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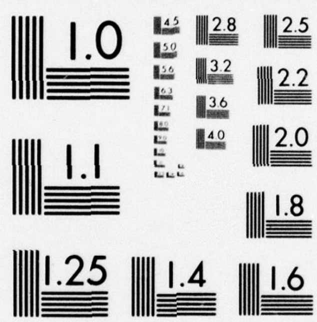

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TECHNICAL REPORT ARBRL-TR-02123

HIGHLY SURVIVABLE TRUSS TYPE TAIL BOOM

Thomas F. Erline

November 1978

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (*Continue on reverse side if necessary and identify by block number*)

Airframes	Helicopters	Truss
Tail Boom	Survivable	Design
Vulnerability Reduction	Semimonocoque	Anti-Aircraft
30mm HEI	23mm HEI	Threat
Structural Integrity	Highly Redundant	Substructured

20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

Highly redundant truss type structures, which are lightweight, have been analyzed by NASTRAN for replacement of the semimonocoque type tail boom. Analyses show that even with massive damage criterion imposed the structure retains its integrity with level flight loads up to 130 knots. The truss presents itself as a structural challenge to Soviet AA threat of the 23mm and 30mm HEI rounds.

Comparing the vulnerable semimonocoque configuration with the truss structure: semimonocoque's vulnerable area is nearly 100% of the present area; the

(over)

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SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*) truss has a greatly reduced vulnerable area (the joints are most vulnerable and their areas are small). The semimonocoque is blast sensitive to the AA threats mentioned because the detonation is confined and a large surface area is blown away; the truss does not confine the blast, thus is less sensitive. Since the thin skin structure of the semimonocoque carries a great deal of load it is sensitive to crack propagation; the truss is insensitive to crack propagation. Since the truss can be easily designed lightweight, the truss presents itself as a highly survivable competitive alternate for future Army helicopters.

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I. INTRODUCTION

Successful completion of Army helicopter missions in future battle scenarios may well depend upon survival of the structure after battle damage. Survivability of a helicopter will depend significantly upon the structure's ability to retain structural integrity. The principal purpose of this study is to develop a structural concept which assures a high degree of confidence in the integrity of a structure that has received combat damage. This study has been pursued because the Army needs to meet and provide a solution to the ever escalating high explosive anti-aircraft threat to the helicopter tail boom.

The highly lethal 23mm high explosive projectile represents an existing widely deployed threat to Army helicopters. The more lethal 30mm high explosive projectile appears on the horizon as the potential future threat. Because of this potentially severe 30mm threat and the possible inadequacy of present semimonocoque designs to survive hits by the 30mm, the present study was initiated to develop a structural challenge to the 30mm and to improve upon the present designs.

The tail boom of a helicopter (for example, the present AH-1 and UH-1 models) presents a significant amount of vulnerable area, and due to the flight loads of the tail rotor and elevators, the tail boom is constantly in some stressed condition. The semimonocoque tail boom construction configuration consists of skins, longerons, stringers, and bulkheads. Four longerons provide the main bending support for the tail boom. Shear loads are carried by the skin structure which is locally supported against buckling by the stringers. Presently the semimonocoque structure is configured to a minimum weight design. Ballistics tests using the 23mm high explosive against the minimum weight semimonocoque tail boom design have demonstrated its lack of damage tolerance[1]. Structural modifications have been shown to increase the damage tolerance of the structure but the amount of damage is predictably a function of confined volume and detonation distance to the surface[1]. Clearly the larger 30mm projectile reduces the survivability of the entire semimonocoque tail boom structure.

The solution for a structural challenge in this study took the form of a search for a highly redundant tail boom structure. A highly redundant structure is a structure that starts with a compact unit structure. The compact unit structure is interconnected within itself by comparatively small, relative to the entire structure, but stiff structural elements. The entire structure is then built up by a replication of the unit structure, scaling as desired or necessitated. The main reason for a high degree of redundancy is to build up damage tolerance by attempting to keep damage strictly localized.

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[1]D.F. Haskell, Damage Tolerance of Semimonocoque Aircraft, Paper at 41st Meeting of NATO-AGARD Impact Damage Tolerance of Structures Conference, Ankara, Turkey, October 1975.

A possible engineering solution that can easily be made highly redundant is the truss type structure. Use of modern technology and standard elements can make a truss both practical and economical. Because of its potential to fulfill such characteristics, the truss type structure was selected for this study in place of the semimonocoque structure. This study not only utilizes the truss concept but also introduces the concept of complete imbedded substructures. Complete imbedded substructures are easily generated within a truss structure that has a base figure equivalent to a quadrilateral by including the interior diagonals in a simple open truss structure. The intent is to develop a truss type tail boom with complete substructures that is highly redundant so that it can absorb massive damage and yet still hold the aerodynamic loads of flight. The truss tail boom can reduce vulnerability while lowering the weight of the tail boom. The observable surface area drops significantly reducing visibility and radar echo. A bonus would be the possibility of mounting a recoilless rifle on the helicopter because the openness of the truss allows the passage of back blast.

The development was performed throughout by computer modeling. The aerodynamic loads can be simulated and a damage criterion established very easily by this technique. A damage criterion should reflect a maximum amount of damage that can be sustained by the structure. The design objective is to retain structural integrity after imposition of the damage criterion.

Damage to a truss structure would not be in terms of confined volume or surface distance as it is in the semimonocoque structure, but damage would be in terms of loss of a member(s) or a loss of a joint. Not counting a completely destructive blast, the most catastrophic single event that could occur to a truss structure would be the destruction of a joint. The loss of a joint in a truss structure can be considered as massive damage because the loss of many members assembled at the joint is associated with loss of the joint. The demand that the truss sustain loss of a single joint and still retain structural integrity (not have other members buckle or fail) under flight loads is considered maximum survivability for the purpose of this study. Thus, loss of a joint is the damage criterion employed in this study.

Static and dynamic analyses of three truss design concepts were performed by the NASTRAN (NASA STRuctural ANalysis)[2] program. One of these truss concepts is a simple open truss design. The other two models incorporate the concept of complete substructures. The semimonocoque tail boom of AH-1 helicopter series is used as the basis for a replacement truss tail boom model. The AH-1 series helicopter presents a logical choice to develop a truss structure tail boom to

[2]Caleb, W. McCormick, Editor, The NASTRAN User's Manual, NASA SP 222(03), March 1976, Washington, D.C.

replace a semimonocoque structure. This helicopter has been in the Army's arsenal for a while and will continue in service for a number of years.

Selection of the design concept that is most likely to defeat the AA threat mentioned previously is dependent upon highest survivability and lowest weight. A selected design will be built, tested experimentally and reported on separately.

II. PROCEDURES

The longerons are the longitudinal elements which constitute the basic configuration to be employed in the truss structure model development. The basic overall dimensions come from the AH-1G helicopter reported in reference 3 (see figure 1). Longeron pattern at the larger (or base) end has been selected to conform to the bolt pattern of the AH-1G model at the tail boom - main fuselage manufacturing break line. The aerodynamic loading conditions were obtained from Bell Helicopter Company[4]. Common design parameters and formulas are listed in Table 1.

2.1 First Design Development

The initial goal was a high degree of redundancy. Thus, in the first iteration the structural member layout was generated by orienting the outside diagonals at 45^{o} angles from the base. The vertical and transverse members were located at diagonal and longeron intersection points, see figure 2. In addition to the longeron, outside diagonal, and transverse members, diagonal members were included within the

[3]J.D. Cronkite, V.L. Berry, J.E. Brunlsen, A. NASTRAN Vibration Model of AH-1G Helicopter Airframe, June 1974, AD A009482.
[4]Private communication between D.F. Haskell of BRL and D. Reisdorfer, Bell Helicopter Company.

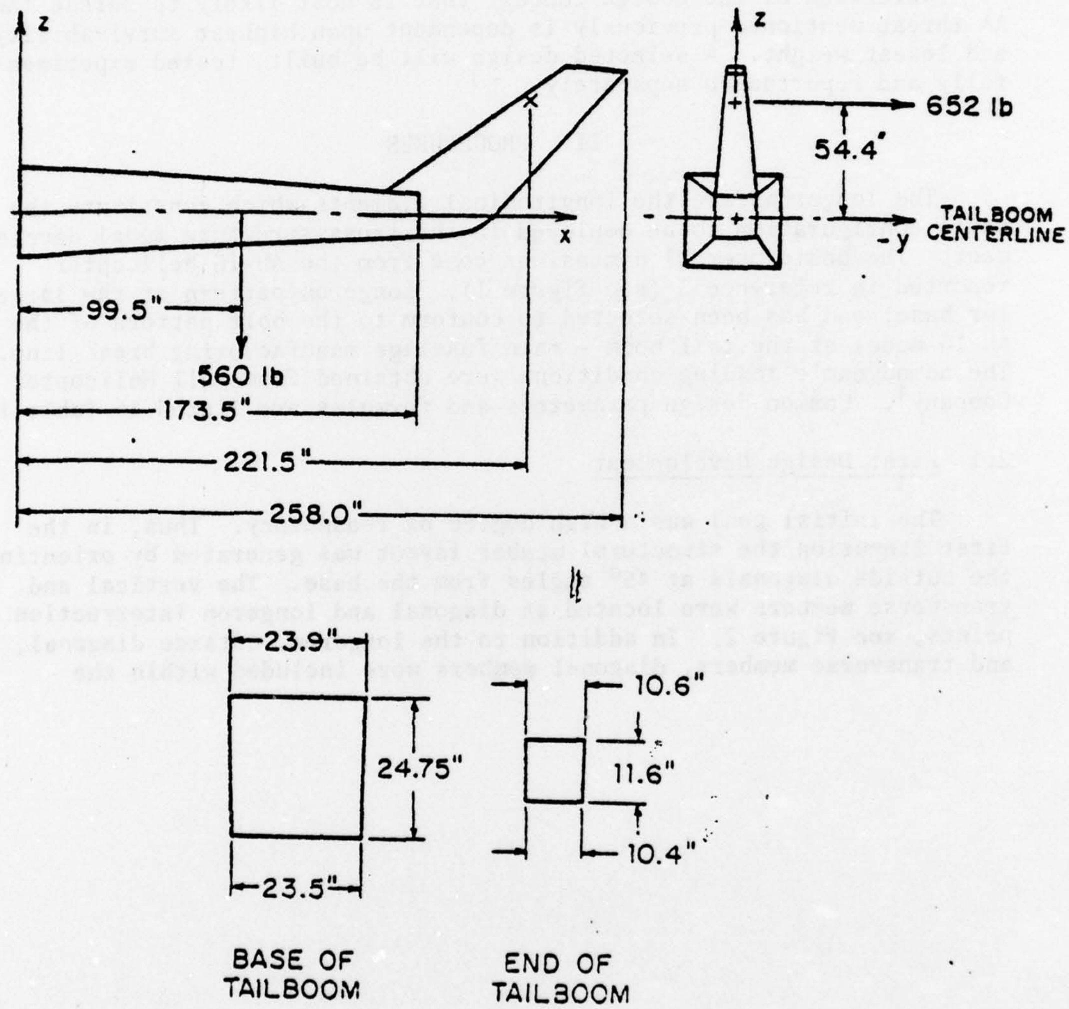

Figure 1. Geometry of Helicopter Tail Boom.

TABLE 1.

Common Design Parameters and Formulas

Material:	Aluminum Alloy	
Modulus of Elasticity:	$E = 7. \times 10^{10}$ n/m^2(10.5 x 10^6 psi)	(5)
Density ρ:	$\rho = 2.7 \times 10^3$ kg/m^3(0.1 lbs/in^3)	(5)
Margin of Safety: of Individual Member	$M.S. = \frac{\text{stress limit}}{\text{applied stress}} - 1.$	(6)

Stress Limits per member

Compressive $\quad CSL = .8 * \delta_{cr}$

Tensile $\quad TSL = \delta_{cr}$

Euler Column Buckling (7)

$$\delta_{cr} = \frac{Pcr}{CSA}$$

Cross Sectional Area of Tube: $CSA = \pi(r_o^2 - r_i^2)$

Compressive Critical Load with Hinged Ends (7)

$$Pcr = \frac{\pi^2 EI}{l^2}$$ where l = length of member

[5]ALCOA STRUCTURAL HANDBOOK. A Design Manual for Aluminum Company of America, Pittsburg, PA, 1958.

[6]NASTRAN Programmer's Manual, NASA SP-221(03), July, 1976, Washington, D.C.

[7]S. Timoshenko, Strength of Materials, Part I. D. VanNostrand Company, Inc., New York, N.Y., 1940, pp 244-254.

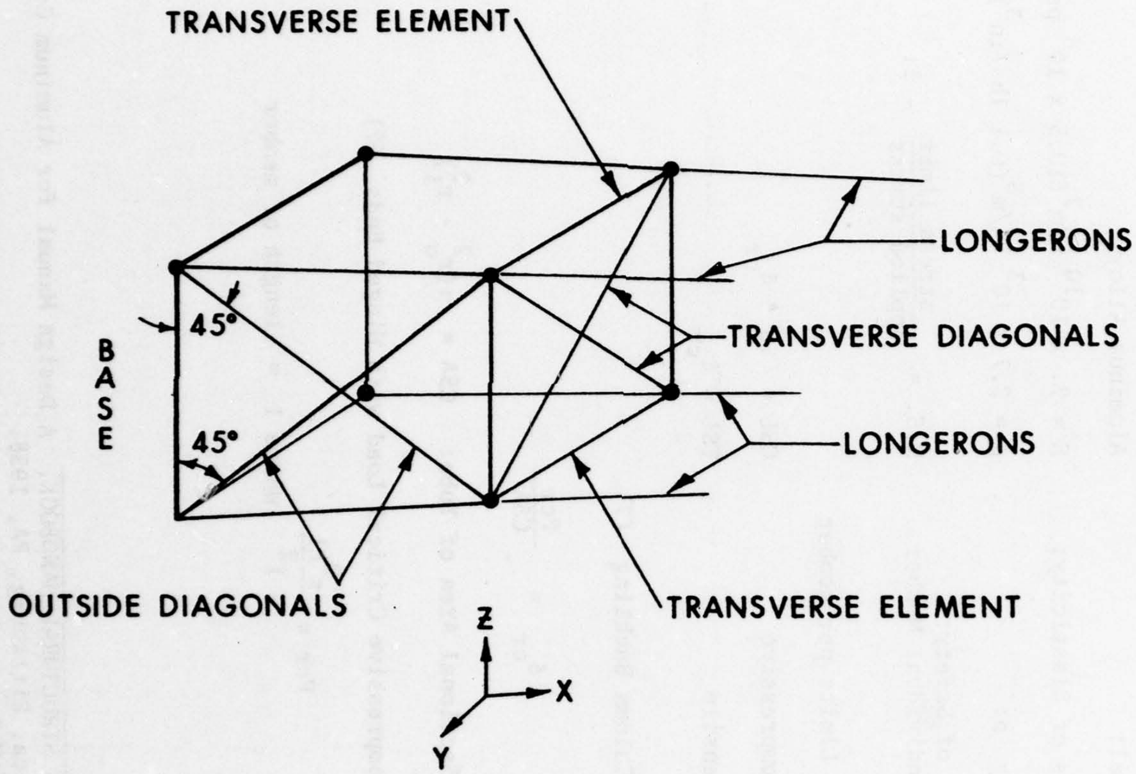

Figure 2. First Iteration Member Layout.

transverse sections defined by the transverse members, see figure 2. This layout was aided by geometry programs developed in-house[8]. The overall configuration consists of 44 joints, 120 degrees of freedom, with 186 members.

Analyses of this first design concept were started with the structural optimization program OPTBAR[9]. The OPTBAR program is an optimization procedure based on an energy criterion and a search procedure based on constraint gradient values. Constraint values of the geometric configuration, same material throughout, minimum element sizes and stress limit are input to OPTBAR and the indeterminate structure is optimized to lowest weight design. For this first simple open truss model the lowest weight was 44.45 kg (98 lbs). Initial damage criteria was loss of a member or members, and analyses of these cases produced higher weights. This was predictable because as the load path changes OPTBAR must strengthen the remaining members to take up the load. Of course, a critical event would be the loss of a joint and analyses simulating the loss of a joint using OPTBAR on the first iteration model indicated a geometrical instability.

Intuitively, one can observe the geometrical instability in a triangular cross section based truss (figure 3) if it would lose a joint. The structural integrity of a quadrilateral cross section based simple open truss that absorbed a loss of a joint has an uncertainty factor. This uncertainty in the simple open quad based truss led to the belief that it may be dependent on each and every joint. Dependence on a joint and the uncertainty of structural stability due to a geometric instability when a joint is lost reduces confidence in structural integrity.

This "simple" open truss structure was deemed unacceptable (simple is defined here as joint dependent). At this time the damage criterion was firmly established to be the loss of a single joint. A concept for independence of a joint was needed to reduce uncertainty of stability and increase confidence of structural integrity after damage. A number of ideas were passed over until the idea of complete substructures was conceived.

The concept that was used to generate complete substructures so as to obtain joint independence introduced the interior diagonals. The connection of all the interior diagonals from vertical station to vertical station generates forty additional elements in this first design. Because of the inclusion of these interior diagonals an increase in weight occurs, however, an increase in survivability is conceptually

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[8]Keith Applin, Gary Kuehl; "Geometry Programs to Aid in Producing COM-GEOM Target Descriptions," BRL Memorandum Report No. 2712 Dec 1976.

[9]V.B. Venkayya, Design of Optimum Structures-Computers and Structures, Vol. 1, pp 285-309, Pergamon Press 1971.

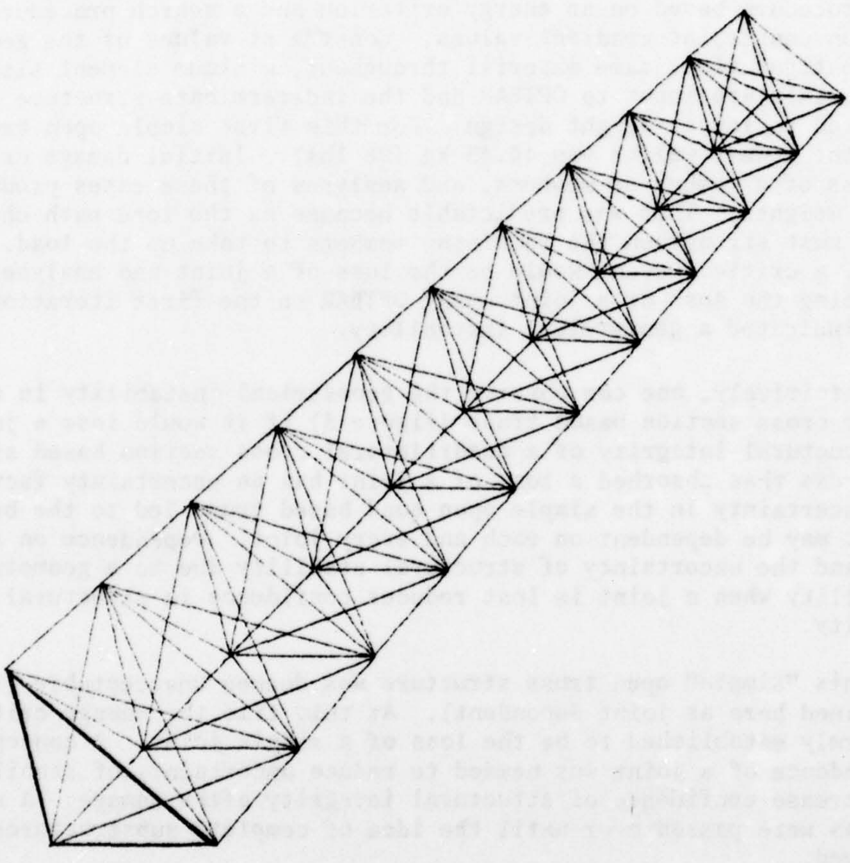

Figure 3. Computer Drawing of a Complete Triangular Substructure of Model 1.

assured because the structure's configuration has increased the ability to retain structural integrity after imposition of the loss of a joint. This method populates a joint with eleven members to be connected and generates a structure that has four complete triangular-based substructures (figure 3) within the entire quadrilateral cross section based structure (figure 4). This structure is highly redundant. The structure of figure 3 is a subset of that shown in figure 4. Figure 5 shows the fully connected composition of the addition of interior diagonals to the structure between the base and vertical station 1. The composition of this structure is truly shown in figure 6 which presents the base, vertical station 1 and vertical station 2. Note that the joints within the extremities are highly populated with eleven members per joint.

This new configuration has 226 members with 44 joints and 120 degrees of freedom. This complete, highly redundant truss when operated on by OPTBAR optimization analysis came to a weight of approximately 52.16 kg (115 lbs). The problem with the structural optimization scheme is that the optimization is for one and only one particular solution (weight optimization). The program results in a wide variety of cross sectional areas to the members so as to optimize the load path. Realistically there cannot be a universe of different size members; however, the weight output can be thought of as representative of an ideal lower bound. Being limited to this one area obviously does not account for a design-to-cost or a design-to-logistics solution.

A full accounting optimization could be defined as: design-to-cost, design-to-weight, design-to-logistics, and many other design-to-areas. For our purposes this study attempts to account for the three areas specifically mentioned. Considering cost and logistics, the ideal design would be to have all the truss members with the same cross sectional end dimensions. It costs less to buy a large quantity of structural elements all the same size than to buy small quantities of various sizes.

The standard tube structural element was chosen for this conceptual design study because of the tube's high inertia over rods of the same cross sectional area. Standard structural tube dimensions[5] provide a wide range of possible designs (see Table 2). Analyses of the first design by changing standard dimensions allow a number of possible choices. Cases increment upward in weight by the different standard structural member dimensions. The structural element choice is 3.81 cm (1 1/2") outside diameter tubes with .159 cm (1/16") thickness. Using these element dimensions the first design weighs 63.73 kg (140.5 lbs) and meets our definition of full accounting.

Since these parameters are now set, the weight optimization program cannot be used for our analysis. Structural analyses from here on are performed by NASTRAN (NASA STRuctural ANalysis)[2]. NASTRAN is a large, comprehensive, general purpose, finite element, displacement method,

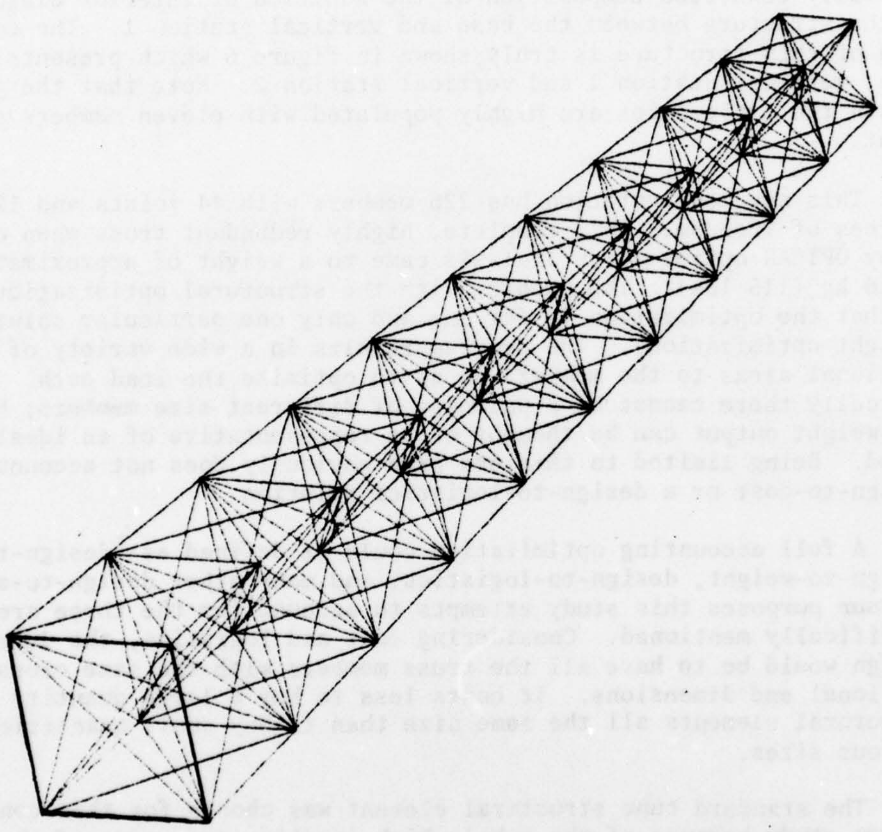

Figure 4. Computer Drawing of the Complete Quad Based Structure Model 1.

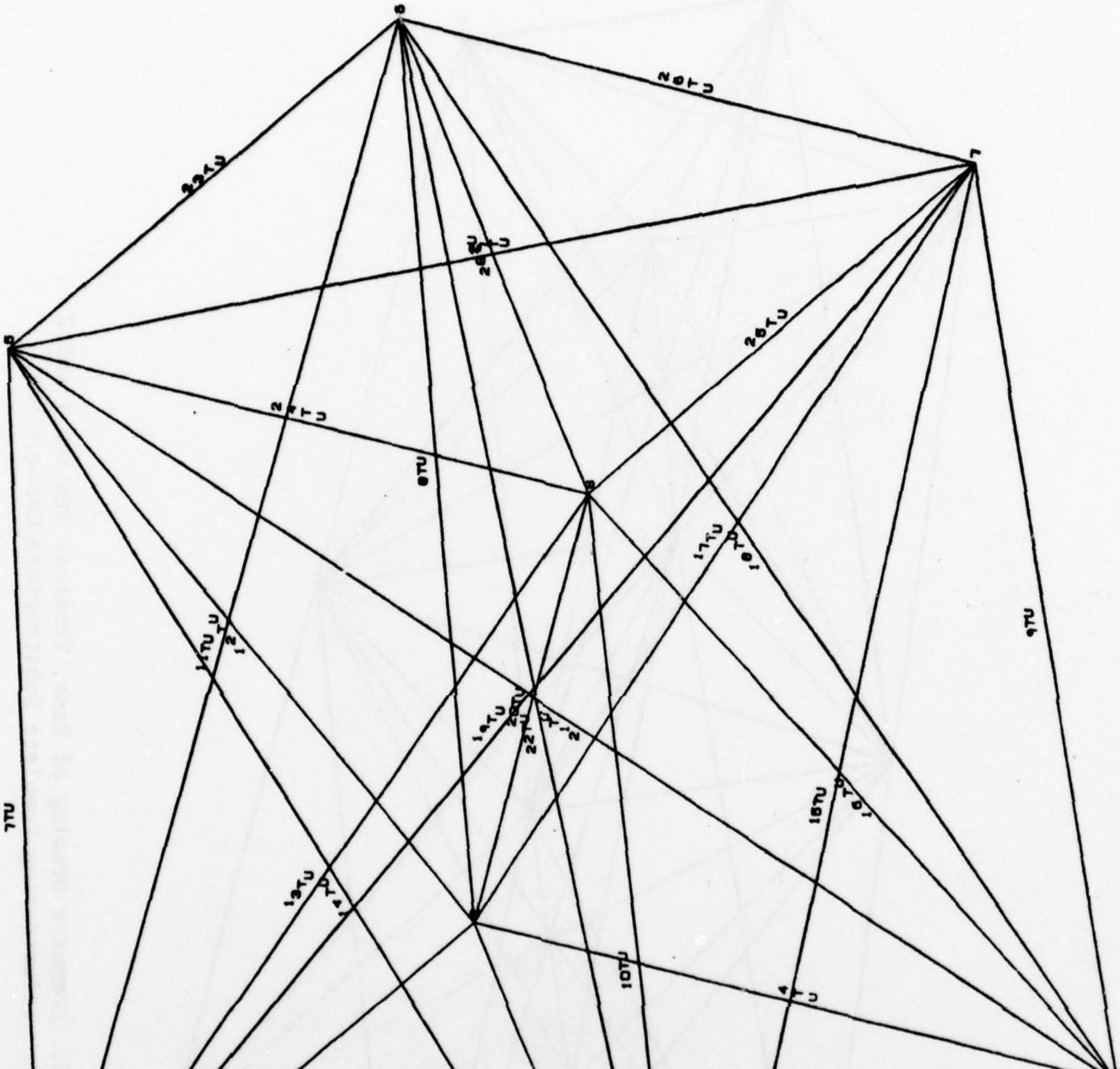

Figure 5. Computer Drawing of the Base and Vertical Station 1 Illustrating the Fully Connected Composition of the Structure.

