MODULAR PROGRAM DEVELOPMENT

FOR VEHICLE CRASH SIMULATION, VOL. 3,

USERS' GUIDE FOR UMVCS-1

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16. Abstract

This Users' Guide to the UMVCS-1 is an instruction and information manual to enable the user to prepare an input data set for exercising the program. The guide describes

- the input quantities which must be provided to the executive section of the program
- a description and sample output of the executive system
- a description and sample of the output produced by the computer program
- an example problem including a sample data set and exercise of the program

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1. INTRODUCTION

This Users' Guide to the UMVCS-1 is an instruction and information manual to enable the user to prepare an input data set for exercising the program. The remaining four parts of the Guide describe:

- the input quantities which must be provided to the executive section of the program
- a description and sample output of the executive system
- a description and sample of the output produced by the computer program
- an example problem including a sample data set and exercise of the program

2. INPUT DESCRIPTION

Input to the Vehicle Crash Simulation consists of a series of eighty character cards describing the vehicle in very general terms. Although this program was developed for the simulation of the vehicle in a crash environment, the model is applicable to a wide range of structural problems.

A summary of the cards required to exercise this program is included as Table 1. This table contains an organization level in column one, the shortest abbreviation for the input card identification in column two, and a short description of the function of the card in three.

The input to this model is organized in three levels. The vehicle is described in terms of idealized subsystems called modules and the connections between the modules. Examples of possible modules are:

- forestructure

- frame
- passenger compartment
- firewall
- drive-train
- bumper
- rear body
- front suspension
- rear suspension

The modules are completely specified by the user in terms of structural components which may be either a general frame or a rigid body, and in terms of connections between the components. The frame components are specified by a set of nodal points connected by elements. The element library includes a large deformation plastic beam element and a variety of generalized mechanisms.

At present, there are no defaults built into the program, so the vehicle must be completely specified for each run. Table 2 contains a detailed description of each input card. The first column of this table shows a facsimile of the descriptive sentence which identifies the card together with markings which indicate possible abbreviations. The second includes sentence abbreviations corresponding to those used in Table 1. The third column includes necessary verbal information for comparing the data while the fourth column refers to line numbers in Table 4 which is a complete example data set.

Underlined letters in the first column are those upon which the identification of the card is made and must be included and correct. The identification process is confined to the first two words. These two words may be abbreviated by these two or three letters placed contiguously or separated by blanks. Any following words must appear as shown unless they are surrounded by parentheses or brackets. Parentheses indicate optional information which may be included for readability or user clarity. If optional information is included,

it must appear as shown. Sometimes optional information is required. The third column of the table will discuss the circumstances involved. Brackets enclose a number of choices separated by slashes. One such choice must be made and appear as shown. Every sentence must end with a period. Sentences may appear on a maximum of ten consecutive cards as needed.

Many sentences are followed by a data section. In such a case, the first column of Table 2 contains a description of the data to be included in the order in which the data is to appear. Column three contains a description of the format expected and tells the number of data terms which must appear to satisfy the sentence.

All data should be provided in a consistent set of units, for example the inch-pound-second system. Output will correspond to the selected system of units with the exception of acceleration which are in "g's".

Several rules should be mentioned for the ordering of cards in the data set. These are:

1. A CRO must come immediately after MC, CC, or NC.
2. An NO must come immediately after NN.
3. An NS must come immediately after NO.
4. A CO must come immediately after CN.
5. A CS must come immediately after CO.
6. A CRS must come immediately after CRN.

7. Each NA or NP must be clustered with an NN. It is assigned to the last previous NN.

8. All cards describing a particular module, component, node, connector, or table must appear contiguously.

Sentences are used as needed to describe the vehicle. Each sentence included must be complete.

TABLE 1. PROGRAM INPUT DATA REQUIREMENT SUMMARY

INFORMATION LEVEL	SENTENCE ABBREVIATION	DATA REQUIRED
For Run Control	CLS	Run control parameters
	RT	Run title
	OD	Standard output specification
	DO	Auxiliary output specifications
	VT	Vary tables of beam quantity fitting coefficients
For entire vehicle		
	VO	Position and orientation of vehicle
	MC	Interconnections between modules
	CRO	Connector orientation if applicable
For each module	MN	Module name
	MO	Position and orientation of modules
	CC	Interconnections between components within module
	CRO	Connector orientation if applicable
For each component	CN	Component name
	CO	Position and orientation of components within module
	NC	Interconnections between nodes within component
	CRO	Connector orientation if applicable
	CA	Applied forces within component

TABLE 1. PROGRAM INPUT DATA REQUIREMENT SUMMARY

(Continued)

INFORMATION LEVEL	SENTENCE ABBREVIATION	DATA REQUIRED
For each node	NN	Nodal point name
	NO	Position of nodes within component
	NS	Nodal parameter specifications
	NA	Applied forces for directions
	NES	Node stop
	NP	Forced displacement for directions
	RS	Special tests to stop run
For each connector	CRN	Connector name and type
	CRS	Connector parameter specifications
For each table	TN	Table name and specifications

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS

Sentence Contents		Sentence Abbreviation	Notes	Table 4 Examples
CONTROL SPECIFICATIONS (FOLLOW).		CLS	Run control parameters. All values specified as floating point numbers separated by commas. End of data marked by asterisk. Start data on new line. Twenty numbers must be specified.	1, 2, 3
(a) IDS	Switch: all beams 0 = remains plastic ≠ 0 = returns to elastic			
(b) KMAX	Maximum number of steps			
(c) TMAX	Maximum time			
(d) DTK	Initial time step			
(e) ALR	Beam length reference			
(f) DR	Beam depth reference			
(g) ER	Elastic modulus reference			
(h) AIR	Moment of inertia reference			
(i) EPS	Allowable error for acceptance			
(j) TR	Time reference unit			
(k) ALOER	Allowable error to test two quantities equal			
(l) ISTART	Restart switch (not available in UM-VCS-1)			
(m) IEND	Record information for restart (not available in UM-VCS-1)			
(n) BASTEP	Normal integration time step			
(o) PERAOW	Fraction of maximum increment			
(p) SIZMAX	Maximum displacement increment			
(q) BUNL	Yield convergence lower bound			
(r) BUNN	Yield convergence upper bound			
(s) GR	Gravity (in/sec^2)			
(t) IGSLEC	Switch: 0 = iterate all inversions 1 = iterate only stiffness inversions 2 = iterate no inversion			

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
RUN TITLE. line/line/ ... /line*	RT	Run title specification. Maximum of 132 characters per line for a maximum of ten lines. End of each line marked by a slash, end of all titles by asterisk. Each line will be centered.	4, 5, 6
OUTPUT DESIRED (FOLLOWS) N, N - N, N* Note: N=1, Generalized force at nodes. 2, Displacements of nodal points. 3, Position of nodal points. 4, Velocities of nodal points. 5, Acceleration of nodal points. 6, Generalized forces at connector ends. 7, Energy dissipation at connector ends.	OD	Output category selections are a string of intermixed entries which are either individual listings (N), or contiguous range listings (N - N) which means N to N) ordered as desired. This sentence is processed normally by the executive but yields no output since tabular output is not available in UMVCS-1.	7, 8

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
DEBUG OUTPUT (FOLLOWS) debug switch (time, level, ..., time, level), ...*	DO	Specification for each debug switch at various times with a debug level for each time point. Up to ten time points may be selected for each switch. This sentence must be used with great caution since the volume of printing is extensive. (See Part 5) Debug output from the executive may be obtained by debug switch zero, no time and a single level number.	9, ...,18

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
VARY TABLES. (a) Switch: 1 = Box cross-section 2 = Channel cross-section (b) Switch: 1 = Strong bending 2 = Weak bending 3 = Torsion 4 = Axial (c) Switch: 1 = k_1 2 = k_2 3 = X_m 4 = β 5 = f 6 = M_o (d) Ten fitting coefficients		Changes the default setting of beam quantity fitting coefficient tables for run. See CRS for explanation of beam quantities. Thirteen numbers must be specified.	None
MODULE NAMED module name.	MN	Marks start of a specification of a module. Each module name must be unique and may have up to eight characters with no blanks.	19

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
VEHICLE ORIENTATION (FOLLOWS). (a) X-coordinate (b) Y-coordinate (c) Z-coordinate (d) nine direction cosines.	VO	Specification of starting position and orientation. Sentence abbreviation is on first line. The data follows on the next. Quantities a, b, c are linear dimension. The first three direction cosines are for X-coordinate, the next for Y and the last for Z. Each set are cosine of the angle with respect to X, Y, and Z, respectively. This sentence has no effect since the option is not available in UMVCS-1. Twelve numbers must be specified if a VO card is included.	NONE

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
MODULES CONNECTED Nodal-point-name ((OF COMPONENT) component-name) ((OF MODULE) module-name) TO Nodal-point-name ((OF COMPONENT) component-name) ((OF MODULE) module-name) BY Connector name.	MC	This sentence specifies one connection between two modules. "OF COMPONENT" and "OF MODULE" phrases are necessary only if the respective nodal point name is not unique within vehicle. If only one of the two phrases is present, "OF COMPONENT" or "OF MODULE" must be specified. Connectors are defined separately (See CRN) and used as many times as desired. All names must be < eight characters. Each phrase must be entirely on one line. The node in the current module must appear first in this sentence.	20
MODULE ORIENTATION (FOLLOWS) (a) X-coordinate (b) Y-coordinate (c) Z-coordinate (d) nine direction cosines	MO	See VO. for specifications. This sentence has no effect since the option is not available in UMVCS-1. Twelve numbers must be specified if a MO card is included.	NONE

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
CONNECTOR ORIENTATION (FOLLOWS). A. For BEAM type: a. connector length b. nine direction cosines for i-end c. nine direction cosines for j-end B. For all connectors except BEAM: a. connector length b. three direction cosines for 1-direction (BEND and SHAR only) c. three direction cosines for 2-direction (BEND and SHAR only)	CRO	Must follow MC, CC, or NC to which it applies immediately. For beams, nineteen numbers must be specified. For UMVCS-1, the two sets of direction cosines should be the same. The 3-direction lies along the beam and points from the node occurring first in the data set to the node occurring second in the data set. Directions 1 and 2 must form a righthand system with direction 3. For all other connectors, one number must be specified except for bending and shear connectors for which seven numbers must be specified. Directions 1 and 2 must form a righthand system with direction 3 which lies along the connector pointing from the frame node to the rigid body or from the rigid body node named first in the data set to the rigid body node named second in the data set.	21, 24

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
COMPONENT NAMED component-name (AND IS OF TYPE) [FRAME/RIGID].	CN	Marks start of a specification of a component within a module.	32, 60 157
COMPONENT CONNECTED Nodal-point-name ((OF COMPONENT) component-name) TO Nodal-point-name ((OF COMPONENT) component-name) BY connector name.	CC	This sentence specifies one connection between two components within a particular module. The "OF COMPONENT" phrases are necessary only if respective nodal point name is not unique within the module. Connectors are defined separately (See CRN) and may be used as many times as desired. The node in the current component must appear first in this sentence.	NONE
COMPONENT ORIENTATION (FOLLOWS). (a) X, Y, Z (b) nine direction cosines (c) θ_1, θ_2, θ_3 . . . . . . (d) X, Y, Z, θ_1, θ_2, θ_3 .. .. (e) X, Y, Z, θ_1, θ_2, θ_3 (f) F_1, F_2, F_3, M_1, M_2, M_3	CO	Needed only for RIGID components. Coordinates of the center of gravity coordinate system are X, Y, Z. The angles θ_1, θ_2, θ_3 orient the coordinate system along the three principal axes of inertia of the body. The direction cosines are defined as in VO. The six generalized forces are applied at the center of gravity along and around the principal axes of inertia. Thirty-three numbers must be specified.	33,34,35

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
COMPONENT SPECIFICATIONS (FOLLOWS) (a) weight (b) three moments of inertia	CS	Specification of values pertaining to entire component. Needed only for RIGID. Four numbers must be specified.	36,37
NODE NAMED Nodal-point-name ((IS) PRINTED).	NN	"Nodal-point-name" specifies a connect point on a rigid body and a mass point for a frame component. "IS PRINTED" applies to rigid bodies and specifies a point for which information is to be printed. If this point is a connect point and also printed information is desired, two names must be provided.	38,241
NODES CONNECTED Nodal-point-name TO Nodal-point-name BY Connector name.	NC	This sentence specifies one connection between two nodal points within a particular component. Connectors are defined separately. (See CRN) and used as many times as desired. Not used for RIGID components.	79

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
COMPONENT APPLIED (FORCE FOLLOWS). (a) X, Y, Z of point (b) F_1, F_2, F_3, M_1, M_2, M_3	CA	Applies only to RIGID. This sentence has no effect since option not available in UMVCS-1. Nine numbers must be specified if a CA card is included.	NONE
NODE ORIENTATION (FOLLOWS). A. For RIGID (a) X, Y, Z B. For FRAME (a) X, Y, Z, θ_1, θ_2, θ_3 . . . . . . (b) X, Y, Z, θ_1, θ_2, θ_3 .. .. (c) X, Y, Z, θ_1, θ_2, θ_3	NO	These cards must follow their NN immediately. For RIGID, the X, Y, Z are specified with respect to the coordinate system defined on CO cards. Three numbers must be specified. For FRAME, all quantities are inertial. Eighteen numbers must be specified.	39,40, 62,63
NODE SPECIFICATIONS (FOLLOW). (a) weight of mass point	NS	Specification of values pertaining to this nodal point. Needed only for FRAME. One number must be specified.	64,65
NODAL APPLIED table-name (FOR DIRECTION) [X/Y/Z/1/2/3].	NA	Specification for forces (specified as tabular functions defined by cards TN) to be applied at nodal points.	NONE

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
NODAL POSITION table-name-A table-name-B table-name-C (FOR DIRECTION) [X/Y/Z/1/2/3] ((IS)INERTAL). (a) P, period (b) τ, time step * If a rigid body, the condition always applies to c.g.	NP	NP cards refer to nearest previous NN card.*The two alternatives are: 1. A specification of nodal point motion. Three coefficients (A, B, C) are defined in time-dependent (TN) tables. Two additional coefficients, P and τ, are then given. The motion obeys $\text{position} = A+BT+\frac{C}{\omega}\sin\omega T$ $T < \tau$ where $\omega = \frac{2\pi}{P}$. Motion stops if $T \geq \tau$. Two numbers must be specified. 2. If the "IS INTERAL" option is included, the nodal point cannot move in the direction specified. All table names are replaced by "NONE". No numbers can be specified.	41,127, 128

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
NODE STOP nodal-point-name (FOR DIRECTION) [X/Y/Z/1/2/3]	NES	If relative displacement occurs between NN nearest to NES statement and "nodal-point-name," then NN one begins to stop in inertial space. If $\rho > 0$, the two points cannot approach closer than ρ on the positive side. If $\rho < 0$, they can approach no closer on the negative side. If nodal-point-name is replaced by NONE, the motion restriction is based on motion from zero time. If $\rho \neq 0$, item (c) is used while (b) and (d) are ignored. If $\rho = 0$, (b) and (d) are used while (c) is ignored. When T_i in time is reached, the node begins to stop. The	72,73 120,121

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
		quantity λ is the stopping distance if stopping is based on a displacement. The quantity τ is the time required for stopping. Four numbers must be specified.	107,120
RUN STOP [DISP/FORC] (FOR DIRECTION) [X/Y/Z/1/2/3]. (a) Displacement or force value	RS	The model stops execution if displacement (DISP) or force (FORC) value specified by (a) are exceeded in the specified direction. RS applies to the nearest previous NN for frame elements or CN for rigid bodies. It is computed at the mass point for FRAME and the CG for RIGID. One number must be specified.	NONE
CONNECTOR NAMED connector-name (AND IS OF TYPE) connector-type-keyword.	CRN	Marks start of a specification for a connector. Name must be unique. The connector type is one of the prescribed names which are available (See Table 3).	312
CONNECTOR SPECIFICATIONS (table name). A. For BEAM (full specification, 30 numbers required) (a) k_{1i}, k_{2i}, X_{mi}, β_i, f_i, M_{oi} for i = 1, 2, 3, 4 where plastic bending load-deflection for each direction is modelled by: $\alpha_i = M_{oi}(a_{ji} + b_{ji}[1 + k_{ji}(x_i - x_{mi})]e^{-k_{ji}(x_i - x_{mi})}$ where j = 1 if $x_i < x_{mi}$, otherwise j = 2. $a_{1i} = \frac{1-f_i y_i}{1-y_i}$, $b_{1i} = \frac{f_i - 1}{1 - y_i}$	CRS	Specification of values pertaining to connector. Unused for RPIN, REAM, HPIN, CRS cards follow immediately after CRN. Note $M_{04} = P_0$ along the 3-direction. Table name provided for load-deflection characteristics for EXTS, TORS, SHAR, and BEND only. Data number requirements are in column one for this sentence.	313, 314, 315, 316, 328, 329, 353, 354, 356

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples

$a_{2i} = \beta_i$, $b_{2i} = f_i - \beta_i$

$y_i = (1 - k_{1i}) x_{mi}) e^{k_{1i} x_{mi}}$

(b) E, Young's modulus

(c) G, shear modulus

(d) AJ, torsion constant

(e) AI1, moment of inertia about 1-direction

(f) AI2, moment of inertia about 2-direction

(g) A, area of cross-section

B. For BEAM (short specification, 11 numbers)

(a) σ_y yield stress

(b) H, height of cross-section

(c) B, width of cross-section

(d) T, material thickness

(e) Switch:

1 = Box cross-section

2 = Channel cross-section

(f) E, Young's modulus

(g) G, shear modulus

(h) AJ, torsion constant

(i) AI1,moment of inertia about 1-direction (major principal axis)

(j) AI2, moment of inertia about 2-direction (minor principal direction)

(k) A, area of cross-section

C. For EXTS (only one number)

(a) switch, 0 = regular spring

1 = one-sided extensional spring

2 = one-sided compressive spring

TABLE 2. GENERAL VEHICLE INPUT DATA FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes	Table 4 Examples
TABLE NAMED table-name (ABSCISSA, ORDINATE), ... *	TN	Specifications of tables. Pairs of abscissas and ordinates are enclosed in parenthesis and separated by commas. An asterisk marks end of data.	361, 362

TABLE 3. AVAILABLE CONNECTOR TYPES

CONNECTION TYPE	KEYWORD	COMMENTS
Extensional	EXTS	Available between components in all possibilities and within frame components (Applies to all except REAM and BEAM).
Torsional	TORS	
Shear force	SHAR	
Bending	BEND	
Special connector	SPEC	Not available in UMVCS-1.
Rigid beam	REAM	Available between rigid components and between one frame component and one rigid component.
Ball Joint Pin	RPIN	Only one rigid or pin connector may be used at any one node.
Pin hinge (Universal joint or door hinge)	HPIN	Not available in UMVCS-1.
Deformable beam	BEAM	Available only within or between frame components

```
$RUN VILO MAP S=*AFD* 7=VM 8=VCH T=12S P=200

... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ...

 ENTRY = 600320   SIZE = 0287CC

   SECTION DEFINITIONS:(NAME SI# VALUE RELCC TYPE LENGTH)
 MAIN      80 600320 600320    000158  IO        80 600478 600478 C 000038  TABLES    80 600480 600480 C 0008E0
 CONST     80 600D90 600D9C C  000030  CEKLIN    80 600DC0 600DC0    000178  KCONTL    80 600F38 600F38 C 000CA0
 TAB       80 600FD8 600FD8 C  000020  KONMOR    80 600FF8 600FF8 C  000006  BFIT      80 601000 601000 C 0009F0
 COMPAR    80 6019F0 6019FC    000468  FIGURE    80 601E58 601E58    000188  PRTCON    80 601FE0 601FEC C 000010
 TABCNT    80 601FF0 601FFC C  000008  BEAMER    80 602000 602000    0008E8  FINTAB    80 6028E8 6028E8    000310
 IDIGIT    80 6028F8 6028F8    000300  IHCLOGIC  80 602EF8 602EF8 L  0000E8  LOR       80 602F26           E
 SHFTL     80 602FA6         E         SHFTR     80 602FBC         E         BRAKUP    80 603000 603000    000998
 GRAPIT    80 603998 603998    000440  KKTEST    80 603DD8 603DD8    000178  SOUT      80 603F50 603F50 C 000050
 LAYT      80 603FA0 603FA0 C  000038  BUGMAK    80 604000 604000    0008A0  INTAB     80 6048A0 6048AC    000378
 KARDER    80 604C18 604C18    000248  PCUN      80 604E60 604E60 C  0000F0  CONVER    80 605000 605000    0007A0
 IDENTF    80 6057A0 6057A0    000780  INMAIN    80 606000 606000    001848  KKIPER    80 607848 607848    000430
 LAYOUT    80 607C78 607C78    000290  PACK      80 608000 608000    000408  PULOFF    80 608408 608408    000280
 RECORD    80 608688 608688    000788  INFO      80 608E40 608E40 C  000170  REDTAB    80 609000 609000    000200
 RUNTIT    80 609200 609200    000450  SEEKNM    80 6096E0 6096E0    000408  STASH     80 6098B8 6098B8    0001F8
 SORCUT    80 60A000 60A00C    002200  TABMAK    80 60C200 60C200    000330  TITLE     80 60C530 60C530    000280
 INFOB     80 60C7E0 60C7E0 C  000578  SORLAY    80 60D000 60D000    002070  SORPRT    80 610000 610000    001DA8
 SORDUT    80 612000 612000    0034A8  SORDU2    80 616000 616000    0046A0  REAL      80 618000 618CCC C  0C9C40
 INTGR     80 625000 625000 C  001F40  SAVE      80 627000 627000 C  004E20

... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ...

EXECUTION BEGINS    17:01:31
        1      MAIN      CLS.
        2      FIGR      1.,10.,.05,.0002,10.,1.,30000000.,1.,.0001,10.E-1,.C05,0.,0.,
        3      FIGR      .0002,.8,.025,5.0E-4,.01,386.4,0*
        4      MAIN      RUN TITLE.
        5      SKIP      80A
        6      SKIP      /BB3/CCCC/DDDDD*
        7      MAIN      OXZ DZQM FZIR.
        8      BRAK      7,6-5,2-4,1*
        9      MAIN      D O.
       10      BUGM      0(3),
       11      SKIP      1(0,3,.0005,0,100,0),2(0,3,.0005,0,100,0)
       12      SKIP      3(0,3,.0005,0,100,0),4(0,3,.0005,0,100,0)
       13      SKIP      5(0,3,.0005,0,100,0),6(0,3,.0005,0,100,0)
       14      SKIP      7(0,3,.0005,0,100,0),8(0,3,.0005,0,100,0)
       15      SKIP      9(0,3,.0005,0,100,0),10(0,3,.0005,0,100,0)
       16      SKIP      11(0,3,.0005,0,100,0),12(0,3,.0005,0,100,0)
       17      SKIP      13(0,3,.0005,0,100,0),14(0,3,.0005,0,100,0)
       18      SKIP      15(0,3,.0005,0,100,0),18(0,3,.0005,0,100,0)*
       19      MAIN      MN ENGTRANS.
       20      MAIN      MC M2 TO PT11 BY PIN.
       21      MAIN      C R O.
       22      FIGR      .1*
       23      MAIN      MC M3 TO PT16 BY PIN.
       24      MAIN      CRO.
       25      FIGR      .1*
       26      MAIN      MC M4 TO PT18 BY EXTA.
       27      MAIN      CRO.
       28      FIGR      57.0351*
       29      MAIN      MC M1 TO PT2 BY EXTB.
       30      MAIN      CRC.
```

