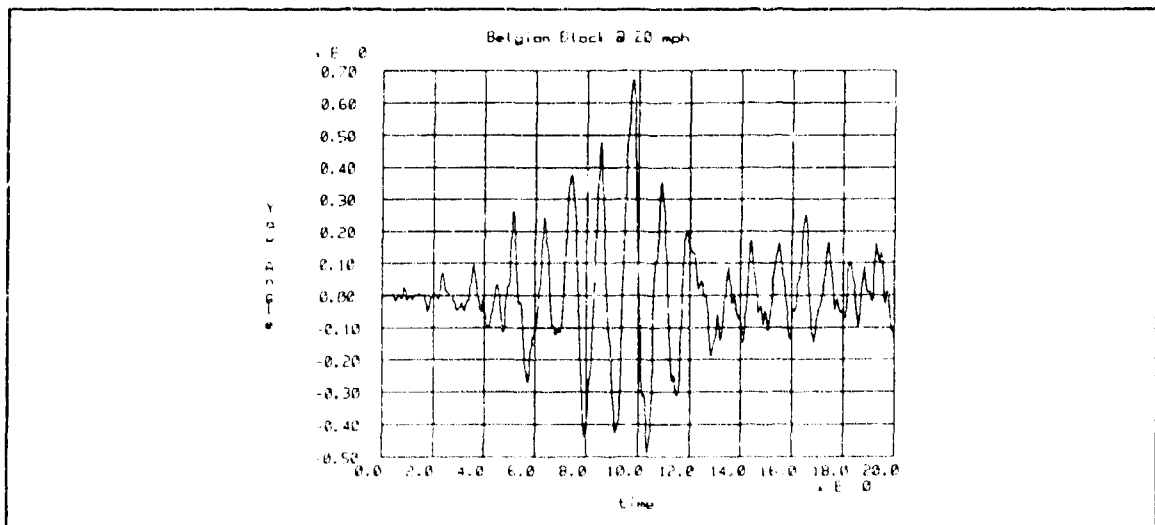
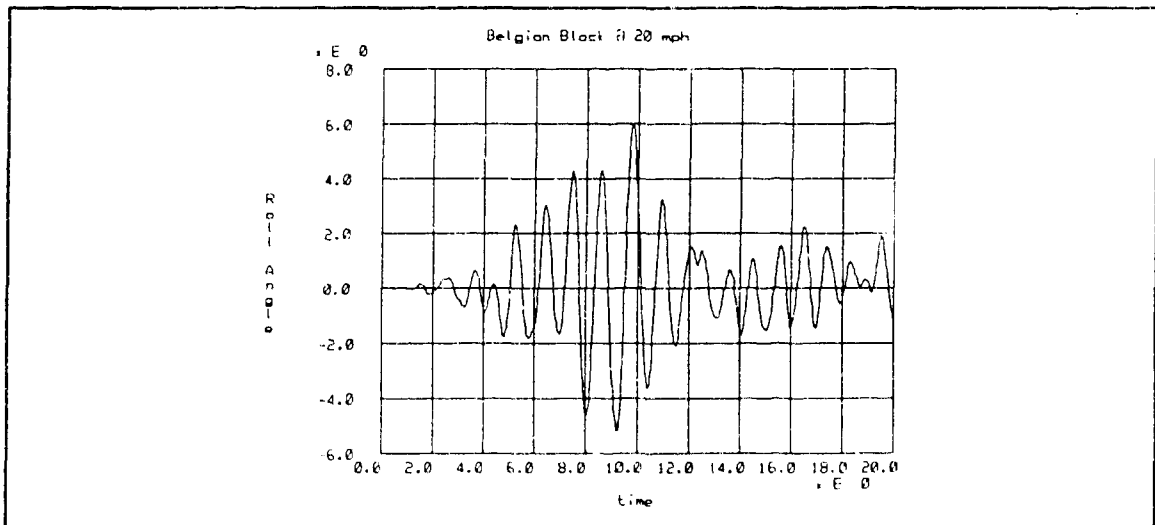
