

**ACCIDENT DATA SIMULATION
AND
SIDE IMPACT-3D**

EDC Library Ref. No. 1013

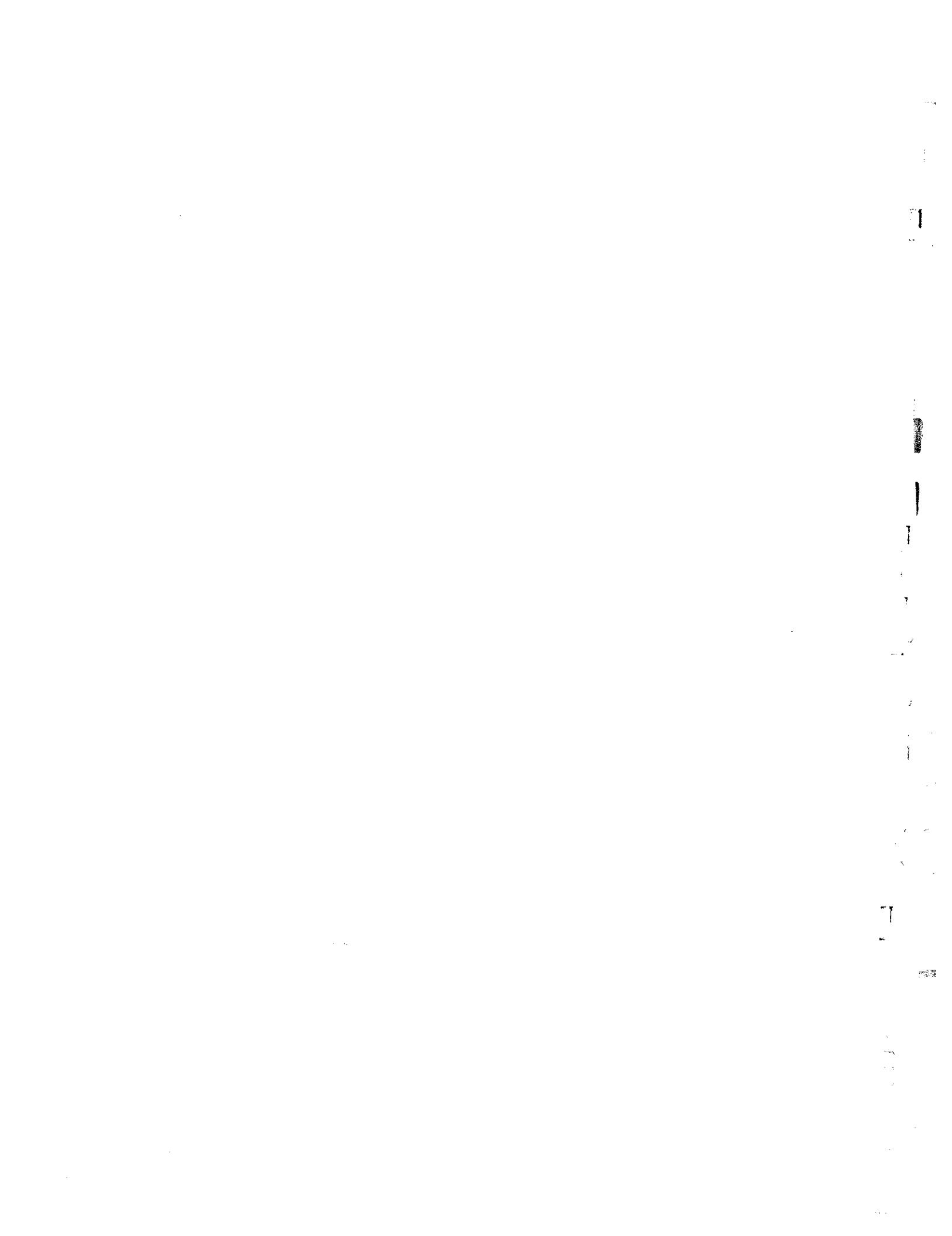
DISCLAIMER

These materials are available in the public sector and are not copyrighted. Engineering Dynamics Corporation copies and distributes these materials to provide a source of information to the accident investigation community. We make no claims as to the accuracy and assume no liability for the contents or use thereof.

Technical Report Documentation Page

HSRI

| | | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------------|-----------|
| 1. Report No. UM-HSRI-80-75 | 2. Government Accession No. | 3. Recipient's Catalog No. | |
| 4. Title and Subtitle Accident Data Simulation Pedestrian and Side Impact-3D | | 5. Report Date December 19, 1980 45630 | |
| 7. Author(s) Robbins, D.H., Becker, J.M., Bennett, R.O., and Bowman, B.M. | | 6. Performing Organization Code | |
| 9. Performing Organization Name and Address Highway Safety Research Institute The University of Michigan Ann Arbor, Michigan 48109 | | 8. Performing Organization Report No. UM-HSRI-80-75 | |
| 12. Sponsoring Agency Name and Address Motor Vehicle Manufacturers Association, Inc. 320 New Center Building Detroit, Michigan 48202 | | 10. Work Unit No. 361727 | |
| | | 11. Contract or Grant No. 1150 | |
| | | 13. Type of Report and Period Covered Final - July 1979 - June 1980 | |
| 15. Supplementary Notes | | 14. Sponsoring Agency Code | |
| 16. Abstract The objective of this study has been to provide practical baseline data sets to describe a vehicle occupant in side impacts and to describe a pedestrian in frontal impacts. A concurrent project at HSRI, sponsored by NHTSA, included addition of mutual deformation and other features to the Calspan Three Dimensional occupant dynamics model. The baseline data sets were prepared to work with this new software and to represent advanced production vehicle design geometry. | | | |
| This report describes the baseline vehicle geometry in Part 2. The occupant and pedestrian, along with their contact interactions with the vehicle, are described in Parts 3 and 4. The baseline data sets and a sampling of the resulting computer program output are given in Part 5. A summary of information about the HSRI version of the Calspan occupant dynamics program is given in Part 6. | | | |
| 17. Key Words Automotive Safety Design Crash Dynamics Occupant Dynamics, Pedestrian Protection Restraint System | 18. Distribution Statement | | |
| 19. Security Classif. (of this report) Unclassified | 20. Security Classif. (of this page) Unclassified | 21. No. of Pages 82 | 22. Price |



CONTENTS

| | <u>Page</u> |
|----------------------------------------------------------|-------------|
| 1.0 Introduction | 1 |
| 2.0 The Vehicles | 2 |
| 2.1 Baseline Interior for Side Impact | 2 |
| 2.2 Baseline Exterior for Pedestrian Impact | 5 |
| 3.0 The Occupant and Pedestrian Models | 8 |
| 3.1 Occupant for Side Impact Simulation | 8 |
| 3.2 Pedestrian for Impact Simulation | 8 |
| 4.0 Contact Interactions with the Vehicle | 16 |
| 4.1 Vehicle Interior Force-Deformation Characteristics | 16 |
| 4.1.1 Intrusion of Vehicle Components During Side Impact | 21 |
| 4.2 Vehicle Exterior Force-Deformation Characteristics | 21 |
| 5.0 The Computer Exercises | 24 |
| 5.1 Vehicle Decelerations and Motions | 24 |
| 5.2 Side Impact Input Data | 26 |
| 5.3 Pedestrian Impact Input Data | 46 |
| 5.4 Representative Side Impact Output | 64 |
| 5.5 Representative Pedestrian Impact Output | 68 |
| 6.0 The HSRI Version of the Calspan CVS | 77 |
| 6.1 Modifications to Original Calspan CVS Program | 77 |
| 6.2 Status of Software | 81 |
| 7.0 References | 82 |

LIST OF FIGURES

| | <u>Page</u> |
|------------------------------------------------------------|-------------|
| 1. Vehicle Interior for Side Impact (Front View) | 3 |
| 2. Vehicle Interior for Side Impact (Side View) | 4 |
| 3. Vehicle Exterior for Pedestrian Impact (Side View) | 6 |
| 4. Vehicle Exterior for Pedestrian Impact (Front View) | 7 |
| 5. Occupant for Side Impact Simulation (Side View) | 9 |
| 6. Occupant for Side Impact Simulation (Rear View) | 10 |
| 7. Side View of Pedestrian (Initial Position) | 12 |
| 8. Back View of Pedestrian (Initial Position) | 13 |
| 9. Schematic of Euler Knee Joint | 15 |
| 10. Panel Force-Deflection Curve | 19 |
| 11. Side Window Force-Deflection Curve | 20 |
| 12. Intrusion of Hip Panel Contact Surface | 22 |
| 13. Side Impact Vehicle Acceleration Curve | 25 |
| 14. Body Segment Accelerations. Side Impact | 65 |
| 15. Body Segment Motions. Side Impact | 66 |
| 16. Pedestrian Kinematics | 70-72 |
| 17. Right Upper Shin Accelerations. Pedestrian Impact. | 74 |
| 18. Right Lower Shin Accelerations. Pedestrian Impact. | 74 |
| 19. Right Upper Leg Accelerations. Pedestrian Impact. | 75 |
| 20. Lower Torso Accelerations. Pedestrian Impact. | 75 |
| 21. Upper Torso Accelerations. Pedestrian Impact. | 76 |
| 22. Head Accelerations. Pedestrian Impact. | 76 |
| 23. Bivariate Force-Deflection -- Deflection Rate Input. | 78 |
| 24. Corner Forces in British Leyland and MVMA 2-D Software | 80 |

LIST OF TABLES

| | <u>Page</u> |
|----------------------------------------------------------|-------------|
| 1. Occupant/Vehicle Interior Contacts | 17 |
| 2. Pedestrian/Vehicle Exterior Contacts | 18 |
| 3. Contents of Output of Input Table. Side Impact | 27 |
| 4. Output of Baseline Input Data Set. Side Impact. | 28 |
| 5. Listing of Baseline Side Impact Input Data File | 40 |
| 6. Contents of Output of Input Table. Pedestrian Impact. | 46 |
| 7. Output of Baseline Input Data Set. Pedestrian Impact. | 47 |
| 8. Listing of Baseline Pedestrian Impact Input Data File | 57 |
| 9. Changes to Baseline Pedestrian for Euler Joint Knee | 63 |
| 10. Side Impact Occupant/Vehicle Contact History | 67 |
| 11. Pedestrian/Vehicle Contact History | 73 |
| 12. CVS Code Changes | 81 |



1.0 INTRODUCTION

The objective of this study has been to provide practical baseline data sets to describe a vehicle occupant in side impacts and to describe a pedestrian in frontal impacts. During the past ten years a variety of projects have been conducted to study the interaction of pedestrians with motor vehicles. Somewhat more recently the emphasis has been on studying the interaction of a vehicle occupant with side door structures. Experimental studies have utilized both dummy and cadaver test subjects and a variety of vehicle types both experimental and production. Analytical studies have been conducted using both two- and three-dimensional dynamic occupant/pedestrian models.

A current project at HSRI, sponsored by NHTSA, includes addition of mutual deformation and other features to the Calspan Three Dimensional CVS model. The baseline data sets were prepared to work with this new software and to represent advanced production vehicle design geometry.

This report describes the baseline vehicle geometry in Part 2. The occupant and pedestrian along with their contact interactions with the vehicle are described in Parts 3 and 4. The baseline data sets and a sampling of the resulting computer program output are given in Part 5. A summary of information about the HSRI version of the Calspan CVS program is given in Part 6.

2.0 THE VEHICLES

In order to define the geometry of vehicle components with which an occupant might possibly interact during a side impact event or the front exterior components of a vehicle in the case of a pedestrian, it was necessary to obtain measurements from existing vehicles. Three vehicles were selected which are representative of the most modern domestic small car production.

For the front exterior of each vehicle, at least three points were measured with respect to a common inertial coordinate system to define the following surfaces approximately as planes:

- bumper
- grille
- hood
- windshield
- roof

For the vehicle interior the following surfaces were anticipated to be involved during lateral or 300° oblique impact:

- seat cushion
- seat back
- front door sill region (foot/lower leg contact)
- door panel lower region (hip and upper leg contact)
- door panel upper region (head contact)
- window panel (head contact)
- door header (head contact)
- floor (foot contact)
- B-pillar (head contact)

Other data were obtained which would make it possible to expand the simulation to cases of frontal impact.

2.1. BASELINE INTERIOR FOR SIDE IMPACT

Figures 1 and 2 illustrate the individual and average baseline panel locations which form the basis for construction of a side impact data set. These data are used in constructing the actual data sets described in Part 5 of this report.

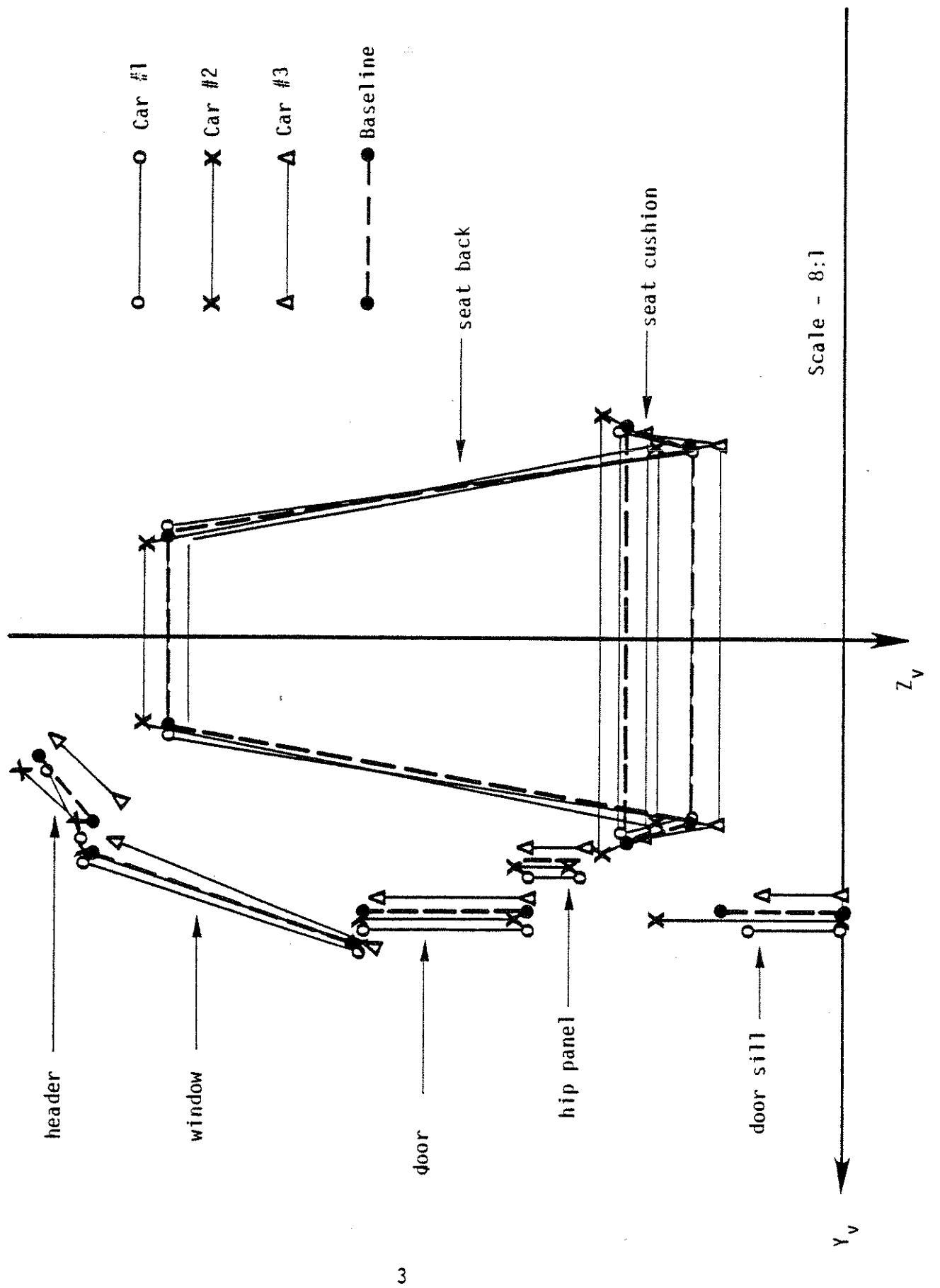


Figure 1. Vehicle interior for side impact (Front view)

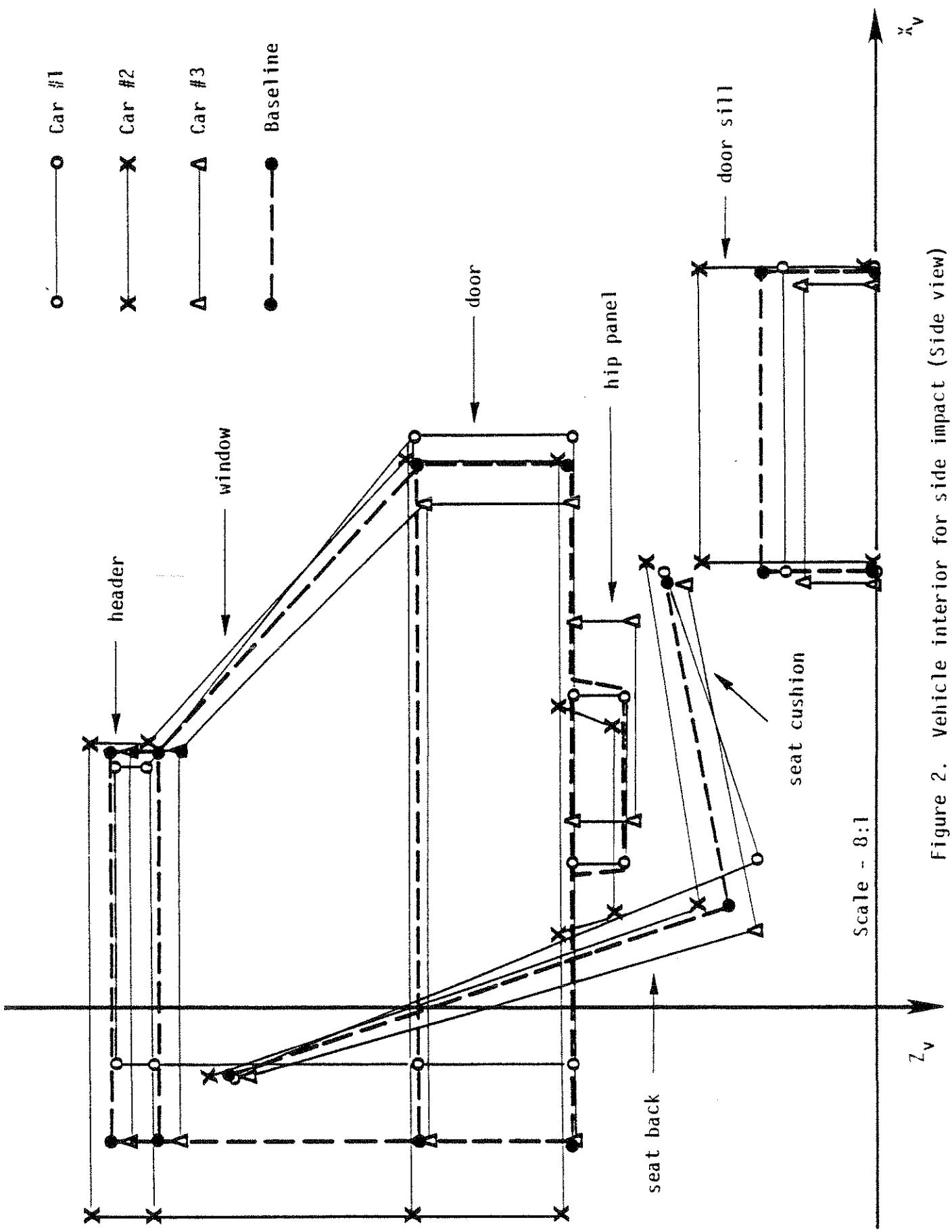


Figure 2. Vehicle interior for side impact (Side view)

2.2. BASELINE EXTERIOR FOR PEDESTRIAN IMPACT

Figures 3 and 4 illustrate the individual and average baseline panel locations which form the basis for a vehicle exterior intended for use in simulation of a pedestrian accident event. The baseline location has been used in constructing the actual data set described in Part 5 of this report. One surface which is not shown is the interface between the grille and hood. There was no clear definition for such a surface based on simple vehicle exterior measurements. Selection of a surface to represent this region was made to describe the stiff intersection between the grille and the hood.

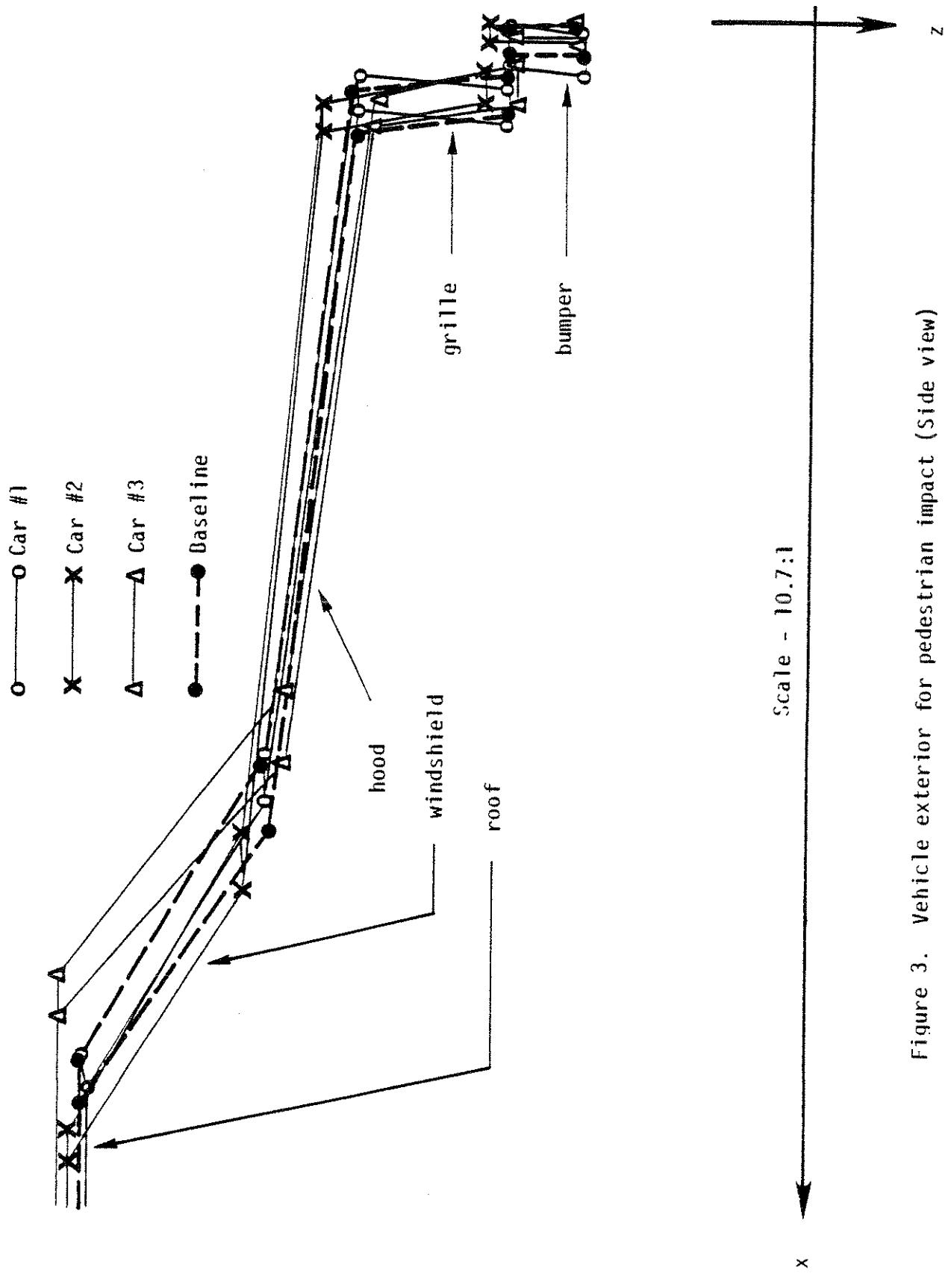


Figure 3. Vehicle exterior for pedestrian impact (Side view)

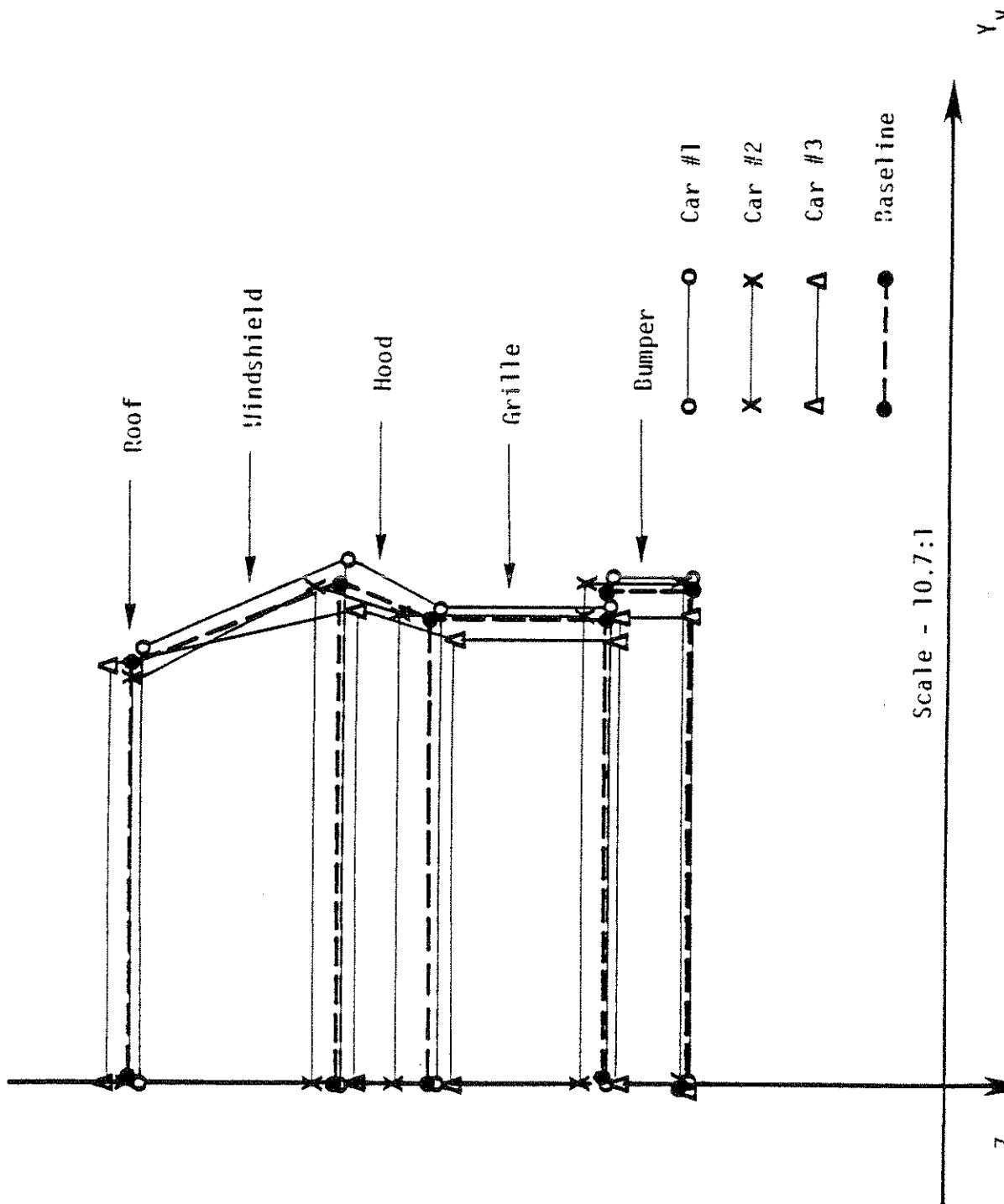


Figure 4. Vehicle exterior for pedestrian impact (Front view)

3.0 THE OCCUPANT AND PEDESTRIAN MODELS

A survey was conducted to identify sources for the most complete and recent data sets describing an occupant in a side impact simulation and a pedestrian. Surprisingly little information is publicly available beyond the original work done at Calspan (1).