TABLE 4: EXAMPLE DATA SET Pages 1-13

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31      FIGR    4.*
32      MAIN    CN MOTOTRAN RIGID.
33      MAIN    CO.
34      FIGR    9.,0.,25.,1.,0.,0.,0.,1.,0.,0.,0.,1.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,
35      FIGR    0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
36      MAIN    CS.
37      FIGR    500.,10.,1335.,10.*
38      MAIN    NN M1.
39      MAIN    NO.
40      FIGR    3.,0.,-21.*
41      MAIN    NP NONE NONE NONE Y INERTAL.
42      MAIN    NP NONE NONE NONE 1 INERTAL.
43      MAIN    NP NONE NONE NONE 3 INERTAL.
44      MAIN    NN M2.
45      MAIN    NO.
46      FIGR    -9.,10.,-11.1*
47      MAIN    NN M3.
48      MAIN    NO.
49      FIGR    -17.,0.,35.1*
50      MAIN    NN M4.
51      MAIN    NO.
52      FIGR    -15.,0.,35.*
53      MAIN    NN M5.
54      MAIN    NO.
55      FIGR    3.,0.,15.*
56      MAIN    MN FORESTUC.
57      MAIN    MC PT4 TO PT8 BY BEAMB.
58      MAIN    CRC.
59      FIGR    9.,1.,0.,0.,0.,1.,0.,0.,0.,1.,1.,0.,0.,0.,1.,0.,0.,0.,1.*
60      MAIN    CN RADIATOR AND IS OF TYPE FRAME.
61      MAIN    NN PT1.
62      MAIN    NO.
63      FIGR    0.,0.,0.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
64      MAIN    NS.
65      FIGR    .8415*
66      MAIN    NC PT1 TO PT4 BY BEAMA.
67      MAIN    CRO.
68      FIGR    16.,0.,0.,1.,1.,0.,0.,0.,1.,0.,0.,0.,1.,1.,0.,0.,0.,1.,0.*
69      MAIN    NP NONE NONE NONE Y INERTAL.
70      MAIN    NP NONE NONE NONE 1 INERTAL.
71      MAIN    NP NONE NONE NONE 3 INERTAL.
72      MAIN    NES NONE Z.
73      FIGR    -10.,0.,-2.,0.*
74      MAIN    NN PT2.
75      MAIN    NO.
76      FIGR    12.,0.,0.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
77      MAIN    NS.
78      FIGR    10.8415*
79      MAIN    NC PT2 TO PT3 BY BEAMA.
80      MAIN    CRO.
81      FIGR    16.,0.,0.,1.,1.,0.,0.,0.,1.,0.,0.,0.,1.,1.,0.,0.,0.,1.,0.*
82      MAIN    NC PT2 TO PT5 BY MEXTA.
83      MAIN    CRO.
84      FIGR    10.*
85      MAIN    NC PT2 TO PT5 BY SHEARA.
86      MAIN    CRO.
87      FIGR    10.,0.,1.,0.,1.,0.,0.*
88      MAIN    NP NONE NONE NONE Y INERTAL.
89      MAIN    NP NONE NONE NONE 1 INERTAL.
90      MAIN    NP NONE NONE NONE 3 INERTAL.
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 91      MAIN     NES PT5 Z.
 92      FIGR     10.,0.,2.,0.*
 93      MAIN     NN PT3.
 94      MAIN     NO.
 95      FIGR     12.,16.,0.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
 96      MAIN     NS.
 97      FIGR     11.96*
 98      MAIN     NC PT3 TO PT4 BY BEAMA.
 99      MAIN     CRO.
100      FIGR     12.,0.,0.,1.,0.,1.,0.,-1.,0.,0.,0.,0.,1.,0.,1.,0.,-1.,0.,0.*
101      MAIN     NC PT3 TO PT6 BY  MEXTA.
102      MAIN     CRO.
103      FIGR     10.*
104      MAIN     NC PT3 TO PT6 BY SHEARA.
105      MAIN     CRO.
106      FIGR     10.,0.,1.,0.,1.,0.,0.*
107      MAIN     NES PT6 Z.
108      FIGR     10.,0.,2.,0.*
109      MAIN     NN PT4.
110      MAIN     NO.
111      FIGR     0.,16.,0.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
112      MAIN     NS.
113      FIGR     4.08*
114      MAIN     NC PT4 TO PT7 BY MEXTB.
115      MAIN     CRO.
116      FIGR     11.*
117      MAIN     NC PT4 TO PT7 BY SHEARB.
118      MAIN     CRO.
119      FIGR     10.,0.,1.,0.,1.,0.,0.*
120      MAIN     NES PT7 Z.
121      FIGR     10.,0.,2.,0.*
122      MAIN     NN PT5.
123      MAIN     NO.
124      FIGR     12.,0.,-10.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
125      MAIN     NS.
126      FIGR     5.*
127      MAIN     NP ZERO TABA TABA Z.
128      FIGR     .022728,.011364*
129      MAIN     NP NONE NONE NONE 1 INERTAL.
130      MAIN     NP NONE NONE NONE 2 INERTAL.
131      MAIN     NP NONE NONE NONE 3 INERTAL.
132      MAIN     NN PT6.
133      MAIN     NO.
134      FIGR     12.,16.,-10.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
135      MAIN     NS.
136      FIGR     5.*
137      MAIN     NP ZERO TABA TABA Z.
138      FIGR     .022728,.011364*
139      MAIN     NP NONE NONE NONE 1 INERTAL.
140      MAIN     NP NONE NONE NONE 2 INERTAL.
141      MAIN     NP NONE NONE NONE 3 INERTAL.
142      MAIN     NN PT7.
143      MAIN     NO.
144      FIGR     0.,16.,-11.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
145      MAIN     NS.
146      FIGR     15.18*
147      MAIN     NP NONE NONE NONE 1 INERTAL.
148      MAIN     NP NONE NONE NONE 2 INERTAL.
149      MAIN     NP NONE NONE NONE 3 INERTAL.
150      MAIN     NP ZERO TABA TABA Z.
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151     FIGR    .015,.0075*
152     MAIN    MN ENGMONT
153     MAIN    MC PT10 TO PT13 BY BEAMB.
154     MAIN    CRO.
155     FIGR    16.125,.86824,0.,.48612,0.,1.,0.,-.48612,0.,.86824,.86824,0.,.48612,
156     FIGR    0.,1.,0.,-.48612,0.,.86824*
157     MAIN    CN CHASSIS FRAME.
158     MAIN    NN PT8.
159     MAIN    NO.
160     FIGR    0.,16.,9.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
161     MAIN    NS.
162     FIGR    4.24*
163     MAIN    NC PT8 TO PT9 BY EXTC.
164     MAIN    CRO.
165     FIGR    12.0416*
166     MAIN    NC PT8 TO PT10 BY BEAMB.
167     MAIN    CRO.
168     FIGR    9.,1.,0.,0.,0.,1.,0.,0.,0.,1.,1.,0.,0.,0.,1.,0.,0.,0.,1.*
169     MAIN    NN PT9.
170     MAIN    NO.
171     FIGR    -8.,16.,18.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
172     MAIN    NS.
173     FIGR    125.*
174     MAIN    NP NONE NONE NONE X INERTAL.
175     MAIN    NP NONE NONE NONE Y INERTAL.
176     MAIN    NP NONE NONE NONE 1 INERTAL.
177     MAIN    NP NONE NONE NONE 2 INERTAL.
178     MAIN    NP NONE NONE NONE 3 INERTAL.
179     MAIN    NN PT10.
180     MAIN    NO.
181     FIGR    0.,16.,18.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
182     MAIN    NS.
183     FIGR    7.62*
184     MAIN    NC PT10 TO PT9 BY EXTD.
185     MAIN    CRO.
186     FIGR    8.*
187     MAIN    NC PT10 TO PT11 BY BEAMB.
188     MAIN    CRO.
189     FIGR    7.2,0.,-.5547,.832,1.,0.,0.,0.,.832,.5547,0.,-.5547,.832,1.,0.,0.,0.,
190     FIGR    .832,.5547*
191     MAIN    NN PT11.
192     MAIN    NO.
193     FIGR    0.,10.,14.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
194     MAIN    NS.
195     FIGR    4.05*
196     MAIN    NC PT11 TO PT12 BY BEAMB.
197     MAIN    CRO.
198     FIGR    10.,0.,0.,1.,-1.,0.,0.,0.,-1.,0.,0.,0.,1.,-1.,0.,0.,0.,-1.,0.*
199     MAIN    NN PT12.
200     MAIN    NO.
201     FIGR    0.,0.,14.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
202     MAIN    NS.
203     FIGR    2.36*
204     MAIN    NP NONE NONE NONE Y INERTAL.
205     MAIN    NP NONE NONE NONE 1 INERTAL.
206     MAIN    NP NONE NONE NONE 3 INERTAL.
207     MAIN    MN PASSCOMP.
208     MAIN    MC C1 TO PT14 BY PIN.
209     MAIN    CRO.
210     FIGR    .1*
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211     MAIN    MC C2 TO PT15 BY PIN.
212     MAIN    CRC.
213     FIGR    .1*
214     MAIN    MC C3 TO PT17 BY EXTE.
215     MAIN    CRO.
216     FIGR    8.*
217     MAIN    MC C3 TO PT17 BY SHEARC.
218     MAIN    CRO.
219     FIGR    8.,0.,1.,0.,0.,0.,1.*
220     MAIN    MC C4 TO PT3 BY EXTF.
221     MAIN    CRO.
222     FIGR    42.*
223     MAIN    MC C5 TO M5 BY EXTG.
224     MAIN    CRO.
225     FIGR    2.*
226     MAIN    CN BODY RIGID.
227     MAIN    CO.
228     FIGR    -2.,0.,67.,1.,0.,0.,0.,1.,0.,0.,0.,1.,0.,0.,0.,0.,0.,-528.,0.,0.,
229     FIGR    0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
230     MAIN    CS.
231     FIGR    1000.,10.,13550.,10.*
232     MAIN    NN C1.
233     MAIN    NO.
234     FIGR    -6.,16.,-25.1*
235     MAIN    NP NONE NONE NONE Y INERTAL.
236     MAIN    NP NONE NONE NONE 1 INERTAL.
237     MAIN    NP NONE NONE NONE 3 INERTAL.
238     MAIN    NN C2.
239     MAIN    NO.
240     FIGR    -6.,16.,-7.1*
241     MAIN    NN C2P PRINTED.
242     MAIN    NO.
243     FIGR    -6.,16.,-7.1*
244     MAIN    NN C3.
245     MAIN    NO.
246     FIGR    2.,16.,50.*
247     MAIN    NN C4.
248     MAIN    NO.
249     FIGR    14.,16.,-25.*
250     MAIN    NN C5.
251     MAIN    NO.
252     FIGR    14.,0.,-25.*
253     MAIN    NN C6 PRINTED.
254     MAIN    NO.
255     FIGR    -8.,0.,117.*
256     MAIN    MN STUBFRAM.
257     MAIN    CN PASMOUNT FRAME.
258     MAIN    NN PT13.
259     MAIN    NO.
260     FIGR    -8.,16.,32.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
261     MAIN    NS.
262     FIGR    6.16*
263     MAIN    NC PT13 TO PT14 BY BEAMB.
264     MAIN    CRC.
265     FIGR    10.,1.,0.,0.,0.,1.,0.,0.,0.,1.,1.,0.,0.,0.,1.,0.,0.,0.,1.*
266     MAIN    NN PT14.
267     MAIN    NO.
268     FIGR    -8.,16.,42.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
269     MAIN    NS.
270     FIGR    6.6*
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271     MAIN    NC PT14 TO PT15 BY BEAMB.
272     MAIN    CRO.
273     FIGR    28.,1.,0.,0.,0.,1.,0.,0.,0.,1.,1.,0.,0.,0.,1.,0.,0.,0.,1.*
274     MAIN    NN PT15.
275     MAIN    NO.
276     FIGR    -8.,16.,60.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
277     MAIN    NS.
278     FIGR    6.6*
279     MAIN    NC PT15 TO PT16 BY BEAMC.
280     MAIN    CRO.
281     FIGR    16.,0.,0.,1.,-1.,0.,0.,0.,-1.,0.,0.,0.,1.,-1.,0.,0.,0.,-1.,0.*
282     MAIN    NN PT16.
283     MAIN    NO.
284     FIGR    -8.,0.,60.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
285     MAIN    NS.
286     FIGR    2.04*
287     MAIN    NP NONE NONE NONE Y INERTAL.
288     MAIN    NP NONE NONE NONE 1 INERTAL.
289     MAIN    NP NONE NONE NONE 3 INERTAL.
290     MAIN    CN BACKAXLE FRAME.
291     MAIN    NN PT17.
292     MAIN    NO.
293     FIGR    -8.,16.,117.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
294     MAIN    NS.
295     FIGR    150.*
296     MAIN    NC PT17 TO PT18 BY BEAMB.
297     MAIN    CRO.
298     FIGR    16.,0.,0.,1.,-1.,0.,0.,0.,-1.,0.,0.,0.,1.,-1,0.,0.,0.,-1.,0.*
299     MAIN    NP NONE NONE NONE X INERTAL.
300     MAIN    NP NONE NONE NONE Y INERTAL.
301     MAIN    NP NONE NONE NONE 1 INERTAL.
302     MAIN    NP NONE NONE NONE 2 INERTAL.
303     MAIN    NP NONE NONE NONE 3 INERTAL.
304     MAIN    NN PT18.
305     MAIN    NO.
306     FIGR    -8.,0.,117.,0.,0.,0.,0.,0.,-528.,0.,0.,0.,0.,0.,0.,0.,0.,0.*
307     MAIN    NS.
308     FIGR    50.*
309     MAIN    NP NONE NONE NONE Y INERTAL.
310     MAIN    NP NONE NONE NONE 1 INERTAL.
311     MAIN    NP NONE NONE NONE 3 INERTAL.
312     MAIN    CRN BEAMA BEAM.
313     MAIN    CRS.
314     FIGR    14.45,3.38,.1815,.4222,1.3778,11600.,14.45,3.38,.1815,.4222,1.3778,
315     FIGR    11600.,3.48,7.41,.262,.5714,1.314,7800.,90.,.1,15.,1.,1.33,20600.,
316     FIGR    30.E6,12.E6,.874,.4369,.4369,.6875*
317     MAIN    CRN BEAMB BEAM.
318     MAIN    CRS.
319     FIGR    14.45,3.38,.1815,.4222,1.3778,49800.,14.45,3.38,.1815,.4222,1.3778,
320     FIGR    49800.,3.48,7.41,.262,.5714,1.314,33900.,90.,.1,15.,1.,1.33,52000.,
321     FIGR    30.E6,12.E6,3.122,1.556,1.556,1.734*
322     MAIN    CRN BEAMC BEAM.
323     MAIN    CRS.
324     FIGR    14.45,3.38,.1815,.4222,1.3778,22000.,14.45,3.38,.1815,.4222,1.3778,
325     FIGR    22000.,3.48,7.41,.262,.5714,1.33,15300.,90.,.1,15.,1.,1.33,28100.,
326     FIGR    30.E6,12.E6,1.104,.55176,.55176,.9375*
327     MAIN    CRN EXTA EXTS.
328     MAIN    CRS LOADA.
329     FIGR    0.*
330     MAIN    CRN EXTB EXTS.
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331     MAIN    CRS LOADB.
332     FIGR    0.*
333     MAIN    CRN EXTC EXTS.
334     MAIN    CRS LOADA.
335     FIGR    0.*
336     MAIN    CRN EXTD EXTS.
337     MAIN    CRS LOADD.
338     FIGR    0.*
339     MAIN    CRN EXTE EXTS.
340     MAIN    CRS LOADE.
341     FIGR    0.*
342     MAIN    CRN EXTF EXTS.
343     MAIN    CRS LOADF.
344     FIGR    0.*
345     MAIN    CRN EXTG EXTS.
346     MAIN    CRS LOADG.
347     FIGR    0.*
348     MAIN    CRN PIN RPIN.
349     MAIN    CRN MEXTA EXTS.
350     MAIN    CRS LOADH.
351     FIGR    0.*
352     MAIN    CRN MEXTB EXTS.
353     MAIN    CRS LOADI.
354     FIGR    0.*
355     MAIN    CRN SHEARA SHAR.
356     MAIN    CRS MOMENT.
357     MAIN    CRN SHEARB SHAR.
358     MAIN    CRS MOMENT.
359     MAIN    CRN SHEARC SHAR.
360     MAIN    CRS MOMENT.
361     MAIN    TN LOADH.
362     TABM    (0.,0.),(100.,100000.)*
363     MAIN    TN LOADI
364     TABM    (0.,0.),(.5142857,45000),(1.81253,8000.),(3.645863,2500.),(100.,2500.)*
365     MAIN    TN LOADD
366     TABM    (0.,0.),(100.,200000.)*
367     MAIN    TN MOMENT
368     TABM    (0.,0.),(100.,1.D7)*
369     MAIN    TN LOADA
370     TABM    (0.,0.),(100.,5.D7)*
371     MAIN    TN LOADE
372     TABM    (0.,0.),(100.,1.E8)*
373     MAIN    TN LOADF
374     TABM    (0.,0.),(5.,5000.),(100.,5000.)*
375     MAIN    TN LOADB
376     TABM    (0.,0.),(4.,0.),(6.,12000.),(105.988,1.E8)*
377     MAIN    TN LOADG
378     TABM    (0.,0.),(2.,0.),(6.,4000.),(100.,4000.)*
379     MAIN    TN ZERO
380     TABM    (0.,0.),(100.,0.)*
381     MAIN    TN TABA.
382     TABM    (0.,-264.),(100.,-264.)*
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INPUT VEHICLE DESCRIPTION

MODULE NUMBER 1 WITH NAME ENGTRANS AND INTERNAL DESIGNATION 6 HAS 1 COMPONENTS.

COMPONENT NUMBER 1 WITH NAME MCTOTRAN AND INTERNAL DESIGNATION 7 HAS 5 NODES AND IS RIGID BODY NO. 1

NODE NO. 1 WITH NAME M1 INTERNAL DESIGNATION 31 CONNECT POINT NO. 1 AND 1 CONNECTIONS.

CONNECTION	NODE			AND NODE		BY CONNECTOR OF TYPE.		
1	40	31	M1	73	PT2	29	EXTB	1

NODE NO. 2 WITH NAME M2 INTERNAL DESIGNATION 38 CONNECT POINT NO. 2 AND 1 CONNECTIONS.