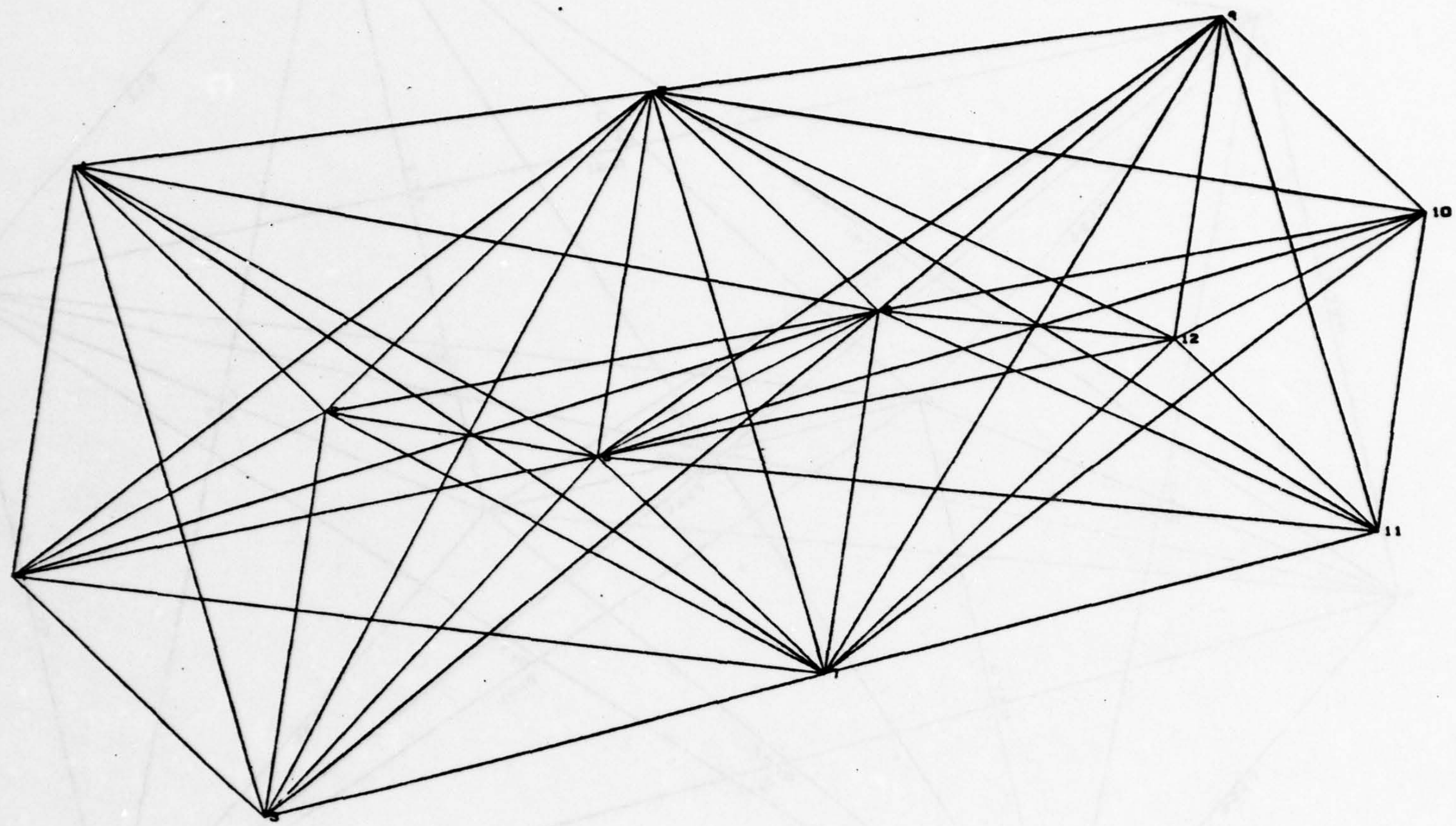

Figure 6. Computer Drawing of Base, Vertical Station 1 and 2 Illustrating Complete Substructure Connections.

TABLE 2

Different Weight Cases of First Design

Design	O.D.	Thickness	Weight
Interior Diagonals	3.81 cm (1 1/2")	.159 cm (1/16")	46.27 kg
Outer Members	3.81 cm (1 1/2")	.0795 cm (1/32")	(102 lbs)
All Members	3.81 cm (1 1/2")	.159 cm (1/16")	63.73 kg (140.5 lbs)
Interior Diagonals	4.45 cm (1 3/4")	.159 cm (1/16")	66.22 kg
Outer Members	3.81 cm (1 1/2")	.159 cm (1/16")	(146 lbs)
Interior Diagonals	4.45 cm (1 3/4")	.159 cm (1/16")	66.68 kg
Outer Members	4.45 cm (1 3/4")	.079 cm (1/32")	(147 lbs)
All Members	4.45 cm (1 3/4")	.159 cm (1/16")	74.66 kg (164.6 lbs)
All Members	5.04 (2")	.159 cm (1/16")	85.73 kg (189 lbs)

computer program. NASA, other government agencies, and aerospace industries have been using it for a number of years now for design and analysis of all forms of airframes.

The NASTRAN rigid format 3, Normal Modes and Frequencies, is a dynamic analysis providing the mode shapes and resonant frequencies of complete models. Analysis of flight loads on the models is performed by NASTRAN rigid format 4, Static Analysis with Differential Stiffness. This method was chosen over rigid format 1, Static Analysis, because design operating stresses are more accurately calculated for analysis of buckling failure of individual members[10]. The NASTRAN mathematical model in the design of the truss structure is straight forward. The joints are grid points and the connections made are with the standard line element CTUBE[2].

2.2 Weight Reduction by Changing Geometry Layout

The initial model truly achieves a high degree of redundancy and populates the structure with many members. This configuration, however, is not a low weight design. To obtain a geometric configuration conducive to a low weight design without doing a geometry optimization analysis, this study utilizes only the joint locations described in reference 11 for the second and third design cases.

2.3 Second Design Case

The second design is a "simple" open truss. The longeron elements are again following the longeron locations of the AH-1 series type helicopter. The configuration consists of 28 joints, 114 members, and 72 degrees of freedom. The same tube dimensions that are in the first design are used here. This configuration (see figure 7) weighs approximately 40.82 kg (90 lbs). This design case is included as a comparison to the third design case.

2.4 The Third Design Case

The third design has the same geometry as the second design except that the interior diagonals are introduced to generate complete substructures. This design has 138 members with 28 joints and 72 degrees of freedom. This highly redundant truss design weighs approximately 52.16 kg (115 lbs) (see figure 8), using the same 3.81 cm (1 1/2") outside diameter tubes with .159 cm (1/16") thickness.

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[10]Robert B. Bennett, NASTRAN Differential Stiffness, Analysis of an Aircraft Canopy, NASA TMX 2378 p 85-105, September 1971.

[11]J. S. Arora, E. J. Haug, A. K. Govil, Fail-Safe Design of an Open Truss Helicopter Tail Boom, Technical Report #32, April 1977, College of Engineering, University of Iowa.

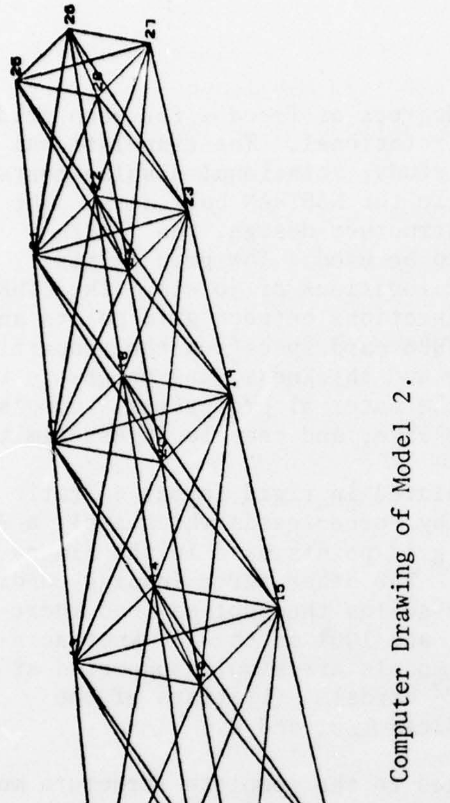

Figure 7. Computer Drawing of Model 2.

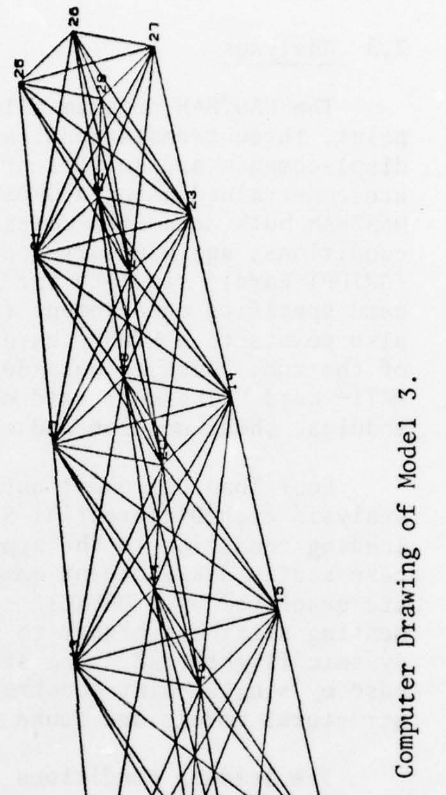

Figure 8. Computer Drawing of Model 3.

2.5 Analyses

The NASTRAN program allows six degrees of freedom for each grid point, three translational and three rotational. The translational displacements are sufficient in this study; rotational displacements are constrained using a GRDSET[2] card in the NASTRAN bulk data. The NASTRAN bulk data deck contains the structure design, the loading conditions, and boundary conditions to be used. The grid points (GRIDPT card)[2] simulate the geometric locations of joints. The CTUBE[2] card specifies the element (tube) connections between grid points and also points to a PTUBE[2] card. The PTUBE card specifies the properties of the tube, such as outside diameter and thickness, and points to the MAT1[2] card. The MAT1 card contains the material properties, Young's modulus, shear modulus and the compressive, and tensile stress limits.

Four loading conditions are simulated in rigid format 4 Static Analysis with Differential Stiffness by Force[2] cards which apply a 30% loading condition to the appropriate grid points used in the linear first case static displacement computation. The other three loading conditions are generated by a DSFACT[2] card which scales the applied load incrementing stiffness higher to 50%, 75%, and 100% of the 130 knot aerodynamic flight load. The structural models are simply supported at the base by single point constraints (SPC[2] cards). (Listings of the structural models are found in Appendices A, B, and C.)

The loading conditions are applied to the complete structure models. The output of interest is the displacements of grid points, the applied stress and margin of safety of each individual member. The margin of safety indicates the closeness of failure. For each individual member the compressive and tensile stress limits were calculated, as indicated in Table 1, and put on the MAT1 NASTRAN material card for that individual element. This scheme allows NASTRAN to compute the margins of safety directly after stresses are calculated (Table 1). A conservative calculation of compressive stress limit is found in Table 1. Then the imposition of the damage criterion is simulated by the removal of a grid point and all the elements connecting that grid point. The damaged structure is then reanalyzed with the same loading conditions as the complete models.

For each model three vertical stations were chosen to have their joints deleted -- a vertical station in front, middle and rear of the structure. For example, each model had front vertical joints 5, 6, 7, and 8 deleted one at a time and then analyzed with the flight loads. The middle vertical station of each model also supports the elevator of the tail boom. On model 1 this is vertical station #5 with joints 21, 22, 23, and 24. On model 2 and model 3 the middle is vertical station #3 with joints 13, 14, 15, and 16. The rear vertical station of model 1 contains joints 37, 38, 39, and 40. Model 2 and model 3 rear vertical contains joints 21, 22, 23, and 24. A total of twelve damage cases per model were simulated.

Extraction of a structure's natural frequencies can be performed by rigid format 3 of NASTRAN Normal Modes and Frequencies. These natural frequencies of structures are important in the analyses of aircraft structures. The natural frequencies are found only for the complete structures in this study.

2.6 Procedural Assumption

The existing semimonocoque tail boom at the base is canted at a small angle upward. Assuming a vertical base in our models is believed to be acceptable. Realistically, portions of members that enter a joint may remain affixed to the truss structure after loss of a joint. The effects of these members (or portions thereof) remaining are considered minor, and therefore are neglected in this study.

III. RESULTS

The appendices A, B, and C are listings of each complete model plus the results of displacements of each joint, stresses and margins of safety for each element for the applied loads. Resultant geometry framework is given in Appendices D, E, and F. Appendix D specifies the element connections between joints. The connection scheme is a replication and is valid for all the truss models. The only exceptions are: models 2 and 3 end at element number 138 and model 2 does not contain interior diagonals. Appendix E lists the joint locations of model 1 and Appendix F lists the joint locations of models 2 and 3.

3.1 Displacements

Maximum deflections at the end of the boom are limited because the maximum angle of the driveshaft couplings is 1°. Figure 9 shows where the couplings are located in reference to the end of the boom and provides the maximum deflection constraint to be 8.13 cm (3.2 in). Table 3 shows the maximum displacements of the truss models with and without damage imposed. These displacements lie comfortably within this maximum deflection constraint.

Table 4 lists the ratio of damage conditions displacements to the undamaged condition displacements of the complete longeron diagonally opposite a deleted node for damage to model 1. Each loading condition is presented. Translations of the X direction displacement are insignificant and not presented.

Table 5 lists the same results for model 2 and the results for model 3 are listed in Table 6.

3.2 Margins of Safety

The margin of safety of an individual element indicates its closeness to failure. Buckling failure determined by margin of safety

$\ell_1 = 159.72\text{cm}$ (62.88 in.)

$\ell_2 = 155.04\text{cm}$ (60.04 in.)

$d_I = \ell_I \tan I^o \quad I=1,2$

$d_1 = \ell_1 \tan 1^o = 2.79\text{cm}$ (1.10 in.)

$d_2 = \ell_2 \tan 2^o = 5.33\text{cm}$ (2.10 in.)

$d_T = d_1 + d_2$

$d_T = 8.12\text{cm}$ (3.2 in.)

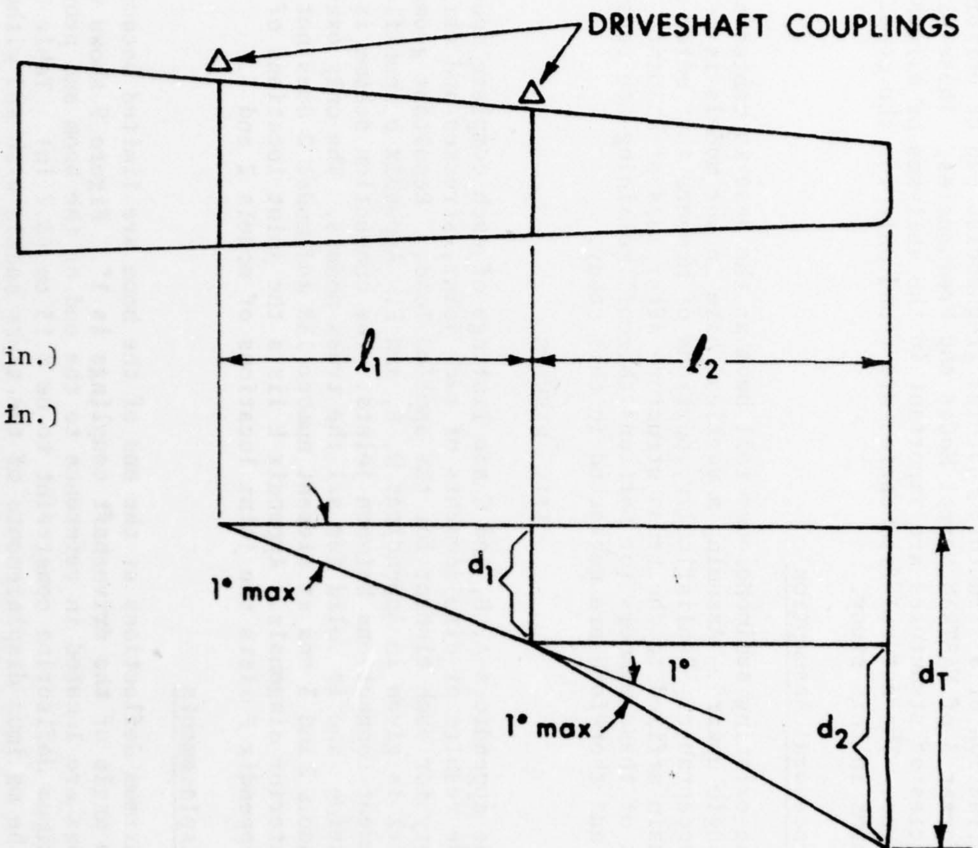

Figure 9. Maximum Deflection Constraint Due to Drive Shaft Couplings.

TABLE 3

Maximum Displacement at End of Boom Due to 100% Flight Load
With Joints Deleted

MODEL 1			MODEL 2			MODEL 3	
Damage	y	z	Damage	y	z	y	z
None	1.17cm	.797cm	None	1.09cm	.797cm	1.10cm	.784cm
-5	1.97cm	1.55cm	-5	1.91cm	1.55cm	1.89cm	1.53cm
-6	1.08cm	.9.50cm	-6	1.10cm	.955cm	1.10cm	.935cm
-7	1.91cm	1.55cm	-7	1.83cm	1.60cm	1.84cm	1.53cm
-8	1.11cm	.965cm	-8	1.17cm	1.01cm	1.13cm	.950cm
-21	1.45cm	1.02cm	-13	1.55cm	1.04cm	1.50cm	1.04cm
-22	1.37cm	.635cm	-14	1.32cm	.630cm	1.33cm	.635cm
-23	1.35cm	1.04cm	-15	1.34cm	1.22cm	1.37cm	1.14cm
-24	1.42cm	.650cm	-16	1.53cm	.81cm	1.46cm	.726cm
-37	1.30cm	.866cm	-21	1.43cm	.889cm	1.36cm	.899cm
-38	1.21cm	.772cm	-22	1.15cm	.726cm	1.19cm	.741cm
-39	1.24cm	.901cm	-23	1.17cm	1.10cm	1.21cm	1.01cm
-40	1.27cm	.795cm	-24	1.39cm	.924cm	1.33cm	.843cm

TABLE 4a. Ratio of Damage Displacements to Undamage Displacements on Longeron Opposite Damage Criterion

MODEL 1 $r_i = \frac{DD}{UD}$, $i = y,z.$

Damage - Joint 5

Lower Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	-.522	1.42	-.541	1.40	-.244	1.41	-.430	1.40
	11	-37.9	1.92	-40.1	1.91	-41.5	1.92	-43.1	1.93
	15	8.02	2.03	8.19	3.01	8.16	2.05	8.17	2.05
	19	4.73	2.00	4.81	2.09	4.74	2.03	4.77	2.04
	23	3.51	1.98	3.59	2.01	3.48	1.98	3.52	1.99
	27	2.90	1.97	2.90	1.98	2.92	1.96	2.93	1.97
	31	2.57	1.96	2.55	1.95	2.54	1.95	2.56	1.96
	35	2.24	1.95	2.23	1.94	2.21	1.94	2.23	1.94
	39	2.01	1.94	2.01	1.93	2.02	1.93	2.10	1.93
	43	1.97	1.93	1.98	1.92	1.96	1.91	1.97	1.92

Damage - Joint 21

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
7	1.00	1.00	.99	1.00	.992	1.00	.989	1.00
11	1.02	1.00	.94	1.00	.898	1.00	.857	1.00
15	1.00	1.00	1.00	1.00	1.0	1.00	1.00	1.00
19	.99	1.00	.990	1.00	.990	1.00	1.00	1.00
23	1.05	1.02	1.06	1.02	1.07	1.02	1.08	1.02
27	1.20	1.10	1.21	1.10	1.21	1.10	1.22	1.10
31	1.27	1.17	1.28	1.18	1.28	1.18	1.29	1.19
35	1.29	1.21	1.31	1.22	1.31	1.22	1.31	1.23
39	1.30	1.25	1.31	1.25	1.31	1.26	1.32	1.27
43	1.29	1.27	1.29	1.28	1.30	1.28	1.31	1.29

Damage - Joint 37

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
7	1.00	1.00	.99	1.00	1.0	1.00	.985	1.00
11	1.00	1.00	.87	1.00	.801	1.00	.722	1.00
15	1.00	1.00	1.00	1.00	1.03	1.00	1.05	1.00
19	1.00	1.00	1.01	1.00	1.02	1.00	1.03	1.00
23	1.00	1.00	1.01	1.00	1.02	1.00	1.02	1.00
27	1.00	1.00	1.01	1.00	1.02	1.00	1.02	1.00
31	1.00	1.00	1.01	1.00	1.02	1.00	1.02	1.00
35	1.00	1.00	1.01	1.00	1.02	1.00	1.02	1.00
39	1.01	1.02	1.02	1.02	1.03	1.02	1.04	1.02
43	1.07	1.07	1.08	1.07	1.09	1.07	1.09	1.08

TABLE 4b. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

MODEL 1 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 6

Upper Right Longeron (viewed from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	.899	1.11	.896	1.11	.892	1.12	.889	1.12
	12	.848	1.21	.843	1.21	.837	1.22	.831	1.22
	16	.857	1.22	.852	1.22	.848	1.23	.841	1.23
	20	.867	1.20	.860	1.21	.857	1.22	.854	1.22
	24	.880	1.19	.879	1.20	.879	1.20	.868	1.20
	28	.893	1.19	.889	1.20	.885	1.20	.883	1.20
	32	.903	1.19	.901	1.19	.895	1.19	.894	1.19
	36	.913	1.18	.908	1.18	.906	1.19	.905	1.19
	40	.915	1.18	.915	1.18	.915	1.19	.913	1.18
	44	.927	1.18	.925	1.18	.922	1.19	.919	1.19

Damage - Joint 22

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
8	.999	.999	1.0	1.0	1.0	1.0	1.0	1.0
12	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
16	.998	1.0	.998	1.0	.999	1.0	1.0	1.0
20	1.0	1.0	1.0	1.0	.999	1.0	.998	1.0
24	1.02	.986	1.02	.989	1.02	.991	1.02	.992
28	1.10	.901	1.10	.916	1.09	.929	1.09	.932
32	1.15	.858	1.15	.864	1.14	.875	1.13	.880
36	1.17	.815	1.17	.826	1.16	.837	1.15	.843
40	1.18	.785	1.18	.788	1.17	.810	1.16	.818
44	1.18	.758	1.18	.773	1.17	.788	1.17	.797

Damage - Joint 38

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
12	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
16	1.0	1.0	1.0	1.0	.996	1.0	1.0	1.0
20	1.0	1.0	1.0	1.0	.995	1.0	.995	1.0
24	1.0	1.0	1.0	1.0	.995	1.0	.994	1.0
28	1.0	1.0	1.0	1.0	.995	1.0	.993	1.0
32	1.0	1.0	1.0	1.0	.994	1.01	.992	1.0
36	1.0	1.0	1.0	1.01	.995	1.01	.994	1.01
40	1.01	.991	1.01	.997	1.0	1.0	1.0	1.0
44	1.04	.947	1.04	.954	1.04	.960	1.03	.964

TABLE 4c. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 1 $r_i = \frac{DD}{UD}$, i = y,z

Damage - Joint 7

Upper Left Longeron (viewed from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	1.5	-5.63	1.51	-6.56	1.53	-7.13	1.54	-7.77
	9	2.13	5.05	2.14	4.99	2.16	4.94	2.17	4.89
	13	2.20	3.69	2.22	3.68	2.24	3.66	2.26	3.64
	17	2.11	3.18	2.13	3.16	2.15	3.15	2.16	3.14
	21	2.0	2.90	2.01	2.89	2.03	2.88	2.04	2.87
	25	1.89	2.79	1.9	2.78	1.92	2.77	1.93	2.75
	29	1.80	2.72	1.82	2.70	1.83	2.68	1.84	2.67
	33	1.72	2.67	1.73	2.65	1.75	2.64	1.76	2.62
	37	1.66	2.69	1.67	2.66	1.68	2.62	1.69	2.58
	41	1.60	2.60	1.61	2.58	1.62	2.55	1.63	2.53

Damage - Joint 23

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	1.0	1.0	1.0	1.0	1.0	.992	1.0	.983
	9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	13	1.0	1.0	1.0	1.0	1.0	1.01	1.0	1.01
	17	1.0	.987	1.0	.990	1.01	.973	1.01	.995
	21	1.03	1.03	1.03	1.03	1.04	1.04	1.04	1.04
	25	1.10	1.17	1.10	1.17	1.11	1.18	1.12	1.18
	29	1.15	1.28	1.15	1.29	1.16	1.30	1.17	1.30
	33	1.17	1.36	1.17	1.36	1.18	1.36	1.19	1.36
	37	1.18	1.41	1.18	1.41	1.19	1.41	1.20	1.41
	41	1.18	1.44	1.19	1.44	1.19	1.44	1.20	1.44

Damage - Joint 39

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	1.0	1.0	1.0	1.0	1.0	.990	1.0	.928
	9	1.0	1.0	1.0	1.0	1.0	1.01	1.0	1.02
	13	1.0	1.0	1.0	1.01	1.0	1.01	1.01	1.01
	17	1.0	1.0	1.0	1.01	1.0	1.01	1.01	1.01
	21	1.0	1.0	1.0	1.0	1.01	1.0	1.01	1.01
	25	1.0	1.0	1.01	1.0	1.01	1.01	1.01	1.01
	29	1.0	1.0	1.01	1.01	1.01	1.01	1.01	1.01
	33	1.0	1.0	1.01	1.01	1.01	1.01	1.01	1.01
	37	1.01	1.02	1.02	1.02	1.02	1.03	1.02	1.03
	41	1.04	1.10	1.04	1.10	1.05	1.11	1.05	1.11

TABLE 4d. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 1 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 8

Lower Left Longeron (viewed from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	6	1.29	.670	1.30	.651	1.31	.627	1.31	.593
	10	3.06	1.0	3.14	1.33	3.24	1.72	3.32	1.98
	14	.013	1.54	-.040	1.55	-.064	1.56	-.087	1.56
	18	.567	1.42	.555	1.43	.538	1.44	.519	1.44
	22	.722	1.36	.710	1.36	.701	1.37	.689	1.38
	26	.795	1.34	.787	1.34	.779	1.35	.771	1.35
	30	.838	1.32	.330	1.32	.324	1.33	.818	1.33
	34	.865	1.31	.859	1.31	.853	1.32	.848	1.32
	38	.887	1.31	.882	1.31	.877	1.31	.872	1.31
	42	.901	1.30	.90	1.30	.889	1.30	.888	1.30

Damage - Joint 24

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
6	1.0	.996	1.0	.991	1.0	.985	1.0	.981
10	.998	1.0	1.04	1.01	1.07	1.01	1.09	1.01
14	1.0	1.0	.995	1.0	.989	1.01	.985	1.01
18	.981	.996	.977	.998	.973.	1.0	.969	1.0
22	1.03	.952	1.03	.956	1.02	.960	1.02	.965
26	1.19	.810	1.18	.822	1.17	.834	1.17	.844
30	1.27	.690	1.26	.707	1.25	.725	1.24	.743
34	1.29	.617	1.28	.639	1.27	.660	1.27	.683
38	1.29	.563	1.29	.594	1.28	.623	1.27	.641
42	1.29	.532	1.28	.560	1.27	.691	1.26	.618

Damage - Joint 40

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
6	1.0	1.0	1.0	.994	1.0	.990	1.0	.986
10	1.0	1.0	1.02	1.01	1.06	1.01	1.08	1.01
14	1.0	1.0	.983	1.01	.967	1.01	.950	1.01
18	1.0	1.0	.989	1.0	.982	1.01	.971	1.01
22	1.0	1.0	.993	1.0	.985	1.01	.977	1.01
26	1.0	1.0	.994	1.0	.987	1.01	.979	1.01
30	1.0	.991	.996	.997	.988	1.0	.981	1.01
34	.996	.999	.990	1.0	.984	1.0	.978	1.01
38	1.01	.970	1.0	.976	1.0	.981	.996	.987
42	1.07	.868	1.06	.879	1.05	.891	1.05	.902

TABLE 5a. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 2 $\quad r_k = \frac{DD}{UD}$, i - y,z.