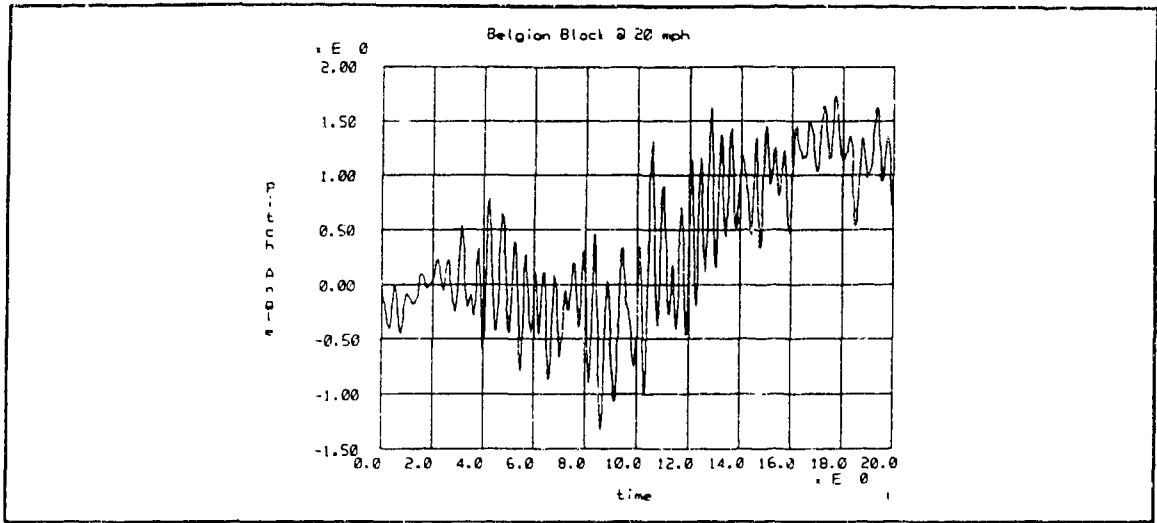


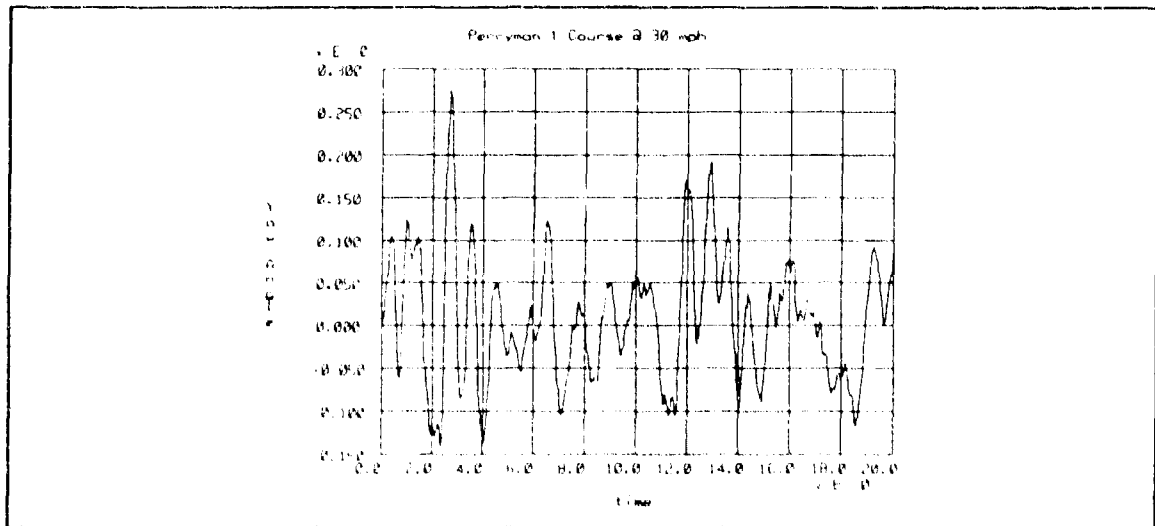
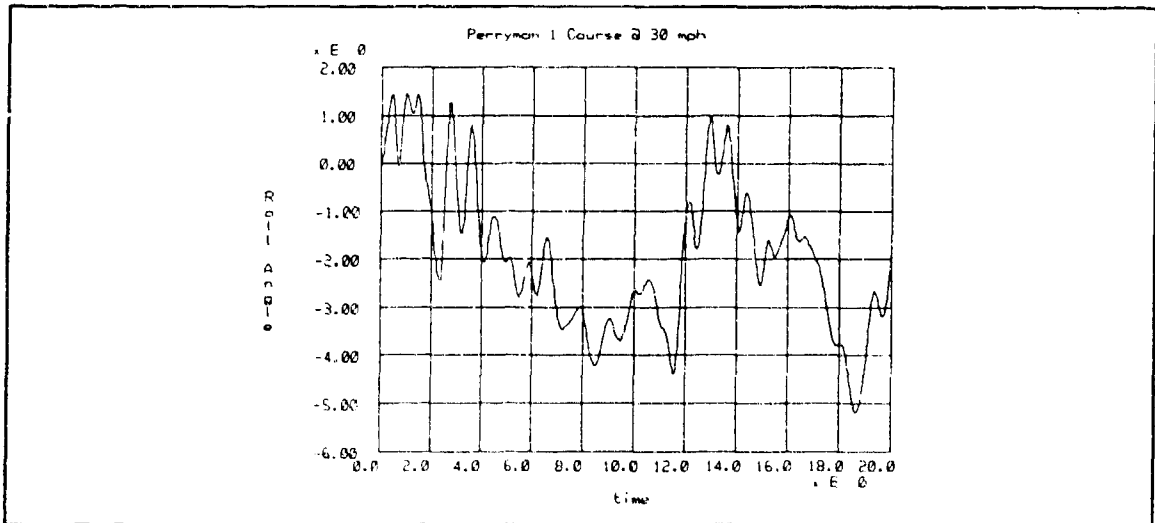