With respect to the seated occupant, the primary data source was the sample data set provided with Calspan CVS Software, Version 18-A. This data set was used to verify model function in front impact before being modified slightly for the side impact case. The data on Part 572 developed for MVMA 2-D occupant modeling by Hubbard and McLeod (2) offered some promise but was restricted to two dimensions. Three-dimensional data, being developed at Calspan under an NHTSA contract, is not yet available.

For the pedestrian a Calspan data set modified by Karnes (3) was used as a starting point. These data were originally developed at General Motors and included a few changes from the standard seated occupant described in the preceding paragraph. Other than placing the subject in a standing position, hands were present and joint properties were changed. The reports from a major experimental and analytical study of pedestrian dynamics sponsored by NHTSA at Wayne State University were not yet available.

3.1 OCCUPANT FOR SIDE IMPACT SIMULATION

The occupant selected for the side impact simulation was essentially the same as that supplied with the sample data set included with Calspan CVS, Version 18-A. To position the occupant in the baseline seat required some minor vertical and horizontal adjustments in order to assure equilibrium. Figure 5 shows a side view of the occupant while Figure 6 shows a rear view. The numerical values for quantities such as segment mass, moments of inertia, position in space, ellipsoid axes, link angles, and joint properties are included in Part 5 which contains the complete listing of the output of the input data set.

3.2 PEDESTRIAN FOR IMPACT SIMULATION

The two pedestrian data sets which were developed on this project were derived largely from the data set reported by Karnes (3) of

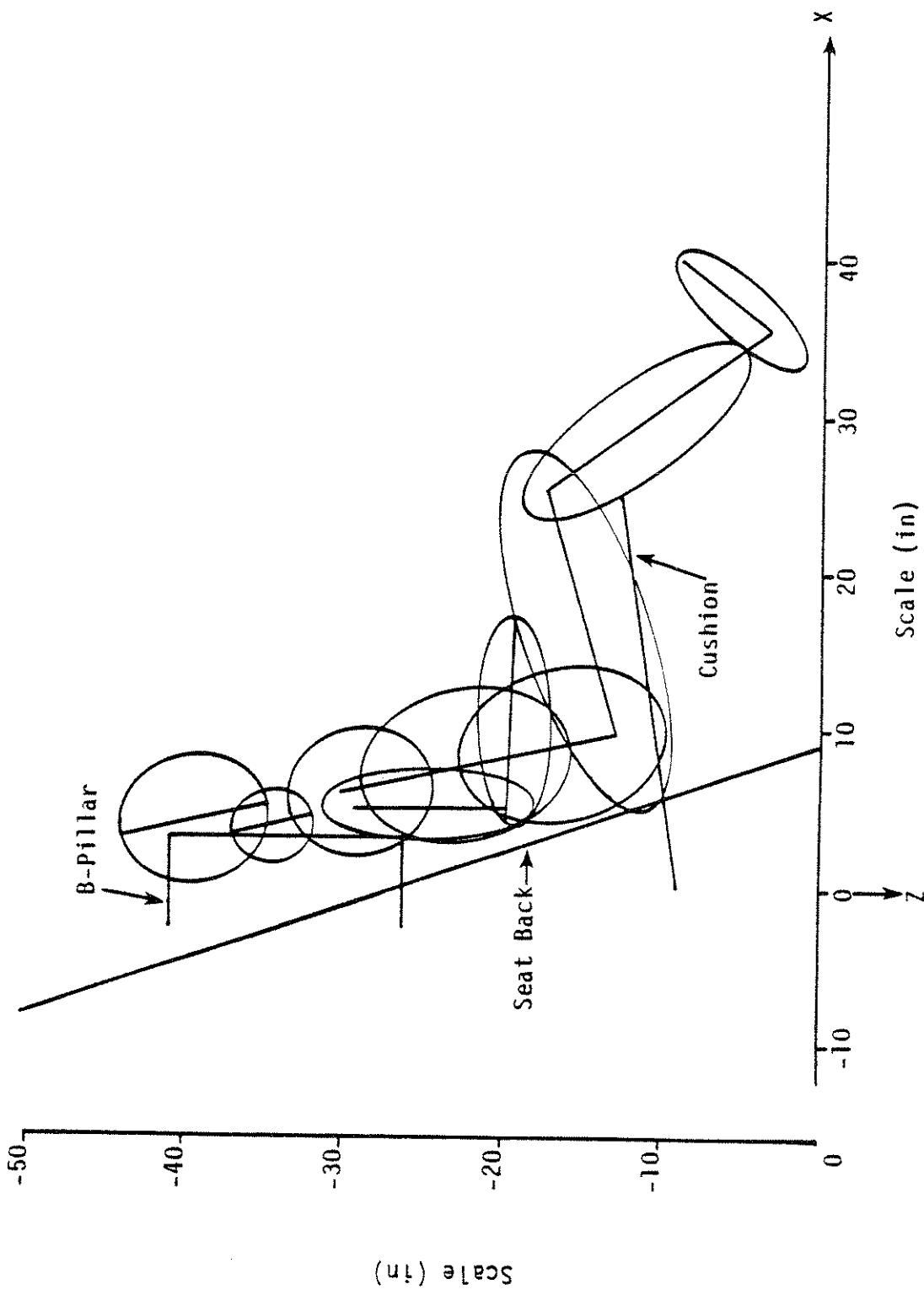


Fig. 5 Occupant for Side Impact Simulation (Side view)

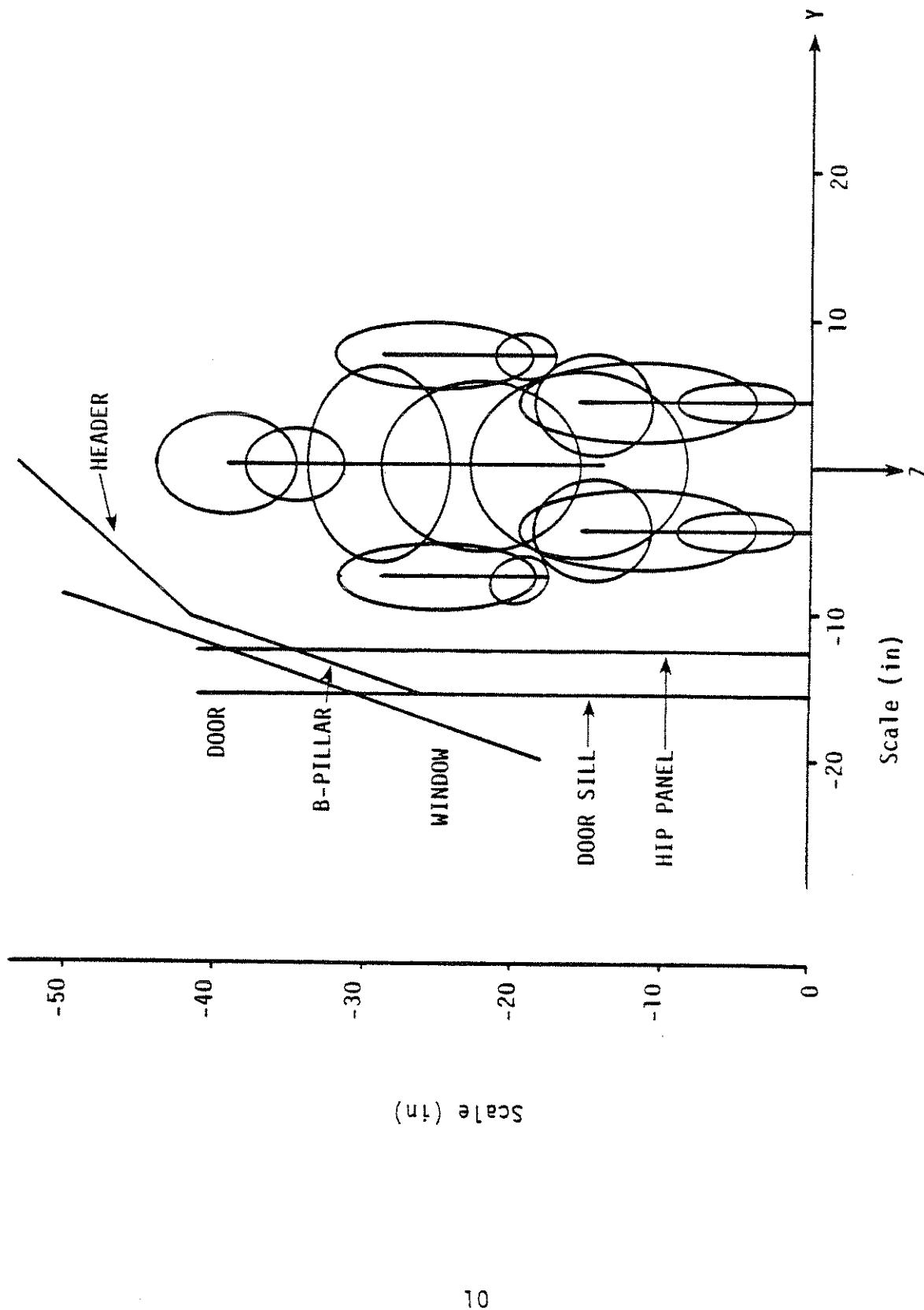


Fig. 6 Occupant for Side Impact Simulation (Rear View)

Boeing Computer Services. It describes the pedestrian as a modified Sierra 292-1050-2004 as has been used in the side impact case discussed in Section 3.1. The only difference is the addition of hands to the linkage. The masses and moments of inertia are identical, as are the joint locations, except for the hips and shoulders which are slightly different. The body ellipsoid semi-major axis lengths are similar but not identical. The joints are free of constraints. It is believed that this is due to the fact that a purpose of the simulation was to model the kinematics of a cadaver with no muscle tension to keep the body erect.

The major addition to the data set was the provision for fracturing of the lower leg and the knee. This was accomplished in two different ways, both of which included an extra joint within the shin (lower leg) mass.

The first case allowed a fracture to occur only in the shin. In order to do this the right lower leg has been partitioned into two segments by the addition of a new ball joint located 3.5 inches below the knee joint. This ball joint was initially locked with the capability of breaking free under a torque of 505.5 ft lb. This is based roughly on the work of Viano (4) and Kramer (5) who report femur and knee fracture loads of 4300 and 6000 N. If this load is applied at the center of a simply supported beam with a length of 18 inches, a torque of 505.5 ft lb is developed. This is used as a rough approximation of lower leg breaking load.

The masses and moments of inertia of the lower leg were then apportioned to the new upper and lower shin segments. A few minor modifications were made to some of the body ellipsoid axis lengths to eliminate unwanted interferences between body segment ellipsoids.

The initial standing posture of the pedestrian represents a person walking perpendicular to the path of the vehicle with 131.7 pounds of body weight supported by the right foot and 37.8 by the left. Figure 7 shows the left side of the pedestrian with the left front of the vehicle behind him. In Figure 8 the view is that of the back of the pedestrian with a front-to-rear section of the vehicle projected through

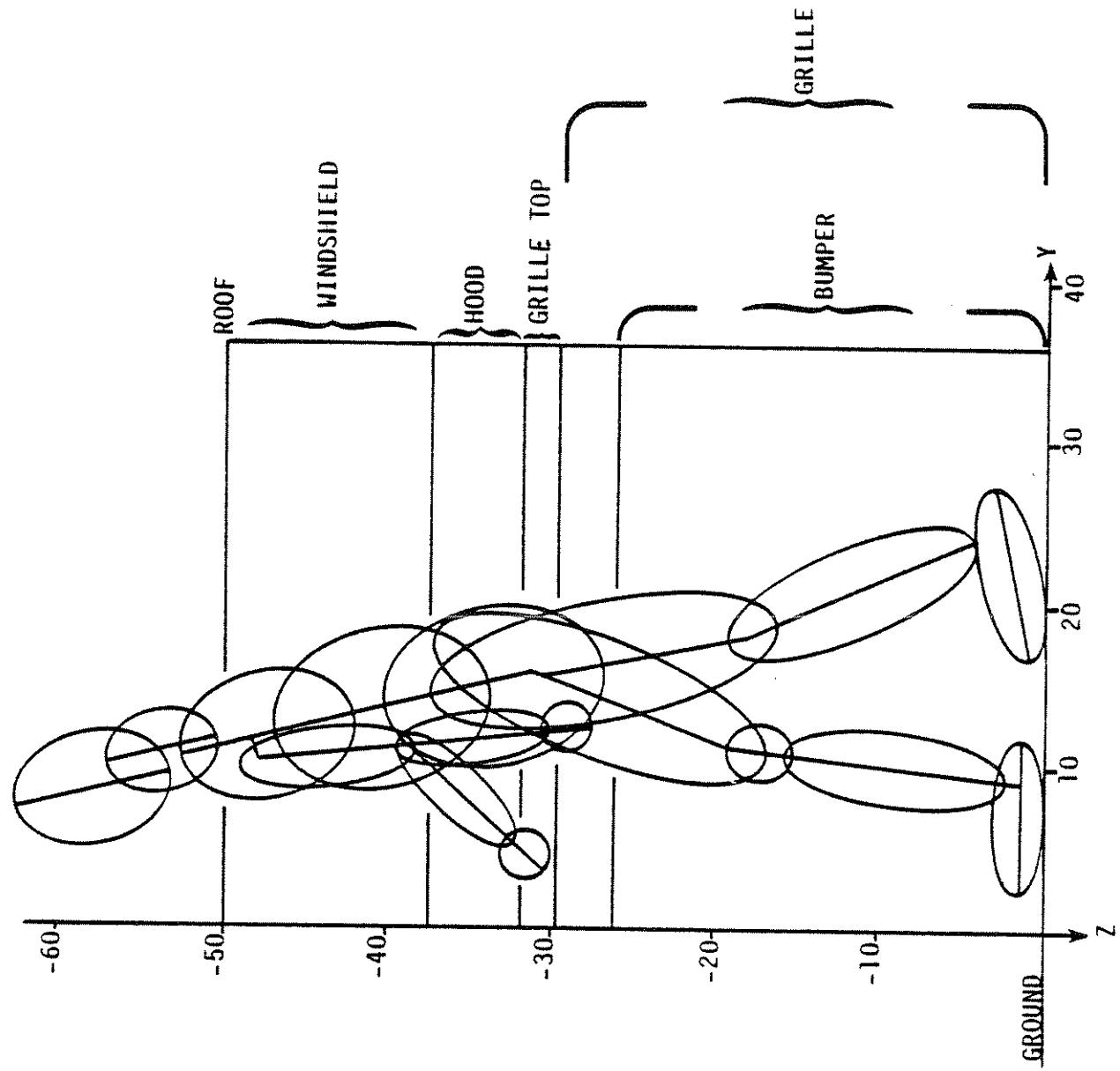


Fig. 7 Side View of Pedestrian (Initial Position).

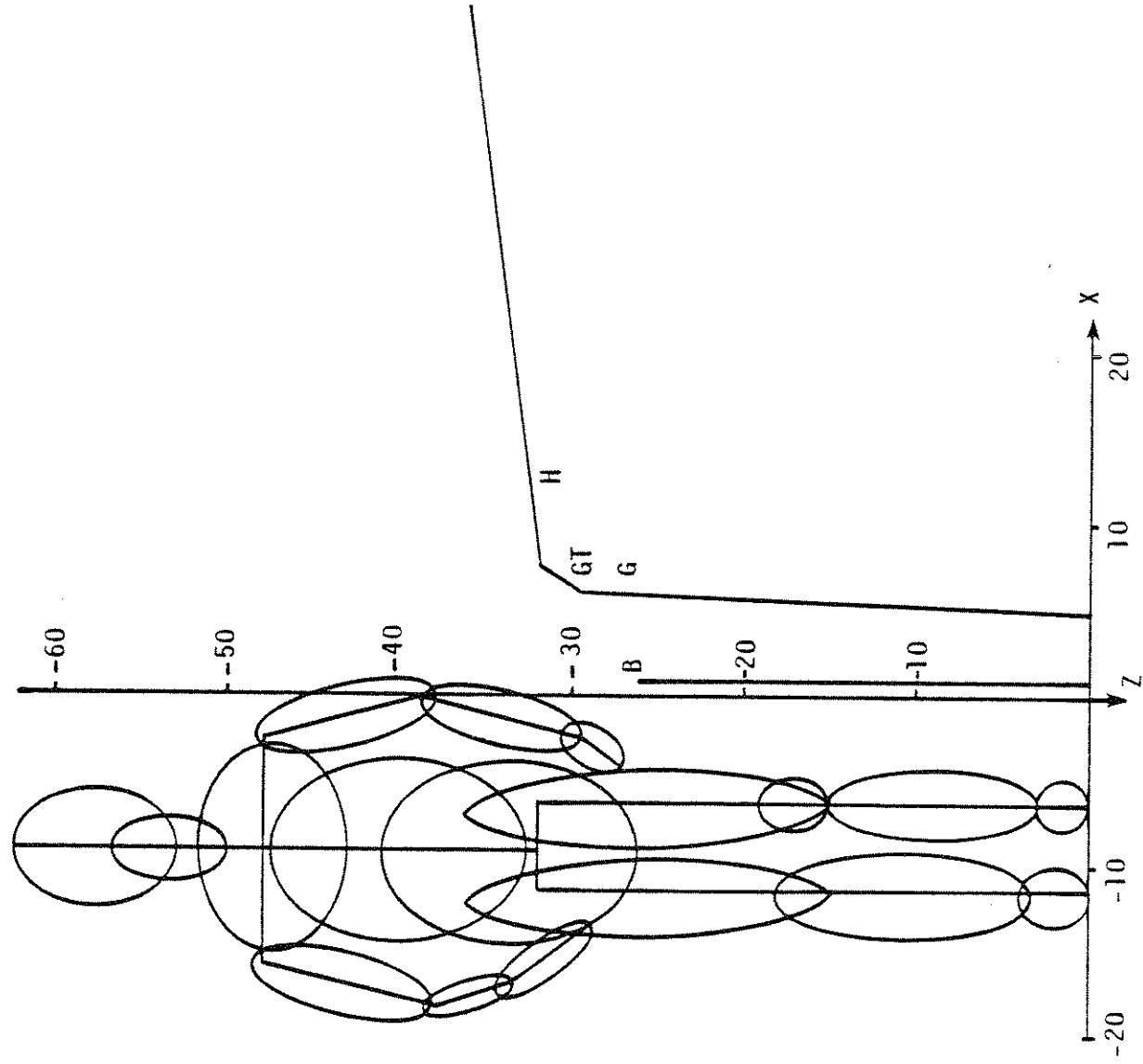
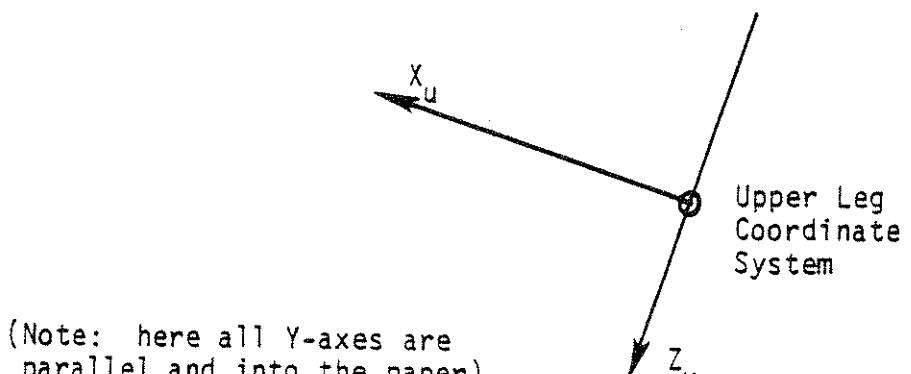


Fig. 8 Back View of Pedestrian (Initial Position)

the y-coordinate of the lower torso center of gravity. This section is on the left, or driver's, side of the vehicle.

The second case allows the fracture in the shin and also a fracture at the knee joint. This additional feature is accomplished by use of the Euler joint option (for which corrected code had been supplied by Calspan as a portion of CVS Version 19). Regular ball and socket joints have torques computed on the basis of two angles - flexure and torsion. The hinge joint uses only flexure. Figure 9 shows initial position of the pedestrian knee joint. This Euler joint has its torques computed on the basis of three angles - precession, nutation, and spin. Precession occurs about the Z-axis at the joint of the first segment. In this data set it is Z_u attached to the upper leg side of the joint. Spin occurs about the Z-axis at the joint of the second segment which in this case is Z_ℓ attached to the upper shin side of the joint. Nutation occurs about an axis perpendicular to these two joint Z-axes. For the case of the knee joint shown in Figure 9, nutation corresponds to flexure and there is no locking of this degree of freedom. Precession and spin, however, are "unnatural" motions at this joint. Therefore, they are initially locked with a breakaway torque of 505.5 ft. lb. This value could be improved with data on lateral fractures or dislocations at the knee. A study should be conducted to compare results, cost of operation, and ease of data preparation for the several modeling options for locking "joints" and modeling fracture.

As in the case of the side impact simulation, the numerical value for quantities such as segment mass, moments of inertia, position in space, ellipsoid axes, link angles, and joint properties are included in Part 5 which contains the complete listing of the output of the input data set.



(Note: here all Y-axes are parallel and into the paper)

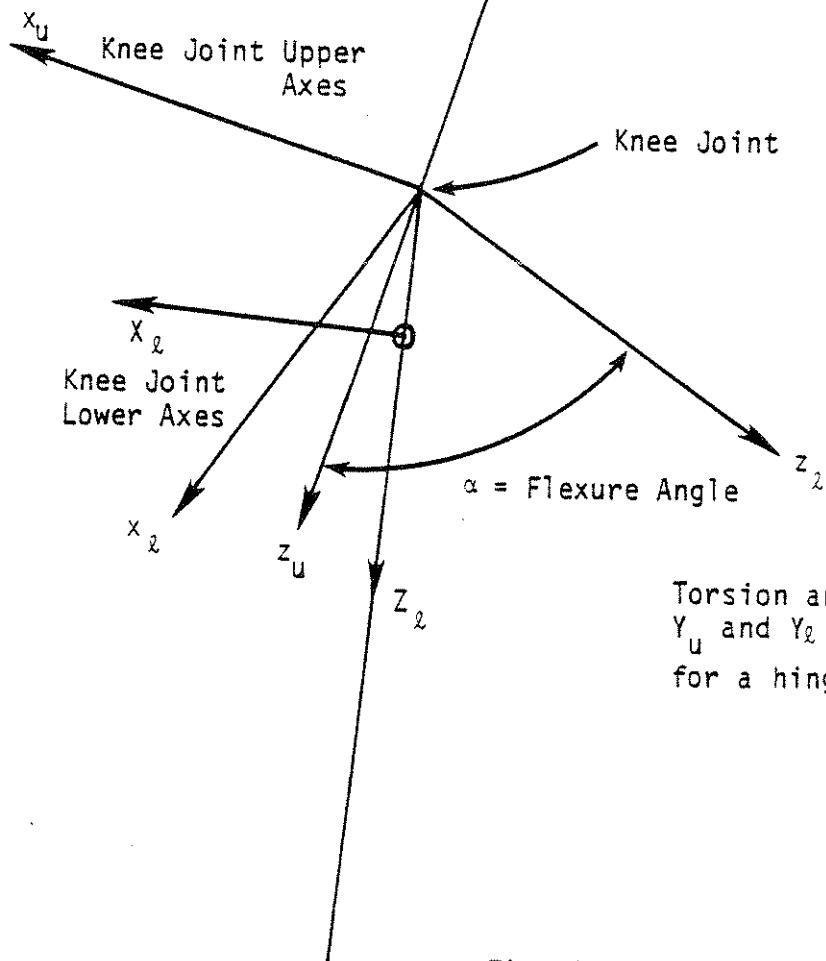


Fig. 9 Schematic of Euler Knee Joint

4.0 CONTACT INTERACTIONS WITH THE VEHICLE

A variety of contacts are allowed for both the occupant with the vehicle interior and the pedestrian with the vehicle exterior. Occupant or pedestrian ellipsoids may contact either flat panels attached to the vehicle or other of the ellipsoids on the subject. Table 1 shows the potential contacts which are allowed for the side impact occupant while Table 2 refers to the pedestrian.

The force-deflection characteristic curves governing interactions between the occupant or pedestrian and the vehicle have been derived from a variety of sources. Some are based on idealized vehicle component tests. Others are hypothetical estimates chosen to fill voids in our compilation of published, realistic vehicle descriptive data. All are intended to be treated as baseline data which should be replaced when measured data are available for use in actual engineering studies.

4.1 VEHICLE INTERIOR FORCE - DEFORMATION CHARACTERISTICS

Five different force-deflection characteristic curves are used to define the properties of the contact surfaces used to define the vehicle interior for side impact. Figure 10 illustrates the curve for a structure entitled, "panel." Tabular implementation of these data define the deformation of the header, front door sill, hip panel region, and B-pillar. The door panel shoulder region contact surface is modeled as a fifth order polynomial fit to the table. The symbol "x" on Figure 10 shows the closeness of fit of this polynomial. The polynomial form is used for this contact surface to allow mutual deformation of the vehicle and occupant thorax. These data are derived from dynamic deformation tests of door interiors and represent a somewhat stiffer structure than that used in recent side impact simulations by Padgaonkar and Prasad (6). Because of a lack of experimental information on the header, front door sill, and B-pillar, the data shown in Figure 10 have also been selected as hypothetical estimates for these surfaces.

Figure 11 shows the representative force-deflection curve for side window tempered glass which has been selected for inclusion in the data.