Damage - Joint 5

Lower Right Longeron (viewed from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	-.144	1.15	-.150	1.16	-.153	1.17	-.158	1.17
	11	-9.47	1.69	-9.83	1.70	-10.02	1.71	-10.21	1.71
	15	10.80	1.82	10.82	1.83	10.77	1.84	10.76	1.84
	19	4.47	1.89	4.53	1.90	4.55	1.90	4.59	1.90
	23	3.11	1.92	3.15	1.91	3.18	1.92	3.20	1.92
	27	2.52	1.95	2.56	1.94	2.57	1.94	2.59	1.94

Damage - Joint 13

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
7	1.0	1.0	.998	1.0	.997	1.0	.996	1.0
11	1.14	1.0	1.11	1.0	1.10	1.0	1.09	1.0
15	1.82	.988	1.84	.995	1.87	1.0	1.88	1.0
19	1.94	1.10	1.97	1.12	2.00	1.12	2.02	1.13
23	1.76	1.21	1.79	1.22	1.80	1.23	1.82	1.24
27	1.63	1.27	1.66	1.29	1.68	1.31	1.69	1.31

Damage - Joint 21

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
7	1.0	1.0	.994	1.0	.990	1.0	.985	1.0
11	.998	1.0	.960	1.0	.940	1.0	.918	1.01
15	.998	1.0	1.04	1.0	1.06	1.0	1.08	1.01
19	.977	1.0	.996	1.0	1.0	1.01	1.01	1.01
23	1.09	.988	1.11	1.0	1.11	1.0	1.12	1.01
27	1.30	1.07	1.32	1.09	1.33	1.10	1.34	1.11

TABLE 5b. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 2 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 6

Upper Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	.860	.973	.855	.977	.852	.981	.849	.986
	12	.919	1.07	.906	1.08	.899	1.09	.893	1.10
	16	1.0	1.13	.989	1.14	,980	1.15	.978	1.16
	20	1.02	1.15	1.01	1.16	1.0	1.17	1.0	1.18
	24	1.02	1.16	1.01	1.17	1.01	1.18	1.0	1.19
	28	1.02	1.17	1.02	1.18	1.01	1.19	1.01	1.19

Damage - Joint 14

Upper Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	.996	1.0	.996	1.0	.995	1.0	.995	1.0
	12	.997	1.01	.997	1.01	.996	1.01	.996	1.01
	16	.984	.950	.982	.959	.981	.964	.980	.967
	20	1.12	.814	1.11	.834	1.11	.842	1.10	.853
	24	1.20	.760	1.19	.788	1.18	.799	1.18	.814
	28	1.23	.724	1.22	.757	1.21	.769	1.21	.788

Damage - Joint 22

Upper Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	1.0	1.0	1.0	1.0	.997	1.0	.997	1.0
	12	1.0	1.0	.998	1.0	.997	1.01	.997	1.01
	16	1.0	1.0	.997	1.0	.996	1.01	.996	1.01
	20	1.0	1.0	1.0	1.01	.997	1.02	.997	1.02
	24	.996	.963	.994	.978	.993	.985	.992	.992
	28	1.06	.866	1.05	.890	1.05	.901	1.05	.912

TABLE 5c. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 2 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 7

Upper Left Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	1.13	-5.89	1.12	-7.54	1.15	-8.66	1.15	-10.0
	9	1.77	6.73	1.80	6.32	1.81	6.16	1.83	5.99
	13	1.86	4.75	1.89	4.54	1.91	4.46	1.93	4.38
	17	1.80	4.50	1.82	4.29	1.84	4.20	1.85	4.10
	21	1.71	4.38	1.74	4.11	1.75	4.01	1.76	3.91
	25	1.63	4.24	1.65	4.00	1.66	3.92	1.67	3.78

Damage - Joint 15

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
5	.994	1.03	.996	.987	.997	.952	.998	.918
9	1.0	.925	1.0	.959	1.0	.968	1.0	.987
13	.986	1.34	.988	1.34	.990	1.34	.992	1.34
17	1.10	1.93	1.11	1.90	1.12	1.88	1.12	1.86
21	1.18	2.11	1.19	2.05	1.20	2.03	1.20	2.00
25	1.21	2.23	1.21	2.15	1.22	2.12	1.22	2.09

Damage - Joint 23

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
5	1.0	1.0	1.0	.960	1.0	.888	1.0	.800
9	1.0	1.0	1.0	1.03	1.0	1.05	1.0	1.06
13	1.0	1.0	1.0	1.04	1.0	1.06	1.0	1.06
17	1.0	.982	1.0	1.01	1.0	1.03	1.0	1.05
21	.996	1.13	1.0	1.15	1.0	1.17	1.0	1.19
25	1.06	1.49	1.06	1.49	1.07	1.49	1.07	1.49

TABLE 5d. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 2 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 8

Lower Left Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	6	.637	-.760	.656	-.978	.666	-1.09	.675	-1.23
	10	-.136	2.86	.011	2.79	.082	2.77	.153	2.74
	14	1.66	1.81	1.48	1.82	1.40	1.83	1.31	1.84
	18	1.17	1.66	1.11	1.67	1.09	1.69	1.06	1.69
	22	1.09	1.59	1.06	1.60	1.04	1.60	1.02	1.61
	26	1.05	1.54	1.03	1.54	1.02	1.55	1.0	1.55

Damage - Joint 16

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
6	.996	.978	.997	.954	.998	.941	1.0	.927
10	1.16	.995	1.18	1.02	1.18	1.03	1.19	1.04
14	1.81	1.18	1.75	1.20	1.72	1.21	1.70	1.21
18	2.00	.735	1.95	.833	1.93	.875	1.91	.911
22	1.82	.381	1.78	.541	1.76	.602	1.74	.666
26	1.68	.200	1.65	.397	1.63	.474	1.62	.549

Damage - Joint 24

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
6	1.0	1.0	1.0	.950	1.0	.960	1.01	.945
10	1.0	.998	1.02	1.02	1.04	1.04	1.05	1.06
14	.998	1.0	.960	1.02	.943	1.04	.928	1.05
18	.977	1.0	.960	1.03	.953	1.04	.946	1.05
22	1.09	1.04	1.07	1.08	1.07	1.09	1.06	1.11
26	1.30	.713	1.28	.815	1.27	.857	1.26	.895

TABLE 6a. Ratio of Damage Displacements to Undamaged Displacements on Longeron Opposite Damage Criteria

MODEL 3 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 5

Lower Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	.129	1.29	.118	1.30	.112	1.30	.106	1.30
	11	-9.28	1.80	-9.67	1.81	-9.90	1.82	-10.13	1.82
	15	9.53	1.89	9.55	1.89	9.57	1.90	9.58	1.90
	19	4.22	1.92	4.27	1.92	4.30	1.93	4.33	1.93
	23	3.00	1.94	3.03	1.94	3.05	1.94	3.07	1.94
	27	2.45	1.96	2.48	1.95	2.50	1.95	2.51	1.95

Damage - Joint 13

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	.996	.998	.991	1.0	.988	1.0	.985	1.0
	11	1.14	1.0	1.12	1.02	1.10	1.01	1.09	1.0
	15	1.34	1.04	1.38	1.04	1.40	1.04	1.41	1.04
	19	1.70	1.16	1.73	1.17	1.75	1.18	1.76	1.18
	23	1.64	1.25	1.67	1.26	1.68	1.27	1.70	1.27
	27	1.56	1.30	1.59	1.31	1.60	1.32	1.61	1.32

Damage - Joint 21

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	1.0	1.0	.993	1.0	.990	1.0	.987	1.0
	11	1.0	1.0	.962	1.0	.941	1.0	.920	1.0
	15	1.0	1.0	1.03	1.0	1.05	1.01	1.07	1.01
	19	.983	1.0	1.0	1.01	1.01	1.01	1.01	1.01
	23	1.03	1.02	1.05	1.02	1.06	1.03	1.06	1.03
	27	1.22	1.11	1.23	1.12	1.24	1.13	1.25	1.14

TABLE 6b. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criteria

MODEL 3 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 6

Upper Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	.945	1.06	.937	1.06	.934	1.07	.930	1.07
	12	1.0	1.16	.990	1.17	.983	1.18	.976	1.18
	16	1.02	1.16	1.01	1.17	1.0	1.18	1.0	1.19
	20	1.02	1.16	1.01	1.17	1.01	1.18	1.0	1.19
	24	1.02	1.16	1.01	1.17	1.01	1.18	1.0	1.19
	28	1.02	1.16	1.01	1.17	1.0	1.18	1.0	1.19

Damage - Joint 14

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
8	.997	.933	.997	1.0	.997	1.0	.997	1.0
12	1.0	1.0	1.0	1.01	1.0	1.01	1.0	1.01
16	1.02	.980	1.02	.987	1.02	.990	1.02	.994
20	1.16	.869	1.15	.887	1.15	.895	1.14	.903
24	1.22	.797	1.21	.822	1.21	.834	1.20	.846
28	1.23	.749	1.22	.780	1.22	.795	1.21	.810

Damage - Joint 22

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
8	1.0	1.0	.998	1.0	.997	1.0	.997	1.0
12	1.0	1.0	.998	1.0	.997	1.0	.997	1.0
16	1.0	1.0	.997	1.0	.996	1.01	.996	1.01
20	1.0	1.0	1.0	1.01	1.0	1.01	1.0	1.02
24	1.01	.985	1.01	.996	1.01	1.0	1.01	1.0
28	1.09	.905	1.08	.925	1.08	.934	1.07	.943

TABLE 6c. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criteria

MODEL 3 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 7

Upper Left Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	1.35	-.971	1.37	-1.20	1.38	-1.34	1.38	-1.49
	9	1.90	8.10	1.93	7.31	1.95	7.01	1.97	6.72
	13	1.91	5.19	1.93	4.89	1.95	4.77	1.97	4.65
	17	1.81	4.74	1.84	4.44	1.86	4.33	1.87	4.22
	21	1.72	4.51	1.74	4.20	1.76	4.09	1.77	3.96
	25	1.62	4.37	1.65	4.05	1.66	3.92	1.67	3.80

Damage - Joint 15

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
5	.998	.991	1.0	.977	1.0	.969	1.0	.961
9	1.0	.890	1.0	.933	1.0	.949	1.01	.965
13	1.04	1.16	1.04	1.17	1.04	1.18	1.05	1.18
17	1.16	1.42	1.17	1.67	1.18	1.66	1.18	1.65
21	1.21	1.96	1.22	1.91	1.23	1.89	1.24	1.87
25	1.22	2.11	1.23	2.04	1.24	2.01	1.24	1.98

Damage - Joint 23

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
5	1.0	1.0	1.0	.976	1.0	.961	1.0	.946
9	1.0	1.0	1.0	1.03	1.0	1.05	1.0	1.07
13	1.0	1.0	1.0	1.03	1.0	1.04	1.0	1.05
17	1.0	.982	1.0	1.01	1.0	1.02	1.0	1.04
21	1.01	1.06	1.01	1.09	1.02	1.10	1.02	1.11
25	1.09	1.36	1.09	1.37	1.10	1.37	1.10	1.37

TABLE 6d. Ratio of Damaged Displacement to Undamaged Displacements on Longeron Opposite Damage Criteria

MODEL 3 $r_i = \frac{DD}{UD}$, i = y,z.

Lower Left Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
				Damage - Joint 8					
	6	1.15	.847	1.17	.806	1.18	.785	1.18	.761
	10	1.30	2.32	1.46	2.29	1.53	2.27	1.62	2.26
	14	.865	1.57	.724	1.60	.659	1.61	.594	1.63
	18	.975	1.48	.921	1.51	.895	1.52	.869	1.53
	22	.991	1.44	.958	1.46	.941	1.47	.925	1.48
	26	.997	1.41	.973	1.43	.962	1.44	.949	1.44
				Damage - Joint 16					
	6	.994	.987	.996	.973	.997	.966	.997	.958
	10	1.12	.914	1.13	.961	1.14	.977	1.14	.994
	14	1.19	.857	1.16	.904	1.14	.929	1.12	.941
	18	1.68	.374	1.64	.508	1.62	.561	1.60	.614
	22	1.65	.100	1.61	.289	1.59	.362	1.58	.435
	26	1.57	.017	1.55	.201	1.53	.284	1.52	.367
				Damage - Joint 24					
	6	1.0	1.0	1.0	.987	1.0	.980	1.0	.973
	10	1.0	1.0	1.02	1.04	1.04	1.06	1.05	1.07
	14	1.0	1.0	.970	1.02	.956	1.04	.942	1.05
	18	.983	.989	.968	1.02	.961	1.03	.955	1.04
	22	1.03	.916	1.02	.963	1.01	.981	1.01	1.0
	26	1.21	.549	1.20	.665	1.19	.797	1.18	.753

for each individual element is calculated in NASTRAN according to the relations given in Table 1. Buckling due to compressive stress occurs before failure of an element due to tension. An additional 20% safety factor is included for compressive stress limits. A margin of safety less than zero indicates failure. A margin of safety between zero and one indicates structural integrity and is acceptable. Margin of safety greater than one is preferred for the purposes of this study.

Members in tension have been found to have margins of safety (M.S.) greater than one for all the models. Since the major changes in M.S. only occur locally, only the neighborhood of the damage criterion joint in question is presented in the tables for the models.

Key for Tables 7 through 12

I.D. = interior diagonal; O.D. = outside diagonal

T.H. = transverse horizontal; T.V. = transverse vertical

T.D. = transverse diagonal; Long. = longeron

J-J = joint-to-joint connection

D = deleted member; T = member in tension

\- = Nonexistant member; Blank space = compressive

Margin of Safety greater than 10.0.

The highly redundant and densely populated model 1 results give the highest margins of safety. The number of elements that have M.S. under ten are few. Tables 7, 8, and 9 present a list of compressive margins of safety under 10.0 for model 1 with damage conditions giving member number, type, and damage condition for the 100% loading condition. Model 1 does not have any margin of safety of less than 1.0.

Models 2 and 3, as explained before, are identical except model 3 has the interior diagonals included. In modeling these structures, elements have a one to one correspondence for ease in comparison (see Appendix D). Therefore, results of models 2 and 3 will be shown together for their margins of safety under 10.0 in Tables 10 through 12. Model 2 produces four cases where the margin of safety drops under 1.0 when damage is imposed. Model 3 has two cases where margin of safety is under 1.0. These cases are displayed in Table 13 where the two structures are presented together with their respective M.S. for different loading conditions. Figures 10 through 15 locate the members in the truss models whose M.S. falls under 1.0