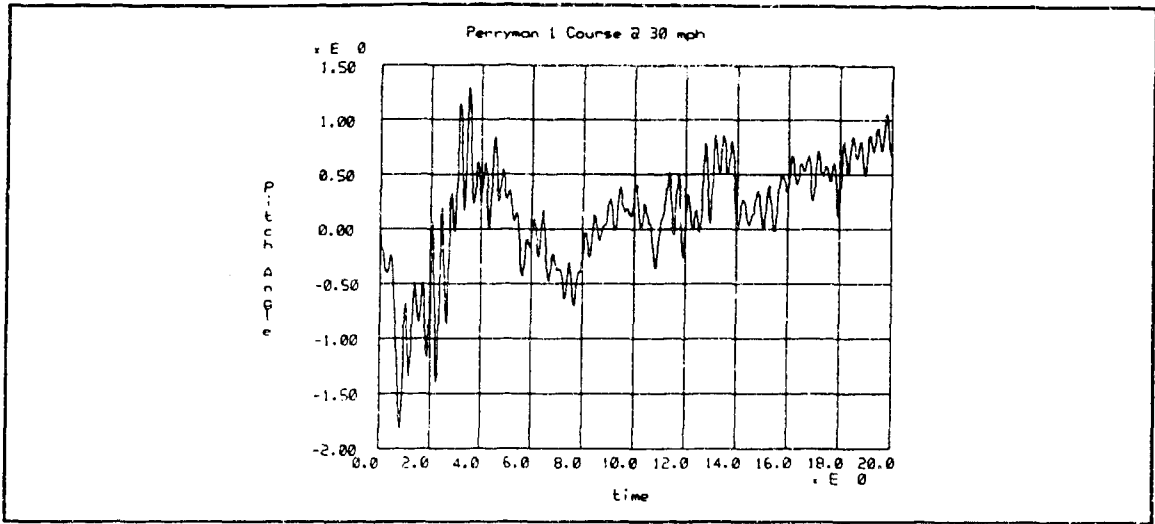


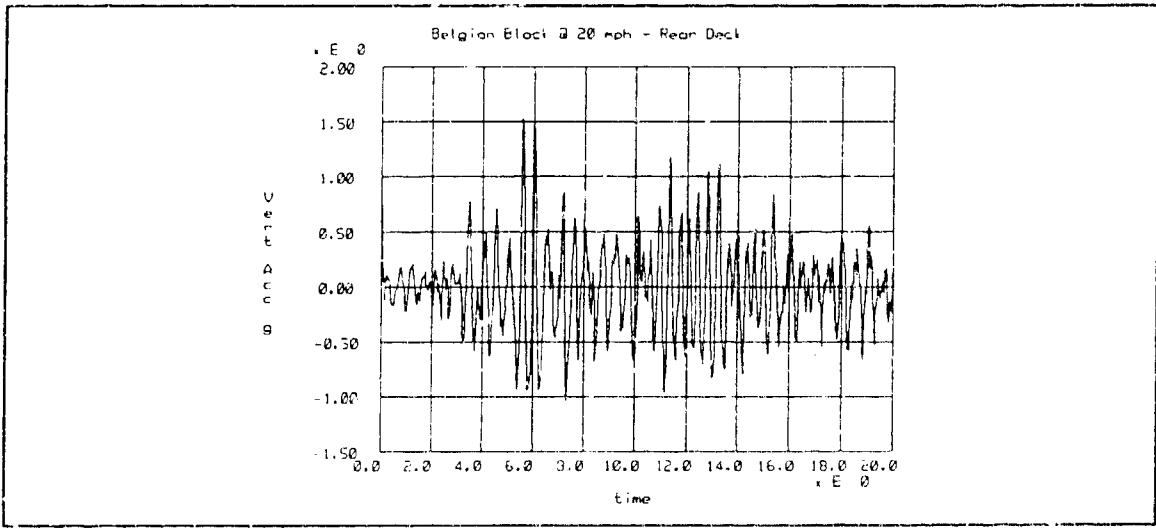