CONNECTION	NODE			AND NODE		BY CONNECTOR OF TYPE.		
1	31	38	M2	156	PT11	47	PIN	7

NODE NO. 3 WITH NAME M3 INTERNAL DESIGNATION 45 CONNECT POINT NO. 3 AND 1 CONNECTIONS.

CONNECTION	NODE			AND NODE		BY CONNECTOR OF TYPE.		
1	34	45	M3	246	PT16	47	PIN	7

NODE NO. 4 WITH NAME M4 INTERNAL DESIGNATION 52 CONNECT POINT NO. 4 AND 1 CONNECTIONS.

CONNECTION	NODE			AND NODE		BY CONNECTOR OF TYPE.		
1	37	52	M4	263	PT18	26	EXTA	1

NODE NO. 5 WITH NAME M5 INTERNAL DESIGNATION 59 CONNECT POINT NO. 5 AND 1 CONNECTIONS.

CONNECTION	NODE			AND NODE		BY CONNECTOR OF TYPE.		
1	106	207	C5	59	M5	44	EXTG	1

MODULE NUMBER 2 WITH NAME FORESTUC AND INTERNAL DESIGNATION 10 HAS 1 COMPONENTS.

COMPONENT NUMBER 1 WITH NAME RADIATOR AND INTERNAL DESIGNATION 17 HAS 7 NODES AND IS PART OF FRAME.

NODE NO. 1 WITH NAME PT1 INTERNAL DESIGNATION 66 MASS POINT NO. 1 AND 1 CONNECTIONS.

CONNECTION	NODE			AND NODE		BY CONNECTOR OF TYPE.		
1	46	66	PT1	94	PT4	17	BEAMA	9

NODE NO. 2 WITH NAME PT2 INTERNAL DESIGNATION 73 MASS POINT NO. 2 AND 4 CONNECTIONS.

CONNECTION	NODE			AND NODE		BY CONNECTOR OF TYPE.		
1	40	31	M1	73	PT2	29	EXTB	1
2	49	73	PT2	83	PT3	17	BEAMA	9
3	52	73	PT2	105	PT5	50	MEXTA	1
4	55	73	PT2	105	PT5	56	SHEARA	3

NODE NO. 3 WITH NAME PT3 INTERNAL DESIGNATION 83 MASS POINT NO. 3 AND 5 CONNECTIONS.

CONNECTION	NODE			AND NODE		BY CONNECTOR OF TYPE.		
1	49	73	PT2	83	PT3	17	BEAMA	9
2	58	83	PT3	94	PT4	17	BEAMA	9
3	61	83	PT3	113	PT6	50	MEXTA	1
4	64	83	PT3	113	PT6	56	SHEARA	3
5	103	200	C4	83	PT3	41	EXTF	1

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NODE NO. 4 WITH NAME PT4 INTERNAL DESIGNATION 94 MASS POINT NO. 4 AND 5 CONNECTIONS.

CONNECTION	AND NODE			BY CONNECTOR OF TYPE.			
1	43	94	PT4	129	PT8	20 BEAMB	9
2	46	66	PT1	94	PT4	17 BEAMA	9
3	58	83	PT3	94	PT4	17 BEAMA	9
4	67	94	PT4	121	PT7	53 MEXTB	1
5	70	94	PT4	121	PT7	59 SHEARB	3

NODE NO. 5 WITH NAME PT5 INTERNAL DESIGNATION 105 MASS POINT NO. 5 AND 2 CONNECTIONS.

CONNECTION	AND NODE			BY CONNECTOR OF TYPE.			
1	52	73	PT2	105	PT5	50 MEXTA	1
2	55	73	PT2	105	PT5	56 SHEARA	3

NODE NO. 6 WITH NAME PT6 INTERNAL DESIGNATION 113 MASS POINT NO. 6 AND 2 CONNECTIONS.

CONNECTION	AND NODE			BY CONNECTOR OF TYPE.			
1	61	83	PT3	113	PT6	50 MEXTA	1
2	64	83	PT3	113	PT6	56 SHEARA	3

NODE NO. 7 WITH NAME PT7 INTERNAL DESIGNATION 121 MASS POINT NO. 7 AND 2 CONNECTIONS.

CONNECTION	AND NODE			BY CONNECTOR OF TYPE.			
1	67	94	PT4	121	PT7	53 MEXTB	1
2	70	94	PT4	121	PT7	59 SHEARB	3

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MODULE NUMBER 3 WITH NAME ENGMONT AND INTERNAL DESIGNATION 14 HAS 1 COMPONENTS.

COMPONENT NUMBER 1 WITH NAME CHASSIS AND INTERNAL DESIGNATION 29 HAS 5 NODES AND IS PART OF FRAME.

NODE NO. 1 WITH NAME PT8 INTERNAL DESIGNATION 129 MASS POINT NO. 8 AND 3 CONNECTIONS.

CONNECTION	AND NODE			BY CONNECTOR OF TYPE.			
1	43	94	PT4	129	PT8	20 BEAMB	9
2	76	129	PT8	138	PT9	32 EXTC	1
3	79	129	PT8	146	PT10	20 BEAMB	9

NODE NO. 2 WITH NAME PT9 INTERNAL DESIGNATION 138 MASS POINT NO. 9 AND 2 CONNECTIONS.

CONNECTION	AND NODE			BY CONNECTOR OF TYPE.			
1	76	129	PT8	138	PT9	32 EXTC	1
2	82	146	PT10	138	PT9	35 EXTD	1

NODE NO. 3 WITH NAME PT10 INTERNAL DESIGNATION 146 MASS POINT NO. 10 AND 4 CONNECTIONS.

CONNECTION	AND NODE			BY CONNECTOR OF TYPE.			
1	73	146	PT10	220	PT13	20 BEAMB	9
2	79	129	PT8	146	PT10	20 BEAMB	9
3	82	146	PT10	138	PT9	35 EXTD	1
4	85	146	PT10	156	PT11	20 BEAMB	9

NODE NO. 4 WITH NAME PT11 INTERNAL DESIGNATION 156 MASS POINT NO. 11 AND 3 CONNECTIONS.

CONNECTION	AND NODE			BY CONNECTOR OF TYPE.			
1	31	38	M2	156	PT11	47 PIN	7

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2	85	146	PT10	156	PT11	20	BEAMB	9
3	88	156	PT11	165	PT12	20	BEAMB	9

NODE NO. 5 WITH NAME PT12 INTERNAL DESIGNATION 165 MASS POINT NO. 12 AND 1 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	88	156	PT11	165	PT12	20	BEAMB	9

MODULE NUMBER 4 WITH NAME PASSCOMP AND INTERNAL DESIGNATION 18 HAS 1 COMPONENTS.

COMPONENT NUMBER 1 WITH NAME BODY AND INTERNAL DESIGNATION 39 HAS 7 NODES AND IS RIGID BODY NO. 2

NODE NO. 1 WITH NAME C1 INTERNAL DESIGNATION 172 CONNECT POINT NO. 1 AND 1 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	91	172	C1	228	PT14	47	PIN	7

NODE NO. 2 WITH NAME C2 INTERNAL DESIGNATION 179 CONNECT POINT NO. 2 AND 1 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	94	179	C2	237	PT15	47	PIN	7

NODE NO. 3 WITH NAME C2P INTERNAL DESIGNATION 186 PRINT POINT NO. 1

NODE NO. 4 WITH NAME C3 INTERNAL DESIGNATION 192 CONNECT POINT NO. 3 AND 2 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	97	192	C3	254	PT17	38	EXTE	1
2	100	192	C3	254	PT17	62	SHEARC	3

NODE NO. 5 WITH NAME C4 INTERNAL DESIGNATION 200 CONNECT POINT NO. 4 AND 1 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	103	200	C4	83	PT3	41	EXTF	1

NODE NO. 6 WITH NAME C5 INTERNAL DESIGNATION 207 CONNECT POINT NO. 5 AND 1 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	106	207	C5	59	M5	44	EXTG	1

NODE NO. 7 WITH NAME C6 INTERNAL DESIGNATION 214 PRINT POINT NO. 2

MODULE NUMBER 5 WITH NAME STUBFRAM AND INTERNAL DESIGNATION 22 HAS 2 COMPONENTS.

COMPONENT NUMBER 1 WITH NAME PASMOUNT AND INTERNAL DESIGNATION 51 HAS 4 NODES AND IS PART OF FRAME.

NODE NO. 1 WITH NAME PT13 INTERNAL DESIGNATION 220 MASS POINT NO. 13 AND 2 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	73	146	PT10	220	PT13	20	BEAMB	9
2	109	220	PT13	228	PT14	20	BEAMB	9

NODE NO. 2 WITH NAME PT14 INTERNAL DESIGNATION 228 MASS POINT NO. 14 AND 3 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	91	172	C1	228	PT14	47	PIN	7
2	109	220	PT13	228	PT14	20	BEAMB	9

888
CCCC
DDDDD

3	112	228	PT14	237	PT15	20	BEAMB	9

NODE NO. 3 WITH NAME PT15 INTERNAL DESIGNATION 237 MASS POINT NO. 15 AND 3 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	94	179 C2	237	PT15	47	PIN	7
2	112	228 PT14	237	PT15	20	BEAMB	9
3	115	237 PT15	246	PT16	23	BEAMC	9

NODE NO. 4 WITH NAME PT16 INTERNAL DESIGNATION 246 MASS POINT NO. 16 AND 2 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	34	45 M3	246	PT16	47	PIN	7
2	115	237 PT15	246	PT16	23	BEAMC	9

COMPONENT NUMBER 2 WITH NAME BACKAXLE AND INTERNAL DESIGNATION 60 HAS 2 NODES AND IS PART OF FRAME.

NODE NO. 1 WITH NAME PT17 INTERNAL DESIGNATION 254 MASS POINT NO. 17 AND 3 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	97	192 C3	254	PT17	38	EXTE	1
2	100	192 C3	254	PT17	62	SHEARC	3
3	118	254 PT17	263	PT18	20	BEAMB	9

NODE NO. 2 WITH NAME PT18 INTERNAL DESIGNATION 263 MASS POINT NO. 18 AND 2 CONNECTIONS.

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	37	52 M4	263	PT18	26	EXTA	1
2	118	254 PT17	263	PT18	20	BEAMB	9

80A

BBB
CCCC
CDDDD

CORRESPONDENCE BETWEEN MASS POINTS AND NODES

MASS POINT NO.	NODE NAME AND NUMBER	
1	PT1	66
2	PT2	73
3	PT3	83
4	PT4	94
5	PT5	105
6	PT6	113
7	PT7	121
8	PT8	129
9	PT9	138
10	PT10	146
11	PT11	156
12	PT12	165
13	PT13	220
14	PT14	228
15	PT15	237
16	PT16	246
17	PT17	254
18	PT18	263

CORRESPONDENCE BETWEEN RIGID BODIES AND COMPONENTS

RIGID BODY NO.	D.O.F. POINT NO.	COMPONENT NAME AND NUMBER	
1	19	MOTOTRAN	7
2	20	BODY	39

CORRESPONDENCE BETWEEN BEAMS AND CONNECTIONS

BEAM NO.		NODE		AND NODE		BY CONNECTOR.	
1	46	66	PT1	94	PT4	17	BEAMA
2	49	73	PT2	83	PT3	17	BEAMA
3	58	83	PT3	94	PT4	17	BEAMA
4	43	94	PT4	129	PT8	20	BEAMB
5	79	129	PT8	146	PT10	20	BEAMB
6	85	146	PT10	156	PT11	20	BEAMB
7	73	146	PT10	220	PT13	20	BEAMB
8	88	156	PT11	165	PT12	20	BEAMB
9	109	220	PT13	228	PT14	20	BEAMB
10	112	228	PT14	237	PT15	20	BEAMB
11	115	237	PT15	246	PT16	23	BEAMC
12	118	254	PT17	263	PT18	20	BEAMB

BBB
CCCC
CDDDD

CORRESPONDENCE BETWEEN GENERALIZED MECHANISMS IN FRAME AND CONNECTIONS

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	52	73 PT2	105	PT5	50	MEXTA	1
2	55	73 PT2	105	PT5	56	SHEARA	3
3	61	83 PT3	113	PT6	50	MEXTA	1
4	64	83 PT3	113	PT6	56	SHEARA	3
5	67	94 PT4	121	PT7	53	MEXTB	1
6	70	94 PT4	121	PT7	59	SHEARB	3
7	76	129 PT8	138	PT9	32	EXTC	1
8	82	146 PT10	138	PT9	35	EXTD	1

CORRESPONDENCE BETWEEN GENERALIZED MECHANISMS OUTSIDE OF FRAME AND CONNECTIONS

CONNECTION	NODE		AND NODE		BY CONNECTOR OF TYPE.		
1	31	38 M2	156	PT11	47	PIN	7
2	34	45 M3	246	PT16	47	PIN	7
3	37	52 M4	263	PT18	26	EXTA	1
4	40	31 M1	73	PT2	29	EXTB	1
5	91	172 C1	228	PT14	47	PIN	7
6	94	179 C2	237	PT15	47	PIN	7
7	97	192 C3	254	PT17	38	EXTE	1
8	100	192 C3	254	PT17	62	SHEARC	3
9	103	200 C4	83	PT3	41	EXTF	1
10	106	207 C5	59	M5	44	EXTG	1

13

USER PROGRAM RETURN.
T=5.007 DR=13 $3.73, $3.82T

K= 1 SCFA= 1.00000 TIME= 0.00020 SEC

	1	2	3	4	5	6
MASS 1						
FORCE	-0.24815E-18	0.74233E-02	0.0	-0.47235E+00	0.0	0.25750E-01
COORD	0.35256E-07	0.0	-0.10560E+00	0.0	0.15789E-06	0.0
VELOC	0.47628E-03	0.0	-0.52800E+03	0.0	0.78944E-03	0.0
ACCEL	0.61630E-02	-0.0	0.56452E-01	-0.0	0.10215E-01	-0.0
MASS 2						
FORCE	0.49631E-18	-0.29823E-02	0.16653E-10	0.25213E-01	-0.10857E-17	0.28634E-02
COORD	0.12000E+02	0.0	-0.10560E+00	0.0	0.19183E-06	0.0
VELOC	0.63086E-04	0.0	-0.52800E+03	0.0	0.95914E-03	0.0
ACCEL	0.81633E-03	-0.0	0.19367E-02	-0.0	0.12411E-01	-0.0
MASS 3						
FORCE	-0.12218E-16	-0.58840E-18	0.20817E-10	0.16758E-11	0.56792E-12	-0.24815E-17
COORD	0.12000E+02	0.16000E+02	-0.10560E+00	0.26558E-07	0.26186E-06	-0.67294E-08
VELOC	0.28914E-03	0.11568E-04	-0.52800E+03	0.13279E-03	0.13093E-02	-0.33647E-04
ACCEL	0.37415E-02	0.14968E-03	0.57906E-02	0.17183E-02	0.16942E-01	-0.43539E-03
MASS 4						
FORCE	-0.11117E-15	0.95291E-16	0.14572E-09	-0.39478E-12	0.94652E-12	0.0
COORD	0.76608E-07	0.16000E+02	-0.10560E+00	0.11269E-06	0.15789E-06	0.19213E-07
VELOC	0.38304E-03	-0.28794E-04	-0.52798E+03	0.56343E-03	0.78944E-03	0.96066E-04
ACCEL	0.49555E-02	-0.37259E-03	0.19482E+00	0.72908E-02	0.10215E-01	0.12431E-02
MASS 5						
FORCE	-0.24815E-18	0.0	0.52216E+02	0.0	0.45907E-01	0.0
COORD	0.12000E+02	0.0	-0.10106E+02	0.0	0.0	0.0
VELOC	-0.14191E-03	0.0	-0.52760E+03	0.0	0.0	0.0
ACCEL	-0.18363E-02	-0.0	0.10438E+02	-0.0	-0.0	-0.0
MASS 6						
FORCE	0.24815E-18	0.24815E-18	0.52216E+02	0.65525E-02	0.60698E-01	0.0
COORD	0.12000E+02	0.16000E+02	-0.10106E+02	0.0	0.0	0.0
VELOC	-0.18763E-03	0.20255E-04	-0.52760E+03	0.0	0.0	0.0
ACCEL	-0.24279E-02	0.26210E-03	0.10438E+02	-0.0	-0.0	-0.0
MASS 7						
FORCE	0.0	0.0	0.36867E+03	0.30419E-01	0.39226E-01	0.0
COORD	-0.72616E-08	0.16000E+02	-0.11106E+02	0.0	0.0	0.0
VELOC	-0.36308E-04	0.28157E-04	-0.52707E+03	0.0	0.0	0.0
ACCEL	-0.46982E-03	0.36435E-03	0.23948E+02	-0.0	-0.0	-0.0
MASS 8						
FORCE	-0.22403E-11	-0.12705E-15	-0.58287E-10	-0.63527E-15	0.15882E-15	0.0
COORD	0.11105E-05	0.16000E+02	0.88944E+01	0.79908E-07	0.57244E-07	0.48536E-07
VELOC	0.55525E-02	-0.43448E-02	-0.52799E+03	0.39954E-03	0.28622E-03	0.24268E-03
ACCEL	0.71849E-01	-0.56221E-01	0.14714E+00	0.51700E-02	0.37037E-02	0.31403E-02
MASS 9						
FORCE	0.30717E+00	-0.19561E-06	0.66613E-10	0.0	0.0	0.0
COORD	-0.80000E+01	0.16000E+02	0.17894E+02	0.0	0.0	0.0
VELOC	0.0	0.0	-0.52800E+03	0.0	0.0	0.0
ACCEL	-0.0	-0.0	0.27799E-02	-0.0	-0.0	-0.0
MASS 10						
FORCE	0.16169E-11	-0.74370E-11	0.20817E-10	0.33915E-10	0.34738E-11	0.12234E-14
COORD	0.85487E-06	0.16000E+02	0.17894E+02	-0.15506E-06	-0.12744E-06	0.77860E-07
VELOC	0.42744E-02	-0.41377E-02	-0.52799E+03	-0.77529E-03	-0.63722E-03	0.38930E-03
ACCEL	0.55310E-01	-0.54188E-01	0.11033E+00	-0.10032E-01	-0.82456E-02	0.50375E-02
MASS 11						
FORCE	-0.10943E+00	-0.64861E+00	-0.97564E+00	0.0	-0.79409E-16	0.55587E-15
COORD	-0.17232E-06	0.10000E+02	0.13894E+02	-0.21981E-06	-0.15748E-06	0.57724E-07
VELOC	-0.86162E-03	-0.67471E-26	-0.52800E+03	-0.10991E-02	-0.78740E-03	0.28862E-03
ACCEL	-0.11149E-01	-0.87307E-25	0.98999E-02	-0.14222E-01	-0.10189E-01	0.37347E-02
MASS 12						
FORCE	-0.39705E-17	0.70197E-23	-0.15613E-11	0.27493E+00	0.0	-0.19969E+00
COORD	0.91384E-07	0.0	0.13894E+02	0.0	-0.15748E-06	0.0