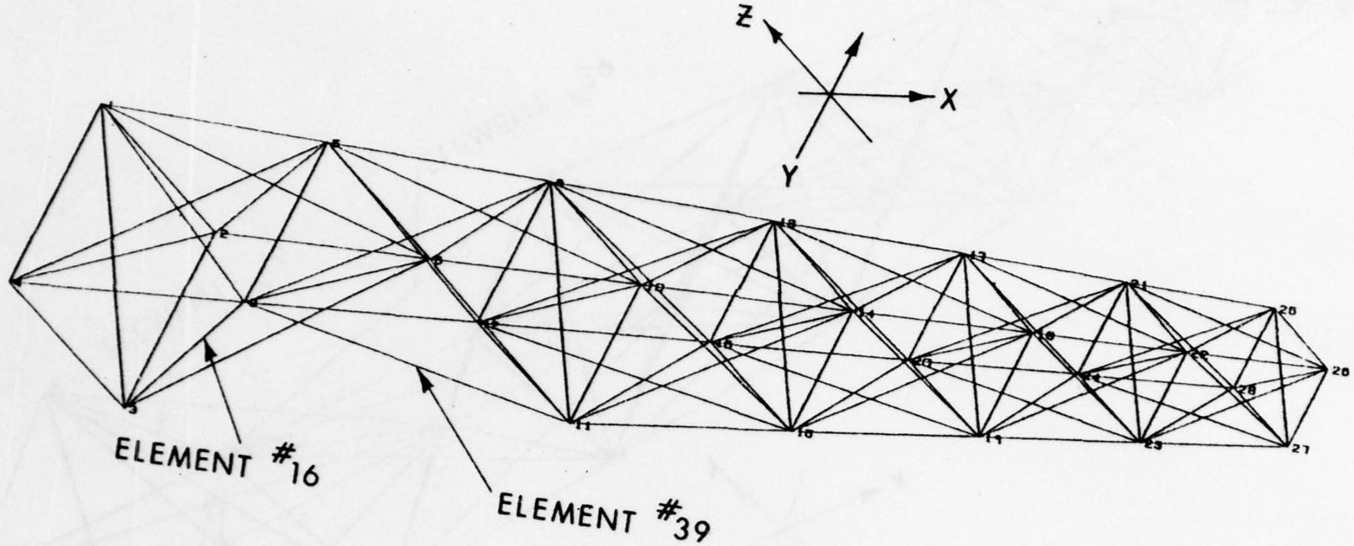

Figure 10. Computer Drawing of Model 2 with Damage of - Joint 7

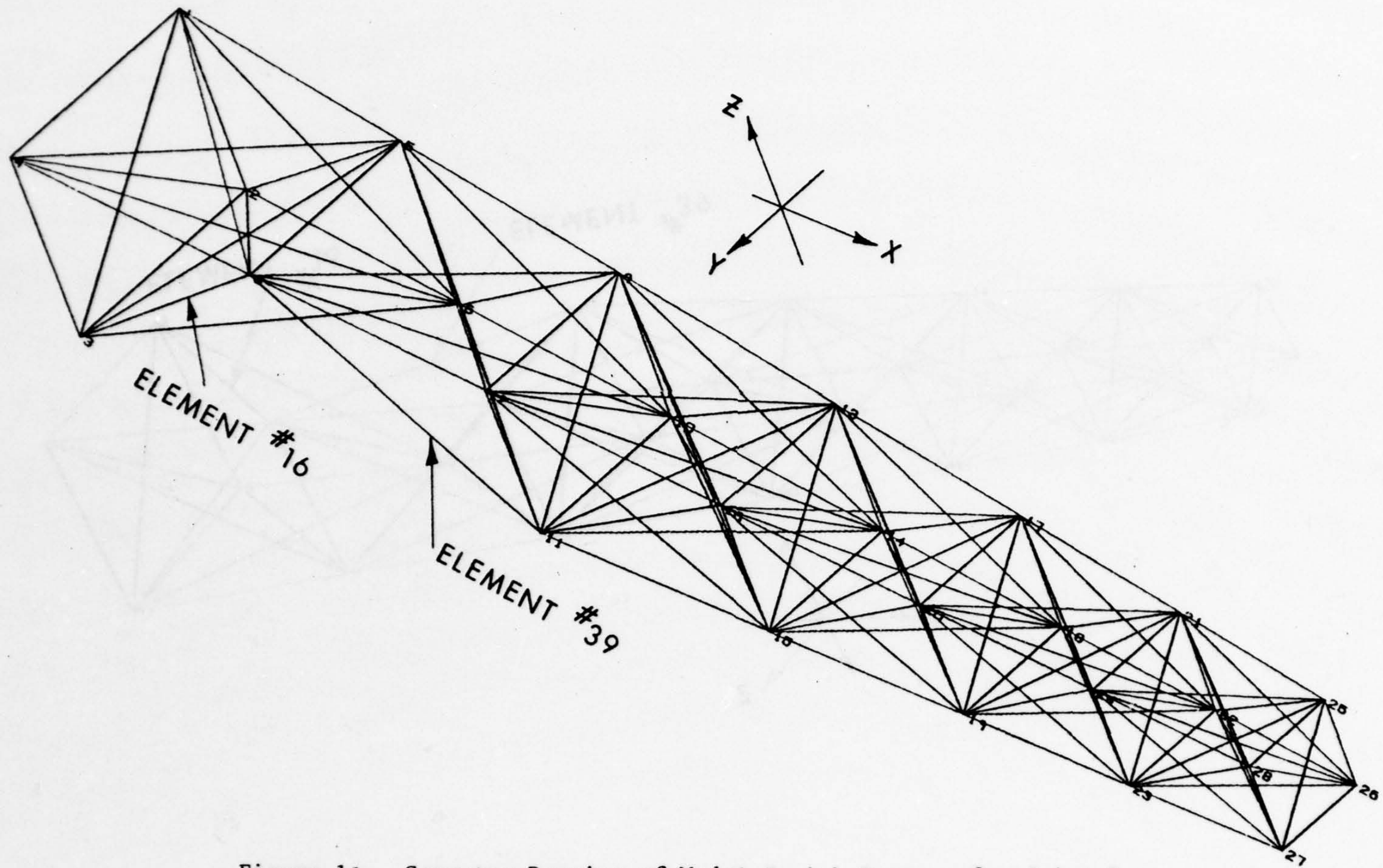

Figure 11. Computer Drawing of Model 3 with Damage of - Joint 7

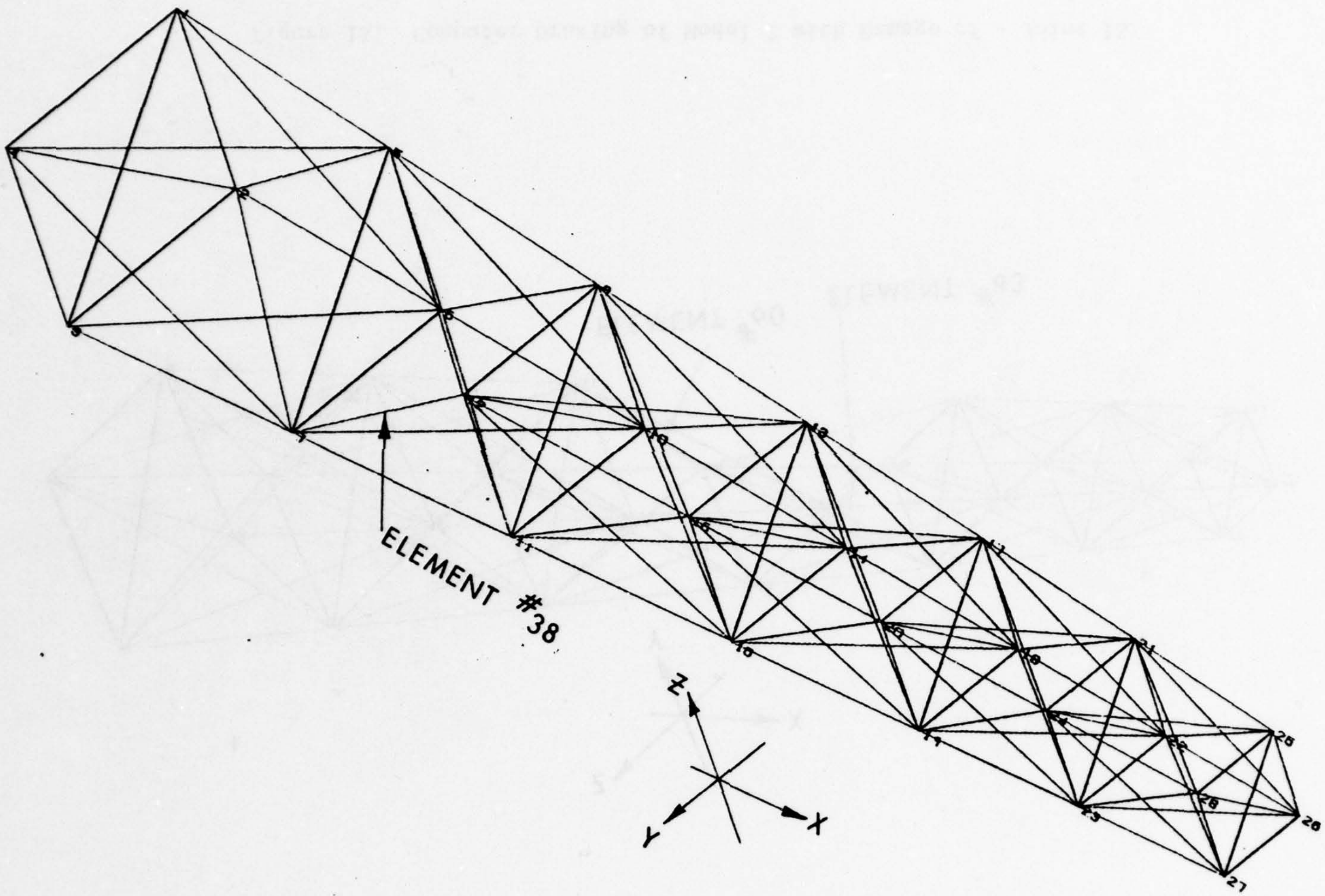

Figure 12. Computer Drawing of Model 2 with Damage of - Joint 8

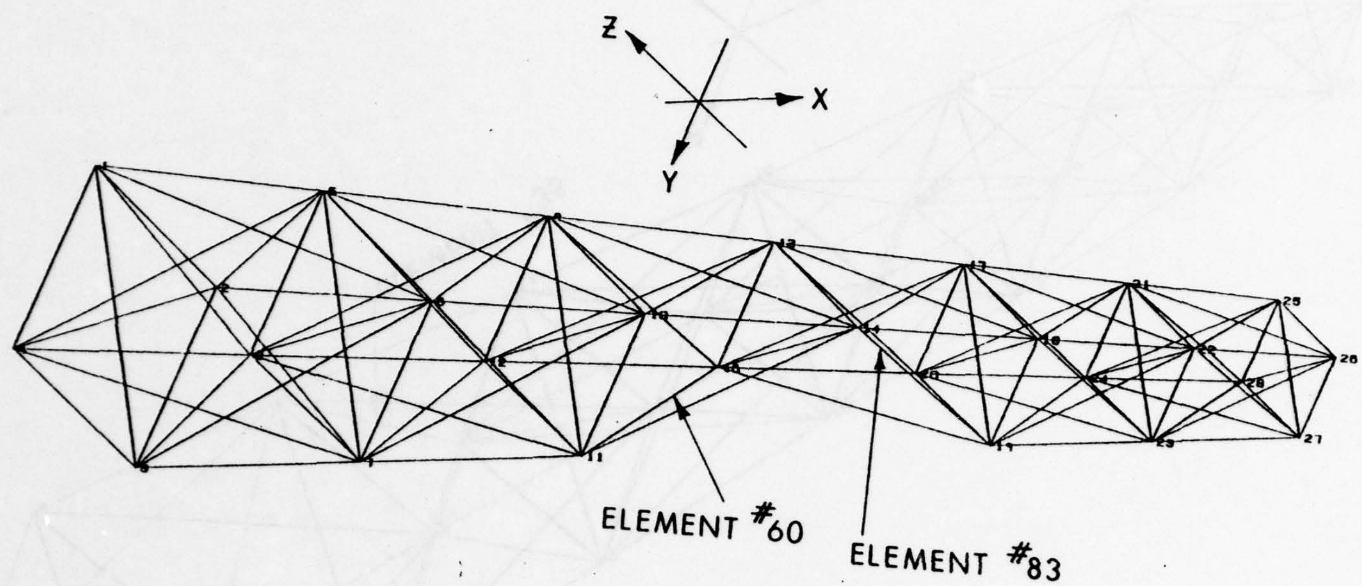

Figure 13. Computer Drawing of Model 2 with Damage of - Joint 15

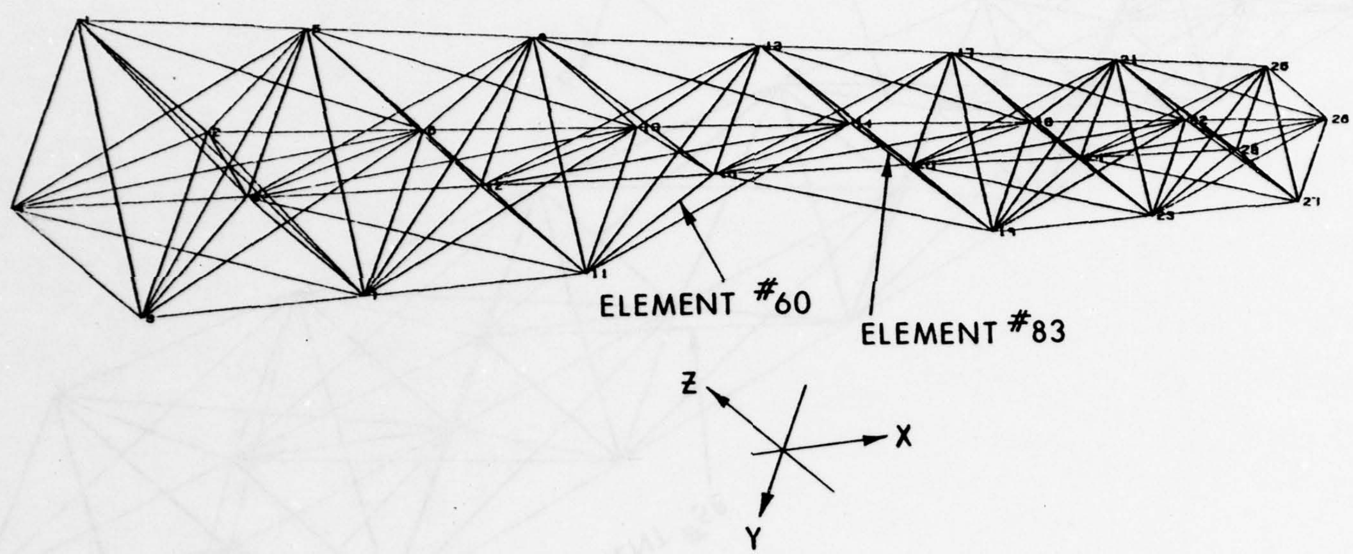

Figure 14. Computer Drawing of Model 3 with Damage of - Joint 15

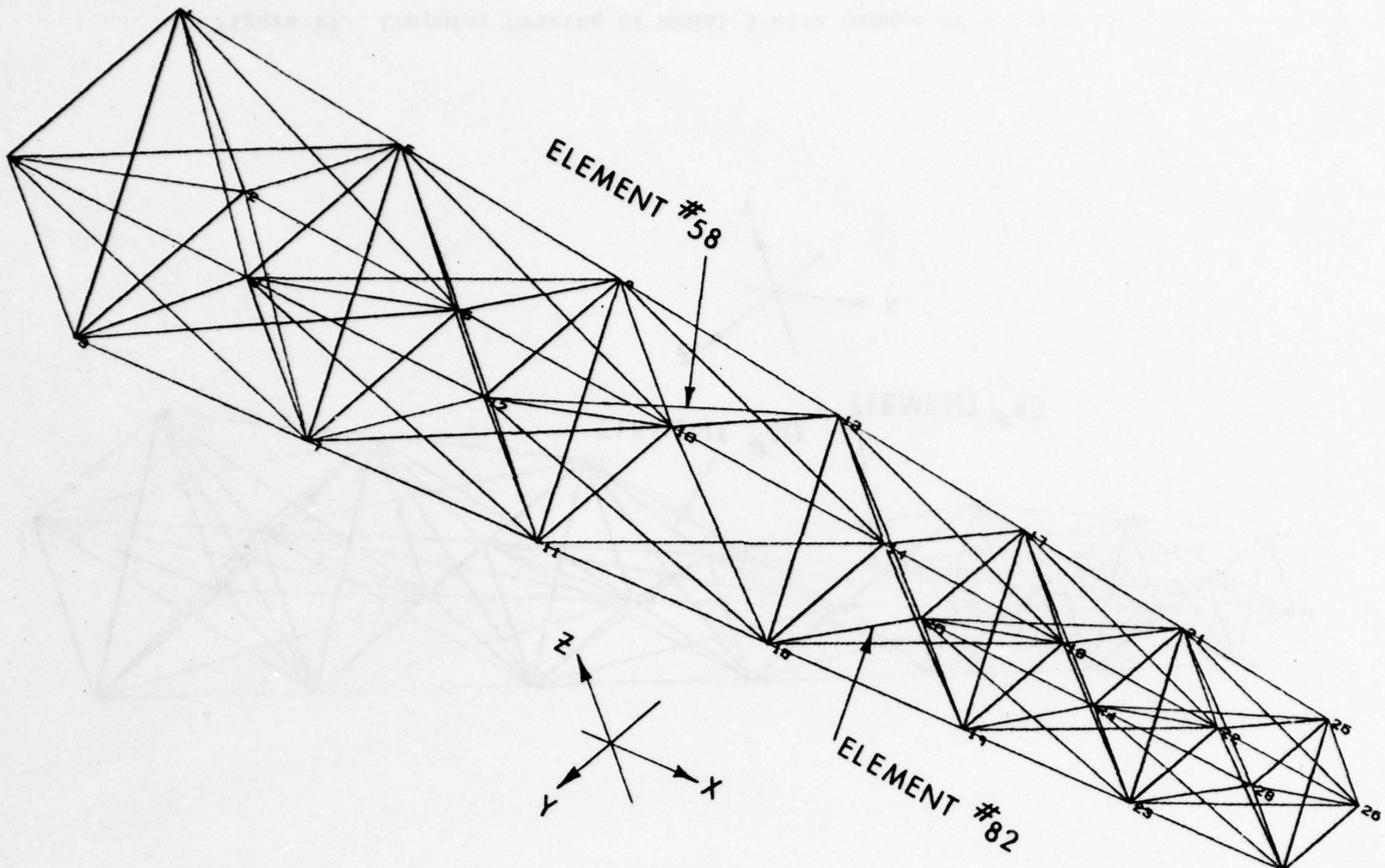

Figure 15. Computer Drawing of Model 2 with Damage of - Joint 16

TABLE 7

Compressive Margins of Safety Under 10.0 Due to 130 knot Flight Load on Forward Vertical Sta with 100% Loading

DAMAGE MODEL 1 MEMBER	J-J	No#	None	Joint 5	Joint 6	Joint 7	Joint 8
Long.	1-5	7	T	D	T	T	T
"	2-6	8		T	D	4.3	
"	3-7	9	6.7	2.7	6.4	D	5.5
"	4-8	10	T	T	T		D
O.D.	1-6	11			D	4.8	
"	2-5	12	T	D	T	T	T
"	1-8	13	T	T	T	T	D
"	4-5	14		D		T	6.6
"	4-7	15	T	T	T	D	T
"	3-8	16	5.1	6.9	5.1	2.2	D
"	2-7	17	4.5	3.2	3.3	D	3.4
"	3-6	18	T	T	D	T	T
I.D.	1-7	19	T	T		D	T
"	2-8	20		T		7.6	D
"	3-5	21		D	T		6.9
"	4-6	22	T		T	T	T
T.V.	5-6	23		D	D		
T.H.	5-8	24		D			D
T.V.	7-8	25	T	T	T	D	D
T.H.	6-7	26	T	T	D	D	T
T.D.	5-7	27		D	T	D	
"	6-8	28		3.7	D	T	D
Long.	5-9	29	T	D	T	T	T
"	6-10	30	T	T	D		
"	7-11	31	8.1	3.7	5.3	D	
"	8-12	32	T	T	T	8.4	D
O.D.	5-10	33		D	5.6		
"	6-9	34	T	T	D	T	T
"	5-12	35	T	D	T	T	T
"	8-9	36				5.1	D
"	8-11	37	T	T	T	T	D
"	7-12	38	5.3	3.3	3.8	D	4.1
"	6-11	39	6.2	9.3	D	2.6	5.4
"	7-10	40	T	T	T	D	T
I.D.	5-11	41	T	D	10.		T
"	6-12	42		T	D	9.7	
"	8-10	44	T		T	T	D

TABLE 8

Compressive Margins of Safety Under 10.0 Due to 130 knot Flight Load on Middle Vertical Sta with 100% Loading

DAMAGE MODEL 1 MEMBER	J-J	No#	None	Joint 21	Joint 22	Joint 23	Joint 24
Long.	17-21	95	T	D	T	T	T
"	18-22	96	T	T	D		T
"	19-23	97		10.		D	8.6
"	20-24	98					D
O.D.	17-22	99			D	8.9	
"	18-21	100	T	D	T	T	T
"	17-24	101	T	T	T	T	D
"	20-21	102		D			5.5
"	20-23	103	T	T	T	D	T
"	19-24	104	7.1	7.3	5.6	3.8	D
"	18-23	105		7.5	8.6	D	6.0
"	19-22	106	T	T	D	T	T
I.D.	17-23	107	T			D	T
"	18-24	108		T			D
"	19-21	109	T	D	T	T	
"	20-22	110	T		D	T	T
T.V.	21-22	111		D	D		
T.H.	21-24	112		D	T		D
T.V.	23-24	113	T	T	T	D	D
T.H.	22-23	114		T	D	D	
T.D.	21-23	115		D		D	T
"	22-24	116			D	T	D
Long.	21-25	117	T	D	T	T	
"	22-26	118	T	T	D	T	T
"	23-27	119				D	
"	24-28	120		T			D
O.D.	21-26	121		D	9.9		9.2
"	22-25	122	T	T	D	T	T
"	21-28	123	T	D	T	T	T
"	24-25	124			9.6	7.7	D
"	24-27	125	T	T	T	T	D
"	23-28	126	8.8	6.6	8.3	D	5.0
"	22-27	127			D	5.5	
"	23-26	128	T	T	T	D	T
I.D.	21-27	129		D			T
"	22-28	1-0	T	T	D		
"	23-25	131		T	T	D	
"	24-26	132	T		T	T	D

TABLE 9
Compressive Margins of Safety Under 10.0 Due to 130 knot
Flight Load on End Vertical Sta with 100% Loading

DAMAGE MODEL 1 MEMBER	J-J	No#	None	Joint 37	Joint 38	Joint 39	Joint 40
Long.	33-37	183	T	D	T	T	T
"		184	T	T	D		T
"		185			T	D	
"		186					D
O.D.		187			D		
"		188	T	D	T	T	T
"		189	T	T	T	T	D
"		190		D			8.0
"		191	T	T	T	D	T
"		192	7.2	7.8	5.6	4.0	D
"		193				D	8.9
"		194	T	T	D	T	T
I.D.		195		T		D	T
"		196		T	T		D
"		197	T	D	T		
"		198	T		D	T	
T.V.		199		D	D		
T.H.		200		D	T		D
T.V.		201	T	T	T	D	D
T.H.		202	T	T	D	D	T
T.[illegible]		203	T	D		D	T
T.[illegible]		204			D	T	D
Long.		205	T	D	T	T	T
"		206	T	T	D	T	T
"		207				D	
"		208		T			D
O.D.		209		D			
"		210	T	T	D	T	T
"		211	T	D	T	T	T
"		212				9.4	D
"		213	T	T	T	T	D
"		214		8.1		D	5.9
"		215			D	7.3	
"		216	T	T	T	D	T
I.D.		217		D			T
"		218	T	T	D		
"		219		T	T	D	
"		220	T		T	T	D

TABLE 10
Compressive Margins of Safety Under 10.0 Due to 130 knot
Flight Load on Forward Vertical Sta with 100% Loading
for Models 2 and 3

DAMAGE			None		Joint 5		Joint 6		Joint 7		Joint 8	
MODEL			2	3	2	3	2	3	2	3	2	3
MEMBER	J-J	No.#										
Long.	1-5	7	T	T	D	D	T	T	T	T	T	T
"	2-6	8			T	T	D	D	2.0	2.3		
"	3-7	9	3.6	3.6	1.4	1.3	4.1	4.1	D	D	1.9	2.2
"	4-8	10	T	T	T	T	T	T			D	D
O.D.	1-6	11		8.0	8.4	10.	D	D	2.8	2.2		7.1
"	2-5	12	T	T	D	D	T	T	T	T	T	T
"	1-8	13	T	T	T	T	T	T	T	T	D	D
"	4-5	14			D	D	8.7	7.6	T	T	1.6	3.0
"	4-7	15	T	T	T	T	T	T	D	D	T	T
"	3-8	16	2.0	2.2	2.8	2.6	2.3	2.3	.36	.71	D	D
"	2-7	17	2.0	2.0	1.5	1.3	1.2	1.4	D	D	1.5	1.2
"	3-6	18	T	T	T	T	D	D	T	T	T	T
I.D.	1-7	19	-	T	-	T	-		-	D	-	T
"	2-8	20	-		-	T	-		-	3.2	-	D
"	3-5	21	-		-	D	-	T	-		-	3.7
"	4-6	22	-	T	-		-	D	-	T	-	T
T.V.	5-6	23			D	D	D	D				
T.H.	5-8	24			D	D					D	D
T.V.	7-8	25	T	T	T	T	T	T	D	D	D	D
T.H.	6-7	26	T	T	T	T	D	D	D	D	T	T
T.D.	5-7	27	T		D	D	T	T	D	D		
"	6-8	28			4.0	3.5	D	D	T	T	D	D
Long.	5-9	29	T	T	D	D	T	T	T	T	T	T
"	6-10	30	T	T	T	T	D	D				T
"	7-11	31	4.4	4.4	1.8	1.8	1.9	2.2	D	D		8.5
"	8-12	32			T	T	T		2.5	3.1	D	D
O.D.	5-10	33	8.6	7.0	D	D	1.6	2.4	T		6.9	4.9
"	6-9	34	T	T	T	T	D	D	T	T		T
"	5-12	35	T	T	D	D	T	T	T	T	T	T
"	8-9	36	6.0	5.7	3.7	5.6		5.7	2.2	1.9	D	D
"	8-11	37	T	T.	T	T	T	T	T	T	D	D
"	7-12	38	1.7	1.9	1.3	1.1	1.2	1.1	D	D	.81	1.2
"	6-11	39	2.3	2.3	3.1	2.6	D	D	.44	.79	2.6	2.1
"	7-10	40	T	T	T	T	T	T	D	D	T	T
I.D.	5-11	41	-	T	-	D	-	5.1	-	T	-	T
"	6-12	42	-		-	T	-	D	-	3.0	-	
"	7-9	43	-		-		-	T	-	D	-	7.5
"	8-10	44	-	T	-		-	T	-	T	-	D

TABLE 11
Compressive Margins of Safety Under 10.0 Due to 130 knot
Flight Load on Middle Vertical Sta with 100% Loading
for Models 2 and 3

DAMAGE			None		Joint 13		Joint 14		Joint 15		Joint 16	
MODEL			2	3	2	3	2	3	2	3	2	3
MEMBER	J-J	No.#										
Long.	9-13	51	T	T	D	D	T	T	T	T	T	T
"	10-14	52	T	T	T	T	D	D	5.1	7.5	T	T
"	11-15	53	6.2	6.2	3.0	3.0	T	T	D	D	1.5	1.9
"	12-16	54			7.6	8.5	5.6	6.1			D	D
O.D.	9-14	55	7.0	5.6	2.5	3.7	D	D	2.9	2.2	T	8.4
"	10-13	56	T	T	D	D	T	T	T	T	T	T
"	9-16	57	T	T	T	T	T	T	T	T	D	D
"	12-13	58	3.5	3.4	D	D	3.8	3.0	10.	4.7	.62	1.1
"	12-15	59	T	T	T	T	T	T	D	D	T	T
"	11-16	60	1.3	1.5	1.3	1.2	1.3	1.2	.24	.56	D	D
"	10-15	61	2.3	2.3	2.2	1.7	1.2	1.7	D	D	1.2	1.0
"	11-14	62	T	T	T	T	D	D	T	T	T	T
I.D.	9-15	63	-	T	-	T	-		-	D	-	T
"	10-16	64	-		-	T	-		-	3.2	-	D
"	11-13	65	-		-	D	-	T	-		-	2.9
"	12-14	66	-	T	-		-	D	-	T	-	T
T.V.	13-14	67			D	D	D	D				
T.H.	13-16	68			D	D	T	T			D	D
T.V.	15-16	69	T	T	T	T	T	T	D	D	D	D
T.H.	14-15	70	T	T	T	T	D	D	D	D		
T.D.	13-15	71			D	D			D	D	T	T
"	14-16	72					D	D	T	T	D	D
Long.	13-17	73	T	T	D	D	T	T	T	T		
"	14-18	74	T	T	T	T	D	D	T	T	T	T
"	15-19	75	9.8	9.9	4.8	4.9	4.7	5.7	D	D		
"	16-20	76			T	T	5.9	5.8	2.6	3.1	D	D
O.D.	13-18	77	5.4	5.4	D	D	1.7	2.9		7.2	3.2	2.8
"	14-17	78	T	T	T	T	D	D	T	T	T	T
"	13-20	79	T	T	D	D	T	T	T	T	T	T
"	16-17	80	4.0	3.9	2.1	2.9	4.8	3.0	2.2	1.9	D	D
"	16-19	81	T	T	T	T	T	T	T	T	D	D
"	15-20	82	2.3	2.3	2.3	1.8	2.1	1.7	D	D	.87	1.2
"	14-19	83	3.3	3.4	3.3	2.8	D	D	.82	1.3	5.5	4.1
"	15-18	84	T	T	T	T	T	T	D	D	T	T
T.D.	13-19	85	-		-	D	-	5.9	-		-	T
"	14-20	86	-		-	T	-	D	-	4.2	-	
"	15-17	87	-	T	-	T	-	T	-	D	-	7.3
"	16-18	88	-	T	-		-	T	-	T	-	D

TABLE 12
Compressive Margins of Safety Under 10.0 Due to 130 knot Flight Load on End Vertical Sta with 100% Loading for Models 2 and 3

DAMAGE			None		Joint 21		Joint 22		Joint 23		Joint 24	
MODEL			2	3	2	3	2	3	2	3	2	3
MEMBER	J-J	No#										
Long.	17-21	95	T	T	D	D	T	T	T	T	T	T
"	18-22	96	T	T	T	T	D	D			T	T
"	19-23	97			5.4	5.6	T	T	D	D	3.2	3.7
"	20-24	98			7.8	9.1	6.6	6.8			D	D
O.D.	17-22	99	6.5	6.5	2.6	4.1	D	D	3.6	3.2		9.1
"	18-21	100	T	T	D	D	T	T	T	T	T	T
"	17-24	101	T	T	T	T	T	T	T	T	D	D
"	20-21	102	5.1	4.9	D	D	5.0	4.1	6.5	6.5	1.4	2.0
"	20-23	103	T	T	T	T	T	T	D	D	T	T
"	19-24	104	2.9	2.9	2.9	2.4	3.0	2.4	1.1	1.5	D	D
"	18-23	105	4.2	4.3	4.1	3.1	2.3	3.3	D	D	2.5	2.2
"	19-22	106	T	T	T	T	D	D	T	T	T	T
I.D.	17-23	107	-		-		-	10.	-	D	-	T
"	18-24	108	-		-	T	-		-	6.7	-	D
"	19-21	109	-	T	-	D	-	T	-	T	-	6.1
"	20-22	110	-	T	-	9.6	-	D	-	T	-	T
T.V.	21-22	111			D	D	D	D				
T.H.	21-24	112			D	D	T	T			D	D
T.V.	23-24	113	T	T	T	T	T	T	D	D	D	D
T.H.	22-23	114			T	T	D	D	D	D		
T.D.	21-23	115		T	D	D			D	D	T	T
T.D.	22-24	116	T				D	D	T	T	D	D
Long.	21-25	117	T	T	D	D	T	T	T	T		
"	22-26	118	T	T	T	T	D	D	T	T	T	T
"	23-27	119			6.7	7.1	5.6	7.4	D	D		
"	24-28	120			T	T	7.8	7.3	3.4	3.9	D	D
O.D.	21-26	121	7.3	7.2	D	D	2.4	4.0			4.1	3.7
"	22-25	122	T	T	T	T	D	D	T	T	T	T
"	21-28	123	T	T	D	D	T	T	T	T	T	T
"	24-25	124	5.0	4.8	2.9	4.0	6.0	3.7	2.9	2.4	D	D
"	24-27	125	T	T	T	T	T	T	T	T	D	D
"	23-28	126	3.1	3.1	2.9	2.3	2.8	2.3	D	D	1.2	1.6
"	22-27	127	4.2	4.4	4.3	3.7	D	D	1.2	1.9	7.4	5.6
"	23-26	128	T	T	T	T	T	T	D	D	T	T
I.D.	21-27	129	-		-	D	-	6.2	-		-	T
"	22-28	130	-	T	-	T	-	D	-	6.3	-	
"	23-25	131	-		-	T	-	T	-	D	-	8.0
"	24-26	132	-	T	-		-	T	-	T	-	D

TABLE 13

Cases of Models 2 and 3 Where M.S. Less Than 1.0

Loading	Element #	J-J	Model 2 M.S.	Model 3 M.S.
Case Where Damage is - Joint 7				
100%	16	3-8	.36	.71
	39	6-11	.44	.79
75%	16	3-8	.82	1.3
	39	6-11	.94	1.4
Case Where Damage is - Joint 8				
100%	38	7-12	.81	1.2
Case Where Damage is - Joint 15				
100%	60	11-16	.24	.56
	83	14-19	.82	1.3
75%	60	11-16	.66	1.1
Case Where Damage is - Joint 16				
100%	58	12-13	.62	1.1
	82	15-20	.87	1.2

3.3 Natural Frequencies

All structures have resonant frequencies. It is important to know these natural frequencies. To find these frequencies NASTRAN has an eigenvalue method, known as rigid format 3 Normal Modes and Frequencies, for extracting a model's natural frequencies. The first three natural frequencies of each complete structure are found with direction. Table 14 lists the frequencies of each model plus the figure that shows the mode shape.

TABLE 14

NATURAL FREQUENCIES

Model 1		
15.67 Hz	FUNDAMENTAL Y	Figure 16 First Mode Shape
16.63 Hz	FUNDAMENTAL Z	Figure 17 Second Mode Shape
76.41 Hz	1st HARMONIC Y	Figure 18 Third Mode Shape
Model 2		
21.62 Hz	FUNDAMENTAL Y	Figure 19 First Mode Shape
22.92 Hz	FUNDAMENTAL Z	Figure 20 Second Mode Shape
88.44 Hz	1st HARMONIC Y	Figure 21 Third Mode Shape
Model 3		
19.30 Hz	FUNDAMENTAL Y	Figure 22 First Mode Shape
20.48 Hz	FUNDAMENTAL Z	Figure 23 Second Mode Shape
77.70 Hz	1st HARMONIC Y	Figure 24 Third Mode Shape

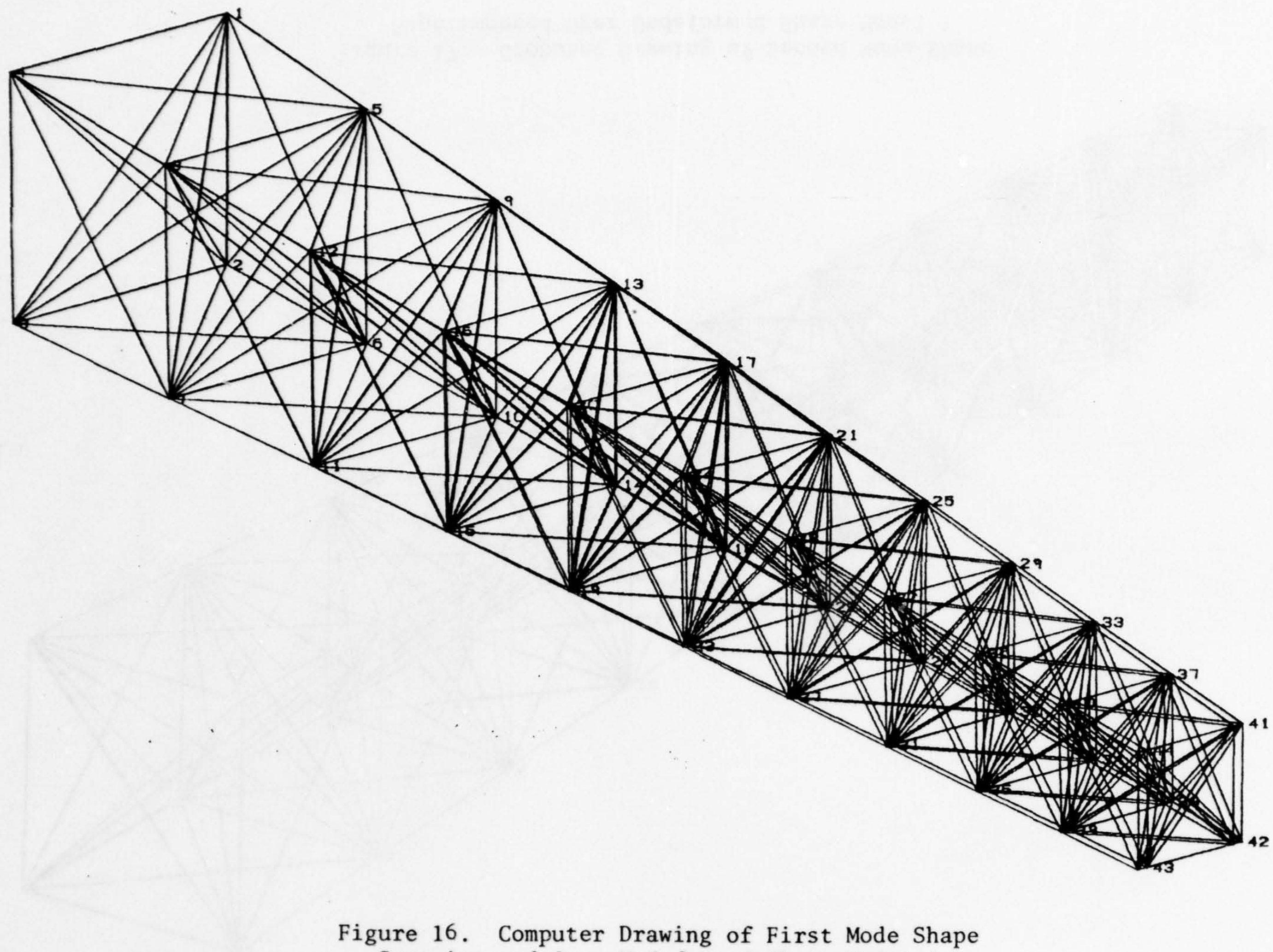

Figure 16. Computer Drawing of First Mode Shape
Superimposed Over Undeformed Shape Model 1