TABLE 1. OCCUPANT/VEHICLE INTERIOR CONTACTS

| <u>Ellipsoid Name</u> | <u>Contact Panel on Ellipsoid Name</u> |
|-----------------------|----------------------------------------|
| Lower torso | Seat back |
| Lower torso | Seat cushion |
| Lower torso | Hip panel |
| Lower torso | Right lower arm |
| Center torso | Seat back |
| Upper torso | Seat back |
| Upper torso | Door |
| Head | Header |
| Head | Window |
| Head | B-pillar |
| Right upper leg | Seat Cushion |
| Right upper leg | Left upper leg |
| Right lower leg | Left lower leg |
| Right foot | Floor |
| Right foot | Left foot |
| Left upper leg | Seat cushion |
| Left upper leg | Hip panel |
| Left lower leg | Door sill |
| Left foot | Floor |
| Left foot | Door sill |
| Left upper arm | B-pillar |

TABLE 2. PEDESTRIAN/VEHICLE EXTERIOR CONTACTS

| Ellipsoid Name | Contact Panel on Ellipsoid Name |
|-----------------|---------------------------------|
| Lower torso | Windshield |
| Lower torso | Hood |
| Lower torso | Grille Top |
| Upper torso | Roof |
| Upper torso | Windshield |
| Upper torso | Hood |
| Head | Roof |
| Head | Windshield |
| Head | Hood |
| Right upper leg | Hood |
| Right upper leg | Grille |
| Right upper leg | Grille Top |
| Right upper leg | Left upper leg |
| Right calf | Bumper |
| Right shin | Bumper |
| Right foot | Ground |
| Left upper leg | Hood |
| Left upper leg | Grille |
| Left upper leg | Grille Top |
| Left lower leg | Bumper |
| Left foot | Ground |
| Right upper arm | Hood |
| Right lower arm | Hood |
| Left upper arm | Hood |
| Left lower arm | Hood |

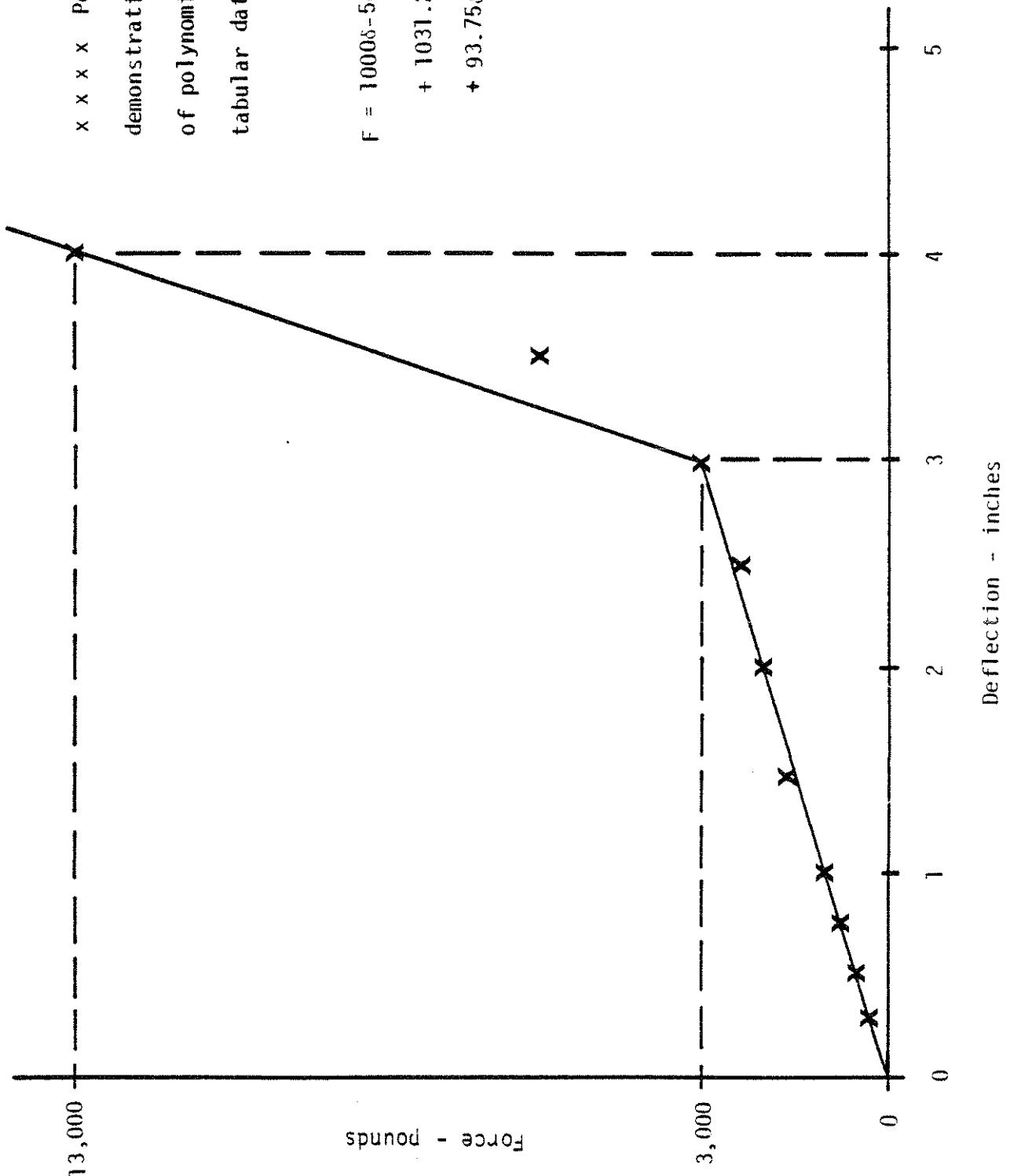


Figure 10. Panel force-deflection curve.

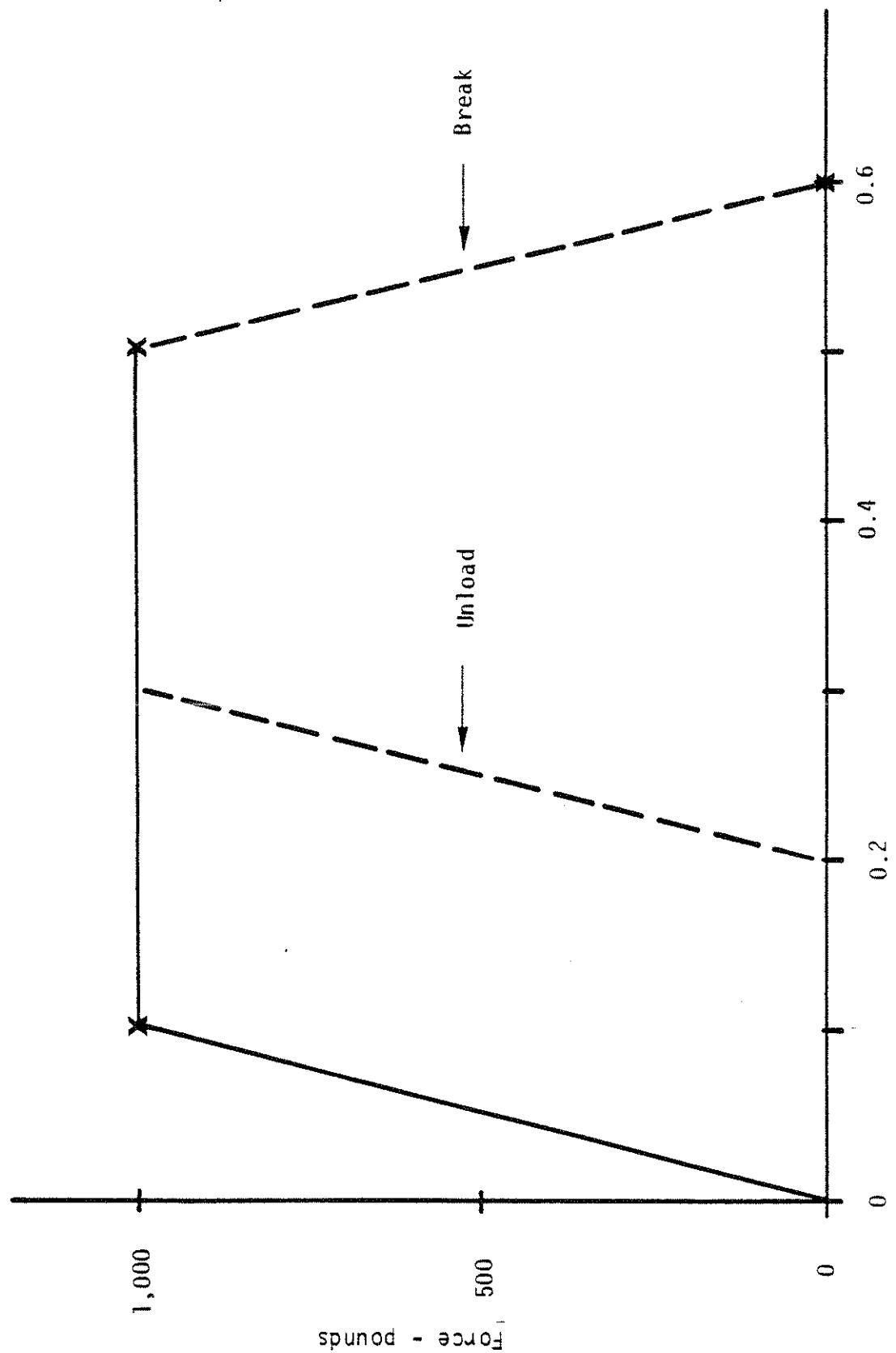


Figure 11. Side window force-deflection curve

This is an idealization of data presented at the 11th Stapp Car Crash Conference by Siemonsen and Bruckner (7). It should be noted that tempered glass holds substantial force for a larger deformation than annealed or laminated glass due to its larger bending stiffness. It is presumed that the glass panel breaks upon reaching a deflection of 0.5 inch and behaves elastically until that deformation is reached.

The floor, seat back, and seat cushion are modeled as linear polynomials in force and deformation. The following coefficients were supplied with the original frontal impact data set by Calspan Corporation:

1. Seat back and seat cushion - 40 lb/in.
2. Floor - 860 lb/in.

4.1.1 Intrusion of Vehicle Components during Side Impact

Figure 12 shows the intrusion of the hip and door contact surfaces during the baseline side impact accident event. The overall motions of the vehicle take place in the coordinate system indicated in the figure. However, in the case of intrusion, the various components of the vehicle move and deform with respect to the vehicle. To represent this physically observed phenomena and to provide a realistic, but hypothetical, example for the baseline exercise, the arm rest and door are seen to begin intrusion at 5 ms and continue moving inward until 30 ms when they stop with respect to the remainder of the vehicle. Total intrusion is 5 inches. The software is capable of linear motion, as is the case used in this example, and also of panel rotation.

4.2 VEHICLE EXTERIOR FORCE-DEFORMATION CHARACTERISTICS

Three different force-deflection characteristic curves are used to define the properties of the seven contact surfaces which define the vehicle exterior and ground for pedestrian impact. All these curves are linear polynomials in deformation. The roof, windshield, hood, grille, and bumper have a coefficient of 1000 lb/in. The ground coefficient is 470 lb/in. The grille top surface was to be twice the average of the hood and grille, which is 2000 lb/in. The body ellipsoids are all as-

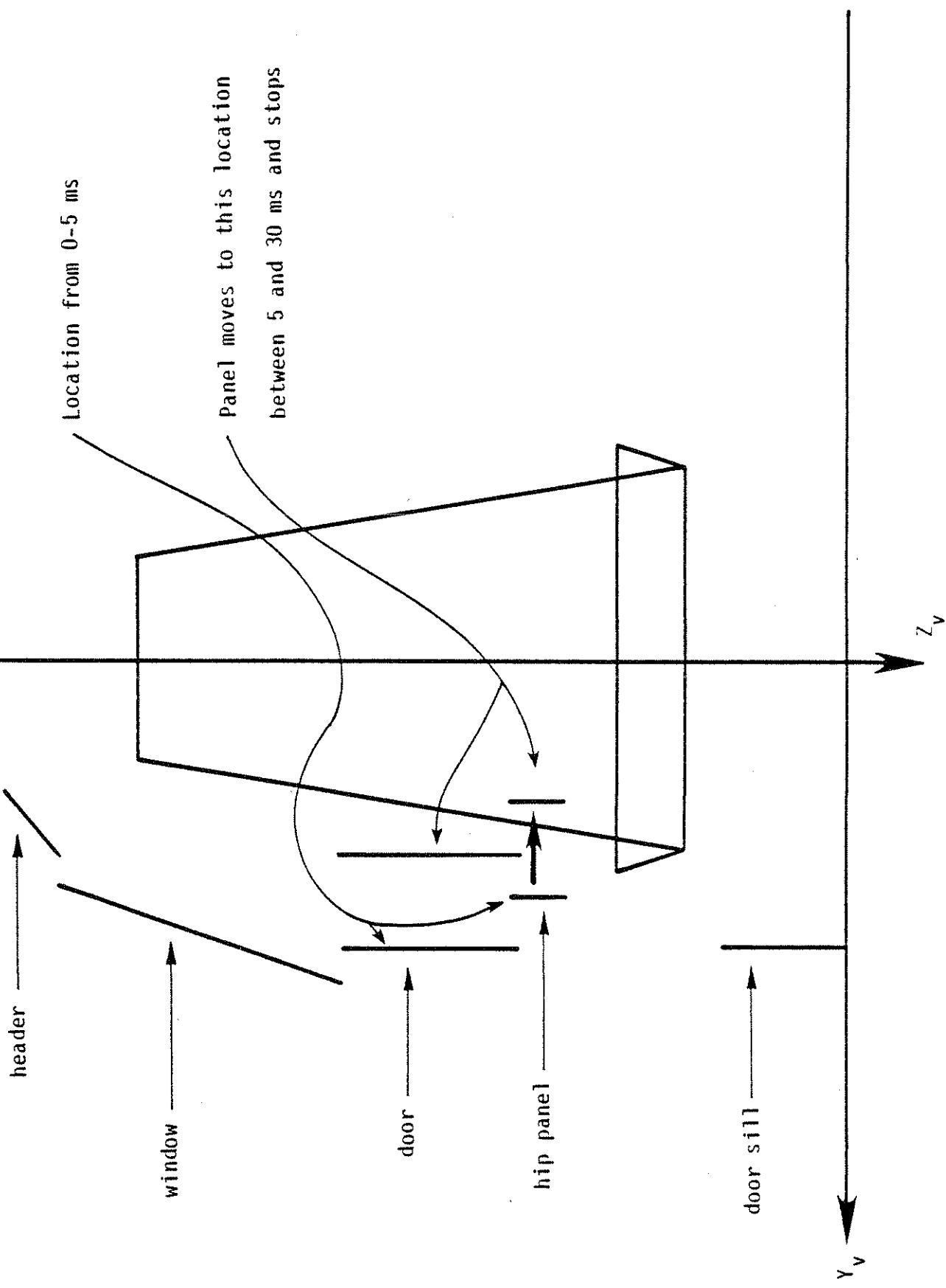


Figure 12. Intrusion of baseline hip panel and door contact surfaces during simulation.

sumed to be rigid. Any contact with the ground will also develop a tangential force to simulate sliding friction, the coefficient for which is 1.0.

These data are incomplete and represent only hypothetical estimates for the properties of a vehicle exterior. The data included in the Boeing Computer Services report by Karnes (3) are somewhat more complete but their sources are unknown. Particular problems exist with specifying both the stiffness and the energy absorbed in the various surfaces. Data from the Wayne State University project mentioned earlier are not available and the "Pedestrian Model Parametric Study" reports by Twigg and Tocher (8) contain values which may be unreasonably soft for current and advanced generation vehicles. It is recommended that the force-deformation data contained in this baseline be regarded as preliminary and that further work should be done to improve their quality.

5.0 THE COMPUTER EXERCISES

The purpose of this part of the report is to present the numerical details of the two baseline data sets and give summary details of the resulting computer exercises. For a complete copy of the simulation output it is necessary to exercise the data set or obtain a copy of the tape containing the exercise from MVMA or HSRI.

5.1 VEHICLE DECELERATIONS AND MOTIONS

The dynamics of the side impact simulation are initiated by forcing an acceleration of the occupant compartment. This causes the vehicle (and its contact surfaces) to begin to move with respect to inertial coordinates. Superimposed upon this movement is the prescribed intrusion of the side door hip contact panel with respect to the vehicle coordinate system. The occupant, initially at rest with respect to both inertial and vehicle coordinate systems, is carried along by the vehicle motions through impacts with the vehicle interior contact surfaces. The lateral acceleration profile applied to the vehicle is shown graphically in Figure 13.

The pedestrian impact is initiated by prescribing motions for the vehicle contact surfaces which are given an initial velocity of 10 mph and maintain this non-stop velocity throughout the simulation. The "vehicle coordinate system" remains motionless and coincident with the inertial coordinate system throughout the simulation. In other words, simulation of vehicle motions is accomplished by moving the vehicle contact surfaces as a unit with respect to the motionless "vehicle coordinate system." It should be noted that no motion was prescribed for the contact surface representing the ground. The reason for this unconventional approach to vehicle motion was to assure that the program output of pedestrian motions would be relative to inertial rather than vehicle coordinates, an option which was not available with the Calspan CVS at the time work started on the baseline simulations.

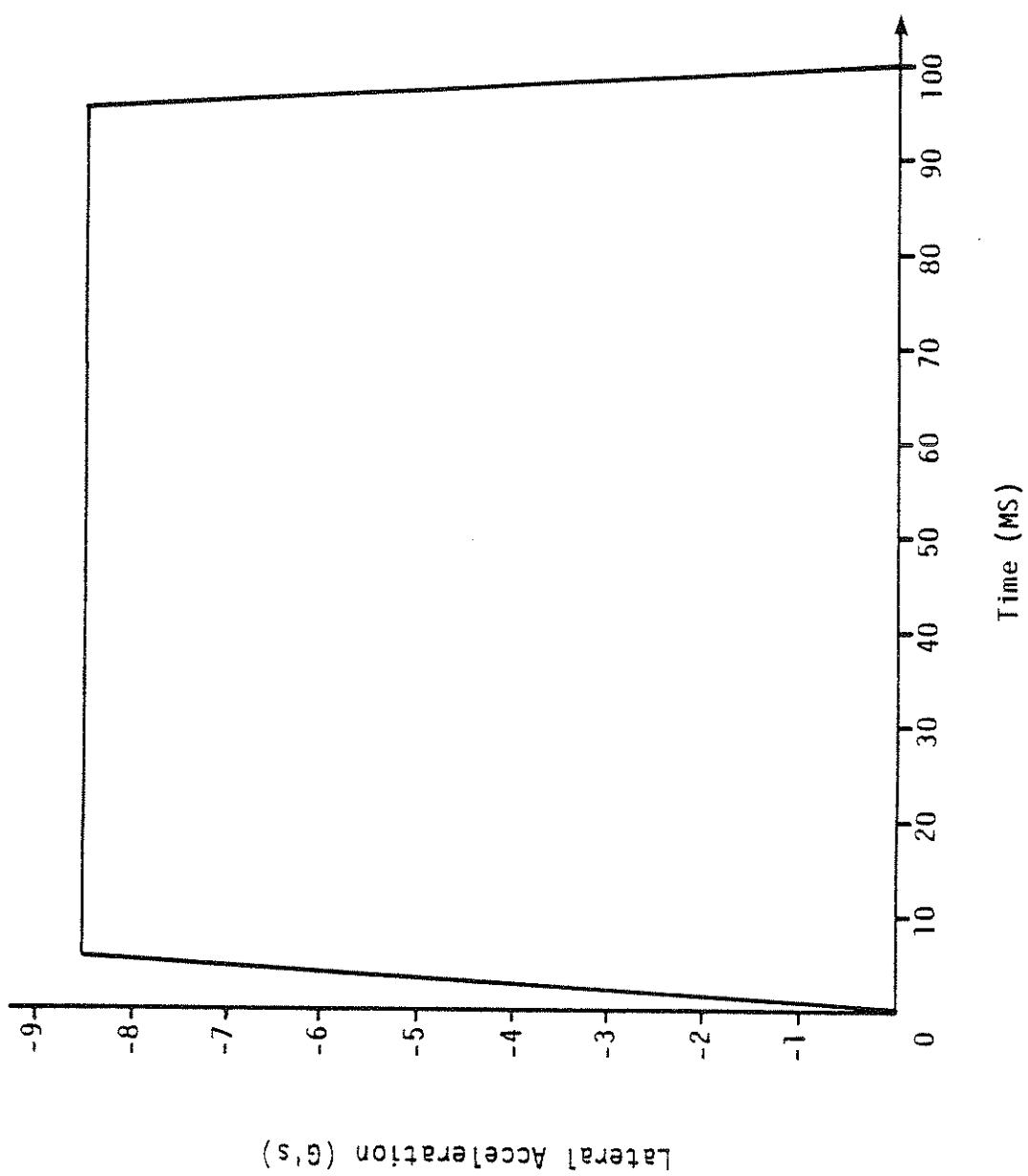


Fig. 13 Side Impact Vehicle Acceleration Curve.

5.2 SIDE IMPACT INPUT DATA

This part of the report contains the numerical details of the baseline side impact data set. Table 4 contains the computer-generated output of the input data set. Table 3 is a summary of the contents of this table to enable the reader to quickly find data quantities of interest. Table 5 is a copy of the baseline data file which was constructed for the exercise.

TABLE 3. CONTENTS OF OUTPUT OF INPUT TABLE (SIDE IMPACT)

| Page in Table 4 | Data Card I.D. | Input Quantities |
|-----------------|-----------------|--------------------------------------------------------------|
| 1 | A | Controls |
| 2 | B.2,B.3 | Occupant mass and inertial properties. Joint definitions. |
| 3 | B.4,B.5 | Joint torque characteristics. |
| 4 | B.6 | Segment integration convergence test input. |
| 5 | C | Vehicle linear time histories. |
| 6 | C | Vehicle angular time histories. |
| 7 | D.2 | Location of contact planes. |
| 8 | D.5 | Ellipsoid semiaxes and orientation |
| 8 | D.7 | Symmetry input |
| 8 | D.9.A | Material normal force specifications. |
| 9,10 | E.5.A-E.5.C. | Bivariate polynomial specifications for force generation |
| 10 | E.5.D-E.5.F,E.6 | Bivariate table specifications for force generation |
| 11 | F.1 | Allowed contacts |
| 12 | G.1,G.2,G.3 | Initial Positions |

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 1 of 12)

CRASII VICIALIS SICURA 222-1650-2004 15 SEGMENTIS 14 JOVIS

INDEX 13

| JOINT | | SYN | PLC# | JNT | PIN | LUMAT LUMAT | IN., J | SEG(JNT) | IN., J | SEG(JNT) | PRIN. AXIST(DEC) | SEC(JNT) | PITCH | PITCH | PITCH | PITCH | CARDS N.3 |
|-------|-----|-----|------|-----|-------|-------------|--------|----------|--------|----------|------------------|----------|-------|-------|-------|--------|-----------|
| J | SYN | | | X | Y | Z | X | Z | Y | Z | X | Y | X | Y | Z | Y | ROLL |
| 1 | P | P | 1 | -2 | -1.60 | 0.0 | -2.50 | -1.50 | 0.0 | 2.50 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 2 | W | 0 | 2 | -2 | -1.50 | 0.0 | -2.30 | -1.50 | 0.0 | 6.80 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 3 | RP | N | 3 | -2 | -0.50 | 0.0 | -2.20 | 0.0 | 0.0 | 3.80 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 4 | RP | P | 4 | -2 | 0.0 | 0.0 | -1.20 | -1.10 | 0.0 | 3.30 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 5 | RH | Q | 1 | 0 | 2.40 | 4.45 | 2.50 | 0.0 | 0.0 | -7.31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -66.50 | |
| 6 | RK | R | 6 | 1 | 0.0 | 0.0 | 6.79 | 0.0 | 0.0 | -7.48 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.72 | |
| 7 | RK | S | 7 | -2 | 0.0 | 0.0 | 8.69 | 1.64 | 0.0 | -1.28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 56.80 | |
| 8 | LH | T | 1 | 0 | 2.10 | -4.45 | 2.50 | 0.0 | 0.0 | -7.31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -81.90 | |
| 9 | LK | U | 9 | 1 | 0.0 | 0.0 | 6.79 | 0.0 | 0.0 | -7.48 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -66.50 | |
| 10 | LA | V | 10 | -2 | 0.0 | 0.0 | 8.69 | 1.54 | 0.0 | -1.28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 11 | KS | W | 3 | -2 | -0.80 | 7.60 | -1.60 | 0.0 | 0.0 | -5.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -81.90 | |
| 12 | RE | X | 12 | -1 | 0.0 | 0.0 | 5.45 | 0.0 | 0.0 | -6.58 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -57.50 | |
| 13 | LS | Y | 3 | -2 | -0.30 | -7.60 | -1.60 | 0.0 | 0.0 | -5.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -64.30 | |
| 14 | LE | Z | 14 | -1 | 0.0 | 0.0 | 5.45 | 0.0 | 0.0 | -6.58 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -57.50 | |