TABLE 5: EXAMPLE OUTPUT Pages 1-9

VELOC	0.45692E-03	0.0	-0.52800E+03	0.0	-0.78740E-03	0.0
ACCEL	0.59126E-02	-0.0	0.63657E-01	-0.0	-0.10189E-01	-0.0
MASS 13						
FORCE	-0.71228E-12	-0.52116E-17	-0.29143E-10	-0.18115E-15	-0.69761E-12	-0.39705E-16
COORD	-0.80000E+01	0.16000E+02	0.31894E+02	-0.32612E-07	-0.11593E-07	0.62742E-07
VELOC	-0.43460E-02	-0.41480E-03	-0.52800E+03	-0.16338E-03	-0.57964E-04	0.31371E-03
ACCEL	-0.56237E-01	-0.53679E-02	0.16333E-01	-0.21099E-02	-0.75005E-03	0.40594E-02
MASS 14						
FORCE	0.18852E+00	-0.30887E-01	-0.11702E+01	0.49631E-17	-0.79409E-16	-0.74446E-17
COORD	-0.80000E+01	0.16000E+02	0.41894E+02	0.42073E-08	0.99403E-07	0.60740E-07
VELOC	-0.35383E-03	-0.67989E-26	-0.52800E+03	0.21037E-04	0.49702E-03	0.30370E-03
ACCEL	-0.45793E-02	-0.87978E-25	0.16438E-02	0.27221E-03	0.64314E-02	0.39298E-02
MASS 15						
FORCE	-0.32870E-01	-0.21950E-02	0.26351E-02	-0.52042E-11	-0.59557E-16	0.0
COORD	-0.80000E+01	0.16000E+02	0.59894E+02	-0.10351E-07	-0.47069E-07	0.55134E-07
VELOC	-0.10814E-03	0.0	-0.52800E+03	-0.51757E-04	-0.23534E-03	0.27567E-03
ACCEL	-0.13993E-02	-0.0	0.16438E-02	-0.66974E-03	-0.30453E-02	0.35671E-02
MASS 16						
FORCE	0.78407E-01	0.0	0.44853E-01	0.76419E-01	0.0	-0.10658E+00
COORD	-0.80000E+01	0.0	0.59894E+02	0.0	-0.47069E-07	0.0
VELOC	0.27357E-02	0.0	-0.52800E+03	0.0	-0.23534E-03	0.0
ACCEL	0.35399E-01	-0.0	0.17960E-01	-0.0	-0.30453E-02	-0.0
MASS 17						
FORCE	-0.13415E+00	0.0	0.19984E-09	0.31627E-01	0.70292E-03	0.11254E-02
COORD	-0.80000E+01	0.16000E+02	0.11689E+03	0.0	0.0	0.0
VELOC	0.0	0.0	-0.52800E+03	0.0	0.0	0.0
ACCEL	-0.0	-0.0	0.27527E-04	-0.0	-0.0	-0.0
MASS 18						
FORCE	-0.43397E-12	0.0	0.13323E-09	0.31627E-01	0.0	0.11254E-02
COORD	-0.80000E+01	0.0	0.11689E+03	0.0	0.0	0.0
VELOC	-0.51433E-05	0.0	-0.52800E+03	0.0	0.0	0.0
ACCEL	-0.63554E-04	-0.0	0.18979E-02	-0.0	-0.0	-0.0
RIGID BODY MASS 1						
COORD	0.90000E+01	0.0	0.24894E+02	0.0	0.15573E-07	0.0
VELOC	0.26657E-05	0.0	-0.52800E+03	0.0	0.77863E-04	0.0
ACCEL	0.34494E-04	-0.0	0.83194E-03	-0.0	0.10075E-02	-0.0
FORCE	0.43397E-12	-0.64861E+00	0.10658E-08	-0.16956E+02	-0.14572E-08	0.69318E+01
RIGID BODY MASS 2						
COORD	-0.20000E+01	0.0	0.66894E+02	0.0	0.27306E-08	0.0
VELOC	-0.11203E-04	0.0	-0.52800E+03	0.0	0.13653E-04	0.0
ACCEL	-0.14497E-03	-0.0	0.58377E-03	-0.0	0.17667E-03	-0.0
FORCE	-0.47646E-16	-0.33082E-01	0.21316E-08	-0.19471E+02	0.20817E-09	-0.44405E+01
ACCEL ON PARTICULAR POINTS						
AT 1	-0.13993E-02	0.0	0.16438E-02			
AT 2	0.20525E-01	0.0	0.19971E-02			

FORCE & MOMENT ON EACH BEAM ENDS

	1	2	3	4	5	6	SW	YFCT	DISSP
BM 1@ 1	0.51862E-02	-0.74233E-02	0.47505E-01	0.47235E+00	0.0	-0.25750E-01	0	0.05000	0.0
BM 1@ 4	0.51862E-02	-0.74233E-02	0.47505E-01	-0.28773E+00	0.0	0.57229E-01	0	0.05000	0.0
BM 2@ 2	-0.33116E-03	0.29823E-02	-0.58711E-02	-0.25213E-01	0.45907E-01	-0.28634E-02	0	0.05000	0.0
BM 2@ 3	-0.33116E-03	0.29823E-02	-0.58711E-02	0.68724E-01	0.45907E-01	-0.81620E-02	0	0.05000	0.0
BM 3@ 3	0.32278E-01	0.60830E-02	0.36695E-01	0.75277E-01	0.10660E+00	-0.81620E-02	0	0.05000	0.0
BM 3@ 4	0.32278E-01	0.60830E-02	0.36695E-01	0.75277E-01	-0.33373E+00	0.64834E-01	0	0.05000	0.0
BM 4@ 4	0.50555E-01	0.26703E-02	-0.42597E+01	-0.18203E+00	-0.29451E+00	0.12206E+00	0	0.05000	0.0
BM 4@ 8	0.50555E-01	0.26703E-02	-0.42597E+01	-0.15800E+00	-0.74950E+00	0.12206E+00	0	0.05000	0.0
BM 5@ 8	0.46315E-01	-0.23571E+00	-0.32884E+01	-0.15800E+00	-0.74950E+00	0.12206E+00	0	0.05000	0.0
BM 5@10	0.46315E-01	-0.23571E+00	-0.32884E+01	-0.22794E+01	-0.11663E+01	0.12206E+00	0	0.05000	0.0

BM 6@10	-0.78232E-01	-0.64851E+00	-0.11660E+01	-0.26154E+01	-0.31245E+00	0.12942E+00	0	0.05000	0.0
BM 6@11	-0.78232E-01	-0.64851E+00	-0.11660E+01	0.17772E+01	-0.79409E-16	-0.33922E+00	0	0.05000	0.0
BM 7@10	0.54772E+00	-0.18213E-04	-0.12817E+01	0.33753E+00	-0.85389E+00	-0.73577E-02	0	0.05000	0.0
BM 7@13	0.54772E+00	-0.18213E-04	-0.12817E+01	0.33728E+00	0.15246E+01	-0.75005E-02	0	0.05000	0.0
BM 8@11	-0.13954E-01	0.70197E-23	-0.15023E+00	0.17772E+01	0.0	-0.33922E+00	0	0.05000	0.0
BM 8@12	-0.13954E-01	0.70197E-23	-0.15023E+00	0.27493E+00	0.0	-0.19969E+00	0	0.05000	0.0
BM 9@13	0.20130E+00	-0.33082E-01	-0.11811E+01	0.33728E+00	0.15246E+01	-0.75005E-02	0	0.05000	0.0
BM 9@14	0.20130E+00	-0.33082E-01	-0.11811E+01	0.64579E-02	-0.48838E+00	-0.75005E-02	0	0.05000	0.0
BM10@14	-0.17442E-01	-0.21950E-02	0.0	0.64579E-02	-0.48838E+00	-0.75005E-02	0	0.05000	0.0
BM10@15	-0.17442E-01	-0.21950E-02	0.0	-0.55001E-01	-0.79409E-16	-0.75005E-02	0	0.05000	0.0
BM11@15	0.61923E-02	0.0	0.82138E-02	-0.55001E-01	0.0	-0.75005E-02	0	0.05000	0.0
BM11@16	0.61923E-02	0.0	0.82138E-02	0.76419E-01	0.0	-0.10658E+00	0	0.05000	0.0
BM12@17	-0.14068E-03	0.0	0.39534E-02	-0.31627E-01	0.0	-0.11254E-02	0	0.05000	0.0
BM12@18	-0.14068E-03	0.0	0.39534E-02	0.31627E-01	0.0	0.11254E-02	0	0.05000	0.0

<= 10 SCFA= 1.00000 TIME= 0.00200 SEC

	1	2	3	4	5	6
MASS 1						
FORCE	-0.49286E-14	0.29725E+03	0.36429E-11	-0.40515E+03	-0.60094E-13	0.28950E+02
COORD	0.25632E-02	0.0	-0.10526E+01	0.0	0.45484E-03	0.0
VELOC	0.51046E+01	0.0	-0.52262E+03	0.0	0.64092E+00	0.0
ACCEL	0.22203E+02	-0.0	0.16640E+02	-0.0	0.15327E+01	-0.0
MASS 2						
FORCE	-0.79646E-13	-0.92544E+01	0.15821E-09	0.18945E+02	-0.82997E-13	0.30032E+03
COORD	0.12000E+02	0.0	-0.10558E+01	0.0	0.39867E-03	0.0
VELOC	0.75027E+00	0.0	-0.52772E+03	0.0	0.61438E+00	0.0
ACCEL	0.39170E+01	-0.0	0.11947E+01	-0.0	0.19385E+01	-0.0
MASS 3						
FORCE	-0.20366E-11	-0.11679E-13	0.34139E-09	0.25299E-10	0.58338E-10	-0.38516E-13
COORD	0.12002E+02	0.16000E+02	-0.10553E+01	0.10761E-03	0.49988E-03	-0.81822E-04
VELOC	0.35136E+01	0.92164E-02	-0.52676E+03	0.17467E+00	0.74283E+00	-0.15674E+00
ACCEL	0.15502E+02	0.13985E-01	0.51770E+01	0.58251E+00	0.21703E+01	-0.64364E+00
MASS 4						
FORCE	0.85314E-12	0.40603E-12	0.26687E-08	0.79074E-10	0.66011E-10	-0.71826E-13
COORD	0.18744E-02	0.16000E+02	-0.10493E+01	0.35690E-03	0.45476E-03	0.14692E-03
VELOC	0.26914E+01	-0.36199E+00	-0.51811E+03	0.53146E+00	0.64071E+00	0.25252E+00
ACCEL	0.15935E+02	-0.10382E+01	0.28423E+02	0.14817E+01	0.15316E+01	0.88497E+00
MASS 5						
FORCE	0.67138E-14	0.0	0.52230E+03	0.0	0.66365E+02	0.0
COORD	0.12000E+02	0.0	-0.11030E+02	0.0	0.0	0.0
VELOC	-0.62540E+00	0.0	-0.48866E+03	0.0	0.0	0.0
ACCEL	-0.26606E+01	-0.0	0.99192E+02	-0.0	-0.0	-0.0
MASS 6						
FORCE	0.16454E-13	-0.51432E-14	0.52179E+03	0.22604E+02	0.24789E+02	-0.32988E-02
COORD	0.12000E+02	0.16000E+02	-0.11030E+02	0.0	0.0	0.0
VELOC	-0.38493E+00	0.19121E+00	-0.48866E+03	0.0	0.0	0.0
ACCEL	-0.99468E+00	0.90611E+00	0.99192E+02	-0.0	-0.0	-0.0
MASS 7						
FORCE	0.15736E-13	-0.10155E-13	0.78642E+04	0.80947E+02	0.26905E+02	-0.10487E-01
COORD	-0.78854E-04	0.16000E+02	-0.11996E+02	0.0	0.0	0.0
VELOC	-0.12931E+00	0.21381E+00	-0.44065E+03	0.0	0.0	0.0
ACCEL	-0.36692E+00	0.98090E+00	0.21268E+03	-0.0	-0.0	-0.0
MASS 8						
FORCE	-0.66262E-10	0.11160E-11	-0.37054E-09	-0.24865E-11	-0.41256E-11	-0.10164E-12
COORD	0.50757E-02	0.15997E+02	0.79499E+01	0.21187E-03	0.17294E-03	0.29189E-03
VELOC	0.81244E+01	-0.47094E+01	-0.51915E+03	0.31067E+00	0.22553E+00	0.48138E+00
ACCEL	0.25826E+02	-0.13144E+02	0.25886E+02	0.84991E+00	0.38855E+00	0.15739E+01
MASS 9						
FORCE	0.24534E+03	-0.81533E-01	0.18652E-08	0.0	0.0	0.0
COORD	-0.80000E+01	0.16000E+02	0.16944E+02	0.0	0.0	0.0
VELOC	0.0	0.0	-0.52739E+03	0.0	0.0	0.0
ACCEL	-0.0	-0.0	0.22754E+01	-0.0	-0.0	-0.0
MASS 10						
FORCE	-0.14989E-09	0.59080E-10	0.42882E-09	0.89397E-09	0.12062E-09	0.22106E-11
COORD	0.38657E-02	0.15998E+02	0.16949E+02	-0.45461E-03	-0.48374E-03	0.43679E-03
VELOC	0.60940E+01	-0.36682E+01	-0.52012E+03	-0.67318E+00	-0.74461E+00	0.71009E+00
ACCEL	0.18578E+02	-0.10110E+02	0.23379E+02	-0.18637E+01	-0.22205E+01	0.22620E+01
MASS 11						
FORCE	-0.40786E+03	-0.41188E+03	-0.16718E+04	0.28547E-09	-0.20139E-11	0.26534E-11
COORD	-0.97517E-03	0.10000E+02	0.12945E+02	-0.63824E-03	-0.63527E-03	0.34521E-03
VELOC	-0.15792E+01	0.36916E-26	-0.52608E+03	-0.94351E+00	-0.98400E+00	0.56065E+00
ACCEL	-0.50803E+01	0.70562E-25	0.70318E+01	-0.26023E+01	-0.29471E+01	0.17757E+01
MASS 12						
FORCE	-0.10191E-12	-0.35377E+01	-0.70777E-10	0.27423E+04	-0.59271E-12	-0.15664E+04
COORD	0.73313E-03	0.0	0.12948E+02	0.0	-0.63526E-03	0.0

VELOC	0.12119E+01	0.0	-0.52141E+03	0.0	-0.98398E+00	0.0
ACCEL	0.38184E+01	-0.0	0.20080E+02	-0.0	-0.29469E+01	-0.0
MASS 13						
FORCE	0.81867E-10	0.19333E-12	0.12698E-08	-0.50927E-12	0.59107E-10	-0.10887E-12
COORD	-0.80027E+01	0.15999E+02	0.30945E+02	-0.18698E-03	-0.74584E-04	0.37907E-03
VELOC	-0.38674E+01	-0.19954E+01	-0.52681E+03	-0.30770E+00	-0.12777E+00	0.63131E+00
ACCEL	-0.10522E+02	-0.71194E+01	0.41250E+01	-0.10023E+01	-0.44073E+00	0.20987E+01
MASS 14						
FORCE	0.55698E+03	-0.15205E+01	-0.21204E+04	-0.57765E-12	0.26638E-11	0.11200E-12
COORD	-0.80005E+01	0.16000E+02	0.40944E+02	-0.50558E-04	0.29156E-03	0.36932E-03
VELOC	-0.77151E+00	0.34307E-26	-0.52739E+03	-0.99187E-01	0.41964E+00	0.61501E+00
ACCEL	-0.27994E+01	-0.58799E-25	0.25629E+01	-0.39288E+00	0.10973E+01	0.20603E+01
MASS 15						
FORCE	-0.10076E+03	-0.31480E+02	-0.41979E+02	-0.57593E-10	-0.57790E-13	0.15042E-12
COORD	-0.80002E+01	0.16000E+02	0.58944E+02	-0.39592E-04	-0.13282E-03	0.34225E-03
VELOC	-0.38961E+00	0.0	-0.52739E+03	-0.60914E-01	-0.18938E+00	0.57234E+00
ACCEL	-0.15897E+01	-0.0	0.25629E+01	-0.18749E+00	-0.48398E+00	0.19569E+01
MASS 16						
FORCE	0.78364E+02	-0.75689E+00	0.82070E+02	0.51496E+03	-0.84968E-14	-0.67203E+03
COORD	-0.79967E+01	0.0	0.58946E+02	0.0	-0.13296E-03	0.0
VELOC	0.55665E+01	0.0	-0.52484E+03	0.0	-0.18979E+00	0.0
ACCEL	0.18931E+02	-0.0	0.11186E+02	-0.0	-0.48680E+00	-0.0
MASS 17						
FORCE	-0.55298E+03	0.41956E-01	0.18652E-08	0.74679E+03	0.11063E+02	0.27778E+02
COORD	-0.80000E+01	0.16000E+02	0.11594E+03	0.0	0.0	0.0
VELOC	0.0	0.0	-0.52789E+03	0.0	0.0	0.0
ACCEL	-0.0	-0.0	0.64082E+00	-0.0	-0.0	-0.0
MASS 18						
FORCE	-0.18858E-11	-0.41956E-01	0.18652E-08	0.74679E+03	0.0	0.27778E+02
COORD	-0.80000E+01	0.0	0.11594E+03	0.0	0.0	0.0
VELOC	-0.50423E-01	0.0	-0.52655E+03	0.0	0.0	0.0
ACCEL	-0.22048E+00	-0.0	0.63843E+01	-0.0	-0.0	-0.0
RIGID BODY MASS 1						
COORD	0.90001E+01	0.0	0.23944E+02	0.0	0.93531E-04	0.0
VELOC	0.13756E+00	0.0	-0.52747E+03	0.0	0.15467E+00	0.0
ACCEL	0.68796E+00	-0.0	0.23535E+01	-0.0	0.51972E+00	-0.0
FORCE	0.43864E-11	-0.41264E+03	0.13989E-08	-0.21263E+05	-0.11199E-07	0.77988E+04
RIGID BODY MASS 2						
COORD	-0.20001E+01	0.0	0.65944E+02	0.0	0.13450E-04	0.0
VELOC	-0.23897E+00	0.0	-0.52752E+03	0.0	0.21217E-01	0.0
ACCEL	-0.11125E+01	-0.0	0.21596E+01	-0.0	0.67208E-01	-0.0
FORCE	0.12136E-11	-0.33001E+02	0.18119E-07	-0.34825E+05	-0.11324E-07	-0.17605E+05
ACCEL ON PARTICULAR POINTS						
AT 1	-0.15897E+01	0.0	0.25629E+01			
AT 2	0.67508E+01	0.0	0.26971E+01			

FORCE & MOMENT ON EACH BEAM ENDS

	1	2	3	4	5	6	SW	YFCT	DISSP
BM 1@ 1	0.18683E+02	-0.29725E+03	0.14003E+02	0.40515E+03	0.60094E-13	-0.28950E+02	0	0.05000	0.0
BM 1@ 4	0.18683E+02	-0.29725E+03	0.14003E+02	0.18034E+03	-0.57464E-01	0.26983E+03	0	0.05000	0.0
BM 2@ 2	0.29163E+02	0.92544E+01	-0.13387E+02	-0.18945E+02	0.66365E+02	-0.30032E+03	0	0.05000	0.0
BM 2@ 3	0.29163E+02	0.92544E+01	-0.13387E+02	0.19524E+03	0.66339E+02	0.16628E+03	0	0.05000	0.0
BM 3@ 3	0.20960E+03	0.13952E+02	0.23318E+02	0.21785E+03	0.91127E+02	0.16628E+03	0	0.05000	0.0
BM 3@ 4	0.20960E+03	0.13952E+02	0.23318E+02	0.21792E+03	-0.18969E+03	0.33366E+03	0	0.05000	0.0
BM 4@ 4	0.23773E+03	-0.27264E+03	-0.44824E+04	0.47921E+03	-0.16284E+03	0.60348E+03	0	0.05000	0.0
BM 4@ 8	0.23773E+03	-0.27264E+03	-0.44824E+04	-0.19850E+04	-0.27639E+04	0.60350E+03	0	0.05000	0.0
BM 5@ 8	0.14415E+03	-0.32829E+03	-0.40882E+04	-0.19850E+04	-0.27639E+04	0.60350E+03	0	0.05000	0.0
BM 5@10	0.14415E+03	-0.32829E+03	-0.40882E+04	-0.49373E+04	-0.40572E+04	0.60326E+03	0	0.05000	0.0

BM 6@10	-0.39630E+03	-0.41542E+03	-0.17477E+04	-0.55389E+04	-0.15882E+04	0.71992E+03	0	0.05000	0.0
BM 6@11	-0.39630E+03	-0.41542E+03	-0.17477E+04	0.32162E+04	0.45856E-01	-0.16565E+04	0	0.05000	0.0
BM 7@10	0.68975E+03	0.10091E+02	-0.21624E+04	0.66167E+03	-0.24690E+04	-0.11666E+03	0	0.05000	0.0
BM 7@13	0.68975E+03	0.10091E+02	-0.21624E+04	0.80527E+03	0.48380E+04	-0.36752E+02	0	0.05000	0.0
BM 8@11	-0.90114E+01	-0.35377E+01	-0.47388E+02	0.32162E+04	0.45856E-01	-0.16565E+04	0	0.05000	0.0
BM 8@12	-0.90114E+01	-0.35377E+01	-0.47388E+02	0.27423E+04	-0.59271E-12	-0.15664E+04	0	0.05000	0.0
BM 9@13	0.62493E+03	-0.33758E+02	-0.21369E+04	0.80527E+03	0.48380E+04	-0.36752E+02	0	0.05000	0.0
BM 9@14	0.62493E+03	-0.33758E+02	-0.21369E+04	0.46961E+03	-0.14149E+04	-0.36135E+02	0	0.05000	0.0
BM10@14	-0.50527E+02	-0.32237E+02	0.35621E+00	0.46961E+03	-0.14149E+04	-0.36135E+02	0	0.05000	0.0
BM10@15	-0.50527E+02	-0.32237E+02	0.35621E+00	-0.43304E+03	-0.11610E+00	-0.36129E+02	0	0.05000	0.0
BM11@15	0.39744E+02	-0.75689E+00	0.59250E+02	-0.43304E+03	-0.11610E+00	-0.36129E+02	0	0.05000	0.0
BM11@16	0.39744E+02	-0.75689E+00	0.59250E+02	0.51496E+03	-0.84968E-14	-0.67203E+03	0	0.05000	0.0
BM12@17	-0.34723E+01	-0.41956E-01	0.93348E+02	-0.74679E+03	0.35822E-16	-0.27778E+02	0	0.05000	0.0
BM12@18	-0.34723E+01	-0.41956E-01	0.93348E+02	0.74679E+03	0.0	0.27778E+02	0	0.05000	0.0