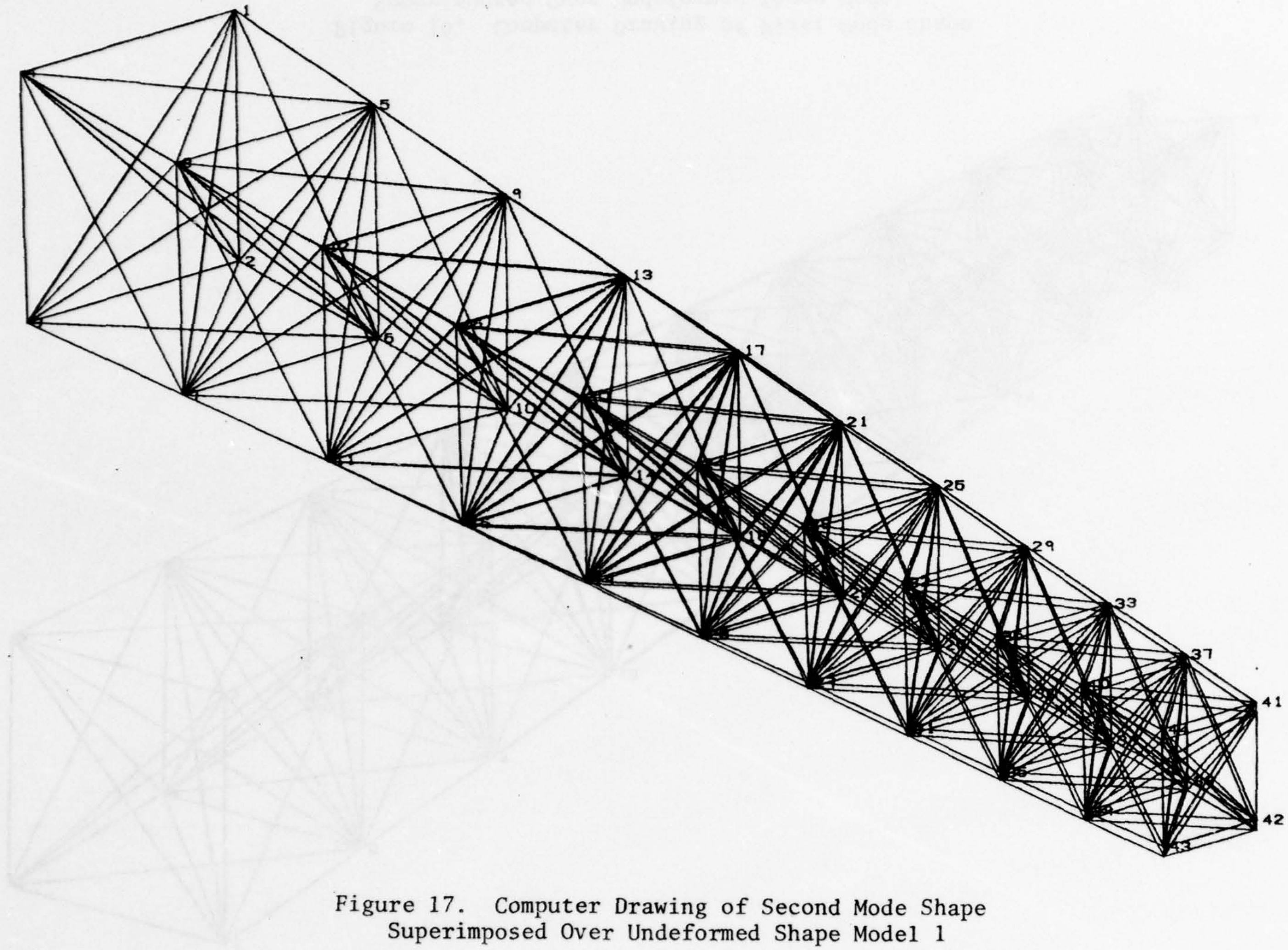

Figure 17. Computer Drawing of Second Mode Shape Superimposed Over Undeformed Shape Model 1

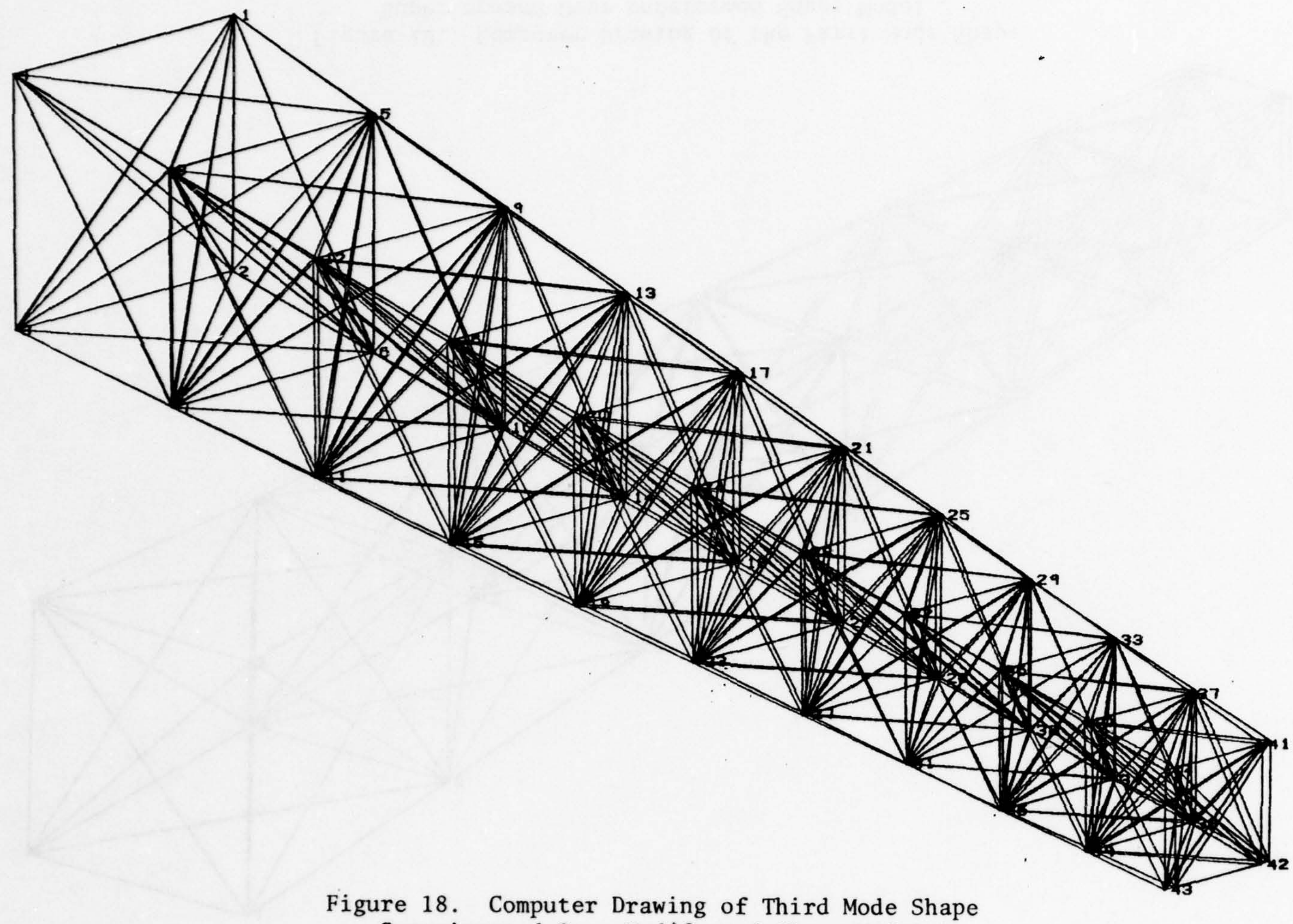

Figure 18. Computer Drawing of Third Mode Shape
Superimposed Over Undeformed Shape Model 1

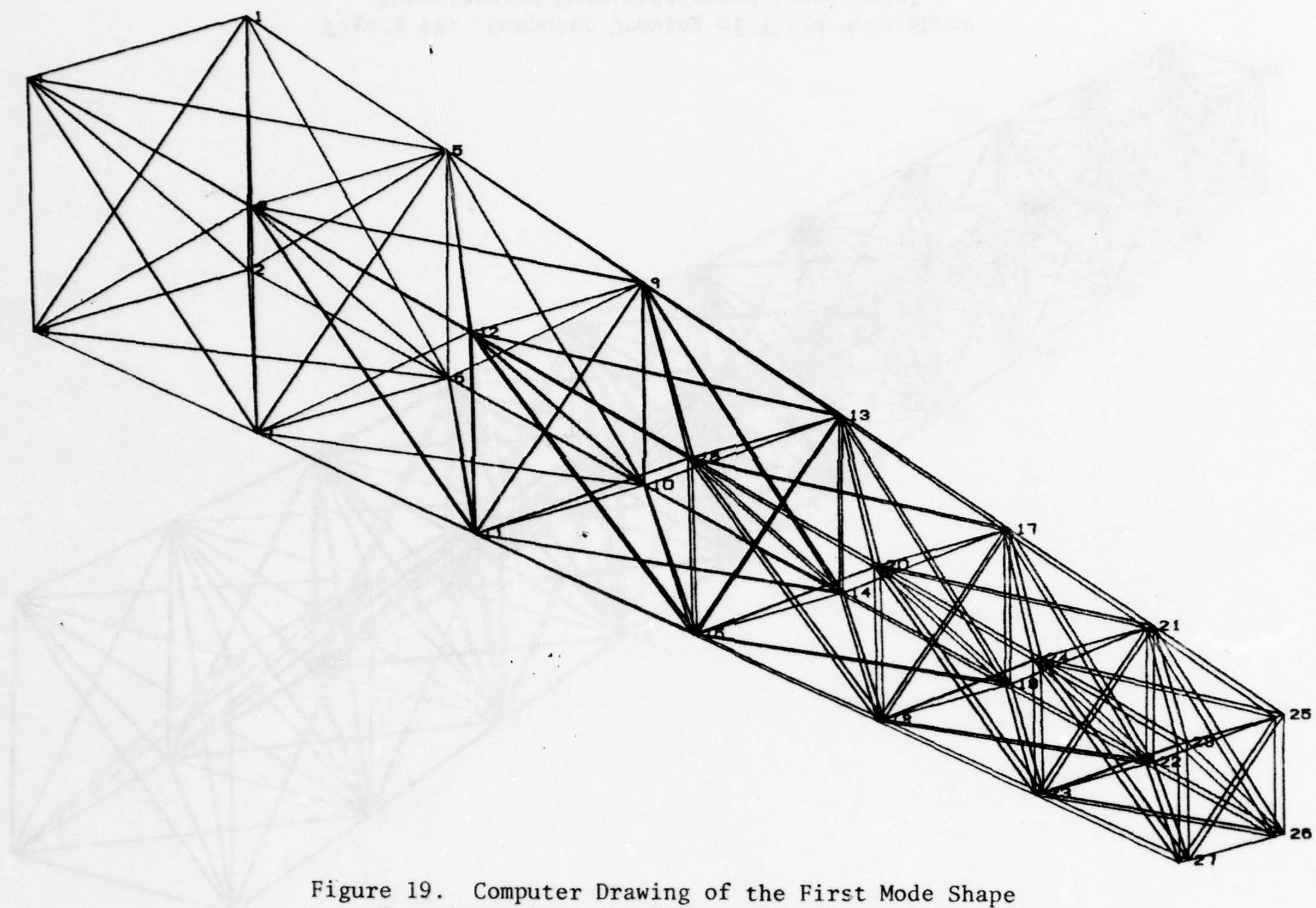

Figure 19. Computer Drawing of the First Mode Shape Superimposed Over Undeformed Shape Model 2

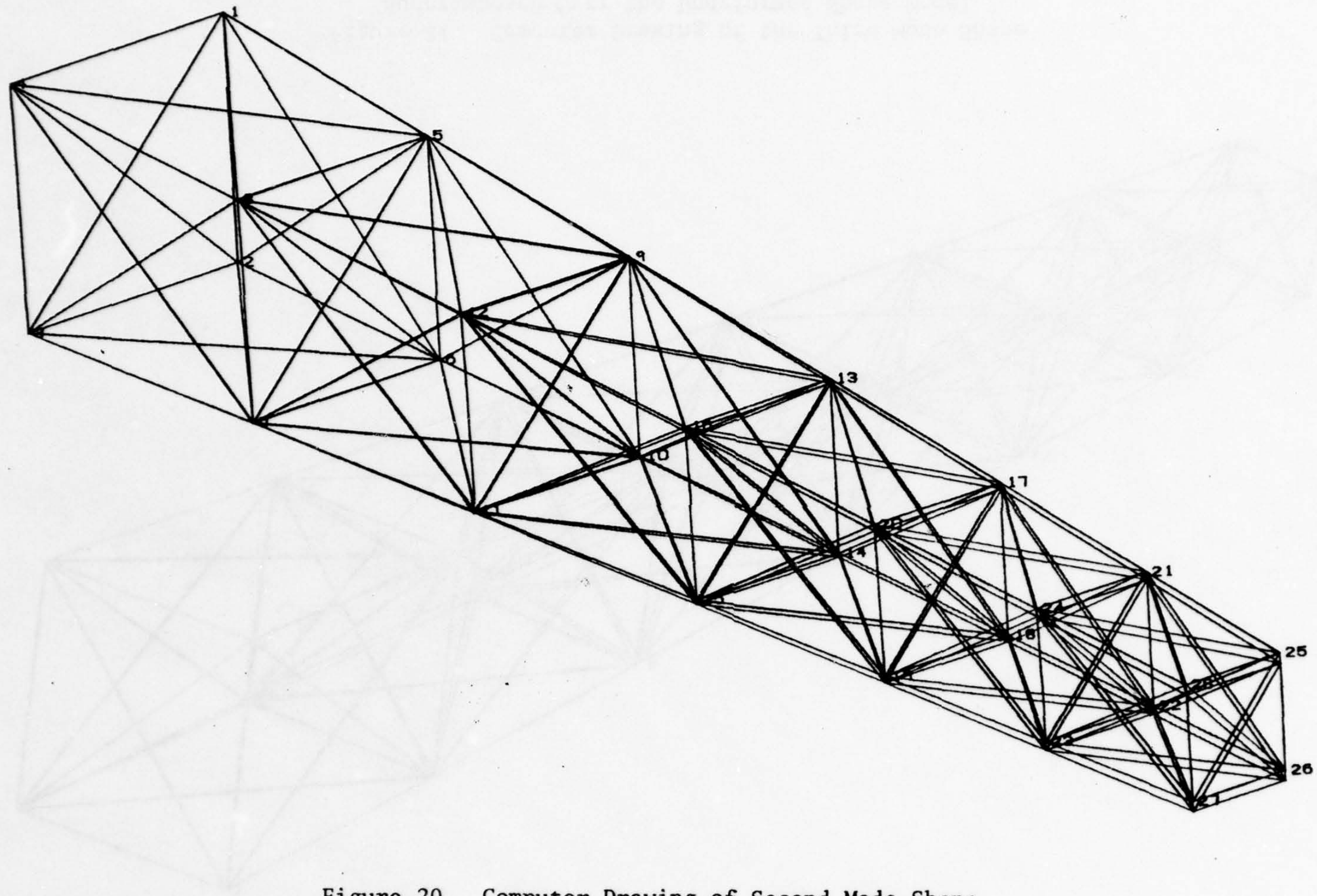

Figure 20. Computer Drawing of Second Mode Shape
Superimposed Over Undeformed Shape Model 2

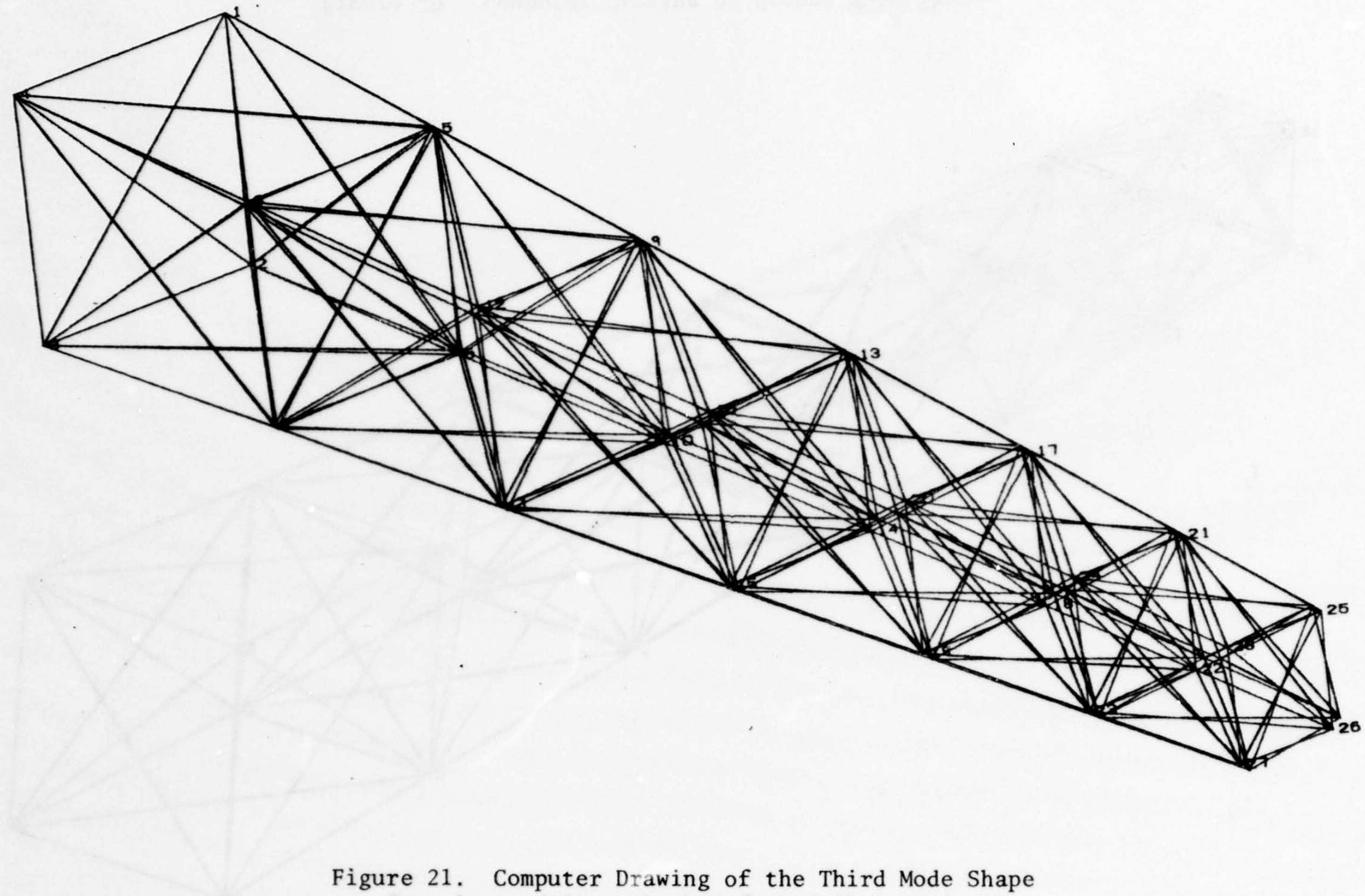

Figure 21. Computer Drawing of the Third Mode Shape
Superimposed Over the Undeformed Shape Model 2

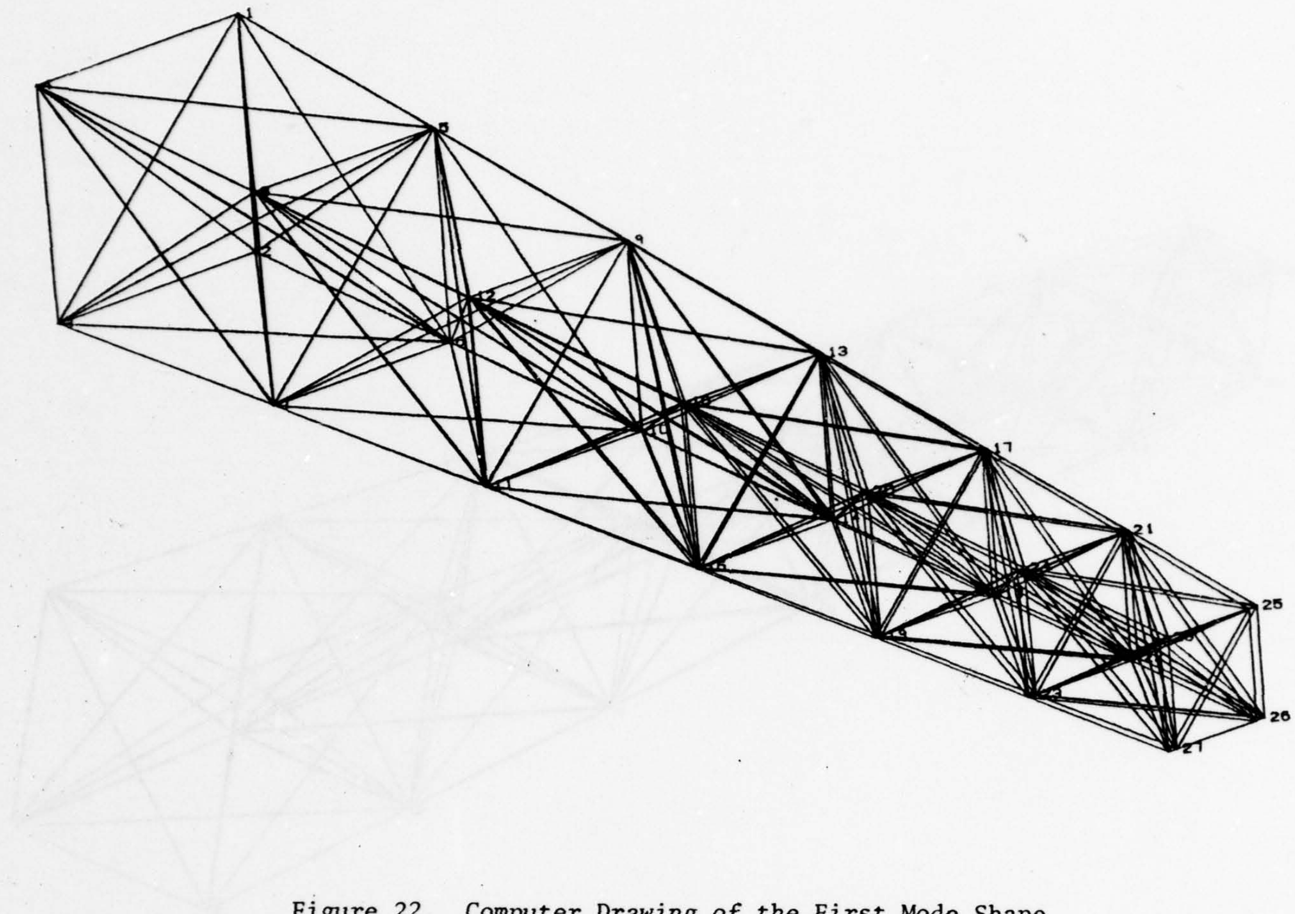

Figure 22. Computer Drawing of the First Mode Shape
Superimposed Over Undeformed Shape Model 3

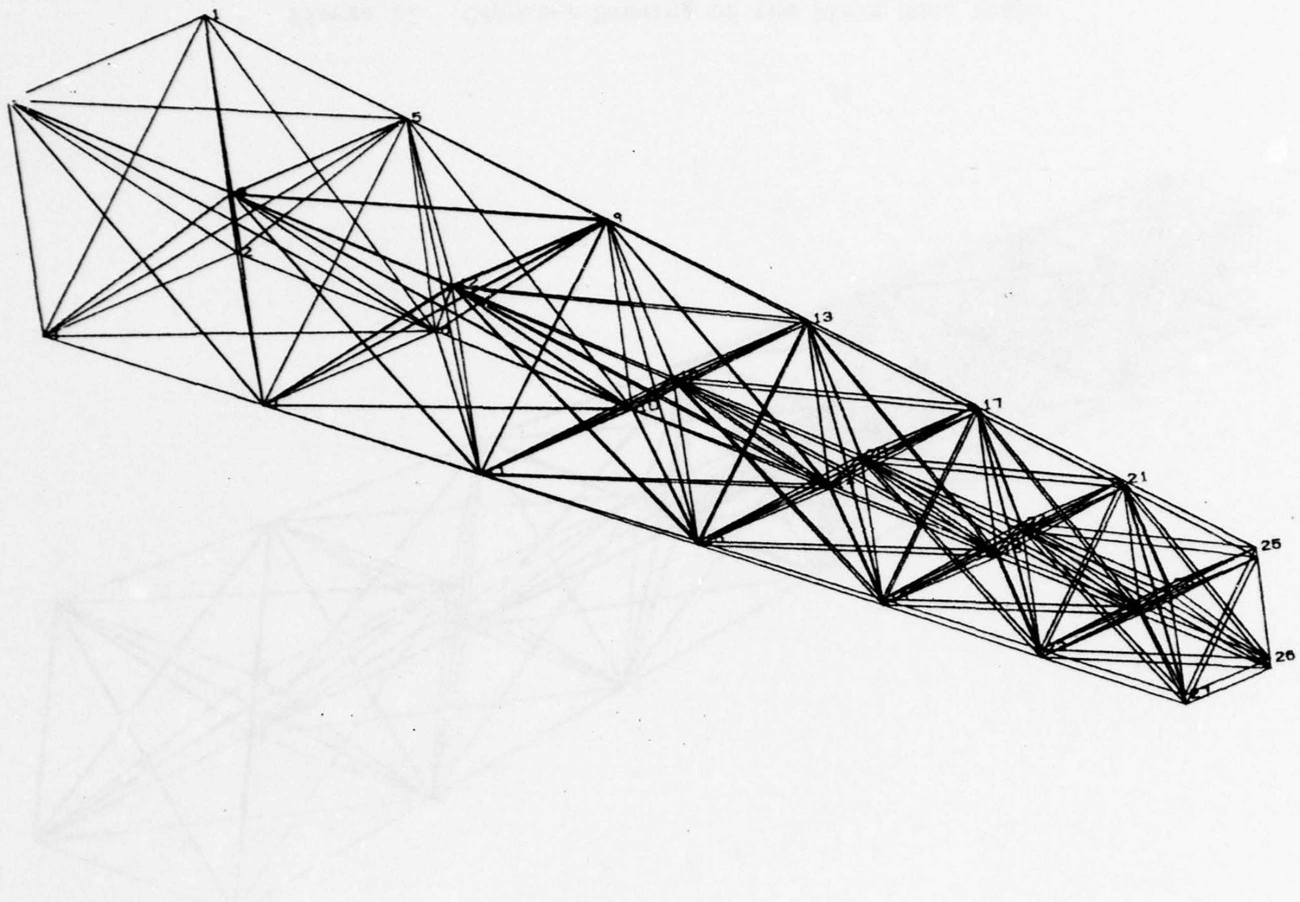

Figure 23. Computer Drawing of Second Mode Shape
Superimposed Over Undeformed Shape Model 3

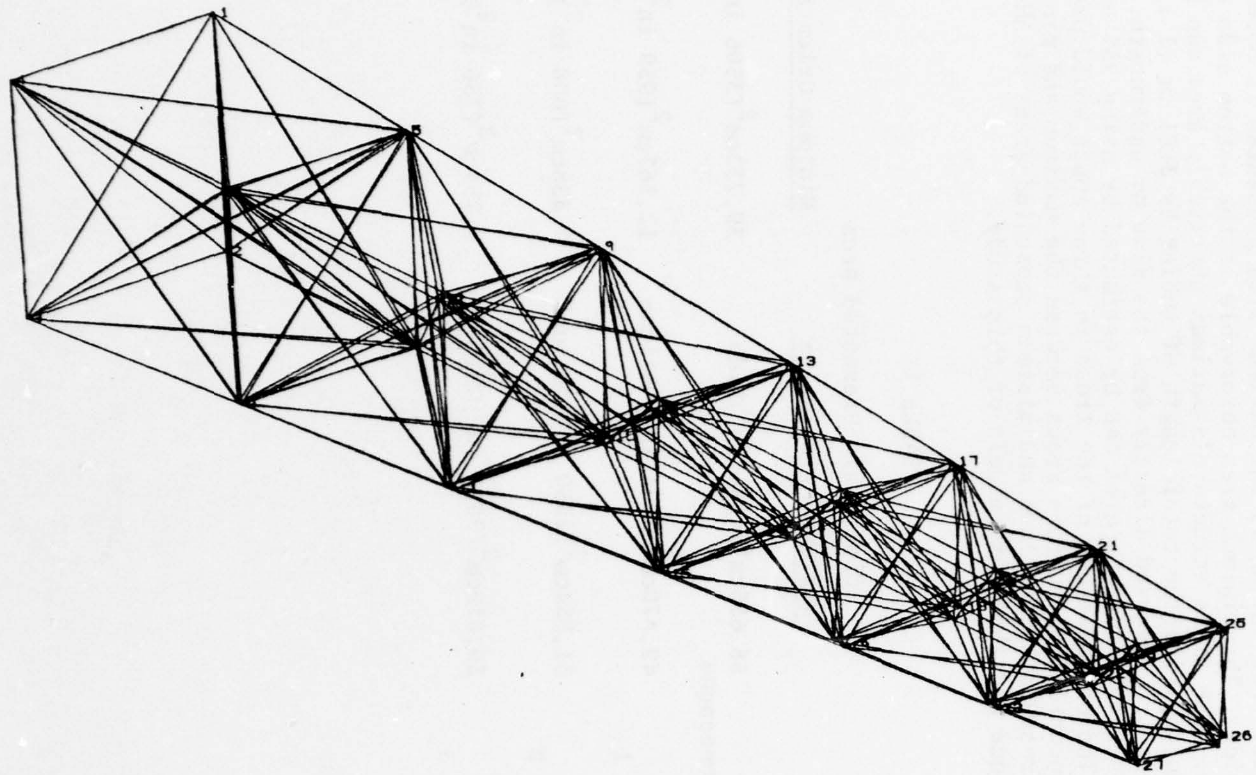

Figure 24. Computer Drawing of the Third Mode Shape Superimposed Over Undeformed Shape Model 3

3.4 Observable Surface Area

The semimonocoque surface area observed can be considered flat and can be easily calculated by the area of the quadrilateral that presents itself. For the AH-1G the maximum area presented is observed from the side. The minimum area observable is the bottom side directly underneath. The truss structure's maximum observable area can be estimated by multiplying the total length of tubing by 3.81 cm (1 1/2 in). The minimums are observed directly from the side or underneath. The minimum observable surface area can be estimated by using 25% of the maximum. The orientations of the truss in three space would present varying noncontinuous surface areas between the maximum and minimum. Table 15 presents the maximum and minimum presented areas of AH-1G semimonocoque and the truss models of this study.