JOINT TORQUE CHARACTERISTICS

FLEXURAL SPRING CHARACTERISTICS

TORSIONAL SPRING CHARACTERISTICS

| JOINT | SPRING COEF. (IN. LB./DEG.) | | | ENERGY DISSIPATION | | | JOINT STOP (DEG.) | | | SPRING COEF. (IN. LB./DEG.*J) | | | ENERGY DISSIPATION | | | JOINT STOP (DEG.) | | |
|-------|------------------------------|-------------|-------------|--------------------|-----------------|-------------|-------------------|-----------------|-------------|---------------------------------|-----------------|-------------|--------------------|-----------------|-------------|-------------------|-----------------|-------------|
| | LINEAR (J=1) | CUBIC (J=2) | CUBIC (J=3) | LINEAR (J=1) | QUADRATIC (J=2) | CUBIC (J=3) | LINEAR (J=1) | QUADRATIC (J=2) | CUBIC (J=3) | LINEAR (J=1) | QUADRATIC (J=2) | CUBIC (J=3) | LINEAR (J=1) | QUADRATIC (J=2) | CUBIC (J=3) | LINEAR (J=1) | QUADRATIC (J=2) | CUBIC (J=3) |
| 1 P | 20.9446 | 60.9230 | 0.0 | 1.00 | 5.000 | 3.433.830 | 60.9230 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 5.000 | 1.00 | 1.00 | |
| 2 W | 20.944 | 60.923 | 0.0 | 1.00 | 35.000 | 34.383 | 60.923 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 35.000 | 1.00 | 1.00 | |
| 3 RP | 17.174 | 60.923 | 0.0 | 1.00 | 25.000 | 8.011 | 60.923 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 35.000 | 1.00 | 1.00 | |
| 4 IP | 21.293 | 60.923 | 0.0 | 1.00 | 25.000 | 0.011 | 60.923 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 35.000 | 1.00 | 1.00 | |
| 5 RH | 0.0 | 60.9230 | 0.0 | 1.00 | 85.500 | 0.0 | 60.9230 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 55.500 | 1.00 | 1.00 | |
| 6 RK | 0.0 | 16.754 | 0.0 | 1.00 | 50.300 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 7 RA | 0.0 | 62.7510 | 0.0 | 1.00 | 37.000 | 0.0 | 94.431 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 20.700 | 1.00 | 1.00 | |
| 8 LH | 0.0 | 60.9230 | 0.0 | 1.00 | 85.500 | 0.0 | 60.9230 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 55.500 | 1.00 | 1.00 | |
| 9 LK | 0.0 | 16.754 | 0.0 | 1.00 | 50.300 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 10 LA | 0.0 | 62.7510 | 0.0 | 1.00 | 37.000 | 0.0 | 94.431 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 20.700 | 1.00 | 1.00 | |
| 11 RS | 0.0 | 60.9230 | 0.0 | 1.00 | 122.500 | 0.0 | 60.9230 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 180.000 | 1.00 | 1.00 | |
| 12 RE | 0.0 | 11.697 | 0.0 | 1.00 | 65.300 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 13 LS | 0.0 | 60.9230 | 0.0 | 1.00 | 122.500 | 0.0 | 60.9230 | 0.0 | 1.00 | 1.00 | 1.00 | 0.0 | 1.00 | 1.00 | 180.000 | 1.00 | 1.00 | |
| 14 LT | 0.0 | 11.697 | 0.0 | 1.00 | 65.300 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |

| JOINT | JOINT VISCOSUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS | | | JOINT VISCOSUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS | | | JOINT VISCOSUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS | | | JOINT VISCOSUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS | | | JOINT VISCOSUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS | | | IMPULSE RESTITUTION COEFFICIENT |
|-------|-----------------------------------------------------------|------------------------------|-------------------------------|-----------------------------------------------------------|------------------|--------------------------------------------|-----------------------------------------------------------|------------------|-----------------------------------------------|-----------------------------------------------------------|------------------|-----------------------------------------------|-----------------------------------------------------------|------------------|-----------------------------------------------|---------------------------------|
| | COEFFICIENT (IN. LB. SEC./DEG) | FRICITION COEFF. (IN. LB.) | ANGULAR VELOCITY (DEG/SEC.) | MAX. FRICTION | ANGULAR VELOCITY | MIN. TORQUE FOR A LOCKED JOINT (IN. LB.) | MAX. FRICTION | ANGULAR VELOCITY | MIN. TORQUE FOR AN UNLOCKED JOINT (IN. LB.) | MAX. FRICTION | ANGULAR VELOCITY | MIN. TORQUE FOR AN UNLOCKED JOINT (IN. LB.) | MAX. FRICTION | ANGULAR VELOCITY | MIN. TORQUE FOR AN UNLOCKED JOINT (IN. LB.) | IMPULSE RESTITUTION COEFFICIENT |
| 1 P | 104.720 | 60.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 W | 10.472 | 60.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 RP | 1.745 | 10.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 IP | 1.745 | 10.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 RH | 3.997 | 229.000 | 229.000 | 60.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 RK | 3.456 | 194.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 RA | 6.436 | 225.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 LH | 3.997 | 229.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 LK | 3.456 | 198.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 LA | 6.436 | 225.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 RS | 3.229 | 185.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 RE | 1.292 | 74.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 LS | 3.229 | 135.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 14 LT | 1.292 | 74.000 | 60.000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 3 of 12)

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 4 of 12)

CAPOS B.6

SEGMENTATION CURVATURE INPUT

| SEGMENT NO. | SYN | ANGULAR VELOCITIES | | | | LINEAR VELOCITIES | | | | ANGULAR ACCELERATIONS | | | | LINEAR ACCELERATIONS | | | |
|-------------|-----|--------------------|------|------------|------|-------------------|------|---------------|------|-----------------------|------|--------|------|----------------------|------|------|------|
| | | (RAD/SEC.) | | (IN./SEC.) | | (RAD/SEC.**2) | | (IN./SEC.**2) | | MAG. | | MAG. | | MAG. | | MAG. | |
| | | MAG. | TEST | ABS. | TEST | MAG. | TEST | ABS. | TEST | MAG. | TEST | ABS. | TEST | MAG. | TEST | ABS. | TEST |
| 1 | L1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | C1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | DT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4 | R1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | H | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | RUL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | RLL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | RF | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | LUL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | LLL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | L1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 | RUA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 13 | RLA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 14 | LUA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15 | LIA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.01 | 0.0100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

VEHICLE DECLERATION INPUTS

DIRECT LATERAL IMPACT FROM RE54

| TIME (sec.) | LINEAR VELOCITY (IN./SEC.) | | | LINEAR ACCELERATIONS (IN./SEC. ²) | | | ROTATING VEHICLE LINEAR VELOCITY | | | ROTATING VEHICLE LINEAR ACCELERATION (IN./SEC. ²) | | | ROTATIONAL VELOCITY (IN./SEC.) | | | ROTATIONAL ACCELERATION (IN./SEC. ²) | | | LINEAR DISPLACEMENTS (IN.) | | | ROTATIONAL DISPLACEMENTS (IN.) | | |
|----------------|----------------------------|-----|-----|-----------------------------------------------|-----|-----|----------------------------------|-----|-----|---------------------------------------------------------------|-----|-----|--------------------------------|-----|-----|--------------------------------------------------|-----|-----|----------------------------|-----|-----|--------------------------------|-----|-----|
| | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.00500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.204 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.01000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 24.613 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.01500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 41.022 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.02000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 57.431 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.02500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 73.839 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.03000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 90.248 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.03500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 106.657 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.04000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 123.066 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.04500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 139.474 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.05000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 155.883 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.05500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 172.252 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.06000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 188.701 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.06500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 205.110 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.07000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 221.519 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.07500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 237.927 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.08000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 254.336 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.08500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 270.745 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.09000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 287.153 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.09500 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 303.562 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.10000 | 0.0 | 0.0 | 0.0 | -8.200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 311.767 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 5 of 12)

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 6 of 12)

| ROTATING VEHICLE ANGULAR HISTORY | | | | ANGULAR ACCELERATIONS (DEG/SEC. ²) | | | | ANGULAR VELOCITIES (DEG/SEC.) | | | | ANGULAR DISPLACEMENTS (deg) | | | |
|----------------------------------|-----|-----|-----|------------------------------------------------|-----|-----|-----|-------------------------------|-----|-----|-----|-----------------------------|-------|------|-----|
| TIME (SEC.) | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | PITCH | ROLL | YAW |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.00500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.01000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.01500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.02000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.02500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.03000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.03500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.04000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.04500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.05000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.05500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.06000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.06500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.07000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.07500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.08000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.08500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.09000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.09500 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.10000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| PLANE NO. | 1. ROTATION = | 4. ISOLATE = | 1. LEGGSW = | 3. NINIRL = | 16, ISOLAT = | 0, WITH NAME OF | HEAD |
|---------------------------------------------|------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------|
| TIMEFF 0.0 | X1 -21.0000 | Y1 0.0 | Z1 -53.0000 | X2 -12.0000 | Y2 0.0 | Z2 -53.0000 | X3 31.0000 -10.5000 -41.0000 |
| PLANE NO. | 2. ROTATION = | 1. ISOLATE = | 0, LEGGSW = | 4, NINIRL = | 16, ISOLAT = | 0, WITH NAME OF | WINDW |
| TIMEFF 0.0 | X1 -21.0000 | Y1 -9.0000 | Z1 -50.0000 | X2 -12.0000 | Y2 -9.0000 | Z2 -50.0000 | X3 31.0000 -20.0000 -18.0000 |
| PLANE NO. | 3. ROTATION = | 1. ISOLATE = | 4, LEGGSW = | 3, NINIRL = | 16, ISOLAT = | 0, WITH NAME OF | SLAT BACK |
| TIMEFF 0.0 | X1 9.0000 | Y1 -22.0000 | Z1 0.0 | X2 -8.5000 | Y2 -22.0000 | Z2 -50.0000 | X3 9.0000 12.0000 0.0 |
| PLANE NO. | 4. ROTATION = | 1. ISOLATE = | 4, LEGGSW = | 3, NINIRL = | 16, ISOLAT = | 0, WITH NAME OF | SLAT LUSHION |
| TIMEFF 0.0 | X1 25.0000 | Y1 -22.0000 | Z1 -12.7500 | X2 0.0 | Y2 -22.0000 | Z2 -9.0000 | X3 25.0000 12.0000 -12.7500 |
| PLANE NO. | 5. ROTATION = | 1. ISOLATE = | 3, LEGGSW = | 3, NINIRL = | 16, ISOLAT = | 0, WITH NAME OF | FLOOR |
| TIMEFF 0.0 | X1 54.0000 | Y1 -22.0000 | Z1 0.0 | X2 0.0 | Y2 -22.0000 | Z2 0.0 | X3 54.0000 22.0000 0.0 |
| PLANE NO. | 6. ROTATION = | 1. ISOLATE = | 1, LEGGSW = | 3, NINIRL = | 16, ISOLAT = | 0, WITH NAME OF | OCOR SITE |
| TIMEFF 0.0 | X1 26.0000 | Y1 -12.5000 | Z1 -26.0000 | X2 0.0 | Y2 -15.5000 | Z2 -26.0000 | X3 64.0000 -15.5000 0.0 |
| PLANE NO. | 7. ROTATION = | 6, ISOLATE = | 5, LEGGSW = | 3, NINIRL = | 16, ISOLAT = | 0, WITH NAME OF | DOOR |
| TIMEFF 0.0 | X1 31.0000 | Y1 -15.5000 | Z1 -40.0000 | X2 -12.0000 | Y2 -15.5000 | Z2 -40.0000 | X3 31.0000 -15.5000 -40.0000 |
| 0.0050 0.0300 0.1000 | X1 31.0000 31.0000 31.0000 | Y1 -12.5000 -19.5000 -19.5000 | Z1 -40.0000 -40.0000 -46.0000 | X2 -12.0000 -12.0000 -12.0000 | Y2 -15.5000 -10.5000 -10.5000 | Z2 -40.0000 -40.0000 -40.0000 | X3 31.0000 31.0000 31.0000 -15.5000 -10.5000 -10.5000 |
| PLANE NO. | 8. ROTATION = | 4, ISOLATE = | 1, LEGGSW = | 3, NINIRL = | 16, ISOLAT = | 0, WITH NAME OF | HIP PANEL |
| TIMEFF 0.0 0.0050 0.0300 0.1000 | X1 31.0000 31.0000 31.0000 31.0000 | Y1 -12.5000 -12.5000 -12.5000 -12.5000 | Z1 -40.0000 -40.0000 -40.0000 -40.0000 | X2 -12.0000 -12.0000 -12.0000 -12.0000 | Y2 -12.5000 -12.5000 -12.5000 -12.5000 | Z2 -40.0000 -40.0000 -40.0000 -40.0000 | X3 31.0000 31.0000 31.0000 31.0000 -12.5000 -12.5000 -12.5000 -12.5000 |

TABLE 4. Output of Baseline Input Data Set. Side Impact (Page 7 of 12)

C.L. 0.2

PLATE NO. 1, NOMINAL 1. MATERIAL = 1, LUDWIG = 3, HINRITZ = 16, 1 SOLN = 0, WITH NAME OF
 PLATE
X1 Y1 X2 Y2 X3 Y3
0.0 3.000 -10.500 -41.000 -10.500 -61.000 -15.900
L1
-41.000

ADDITIONAL ELLIPTICAL INPUT

| NO. | SUMMITS & IN.1 | | | OFFSET & IN.1 | ROTATION (deg) | YAW | PITCH | ROLL |
|-----|----------------|---|-----------------|---------------|----------------|--------|-------|------|
| | X | Y | Z | | | | | |
| 1 | 1 | 0 | LOWER TORSO | 4.940 | 6.940 | 7.600 | 0.0 | 0.0 |
| 2 | 2 | 0 | CENTER TORSO | 4.910 | 6.350 | 7.630 | 0.0 | 0.0 |
| 3 | 3 | 2 | UPPER TORSO | 4.410 | 6.760 | 4.940 | 0.0 | 0.0 |
| 4 | 4 | 0 | NECK | 2.570 | 2.260 | 2.280 | 0.0 | 0.0 |
| 5 | 5 | 0 | HEAD | 3.950 | 3.100 | 4.590 | 0.0 | 0.0 |
| 6 | 6 | 0 | RIGHT UPPER LEG | 2.950 | 3.740 | 12.450 | 0.0 | 0.0 |
| 7 | 7 | 0 | RIGHT LOWER LEG | 2.360 | 2.230 | 9.070 | 0.0 | 0.0 |
| 8 | 8 | 0 | RIGHT FOOT | 1.520 | 1.800 | 5.220 | 0.0 | 0.0 |
| 9 | 9 | 0 | LEFT UPPER LEG | 2.990 | 3.740 | 12.400 | 0.0 | 0.0 |
| 10 | 10 | 0 | LEFT LOWER LEG | 2.360 | 2.230 | 9.070 | 0.0 | 0.0 |
| 11 | 11 | 0 | LEFT FOOT | 1.520 | 1.800 | 5.220 | 0.0 | 0.0 |
| 12 | 12 | 0 | RIGHT UPPER ARM | 2.070 | 1.640 | 6.080 | 0.0 | 0.0 |
| 13 | 13 | 0 | RIGHT LOWER ARM | 1.300 | 1.110 | 8.300 | 0.0 | 0.0 |
| 14 | 14 | 0 | LEFT UPPER ARM | 2.070 | 1.640 | 6.080 | 0.0 | 0.0 |
| 15 | 15 | 0 | LEFT LOWER ARM | 1.300 | 1.110 | 8.300 | 0.0 | 0.0 |

33 BODY SEGMENT SYMMETRY INPUT

SIG NO. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
 NSYM 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

MATERIAL NORMAL FORCE SPECIFICATION

| MATERIAL | NAME | HSW | DC | DC | DT | DT | FSAT | DM |
|----------|-----------------|-----|----|----|------------|-----|---------|-----|
| 1 | PANEL MATERIAL | 1 | -1 | 0 | 0.0 | 0.0 | 6.5E+00 | 6.0 |
| 2 | TEHRAX MATERIAL | -1 | -1 | 0 | 0.0 | 0.0 | 6.5E+00 | 6.0 |
| 3 | FLUR MATERIAL | -1 | -1 | 0 | 0.0 | 0.0 | 0.5E+00 | 0.0 |
| 4 | SEAT MATERIAL | -2 | -1 | 0 | 0.0 | 0.0 | 6.5E+00 | 6.0 |
| 5 | DOOR MATERIAL | -1 | -1 | 0 | 0.0 | 0.0 | 6.5E+00 | 6.0 |
| 6 | GLASS MATERIAL | -2 | -1 | 0 | 0.100E-012 | 0.0 | 6.5E+00 | 6.0 |
| 7 | PILOT MATERIAL | -6 | -1 | 0 | 0.0 | 0.0 | 6.0E+00 | 6.0 |

UNIVARIATE POLYNOMIAL SPECIALIZED INPUT
 UPPLY

CLUTCH BRAKE

CAMS F.S.A-F.S.C

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 8 of 12)

| | | | | | | | |
|---|------------------|------------------|-----------------|-----------------|-----------------|-----|-----|
| 1 | 0.000000000E+00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 0.000000000E+00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 | 0.000000000E+00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | C.1000000000E+04 | -0.502500000E+03 | 0.103125000E+04 | -0.5t250000E+03 | 0.937500000E+02 | 0.0 | 0.0 |
| | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 9 of 12)

BIVALENT POLYNUCLEIC ACID ANALOGS

| NPCELLY | 0.10000000000000002 | COEFFICIENTS | |
|---------|---------------------|--------------|-----|
| | | C | D |
| 5 | 0.0 | 0.0 | 0.0 |
| 0.9 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 |
| 0.3 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 |

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 10 of 12)

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 11 of 12)

ALIGNED CONTACTS AND ASSOCIATED LOCATIONS

| INDEX | INDEX NAME | INDEX NAME | POINT NAME | OR INDEX NAME | INDEX NAME |
|-------|-----------------|------------|--------------|------------------|------------|
| 1 | LOWER TORSO | 3 | STAT BACK | | |
| 1 | LOWER TORSO | 4 | SEAT CUSHION | | |
| 1 | LOWER TORSO | 6 | HIP PANTIL | | |
| 1 | LOWER TORSO | 7 | STAT BACK | | |
| 1 | LOWER TORSO | 8 | STAT BACK | | |
| 2 | CENTER TORSO | 3 | STAT BACK | | |
| 3 | UPPER TORSO | 3 | STAT BACK | | |
| 3 | UPPER TORSO | 7 | DOOR | | |
| 5 | HEAD | 1 | WALL | | |
| 5 | HEAD | 2 | RIGHTCM | | |
| 5 | HEAD | 7 | UPILLAR | | |
| 6 | RIGHT UPPER LEG | 4 | STAT CUSHION | | |
| 6 | RIGHT UPPER LEG | 5 | FLOOR | | |
| 7 | RIGHT LOWER LEG | 9 | SEAT CUSHION | | |
| 8 | RIGHT FOOT | 8 | HIP PANTIL | | |
| 8 | RIGHT FOOT | 9 | DOOR SILL | | |
| 9 | LEFT UPPER LEG | 9 | SEAT CUSHION | | |
| 9 | LEFT UPPER LEG | 8 | HIP PANTIL | | |
| 10 | LEFT LOWER LEG | 9 | DOOR SILL | | |
| 11 | LEFT FOOT | 5 | FLOOR | | |
| 11 | LEFT FOOT | 6 | DOOR SILL | | |
| 14 | LEFT UPPER ARM | 9 | UPILLAR | | |

SOURCER FILE INITIAL INPUT

| LPT1(X) | LPT1(Y) | LPT1(Z) | LPT1(TL) | L1 | J1 | J2 | J3 |
|---------|---------|---------|----------|----|----|----|----|
| 10.00 | 10.00 | 1.00 | 0 | 0 | 0 | 0 | 0 |

INITIAL POSITION (INITIAL ATTITUDE)

| SEGMENT NO. | SEG | LINEAR POSITION (IN.) | | | LINEAR VELOCITY (IN./SEC.) | | |
|----------------|-----|-----------------------|----------|-----------|----------------------------|-----|-----|
| | | X | Y | Z | X | Y | Z |
| 1 | LT | 9.00000 | 0.0 | -15.50000 | 0.0 | 0.0 | 0.0 |
| 2 | CT | 7.06263 | 0.0 | -26.36995 | 0.0 | 0.0 | 0.0 |
| 3 | UT | 5.97063 | 0.0 | -25.27109 | 0.0 | 0.0 | 0.0 |
| 4 | N | 3.84283 | 0.0 | -34.92816 | 0.0 | 0.0 | 0.0 |
| 5 | H | 3.96319 | 0.0 | -39.53322 | 0.0 | 0.0 | 0.0 |
| 6 | RUL | 18.59556 | 4.42000 | -15.68940 | 0.0 | 0.0 | 0.0 |
| 7 | RLL | 29.41793 | 4.46500 | -11.61975 | 0.0 | 0.0 | 0.0 |
| 8 | RF | 36.52826 | 4.45000 | -4.64004 | 0.0 | 0.0 | 0.0 |
| 9 | RUA | 16.54556 | -4.42000 | -15.68940 | 0.0 | 0.0 | 0.0 |
| 10 | RLA | 29.41793 | -4.42000 | -11.61975 | 0.0 | 0.0 | 0.0 |
| 11 | LF | 36.52826 | -4.42000 | -4.64004 | 0.0 | 0.0 | 0.0 |
| 12 | RUA | 4.05545 | 1.00000 | -25.41930 | 0.0 | 0.0 | 0.0 |
| 13 | RLA | 11.41041 | 1.00000 | -15.39631 | 0.0 | 0.0 | 0.0 |
| 14 | LUA | 4.85545 | -1.00000 | -25.41930 | 0.0 | 0.0 | 0.0 |
| 15 | LLA | 11.41041 | -1.00000 | -15.39631 | 0.0 | 0.0 | 0.0 |

INITIAL ANGULAR ROTATION AND VELOCITY

| SEGMENT NO., SEG | ANGULAR POSITION (DEG) | | | ANGULAR VELOCITY (DEG/SEC.) | | |
|---------------------|------------------------|-------|-----------|-----------------------------|-----|-----|
| | YAW | PITCH | ROLL | X | Y | Z |
| 1 | LT | 0.0 | 12.00000 | 6.0 | 0.0 | 0.0 |
| 2 | CT | 0.0 | 12.00000 | 0.0 | 0.0 | 0.0 |
| 3 | UT | 0.0 | 12.00000 | 0.0 | 0.0 | 0.0 |
| 4 | N | 0.0 | 12.00000 | 0.0 | 0.0 | 0.0 |
| 5 | H | 0.0 | 12.00000 | 0.0 | 0.0 | 0.0 |
| 6 | RUL | 6.0 | 107.50000 | 6.0 | 0.0 | 0.0 |
| 7 | RLL | 0.0 | 26.00000 | 0.0 | 0.0 | 0.0 |
| 8 | RF | 0.0 | 149.30000 | 0.0 | 0.0 | 0.0 |
| 9 | LT | 0.0 | 107.50000 | 6.0 | 0.0 | 0.0 |
| 10 | LLI | 0.0 | 36.00000 | 0.0 | 0.0 | 0.0 |
| 11 | LF | 0.0 | 149.00000 | 0.0 | 0.0 | 0.0 |
| 12 | RUA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 | RLA | 0.0 | 45.00000 | 0.0 | 0.0 | 0.0 |
| 14 | LUA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 15 | LLA | 0.0 | 45.00000 | 0.0 | 0.0 | 0.0 |

INITIAL AND ANGULAR VELOCITIES HAVE BEEN SET EQUAL TO THE INITIAL VEHICLE VELOCITIES.

CARO 6.1

CAROS 6.2

CAROS 6.3

TABLE 4. Output of Baseline Input Data Set. Side Impact. (Page 12 of 12)

TABLE 5. Listing of Baseline Side Impact Input Data File (Page 2 of 6)

| ITEM | DESCRIPTION | QTY | UNIT | PRICE | AMOUNT |
|------|---------------------|------|------|--------|---------|
| 8 | 1 FC | 1 | PC | 0.8 | 0. |
| 9 | 0 LEFT UPPER LEG | 2.99 | PC | 3.74 | 12.40 |
| 10 | 0 LEFT LOWER LEG | 2.36 | PC | 2.23 | 9.07 |
| 11 | 0 LEFT FOOT | 1.52 | PC | 1.8 | 5.22 |
| 12 | 12 ORIGHT UPPER ARM | 2.07 | PC | 1.64 | 6.88 |
| 13 | 13 ORIGHT LOWER ARM | 1.3 | PC | 1.11 | 8.38 |
| 14 | 14 0 LEFT UPPER ARM | 2.07 | PC | 1.64 | 6.88 |
| 15 | 15 0 LEFT LOWER ARM | 1.3 | PC | 1.11 | 8.38 |
| 16 | 0 0 0 0 0 | 0 | PC | 0 | 0 |
| 17 | 1 PANEL MATERIAL | 1 | PC | 0 | 0 |
| 18 | 2 THORAX MATERIAL | -1 | PC | 0 | 0 |
| 19 | 3 FLOOR MATERIAL | -3 | PC | 0 | 0 |
| 20 | 4 SEAT MATERIAL | -2 | PC | 0 | 0 |
| 21 | 5 DOOR MATERIAL | -4 | PC | 0 | 0 |
| 22 | 6 GLASS MATERIAL | -5 | PC | 0 | 0 |
| 23 | 7 PILLAR MATERIAL | -6 | PC | 0 | 0 |
| 24 | 1 4080. | 1 | PC | 0 | 0 |
| 25 | 1 87 | 1 | PC | 0 | 0 |
| 26 | 2 40. | 2 | PC | 0 | 0 |
| 27 | 2 88 | 2 | PC | 0 | 0 |
| 28 | 3 89 | 2 | PC | 0 | 0 |
| 29 | 3 90 | 3 | PC | 0 | 0 |
| 30 | 3 91 | 3 | PC | 0 | 0 |
| 31 | 3 92 | 3 | PC | 0 | 0 |
| 32 | 4 1000. | 4 | PC | -562.5 | 1031.25 |
| 33 | 4 93 | 4 | PC | -562.5 | 1031.25 |
| 34 | 4 94 | 4 | PC | -562.5 | 1031.25 |
| 35 | 4 95 | 4 | PC | -562.5 | 1031.25 |
| 36 | 5 10000. | 5 | PC | 0 | 0 |
| 37 | 5 97 | 5 | PC | 0 | 0 |
| 38 | 5 98 | 5 | PC | 0 | 0 |
| 39 | 6 98.2 | 6 | PC | 4000. | 0 |
| 40 | 6 98.4 | 6 | PC | 0 | 0 |
| 41 | 6 98.6 | 6 | PC | 0 | 0 |
| 42 | 6 99 | 6 | PC | 0 | 0 |
| 43 | 0 0 0 | 0 | PC | 0 | 0 |
| 44 | 0 1 -1. | 1 | PC | 0. | 0. |
| 45 | 0 1 0. | 1 | PC | 3. | 4. |
| 46 | 0 1 0. | 1 | PC | 0. | 0. |
| 47 | 0 2 0. | 2 | PC | 0. | 0. |
| 48 | 0 2 0. | 2 | PC | 0. | 0. |
| 49 | 0 3 0. | 3 | PC | 0. | 0. |
| 50 | 0 4 0. | 4 | PC | 0. | 0. |
| 51 | 0 5 0. | 5 | PC | 0. | 0. |
| 52 | 0 6 0. | 6 | PC | 0. | 0. |
| 53 | 0 7 0. | 7 | PC | 0. | 0. |
| 54 | 0 8 0. | 8 | PC | 0. | 0. |
| 55 | 0 9 0. | 9 | PC | 0. | 0. |
| 56 | 1 0 0. | 10 | PC | 0. | 0. |
| 57 | 1 1 0. | 11 | PC | 0. | 0. |
| 58 | 1 2 0. | 12 | PC | 0. | 0. |
| 59 | 1 3 0. | 13 | PC | 0. | 0. |
| 60 | 1 4 0. | 14 | PC | 0. | 0. |
| 61 | 1 5 0. | 15 | PC | 0. | 0. |
| 62 | 1 6 0. | 16 | PC | 0. | 0. |
| 63 | 1 7 0. | 17 | PC | 0. | 0. |
| 64 | 1 8 0. | 18 | PC | 0. | 0. |
| 65 | 1 9 0. | 19 | PC | 0. | 0. |
| 66 | 1 9.5 0. | 19.5 | PC | 0. | 0. |
| 67 | 2 0 0. | 20 | PC | 0. | 0. |
| 68 | 2 1 0. | 21 | PC | 0. | 0. |

TABLE 5. Listing of Baseline Side Impact Input Data File (Page 4 of 6)

TABLE 5. Listing of Baseline Side Impact Test Data for PA-2000.

TABLE 5. Listing of Baseline Side Impact Input Data File (page 6 of 6)

| | | | | | | | | | | | | | |
|--------------------|----|----|----|----|---|---|---|----|----|----|----|----|-------|
| 281 | 11 | 1 | 3 | 5 | 6 | 8 | 9 | 11 | 12 | 13 | 14 | 15 | H.4.A |
| 282 | 0 | | | | | | | | | | | | H.5.A |
| 283 | 11 | 1 | 3 | 5 | 6 | 8 | 9 | 11 | 12 | 13 | 14 | 15 | H.6.A |
| 284 | 14 | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 9 | 7 | 10 | 11 | H.7.A |
| 285 | 13 | 12 | 12 | 14 | | | | | | | | | H.7.B |
| END OF FILE | | | | | | | | | | | | | |

5.3 PEDESTRIAN IMPACT INPUT DATA

This part of the report contains the numerical details of the baseline pedestrian impact data set. Table 7 contains the computer-generated output of the input data set. Table 6 is a summary of the contents of this table. Table 8 is a copy of the baseline data file which was constructed for this exercise.