EXECUTION TERMINATED 17:02:55 T=28.344 RC=0 $22.13
T=28.911 DR=255 $22.37, $26.97T

K= 39 SCRA= 1.00000 TIME= 0.00460 SEC

	1	2	3	4	5	6
MASS 1						
FORCE	-0.77136E-11	0.18097E+04	0.11839E-09	-0.67791E+04	-0.51737E-12	-0.11889E+04
COORD	0.80856E-01	0.0	-0.23419E+01	0.0	0.51714E-02	0.0
VELOC	0.59995E+02	0.0	-0.39819E+03	0.0	0.58976E+01	0.0
ACCEL	0.81093E+02	-0.0	0.55390E+03	-0.0	-0.11790E+01	-0.0
MASS 2						
FORCE	-0.22163E-09	0.24570E+02	0.37387E-08	-0.23964E+04	-0.47758E-12	0.74292E+04
COORD	0.12030E+02	0.0	-0.24187E+01	0.0	0.93539E-02	0.0
VELOC	0.31984E+02	0.0	-0.51609E+03	0.0	0.11309E+02	0.0
ACCEL	0.73945E+02	-0.0	0.34449E+02	-0.0	0.48200E+02	-0.0
MASS 3						
FORCE	-0.57134E-09	0.17105E-11	0.84890E-08	0.64425E-10	0.16222E-09	-0.16052E-11
COORD	0.12064E+02	0.16000E+02	-0.23996E+01	0.21238E-02	0.98137E-02	-0.18776E-02
VELOC	0.54848E+02	-0.19492E+00	-0.49785E+03	0.16581E+01	0.12490E+02	-0.11933E+01
ACCEL	0.83890E+02	-0.19522E+01	0.82199E+02	0.30821E+01	0.59479E+02	0.28536E+00
MASS 4						
FORCE	-0.45793E-09	-0.13021E-10	0.92509E-08	0.20562E-09	0.96661E-10	0.41261E-11
COORD	0.65937E-01	0.15999E+02	-0.23007E+01	0.36381E-02	0.51570E-02	0.20870E-02
VELOC	0.55175E+02	0.11375E+01	-0.37144E+03	0.16061E+01	0.58803E+01	0.55258E+00
ACCEL	0.88272E+02	0.10213E+02	0.57673E+03	-0.20068E+01	-0.11479E+01	-0.60896E+01
MASS 5						
FORCE	0.81331E-11	0.0	0.11939E+04	0.0	0.31212E+03	0.0
COORD	0.11991E+02	0.0	-0.12127E+02	0.0	0.0	0.0
VELOC	-0.63508E+01	0.0	-0.34180E+03	0.0	0.0	0.0
ACCEL	-0.13077E+02	-0.0	0.18049E+03	-0.0	-0.0	-0.0
MASS 6						
FORCE	-0.13146E-10	-0.77748E-11	0.11754E+04	0.23633E+03	-0.44455E+03	-0.15520E+01
COORD	0.12009E+02	0.16006E+02	-0.12127E+02	0.0	0.0	0.0
VELOC	0.10964E+02	0.53050E+01	-0.34180E+03	0.0	0.0	0.0
ACCEL	0.17940E+02	0.37359E+01	0.18049E+03	-0.0	-0.0	-0.0
MASS 7						
FORCE	-0.10134E-10	-0.11574E-10	0.47416E+05	0.60006E+03	-0.18170E+04	-0.46190E+01
COORD	0.24575E-02	0.16006E+02	-0.12805E+02	0.0	0.0	0.0
VELOC	0.35102E+01	0.52899E+01	-0.17196E+03	0.0	0.0	0.0
ACCEL	0.62613E+01	0.93536E+01	0.26824E+03	-0.0	-0.0	-0.0
MASS 8						
FORCE	-0.47411E-09	0.38456E-10	0.14072E-08	0.27430E-10	-0.66477E-10	-0.33644E-11
COORD	0.95971E-01	0.15969E+02	0.66840E+01	0.19763E-02	-0.44956E-04	0.39103E-02
VELOC	0.95717E+02	-0.14220E+02	-0.42195E+03	0.11445E+00	-0.15886E+01	0.22164E+01
ACCEL	0.32545E+03	-0.10719E+03	0.40776E+03	0.48005E+02	0.78721E+02	-0.11212E+02
MASS 9						
FORCE	0.41121E+04	-0.15164E+02	0.44698E-07	0.0	0.0	0.0
COORD	-0.80000E+01	0.16000E+02	0.15581E+02	0.0	0.0	0.0
VELOC	0.0	0.0	-0.51684E+03	0.0	0.0	0.0
ACCEL	-0.0	-0.0	0.37405E+02	-0.0	-0.0	-0.0
MASS 10						
FORCE	-0.99036E-09	0.50745E-09	0.84932E-08	0.26337E-08	0.25088E-09	0.10237E-09
COORD	0.68096E-01	0.15969E+02	0.15653E+02	-0.60748E-02	-0.89019E-02	0.63353E-02
VELOC	0.68373E+02	-0.18678E+02	-0.45228E+03	-0.22121E+01	-0.64372E+01	0.35848E+01
ACCEL	0.18230E+03	-0.82374E+02	0.11414E+03	0.60783E+02	0.45306E+02	-0.43288E+01
MASS 11						
FORCE	-0.47135E+04	-0.19345E+04	-0.14767E+05	0.14331E-08	-0.13154E-10	0.14615E-09
COORD	-0.11733E-01	0.10000E+02	0.11598E+02	-0.78538E-02	-0.11734E-01	0.48719E-02
VELOC	-0.96390E+00	0.16612E-25	-0.51171E+03	-0.64515E+01	-0.11954E+02	0.34290E+01
ACCEL	0.27008E+02	0.42253E-23	0.60634E+01	-0.21330E+02	-0.30905E+02	0.93171E+01
MASS 12						
FORCE	-0.89724E-11	-0.69797E+03	-0.48139E-10	0.35029E+05	-0.86124E-11	-0.22184E+04
COORD	0.11917E-01	0.0	0.11637E+02	0.0	-0.11733E-01	0.0

VELOC	0.16629E+02	0.0	-0.47947E+03	0.0	-0.11943E+02	0.0
ACCEL	0.45901E+02	-0.0	0.13610E+03	-0.0	-0.31006E+02	-0.0
MASS 13						
FORCE	0.30649E-09	0.23320E-10	0.74815E-08	-0.10274E-10	0.24175E-09	-0.15624E-11
COORD	-0.80284E+01	0.15983E+02	0.23588E+02	-0.26397E-02	-0.13830E-02	0.59179E-02
VELOC	-0.48707E+01	-0.87928E+01	-0.51032E+03	-0.15364E+01	-0.19700E+01	0.26152E+01
ACCEL	-0.26322E+02	-0.26662E+02	0.18627E+03	-0.15047E+02	-0.57237E+02	-0.36853E+02
MASS 14						
FORCE	0.61705E+04	0.34448E+03	-0.16109E+05	-0.43089E-11	0.22404E-10	0.57685E-11
COORD	-0.80133E+01	0.16000E+02	0.39585E+02	-0.83437E-03	0.24476E-02	0.59032E-02
VELOC	-0.87163E+01	0.17423E-25	-0.51624E+03	-0.50477E+00	-0.27390E+00	0.25889E+01
ACCEL	-0.24635E+01	-0.54831E-23	0.15062E+02	-0.17596E+01	0.34543E+01	-0.30018E+02
MASS 15						
FORCE	-0.12252E+04	-0.24062E+03	-0.80774E+03	-0.13742E-09	-0.11223E-12	0.10184E-12
COORD	-0.80081E+01	0.16000E+02	0.57585E+02	-0.59938E-03	-0.10038E-02	0.59022E-02
VELOC	-0.68041E+01	-0.10145E-24	-0.51624E+03	-0.13114E+00	0.23769E+00	0.25430E+01
ACCEL	-0.78489E+01	-0.26782E-22	0.15062E+02	0.13057E+01	-0.20248E+01	-0.10374E+02
MASS 16						
FORCE	0.66167E+03	-0.27792E+03	0.92168E+03	0.81119E+04	-0.26884E-12	-0.12215E+05
COORD	-0.79452E+01	0.0	0.57609E+02	0.0	-0.10503E-02	0.0
VELOC	0.20146E+02	0.0	-0.50809E+03	0.0	0.19802E+00	0.0
ACCEL	-0.50764E+02	-0.0	-0.73418E+01	-0.0	-0.19824E+01	-0.0
MASS 17						
FORCE	-0.40115E+04	0.45378E+02	0.36904E-07	0.21629E+05	0.30202E+03	0.93066E+03
COORD	-0.80000E+01	0.16000E+02	0.11458E+03	0.0	0.0	0.0
VELOC	0.0	0.0	-0.52027E+03	0.0	0.0	0.0
ACCEL	-0.0	-0.0	0.18548E+02	-0.0	-0.0	-0.0
MASS 18						
FORCE	0.71463E-11	-0.45378E+02	0.19051E-07	0.21630E+05	0.0	0.93070E+03
COORD	-0.80009E+01	0.0	0.11460E+03	0.0	0.0	0.0
VELOC	-0.57268E+00	0.0	-0.50849E+03	0.0	0.0	0.0
ACCEL	-0.10713E-02	-0.0	0.10557E+02	-0.0	-0.0	-0.0
RIGID BODY MASS 1						
COORD	0.90043E+01	0.0	0.22585E+02	0.0	0.14410E-02	0.0
VELOC	0.41007E+01	0.0	-0.51583E+03	0.0	0.45681E+00	0.0
ACCEL	0.83365E+01	-0.0	0.21226E+02	-0.0	-0.16831E+01	-0.0
FORCE	-0.68022E-09	-0.22624E+04	0.52025E-07	-0.15991E+06	0.31433E-07	0.69737E+05
RIGID BODY MASS 2						
COORD	-0.20065E+01	0.0	0.64584E+02	0.0	0.23015E-03	0.0
VELOC	-0.60499E+01	0.0	-0.51687E+03	0.0	0.10623E+00	0.0
ACCEL	-0.99731E+01	-0.0	0.16857E+02	-0.0	-0.29919E+00	-0.0
FORCE	0.20532E-09	0.10386E+03	0.17799E-06	-0.26279E+06	0.28144E-07	-0.16020E+06
ACCEL ON PARTICULAR POINTS						
AT 1	-0.78526E+01	0.0	0.15060E+02			
AT 2	-0.44982E+02	0.0	0.14458E+02			

FORCE & MOMENT ON EACH BEAM ENDS

	1	2	3	4	5	6	SW	YFCT	DISSP
BM 1@ 1	0.68332E+02	-0.18097E+04	0.46611E+03	0.67791E+04	0.51737E-12	0.11889E+04	0	0.35976	0.0
BM 1@ 4	0.68332E+02	-0.18097E+04	0.46611E+03	-0.74857E+03	-0.94354E+01	0.22555E+04	0	0.05000	0.0
BM 2@ 2	0.72629E+02	-0.24570E+02	0.82018E+02	0.23964E+04	0.31212E+03	-0.74292E+04	0	0.45445	0.0
BM 2@ 3	0.72629E+02	-0.24570E+02	0.82018E+02	0.10836E+04	0.30137E+03	0.43523E+04	0	0.15105	0.0
BM 3@ 3	0.18292E+04	0.76126E+00	0.81218E+03	0.13200E+04	-0.14318E+03	0.43507E+04	0	0.17628	0.0
BM 3@ 4	0.18292E+04	0.76126E+00	0.81219E+03	0.13212E+04	-0.10062E+05	0.43574E+04	0	0.92900	0.0
BM 4@ 4	0.23526E+04	-0.16253E+04	-0.39713E+05	0.11727E+04	-0.11888E+05	0.66083E+04	0	0.67854	0.0
BM 4@ 8	0.23526E+04	-0.16253E+04	-0.39713E+05	-0.14546E+05	-0.34193E+05	0.65898E+04	1	1.01044	0.35148E+03
BM 5@ 9	-0.51654E+03	-0.20641E+04	-0.33309E+05	-0.14546E+05	-0.34193E+05	0.65898E+04	1	1.00319	0.29931E+01
BM 5@10	-0.51654E+03	-0.20641E+04	-0.33309E+05	-0.33121E+05	-0.28658E+05	0.65333E+04	1	1.01637	0.94625E+03

BM 6@10	-0.40331E+04	-0.20824E+04	-0.15112E+05	-0.42667E+05	-0.20590E+05	0.66185E+04	1	1.00187	0.10830E+03
BM 6@11	-0.40331E+04	-0.20824E+04	-0.15112E+05	0.38267E+05	0.33681E+01	-0.23284E+05	0	0.93051	0.0
BM 7@10	0.59409E+04	-0.98340E+01	-0.17326E+05	0.90457E+04	-0.80682E+04	-0.85123E+02	0	0.18713	0.0
BM 7@11	0.59409E+04	-0.98340E+01	-0.17326E+05	0.91322E+04	0.46544E+05	-0.85979E+02	1	1.00381	0.10139E+03
BM 8@11	-0.10833E+03	-0.60797E+03	-0.32118E+03	0.38267E+05	0.33681E+01	-0.23284E+05	0	0.80924	0.0
BM 8@12	-0.10833E+03	-0.60797E+03	-0.32118E+03	0.35029E+05	-0.86124E-11	-0.22184E+05	0	0.69340	0.0
BM 9@13	0.57786E+04	-0.17407E+03	-0.16179E+05	0.91322E+04	0.46544E+05	-0.85979E+02	1	1.00011	0.12034E+02
BM 9@14	0.57786E+04	-0.17407E+03	-0.16179E+05	0.76511E+04	-0.11468E+05	0.96194E+01	0	0.17327	0.0
BM10@14	-0.40819E+03	-0.51855E+03	0.29511E+02	0.76511E+04	-0.11468E+05	0.96194E+01	0	0.07663	0.0
BM10@15	-0.40819E+03	-0.51855E+03	0.29511E+02	-0.68682E+04	-0.38446E+02	0.11656E+02	0	0.05000	0.0
BM11@15	0.76523E+03	-0.27792E+03	0.93666E+03	-0.68682E+04	-0.38446E+02	0.11656E+02	0	0.09757	0.0
BM11@16	0.76523E+03	-0.27792E+03	0.93666E+03	0.81119E+04	-0.26884E-12	-0.12215E+05	0	0.44435	0.0
BM12@17	-0.11634E+03	-0.45378E+02	0.27037E+04	-0.21629E+05	-0.61041E-16	-0.93066E+03	0	0.18898	0.0
BM12@18	-0.11634E+03	-0.45378E+02	0.27037E+04	0.21630E+05	0.0	0.93070E+03	0	0.18899	0.0

CONNECTOR BETWEEN MASS 2 AND MASS 5 ON FRAME MODULE IS CONNECTOR MEMBER 52

EX CN	52	0.11784E+01	0.0	0.29171E+03

CONNECTOR BETWEEN MASS 2 AND MASS 5 ON FRAME MODULE IS CONNECTOR MEMBER 55

SH CN	55	0.64257E+02	0.0	-0.25924E+00

CONNECTOR BETWEEN MASS 3 AND MASS 6 ON FRAME MODULE IS CONNECTOR MEMBER 61

EX CN	61	0.15876E+01	-0.15798E+00	0.27250E+03

CONNECTOR BETWEEN MASS 3 AND MASS 6 ON FRAME MODULE IS CONNECTOR MEMBER 64

SH CN	64	-0.91217E+02	-0.48528E+02	0.50268E+00

CONNECTOR BETWEEN MASS 4 AND MASS 7 ON FRAME MODULE IS CONNECTOR MEMBER 67

EX CN	67	0.26192E+03	-0.29410E+02	0.43341E+05

CONNECTOR BETWEEN MASS 4 AND MASS 7 ON FRAME MODULE IS CONNECTOR MEMBER 70

SH CN	70	-0.34517E+03	-0.11398E+03	0.20044E+01

CONNECTOR BETWEEN MASS 8 AND MASS 9 ON FRAME MODULE IS CONNECTOR MEMBER 76

EX CN	76	0.42411E+04	-0.16062E+02	-0.46605E+04

CONNECTOR BETWEEN MASS 9 AND MASS 10 ON FRAME MODULE IS CONNECTOR MEMBER 82

EX CN	82	0.13605E+03	-0.52285E+00	0.12271E+01
EX CN	37	-0.11694E+03	0.0	0.32424E+04
EX CN	40	0.0	0.0	0.0
EX CN	97	0.50230E+04	0.0	0.32154E+01
SH CN	100	-0.48255E-01	0.0	0.75457E+02
EX CN	103	0.36581E-01	-0.34385E-04	-0.20021E+02
EX CN	106	0.0	0.0	0.0

PART 3. OUTPUT DESCRIPTION

The Executive Program echoes each input card it reads and then produces a summary of all interconnections between modules, components, and nodes. Table 4 contains the echoed data set for the sample exercise discussed in Part 4 together with the connection summary for this case. Table 5 contains the output from the dynamics solution processor for this same case.

Output is presented for three different time steps, k = 1 (.2 ms), k = 10 (2 ms), and k = 38 (4.6 ms). The step number and time are indicated on the first line.

The remainder of the output describe external force (moment), position, velocity, and acceleration at each of the 18 mass points and for the 2 rigid body masses. One exception is that the force (moment) at node points with a rigid or pin connector is the connector force. These quantities are shown in six columns referring to the six linear and angular coordinates (X, Y, Z, θ_1, θ_2, θ_3). Mass points and rigid bodies are assigned numbers in the order which they appear in the input data. The executive system summary contains a table showing the correspondence of this numbering with the user-supplied names of mass points and rigid bodies.

The same numbering principle is employed separately for each of the three types of connections: beam connections, general mechanism connections between frame mass points, and general mechanism connections between rigid bodies or between a rigid body and a frame mass point. A table for each of these three categories of connections show the correspondence of these numbers with the

connections specified to the executive. These numbers are used as identification in the preliminary output.

The next position of the printout deals with forces and moments at each beam end. As an example, consider the statement, "BM 1 @ 1." The first number is the beam number while the second number is the mass point number, No. 1 in this case. The mass point number is numbered the same as the "MASS" quantities shown earlier. The six columns of information give the forces and moments with respect to X, Y, Z, θ_1, θ_2, θ_3. The quantities SW, YFCT, and DISSP refer to internal activity of the program. If SW = 0, elastic behavior at the node is indicated whereas SW = 1 indicates plastic behavior. YFCT is the current value of the yield function and DISSP is the total energy dissipated at the hinge.

The next sixteen lines relate to generalized mechanisms between frame mass points.

Code letters are:

EX = extensional

CN = connector

SH = shear

BN = bending

TR = torsional

The three columns of numbers refer to forces (or moments) with respect to X, Y, Z axes.

The final six lines describe the connections between rigid bodies or between a rigid body and a mass point. The code letters are the same as previously used. The integer number is the supplied identification number assigned to each connection. The three columns of numbers refer to forces or moments as used before.

PART 4. EXAMPLE EXERCISE

An example problem is presented in this section as an illustration of using UMVCS-1 for modeling vehicle structures. The resulting data set is listed in Table 4. Although the problem is a hypothetical structure, it has features characteristic of realistic applications to vehicle structures.

The "vehicle", shown in Figure 1, is a frame structure with bumper system, engine and transmission, passenger compartment, and front and rear suspension. An isometric view of the frame structure showing the nodes and beam elements is shown in Figure 2. The coordinates of these nodal points and their weights are given in Table 6.

The beam members are shown encircled in the isometric view of the frame structure in Figure 2. The members of the sample frame all have rectangular tubular cross section with three different sizes. Because 1, 2 and 3 are in same size, call them type A. Beams 4 through 10 and beam 12 are in one size and called type B. Beam 11 is another size called type C. Table 7 shows the complete set of sectional and hinge properties of these different cross sections.