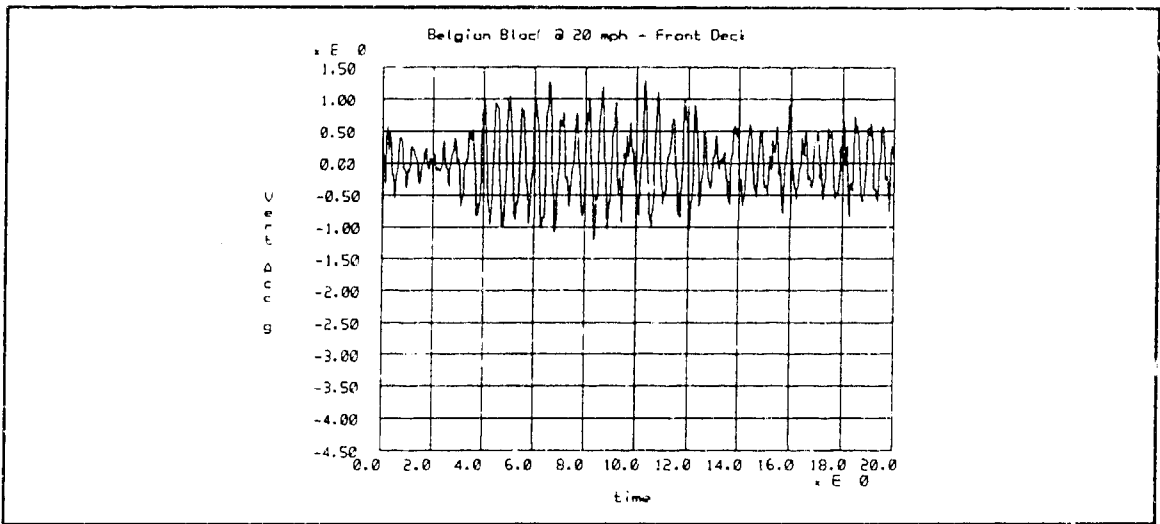


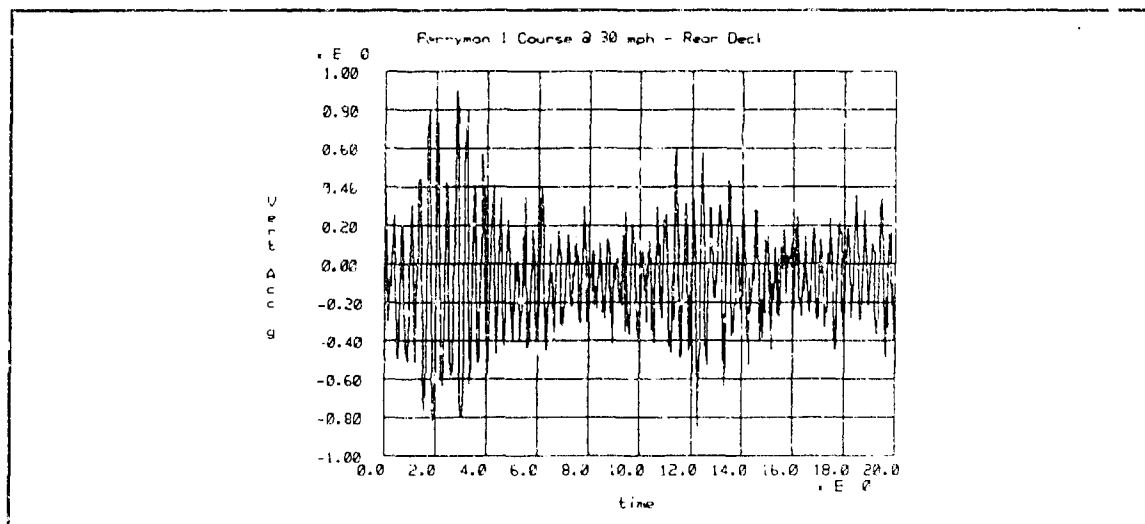