TABLE 6. CONTENTS OF OUTPUT OF INPUT TABLE. PEDESTRIAN IMPACT.

| Page in Table 7 | Data Card I.D. | Input Quantities |
|-----------------|----------------|--------------------------------------------------------------|
| 1 | A | Controls |
| 2 | B.2,B.3 | Occupant mass and inertial properties. Joint definitions. |
| 3 | B.4,B.5 | Joint torque characteristics. |
| 4 | B.6 | Segment integration convergence test input. |
| 5 | C | Vehicle linear and angular time histories. |
| 6 | D.2 | Location of contact planes. |
| 7 | D.5 | Ellipsoid semiaxes and orientation |
| 7 | D.7 | Symmetry input |
| 7 | D.9.A | Material normal force specifications. |
| 7 | D.9.B | Material tangential force specifications. |
| 7,8 | E.5.A-E.5.C | Bivariate polynomial specifications for force generation |
| 9 | F.1 | Allowed contacts |
| 10 | G.1,G.2,G.3 | Initial positions |

The Tables 6-8 have described the pedestrian data set for the case of a simple hinge knee. Some modifications were necessary to simulate the hinge knee with the capability of breakage using the Euler joint option as was discussed in Part 3.2. Changes were necessary to the B.3, B.4, and B.5 cards. Table 9 contains the new or changed lines (marked with an asterisk) in the data listing surrounded by unchanged lines for comparison with Table 8.

C.M. SPAN 3-D CRASH VICTIM SIMULATION PROGRAM
 17 APR 1980 OCT 1, 1980 IRSEN= 0 IRSMU= 0 PSTIME = 0.0
 IMPR ARRAY 1 0 0 0 0 0 0 1 1 0
 BASELINE PEDESTRIAN DATA SET
 MUNIT = IN. UNIT = LB. UNIT = SEC.
 GRAVITY VECTOR = 0.0 , 0.0 , 386.0000
 NDINT = 4 NSIEPS = 200 DT = 0.005000 H0 = 0.05000 HMAX = 0.005000
 KNTLPRZ 1 MAXIN = 501 EPSILONS 0.100000000E-01 0.100000000E-02 0.100000000E-03 0.500000000E+00 0.600000000E+00

TABLE 7. Output of Baseline Input Data Set. Pedestrian Impact. (Page 1 of 10)

| CRASH VICTIM | | | | PROTECTED SERRA | | | | 16 SEGMENTS | | | | 17 JOINS | | | |
|--------------|-----|-----|----|-------------------|---------|---------|---------|------------------------------------------------|---------|---------|---------|----------|---------|---------|---------|
| J | SYM | PNT | PT | (1B,-5FC,*2/ IN.) | | | | SEGMENT MOMENT OF INERTIA (1B,-SFC,*2/ IN.) | | | | | | | |
| | | | | MASS | X | Y | Z | X | Y | Z | X | Y | Z | X | Y |
| 1 | L | I | 5 | 0.093 | 1.18000 | 1.19000 | 1.11000 | 0.32500 | 0.34400 | 0.34400 | 0.14900 | 0.14900 | 0.14900 | 0.14900 | 0.14900 |
| 2 | CI | 4 | 0 | 0.026 | 2.12000 | 1.65000 | 1.33000 | 0.04000 | 0.04000 | 0.04000 | 0.03000 | 0.03000 | 0.03000 | 0.03000 | 0.03000 |
| 3 | 0I | 3 | 0 | 0.002 | 0.008 | 0.008 | 0.008 | 0.25900 | 0.31100 | 0.20000 | 0.15400 | 0.15400 | 0.15400 | 0.15400 | 0.15400 |
| 4 | II | 2 | 0 | 0.026 | 0.026 | 0.026 | 0.026 | 0.12700 | 0.13100 | 0.12000 | 0.09666 | 0.09666 | 0.09666 | 0.09666 | 0.09666 |
| 5 | -I | 1 | 0 | 0.015 | 0.015 | 0.015 | 0.015 | 0.00660 | 0.00663 | 0.00663 | 0.01410 | 0.01410 | 0.01410 | 0.01410 | 0.01410 |
| 6 | RUL | 6 | 0 | 0.004 | 0.004 | 0.004 | 0.004 | 0.21430 | 0.24578 | 0.21430 | 0.01490 | 0.01490 | 0.01490 | 0.01490 | 0.01490 |
| 7 | ORL | 7 | 0 | 0.014 | 0.007 | 0.007 | 0.007 | 0.03030 | 0.03030 | 0.03030 | 0.01320 | 0.01320 | 0.01320 | 0.01320 | 0.01320 |
| 8 | TRL | 7 | 0 | 0.007 | 0.005 | 0.005 | 0.005 | 0.12700 | 0.13090 | 0.12700 | 0.01320 | 0.01320 | 0.01320 | 0.01320 | 0.01320 |
| 9 | RI | 8 | 0 | 0.008 | 0.005 | 0.005 | 0.005 | 0.44000 | 0.44200 | 0.44000 | 0.01410 | 0.01410 | 0.01410 | 0.01410 | 0.01410 |
| 10 | LI | 9 | 0 | 0.018 | 0.018 | 0.018 | 0.018 | 0.03030 | 0.03030 | 0.03030 | 0.01410 | 0.01410 | 0.01410 | 0.01410 | 0.01410 |
| 11 | LL | 4 | 0 | 0.007 | 0.007 | 0.007 | 0.007 | 0.16400 | 0.16600 | 0.16400 | 0.01410 | 0.01410 | 0.01410 | 0.01410 | 0.01410 |
| 12 | LF | 8 | 0 | 0.014 | 0.014 | 0.014 | 0.014 | 0.20000 | 0.20000 | 0.20000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 |
| 13 | ROA | C | 0 | 0.008 | 0.008 | 0.008 | 0.008 | 0.16400 | 0.16600 | 0.16400 | 0.01410 | 0.01410 | 0.01410 | 0.01410 | 0.01410 |
| 14 | RE | D | 0 | 0.006 | 0.006 | 0.006 | 0.006 | 0.20000 | 0.20000 | 0.20000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 |
| 15 | TOA | E | 0 | 0.014 | 0.014 | 0.014 | 0.014 | 0.20000 | 0.20000 | 0.20000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 |
| 16 | TA | F | 0 | 0.008 | 0.008 | 0.008 | 0.008 | 0.10000 | 0.10000 | 0.10000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 |
| 17 | ROA | G | 0 | 0.005 | 0.005 | 0.005 | 0.005 | 0.10000 | 0.10000 | 0.10000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 |
| 18 | TA | H | 0 | 0.005 | 0.005 | 0.005 | 0.005 | 0.10000 | 0.10000 | 0.10000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 | 0.01000 |

| JOINT J - SEGMENT IN. I - SEGMENT IN. J - SEGMENT IN. K | | | | LOCATION IN. I - SEGMENT IN. J - SEGMENT IN. K | | | | PRIN. AX(S) DEG - PITCH | | | | PRIN. AX(S) DEG - YAW | | | | PRIN. AX(S) DEG - ROLL | | | | SEG(J+1) - SEG(J+2) | | | | CARDS B.3 | | | |
|---------------------------------------------------------|-----|-----|----|------------------------------------------------|-------|-------|-------|-------------------------|-------|-------|-----|-----------------------|-----|-----|-----|------------------------|-----|-----|-----|---------------------|-----|-----|-----|-----------|-----|-----|---|
| J | SYM | PNT | PT | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z |
| 1 | P | P | 1 | -2 | -1.69 | 0.0 | -2.50 | -1.50 | 0.0 | 2.50 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 2 | W | 0 | 2 | -2 | -1.50 | 0.0 | -2.30 | -1.50 | 0.0 | 2.60 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 3 | HP | N | 3 | -2 | -0.90 | 0.0 | -2.20 | 0.0 | 0.0 | 3.80 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 4 | HP | H | 4 | -2 | 0.0 | 0.0 | -1.20 | -1.00 | 0.0 | 3.30 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 5 | RH | C | 1 | 0 | 0.0 | 2.80 | 1.50 | 0.0 | 7.31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 6 | RK | R | 6 | 4 | 0.0 | 0.0 | 6.79 | 0.0 | 0.0 | -1.75 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 7 | RTF | J | 7 | -2 | 0.0 | 0.0 | 4.75 | 0.0 | 0.0 | 6.33 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 8 | RA | S | 8 | -2 | 0.0 | 0.0 | 6.33 | 1.54 | 0.0 | -1.28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 9 | LH | T | 1 | 0 | 0.0 | -2.80 | 1.50 | 0.0 | -7.31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 10 | IK | U | 10 | 1 | 0.0 | 0.0 | 6.79 | 0.0 | 0.0 | -7.48 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 11 | LA | V | 11 | -2 | 0.0 | 0.0 | 6.69 | 1.54 | 0.0 | -1.28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 12 | RS | W | 12 | -2 | 1.00 | 6.60 | -1.60 | 0.0 | 0.0 | -5.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 13 | RL | X | 13 | -1 | 0.0 | 5.45 | 0.0 | 0.0 | -4.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 14 | LS | Y | 13 | -2 | 1.00 | -6.60 | -1.60 | 0.0 | 0.0 | -5.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 15 | LF | Z | 15 | -1 | 0.0 | 5.45 | 0.0 | 0.0 | -4.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 16 | RW | K | 14 | -1 | 0.0 | 6.00 | 0.0 | 0.0 | -2.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 17 | LW | L | 16 | -1 | 0.0 | 6.00 | 0.0 | 0.0 | -2.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |

TABLE 7. Output of Baseline Input Data Set. Pedestrian Impact. (Page 2 of 10)

JOINT TORQUE CHARACTERISTICS

FLEXURAL SPRING CHARACTERISTICS

| JOINT | SPRING COEF. (IN. LB./DEG* θ_{ij}) LINFAR QUADRATIC (J=1) | ENERGY DISSIPATION CONST. (J=3) | JOINT STIFF. (DEG) | SPRING COEF. (IN. LB./DEG* θ_{ij}) LINFAR QUADRATIC (J=1) | ENERGY DISSIPATION CONST. (J=3) | JOINT STIFF. (DEG) |
|-------|-------------------------------------------------------------------------|---------------------------------------|-----------------------|-------------------------------------------------------------------------|---------------------------------------|-----------------------|
| 1 P | 10.000 | 609.230 | 0.0 | 1.000 | 20.000 | 0.0 |
| 2 U | 20.944 | 60.923 | 0.0 | 1.000 | 34.383 | 0.0 |
| 3 RP | 17.174 | 60.923 | 0.0 | 1.000 | 60.923 | 0.0 |
| 4 HP | 21.293 | 60.923 | 0.0 | 1.000 | 8.011 | 0.0 |
| 5 RH | 0.0 | 609.230 | 0.3 | 1.000 | 60.923 | 0.0 |
| 6 RK | 0.0 | 16.754 | 0.0 | 1.000 | 60.923 | 0.0 |
| 7 RIF | 0.0 | 0.0 | 0.0 | 0.0 | 609.230 | 0.0 |
| 8 RA | 0.0 | 627.510 | 0.0 | 1.000 | 0.0 | 0.0 |
| 9 LH | 0.0 | 609.230 | 0.0 | 1.000 | 90.000 | 0.0 |
| 10 LK | 0.0 | 16.754 | 0.0 | 1.000 | 85.510 | 0.0 |
| 11 LA | 0.0 | 627.510 | 0.0 | 1.000 | 50.000 | 0.0 |
| 12 RS | 0.0 | 609.230 | 0.0 | 1.000 | 75.500 | 0.0 |
| 13 RE | 0.0 | 11.697 | 0.0 | 1.000 | 80.000 | 0.0 |
| 14 LS | 0.0 | 609.230 | 0.0 | 1.000 | 75.500 | 0.0 |
| 15 LE | 0.0 | 11.697 | 0.0 | 1.000 | 80.000 | 0.0 |
| 16 RW | 0.0 | 600.000 | 0.0 | 1.000 | 45.000 | 0.0 |
| 17 LW | 0.0 | 600.000 | 0.0 | 1.000 | 45.000 | 0.0 |

TORSIONAL SPRING CHARACTERISTICS

| JOINT | SPRING COEF. (IN. LB./DEG* θ_{ij}) LINFAR QUADRATIC (J=2) | ENERGY DISSIPATION CONST. (J=3) | JOINT STIFF. (DEG) | SPRING COEF. (IN. LB./DEG* θ_{ij}) LINFAR QUADRATIC (J=2) | ENERGY DISSIPATION CONST. (J=3) | JOINT STIFF. (DEG) |
|-------|-------------------------------------------------------------------------|---------------------------------------|-----------------------|-------------------------------------------------------------------------|---------------------------------------|-----------------------|
| 1 P | 10.000 | 609.230 | 0.0 | 1.000 | 20.000 | 0.0 |
| 2 U | 20.944 | 60.923 | 0.0 | 1.000 | 34.383 | 0.0 |
| 3 RP | 17.174 | 60.923 | 0.0 | 1.000 | 60.923 | 0.0 |
| 4 HP | 21.293 | 60.923 | 0.0 | 1.000 | 8.011 | 0.0 |
| 5 RH | 0.0 | 609.230 | 0.3 | 1.000 | 60.923 | 0.0 |
| 6 RK | 0.0 | 16.754 | 0.0 | 1.000 | 60.923 | 0.0 |
| 7 RIF | 0.0 | 0.0 | 0.0 | 0.0 | 1000.000 | 0.0 |
| 8 RA | 0.0 | 627.510 | 0.0 | 1.000 | 0.0 | 0.0 |
| 9 LH | 0.0 | 609.230 | 0.0 | 1.000 | 90.000 | 0.0 |
| 10 LK | 0.0 | 16.754 | 0.0 | 1.000 | 609.230 | 0.0 |
| 11 LA | 0.0 | 627.510 | 0.0 | 1.000 | 50.000 | 0.0 |
| 12 RS | 0.0 | 609.230 | 0.0 | 1.000 | 75.500 | 0.0 |
| 13 RE | 0.0 | 11.697 | 0.0 | 1.000 | 80.000 | 0.0 |
| 14 LS | 0.0 | 609.230 | 0.0 | 1.000 | 75.500 | 0.0 |
| 15 LE | 0.0 | 11.697 | 0.0 | 1.000 | 80.000 | 0.0 |
| 16 RW | 0.0 | 600.000 | 0.0 | 1.000 | 1000.000 | 0.0 |
| 17 LW | 0.0 | 600.000 | 0.0 | 1.000 | 600.000 | 0.0 |

CARDS A-4

CARDS B-5

JOINT VISCOUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS

| JOINT | VISCOSITY COEFFICIENT (IN. LB. SEC./DEG) | FRICTION COEF. (IN. LB.) | CONSTANT ANGULAR VELOCITY (DEG/SEC.) | MAX TORQUE FOR LOCKED JOINT (IN. LB.) | MIN TORQUE FOR UNLOCKED JOINT (IN. LB.) | MIN. ANG. VELOCITY FOR UNLOCKED JOINT (RAD/SEC.) | INPUT SECTION COEFFICIENT |
|-------|------------------------------------------|--------------------------|--------------------------------------|---------------------------------------|-----------------------------------------|--------------------------------------------------|---------------------------|
| 1 P | 10.000 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 U | 10.472 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 RP | 1.745 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 HP | 1.745 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 RH | 3.997 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 RK | 1.000 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 RIF | 0.0 | 0.0 | 1.00 | 505.50 | 0.0 | 0.0 | 0.0 |
| 8 RA | 0.436 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 LH | 3.997 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 LK | 1.000 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 LA | 0.436 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 RS | 0.0 | 1.0 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 RE | 0.200 | 10.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 14 LS | 0.0 | 3.0 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 15 LE | 0.300 | 3.0 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 16 RW | 1.000 | 100.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 17 LW | 1.000 | 100.00 | 30.00 | 0.0 | 0.0 | 0.0 | 0.0 |

TABLE 7. Output of Baseline Input Data Set. Pedestrian Impact. (Page 3 of 10)

Pedestrian Impact Data Set Input

| STATION | WKT | ANGULAR VELOCITIES | | | | LINEAR VELOCITIES | | | | ANGULAR ACCELERATIONS | | | | LINEAR ACCELERATIONS | | | |
|---------|-----|--------------------|------|------------|-------|-------------------|------|---------------|-------|-----------------------|------|---------------|-------|----------------------|------|---------------|-------|
| | | (RAD/SEC.) | | (M/S/SEC.) | | (RAD/SEC.**2) | | (M/S/SEC.**2) | | (RAD/SEC.**3) | | (M/S/SEC.**3) | | (RAD/SEC.**4) | | (M/S/SEC.**4) | |
| | | MAG. | ABS. | REL. | ERROR | MAG. | ABS. | REL. | ERROR | MAG. | ABS. | REL. | ERROR | MAG. | ABS. | REL. | ERROR |
| 1 L1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 C1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 R1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 H | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 H | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 RUL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 QRL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 LRL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 RF | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 LRI | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 LRI | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 LF | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 RUA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 14 RIA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 15 TUA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 16 TIA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 17 RIA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 18 TIA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

TABLE 7. Output of Baseline Input Data Set. Pedestrian Impact. (Page 4 of 10)

VEHICLE DECCELERATION INPUTS

VEHICLE AT REST - PART 5 MOVING AT 10 MPH

| YAW | PITCH | ROLL | XIPS | YIPS | ZIPS | TIME | LIPS | XG(X) | XO(Y) | XO(Z) | ANGLE |
|-----|-------|------|------|------|------|------|------|-------|-------|-------|---------|
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -2.0 | 0.00000 |

ROTATING VEHICLE LINEAR TIME HISTORY

| TIME (SEC.) | LINEAR DECELERATIONS (G'S) | | | LINEAR VELOCITIES (IN./SEC.) | | | LINEAR DISPLACEMENTS (IN.) | | | PAGE NO. 1 |
|----------------|----------------------------|-----|-----|------------------------------|-----|-----|----------------------------|-----|-----|------------|
| | X | Y | Z | X | Y | Z | X | Y | Z | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00000 |
| 0.50000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00000 |

ROTATING VEHICLE ANGULAR TIME HISTORY

| TIME (SEC.) | ANGULAR ACCELERATIONS (DEG/SEC.*2) | | | ANGULAR VELOCITIES (DEG/SEC.) | | | ANGULAR DISPLACEMENTS (DEG) | | | PAGE NO. 1 |
|----------------|------------------------------------|-----|-----|-------------------------------|-----|-----|-----------------------------|-----|-----|------------|
| | X | Y | Z | X | Y | Z | X | Y | Z | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00000 |
| 0.50000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00000 |

TABLE 7. Output of Baseline Input Data Set. Pedestrian Impact. (Page 5 of 10)

PLATE I

3110

| PLATE NO. | 1, NUMBER= | 2, NAME= | 1, LENGTH= | 1, FOG SW= | 1, MINRL= | 0, ISOLAT= | 0, WITH NAME OF | ROOF |
|-----------|---------------------|------------------|----------------------------|---------------------------|--------------------------|----------------------------|----------------------------|------------------|
| LINERF | X1 0.0 1.0000 | Y1 0.0 0.0 | Z1 -49.8300 -49.8300 | X2 74.9000 36.0000 | Y2 16.0000 36.0000 | Z2 -49.8300 -49.8300 | X3 100.0000 -76.0000 | Y3 0.0 0.0 |
| PLATE NO. | 2, NUMBER= | 2, NAME= | 1, LENGTH= | 1, FOG SW= | 1, MINRL= | 0, ISOLAT= | 0, WITH NAME OF | WINDSHIELD |
| LINERF | X1 0.0 1.0000 | Y1 1.0 0.0 | Z1 -37.1700 -37.1700 | X2 55.0400 36.0000 | Y2 36.0000 36.0000 | Z2 -37.1700 -37.1700 | X3 71.6700 -104.3300 | Y3 0.0 0.0 |
| PLATE NO. | 3, NUMBER= | 2, NAME= | 1, LENGTH= | 1, FOG SW= | 1, MINRL= | 0, ISOLAT= | 0, WITH NAME OF | HOOD |
| LINERF | X1 0.0 1.0000 | Y1 0.0 0.0 | Z1 -31.7400 -31.7400 | X2 9.3400 36.0000 | Y2 36.0000 36.0000 | Z2 -31.7400 -31.7400 | X3 51.300 -124.9700 | Y3 0.0 0.0 |
| PLATE NO. | 4, NUMBER= | 2, NAME= | 1, LENGTH= | 1, FOG SW= | 1, MINRL= | 0, ISOLAT= | 0, WITH NAME OF | GRILL |
| LINERF | X1 0.0 1.0000 | Y1 0.0 0.0 | Z1 0.0 0.0 | X2 6.4500 -169.5500 | Y2 36.0000 36.0000 | Z2 0.0 0.0 | X3 4.5100 -171.4900 | Y3 0.0 0.0 |
| PLATE NO. | 5, NUMBER= | 2, NAME= | 1, LENGTH= | 1, FOG SW= | 1, MINRL= | 0, ISOLAT= | 0, WITH NAME OF | BUMPER |
| LINERF | X1 0.0 1.0000 | Y1 0.0 0.0 | Z1 0.0 0.0 | X2 2.1200 -173.8800 | Y2 36.0000 36.0000 | Z2 0.0 0.0 | X3 0.0 -176.0000 | Y3 0.0 0.0 |
| PLATE NO. | 6, NUMBER= | 1, NAME= | 2, LENGTH= | 2, FOG SW= | 3, MINRL= | 0, ISOLAT= | 0, WITH NAME OF | GROUND |
| LINERF | X1 0.0 | Y1 0.0000 | Z1 0.0 | X2 10.0000 | Y2 100.0000 | Z2 0.0 | X3 -100.0000 | Y3 -100.0000 |
| PLATE NO. | 7, NUMBER= | 2, NAME= | 3, LENGTH= | 3, FOG SW= | 3, MINRL= | 0, ISOLAT= | 0, WITH NAME OF | GRILL TOP |
| LINERF | X1 0.0 1.0000 | Y1 0.0 0.0 | Z1 -29.5000 -29.5000 | X2 7.2900 -168.7100 | Y2 36.0000 36.0000 | Z2 -29.5000 -29.5000 | X3 6.5700 -169.4100 | Y3 0.0 0.0 |

TABLE 7. Output of Baseline Input Data Set. Pedestrian Impact. (Page 6 of 10)

ADDITIONAL FURTHER INPUT

| NO. | SEGMENT CENTER | | | OFFSET (IN.) | | | ROTATION (deg) | | |
|-----|----------------|---|-----------------|--------------|-------|--------|----------------|-------|--------|
| | X | Y | Z | X | Y | Z | YAW | PITCH | ROLL |
| 1 | 1 | 0 | LOWER TORSO | 4.740 | 5.500 | 7.600 | 0.0 | 0.0 | 0.0 |
| 2 | 2 | 0 | CENTER TORSO | 4.910 | 5.750 | 7.040 | 0.0 | 0.0 | -2.000 |
| 3 | 3 | 0 | UPPER THIGH | 4.210 | 5.800 | 4.940 | 0.0 | 0.0 | 0.0 |
| 4 | 4 | 0 | NECK | 2.510 | 2.200 | 3.260 | 0.0 | 0.0 | 0.0 |
| 5 | 5 | 0 | HEAD | 1.990 | 1.100 | 4.590 | 0.0 | 0.0 | 0.0 |
| 6 | 6 | 0 | RIGHT UPPER LEG | 2.990 | 2.500 | 11.200 | 0.0 | 0.0 | 0.0 |
| 7 | 7 | 0 | RIGHT KNEE | 2.360 | 2.230 | 1.750 | 0.0 | 0.0 | 0.0 |
| 8 | 8 | 0 | RIGHT SHIN | 2.360 | 2.230 | 6.340 | 0.0 | 0.0 | 0.0 |
| 9 | 9 | 0 | RIGHT FOOT | 1.520 | 1.800 | 5.220 | 0.0 | 0.0 | 0.0 |
| 10 | 10 | 0 | LEFT UPPER LEG | 2.990 | 2.500 | 11.200 | 0.0 | 0.0 | 0.0 |
| 11 | 11 | 0 | LEFT LOWER LEG | 2.360 | 2.230 | 9.070 | 0.0 | 0.0 | 0.0 |
| 12 | 12 | 0 | LEFT KNEE | 1.520 | 1.800 | 5.220 | 0.0 | 0.0 | 0.0 |
| 13 | 13 | 0 | RIGHT UPPER ARM | 1.870 | 1.440 | 6.800 | 0.0 | 0.0 | 0.0 |
| 14 | 14 | 0 | RIGHT LOWER ARM | 1.400 | 1.400 | 5.750 | 0.0 | 0.0 | 0.0 |
| 15 | 15 | 0 | LEFT UPPER ARM | 2.070 | 1.660 | 6.800 | 0.0 | 0.0 | 0.0 |
| 16 | 16 | 0 | LEFT LOWER ARM | 1.400 | 1.400 | 5.750 | 0.0 | 0.0 | 0.0 |
| 17 | 17 | 0 | RIGHT HAND | 1.200 | 1.200 | 3.100 | 0.0 | 0.0 | 0.0 |
| 18 | 18 | C | LEFT HAND | 1.200 | 1.200 | 3.100 | 0.0 | 0.0 | 0.0 |

BODY SEGMENT SYMMETRY INPUT

| SEG NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|
| NSYM(J) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

MATERIAL NORMAL FORCE SPECIFICATION

| NAME | NSYM | NORMAL FORCE | DC | DF | FSAT | ON |
|------|-----------------|--------------|----|-----|------|-----|
| 1 | PANEL MATERIAL | -1 | 0 | 0.0 | 0.0 | 0.0 |
| 2 | GROUND | -2 | 1 | 0.0 | 0.0 | 0.0 |
| 3 | GRILL TOP MATT. | -3 | 0 | 0.0 | 0.0 | 0.0 |

| FRICTION COEF. | TANGENTIAL FORCE SPECIFICATION | MAX. VEL. (M/S) | LENGTH (M) | Coefficients |
|----------------|--------------------------------|-----------------|------------|--------------|
| 1 | 0.10000000001 | 0.02 | 0.0 | 0.0 |

BIVARIANT POLYNOMIAL SPECIFICATIONS

| INPUT | 1 | 0.10000000001 | 0.0 | 0.0 | 0.0 | 0.0 |
|-------|---|---------------|-----|-----|-----|-----|
| | 0 | 0.10000000001 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0 | 0.10000000001 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0 | 0.10000000001 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0 | 0.10000000001 | 0.0 | 0.0 | 0.0 | 0.0 |

CARD D.5.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.6.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.7.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.8.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.9.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.10.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.11.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.12.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.13.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.14.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.15.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.16.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.17.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.18.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.19.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.20.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.21.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.22.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.23.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.24.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.25.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.26.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.27.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.28.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.29.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.30.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.31.