TABLE 15

Observable Presented Area

	Maximum Orientation	Minimum Orientation
AH-1G Semimonocoque	58,655cm^2(4546 in^2)Side	39,233cm^2(3506 in^2)Bottom
Truss Model 1	49,470cm^2(3834 in^2)Oblique	12,367cm^2(959 in^2)Side
Truss Model 2	31,354cm^2(2430 in^2)Oblique	7,838cm^2(608 in^2)Side
Truss Model 3	39,019cm^2(3024 in^2)Oblique	9,754cm^2(756 in^2)Side

IV. DISCUSSION

The complete semimonocoque tail boom structure weighs approximately 90.72 kg (200 lbs), reference 4, and its deflections due to 130 knot level flight load are 1.37 cm (.539 in) in y direction and .37 cm (.146 in) in the z direction, reference 12. As indicated in Table 3, the maximum displacements for each maximum loading case of the truss models show only a slight difference between the models. Comparing the complete truss models with the complete semimonocoque structure shows the stiffness of the truss models to be 12% greater in the y direction, and 46% less in the z direction. Considering the weight difference between the truss models and the semimonocoque structure, the stiffness of the truss models is reasonably competitive. Table 3 shows that the maximum increase in displacement for the y direction is .82 cm which occurs for unsubstructured model 2 when joint 5 is deleted. Table 3 also shows the maximum increase in z direction displacement to be .803 cm more than the undamaged case occurring when joint 7 is deleted in model 2. Damage criteria imposed on the models show model 2 to be the least stiff of the three models.

The displacement results of the three truss models show a truss design to be particularly stiff even when damage conditions are imposed. The "simple" open truss of model 2 shows itself to be light and strong in the undamaged condition. Model 3 with inclusion of interior structural diagonals is more massive, and more stiff than model 2. Model 1 is obviously very dense and stiffer than either model 2 or model 3. Table 14 reveals the stiffness of the undamaged three models. The lower the fundamantal frequencies the closer the model approximates a stiff bar.

The goal of retaining structural integrity after imposition of a massive damage criterion is conceptually assured by the incorporation of complete substructures. The "simple" open truss exhibits the response of a geometrical instability when a joint is deleted. The weight optimizing program does not find supporting structure to transfer the loads that were carried by the missing members of the deleted joint. With the substructure models there is additional structural support for transfer of the load that the missing members carried. The interior diagonals carry bigger loads and redistribute the load path to the remaining structure. The distribution of loads into the interior diagonals raises the confidence of stability of the structure. The structural integrity can be assured in the design stage.

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[12] D. A. Reisdorfer, Tail Boom Vulnerability Reduction Test Program, Report No. 699-099-004, August 1975, Bell Helicopter Company, Fort Worth, Texas 76101.

Application of the flight loads to damage simulated models results in margins of safety that indicate no failure of individual elements. Our assumption of an inherently strong truss structure simulated by model 1 is borne out by Tables 7, 8, and 9 which show not a single margin of safety (M.S.) under 1.0 for model 1 and very few M.S. under 10.0. Since models 2 and 3 are similar except that model 3 is substructured, a direct comparison is made. Note in Tables 10, 11, and 12 the substructured model 3 consistently has the interior diagonals taking on tensile and compressive loads. This shows that the interior diagonals are working. Tables 10, 11, and 12 also indicate how the interior diagonals are redistributing the load path and how much of the load they share. Though no members of model 2 or model 3 failed, Table 13 shows that model 2 has four cases where the M.S. falls under 1.0 and model 3 has 2 cases. To show bending a complete longeron diagonally opposite the damage criteria is chosen. The amount of bending is compared by a ratio of the damage displacements to the displacement of the undamaged model in Tables 6, 7, and 8. From Tables 6, 7, and 8 noted is the response of a large amount of displacement to all models where the loss of joint 5 is encountered, yet from the stress analysis of this damage criterion all the models have M.S. greater than 1.0.

Table 15 shows the maximum and minimum presented areas and orientations. The semimonocoque presents a continuous surface whereas the truss models present noncontinuous surface area. For the maximum, model 1 shows a 16% reduction, model 2 shows a 47% reduction, and model 3 shows a 33% reduction in presented area compared to the semimonocoque. Comparison of the minimum present areas shows model 1 with a 69% reduction, model 2 with a 80% reduction, and model 3 with a 75% reduction. These reductions show a clear reduction in visibility of the truss tail boom relative to the semimonocoque type tail boom.

V. CONCLUSIONS

This study presents two ideas for alternative construction of Army helicopter tail booms. The idea of truss structures for tail booms is not new but conceptualizing a high degree of redundancy for greater damage tolerance is preferable for design of combat aircraft. The idea of imbedded substructures is specifically included for increased confidence in the capability to absorb damage and yet retain structural integrity.

The truss type tail boom models of this study provide a reduction in weight over the present semimonocoque tail boom structure of the AH-1G. The truss models are reasonably stiff structures compared to the semimonocoque structure.

Analyses of the highly redundant truss models under the aerodynamic loads of flight and with imposition of a massive damage criterion show:

- o Substantial retention of stiffness
- o Change of load path that is localized to the neighborhood of damage
- o No failure of elements due to tension or compression
- o Retention of structural integrity

The substructured truss models have more supporting structural elements to redistribute the load and consistently have margins of safety higher than the non-substructured truss model. The substructuring concept has vulnerability reduction built-in. The substructure concept assures a higher degree of confidence in the truss concept to retain structural integrity after imposition of the loss of a joint. The substructured truss models have at least a 16% reduction in presented area compared to the semimonocoque structure. The highly redundant substructured truss type tail boom is a highly survivable structure.

ACKNOWLEDGEMENT

I wish to gratefully acknowledge Dr. Donald F. Haskell for initiating the idea of a truss structure for helicopter tail booms and for his continuing confidence shown and demonstrated in my carrying on the analysis.

A note of appreciation is also extended to Dr. V. B. Venkayya and Dr. Harry S. Schaeffer for my recent instruction in use and understanding of the complex NASTRAN program.

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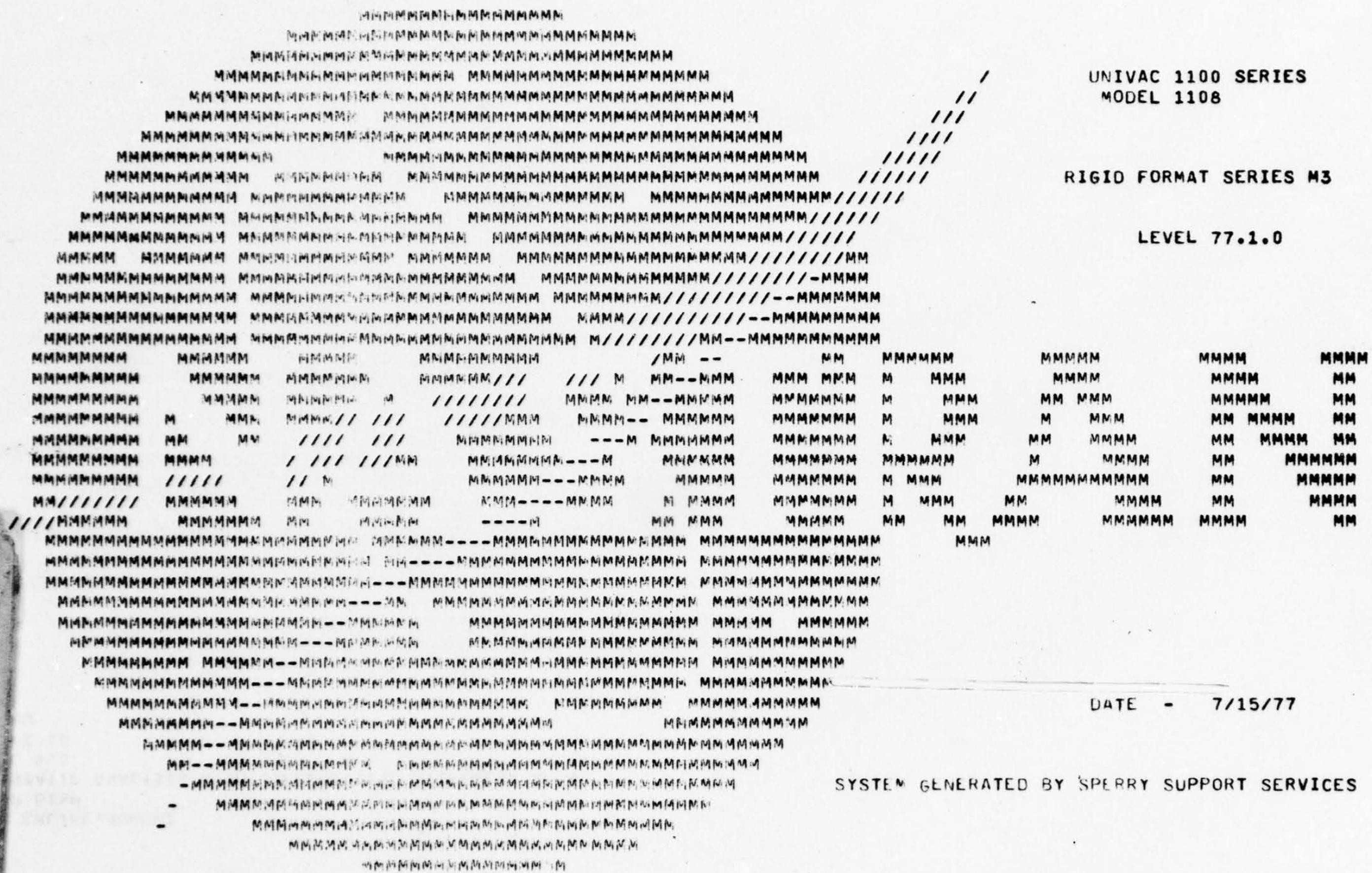
12. D. A. Reisdorfer, Tail Boom Vulnerability Reduction Test Program, Report No. 699-099-004, August 1975, Bell Helicopter Company, Fort Worth, Texas 76101.

APPENDIX A

NASTRAN MATHEMATICAL MODEL OF THE UNDAMAGED TRUSS MODEL 1 PLUS OUTPUT OF DISPLACEMENTS, STRESSES AND MARGINS OF SAFETY DUE TO FLIGHT LOADS.



UNIVAC 1100 SERIES
MODEL 1108

RIGID FORMAT SERIES M3

LEVEL 77.1.0

DATE - 7/15/77

SYSTEM GENERATED BY SPERRY SUPPORT SERVICES

N A S T R A N   E X E C U T I V E   C O N T R O L   D E C K   E C H O

```
ID ERLINE,MODEL1
APP DISP
$ STATIC ANALYSIS WITH DIFFERENTIAL STIFFNESS RF 4
SOL 4,0
TIME 10
CEND
```

C A S E   C O N T R O L   D E C K   E C H O

```
CARD
COUNT
  1      TITLE = TRUSS TAIL BOOM  MODEL1  **A 226 ELEMENT VERSION
  2      SUBTITLE = DAMAGE CRITERION = NONE
  3      OLOAD = ALL
  4      SPC = 10
  5      DISP = ALL
  6      SPCFORCES = ALL
  7      SET 5 = 1 THRU 226
  8          SUBCASE 1
  9          LABEL = LINEAR CASE
 10          LOAD = 11
 11          SUBCASE 2
 12          LABEL = INCREMENTAL STIFFNESS
 13      DSCOEFFICIENT = 200
 14          STRESS = 5
 15      $   METHOD = 15
 16      MAXLINES = 100000
 17      BEGIN BULK
```

*** USER INFORMATION MESSAGE 207, BULK DATA NOT SORTED,XSORT WILL RE-ORDER DECK.

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
1-	CTUBE	1	1	1	2					
2-	CTUBE	2	2	1	4					
3-	CTUBE	3	3	3	4					
4-	CTUBE	4	4	2	3					
5-	CTUBE	5	5	1	3					
6-	CTUBE	6	6	2	4					
7-	CTUBE	7	7	1	5					
8-	CTUBE	8	8	2	6					
9-	CTUBE	9	9	3	7					
10-	CTUBE	10	10	4	8					
11-	CTUBE	11	11	1	6					
12-	CTUBE	12	12	2	5					
13-	CTUBE	13	13	1	8					
14-	CTUBE	14	14	4	5					
15-	CTUBE	15	15	4	7					
16-	CTUBE	16	16	3	8					
17-	CTUBE	17	17	2	7					
18-	CTUBE	18	18	3	6					
19-	CTUBE	19	19	1	7					
20-	CTUBE	20	20	2	8					
21-	CTUBE	21	21	3	5					
22-	CTUBE	22	22	4	6					
23-	CTUBE	23	23	5	6					
24-	CTUBE	24	24	5	8					
25-	CTUBE	25	25	7	8					
26-	CTUBE	26	26	6	7					
27-	CTUBE	27	27	5	7					
28-	CTUBE	28	28	6	8					
29-	CTUBE	29	29	5	9					
30-	CTUBE	30	30	6	10					
31-	CTUBE	31	31	7	11					
32-	CTUBE	32	32	8	12					
33-	CTUBE	33	33	5	10					
34-	CTUBE	34	34	6	9					
35-	CTUBE	35	35	5	12					
36-	CTUBE	36	36	8	9					
37-	CTUBE	37	37	6	11					
38-	CTUBE	38	38	7	12					
39-	CTUBE	39	39	6	11					
40-	CTUBE	40	40	7	10					
41-	CTUBE	41	41	5	11					
42-	CTUBE	42	42	6	12					
43-	CTUBE	43	43	7	9					
44-	CTUBE	44	44	8	10					
45-	CTUBE	45	45	9	10					

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 .. 7 .. 8 .. 9 .. 10 .
46-	CTUBE	46	46	9	12	
47-	CTUBE	47	47	11	12	
48-	CTUBE	48	48	10	11	
49-	CTUBE	49	49	9	11	
50-	CTUBE	50	50	10	12	
51-	CTUBE	51	51	9	13	
52-	CTUBE	52	52	10	14	
53-	CTUBE	53	53	11	15	
54-	CTUBE	54	54	12	16	
55-	CTUBE	55	55	9	14	
56-	CTUBE	56	56	10	13	
57-	CTUBE	57	57	9	16	
58-	CTUBE	58	58	12	13	
59-	CTUBE	59	59	12	15	
60-	CTUBE	60	60	11	16	
61-	CTUBE	61	61	10	15	
62-	CTUBE	62	62	11	14	
63-	CTUBE	63	63	9	15	
64-	CTUBE	64	64	10	16	
65-	CTUBE	65	65	11	13	
66-	CTUBE	66	66	12	14	
67-	CTUBE	67	67	13	14	
68-	CTUBE	68	68	13	16	
69-	CTUBE	69	69	15	16	
70-	CTUBE	70	70	14	15	
71-	CTUBE	71	71	13	15	
72-	CTUBE	72	72	14	16	
73-	CTUBE	73	73	13	17	
74-	CTUBE	74	74	14	18	
75-	CTUBE	75	75	15	19	
76-	CTUBE	76	76	16	20	
77-	CTUBE	77	77	13	18	
78-	CTUBE	78	78	14	17	
79-	CTUBE	79	79	13	20	
80-	CTUBE	80	80	16	17	
81-	CTUBE	81	81	16	19	
82-	CTUBE	82	82	15	20	
83-	CTUBE	83	83	14	19	
84-	CTUBE	84	84	15	18	
85-	CTUBE	85	85	13	19	
86-	CTUBE	86	86	14	20	
87-	CTUBE	87	87	15	17	
88-	CTUBE	88	88	16	18	
89-	CTUBE	89	89	17	18	
90-	CTUBE	90	90	17	20	

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 5
DAMAGE CRITERION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 .. 7 .. 8 .. 9 .. 10 .
91-	CTUBE	91	91	19	20	
92-	CTUBE	92	92	18	19	
93-	CTUBE	93	93	17	19	
94-	CTUBE	94	94	18	20	
95-	CTUBE	95	95	17	21	
96-	CTUBE	96	96	18	22	
97-	CTUBE	97	97	19	23	
98-	CTUBE	98	98	20	24	
99-	CTUBE	99	99	17	22	
100-	CTUBE	100	100	18	21	
101-	CTUBE	101	101	17	24	
102-	CTUBE	102	102	20	21	
103-	CTUBE	103	103	20	23	
104-	CTUBE	104	104	19	24	
105-	CTUBE	105	105	18	23	
106-	CTUBE	106	106	19	22	
107-	CTUBE	107	107	17	23	
108-	CTUBE	108	108	18	24	
109-	CTUBE	109	109	19	21	
110-	CTUBE	110	110	20	22	
111-	CTUBE	111	111	21	22	
112-	CTUBE	112	112	21	24	
113-	CTUBE	113	113	23	24	
114-	CTUBE	114	114	22	23	
115-	CTUBE	115	115	21	23	
116-	CTUBE	116	116	22	24	
117-	CTUBE	117	117	21	25	
118-	CTUBE	118	118	22	26	
119-	CTUBE	119	119	23	27	
120-	CTUBE	120	120	24	28	
121-	CTUBE	121	121	21	26	
122-	CTUBE	122	122	22	25	
123-	CTUBE	123	123	21	28	
124-	CTUBE	124	124	24	25	
125-	CTUBE	125	125	24	27	
126-	CTUBE	126	126	23	28	
127-	CTUBE	127	127	22	27	
128-	CTUBE	128	128	23	26	
129-	CTUBE	129	129	21	27	
130-	CTUBE	130	130	22	28	
131-	CTUBE	131	131	23	25	
132-	CTUBE	132	132	24	26	
133-	CTUBE	133	133	25	26	
134-	CTUBE	134	134	25	28	
135-	CTUBE	135	135	27	28	

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
136-	CTUBE	136	136	26	27					
137-	CTUBE	137	137	25	27					
138-	CTUBE	138	138	26	28					
139-	CTUBE	139	139	25	29					
140-	CTUBE	140	140	26	30					
141-	CTUBE	141	141	27	31					
142-	CTUBE	142	142	28	32					
143-	CTUBE	143	143	25	30					
144-	CTUBE	144	144	26	29					
145-	CTUBE	145	145	25	32					
146-	CTUBE	146	146	28	29					
147-	CTUBE	147	147	28	31					
148-	CTUBE	148	148	27	32					
149-	CTUBE	149	149	26	31					
150-	CTUBE	150	150	27	30					
151-	CTUBE	151	151	25	31					
152-	CTUBE	152	152	26	32					
153-	CTUBE	153	153	27	29					
154-	CTUBE	154	154	28	30					
155-	CTUBE	155	155	29	30					
156-	CTUBE	156	156	29	32					
157-	CTUBE	157	157	31	32					
158-	CTUBE	158	158	30	31					
159-	CTUBE	159	159	29	31					
160-	CTUBE	160	160	30	32					
161-	CTUBE	161	161	29	33					
162-	CTUBE	162	162	30	34					
163-	CTUBE	163	163	31	35					
164-	CTUBE	164	164	32	36					
165-	CTUBE	165	165	29	34					
166-	CTUBE	166	166	30	33					
167-	CTUBE	167	167	29	36					
168-	CTUBE	168	168	32	33					
169-	CTUBE	169	169	32	35					
170-	CTUBE	170	170	31	36					
171-	CTUBE	171	171	30	35					
172-	CTUBE	172	172	31	34					
173-	CTUBE	173	173	29	35					
174-	CTUBE	174	174	30	36					
175-	CTUBE	175	175	31	33					
176-	CTUBE	176	176	32	34					
177-	CTUBE	177	177	33	34					
178-	CTUBE	178	178	33	36					
179-	CTUBE	179	179	35	36					
180-	CTUBE	180	180	34	35					

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
181-	CTUBE	181	181	33	35					
182-	CTUBE	182	182	34	36					
183-	CTUBE	183	183	33	37					
184-	CTUBE	184	184	34	38					
185-	CTUBE	185	185	35	39					
186-	CTUBE	186	186	36	40					
187-	CTUBE	187	187	33	38					
188-	CTUBE	188	188	34	37					
189-	CTUBE	189	189	33	40					
190-	CTUBE	190	190	36	37					
191-	CTUBE	191	191	36	39					
192-	CTUBE	192	192	35	40					
193-	CTUBE	193	193	34	39					
194-	CTUBE	194	194	35	38					
195-	CTUBE	195	195	33	39					
196-	CTUBE	196	196	34	40					
197-	CTUBE	197	197	35	37					
198-	CTUBE	198	198	36	38					
199-	CTUBE	199	199	37	38					
200-	CTUBE	200	200	37	40					
201-	CTUBE	201	201	39	40					
202-	CTUBE	202	202	38	39					
203-	CTUBE	203	203	37	39					
204-	CTUBE	204	204	38	40					
205-	CTUBE	205	205	37	41					
206-	CTUBE	206	206	38	42					
207-	CTUBE	207	207	39	43					
208-	CTUBE	208	208	40	44					
209-	CTUBE	209	209	37	42					
210-	CTUBE	210	210	38	41					
211-	CTUBE	211	211	37	44					
212-	CTUBE	212	212	40	41					
213-	CTUBE	213	213	40	43					
214-	CTUBE	214	214	39	44					
215-	CTUBE	215	215	38	43					
216-	CTUBE	216	216	39	42					
217-	CTUBE	217	217	37	43					
218-	CTUBE	218	218	38	44					
219-	CTUBE	219	219	39	41					
220-	CTUBE	220	220	40	42					
221-	CTUBE	221	221	41	42					
222-	CTUBE	222	222	41	44					
223-	CTUBE	223	223	43	44					
224-	CTUBE	224	224	42	43					
225-	CTUBE	225	225	41	43					

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 8

DAMAGE CRITERION = NONE

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
226-	CTUBE	226	226	42	44					
227-	USFACT	200	1.60422	2.40632	3.20843					
228-	FORCE	11	21	0	44.2200	.0	0.0	-1.		
229-	FORCE	11	22	0	44.2200	.0	0.0	-1.		
230-	FORCE	11	23	0	44.2200	.0	0.0	-1.		
231-	FORCE	11	24	0	44.2200	.0	0.0	-1.		
232-	FORCE	11	41	0	464.5	1.	.0	.0		
233-	FORCE	11	41	0	527.3	.0	-1.0	.0		
234-	FORCE	11	42	0	464.5	1.0	0.0	.0		
235-	FORCE	11	42	0	527.3	.0	1.	.0		
236-	FORCE	11	43	0	464.5	-1.	0.0	.0		
237-	FORCE	11	43	0	527.5	.0	1.	.0		
238-	FORCE	11	44	0	464.5	-1.	.0	.0		
239-	FORCE	11	44	0	527.3	.0	-1.	.0		
240-	GRDSET							456		
241-	GRID	1		.000	12.300	13.300				
242-	GRID	2		.000	12.100	-11.500				
243-	GRID	3		.000	-11.400	-11.500				
244-	GRID	4		.000	-11.600	13.300				
245-	GRID	5		23.700	11.300	12.300				
246-	GRID	6		23.900	11.100	-10.700				
247-	GRID	7		23.900	-10.600	-10.700				
248-	GRID	8		23.750	-10.800	12.300				
249-	GRID	9		45.950	10.400	11.300				
250-	GRID	10		45.950	10.200	-9.900				
251-	GRID	11		45.950	-9.800	-9.900				
252-	GRID	12		45.950	-10.000	11.300				
253-	GRID	13		66.400	9.500	10.500				
254-	GRID	14		66.500	9.300	-9.200				
255-	GRID	15		66.500	-9.100	-9.200				
256-	GRID	16		66.400	-9.300	10.500				
257-	GRID	17		85.400	8.800	9.700				
258-	GRID	18		85.400	8.600	-8.600				
259-	GRID	19		85.400	-8.400	-8.600				
260-	GRID	20		85.400	-8.600	9.700				
261-	GRID	21		103.000	8.000	8.900				
262-	GRID	22		103.000	7.900	-8.000				
263-	GRID	23		103.000	-7.800	-8.000				
264-	GRID	24		103.000	-8.000	8.900				
265-	GRID	25		119.300	7.400	8.300				
266-	GRID	26		119.300	7.200	-7.400				
267-	GRID	27		119.300	-7.300	-7.400				
268-	GRID	28		119.300	-7.500	8.300				
269-	GRID	29		134.400	8.700	7.800				
270-	GRID	30		134.500	6.600	-6.900				