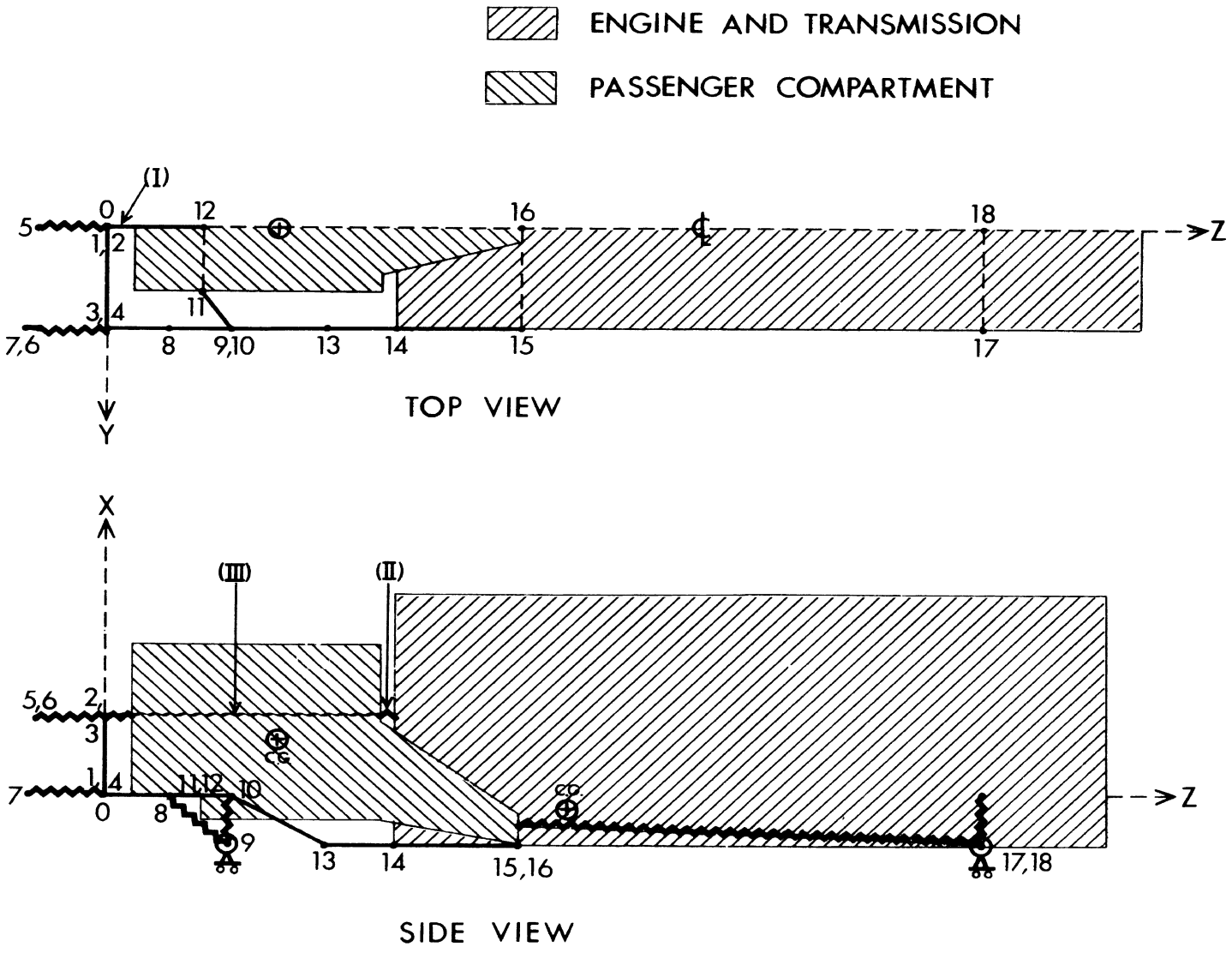

Figure 1. Schematic of Example Problem

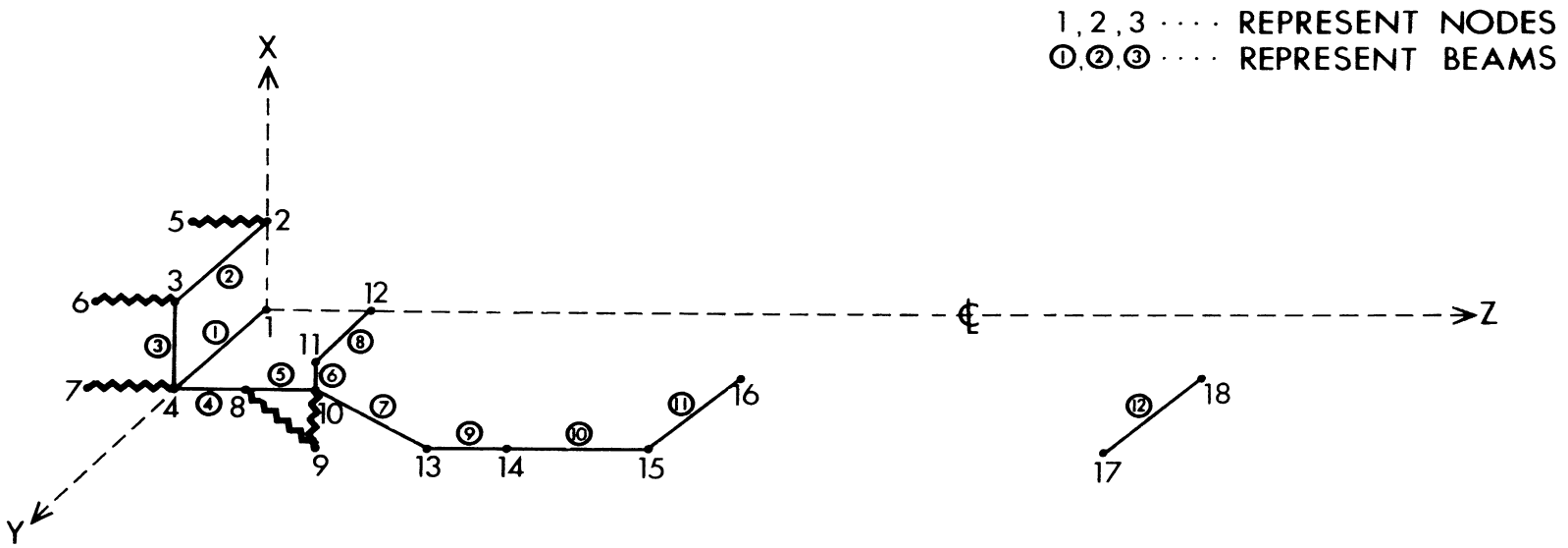

Figure 2. Detail of front frame section

TABLE 6. NODAL COORDINATES (inches) AND WEIGHTS (lbs)

Node number	Coordinates			Weight lbs.
	X	Y	Z	
1	0	0	0	.8415
2	12	0	0	10.8415
3	12	16	0	11.96
4	0	16	0	4.08
5	12	0	-10	5.0
6	12	16	-10	5.0
7	0	16	-11	15.18
8	0	16	9	4.24
9	- 8	16	18	125.0
10	0	16	18	7.62
11	0	10	14	4.05
12	0	0	14	2.36
13	- 8	16	32	6.16
14	- 8	16	42	6.6
15	- 8	16	60	6.6
16	- 8	0	60	2.04
17	- 8	16	117	150.0
18	- 8	0	117	50.0

The origin is located on node 1. The orientation of the coordinate system can be seen in Figure 2.

To illustrate the modular structure of the program, the vehicle has been divided into a number of modules. They are outlined below with the components which make up the module indicated.

Component	Type	Nodes
Module: ENGTRANS		
Mototran	Rigid	--
Module: FORESTVC		
Radiator	Frame	PT1, PT2, PT3, PT4, PT5, PT6, PT7
Module: ENGMONT		
Chassis	Frame	PT8, PT9, Pt10, PT11 PT12
Module: PASSCOMP		
Body	Rigid	--
Module: STUBFRAM		
Pasmount	Frame	PT13, PT14, PT15 PT 16
Backaxle	Frame	PT17, PT18

The connections between modules, generalized mechanisms that are employed in some of the frame components, and constraint conditions imposed are discussed in the following paragraphs.

Engine and transmission are mounted on nodes 11 and 16 with pin connectors. The center of gravity of this point is located at (9, 0, 25) of the global system. A linear extensional spring with a stiffness of 5×10^5 lb/in represents a drive shaft which connects the transmission and differential gear at node 18.

The coordinate (-2, 0, 67) is the location of the center of gravity of the passenger compartment and is mounted on nodes 14 and 15 with pin connectors. The passenger compartment also connects to the rear end suspension of node 17 with extensional and shear connectors. The stiffnesses are 2×10^3 lb/in and 10^6 lb/rad respectively.

The bumper system and its support are represented by extensional and shear connectors between nodal points 4 and 7. The force-displacement relation of the extensional connector is shown in Figure 3. The stiffness of the shear connector is 1×10^6 lb/rad. The mechanism between nodes 2, 5 and nodes 3, 6 represent the parts in front of the engine, such as the grill, radiator, fan, etc. The force-deflection relation of these mechanisms is shown in Figure 4.

In the frame structures, the nodes 1, 2, 5, 12, 16 and 18 have a symmetric condition. Nodes 9 and 17 can not move in any direction except in the Z-direction. Since only half of the vehicle is modeled, the center of gravity of the engine and passenger compartments have a symmetric condition.

Beside the pin connectors which connect different modules, there are three more connectors between different modules.

1. node 2 on the frame structure will contact the front end of the engine (sign (I) on Fig. 1). An extensional

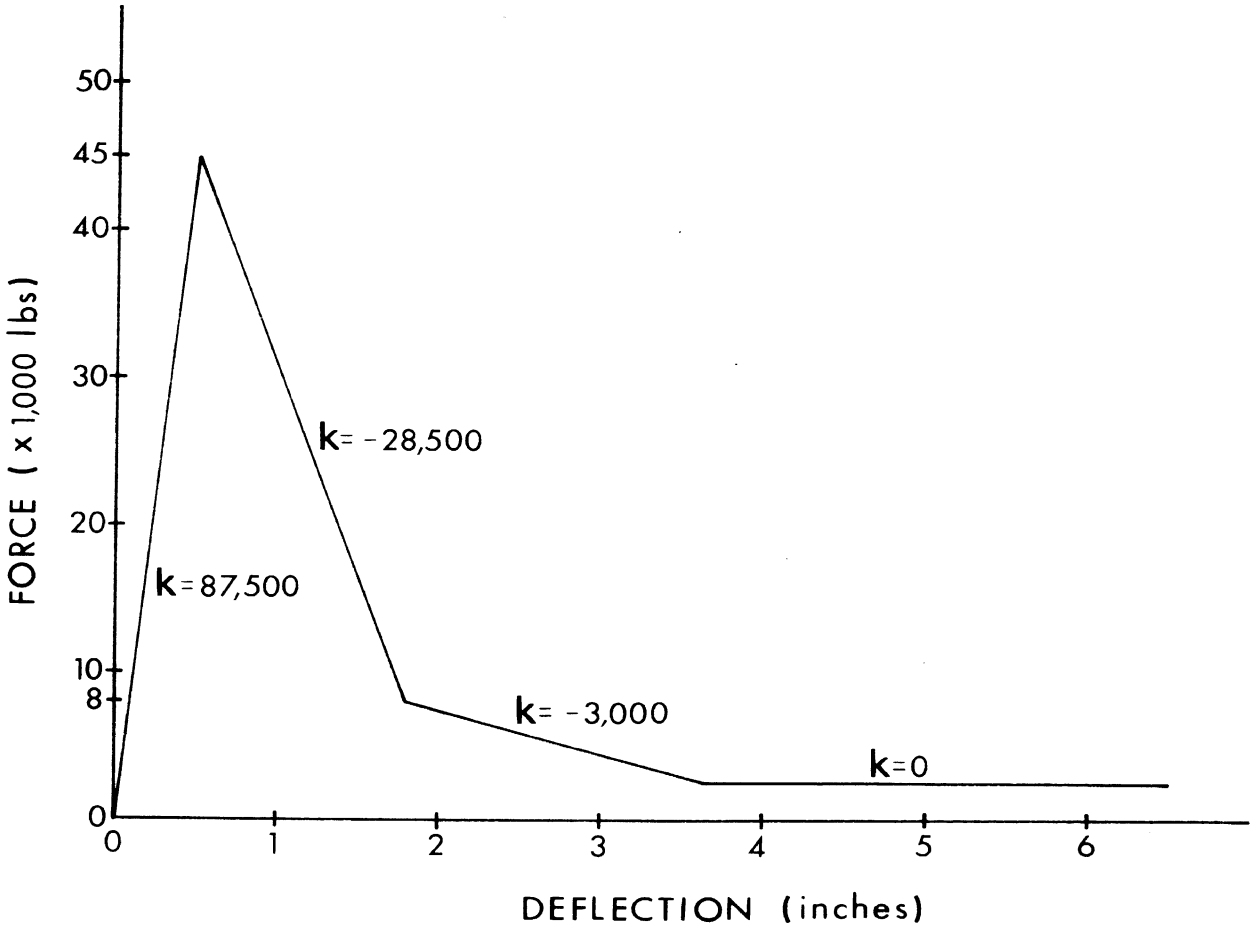

FIGURE 3. Force-deflection curve of bumper system

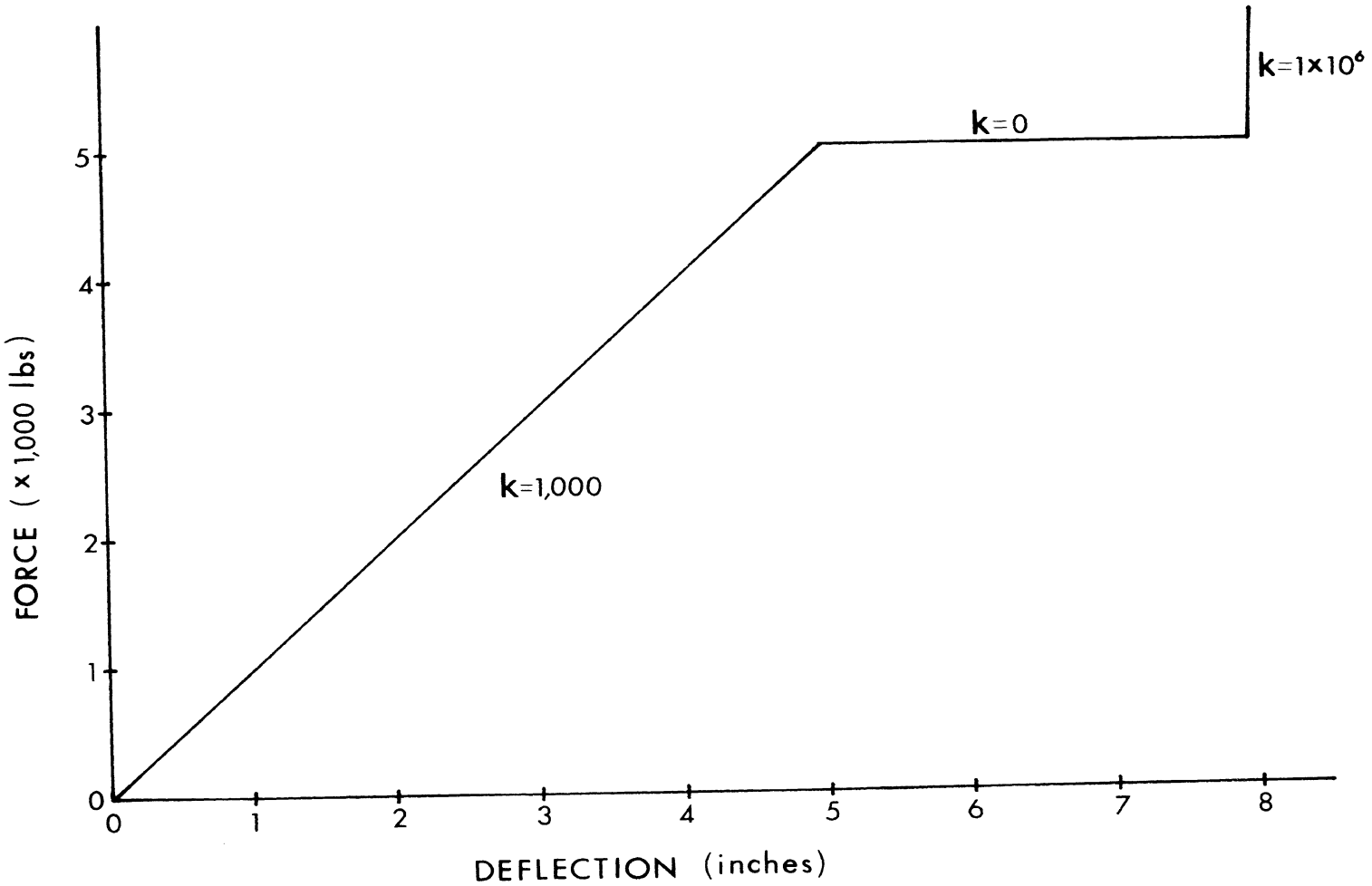

Figure 4. Force-deflection for mechanism in front of engine

Table 7. Sectional Properties

CROSS SECTION SHAPES	Sectional Properties				Hinge Properties						
	I_1	I_2	J	A	k_1	k_2	X_m	β	f	M_o	Direction
A	.437	.437	.874	.6875	14.45	3.38	.1815	.4222	1.3778	11600	Bending in 1
					14.45	3.38	.1815	.4222	1.3778	11600	Bending in 2
					3.48	7.41	.262	.5714	1.314	7800	Torsion
1.5 x 1.5 x .125					9.00	-	∞	-	1.33	20600	Axial
B	1.556	1.556	3.122	1.734						49800	Bending in 1
										49800	Bending in 2
					SAME AS TYPE A					33900	Torsion
2.5 x 2.5 x .1875										52000	Axial
C	.5517	.5517	1.104	.9375						22000	Bending in 1
										22000	Bending in 2
					SAME AS TYPE A					15300	Torsion
2. x 2. x .125										28100	Axial

connector is used to transmit the contact force. The force-displacement relation is shown in Figure 5.

2. Rear end of engine will penetrate into the passenger compartment. A symbol (II) on figure 1 indicates the location. Again an extensional connector, with force-displacement relation is shown in Figure 6, B, is used to transmit the force.
3. Nodal point 3 will transmit force to passenger compartment. It is shown in Figure 1 with symbol (III). The force-displacement curve is shown in Figure 7.

The vehicle B is moving along the negative Z-direction with initial velocity of 30 mph (or 528 ips). The three contact points, 5, 6 and 7 will be stopped (5 and 6 in .011364 seconds and 7 in 0.0075 seconds). The velocity of these three points will be:

$$V = \frac{528}{2}(1 + \cos\omega t) \text{ in/sec} \qquad 0 \leq t \leq 0.011364 \text{ seconds}$$

$$= 0 \qquad 0.011364 < t \qquad \text{(for points 5 and 6)}$$

while $\omega = 3.14159/0.011364$

$$V = \frac{528}{2}(1 + \cos\omega t) \text{ in/sec} \quad 0 \leq t \leq 0.0075 \text{ seconds}$$