SEGMENT CENTER

OFFSET (IN.)

ROTATION (deg)

MAX. VEL. LENGTH

Coefficients

0.0

CARD D.32.

SEGMENT CENTER

OFFSET (IN.)

TABLE 7. Output of Baseline Input Data Set. Pedestrian Impact. (Page 8 of 10)

| | | | | |
|-----|--------------------|-----|-----|-----|
| 2 | 0.4700000000000001 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 | 0.4700000000000001 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

ALL CROWD CONTACTS AND ASSOCIATED FUNCTIONS

| CONTACT INDEX | CONTACT NAME | PANEL INDEX NAME | OR | CONTACT INDEX NAME |
|---------------|-----------------|------------------|----|--------------------|
| 1 | LOWER TORSO | 2 | | WINDSHIELD |
| 1 | LOWER TORSO | 3 | | ROOF |
| 1 | LOWER TORSO | 7 | | GRILL TOP |
| 3 | UPPER TORSO | 1 | | ROOF |
| 3 | UPPER TORSO | 2 | | WINDSHIELD |
| 3 | UPPER TORSO | 3 | | ROOF |
| 5 | HEAD | 1 | | ROOF |
| 5 | HEAD | 2 | | WINDSHIELD |
| 5 | HEAD | 3 | | ROOF |
| 6 | RIGHT UPPER LEG | 3 | | WINDSHIELD |
| 6 | RIGHT UPPER LEG | 4 | | ROOF |
| 6 | RIGHT UPPER LEG | 6 | | GRILL |
| 6 | RIGHT UPPER LEG | 7 | | GRILL TOP |
| 6 | RIGHT UPPER LEG | 8 | | |
| 7 | RIGHT KNEE | 5 | | BUMPER |
| 8 | RIGHT SHIN | 5 | | BUMPER |
| 9 | RIGHT FOOT | 6 | | GROUND |
| 10 | LEFT UPPER LEG | 3 | | ROOF |
| 10 | LEFT UPPER LEG | 4 | | GRILL |
| 10 | LEFT UPPER LEG | 7 | | GRILL TOP |
| 11 | LEFT LOWER LEG | 5 | | BUMPER |
| 12 | LEFT FOOT | 6 | | GROUND |
| 13 | RIGHT UPPER ARM | 3 | | ROOF |
| 14 | RIGHT LOWER ARM | 3 | | ROOF |
| 15 | LEFT UPPER ARM | 3 | | ROOF |
| 16 | LEFT LOWER ARM | 3 | | ROOF |

TABLE 7. Output of Baseline Input Data Set. Pedestrian Impact. (Page 9 of 10)

SIMULATION INITIAL INPUT

| LPT1(X) | LPT1(Y) | ZPT1(L) | L1 | J1 | J2 | J3 |
|---------|---------|---------|----|----|----|----|
| 10.00 | 30.00 | 1.00 | 0 | 0 | 0 | 0 |

INITIAL POSITION'S (INERTIAL REFERENCE)

| SEGMENT NO. | SEG | LINEAR POSITION (IN.) | | | LINEAR VELOCITY (IN./SEC.) | | |
|-------------|------|-----------------------|----------|-----------|----------------------------|-----|-----|
| | | X | Y | Z | X | Y | Z |
| 1 | L1 | -7.50000 | 15.00000 | -33.72000 | 0.0 | 0.0 | 0.0 |
| 2 | C1 | -7.50000 | 13.00250 | -38.57551 | 0.0 | 0.0 | 0.0 |
| 3 | U1 | -7.50000 | 11.47124 | -47.36546 | 0.0 | 0.0 | 0.0 |
| 4 | H | -7.50300 | 10.16366 | -53.39393 | 0.0 | 0.0 | 0.0 |
| 5 | H | -7.50000 | 9.51666 | -57.45589 | 0.0 | 0.0 | 0.0 |
| 6 | RUL | -6.70000 | 13.12931 | -25.31889 | 0.0 | 0.0 | 0.0 |
| 7 | URLL | -4.70000 | 10.84016 | -17.12080 | 0.0 | 0.0 | 0.0 |
| 8 | URLL | -4.70000 | 10.00305 | -5.08009 | 0.0 | 0.0 | 0.0 |
| 9 | FF | -4.70000 | 9.06086 | -1.23980 | 0.0 | 0.0 | 0.0 |
| 10 | TOL | -10.40000 | 16.65160 | -25.07217 | 0.0 | 0.0 | 0.0 |
| 11 | L1L | -10.30000 | 20.99185 | -11.60614 | 0.0 | 0.0 | 0.0 |
| 12 | L1F | -10.30000 | 23.73956 | -1.95785 | 0.0 | 0.0 | 0.0 |
| 13 | RJA | 0.19154 | 10.60399 | -43.54496 | 0.0 | 0.0 | 0.0 |
| 14 | PLA | 0.49301 | 11.57020 | -36.35210 | 0.0 | 0.0 | 0.0 |
| 15 | LUA | -15.45800 | 10.59128 | -43.60877 | 0.0 | 0.0 | 0.0 |
| 16 | LUA | -15.83409 | 0.51251 | -35.54758 | 0.0 | 0.0 | 0.0 |
| 17 | P1W | -1.33864 | 12.16022 | -28.13838 | 0.0 | 0.0 | 0.0 |
| 18 | L1W | -13.79881 | 4.69622 | -31.45510 | 0.0 | 0.0 | 0.0 |

INITIAL ANGULAR ROTATION AND VELOCITY

| SEGMENT NO. | SEG | ANGULAR ROTATION (DEG) | | | ANGULAR VELOCITY (DEG/SEC.) | | |
|-------------|------|------------------------|-----------|-----------|-----------------------------|-----|-----|
| | | YAW | PITCH | ROLL | X | Y | Z |
| 1 | L1 | -90.00000 | 0.0 | -15.00000 | 0.0 | 0.0 | 0.0 |
| 2 | C1 | -90.00000 | 0.0 | -15.00000 | 0.0 | 0.0 | 0.0 |
| 3 | U1 | -90.00000 | 0.0 | -15.00000 | 0.0 | 0.0 | 0.0 |
| 4 | H | -90.00000 | 0.0 | -15.00000 | 0.0 | 0.0 | 0.0 |
| 5 | H | -90.00000 | 0.0 | -15.00000 | 0.0 | 0.0 | 0.0 |
| 6 | RUL | -99.00000 | 0.0 | 18.00000 | 0.0 | 0.0 | 0.0 |
| 7 | URLL | -99.00000 | 0.0 | 6.00000 | 0.0 | 0.0 | 0.0 |
| 8 | URLL | -90.00000 | 0.0 | 6.00000 | 0.0 | 0.0 | 0.0 |
| 9 | RF | -90.00000 | 0.0 | 90.00000 | 0.0 | 0.0 | 0.0 |
| 10 | T1W | -90.00000 | 0.0 | -10.00000 | 0.0 | 0.0 | 0.0 |
| 11 | L1L | -90.00000 | 0.0 | -25.00000 | 0.0 | 0.0 | 0.0 |
| 12 | L1F | -99.00000 | 0.0 | 78.00000 | 0.0 | 0.0 | 0.0 |
| 13 | RQA | -90.00000 | 12.00000 | -6.00000 | 0.0 | 0.0 | 0.0 |
| 14 | R1A | -90.00000 | -12.00000 | -6.00000 | 0.0 | 0.0 | 0.0 |
| 15 | I1A | -90.00000 | -15.00000 | -6.00000 | 0.0 | 0.0 | 0.0 |
| 16 | I1A | -90.00000 | 15.00000 | 43.00000 | 0.0 | 0.0 | 0.0 |
| 17 | P1W | -90.00000 | -30.00000 | -6.00000 | 0.0 | 0.0 | 0.0 |
| 18 | L1W | -90.00000 | 30.00000 | 43.00000 | 0.0 | 0.0 | 0.0 |

INITIAL AND ANGULAR VELOCITIES HAVE BEEN SET FROM THE INITIAL VEHICLE VELOCITIES.

CARD G.1

CARDS G.2

CARDS G.3

TABLE 7. Output of Baseline Input Data Set. Pedestrian Impact. (Page 10 of 10)

TABLE 8. Listing of Baseline Pedestrian Impact Input Data File. (Page 1 of 6)

| | | | | | | | | | | | | | | |
|-----|----------------|----------|-------|--------|-------------------|-------|----------------|------------|-------|--------|-------|----|---------|---------|
| 14 | UE | 2 | 15 | -4 | 0. | 0. | 5.45 | 0. | 0. | -4.00 | | 15 | B..3..A | |
| 57 | R4 | K | 44 | -1 | 0..0 | 0..0 | 0..0 | 0..0 | <5..4 | -90..0 | | 15 | B..3..B | |
| 58 | R4 | K | 44 | -1 | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | -2..0 | | 16 | B..2..A | |
| 59 | R4 | K | 44 | -1 | 0..0 | 0..0 | 0..0 | 0..0 | 10..0 | 45..0 | | 16 | B..3..B | |
| 60 | IH | 4 | 16 | -1 | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | -2..0 | | 17 | B..3..A | |
| 61 | IH | 4 | 16 | -1 | 0..0 | 0..0 | 0..0 | 0..0 | 10..0 | -45..0 | | 17 | B..3..B | |
| 62 | 10..0 | 609..73 | -0 | 1..0 | 20..0 | 10..0 | 0..09 | 23..0 | 0..0 | 20..0 | | 1 | B..4..A | |
| 63 | 20..94460..923 | -0 | 1..0 | 35..0 | 34..38160..923..0 | 0..0 | 1..0 | 35..0 | | 35..0 | | 2 | B..4..A | |
| 64 | 17..17460..923 | -0 | 1..0 | 25..0 | 0..01160..923..0 | 0..0 | 1..0 | 35..0 | | 35..0 | | 3 | B..4..A | |
| 65 | 21..29360..923 | -0 | 1..0 | 25..0 | 0..01160..923..0 | 0..0 | 1..0 | 35..0 | | 35..0 | | 4 | B..4..A | |
| 66 | -0 | 609..23 | -0 | 1..0 | 85..5 | 0..0 | 0..09..23..0 | 0..0 | 1..0 | 70..0 | | 5 | B..4..A | |
| 67 | -0 | 16..1754 | -0 | 1..0 | 90..0 | 0..0 | 1000..0..0 | 0..0 | 1..0 | 90..0 | | 6 | B..4..A | |
| 68 | -0 | 0..0 | -0 | 1..0 | 90..0 | 0..0 | 1000..0..0 | 0..0 | 1..0 | 0..0 | | 7 | B..4..A | |
| 69 | -0 | 621..51 | -0 | 1..0 | 90..0 | 0..0 | 0..0 | 0..0 | 1..0 | 90..0 | | 8 | B..4..A | |
| 70 | -0 | 609..23 | -0 | 1..0 | 85..5 | 0..0 | 0..09..23..0 | 0..0 | 1..0 | 10..5 | | 9 | B..4..A | |
| 71 | -0 | 16..1754 | -0 | 1..0 | 90..0 | 0..0 | 1000..0..0 | 0..0 | 1..0 | 90..0 | | 10 | B..4..A | |
| 72 | -0 | 621..51 | -0 | 1..0 | 90..0 | 0..0 | 0..0..4..31..0 | 0..0 | 1..0 | 90..0 | | 11 | B..4..A | |
| 73 | -0 | 609..23 | -0 | 1..0 | 15..5 | 0..0 | 0..09..23..0 | 0..0 | 1..0 | 180..0 | | 12 | B..4..A | |
| 74 | -0 | 11..691 | -0 | 1..0 | - | 80..0 | 0..0 | 1000..0..0 | 0..0 | 1..0 | 90..0 | | 13 | B..4..A |
| 75 | -0 | 609..23 | -0 | 1..0 | 75..5 | 0..0 | 0..09..23..0 | 0..0 | 1..0 | 180..0 | | 14 | B..4..A | |
| 76 | -0 | 11..691 | -0 | 1..0 | 80..0 | 0..0 | 1000..0..0 | 0..0 | 1..0 | 90..0 | | 15 | B..4..A | |
| 77 | -0 | 600..0 | -0 | 1..0 | 45..0 | 0..0 | 600..0..0 | 0..0 | 1..0 | 90..0 | | 16 | B..4..A | |
| 78 | -0 | 600..0 | -0 | 1..0 | 45..0 | 0..0 | 600..0..0 | 0..0 | 1..0 | 90..0 | | 17 | B..4..A | |
| 79 | 10..0 | 10..0 | 30..0 | | | | | | | | | 1 | B..5..A | |
| 80 | 10..4..12 | 10..00 | 30..0 | | | | | | | | | 2 | B..5..A | |
| 81 | 1..745 | 10..00 | 30..0 | | | | | | | | | 3 | B..5..A | |
| 82 | 1..745 | 10..00 | 30..0 | | | | | | | | | 4 | B..5..A | |
| 83 | 3..957 | 10..0 | 30..0 | | | | | | | | | 5 | B..5..A | |
| 84 | 1..0 | 10..0 | 30..0 | | | | | | | | | 6 | B..5..A | |
| 85 | 0..0 | 0..0 | 1..0 | 505..5 | | | | | | | | 7 | B..5..A | |
| 86 | 0..4..36 | 10..0 | 30..0 | | | | | | | | | 8 | B..5..A | |
| 87 | 3..997 | 10..0 | 30..0 | | | | | | | | | 9 | B..5..A | |
| 88 | 1..0 | 10..0 | 30..0 | | | | | | | | | 10 | B..5..A | |
| 89 | 0..4..36 | 10..0 | 30..0 | | | | | | | | | 11 | B..5..A | |
| 90 | 0..0 | 0..0 | 30..0 | | | | | | | | | 12 | B..5..A | |
| 91 | 0..2 | 10..0 | 30..0 | | | | | | | | | 13 | B..5..A | |
| 92 | 0..0 | 0..0 | 30..0 | | | | | | | | | 14 | B..5..A | |
| 93 | 0..3 | 50..0 | 30..0 | | | | | | | | | 15 | B..5..A | |
| 94 | 1..0 | 100..0 | 40..0 | | | | | | | | | 16 | B..5..A | |
| 95 | 1..0 | 100..0 | 30..0 | | | | | | | | | 17 | B..5..A | |
| 96 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 1 | B..6.. | |
| 97 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 2 | B..6.. | |
| 98 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 3 | B..6.. | |
| 99 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 4 | B..6.. | |
| 100 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 5 | B..6.. | |
| 101 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 6 | B..6.. | |
| 102 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 7 | B..6.. | |
| 103 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 8 | B..6.. | |
| 104 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 9 | B..6.. | |
| 105 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 10 | B..6.. | |
| 106 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 11 | B..6.. | |
| 107 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 12 | B..6.. | |
| 108 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 13 | B..6.. | |
| 109 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 14 | B..6.. | |
| 110 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 15 | B..6.. | |
| 111 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 16 | B..6.. | |
| 112 | | | | | | | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 17 | B..6.. | |
| 113 | VHICL | A1 | RHS1 | - | PASSENGER | MVTRK | A1 | 10..WPH | 0..0 | 0..0 | 0..0 | 18 | B..5.. | |
| 114 | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | 0..0 | -2 | 0..0 | 19 | C..2.. | |
| 115 | | | | | | | | | | | | | | |

Figure 8. Listing of Baseline pedestrian Impact Input Data File. (Page 2 of 6)

TABLE 8. Listing of Baseline Pedestrian Impact Input Data File. (Page 3 of 6)

| | | | | | | | | | | | | | |
|-----|----|----|---|-------|------|-----|------|----|----|-----|----|----|----|
| 176 | 12 | 12 | 0 | 0.000 | 1.52 | 1.0 | 5.22 | 0. | 0. | .95 | 4. | 0. | 0. |
| 177 | 13 | 13 | 0 | 0.000 | 1.87 | 1.4 | 6.88 | 0. | 0. | 0. | 0. | 0. | 0. |
| 178 | 14 | 14 | 0 | 0.000 | 1.07 | 1.4 | 5.75 | 0. | 0. | 0. | 0. | 0. | 0. |
| 179 | 15 | 15 | 0 | 0.000 | 1.41 | 1.4 | 6.64 | 0. | 0. | 0. | 0. | 0. | 0. |
| 180 | 16 | 16 | 0 | 0.000 | 1.01 | 1.4 | 5.75 | 0. | 0. | 0. | 0. | 0. | 0. |
| 181 | 17 | 17 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 182 | 18 | 18 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 183 | 19 | 19 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 184 | 20 | 20 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 185 | 21 | 21 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 186 | 22 | 22 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 187 | 23 | 23 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 188 | 24 | 24 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 189 | 25 | 25 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 190 | 26 | 26 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 191 | 27 | 27 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 192 | 28 | 28 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 193 | 29 | 29 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 194 | 30 | 30 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 195 | 31 | 31 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 196 | 32 | 32 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 197 | 33 | 33 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 198 | 34 | 34 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 199 | 35 | 35 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 200 | 36 | 36 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 201 | 37 | 37 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 202 | 38 | 38 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 203 | 39 | 39 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 204 | 40 | 40 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 205 | 41 | 41 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 206 | 42 | 42 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 207 | 43 | 43 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 208 | 44 | 44 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 209 | 45 | 45 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 210 | 46 | 46 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 211 | 47 | 47 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 212 | 48 | 48 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 213 | 49 | 49 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 214 | 50 | 50 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 215 | 51 | 51 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 216 | 52 | 52 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 217 | 53 | 53 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 218 | 54 | 54 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 219 | 55 | 55 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 220 | 56 | 56 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 221 | 57 | 57 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 222 | 58 | 58 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 223 | 59 | 59 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 224 | 60 | 60 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 225 | 61 | 61 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 226 | 62 | 62 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 227 | 63 | 63 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 228 | 64 | 64 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 229 | 65 | 65 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 230 | 66 | 66 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 231 | 67 | 67 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 232 | 68 | 68 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 233 | 69 | 69 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 234 | 70 | 70 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |
| 235 | 71 | 71 | 0 | 0.000 | 1.01 | 1.2 | 5.7 | 0. | 0. | 0. | 0. | 0. | 0. |

TABLE 8. Listing of Baseline Pedestrian Impact Input Data File. (Page 4 of 6)

TABLE 8. Listing of Baseline Pedestrian Impact Input Data File. (Page 5 of 6)

| | | | | | |
|-----|------|------|--------|-----|-------|
| 216 | 14 | 3 | | | F-1-B |
| 217 | 15 | 1 | | | F-1-A |
| 218 | 15 | 3 | | | F-1-B |
| 219 | 16 | 1 | | | F-1-A |
| 240 | 16 | 3 | | | F-1-B |
| 261 | 17 | 0 | | | F-1-A |
| 262 | 18 | 0 | | | F-1-A |
| 263 | 19 | 0 | | | F-1-B |
| 244 | 10.0 | 0 | 40.0 | 0 | |
| 245 | -7.5 | 15. | -33.12 | 0 | |
| 246 | -90. | 0.0 | -15. | 1 | 6.2 |
| 247 | -90. | 0.0 | -15. | 1 | 6.3 |
| 248 | -90. | 0.0 | -15. | 2 | 6.3 |
| 249 | -90. | 0.0 | -15. | 3 | 6.3 |
| 249 | -90. | 0.0 | -15. | 4 | 6.3 |
| 250 | -90. | 0.0 | -15. | 5 | 6.3 |
| 251 | -90. | 0.0 | 10. | 6 | 6.3 |
| 252 | -90. | 0.0 | 6.0 | 7 | 6.3 |
| 253 | -90. | 0.0 | 6.0 | 8 | 6.3 |
| 254 | -90. | 0.0 | 90. | 9 | 6.3 |
| 255 | -90. | 0.0 | -10. | 10 | 6.3 |
| 256 | -90. | 0.0 | -25. | 11 | 6.3 |
| 257 | -90. | 0.0 | 70. | 12 | 6.3 |
| 258 | -90. | 12. | -6. | 13 | 6.3 |
| 259 | -90. | -12. | -6. | 14 | 6.3 |
| 260 | -90. | -15. | -6. | 15 | 6.3 |
| 261 | -90. | 45.0 | 43. | 16 | 6.3 |
| 262 | -90. | -30. | -6. | 17 | 6.3 |
| 263 | -90. | 30. | 43. | 18 | 6.3 |
| 264 | 1 | 0.0 | 0.0 | 0.0 | H-1-A |
| 265 | 3 | 0.0 | 0.0 | 0.0 | H-1-B |
| 266 | 5 | 0.0 | 0.0 | 0.0 | H-1-B |
| 267 | 6 | 0.0 | 0.0 | 0.0 | H-1-B |
| 268 | 7 | 0.0 | 0.0 | 0.0 | H-1-B |
| 269 | 8 | 0.0 | 0.0 | 0.0 | H-1-B |
| 270 | 9 | 0.0 | 0.0 | 0.0 | H-1-B |
| 271 | 10 | 0.0 | 0.0 | 0.0 | H-1-B |
| 272 | 11 | 0.0 | 0.0 | 0.0 | H-1-B |
| 273 | 12 | 0.0 | 0.0 | 0.0 | H-1-B |
| 274 | 13 | 0.0 | 0.0 | 0.0 | H-1-B |
| 275 | 14 | 0.0 | 0.0 | 0.0 | H-1-B |
| 276 | 15 | 0.0 | 0.0 | 0.0 | H-1-B |
| 277 | 16 | 0.0 | 0.0 | 0.0 | H-1-B |
| 278 | 17 | 0.0 | 0.0 | 0.0 | H-1-B |
| 279 | 18 | 0.0 | 0.0 | 0.0 | H-1-B |
| 280 | 0 | 0.0 | 0.0 | 0.0 | H-2-A |
| 281 | 16 | 1 | 0.0 | 0.0 | H-3-A |
| 282 | 3 | 0.0 | 0.0 | 0.0 | H-3-B |
| 283 | 5 | 0.0 | 0.0 | 0.0 | H-3-B |
| 284 | 6 | 0.0 | 0.0 | 0.0 | H-3-B |
| 285 | 7 | 0.0 | 0.0 | 0.0 | H-3-B |
| 286 | 8 | 0.0 | 0.0 | 0.0 | H-3-B |
| 287 | 9 | 0.0 | 0.0 | 0.0 | H-3-B |
| 288 | 10 | 0.0 | 0.0 | 0.0 | H-3-B |
| 289 | 11 | 0.0 | 0.0 | 0.0 | H-3-B |
| 290 | 12 | 0.0 | 0.0 | 0.0 | H-3-B |
| 291 | 13 | 0.0 | 0.0 | 0.0 | H-3-B |
| 292 | 14 | 0.0 | 0.0 | 0.0 | H-3-B |
| 293 | 15 | 0.0 | 0.0 | 0.0 | H-3-B |
| 294 | 16 | 0.0 | 0.0 | 0.0 | H-3-B |
| 295 | 17 | 0.0 | 0.0 | 0.0 | H-3-B |

TABLE 8. Listing of Baseline Pedestrian Impact Input Data File. (Page 6 of 6)

| | | | | | | | | | | | | |
|-------------|----|----|----|----|---|---|---|----|----|----|----|-------|
| 296 | 18 | 3 | 5 | 6 | 7 | 9 | 9 | 10 | 11 | 12 | 13 | 16 |
| 297 | 10 | 1 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | H,3,A |
| 298 | 6 | | | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | H,4,A |
| 299 | 1C | 1 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | H,5,A |
| 300 | 14 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | H,6,A |
| 301 | 13 | 12 | 12 | 14 | | | | | | | | H,7,A |
| END OF FILE | | | | | | | | | | | | |

| | | | | | | | | | | | |
|------|----|-----|--------|-----|------|------|-------|-----|--------|-------|---------|
| 37 | RK | R | 6 | -6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| * 38 | | | | | 0. | 0. | 6.79 | 0. | 0. | -1.75 | 5 B.3.B |
| 39 | | | | | 0.0 | 0.0 | 0.0 | 0.0 | -60.0 | 0.0 | 6 B.3.A |
| | | | | | | | | | | | 6 B.3.B |
| 66 | . | 0 | 609.23 | 0 | 1.0 | 85.5 | . | 0 | 609.23 | 0 | 5 B.4.A |
| * 67 | . | 0 | 1000.0 | 0 | 1.0 | 90.0 | . | 0 | 16.754 | 0 | 6 B.4.A |
| * 68 | . | 0 | 1000.0 | 0 | 1.0 | 90.0 | . | 0 | 1.0 | 90.0 | 6 B.4.B |
| 69 | . | 0 | 0.0 | 0.0 | 1.0 | 0.0 | . | 0 | 0.0 | 0.0 | 7 B.4.A |
| | | | | | | | | | | | |
| 85 | | 0.0 | | | 0.0 | 1.0 | 505.5 | | | | 6 B.5.A |
| * 86 | | 1.0 | | | 10.0 | 30.0 | | | | | 6 B.5.B |
| * 87 | | 0.0 | | | 0.0 | 1.0 | 505.5 | | | | 6 B.5.C |
| 88 | | 0.0 | | | 0.0 | 1.0 | 505.5 | | | | 7 B.5.A |

*New or changed lines

TABLE 9. Changes to Baseline Pedestrian for Euler Joint Knee.

5.4 REPRESENTATIVE SIDE IMPACT OUTPUT

Figures 14 and 15 are a graphical presentation of some of the important kinematic variables produced by the computer exercise using the baseline side impact data. Figure 14 shows the major contact with the side structures at approximately 70 ms. By this time the space between the occupant and the side structures are used up. An additional major contact is noted at approximately 30 ms for the lower torso. This is caused by the intrusion of the lower door contact panel into the occupant compartment. This intrusion uses up the "slack" between the occupant and the side structures at an earlier point in time indicating the sensitivity of phasing of occupant contact with side structures to intrusion.

Figure 15 shows a trace of the motions of several body segments during the simulation. Lower torso excursion is relatively small due to the early interaction with side structures. The head pitches to the side but interacts only with the side header and B-pillar in this simulation. The fact that lower torso motion is limited prohibits the head from moving too far to the side.

Table 10 is a summary of all occupant/vehicle contact interactions. The time, deflection, and force are given for initiation of contact, peak force, and the final time of a contact event. In some cases it is seen that the peak force occurs at the end of the simulation. For a further study of the output, including cases of multiple peaks such as occurs for the lower torso, it is necessary to review the complete simulation output.