S O R T E D   B U L K   D A T A   E C H O

```
CARD
COUNT     .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 271-     GRID    31              134.500 -6.800  -6.900
 272-     GRID    32              134.400 -6.900  7.600
 273-     GRID    33              148.500 6.100   7.000
 274-     GRID    34              148.500 6.000   -6.500
 275-     GRID    35              148.500 -6.300  -6.500
 276-     GRID    36              148.500 -6.400  7.000
 277-     GRID    37              161.400 5.600   6.500
 278-     GRID    38              161.500 5.500   -6.000
 279-     GRID    39              161.500 -5.800  -6.000
 280-     GRID    40              161.400 -6.000  6.500
 281-     GRID    41              173.500 5.100   6.000
 282-     GRID    42              173.500 5.000   -5.600
 283-     GRID    43              173.500 -5.400  -5.600
 284-     GRID    44              173.500 -5.500  6.000
 285-     MAT1    1       10.5E6  3.8E6   .33     .1                                      +MAT001
 286-     +MAT001 4.36+04 3.49+04
 287-     MAT1    2       10.5E6  3.8E6   .33     .1                                      +MAT002
 288-     +MAT002 4.70+04 3.76+04
 289-     MAT1    3       10.5E6  3.8E6   .33     .1                                      +MAT003
 290-     +MAT003 4.36+04 3.49+04
 291-     MAT1    4       10.5E6  3.8E6   .33     .1                                      +MAT004
 292-     +MAT004 4.86+04 3.89+04
 293-     MAT1    5       10.5E6  3.8E6   .33     .1                                      +MAT005
 294-     +MAT005 2.28+04 1.83+04
 295-     MAT1    6       10.5E6  3.8E6   .33     .1                                      +MAT006
 296-     +MAT006 2.28+04 1.83+04
 297-     MAT1    7       10.5E6  3.8E6   .33     .1                                      +MAT007
 298-     +MAT007 4.76+04 3.81+04
 299-     MAT1    8       10.5E6  3.8E6   .33     .1                                      +MAT008
 300-     +MAT008 4.69+04 3.75+04
 301-     MAT1    9       10.5E6  3.8E6   .33     .1                                      +MAT009
 302-     +MAT009 4.69+04 3.75+04
 303-     MAT1    10      10.5E6  3.8E6   .33     .1                                      +MAT010
 304-     +MAT010 4.75+04 3.80+04
 305-     MAT1    11      10.5E6  3.8E6   .33     .1                                      +MAT011
 306-     +MAT011 2.34+04 1.87+04
 307-     MAT1    12      10.5E6  3.8E6   .33     .1                                      +MAT012
 308-     +MAT012 2.38+04 1.90+04
 309-     MAT1    13      10.5E6  3.8E6   .33     .1                                      +MAT013
 310-     +MAT013 2.44+04 1.95+04
 311-     MAT1    14      10.5E6  3.8E6   .33     .1                                      +MAT014
 312-     +MAT014 2.47+04 1.98+04
 313-     MAT1    15      10.5E6  3.8E6   .33     .1                                      +MAT015
 314-     +MAT015 2.34+04 1.87+04
 315-     MAT1    16      10.5E6  3.8E6   .33     .1                                      +MAT016
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S O R T E D   B U L K   D A T A   E C H O

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CARD
COUNT       .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  316-      +MAT016  2.37+04 1.90+04
  317-      MAT1    17      10.5E6  3.8E6   .33     .1                                      +MAT017
  318-      +MAT017  2.47+04 1.98+04
  319-      MAT1    18      10.5E6  3.8E6   .33     .1                                      +MAT018
  320-      +MAT018  2.49+04 1.99+04
  321-      MAT1    19      10.5E6  3.8E6   .33     .1                                      +MAT019
  322-      +MAT019  1.61+04 1.28+04
  323-      MAT1    20      10.5E6  3.8E6   .33     .1                                      +MAT020
  324-      +MAT020  1.62+04 1.30+04
  325-      MAT1    21      10.5E6  3.8E6   .33     .1                                      +MAT021
  326-      +MAT021  1.63+04 1.31+04
  327-      MAT1    22      10.5E6  3.8E6   .33     .1                                      +MAT022
  328-      +MAT022  1.61+04 1.29+04
  329-      MAT1    23      10.5E6  3.8E6   .33     .1                                      +MAT023
  330-      +MAT023  5.07+04 4.06+04
  331-      MAT1    24      10.5E6  3.8E6   .33     .1                                      +MAT024
  332-      +MAT024  5.50+04 4.40+04
  333-      MAT1    25      10.5E6  3.8E6   .33     .1                                      +MAT025
  334-      +MAT025  5.07+04 4.06+04
  335-      MAT1    26      10.5E6  3.8E6   .33     .1                                      +MAT026
  336-      +MAT026  5.70+04 4.56+04
  337-      MAT1    27      10.5E6  3.8E6   .33     .1                                      +MAT027
  338-      +MAT027  2.66+04 2.13+04
  339-      MAT1    28      10.5E6  3.8E6   .33     .1                                      +MAT028
  340-      +MAT028  2.66+04 2.13+04
  341-      MAT1    29      10.5E6  3.8E6   .33     .1                                      +MAT029
  342-      +MAT029  5.40+04 4.32+04
  343-      MAT1    30      10.5E6  3.8E6   .33     .1                                      +MAT030
  344-      +MAT030  5.51+04 4. 0+04
  345-      MAT1    31      10.5E6  3.8E6   .33     .1                                      +MAT031
  346-      +MAT031  5.51+04 4.40+04
  347-      MAT1    32      10.5E6  3.8E6   .33     .1                                      +MAT032
  348-      +MAT032  5.43+04 4.34+04
  349-      MAT1    33      10.5E6  3.8E6   .33     .1                                      +MAT033
  350-      +MAT033  2.71+04 2.17+04
  351-      MAT1    34      10.5E6  3.8E6   .33     .1                                      +MAT034
  352-      +MAT034  2.76+04 2.21+04
  353-      MAT1    35      10.5E6  3.8E6   .33     .1                                      +MAT035
  354-      +MAT035  2.83+04 2.26+04
  355-      MAT1    36      10.5E6  3.8E6   .33     .1                                      +MAT036
  356-      +MAT036  2.85+04 2.28+04
  357-      MAT1    37      10.5E6  3.8E6   .33     .1                                      +MAT037
  358-      +MAT037  2.72+04 2.18+04
  359-      MAT1    38      10.5E6  3.8E6   .33     .1                                      +MAT038
  360-      +MAT038  2.77+04 2.21+04
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S O R T E D   B U L K   D A T A   E C H O

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CARD
COUNT     .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 361-     MAT1     39       10.5E6  3.8E6   .33     .1                               +MAT039
 362-     +MAT039  2.91+04  2.33+04
 363-     MAT1     40       10.5E6  3.8E6   .33     .1                               +MAT040
 364-     +MAT040  2.92+04  2.34+04
 365-     MAT1     41       10.5E6  3.8E6   .33     .1                               +MAT041
 366-     +MAT041  1.67+04  1.50+04
 367-     MAT1     42       10.5E6  3.8E6   .33     .1                               +MAT042
 368-     +MAT042  1.90+04  1.52+04
 369-     MAT1     43       10.5E6  3.8E6   .33     .1                               +MAT043
 370-     +MAT043  1.90+04  1.52+04
 371-     MAT1     44       10.5E6  3.8E6   .33     .1                               +MAT044
 372-     +MAT044  1.88+04  1.51+04
 373-     MAT1     45       10.5E6  3.8E6   .33     .1                               +MAT045
 374-     +MAT045  5.97+04  4.78+04
 375-     MAT1     46       10.5E6  3.8E6   .33     .1                               +MAT046
 376-     +MAT046  6.45+04  5.16+04
 377-     MAT1     47       10.5E6  3.8E6   .33     .1                               +MAT047
 378-     +MAT047  5.97+04  4.78+04
 379-     MAT1     48       10.5E6  3.8E6   .33     .1                               +MAT048
 380-     +MAT048  6.71+04  5.37+04
 381-     MAT1     49       10.5E6  3.8E6   .33     .1                               +MAT049
 382-     +MAT049  3.13+04  2.50+04
 383-     MAT1     50       10.5E6  3.8E6   .33     .1                               +MAT050
 384-     +MAT050  3.13+04  2.50+04
 385-     MAT1     51       10.5E6  3.8E6   .33     .1                               +MAT051
 386-     +MAT051  6.39+04  5.11+04
 387-     MAT1     52       10.5E6  3.8E6   .33     .1                               +MAT052
 388-     +MAT052  6.34+04  5.07+04
 389-     MAT1     53       10.5E6  3.8E6   .33     .1                               +MAT053
 390-     +MAT053  6.34+04  5.08+04
 391-     MAT1     54       10.5E6  3.8E6   .33     .1                               +MAT054
 392-     +MAT054  6.40+04  5.12+04
 393-     MAT1     55       10.5E6  3.8E6   .33     .1                               +MAT055
 394-     +MAT055  3.18+04  2.54+04
 395-     MAT1     56       10.5E6  3.8E6   .33     .1                               +MAT056
 396-     +MAT056  3.22+04  2.57+04
 397-     MAT1     57       10.5E6  3.8E6   .33     .1                               +MAT057
 398-     +MAT057  3.33+04  2.66+04
 399-     MAT1     58       10.5E6  3.8E6   .33     .1                               +MAT058
 400-     +MAT058  3.36+04  2.69+04
 401-     MAT1     59       10.5E6  3.8E6   .33     .1                               +MAT059
 402-     +MAT059  3.18+04  2.55+04
 403-     MAT1     60       10.5E6  3.8E6   .33     .1                               +MAT060
 404-     +MAT060  3.22+04  2.57+04
 405-     MAT1     61       10.5E6  3.8E6   .33     .1                               +MAT061
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TRUSS TAIL BOOM  MODEL1   **A 226 ELEMENT VERSION                    OCTOBER  28, 1977   NASTRAN  7/15/77    PAGE     12
DAMAGE CRITERION = NONE

                                     S O R T E D   B U L K   D A T A   E C H O
        CARD
        COUNT         .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
         406-         +MAT061  3.38+04 2.70+04
         407-         MAT1    62      10.5E6  3.8E6   .33     .1                                      +MAT062
         408-         +MAT062  3.41+04 2.73+04
         409-         MAT1    63      10.5E6  3.8E6   .33     .1                                      +MAT063
         410-         +MAT063  2.19+04 1.76+04
         411-         MAT1    64      10.5E6  3.8E6   .33     .1                                      +MAT064
         412-         +MAT064  2.21+04 1.77+04
         413-         MAT1    65      10.5E6  3.8E6   .33     .1                                      +MAT065
         414-         +MAT065  2.22+04 1.78+04
         415-         MAT1    66      10.5E6  3.8E6   .33     .1                                      +MAT066
         416-         +MAT066  2.21+04 1.77+04
         417-         MAT1    67      10.5E6  3.8E6   .33     .1                                      +MAT067
         418-         +MAT067  6.92+04 5.53+04
         419-         MAT1    68      10. E6  3.8E6   .33     .1                                      +MAT068
         420-         +MAT068  7.59+04 6.08+04
         421-         MAT1    69      10.5E6  3.8E6   .33     .1                                      +MAT069
         422-         +MAT069  6.92+04 5.53+04
         423-         MAT1    70      10.5E6  3.8E6   .33     .1                                      +MAT070
         424-         +MAT070  7.93+04 6.34+04
         425-         MAT1    71      10.5E6  3.8E6   .33     .1                                      +MAT071
         426-         +MAT071  3.66+04 2.93+04
         427-         MAT1    72      10.5E6  3.8E6   .33     .1                                      +MAT072
         428-         +MAT072  3.66+04 2.93+04
         429-         MAT1    73      10.5E6  3.8E6   .33     .1                                      +MAT073
         430-         +MAT073  7.41+04 5.93+04
         431-         MAT1    74      10.5E6  3.8E6   .33     .1                                      +MAT074
         432-         +MAT074  7.50+04 6.00+04
         433-         MAT1    75      10.5E6  3.8E6   .33     .1                                      +MAT075
         434-         +MAT075  7.50+04 6.00+04
         435-         MAT1    76      10.5E6  3.8E6   .33     .1                                      +MAT076
         436-         +MAT076  7.41+04 5.93+04
         437-         MAT1    77      10.5E6  3.8E6   .33     .1                                      +MAT077
         438-         +MAT077  3.69+04 2.95+04
         439-         MAT1    78      10.5E6  3.8E6   .33     .1                                      +MAT078
         440-         +MAT078  3.76+04 3.01+04
         441-         MAT1    79      10.5E6  3.8E6   .33     .1                                      +MAT079
         442-         +MAT079  3.90+04 3.12+04
         443-         MAT1    80      10.5E6  3.8E6   .33     .1                                      +MAT080
         444-         +MAT080  3.90+04 3.12+04
         445-         MAT1    81      10.5E6  3.8E6   .33     .1                                      +MAT081
         446-         +MAT081  3.69+04 2.95+04
         447-         MAT1    82      10.5E6  3.8E6   .33     .1                                      +MAT082
         448-         +MAT082  3.76+04 3.01+04
         449-         MAT1    83      10.5E6  3.8E6   .33     .1                                      +MAT083
         450-         +MAT083  4.00+04 3.20+04
```

S O R T E D   B U L K   D A T A   E C H O

```
 CARD
 COUNT     .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  451-     MAT1    84      10.5E6  3.8E6   .33     .1                              +MAT084
  452-     +MAT084  4.00+04 3.20+04
  453-     MAT1    85      10.5E6  3.8E6   .33     .1                              +MAT085
  454-     +MAT085  2.56+04 2.05+04
  455-     MAT1    86      10.5E6  3.8E6   .33     .1                              +MAT086
  456-     +MAT086  2.59+04 2.07+04
  457-     MAT1    87      10.5E6  3.8E6   .33     .1                              +MAT087
  458-     +MAT087  2.59+04 2.07+04
  459-     MAT1    88      10.5E6  3.8E6   .33     .1                              +MAT088
  460-     +MAT088  2.56+04 2.05+04
  461-     MAT1    89      10.5E6  3.8E6   .33     .1                              +MAT089
  462-     +MAT089  8.02+04 6.41+04
  463-     MAT1    90      10.5E6  3.8E6   .33     .1                              +MAT090
  464-     +MAT090  8.87+04 7.09+04
  465-     MAT1    91      10.5E6  3.8E6   .33     .1                              +MAT091
  466-     +MAT091  8.02+04 6.41+04
  467-     MAT1    92      10.5E6  3.8E6   .33     .1                              +MAT092
  468-     +MAT092  9.29+04 7.43+04
  469-     MAT1    93      10.5E6  3.8E6   .33     .1                              +MAT093
  470-     +MAT093  4.26+04 3.41+04
  471-     MAT1    94      10.5E6  3.8E6   .33     .1                              +MAT094
  472-     +MAT094  4.26+04 3.41+04
  473-     MAT1    95      10.5E6  3.8E6   .33     .1                              +MAT095
  474-     +MAT095  8.63+04 6.90+04
  475-     MAT1    96      10.5E6  3.8E6   .33     .1                              +MAT096
  476-     +MAT096  8.65+04 6.92+04
  477-     MAT1    97      10.5E6  3.8E6   .33     .1                              +MAT097
  478-     +MAT097  8.65+04 6.92+04
  479-     MAT1    98      10.5E6  3.8E6   .33     .1                              +MAT098
  480-     +MAT098  8.64+04 6.91+04
  481-     MAT1    99      10.5E6  3.8E6   .33     .1                              +MAT099
  482-     +MAT099  4.30+04 3.44+04
  483-     MAT1    100     10.5E6  3.8E6   .33     .1                              +MAT100
  484-     +MAT100  4.35+04 3.48+04
  485-     MAT1    101     10.5E6  3.8E6   .33     .1                              +MAT101
  486-     +MAT101  4.53+04 3.62+04
  487-     MAT1    102     10.5E6  3.8E6   .33     .1                              +MAT102
  488-     +MAT102  4.58+04 3.66+04
  489-     MAT1    103     10.5E6  3.8E6   .33     .1                              +MAT103
  490-     +MAT103  4.31+04 3.44+04
  491-     MAT1    104     10.5E6  3.8E6   .33     .1                              +MAT104
  492-     +MAT104  4.36+04 3.49+04
  493-     MAT1    105     10.5E6  3.8E6   .33     .1                              +MAT105
  494-     +MAT105  4.64+04 3.71+04
  495-     MAT1    106     10.5E6  3.8E6   .33     .1                              +MAT106
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TRUSS TAIL BOOM  MODEL1   **A 226 ELEMENT VERSION                    OCTOBER  28, 1977   NASTRAN  7/15/77     PAGE     14
DAMAGE CRITERION = NONE

                                   S O R T E D   B U L K   D A T A   E C H O
            CARD
            COUNT        .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
             496-        +MAT106  4.66+04 3.73+04
             497-        MAT1    107      10.5E6  3.8E6   .33     .1                              +MAT107
             498-        +MAT107  2.99+04 2.39+04
             499-        MAT1    108      10.5E6  3.8E6   .33     .1                              +MAT108
             500-        +MAT108  3.01+04 2.41+04
             501-        MAT1    109      10.5E6  3.8E6   .33     .1                              +MAT109
             502-        +MAT109  3.03+04 2.43+04
             503-        MAT1    110      10.5E6  3.8E6   .33     .1                              +MAT110
             504-        +MAT110  3.00+04 2.40+04
             505-        MAT1    111      10.5E6  3.8E6   .33     .1                              +MAT111
             506-        +MAT111  9.40+04 7.52+04
             507-        MAT1    112      10.5E6  3.8E6   .33     .1                              +MAT112
             508-        +MAT112  1.05+05 8.39+04
             509-        MAT1    113      10.5E6  3.8E6   .33     .1                              +MAT113
             510-        +MAT113  9.40+04 7.52+04
             511-        MAT1    114      10.5E6  3.8E6   .33     .1                              +MAT114
             512-        +MAT114  1.09+05 8.71+04
             513-        MAT1    115      10.5E6  3.8E6   .33     .1                              +MAT115
             514-        +MAT115  5.01+04 4.01+04
             515-        MAT1    116      10.5E6  3.8E6   .33     .1                              +MAT116
             516-        +MAT116  4.99+04 3.99+04
             517-        MAT1    117      10.5E6  3.8E6   .33     .1                              +MAT117
             518-        +MAT117  1.01+05 8.06+04
             519-        MAT1    118      10.5E6  3.8E6   .33     .1                              +MAT118
             520-        +MAT118  1.01+05 8.05+04
             521-        MAT1    119      10.5E6  3.8E6   .33     .1                              +MAT119
             522-        +MAT119  1.01+05 8.06+04
             523-        MAT1    120      10.5E6  3.8E6   .33     .1                              +MAT120
             524-        +MAT120  1.01+05 8.06+04
             525-        MAT1    121      10.5E6  3.8E6   .33     .1                              +MAT121
             526-        +MAT121  5.04+04 4.03+04
             527-        MAT1    122      10.5E6  3.8E6   .33     .1                              +MAT122
             528-        +MAT122  5.05+04 4.04+04
             529-        MAT1    123      10.5E6  3.8E6   .33     .1                              +MAT123
             530-        +MAT123  5.30+04 4.24+04
             531-        MAT1    124      10.5E6  3.8E6   .33     .1                              +MAT124
             532-        +MAT124  5.34+04 4.27+04
             533-        MAT1    125      10.5E6  3.8E6   .33     .1                              +MAT125
             534-        +MAT125  5.05+04 4.04+04
             535-        MAT1    126      10.5E6  3.8E6   .33     .1                              +MAT126
             536-        +MAT126  5.05+04 4.04+04
             537-        MAT1    127      10.5E6  3.8E6   .33     .1                              +MAT127
             538-        +MAT127  5.40+04 4.32+04
             539-        MAT1    128      10.5E6  3.8E6   .33     .1                              +MAT128
             540-        +MAT128  5.47+04 4.37+04
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SORTED BULK DATA ECHO

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CARD
COUNT   .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 541-   MAT1     129      10.5E6   3.8E6   .33     .1                       +MAT129
 542-   +MAT129  3.51+04  2.80+04
 543-   MAT1     130      10.5E6   3.8E6   .33     .1                       +MAT130
 544-   +MAT130  3.49+04  2.79+04
 545-   MAT1     131      10.5E6   3.8E6   .33     .1                       +MAT131
 546-   +MAT131  3.52+04  2.82+04
 547-   MAT1     132      10.5E6   3.8E6   .33     .1                       +MAT132
 548-   +MAT132  3.52+04  2.82+04
 549-   MAT1     133      10.5E6   3.8E6   .33     .1                       +MAT133
 550-   +MAT133  1.09+05  8.71+04
 551-   MAT1     134      10.5E6   3.8E6   .33     .1                       +MAT134
 552-   +MAT134  1.21+05  9.67+04
 553-   MAT1     135      10.5E6   3.8E6   .33     .1                       +MAT135
 554-   +MAT135  1.09+05  8.71+04
 555-   MAT1     136      10.5E6   3.8E6   .33     .1                       +MAT136
 556-   +MAT136  1.28+05  1.02+05
 557-   MAT1     137      10.5E6   3.8E6   .33     .1                       +MAT137
 558-   +MAT137  5.80+04  4.64+04
 559-   MAT1     138      10.5E6   3.8E6   .33     .1                       +MAT138
 560-   +MAT138  5.80+04  4.64+04
 561-   MAT1     139      10.5E6   3.8E6   .33     .1                       +MAT139
 562-   +MAT139  1.17+05  9.38+04
 563-   MAT1     140      10.5E6   3.8E6   .33     .1                       +MAT140
 564-   +MAT140  1.16+05  9.27+04
 565-   MAT1     141      10.5E6   3.8E6   .33     .1                       +MAT141
 566-   +MAT141  1.16+05  9.27+04
 567-   MAT1     142      10.5E6   3.8E6   .33     .1                       +MAT142
 568-   +MAT142  1.17+05  9.38+04
 569-   MAT1     143      10.5E6   3.8E6   .33     .1                       +MAT143
 570-   +MAT143  5.80+04  4.64+04
 571-   MAT1     144      10.5E6   3.8E6   .33     .1                       +MAT144
 572-   +MAT144  5.92+04  4.74+04
 573-   MAT1     145      10.5E6   3.8E6   .33     .1                       +MAT145
 574-   +MAT145  6.20+04  4.96+04
 575-   MAT1     146      10.5E6   3.8E6   .33     .1                       +MAT146
 576-   +MAT146  6.24+04  4.99+04
 577-   MAT1     147      10.5E6   3.8E6   .33     .1                       +MAT147
 578-   +MAT147  5.80+04  4.64+04
 579-   MAT1     148      10.5E6   3.8E6   .33     .1                       +MAT148
 580-   +MAT148  5.92+04  4.74+04
 581-   MAT1     149      10.5E6   3.8E6   .33     .1                       +MAT149
 582-   +MAT149  6.28+04  5.03+04
 583-   MAT1     150      10.5E6   3.8E6   .33     .1                       +MAT150
 584-   +MAT150  6.33+04  5.06+04
 585-   MAT1     151      10.5E6   3.8E6   .33     .1                       +MAT151
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                         S O R T E D   B U L K   D A T A   E C H O
CARD
COUNT      .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  .. 10  .
  586-     +MAT151  4.05+04 3.24+04
  587-     MAT1    152     10.5E6  3.8E6   .33     .1                                      +MAT152
  588-     +MAT152  4.12+04 3.29+04
  589-     MAT1    153     10.5E6  3.8E6   .33     .1                                      +MAT153
  590-     +MAT153  4.13+04 3.31+04
  591-     MAT1    154     10.5E6  3.8E6   .33     .1                                      +MAT154
  592-     +MAT154  4.06+04 3.25+04
  593-     MAT1    155     10.5E6  3.8E6   .33     .1                                      +MAT155
  594-     +MAT155  1.28+05 1.02+05
  595-     MAT1    156     10.5E6  3.8E6   .33     .1                                      +MAT156
  596-     +MAT156  1.45+05 1.16+05
  597-     MAT1    157     10.5E6  3.8E6   .33     .1                                      +MAT157
  598-     +MAT157  1.28+05 1.02+05
  599-     MAT1    158     10.5E6  3.8E6   .33     .1                                      +MAT158
  600-     +MAT158  1.49+05 1.20+05
  601-     MAT1    159     10.5E6  3.8E6   .33     .1                                      +MAT159
  602-     +MAT159  6.84+04 5.47+04
  603-     MAT1    160     10.5E6  3.8E6   .33     .1                                      +MAT160
  604-     +MAT160  6.84+04 5.47+04
  605-     MAT1    161     10.5E6  3.8E6   .33     .1                                      +MAT161
  606-     +MAT161  1.34+05 1.08+05
  607-     MAT1    162     10.5E6  3.8E6   .33     .1                                      +MAT162
  608-     +MAT162  1.37+05 1.09+05
  609-     MAT1    163     10.5E6  3.8E6   .33     .1                                      +MAT163
  610-     +MAT163  1.37+05 1.09+05
  611-     MAT1    164     10.5E6  3.8E6   .33     .1                                      +MAT164
  612-     +MAT164  1.35+05 1.08+05
  613-     MAT1    165     10.5E6  3.8E6   .33     .1                                      +MAT165
  614-     +MAT165  6.74+04 5.40+04
  615-     MAT1    166     10.5E6  3.8E6   .33     .1                                      +MAT166
  616-     +MAT166  6.90+04 5.52+04
  617-     MAT1    167     10.5E6  3.8E6   .33     .1                                      +MAT167
  618-     +MAT167  7.24+04 5.79+04
  619-     MAT1    168     10.5E6  3.8E6   .33     .1                                      +MAT168
  620-     +MAT168  7.29+04 5.83+04
  621-     MAT1    169     10.5E6  3.8E6   .33     .1                                      +MAT169
  622-     +MAT169  6.74+04 5.40+04
  623-     MAT1    170     10.5E6  3.8E6   .33     .1                                      +MAT170
  624-     +MAT170  6.90+04 5.52+04
  625-     MAT1    171     10.5E6  3.8E6   .33     .1                                      +MAT171
  626-     +MAT171  7.40+04 5.92+04
  627-     MAT1    172     10.5E6  3.8E6   .33     .1                                      +MAT172
  628-     +MAT172  7.46+04 5.97+04
  629-     MAT1    173     10.5E6  3.8E6   .33     .1                                      +MAT173
  630-     +MAT173  4.74+04 3.79+04
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S C R T E D B U L K D A T A E C H O

CARD COUNT	1	2	3	4	5	6	7	8	9	10
631-	MAT1	174	10.5E6	3.8E6	.33	.1				+MAT174
632-	+MAT174	4.81+04	3.85+04							
633-	MAT1	175	10.5E6	3.8E6	.33	.1				+MAT175
634-	+MAT175	4.83+04	3.87+04							
635-	MAT1	176	10.5E6	3.8E6	.33	.1				+MAT176
636-	+MAT176	4.76+04	3.81+04							
637-	MAT1	177	10.5E6	3.8E6	.33	.1				+MAT177
638-	+MAT177	1.47+05	1.18+05							
639-	MAT1	178	10.5E6	3.8E6	.33	.1				+MAT178
640-	+MAT178	1.72+05	1.37+05							
641-	MAT1	179	10.5E6	3.8E6	.33	.1				+MAT179
642-	+MAT179	1.47+05	1.18+05							
643-	MAT1	180	10.5E6	3.8E6	.33	.1				+MAT180
644-	+MAT180	1.77+05	1.42+05							
645-	MAT1	181	10.5E6	3.8E6	.33	.1				+MAT181
646-	+MAT181	7.99+04	6.39+04							
647-	MAT1	182	10.5E6	3.8E6	.33	.1				+MAT182
648-	+MAT182	7.99+04	6.39+04							
649-	MAT1	183	10.5E6	3.8E6	.33	.1				+MAT183
650-	+MAT183	1.61+05	1.29+05							
651-	MAT1	184	10.5E6	3.8E6	.33	.1				+MAT184
652-	+MAT184	1.58+05	1.27+05							
653-	MAT1	185	10.5E6	3.8E6	.33	.1				+MAT185
654-	+MAT185	1.58+05	1.27+05							
655-	MAT1	186	10.5E6	3.8E6	.33	.1				+MAT186
656-	+MAT186	1.61+05	1.29+05							
657-	MAT1	187	10.5E6	3.8E6	.33	.1				+MAT187
658-	+MAT187	7.94+04	6.35+04							
659-	MAT1	188	10.5E6	3.8E6	.33	.1				+MAT188
660-	+MAT188	8.00+04	6.40+04							
661-	MAT1	189	10.5E6	3.8E6	.33	.1				+MAT189
662-	+MAT189	8.58+04	6.86+04							
663-	MAT1	190	10.5E6	3.8E6	.33	.1				+MAT190
664-	+MAT190	8.64+04	6.91+04							
665-	MAT1	191	10.5E6	3.8E6	.33	.1				+MAT191
666-	+MAT191	7.94+04	6.35+04							
667-	MAT1	192	10.5E6	3.8E6	.33	.1				+MAT192
668-	+MAT192	5.60+04	4.48+04							
669-	MAT1	193	10.5E6	3.8E6	.33	.1				+MAT193
670-	+MAT193	8.71+04	6.96+04							
671-	MAT1	194	10.5E6	3.8E6	.33	.1				+MAT194
672-	+MAT194	8.71+04	6.96+04							
673-	MAT1	195	10.5E6	3.8E6	.33	.1				+MAT195
674-	+MAT195	5.60+04	4.48+04							
675-	MAT1	196	10.5E6	3.8E6	.33	.1				+MAT196

DAMAGE CRITERION = NONE

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                                 S O R T E D   B U L K   D A T A   E C H O
 CARD
 COUNT        .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
  676-        +MAT196  5.60+04 4.48+04
  677-        MAT1    197     10.5E6  3.8E6   .33     .1                                      +MAT197
  678-        +MAT197  5.63+04 4.50+04
  679-        MAT1    198     10.5E6  3.8E6   .33     .1                                      +MAT198
  680-        +MAT198  5.60+04 4.48+04
  681-        MAT1    199     10.5E6  3.8E6   .33     .1                                      +MAT199
  682-        +MAT199  1.72+05 1.37+05
  683-        MAT1    200     10.5E6  3.8E6   .33     .1                                      +MAT200
  684-        +MAT200  1.99+05 1.60+05
  685-        MAT1    201     10.5E6  3.8E6   .33     .1                                      +MAT201
  686-        +MAT201  1.72+05 1.37+05
  687-        MAT1    202     10.5E6  3.8E6   .33     .1                                      +MAT202
  688-        +MAT202  2.10+05 1.68+05
  689-        MAT1    203     10.5E6  3.8E6   .33     .1                                      +MAT203
  690-        +MAT203  9.38+04 7.50+04
  691-        MAT1    204     10.5E6  3.8E6   .33     .1                                      +MAT204
  692-        +MAT204  9.30+04 7.44+04
  693-        MAT1    205     10.5E6  3.8E6   .33     .1                                      +MAT205
  694-        +MAT205  1.83+05 1.46+05
  695-        MAT1    206     10.5E6  3.8E6   .33     .1                                      +MAT206
  696-        +MAT206  1.86+05 1.49+05
  697-        MAT1    207     10.5E6  3.8E6   .33     .1                                      +MAT207
  698-        +MAT207  1.86+05 1.49+05
  699-        MAT1    208     10.5E6  3.8E6   .33     .1                                      +MAT208
  700-        +MAT208  1.83+05 1.46+05
  701-        MAT1    209     10.5E6  3.8E6   .33     .1                                      +MAT209
  702-        +MAT209  9.16+04 7.33+04
  703-        MAT1    210     10.5E6  3.8E6   .33     .1                                      +MAT210
  704-        +MAT210  9.31+04 7.45+04
  705-        MAT1    211     10.5E6  3.8E6   .33     .1                                      +MAT211
  706-        +MAT211  9.94+04 7.95+04
  707-        MAT1    212     10.5E6  3.8E6   .33     .1                                      +MAT212
  708-        +MAT212  9.94+04 7.95+04
  709-        MAT1    213     10.5E6  3.8E6   .33     .1                                      +MAT213
  710-        +MAT213  9.16+04 7.33+04
  711-        MAT1    214     10.5E6  3.8E6   .33     .1                                      +MAT214
  712-        +MAT214  9.32+04 7.46+04
  713-        MAT1    215     10.5E6  3.8E6   .33     .1                                      +MAT215
  714-        +MAT215  1.02+05 8.16+04
  715-        MAT1    216     10.5E6  3.8E6   .33     .1                                      +MAT216
  716-        +MAT216  1.03+05 8.23+04
  717-        MAT1    217     10.5E6  3.8E6   .33     .1                                      +MAT217
  718-        +MAT217  6.49+04 5.19+04
  719-        MAT1    218     10.5E6  3.8E6   .33     .1                                      +MAT218
  720-        +MAT218  6.57+04 5.25+04
```

```
                                 S O R T E D   B U L K   D A T A   E C H O
  CARD
  COUNT        .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
   721-        MAT1    219     10.5E6  3.8E6   .33    .1                          +MAT219
   722-        +MAT219  6.60+04 5.28+04
   723-        MAT1    220     10.5E6  3.8E6   .33    .1                          +MAT220
   724-        +MAT220  6.49+04 5.19+04
   725-        MAT1    221     10.5E6  3.8E6   .33    .1                          +MAT221
   726-        +MAT221  1.99+05 1.60+05
   727-        MAT1    222     10.5E6  3.8E6   .33    .1                          +MAT222
   728-        +MAT222  2.39+05 1.91+05
   729-        MAT1    223     10.5E6  3.8E6   .33    .1                          +MAT223
   730-        +MAT223  1.99+05 1.60+05
   731-        MAT1    224     10.5E6  3.8E6   .33    .1                          +MAT224
   732-        +MAT224  2.48+05 1.99+05
   733-        MAT1    225     10.5E6  3.8E6   .33    .1                          +MAT225
   734-        +MAT225  1.10+05 8.77+04
   735-        MAT1    226     10.5E6  3.8E6   .33    .1                          +MAT226
   736-        +MAT226  1.10+05 8.77+04
   737-        PARAM   GRDPNT  0
   738-        PTUBE   1       1       1.5     .0625
   739-        PTUBE   2       2       1.5     .0625
   740-        PTUBE   3       3       1.5     .0625
   741-        PTUBE   4       4       1.5     .0625
   742-        PTUBE   5       5       1.5     .0625
   743-        PTUBE   6       6       1.5     .0625
   744-        PTUBE   7       7       1.5     .0625
   745-        PTUBE   8       8       1.5     .0625
   746-        PTUBE   9       9       1.5     .0625
   747-        PTUBE   10      10      1.5     .0625
   748-        PTUBE   11      11      1.5     .0625
   749-        PTUBE   12      12      1.5     .0625
   750-        PTUBE   13      13      1.5     .0625
   751-        PTUBE   14      14      1.5     .0625
   752-        PTUBE   15      15      1.5     .0625
   753-        PTUBE   16      16      1.5     .0625
   754-        PTUBE   17      17      1.5     .0625
   755-        PTUBE   18      18      1.5     .0625
   756-        PTUBE   19      19      1.5     .0625
   757-        PTUBE   20      20      1.5     .0625
   758-        PTUBE   21      21      1.5     .0625
   759-        PTUBE   22      22      1.5     .0625
   760-        PTUBE   23      23      1.5     .0625
   761-        PTUBE   24      24      1.5     .0625
   762-        PTUBE   25      25      1.5     .0625
   763-        PTUBE   26      26      1.5     .0625
   764-        PTUBE   27      27      1.5     .0625
   765-        PTUBE   28      28      1.5     .0625
```