$$= 0 \qquad 0.0075 < t \qquad \text{(for point 7)}$$

while $\omega = 3.14159/0.0075$

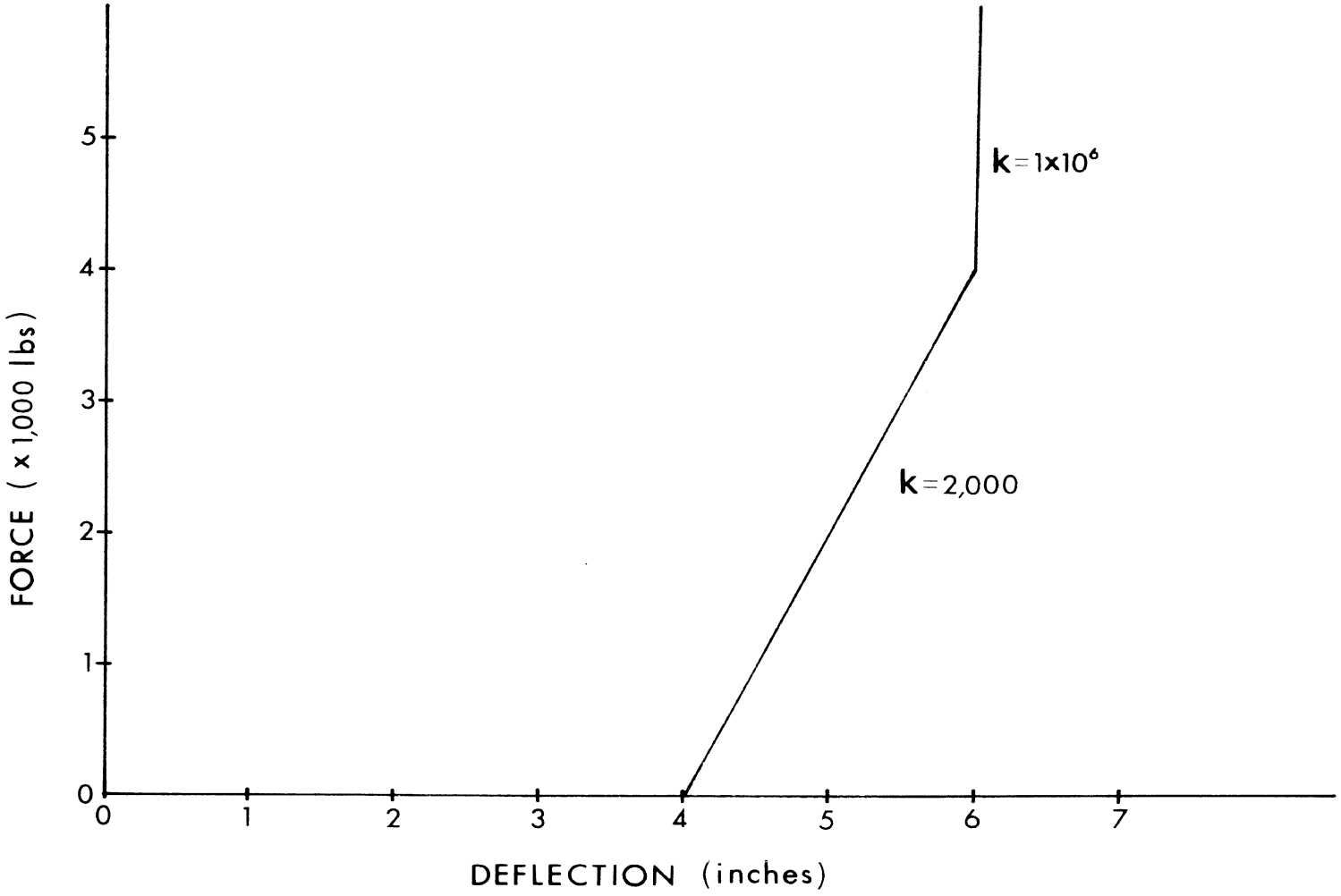

Figure 5. Force-deflection between frame and front of engine

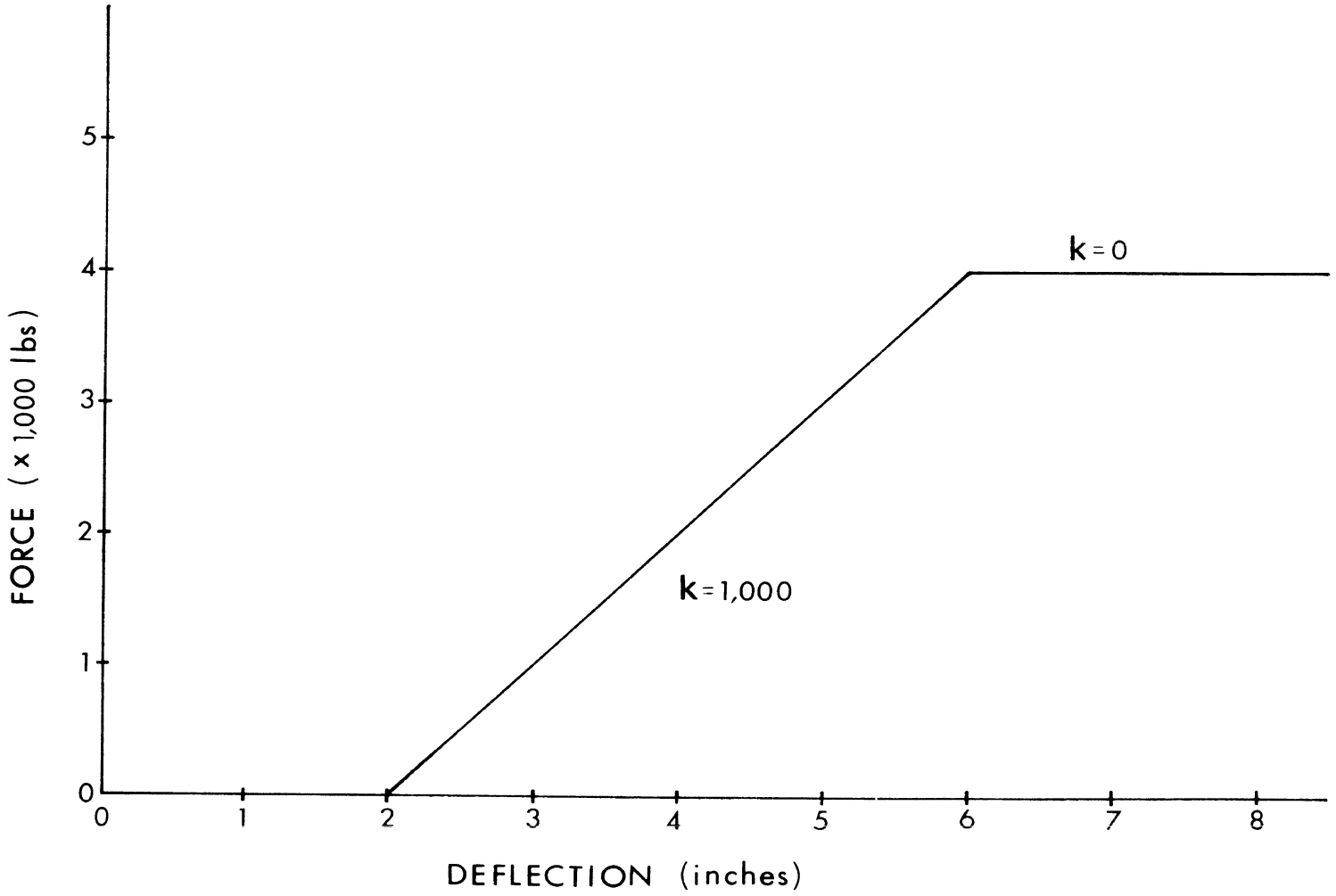

Figure 6. Force Deflection between engine and passenger compartment

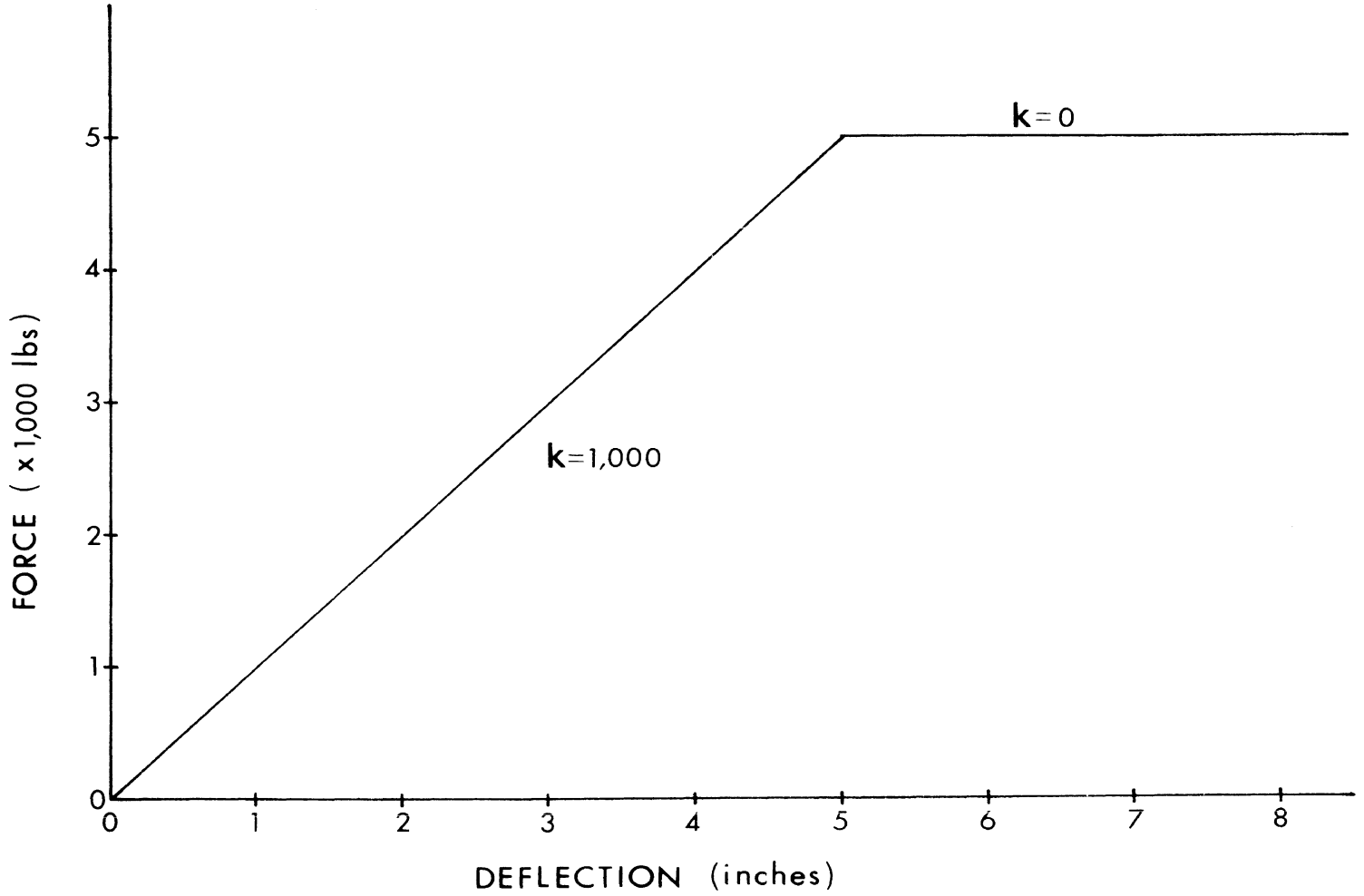

Figure 7. Force to occupant compartment through nodal point 3.

PART 5. UMVCS-1 PROGRAM INFORMATION

Input is presented to the executive as strings of alpha-numeric characters arranged in 28 distinctive formats (See Tables 1 and 2). The first step of the executive is to read each of the strings in turn, determine the format which is the prototype of the string, convert any numeric information present, identify which of the possible options have been elected and produce a binary record in internal storage which contains all this information.

When all the input has been read and exists in binary form in internal storage, the process of producing the tables needed by the vehicle crush solution processor begins by taking several passes to locate and organize the connections between modules, components, and nodes. The first version of the connection control tables IV (see Table 8), IELM (see Table 9), and IFCN (see Table 10) are produced at this time.

Next, the storage layout for the input tables and the temporary storage tables used by the vehicle crush solution processor is completed. This step consists of first computing the beginning of each of the 134 tables, analyzing the piece-wise linear tabular information the user supplied, and then offsetting each of these beginnings for convenient use in the solution processor.

The 134 tables are arranged in four large arrays. The offset beginnings are stored in array ID and are computed such that the index in the appropriate large array corresponding to a reference A(I,J,K) of a particular table of dimensions A(L,M,N) is

index = ID(N) + I + L * J + L * M * K.

where N is the ID index for the table "A".

If the table is one-dimensional only the first two terms are used. If the table is two-dimensional only the first three terms are used. Table 11 contains a listing of the ID indices for each of the 134 tables. Table 12 contains an alphabetical listing of the tables together with a one phrase description of each.

The layout of the binary output tape is completed next. There are 45 tables of input quantities used directly by the solution processor and 26 tables of control information which are used secondarily by the solution processor to control the input, the output, and certain internal features. Table 13 lists the 71 tables in the order stored in external binary output storage.

Each of the 71 tables is filled by making passes over the binary input information in internal storage and selecting appropriate quantities. To conserve the amount of storage needed for this assembling process, tables are outputted to external binary storage as soon as completed and the assembly storage is reused.

When all tables are completed and outputted, a main program for the solution processor containing correct dimension statements for the four large arrays is outputted. The last function of the executive is to produce a printed summary of modules, components, nodes, connectors, and connections.

The solution processor uses the external binary storage and the main program produced by the executive. The solution processor

optionally produces extensive printout of intermediate results which is occasionally useful in finding errors in a data set. The special output is controlled by eighteen four-level switches. Table 18 contains an explanation of the meaning of each of the four levels. Table 15 contains a specification of the quantities which may be printout under each of the eighteen switches. Table 16 contains a variable name dictionary for the names used in the tables and not described in one of the tables.

TABLE 8

CONNECTIONS NOT WITHIN FRAME (IV ARRAY) SUBSCRIPTS

1. Connection number (beginning index)

2. Module A number = 1 = frame

3. Module B number > 1 = rigid body number + 1

4. Number of Nodal Point of Module A
   (local numbering)

5. Number of Nodal Point of Module B
   (local numbering)

6. Type of connection

   1 = extensional

   2 = torsional

   3 = shear

   4 = bending

   5 = special connector (dummy)

   6 = rigid connector beam

   7 = pin connector

   8 = hinge connector (dummy)

7. Number of table of force deformation curve

   + 100000 * ILEXT (if extensional)

   where

   ILEXT = 0 = regular spring
   1 = extensional only
   2 = compressive only

TABLE 9

BEAM CONNECTIONS (IELM ARRAY) SUBSCRIPTS

$$K = IELM(I,J)$$

where $1 \leq I < J \leq NUMP$ are mass point numbers

and $K =$

>0	connection index for deformable beam
=0	no connection
<0	negative of connection index for general connector (if more than one such connection between two mass points last one encountered appears)

TABLE 10

GENERALIZED CONNECTIONS WITHIN FRAME (IICN ARRAY)
SUBSCRIPTS

1. Connection Number (beginning index)

2. Mass Point A Number

3. Mass Point B Number

4. Type of Connection

   1 = extensional

   2 = torsional

   3 = shear

   4 = bending

   5 = special connector (dummy)

   6 = rigid connector beam (not allowed)

   7 = pin connector

   8 = hinge connector (dummy)

5. Number of table of force deformation curve

   + 100000 * ILEXT (if extensional, see note in Table 8).

TABLE 11

VARIABLE STORAGE LIST

(Ordered by ID Index)

ID INDEX	NAME	LENGTH	ID INDEX	NAME	LENGTH
1**	TK (MT,MT)	MT * MT	31	PO (NUB)	NUB
2	DBM (MT)	MT	32	THOLD (NDØFMX, NDOFMX)	max(NDOFMX * NDØFMX, 144)
3	DR (MT)	MT	33	RHOLD (NDOFMX)	max(12, NDOFMX)
4	DCTK (3,3,NRB)	9 * NRB	34	GCNLO (NGCN)	NGCN
5	CLF (3,NEF)	3 * NEF	35	AR1 (2,NUB)	2 * NUB
6	CL (3,NCRB)	3 * NCRB	36	AR2 (2,NUB)	2 * NUB
7	DISM (6,NRB)	6 * NRB	37	AR3 (2,NUB)	2 * NUB
8	VO (6,NRB)	6 * NRB	38	DC1K (3,3,NUB)	9 * NUB
9	DRFE (6,NEF)	6 * NEF	39	DC2K (3,3,NUB)	9 * NUB
10	DCTKM1 (3,3,NRB)	9 * NRB	40	FL (2,NUB)	2 * NUB
11	DCTKM2 (3,3,NRB)	9 * NRB	41	DDK (2,NUB)	2 * NUB
12	RFOM (6,NRB)	6 * NRB	42	RK (MT)	MT
13	DRE (NRB6)	6 * NRB	43	FRK (12,NUB)	12 * NUB
14	RMAST (NRB)	NRB	44	DISK (MT)	MT
15	RMIT (3,NRB)	3 * NRB	45	AL (NUB)	NUB
16	SON (NNC)	NNC	46	SCFP (2,NUB)	2 * NUB
17	DDKT (6,NRB)	6 * NRB	47	DU (MT)	MT
18	DDKTM1 (6,NRB)	6 * NRB	48	DXKM1 (MT)	MT
19	DDKTM2 (6,NRB)	6 * NRB	49	UDD (MT)	MT
20	ZA (NUB)	NUB	50	UD (MT)	MT
21	ZG (NUB)	NUB	51	RNK (12,NUB)	12 * NUB
22	Z11 (NUB)	NUB	52	UE (6,NUB)	6 * NUB
23	Z12 (NUB)	NUB	53	AKAP (6,NUB)	6 * NUB
24	Z21 (NUB)	NUB	54	BETA (6,NUB)	6 * NUB
25	Z22 (NUB)	NUB	55	PANG (2,4,NUB)	8 * NUB
26	Z31 (NUB)	NUB	56	AKPT (2,4,NUB)	8 * NUB
27	Z32 (NUB)	NUB	57	AGRFT (2,4,NUB)	8 * NUB
28	M10 (NUB)	NUB	58	DRN (12,NUB)	12 * NUB
29	M20 (NUB)	NUB	59	DC1KP1 (3,3,NUB)	9 * NUB
30	M30 (NUB)	NUB	60	DC2KP1 (3,3,NUB)	9 * NUB

TABLE 11

VARIABLE STORAGE LIST

(Ordered by ID Index)

ID INDEX	NAME	LENGTH	ID INDEX	NAME	LENGTH
61	RNKP1 (12,NUB)	12 * NUB	90	IPERM (MT)	max(MT,12)
62	FRKP (12,NUB)	12 * NUB	91	AKE (3,NUB)	3 * NUB
63	FK1 (2,NUB)	2 * NUB	92	BKE (3,NUB)	3 * NUB
64	UNC (3,NCRB)	3 * NCRB	93	AKT (6,6,NRB)	36 * NRB
65*	RHS (MT)	MT	94	SM1T (NNC)	NNC
66*	RHSB (NDOFMX)	NDOFMX	95	U3T (3,NNC)	3 * NNC
67*	RK (NDOFMX,NDOFMX)	NDOFMX*NDOFMX	96**	TKN (MT,MT)	MT * MT
68	DISSK (2,NUB)	2 * NUB	97	TMTX1 (6,MT)	6 * MT
69	IFCN (5,NGCN)	5 * NGCN	98	TMTX2 (6,MT)	6 * MT
70	XM1 (MT)	MT	99	DBMN (MT)	MT
71	AMASS (NUMP)	NUMP	100	IMPCTL (MT)	MT
72	DUDD (MT)	MT	101*	XO (MT)	MT
73	DISKP1 (MT)	MT	102*	A (MT)	MT
74	DXKM2 (MT)	MT	103*	AT (MT)	MT
75	DUB (MT)	MT	104*	R (MT)	MT
76	RKP1 (MT)	MT	105*	RT (MT)	MT
77	DISP (2,NUB)	2 * NUB	106	ACCO (6,NRB)	6 * NRB
78	E1T (3,NNC)	3 * NNC	107	AKA1 (6,NUB)	6 * NUB
79	E2T (3,NNC)	3 * NNC	108	NPV (NRB)	NRB
80	ANG1 (NNC)	NNC	109	PRPT (3,NPRT)	3 * NPRT
81	ANG2 (NNC)	NNC	110	ZRHO (5,NSTOP)	5 * NSTOP
82	GAMT (2,NNC)	2 * NNC	111	ZVO (5,NSTOP)	5 * NSTOP
83	ANG3 (NNC)	NNC	112	AKA2 (6,NUB)	6 * NUB
84	SW (2,NUB)(Integer)	2 * NUB	113	KX (NNC)	NNC
85	IELM (NMPM1, NUMP)	(NUMP-1) * (NUMP)	114	AR4 (2,NUB)	2 * NUB
			115	B (2,NUB)	2 * NUB
86	IV (7,NNC)	7 * NNC	116	BC (2,NUB)	2 * NUB
87	NCV (NRB)	NRB	117	C (2,NUB)	2 * NUB
88	INRS (2,NRB)	2 * NRB	118	T (2,NUB)	2 * NUB
89	NF (NRB)	NRB	119	AX (2,NUB)	2 * NUB

TABLE 11 (continued)

VARIABLE STORAGE LIST

(Ordered by ID Index)

ID INDEX	NAME	LENGTH
120	AA (2,NUB)	2 * NUB
121	AB (2,NUB)	2 * NUB
122	AT (2,NUB)	2 * NUB
123	IA (2,NUB)	2 * NUB
124	IRIV (5,IRMAX)	5 * IRMAX
125	IRPV (5, IRPMAX)	5 * IRPMAX
126	IPIV (3,IPMAX)	3 * IPMAX
127	RRTC (6,IRMAX)	6 * IRMAX
128	RTKN (6,MT,IRMAX)	6 * MT*IRMAX
129	RPTC (3,IRPMAX)	3 * IRPMAX
130	RPTKN (3,MT,IRPMAX)	3 * MT*IRPMAX
131	PTC (3,IPMAX)	3 * IPMAX
132	PTKN (3,MT,IPMAX)	3 * MT*IPMAX
133	DCCLR(3,4,IRMAX)	12 * IRMAX
134	DCCLRP(3,4, IRPMAX)	12 * IRPMAX

* belongs in TQ array

** belongs in SQ array

NOTE: All other reals are in RQ array and all other integers are in IQ array

TABLE 12

VARIABLE STORAGE LIST

(Ordered by Name)

VARIABLE	ID INDEX	DESCRIPTION
A (MT)	102*	Accumulated displacements for selected degrees of freedom.
AA (2, NUB)	120	Strong axis first plastic bending coefficient.
AB (2, NUB)	121	Weak axis first plastic bending coefficient.
ACCO (6, NRB)	106	Accelerations of rigid bodies at time zero. (Input)
AGRFT (2,4,NUB)	57	Gradient of yield functions at beam ends (force and 3 moments).
AKAP (6,NUB)	53	Coefficients for plastic load-deflection of bending around direction 1. (Input) (Strong axis)
AKA1 (6,NUB)	107	Coefficients for plasting load-deflection of bending in direction 2. (Input) (Weak axis)
AKA2 (6,NUB)	112	Extensional force along direction 3. (Input) (Axial)
AKE (3,NUB)	91	Computed coefficient of 2nd order elastic rotation for each beam.
AKPT (2,4,NUB)	56	Total plastic deformation for beam ends.
AKT (6,6,NRB)	93	Temporary storage for computed quantities.
AL (NUB)	45	Length of each beam. (Input)
AMASS (NUMP)	71	Mass of each node point of frame structure. (Input)
ANG1 (NNC)	80	Total rotation in the 1-direction.
ANG2 (NNC)	81	Total rotation in the 2-direction.
ANG3 (NNC)	83	Total rotation in the 3-direction.
AR1 (2,NUB)	35	Maximum moment at each bean end around 1-direction.
AR2 (2,NUB)	36	Maximum moment at each beam end toward 2-direction.
AR3 (2,NUB)	37	Maximum moment at each beam end toward 3-direction.
AR4 (2,NUB)	114	Maximum force along 3-direction.
AT (MT)	103 *	Test values for accumulated displacements for selected degrees of freedom. (Input)
AT (2,NUB)	122	Torsion first plastic bending coefficient.
AX (2,NUB)	119	Axial first plastic deformation coefficient.
B (2,NUB)	115	Strong axis second plastic bending coefficient.
BC (2,NUB)	116	Axial second plastic deformation coefficient.