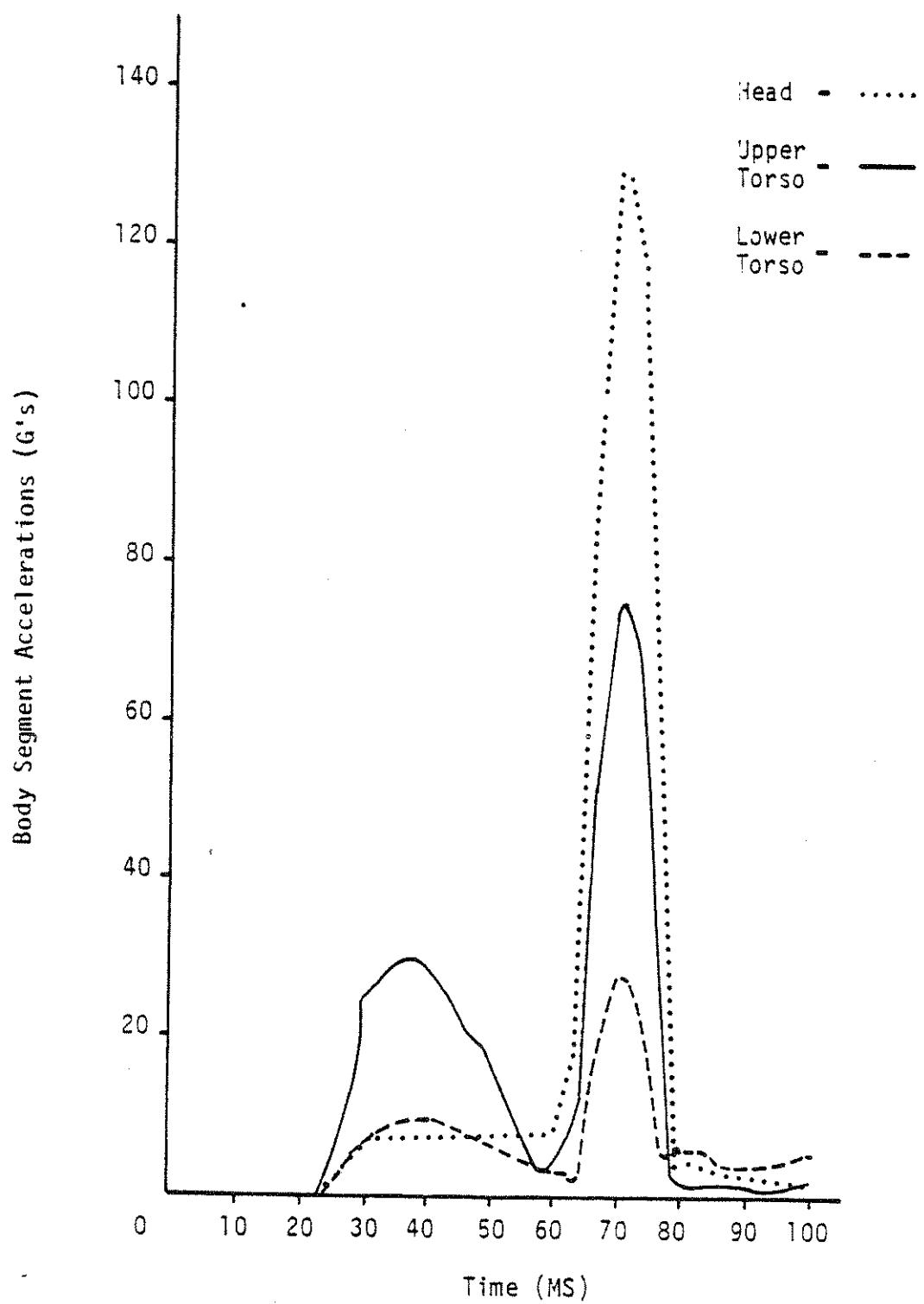


Fig. 14 Body Segment Accelerations. Side Impact

Dots are c-g positions
every 5 ms. starting at
20 ms.

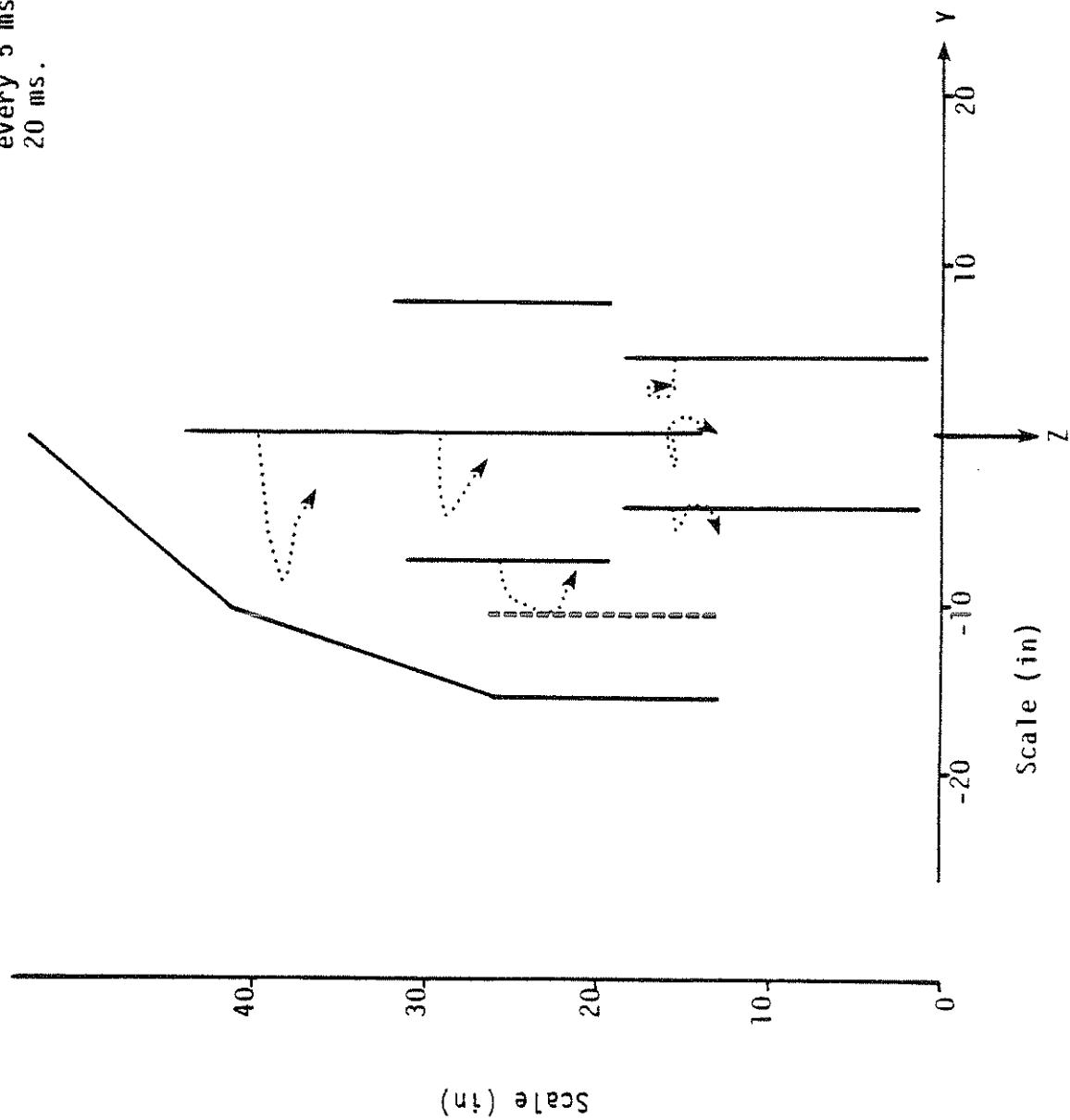


Fig. 15 Body Segment Motions. Side Impact.

TABLE 10. Side Impact Occupant Vehicle Contact History

| E11psoid Name | Contact Name | Initial Contact | | | Peak Contact | | | Final Contact | | |
|-----------------|----------------|-----------------|-----------------|------------|--------------|-----------------|------------|---------------|-----------------|------------|
| | | Time (ms) | Deflection (in) | Force (1b) | Time (ms) | Deflection (in) | Force (1b) | Time (ms) | Deflection (in) | Force (1b) |
| LOWER TORSO | SEAT BACK | 88 | 0.0 | .3 | 100 | 0.1 | 4 | 100 | 0.1 | 4 |
| LOWER TORSO | SEAT CUSHION | 0 | 2.5 | 100 | 100 | 4.1 | 162 | 100 | 4.1 | 162 |
| LOWER TORSO | HIP PANEL | 28 | 0.1 | 93 | 39 | 0.9 | 929 | 57 | 0.0 | 12 |
| UPPER TORSO | DOOR | 60 | 0.1 | 66 | 71 | 0.9 | 668 | 81 | 0.0 | 14 |
| HEAD | HEADER | 62 | 0.1 | 119 | 70 | 1.0 | 965 | 78 | 0.2 | 149 |
| HEAD | B-PILLAR | 65 | 0.2 | 738 | 71 | 0.9 | 3579 | 78 | 0.1 | 274 |
| RIGHT UPPER LEG | SEAT CUSHION | 0 | 0.1 | 3 | 28 | .1 | 4 | 36 | 0.0 | 1 |
| | | 92 | 0.1 | 2 | 100 | 0.8 | 32 | 100 | 0.8 | 32 |
| LEFT UPPER LEG | SEAT CUSHION | 0 | 0.1 | 3 | 100 | 2.5 | 101 | 100 | 2.5 | 101 |
| LEFT UPPER LEG | HIP PANEL | 24 | 0.3 | 252 | 36 | 2.0 | 2002 | 100 | 0.7 | 675 |
| LEFT FOOT | FLOOR | 71 | 0.1 | 52 | 80 | 0.5 | 421 | 89 | 0.0 | 13 |
| RIGHT UPPER LEG | LEFT UPPER LEG | 50 | 0.0 | 40 | 60 | 0.8 | 783 | 100 | 0.0 | 47 |
| RIGHT LOWER LEG | LEFT LOWER LEG | 84 | 0.0 | 20 | 90 | 0.3 | 302 | 97 | 0.0 | 33 |

5.5 REPRESENTATIVE PEDESTRIAN IMPACT OUTPUT

Figure 16 includes a series of frames showing pedestrian kinematics at various time points during the exercise. The initial bumper contact with the lower right leg segments starts at 20 milliseconds and is over by 30 milliseconds. The grille, grille top and hood contact with the right upper leg and lower torso starts at 55 milliseconds and is over by 70 milliseconds. The pedestrian remains essentially upright throughout the time of initial contact involvement with the vehicle and for a long time thereafter.

Table 11 is a summary of all pedestrian/vehicle exterior contacts. As in Table 10, the time, deflection and force are given for initiation of contact, peak force and the final time of each contact event. Peak loads on the lower leg are somewhat in excess of human tolerance values for leg fracture. It is not known how the values compare with forces necessary to fracture the leg of a Part 572.

Figures 17-22 are plots of the G-levels predicted in several of the body segments. Generally the phasing of peak accelerations progresses from the initial leg contacts up through the head.

It should be noted that the torso segments, the head, and the neck operate as a single mass unit. The joints connecting these masses were locked with no unlocking torque provided. This contributes to the continuing upright position of the torso during much of the run. The addition of realistic flexibility to the spine would decrease this effect.

It should also be noted that the force-deflection curves used to govern the interactions between the vehicle and pedestrian are hypothetical and do not account for absorption of energy. This tends to increase the energy input to the lower extremities beyond what would normally be expected in a more realistic simulation.

In conclusion, the data set for simulation of a pedestrian interacting with the front of a vehicle is complete and functional. The location and shape of vehicle surfaces represents probably the most advanced information available. Likewise, position is based on human walking posture and a typical impact site both from the viewpoint of the vehicle

and the pedestrian. The leg fracture model is totally new. The two shortcomings in the data set relate to vehicle deformation properties and specification of joint properties in the pedestrian. Within the data framework already established it should not be difficult to improve these quantities when application to real vehicle problems is required.

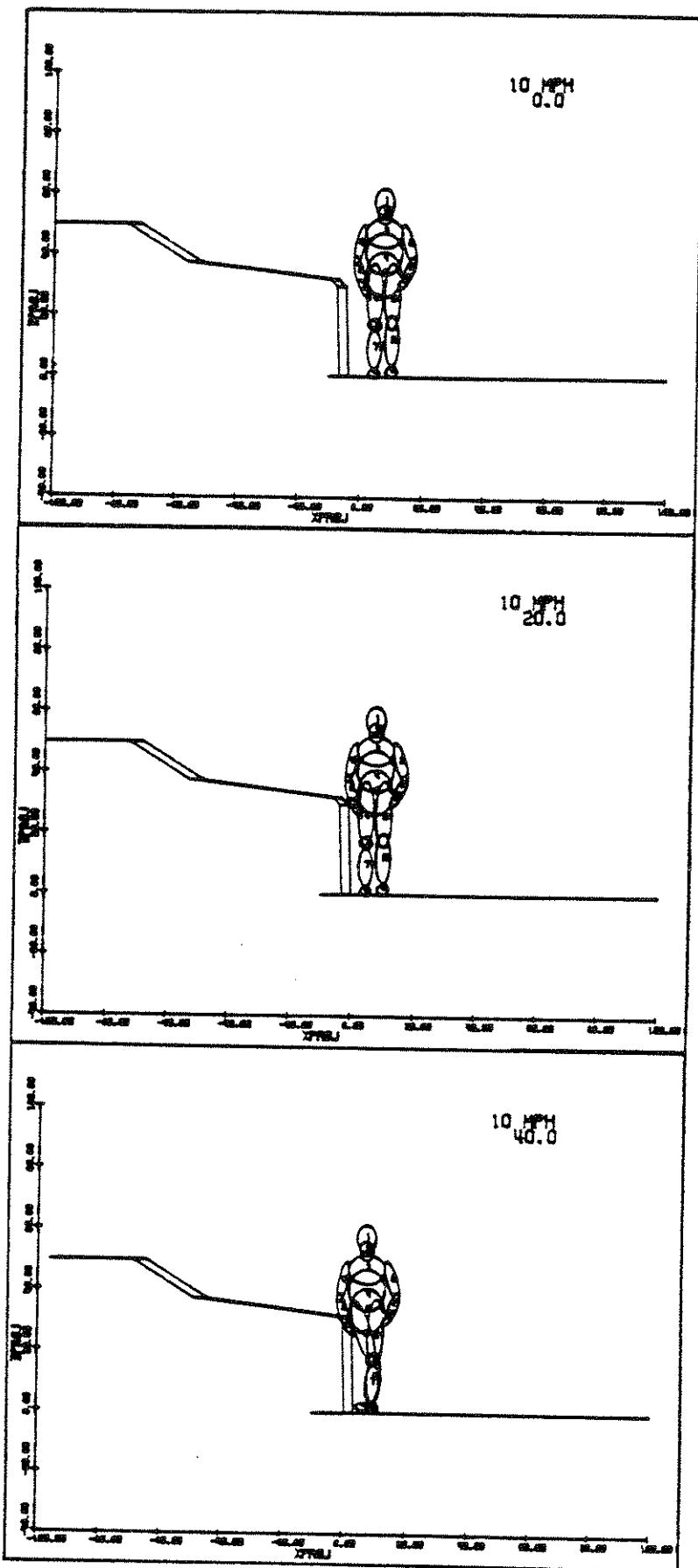


Fig. 16. Pedestrian Kinematics. (1 of 3; 0, 20, 40 ms)

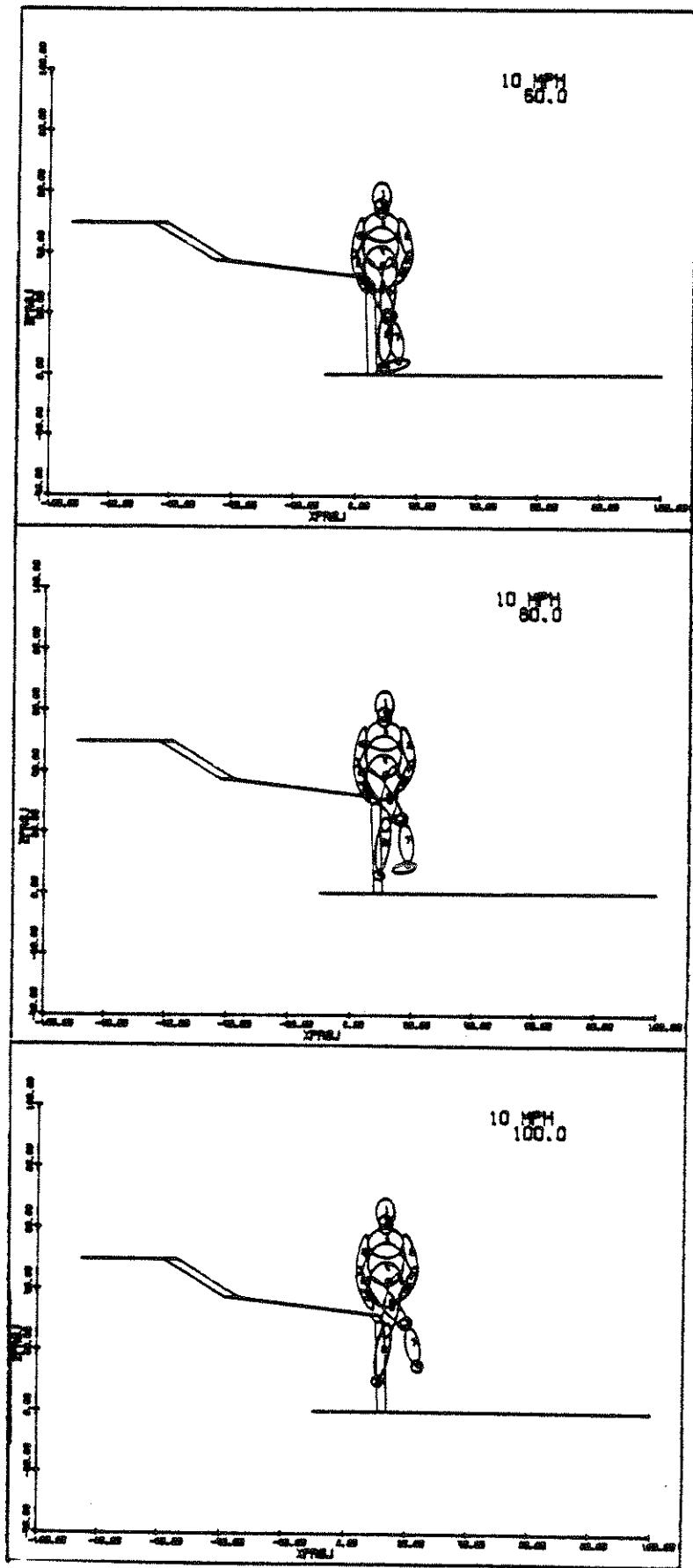


Fig. 16. Pedestrian Kinematics. (2 of 3; 60, 80, 100 ms)

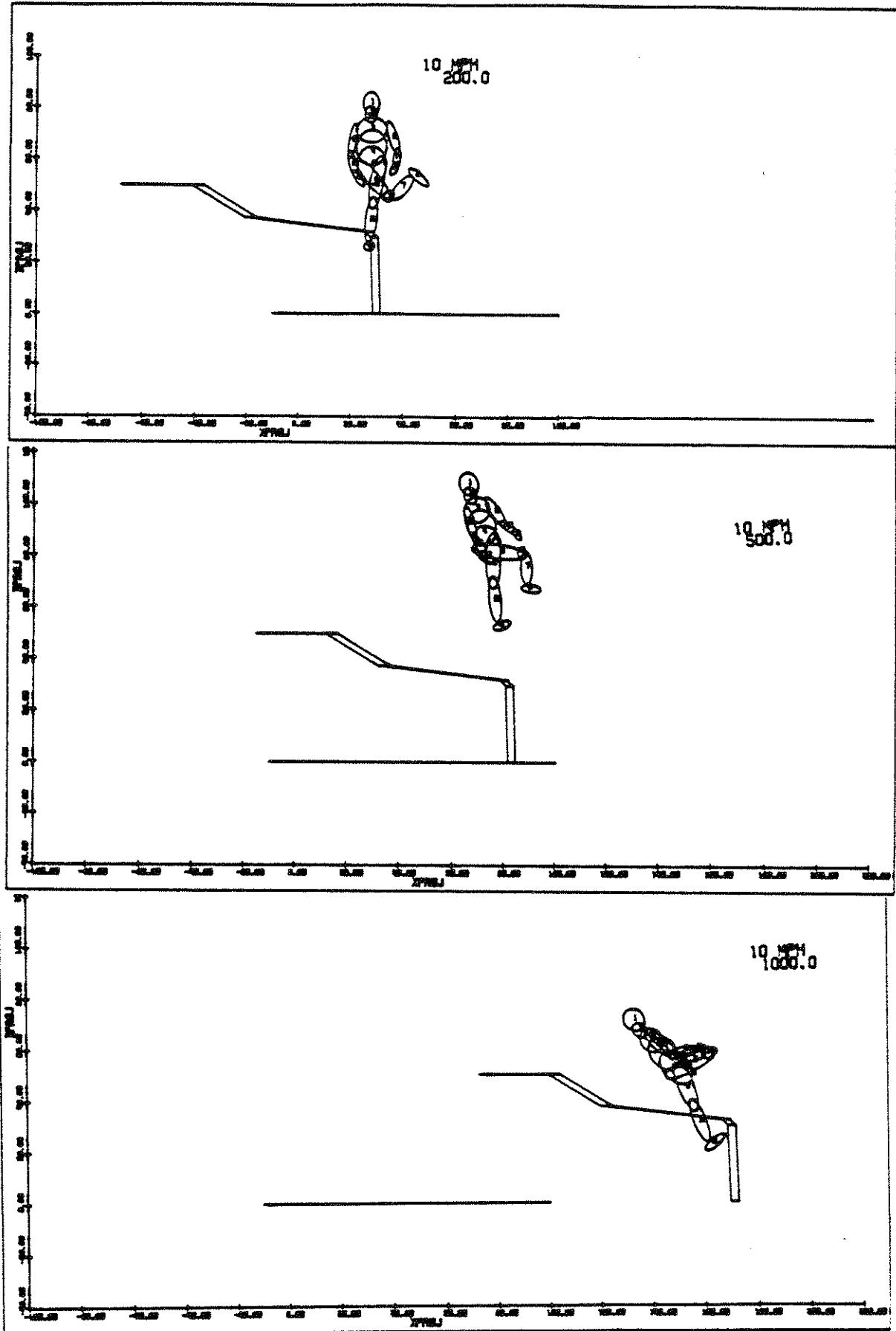


Fig. 16. Pedestrian Kinematics. (3 of 3; 200, 500, 1000 ms)

TABLE 11. PEDESTRIAN/VEHICLE CONTACT HISTORY

| Ellipsoid Name | Contact Name | Initial Contact | | | Peak Contact | | | Final Contact | | |
|-----------------|----------------|----------------------|------------|-----------|-----------------------|-----------|------------|----------------------|------------|------|
| | | Time Deflection (ms) | Force (in) | Time (ms) | Deflection Force (in) | Time (ms) | Force (in) | Time Deflection (ms) | Force (in) | |
| Lower Torso | Hood | 65. | .03 | 35. | 65. | .03 | 35. | 65. | .03 | 35. |
| | Grille Top | 55. | .31 | 611. | 60. | .56 | 1127. | 70. | .00 | 10. |
| Right Upper Leg | Grille Top | 55. | .19 | 381. | 65. | .85 | 1705. | 70. | .28 | 567. |
| | Grille | 55. | .12 | 122. | 65. | .79 | 786. | 70. | .24 | 244. |
| Right Knee | Bumper | 20. | .45 | 454. | 25. | .77 | 738. | 30. | .07 | 70. |
| | | 60. | .73 | 732. | 65. | .92 | 922. | 70. | .05 | 53. |
| Right Shin | Bumper | 20. | .41 | 410. | 25. | .90 | 896. | 30. | .47 | 474. |
| Right Foot | Ground | 0. | .28 | 132. | 0. | .28 | 132. | 30. | .03 | 13. |
| Left Foot | Ground | 0. | .08 | 38. | 40. | .17 | 80. | 45. | .11 | 53. |
| Right Lower Arm | Hood | 40. | 1.35 | 1352. | 50. | 3.01 | 3011. | 70. | .52 | 518. |
| Right Upper Leg | Left Upper Leg | 35. | .14 | 69. | 80. | 1.35 | 600. | 295. | .00 | 2. |

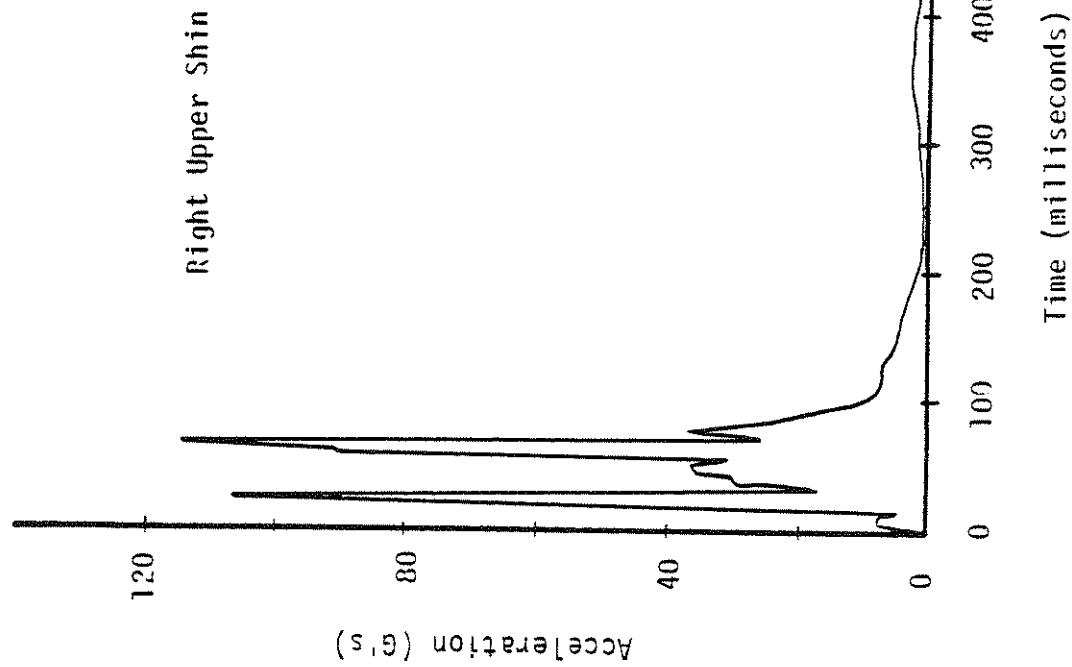


Fig. 17. Right Upper Shin Acceleration
Pedestrian Impact (10 mph)