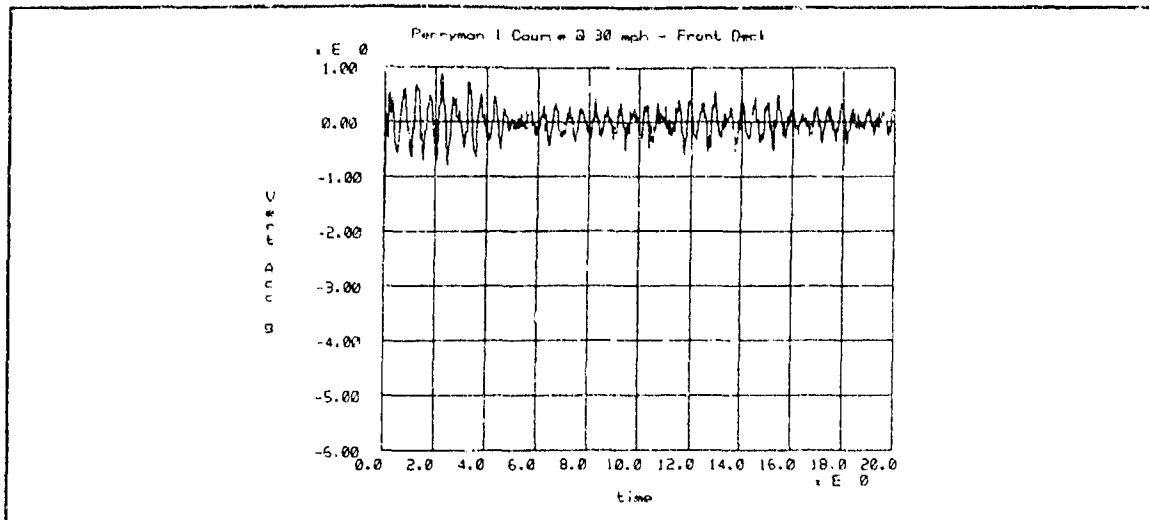














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