TABLE 12 (continued)

VARIABLE STORAGE LIST

(Ordered by Name)

VARIABLE	ID INDEX	DESCRIPTION
BETA (6,NUB)	54	Input torsional coefficient of plastic region of load deflection curve for beams. (Input)
BKE (3,NUB)	92	Computed constants for each beam.
C (2,NUB)	117	Weak axis second plastic bending coefficient
CL (3,NCRB)	6	Coordinates of rigid body connect points. (Input)
CLF (3,NEF)	5	Coordinates of rigid body external applied force points. (Input)
DBM (MT)	2	Terms of RHS due to past time points.
DBMN (MT)	99	Temporary version of DBM.
DCCLR(3,4,IRMAX)	133	Temporary storage for coordinates and direction cosines for rigid connection.
DCCLRP(3,4,IRPMAX)	134	Temporary storage for coordinates and direction cosines for pin connections.
DCTK (3,3,NRB)	4	Direction cosines of each rigid body for current time. (Input)
DCTKM1 (3,3NRB)	10	Direction cosines of each rigid body for last time. (Input)
DCTKM2 (3,3,NRB)	11	Direction cosines of each rigid body for next to last time. (Input)
DC1K (3,3,NUB)	38	Current direction cosines for each beam at i-end. (Input)
DC1KP1 (3,3,NUB)	59	Next time direction cosines at i-end of each beam.
DC2K (3,3,NUB)	39	Current direction cosines for j-end of each beam. (Input)
DC2KP1 (3,3,NUB)	60	Next time direction cosines at j-end of each beam.
DDK (2,NUB)	41	Dissipated energy at each beam end due to plastic deformation.
DDKT (6,NRB)	17	Positional increment for each rigid body at current time. (Input)
DDKTM1 (6,NRB)	18	Positional increment for each rigid body at last time.
DDKTM2 (6,NRB)	19	Positional increment for each rigid body at next to last time.

TABLE 12 (Continued)

VARIABLE STORAGE LIST

(Ordered by Name)

VARIABLE	ID INDEX	DESCRIPTION
DISK (MT)	44	Position of each nodal point at current time. (Input)
DISKP1 (MT)	73	Position of each nodal point at next time.
DISM (6,NRB)	7	Inertial coordinates of each rigid body. (Input)
DISP (2,NUB)	77	Total energy dissipated at each beam end.
DISSK (2,NUB)	68	Incremental dissipated energy at each beam end due to plastic.
DR (MT)	3	Generalized force increments.
DRE (NRB6)	13	External applied force on each rigid body.

TABLE 12 (Continued)

Variable Storage List

(Ordered by Name)

VARIABLE	ID INDEX	DESCRIPTION
DRFE (6,NEF)	9	Resultant force due to each applied force.
DRN (12,NUB)	58	Force increment on both beam ends.
DU (MT)	47	Positional increments of nodal and rigid bodies.
DUB (MT)	75*	Solution of positional increments.
DUDD (MT)	72	Acceleration increments of nodal and rigid bodies.
DXKM1 (MT)	48	Positional increments of nodal and rigid at last time. (Input)
DXKM2 (MT)	74	Positional increments of nodal and rigid bodies at next to last time. (Input)
E1T (3,NNC)	78	Unit vector in 1-direction of connector. (Input)
E2T (3,NNC)	79	Unit vector in 2-direction of connector. (Input)
FK (2,NUB)	40	Current yield function value for each beam end.
FK1 (2,NUB)	63	Next time yield function value for each beam end.
FRK (12,NUB)	43	Current force on beam ends relative to local coordinates.
FRKP (12,NUB)	62	Next force on beam ends relative to local coordinates.
GAMT (2,NNC)	82	Shear deformation of shear connectors.
GCNLO (NGCN)	34	Length of general connector in frame (Input)
IA (2, NUB)	123	Yield function computation control switch.
IELM (NUMP-1,NUMP)	85	Connection switches (See Table 9). (Input)
IFCN (5,NGCN)	69	Controls for general connections in frame (See Table 10). (Input)
IMPCTL (MT)	100	Control of controlled force and position options for mass points and rigid bodies. (Input)
INRS (2,NRB)	88	Global connect and forced point base indices for rigid bodies (partial sums of NCV and NF arrays for 1 and 2 respectively. (Input)
IPERM (MT)	90	Used as temporary storage for solutions of equations.
IPIV (3,IPMAX)	126	Used as temporary storage of pin controls in frame.
IRIV (5,IRMAX)	124	Used as temporary storage of rigid connector controls.
IRPV (5,IRPMAX)	125	Used as temporary storage of pin controls out of frame.
IV (7,NNC)	86	Connection controls outside frame (See Table 8).
KX (NNC)	113	Last step number for connectors.
M1O (NUB)	28	Maximum moment for each beam along 1-direction. (Input)
M2O (NUB)	29	Maximum moment for each beam along 2-direction. (Input)

TABLE 12 (Continued)

VARIABLE STORAGE LIST

(Ordered by Name)

VARIABLE	ID INDEX	DESCRIPTION
M30 (NUB)	30	Maximum moment for each beam along 3-direction. (Input)
NCV (NRB)	87	Number of connect points in each rigid body. (Input)
NF (NRB)	89	Number of applied points on rigid body. (Input)
NPV (NRB)	108	Number of points at which accelerations to be printed on each rigid body. (Input)
PANG (2,4,NUB)	55	Accumulated plastic rotation at each beam end.
PO (NUB)	31	Maximum axial force for each beam. (Input)
PRPT (3,NPRT)	109	Points on rigid bodies at which accelerations are to be printed. (Input)
PTC (3,IPMAX)	131	Used as temporary storage for pin quantities
PTKN (3,MT,IPMAX)	132	Used as temporary storage for matrix elements replaced by pin constraints.
R (MT)	104*	Accumulated force for selected degrees of freedom.
RFOM (6,NRB)	12	Resultant force on each rigid body due to motion and applied force.
RHOLD (NDOFMX)	33	Temporary storage for matrix equation residual.
RHS (MT)	65*	RHS of main equations.
RHSB (NDOFMX)	66*	RHS of reduced equations.
RK (MT)	42*	Current inertial force on each nodal point and rigid body.
RK (NDOFMX,NDOFMX)	67	Reduced stiffness matrix.
RKP1 (MT)	76	Next time RK (MT).
RMASS (NRB)	14	Mass of each rigid body. (Input)
RMIT (3,NRB)	15	Moment of inertia of each rigid body. (Input)
RNK (12,NUB)	51	Current time force on each beam end relative to inertial coordinates.
RNKP1 (12,NUB)	61	Next time force on each beam end relative to inertial coordinates.

TABLE 12 (Continued)

VARIABLE STORAGE LIST

(Ordered by Name)

VARIABLE	ID INDEX	DESCRIPTION
RPTC (3,IRPMAX)	129	Used as temporary storage for pin quantities.
RPTKN (3,MT,IRPMAX)	130	Used as temporary storage for matrix elements replaced by pin constraints.
RRTC (6,IRMAX)	127	Used as temporary storage for rigid quantities.
RT (MT)	105*	Test values for accumulated force for selected degrees of freedom. (Input)
RTKN(6,MT,IRMAX)	128	Used as temporary storage for matrix elements replaced by rigid constraints.

TABLE 12 (Continued)

Variable Storage List

(Ordered by Name)

VARIABLE	ID INDEX	DESCRIPTION
SCFP (2,NUB)	46	Scaling factor for each beam end at current time.
SON (NNC)	16	Initial length of connectors. (Input)
SM1T (NNC)	94	Current length of connectors.
SW (2,NUB)	84	Switch which indicates elastic or plastic for each beam end.
T (2,NUB)	118	Torsion second plastic bending coefficient.
THOLD (NDOFMX,NDOFMX)	32	Temporary storage for matrix decomposition.
TK (MT,MT)	1**	Combined mass and stiffness matrix.
TKN (MT,MT)	96**	Temporary TK.
TMTX1 (6,MT)	97	Storage matrix.
TMTX2 (6,MT)	98	Storage matrix.
UD (MT)	50	Velocity of each nodal point and rigid body.
UDD (MT)	49	Acceleration at each nodal point and rigid body.
UE (6,NUB)	52	Relative elastic displacement between each two beam ends.
UNC (3,NCRB)	64	Current inertial position of all rigid body connect points.
U3T (3,NNC)	95	3-Unit vector in inertial space.
VO (6,NRB)	8	Initial inertial velocities of each rigid body. (Input)
XM1 (MT)	70	Displacement at last time step. (Input)
XO (MT)	101*	Displacement at current time step. (Input)
ZA (NUB)	20	Computed constant for each beam.
ZG (NUB)	21	Computed constant for each beam.
Z11 (NUB)	22	Computed constant for each beam.
Z12 (NUB)	23	Computed constant for each beam.
Z21 (NUB)	24	Computed constant for each beam.
Z22 (NUB)	25	Computed constant for each beam.
Z31 (NUB)	26	Computed constant for each beam.
Z32 (NUB)	27	Computed constant for each beam.
ZRHO (5,NSTOP)	110	Node stop control (#, ρ, t, λ, T) (Input)
ZVO (5,NSTOP)	111	Node stop working storage (t_1, t_2, A, B, C)

TABLE 13

LAYOUT OF EXTERNAL BINARY STORAGE

	NAME	LENGTH	NUMINP INDEX
1.	NUMINP(NØINP,3)	3*NØINP	(starts line 6)
2.	ID (NØID)	NØID	3
3.	NUMØUT (NØUT,2)	2*NØUT	4
4.	DMASKS (KDBPWD)	KDBPWD	19
5.	DSHIFT (KDBPWD)	KDBPWD	49
6.	CMASKS (KCHPWD)	KCHPWD	50
7.	CSHIFT (KCHPWD)	KCHPWD	51
8.	MSTØR (KTBCSZ*NUMTAB)	KTBCSZ*NUMTAB	52
9.	STØR (NUMENT)	NUMENT	1
10.	AL (NUB)	NUB	2
11.	M1O (NUB)	NUB	5
12.	M2O (NUB)	NUB	6
13.	M3O (NUB)	NUB	7
14.	PØ (NUB)	NUB	8
15.	Z11 (NUB)	NUB	9
16.	Z12 (NUB)	NUB	10
17.	Z21 (NUB)	NUB	11
18.	Z22 (NUB)	NUB	12
19.	Z31 (NUB)	NUB	13
20.	Z32 (NUB)	NUB	14
21.	ZA (NUB)	NUB	15
22.	ZG (NUB)	NUB	16
23.	AKE (3,NUB)	3*NUB	17
24.	BKE (3,NUB)	3*NUB	18
25.	DC1K (9,NUB)	9*NUB	20
26.	DISK (M6)	M6	21
27.	NF(NRB)	NRB	22
28.	NCV (NRB)	NRB	23
29.	SØN (NNC)	NNC	24
30.	IV (7,NNC)	7*NNC	25

TABLE 13 (Continued)

LAYOUT OF EXTERNAL BINARY STORAGE

	NAME	LENGTH	NUMINP INDEX
31.	RFØM (6,NRB)	6*NRB	26
32.	RMAST (NRB)	NRB	27
33.	AKAP (6,NUB)	6*NUB	28
34.	AKA1 (6,NUB)	6*NUB	46
35.	BETA (6,NUB)	6*NUB	38
36.	AKA2 (6,NUB)	6*NUB	71
37.	IELM (NUMP-1,NUMP)	(NUMP-1)*NUMP	29
38.	RMIT (3,NRB)	3*NRB	30
39.	DISM (6,NRB)	NRB6	31
40.	VØ (6,NRB)	NRB6	32
41.	DCTK (9,NRB)	9*NRB	33
42.	CL (3,NCRB)	3*NCRB	34
43.	CLF (3,NEF)	3*NEF	35
44.	DRFE (6,NEF)	6*NEF	36
45.	EIT (3,NCNBS)	3*NCNBS	41
46.	E2T (3,NCNBS)	3*NCNBS	42
47.	AMASS (NUMP)	NUMP	37
48.	XØ (M6)	M6	39
49.	XM1 (M6)	M6	40
50.	AT (MT)	MT	43
51.	RT (MT)	MT	44
52.	ACCØ (6,NRB)	NRB6	45
53.	NPV (NRB)	NRB	47
54.	PRPT (3,NPRT)	3*NPRT	48
55.	INFC (5,NGCN)	5*NGCN	55
56.	GCNLØ (NGCN)	NGCN	56
57.	DC2K (9,NUB)	9*NUB	57
58.	U (6,NUB)	6*NUB	58
59.	IMPCTL (MT)	MT	59
60.	INRS (2,NRB)	2*NRB	60

TABLE 13 (Continued)

LAYOUT OF EXTERNAL BINARY STORAGE

	NAME	LENGTH	NUMINP INDEX
61.	KTITLE (KRUNT)	KRUNT	62
62.	PØSCØN (5,NØNP)	5*NØNP	63
63.	PØSVAL (3,NØNP)	3*NØNP	64
64.	KCMØD (LGMØD)	LGMØD	53
65.	KCØMP (LGCØM)	LGCØM	54
66.	KCNØD (LGNØD	LGNØD	65
67.	KCØNTN (3*NØCØNN)	3*KNØCØNN	66
68.	KCØNTR (LGCTR)	LGCTR	67
69.	MASNØD (NUMP)	NUMP	68
70.	KRBCØM (NRB)	NRB	69
71.	ZRHØ (5,NSTØP)	5*NSTØP	70

TABLE 14

DEBUG SWITCH LEVEL DEFINITION

Level	Description
0	No Debug Output
1	Values printed to five significant figures
2	Values printed to five significant figures except k = 1, 6, etc where values printed to sixteen significant figures
3	Values printed to sixteen significant figures.

TABLE 15

DESCRIPTION OF DEBUG PRINTOUT

DEBUG SWITCH	VARIABLES PRINTED	ROUTINE
1	ZA (NUB) K = 1 only ZG (NUB) K = 1 only Z11 (NUB) K = 1 only Z12 (NUB) K = 1 only Z21 (NUB) K = 1 only Z22 (NUB) K = 1 only Z31 (NUB) K = 1 only Z32 (NUB) K = 1 only AKE (3,NUB) K = 1 only BKE (3,NUB) K = 1 only DC1K (3,3,beam) DC2K (3,3,beam)	GTKMTX
2	PANG (2,4,beam) TH (2,6) TB (2,3)	GTKMTX
3	RNK (7-12,beam) STIF1 (6,6)	GTKMTX
4	AKRT (6,3) BKRT (6,3)	GTKMTX
5	DUE1 (6) DUE2 (6) DUE3 (6) DUE (6)	GØMAIN

TABLE 15 (Continued)

DESCRIPTION OF DEBUG PRINTOUT

DEBUG SWITCH	VARIABLES PRINTED	ROUTINE
6	STK (12,12)	GTKMTX
7	DUB(NDØFMX)* DU (MT) before scaling DR (MT) before scaling	GØMAIN
8	DC1KP1 (3,3,beam) DC2KP1 (3,3,beam)	NØDFØC
9	FK1 (2,beam)	NØDFØC
10	DU (M6) after scaling DR (M6) after scaling	GØMAIN
11	increments of plastic deformation DISSK (2,beam)	CHDISP
12	RNKP (12) FRKP1 (12)	NØDFØC
13	HP (12,12) BP (12,12)	HINVB
14	RK (NDØFMX,NDØFMX)* RHS (MT) RHSB (NDØFMX)*	ASSEMB

TABLE 15 (Continued)

DESCRIPTION OF DEBUG PRINTOUT

DEBUG SWITCH	VARIABLES PRINTED	ROUTINE
15	TK (I,I) , I = 1, M6	GØMAIN
16**	connection no	BENCNT
	three force components or moments	EXTCNT
		SHRCNT
		TORCNT
16**	old regular output	ØUTP
17	TKN (MT,MT)	ASSEMB
	DU (MT)	
18	AK (6,6)	RGBMEØ
	BK (6,6)	
	CK (6,6)	
19-30	unused	

NOTE: Where "beam" appears, all quantities for each beam appears together followed by all quantities for the next beam if any and so on.

* Only actual degrees of freedom are printed, NDØFMX is the dimension and maximum number ever printed.

** Switch 16 is permanently set on in the absence of the output processor.

TABLE 16

VARIABLE NAME DICTIONARY

VARIABLE NAME	DESCRIPTION
AK (6,6)	Rigid body quantity
AKRT (6,3)	Beam quantity
BK (6,6)	Rigid body quantity
BKRT (6,3)	Beam quantity
CK (6,6)	Rigid body quantity
CMASKS (KCHPWD)	Masks for character unpacking and packing
CSHIFT (KCHPWD)	Shifts for character unpacking and pakcing
DMASKS (KDBPWD)	Masks for debug switch unpacking and packing
DSHIFT (KDBPWD)	Shifts for debug switch unpacking and packing
DUE (6)	Beam quantity
DUE1(6)	Beam quantity
DUE2(6)	Beam quantity
DUE3(6)	Beam quantity
FRKP1 (12)	Beam quantity
ID (NØID)	Offset beginning indices for variable length arrays
IPMAX	Number of pin connectors in frame
IRMAX	Number of rigid connectors outside of frame
IRPMAX	Number of pin connectors outside of frame
KCHPWD	Number of characters per machine word
KCMØD (LGMØD)	Summary of modules specified in input
KCNØD (LGNØD)	Summary of nodes specified in input
KCØMP (LGCØM)	Summary of components specified in input
KCØNTN (3*NØCØNN)	Summary of connections specified in input
KCØNTR (LGCTR)	Summary of connectors specified in input
KDBPWD	Number of debug switches packed per machine word
KRBCØM (NRB)	Cross reference list of beam number to connection number
KTBCSZ	Number of words per table control entry
KTITLE (KRUNT)	Run title = 4 + KWDPNM in packed characters

TABLE 16 (Continued)

VARIABLE NAME DICTIONARY

VARIABLE NAME	DESCRIPTION
KRUNT	Number of words of title = 132*NØLINE/KCHPWD
KWDPNM	Number of machine words per packed name
LGCØM	Number of words in component summary = NUNØDE + NØCMPT*(4+KWDPNM)
LGCTR	Number of words in connector summary = NØCØNC * (1+KWDPNM)
LGMØD	Number of words in module summary = NØCMPT + NØMØD*(2+KWDPNM)
LGNØD	Number of words in node summary = NØCØNN + NUNØDE*(5+KWDPNM)
MASNØD (NUMP)	Cross reference list of mass point numbers to node beginning number in KCNOD
MSTØR (KTBCSZ*NUMTAB)	Table control array
MT	6*(NUMP + NRB) total d.o.f. with no constraints
M6	6*NUMP total d.o.f. in frame
NCNBS	Total number of shear and bending connections in vehicle
NCRB	Number of rigid body connect points
NDØFMX	Number of d.o.f. in reduced matrix
NEF	Number of constant applied forces for rigid bodies
NGCN	Number of generalized connections in frame
NMPM1	NUMP-1
NNC	Number of generalized connections outside of frame
NØCMPT	Number of components of both types
NØCØNC	Number of connectors defined
NØCØNN	Number of connections
NØID	Number of tables laid out in ID = 134
NØINP	Number of external binary tables laid out in NUMINP = 71

TABLE 16 (Continued)

VARIABLE NAME DICTIONARY

VARIABLE NAME	DESCRIPTION
NØLINE	Number of lines in run title
NØMØD	Number of modules
NØNP	Number of nodal position control specifications
NØUT	Number of output categories in NUMØUT = 7
NPRT	Number of print points on rigid bodies
NRB	Number of rigid bodies
NRB6	6*NRB Number of d.o.f. in rigid bodies
NSTØP	Number of nodal stop specifications
NUB	Number of beam connections
NUMENT	Number of words used in STØK
NUMINP (NØINP,3)	Control array for external binary storage
NUMØUT (NØUT,2)	Control array for output processor
NUMP	Number of mass points in frame
NUMTAB	Number of tables used
NUNØDE	Number of nodes of all types
PØSCØN (8,NØNP)	Nodal position control array
RNKP (12)	Beam quantity
STIF1 (6,6)	KUKL matrix for beam
STK (12,12)	HINVB matrix for beam
STØR (NUMENT)	Storage array for table values
TB (2,3)	Beam quantity
TH (2,6)	Beam quantity
U (6,NUB)	Beam quantities: E,G,AJ, AI1,AI2,A