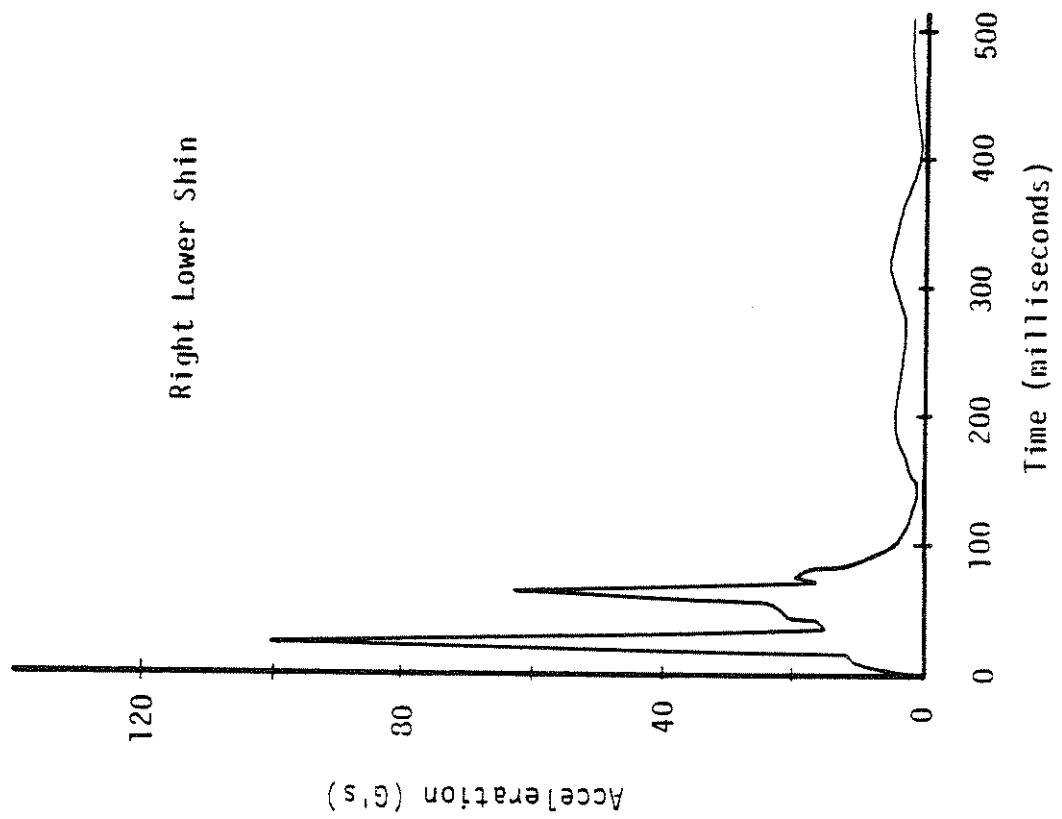


Fig. 16. Right Lower Shin Acceleration
Pedestrian Impact (10 mph)

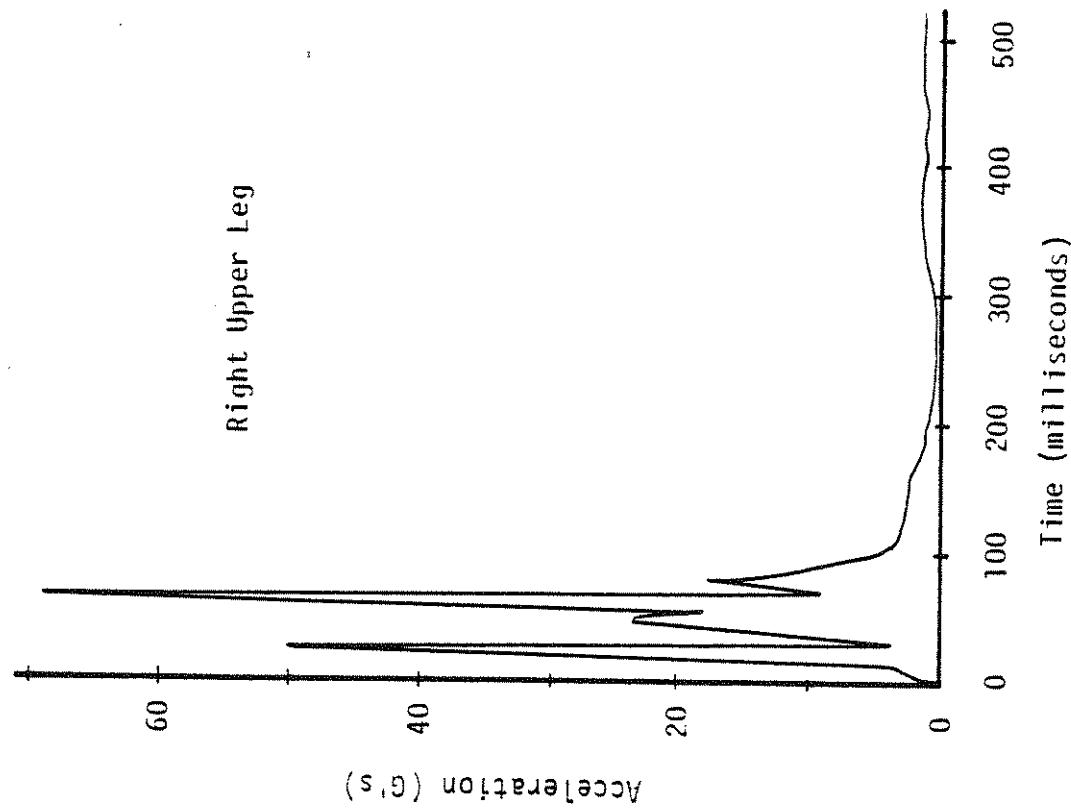


Fig. 19. Right Upper Leg Acceleration.
Pedestrian Impact (10 mph)

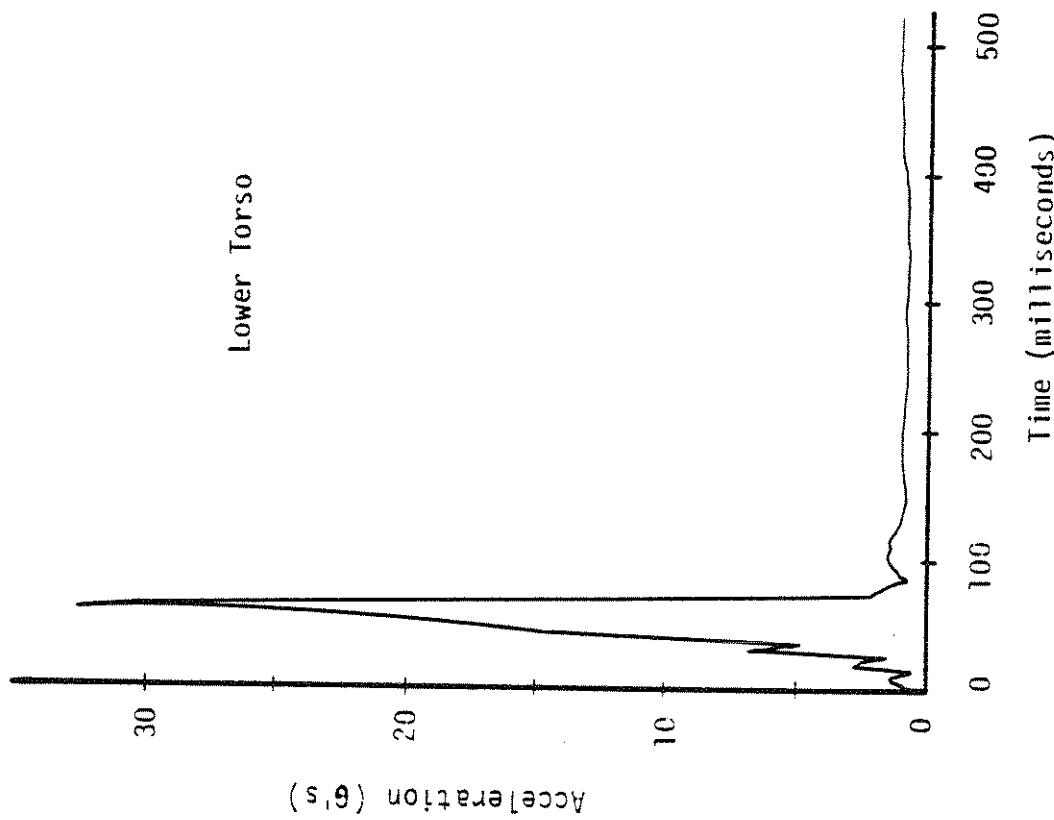


Fig. 20. Lower Torso Acceleration.
Pedestrian Impact (10 mph)

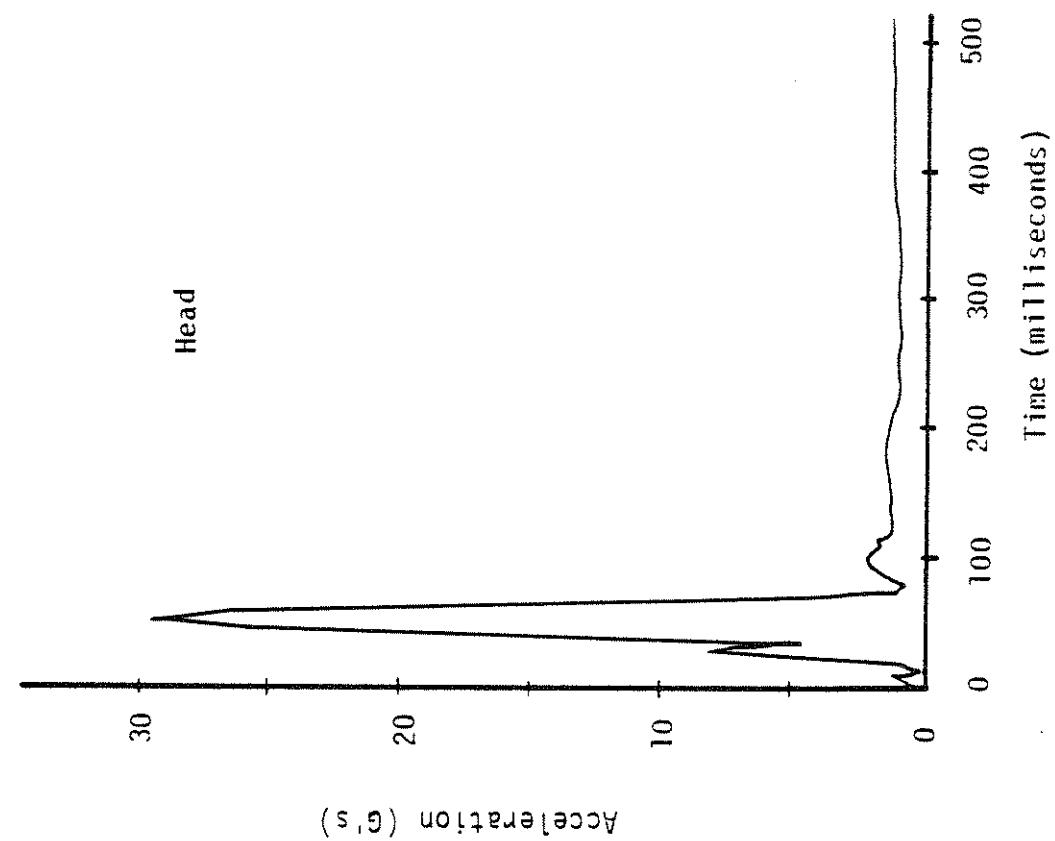


Fig. 22. Head Accelerations.
Pedestrian Impact (10 mph)

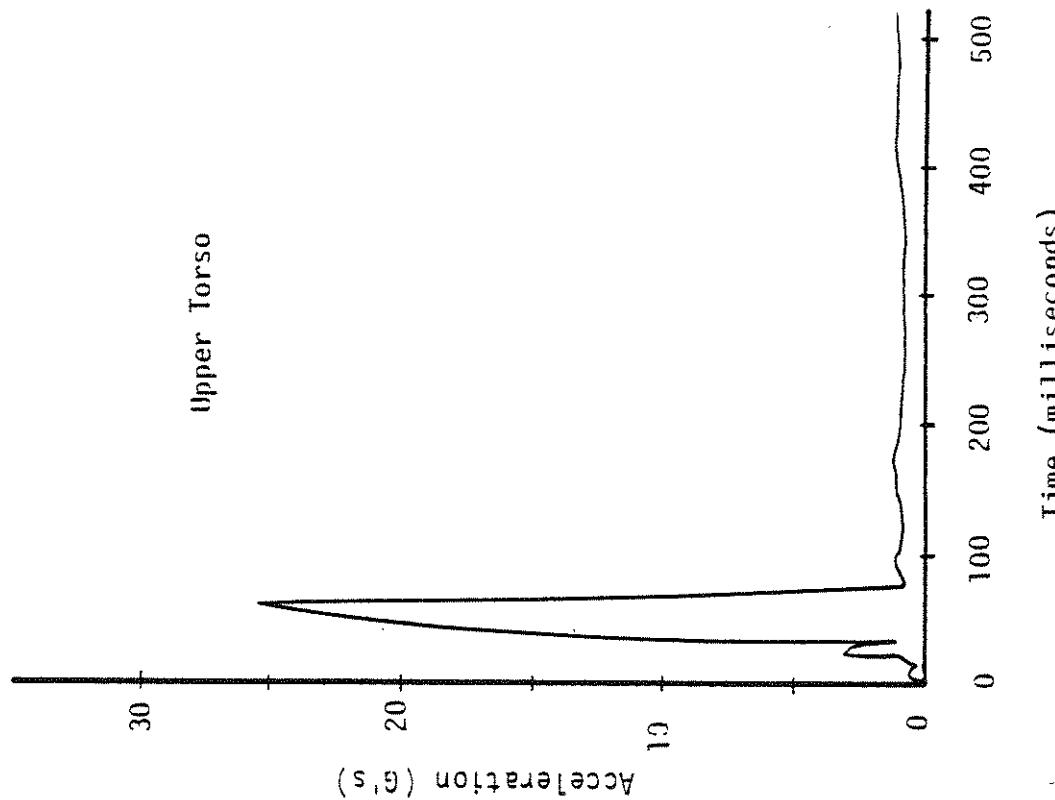


Fig. 21. Upper Torso Accelerations.
Pedestrian Impact (10 mph)

6.0 THE HSRI VERSION OF THE CALSPAN CVS

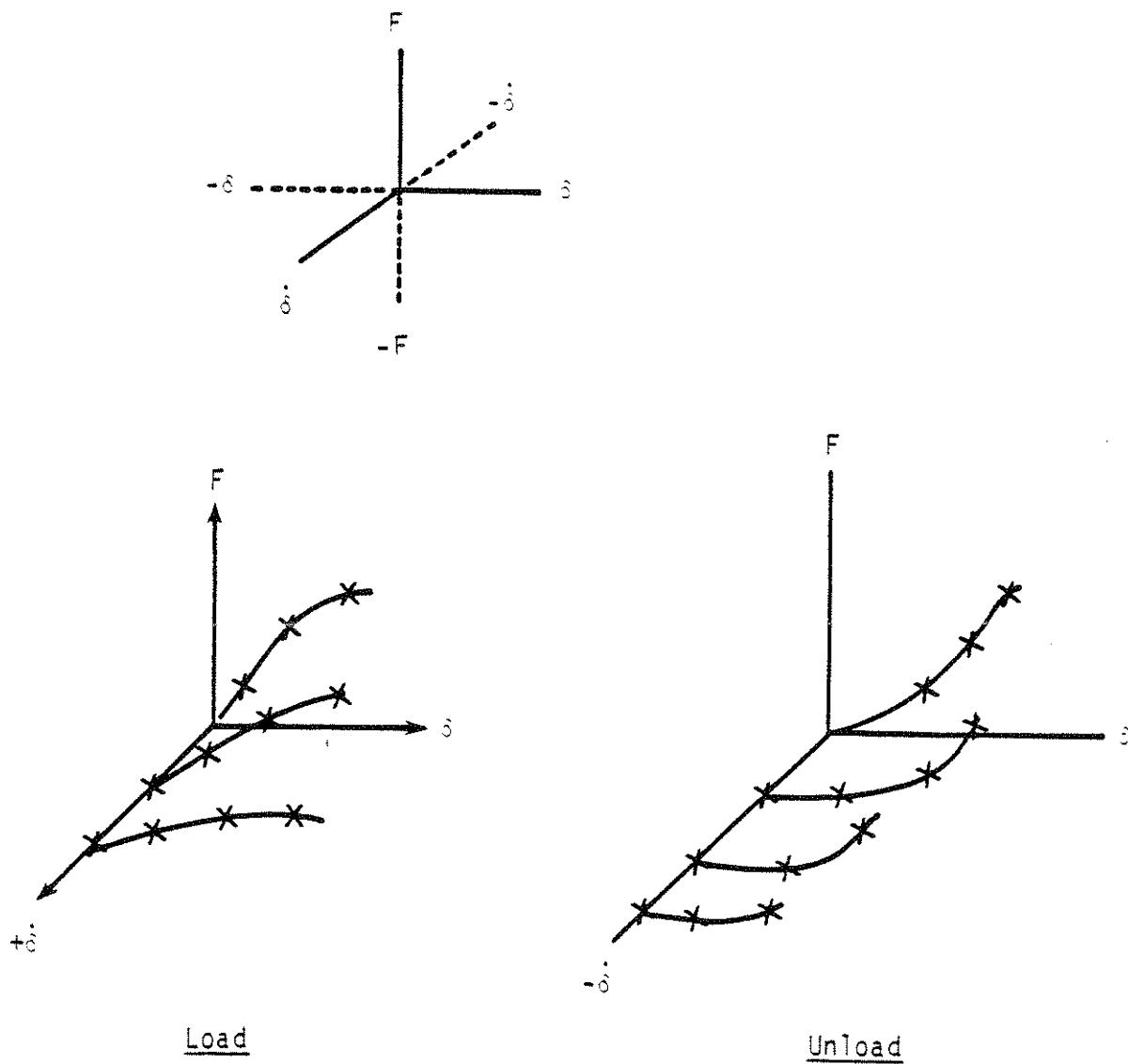
The HSRI version of the Calspan CVS has been and is being developed under NHTSA Contract No. DOT-HS-7-01659, "Occupant Side Impact Simulations Using CVS Program." The two sections of Part 6 describe the changes which have been made and the status of the code.

6.1 MODIFICATIONS TO ORIGINAL CALSPAN CVS PROGRAM

Several major and minor changes have been made to the original Calspan CVS program, Version 18-A, with some corrections being added from later Calspan issues. The most important changes have to do with the addition of mutual force-deformation properties for two contacting elements (ellipsoid/panel or ellipsoid/ellipsoid) and dynamic force-deflection relations. The concept of mutual deformation of contacting elements is drawn from earlier two- and three-dimensional modeling efforts at HSRI such as the MVMA 2-D model.

Figure 23 illustrates the means which has been coded for handling multiple dynamic force-deflection curves in the new CVS. It is first presumed that the rate of force application and deformation during a dynamic event (or computer simulation) is unknown ahead of time. In order to cope with this problem, it is necessary to have a description of material response under a range of dynamic loading conditions included as data with the operating program. A series of curves for different specimen loading and unloading rates may be available from an experimental program. Bivariate loading and unloading tables are the mechanism used to accomplish this. For the case of loading ($+\delta$) a series of curves are input at various loading rates. A similar series is shown for material unloading ($-\delta$). The software interpolates through this load-unload space to select that force-deformation curve which actually occurs based on the space of known material response data. Crosses on the curves hint at our recommendation for manual intervention or simplification of experimental curves. The software has been tested and is functioning properly for trial cases. It remains to validate it with real experimental data.

Bivariate Force-Deflection - Deflection Rate Input



Input data from structural material tests.

Figure 23.

Force discontinuities at the edge of contact surfaces received considerable attention in order to include features of the MVMA 2-D software such as a transition zone as an ellipsoid slides off the edge and a penetration limit to avoid large forces when an ellipsoid starts out behind a contact surface. Figure 24 illustrates the means by which corner intersections of surfaces are handled in the new simulation. In the Calspan CVS all contact surfaces were independent of one another. As a result it was very easy for an ellipsoid to go "behind" a surface. This is particularly true for the case of pedestrian impact. British Leyland modified the CVS to avoid this problem and generated forces as shown in the upper of the two sketches. The MVMA 2-D model had a further capability of adjusting the force direction for a corner impact. Aspects of the British Leyland and HSRI concepts were combined for a new 3-D corner simulation for use with the HSRI version of the CVS.

Several additional changes should also be mentioned. As has been described earlier in this report, moving contact surfaces with respect to a vehicle (or inertial) coordinate system have been added to facilitate the study of intrusion. Code corrections have been made to the ellipsoid versus ellipsoid contact interaction so that one may not "pass through" the other. To facilitate studies of side, oblique, and general six-dimensional deceleration events the software was modified to ease the burden of the user in setting up vehicle geometry in strange coordinate systems. Finally more output categories were provided for useful physical quantities and for kinematics in inertial coordinates.

Table 12 briefly summarizes the quantity of code which is new to the HSRI version of the Calspan CVS. There are 24 new routines. Most of these deal with the contact between surfaces and ellipsoids, the generation of mutual deformation of surfaces, and the inclusion of dynamic deflection rate terms. Major changes refer to changes of approximately two-thirds of the code while minor changes involve one-third. "No" changes indicates that the only changes were in dimension size and array names. It is estimated that approximately one third of the code is new.

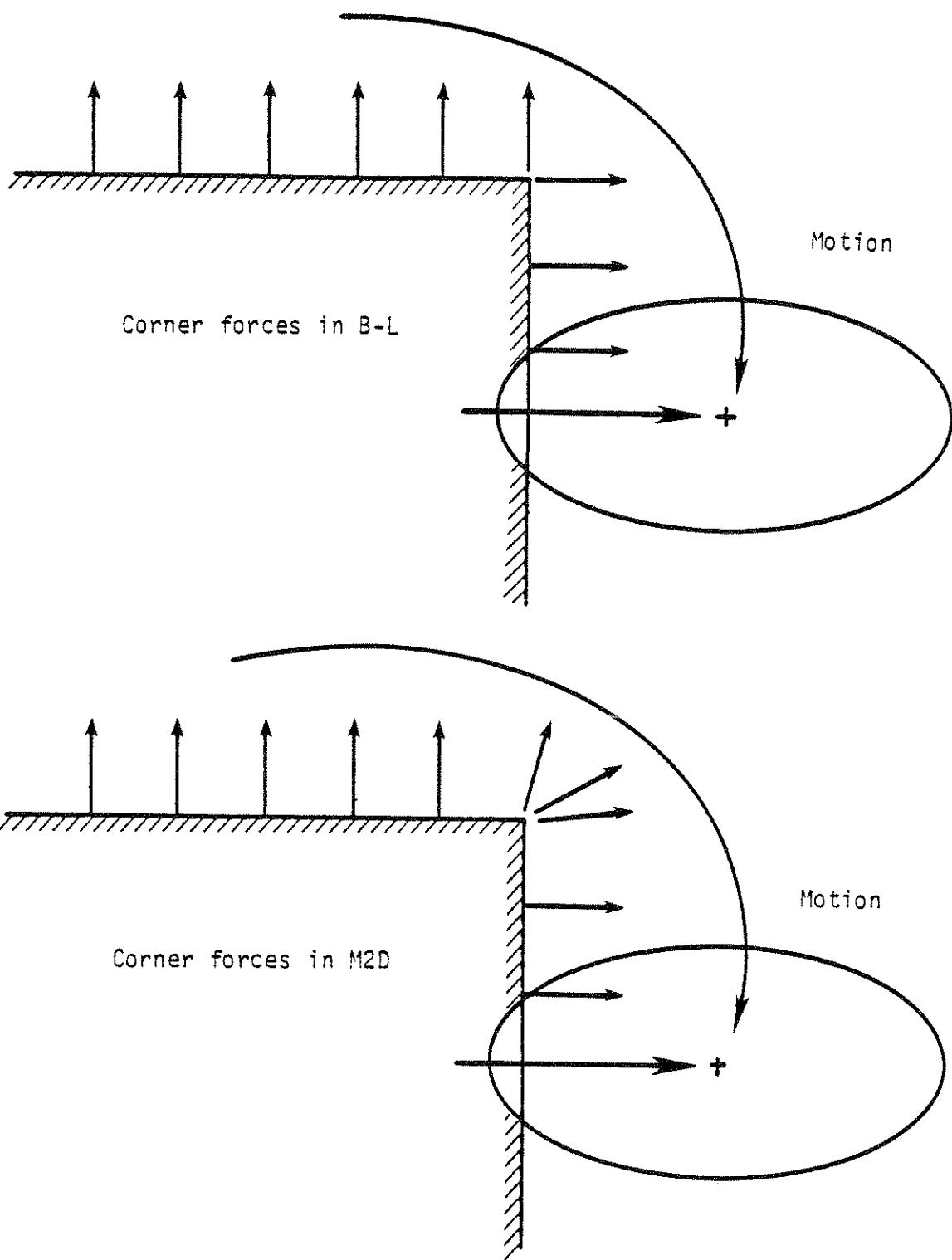


Fig. 24. Corner forces in British Leyland and MVMA 2-D Software

TABLE 12. CVS CODE CHANGES

| | | |
|-----------------|---|----|
| - New routines | - | 24 |
| - Major changes | - | 6 |
| - Some changes | - | 10 |
| - "No" changes | - | 72 |

6.2 STATUS OF SOFTWARE

The software which has been used in this project is functional and appears to operate correctly on the baseline data sets. Formal documentation of the algorithms will be initiated in early 1981. Only a summary input description for the various data cards has been delivered to the sponsor. The original contract on which this software was developed was scheduled for completion, including development of documentation and delivery of tapes, at the end of 1979. That schedule was in effect as we initiated this MVMA project. However, the sponsor requested modifications of HSRI work efforts in order to concentrate on development of a side impact dummy thorax. This has delayed completion of the documentation to the current estimate of mid-1981.

7.0 REFERENCES

1. Fleck, J. T., et al, "An Improved Three Dimensional Computer Simulation of Vehicle Crash Victims," 4 volume report on Contract No. DOT-HS-053-2-485, NTIS Nos. PB241692,3,4,5, April 1975.
2. Hubbard, R. P. and McLeod, D. G., "Geometric, Inertial, and Joint Characteristics of Two Part 572 Dummies for Occupant Modeling," SAE Paper No. 770937, Proc. 21st Stapp Car Crash Conf., pp. 933-972, October 1977.
3. Karnes, R. N., "CAL3D Crash Victim Simulation Computer Program User Manual," Report on MVMA Contract No. BCS 7501-C4.16, Boeing Computer Services, March 1975.
4. Viano, D. C. and Culver, C. C., "Performance of a Shoulder Belt and Knee Restraint in Barrier Crash Simulations," SAE Paper No. 791006, Proc. 23rd Stapp Car Crash Conf., pp. 105-132, October 1979.
5. Kramer, M., "Pedestrian Vehicle Accident Simulation Through Dummy Tests," SAE Paper No. 751165, Proc. 19th Stapp Car Crash Conf., pp. 705-724, November 1975.
6. Padgaonkar, A. J. and Prasad, P., "Simulation of Side Impact Using the CAL3D Occupant Simulation Model," SAE Paper No. 791007, Proc. 23rd Stapp Car Crash Conf., pp. 133-158, November 1979.
7. Siemonsen, H. D. and Bruckner, F., "Impacts on Plates, Particularly Glass Plates," SAE Paper No. 670924, Proc. 11th Stapp Car Crash Conf., pp. 293-298, November 1967.
8. Twigg, D. W. and Tocher, J. L., "Pedestrian Model Parametric Studies," 2 vol. report under Contract No. DOT-HS-356-3-719, NTIS Nos. DOT-HS-802419, 20, June 1977.

Highway Safety
Research Institute