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 .. 7 .. 8 .. 9 .. 10 .
766-	PTUBE	29	29	1.5	.0625	
767-	PTUBE	30	30	1.5	.0625	
768-	PTUBE	31	31	1.5	.0625	
769-	PTUBE	32	32	1.5	.0625	
770-	PTUBE	33	33	1.5	.0625	
771-	PTUBE	34	34	1.5	.0625	
772-	PTUBE	35	35	1.5	.0625	
773-	PTUBE	36	36	1.5	.0625	
774-	PTUBE	37	37	1.5	.0625	
775-	PTUBE	38	38	1.5	.0625	
776-	PTUBE	39	39	1.5	.0625	
777-	PTUBE	40	40	1.5	.0625	
778-	PTUBE	41	41	1.5	.0625	
779-	PTUBE	42	42	1.5	.0625	
780-	PTUBE	43	43	1.5	.0625	
781-	PTUBE	44	44	1.5	.0625	
782-	PTUBE	45	45	1.5	.0625	
783-	PTUBE	46	46	1.5	.0625	
784-	PTUBE	47	47	1.5	.0625	
785-	PTUBE	48	48	1.5	.0625	
786-	PTUBE	49	49	1.5	.0625	
787-	PTUBE	50	50	1.5	.0625	
788-	PTUBE	51	51	1.5	.0625	
789-	PTUBE	52	52	1.5	.0625	
790-	PTUBE	53	53	1.5	.0625	
791-	PTUBE	54	54	1.5	.0625	
792-	PTUBE	55	55	1.5	.0625	
793-	PTUBE	56	56	1.5	.0625	
794-	PTUBE	57	57	1.5	.0625	
795-	PTUBE	58	58	1.5	.0625	
796-	PTUBE	59	59	1.5	.0625	
797-	PTUBE	60	60	1.5	.0625	
798-	PTUBE	61	61	1.5	.0625	
799-	PTUBE	62	62	1.5	.0625	
800-	PTUBE	63	63	1.5	.0625	
801-	PTUBE	64	64	1.5	.0625	
802-	PTUBE	65	65	1.5	.0625	
803-	PTUBE	66	66	1.5	.0625	
804-	PTUBE	67	67	1.5	.0625	
805-	PTUBE	68	68	1.5	.0625	
806-	PTUBE	69	69	1.5	.0625	
807-	PTUBE	70	70	1.5	.0625	
808-	PTUBE	71	71	1.5	.0625	
809-	PTUBE	72	72	1.5	.0625	
810-	PTUBE	73	73	1.5	.0625	

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
811-	PTUBE	74	74	1.5	.0625					
812-	PTUBE	75	75	1.5	.0625					
813-	PTUBE	76	76	1.5	.0625					
814-	PTUBE	77	77	1.5	.0625					
815-	PTUBE	78	78	1.5	.0625					
816-	PTUBE	79	79	1.5	.0625					
817-	PTUBE	80	80	1.5	.0625					
818-	PTUBE	81	81	1.5	.0625					
819-	PTUBE	82	82	1.5	.0625					
820-	PTUBE	83	83	1.5	.0625					
821-	PTUBE	84	84	1.5	.0625					
822-	PTUBE	85	85	1.5	.0625					
823-	PTUBE	86	86	1.5	.0625					
824-	PTUBE	87	87	1.5	.0625					
825-	PTUBE	88	88	1.5	.0625					
826-	PTUBE	89	89	1.5	.0625					
827-	PTUBE	90	90	1.5	.0625					
828-	PTUBE	91	91	1.5	.0625					
829-	PTUBE	92	92	1.5	.0625					
830-	PTUBE	93	93	1.5	.0625					
831-	PTUBE	94	94	1.5	.0625					
832-	PTUBE	95	95	1.5	.0625					
833-	PTUBE	96	96	1.5	.0625					
834-	PTUBE	97	97	1.5	.0625					
835-	PTUBE	98	98	1.5	.0625					
836-	PTUBE	99	99	1.5	.0625					
837-	PTUBE	100	100	1.5	.0625					
838-	PTUBE	101	101	1.5	.0625					
839-	PTUBE	102	102	1.5	.0625					
840-	PTUBE	103	103	1.5	.0625					
841-	PTUBE	104	104	1.5	.0625					
842-	PTUBE	105	105	1.5	.0625					
843-	PTUBE	106	106	1.5	.0625					
844-	PTUBE	107	107	1.5	.0625					
845-	PTUBE	108	108	1.5	.0625					
846-	PTUBE	109	109	1.5	.0625					
847-	PTUBE	110	110	1.5	.0625					
848-	PTUBE	111	111	1.5	.0625					
849-	PTUBE	112	112	1.5	.0625					
850-	PTUBE	113	113	1.5	.0625					
851-	PTUBE	114	114	1.5	.0625					
852-	PTUBE	115	115	1.5	.0625					
853-	PTUBE	116	116	1.5	.0625					
854-	PTUBE	117	117	1.5	.0625					
855-	PTUBE	118	118	1.5	.0625					

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
856-	PTUBE	119	119	1.5	.0625					
857-	PTUBE	120	120	1.5	.0625					
858-	PTUBE	121	121	1.5	.0625					
859-	PTUBE	122	122	1.5	.0625					
860-	PTUBE	123	123	1.5	.0625					
861-	PTUBE	124	124	1.5	.0625					
862-	PTUBE	125	125	1.5	.0625					
863-	PTUBE	126	126	1.5	.0625					
864-	PTUBE	127	127	1.5	.0625					
865-	PTUBE	128	128	1.5	.0625					
866-	PTUBE	129	129	1.5	.0625					
867-	PTUBE	130	130	1.5	.0625					
868-	PTUBE	131	131	1.5	.0625					
869-	PTUBE	132	132	1.5	.0625					
870-	PTUBE	133	133	1.5	.0625					
871-	PTUBE	134	134	1.5	.0625					
872-	PTUBE	135	135	1.5	.0625					
873-	PTUBE	136	136	1.5	.0625					
874-	PTUBE	137	137	1.5	.0625					
875-	PTUBE	138	138	1.5	.0625					
876-	PTUBE	139	139	1.5	.0625					
877-	PTUBE	140	140	1.5	.0625					
878-	PTUBE	141	141	1.5	.0625					
879-	PTUBE	142	142	1.5	.0625					
880-	PTUBE	143	143	1.5	.0625					
881-	PTUBE	144	144	1.5	.0625					
882-	PTUBE	145	145	1.5	.0625					
883-	PTUBE	146	146	1.5	.0625					
884-	PTUBE	147	147	1.5	.0625					
885-	PTUBE	148	148	1.5	.0625					
886-	PTUBE	149	149	1.5	.0625					
887-	PTUBE	150	150	1.5	.0625					
888-	PTUBE	151	151	1.5	.0625					
889-	PTUBE	152	152	1.5	.0625					
890-	PTUBE	153	153	1.5	.0625					
891-	PTUBE	154	154	1.5	.0625					
892-	PTUBE	155	155	1.5	.0625					
893-	PTUBE	156	156	1.5	.0625					
894-	PTUBE	157	157	1.5	.0625					
895-	PTUBE	158	158	1.5	.0625					
896-	PTUBE	159	159	1.5	.0625					
897-	PTUBE	160	160	1.5	.0625					
898-	PTUBE	161	161	1.5	.0625					
899-	PTUBE	162	162	1.5	.0625					
900-	PTUBE	163	163	1.5	.0625					

DAMAGE CRITERION = NONE

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
901-	PTUBE	164	164	1.5	.0625					
902-	PTUBE	165	165	1.5	.0625					
903-	PTUBE	166	166	1.5	.0625					
904-	PTUBE	167	167	1.5	.0625					
905-	PTUBE	168	168	1.5	.0625					
906-	PTUBE	169	169	1.5	.0625					
907-	PTUBE	170	170	1.5	.0625					
908-	PTUBE	171	171	1.5	.0625					
909-	PTUBE	172	172	1.5	.0625					
910-	PTUBE	173	173	1.5	.0625					
911-	PTUBE	174	174	1.5	.0625					
912-	PTUBE	175	175	1.5	.0625					
913-	PTUBE	176	176	1.5	.0625					
914-	PTUBE	177	177	1.5	.0625					
915-	PTUBE	178	178	1.5	.0625					
916-	PTUBE	179	179	1.5	.0625					
917-	PTUBE	180	180	1.5	.0625					
918-	PTUBE	181	181	1.5	.0625					
919-	PTUBE	182	182	1.5	.0625					
920-	PTUBE	183	183	1.5	.0625					
921-	PTUBE	184	184	1.5	.0625					
922-	PTUBE	185	185	1.5	.0625					
923-	PTUBE	186	186	1.5	.0625					
924-	PTUBE	187	187	1.5	.0625					
925-	PTUBE	188	188	1.5	.0625					
926-	PTUBE	189	189	1.5	.0625					
927-	PTUBE	190	190	1.5	.0625					
928-	PTUBE	191	191	1.5	.0625					
929-	PTUBE	192	192	1.5	.0625					
930-	PTUBE	193	193	1.5	.0625					
931-	PTUBE	194	194	1.5	.0625					
932-	PTUBE	195	195	1.5	.0625					
933-	PTUBE	196	196	1.5	.0625					
934-	PTUBE	197	197	1.5	.0625					
935-	PTUBE	198	198	1.5	.0625					
936-	PTUBE	199	199	1.5	.0625					
937-	PTUBE	200	200	1.5	.0625					
938-	PTUBE	201	201	1.5	.0625					
939-	PTUBE	202	202	1.5	.0625					
940-	PTUBE	203	203	1.5	.0625					
941-	PTUBE	204	204	1.5	.0625					
942-	PTUBE	205	205	1.5	.0625					
943-	PTUBE	206	206	1.5	.0625					
944-	PTUBE	207	207	1.5	.0625					
945-	PTUBE	208	208	1.5	.0625					

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TRUSS TAIL BOOM  MODEL1  **A 226 ELEMENT VERSION                  OCTOBER  28, 1977   NASTRAN  7/15/77    PAGE    24
DAMAGE CRITERION = NONE

                                     S O R T E D   B U L K   D A T A   E C H O
            CARD
            COUNT       .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
             946-       PTUBE   209     209     1.5     .0625
             947-       PTUBE   210     210     1.5     .0625
             948-       PTUBE   211     211     1.5     .0625
             949-       PTUBE   212     212     1.5     .0625
             950-       PTUBE   213     213     1.5     .0625
             951-       PTUBE   214     214     1.5     .0625
             952-       PTUBE   215     215     1.5     .0625
             953-       PTUBE   216     216     1.5     .0625
             954-       PTUBE   217     217     1.5     .0625
             955-       PTUBE   218     218     1.5     .0625
             956-       PTUBE   219     219     1.5     .0625
             957-       PTUBE   220     220     1.5     .0625
             958-       PTUBE   221     221     1.5     .0625
             959-       PTUBE   222     222     1.5     .0625
             960-       PTUBE   223     223     1.5     .0625
             961-       PTUBE   224     224     1.5     .0625
             962-       PTUBE   225     225     1.5     .0625
             963-       PTUBE   226     226     1.5     .0625
             964-       SPC     10      1       123456          2       123456
             965-       SPC     10      3       123456          4       123456
                        ENDDATA

 *  19.6 CPU-S  71.0 COR-S    119 ELP-S.      XGP1

         **NO ERRORS FOUND - EXECUTE NASTRAN PROGRAM**

 *  23.1 CPU-S  75.3 COR-S    131 ELP-S.      SEM1  END

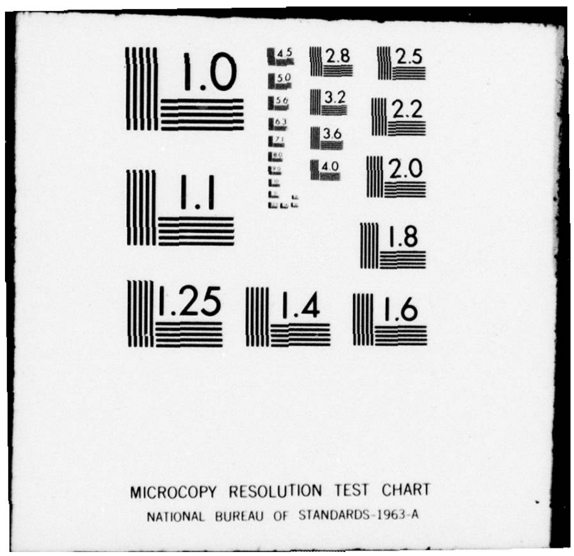
 *  23.1 CPU-S  75.3 COR-S    131 ELP-S.      ----  LINK  END  ---
```

AD-A064 181 ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND ABERD--ETC F/G 1/3
HIGHLY SURVIVABLE TRUSS TYPE TAIL BOOM.(U)
NOV 78 T F ERLINE

UNCLASSIFIED ARBRL-TR-02123 SBIE-AD-E430 172 NL

2 OF 2
AD
A064181

END
DATE
FILMED
4-79
DDC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3.2
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4.5
5.0
5.6
6.3
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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DAMAGE CRITERION = NONE

                                  S O R T E D   B U L K   D A T A   E C H O
           CARD
           COUNT      .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
            946-      PTUBE  209     209     1.5     .0625
            947-      PTUBE  210     210     1.5     .0625
            948-      PTUBE  211     211     1.5     .0625
            949-      PTUBE  212     212     1.5     .0625
            950-      PTUBE  213     213     1.5     .0625
            951-      PTUBE  214     214     1.5     .0625
            952-      PTUBE  215     215     1.5     .0625
            953-      PTUBE  216     216     1.5     .0625
            954-      PTUBE  217     217     1.5     .0625
            955-      PTUBE  218     218     1.5     .0625
            956-      PTUBE  219     219     1.5     .0625
            957-      PTUBE  220     220     1.5     .0625
            958-      PTUBE  221     221     1.5     .0625
            959-      PTUBE  222     222     1.5     .0625
            960-      PTUBE  223     223     1.5     .0625
            961-      PTUBE  224     224     1.5     .0625
            962-      PTUBE  225     225     1.5     .0625
            963-      PTUBE  226     226     1.5     .0625
            964-      SPC    10      1       123456          2       123456
            965-      SPC    10      3       123456          4       123456
                      ENDDATA

 *  19.6 CPU-S  71.0 COR-S   119 ELP-S.     XGP1

        **NO ERRORS FOUND - EXECUTE NASTRAN PROGRAM**

 *  23.1 CPU-S  75.3 COR-S   131 ELP-S.     SEM1  END

 *  23.1 CPU-S  75.3 COR-S   131 ELP-S.     ----  LINK  END  ---
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TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 28
DAMAGE CRITERION = NONE

LINEAR CASE 30 % LOADING SUBCASE 1

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1*	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	3.317836-03	-4.525320-03	2.740695-04	.0	.0	.0
6	G	-7.179699-04	2.263182-03	8.276372-04	.0	.0	.0
7	G	-3.250243-03	1.422724-03	-5.456768-03	.0	.0	.0
8	G	5.966247-04	-3.688462-03	-4.836820-03	.0	.0	.0
9	G	6.047826-03	-1.120983-02	-2.942591-03	.0	.0	.0
10	G	-8.974057-04	9.010426-04	-2.458876-03	.0	.0	.0
11	G	-5.959460-03	3.353342-04	-1.394383-02	.0	.0	.0
12	G	6.588768-04	-1.062861-02	-1.344618-02	.0	.0	.0
13	G	8.030114-03	-2.034682-02	-8.673496-03	.0	.0	.0
14	G	-5.977568-04	-3.228083-03	-8.271170-03	.0	.0	.0
15	G	-8.014410-03	-3.596386-03	-2.457499-02	.0	.0	.0
16	G	2.322426-04	-1.998783-02	-2.408844-02	.0	.0	.0
17	G	9.446027-03	-3.179971-02	-1.560709-02	.0	.0	.0
18	G	1.477403-04	-9.917407-03	-1.523586-02	.0	.0	.0
19	G	-9.468949-03	-1.008557-02	-3.600965-02	.0	.0	.0
20	G	-6.510956-04	-3.161392-02	-3.562558-02	.0	.0	.0
21	G	1.018451-02	-4.528521-02	-2.304737-02	.0	.0	.0
22	G	1.261433-03	-1.915144-02	-2.259622-02	.0	.0	.0
23	G	-1.039838-02	-1.912108-02	-4.751317-02	.0	.0	.0
24	G	-1.976220-03	-4.531758-02	-4.721712-02	.0	.0	.0
25	G	1.084307-02	-6.111844-02	-2.947164-02	.0	.0	.0
26	G	2.441486-03	-3.066077-02	-2.924202-02	.0	.0	.0
27	G	-1.109875-02	-3.065947-02	-5.797527-02	.0	.0	.0
28	G	-3.362920-03	-6.112394-02	-5.775036-02	.0	.0	.0
29	G	1.124946-02	-7.849591-02	-3.567908-02	.0	.0	.0
30	G	3.547208-03	-4.429195-02	-3.534126-02	.0	.0	.0
31	G	-1.177890-02	-4.428613-02	-6.770101-02	.0	.0	.0
32	G	-4.606679-03	-7.850019-02	-6.726075-02	.0	.0	.0
33	G	1.171436-02	-9.796644-02	-4.140473-02	.0	.0	.0
34	G	4.472547-03	-5.969817-02	-4.105748-02	.0	.0	.0
35	G	-1.240374-02	-5.969571-02	-7.659027-02	.0	.0	.0
36	G	-5.828729-03	-9.796801-02	-7.623815-02	.0	.0	.0
37	G	1.230858-02	-1.190330-01	-4.650517-02	.0	.0	.0
38	G	5.372231-03	-7.750216-02	-4.624579-02	.0	.0	.0
39	G	-1.278492-02	-7.749596-02	-8.468287-02	.0	.0	.0
40	G	-7.096980-03	-1.190386-01	-8.465548-02	.0	.0	.0
41	G	1.287949-02	-1.425276-01	-5.188111-02	.0	.0	.0
42	G	5.943539-03	-9.621248-02	-5.194198-02	.0	.0	.0
43	G	-1.310663-02	-9.621593-02	-9.160534-02	.0	.0	.0
44	G	-8.188774-03	-1.425316-01	-9.167417-02	.0	.0	.0

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 39

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	8.161912-03	-1.098737-02	5.579749-04	.0	.0	.0
6	G	-1.331652-03	5.506288-03	1.917068-03	.0	.0	.0
7	G	-7.990130-03	3.424577-03	-1.329790-02	.0	.0	.0
8	G	1.547047-03	-8.898459-03	-1.179971-02	.0	.0	.0
9	G	1.490923-02	-2.720790-02	-7.559873-03	.0	.0	.0
10	G	-2.355201-03	2.166273-03	-6.371371-03	.0	.0	.0
11	G	-1.467079-02	7.538492-04	-3.417505-02	.0	.0	.0
12	G	1.803218-03	-2.573578-02	-3.296987-02	.0	.0	.0
13	G	1.963718-02	-4.940244-02	-2.198809-02	.0	.0	.0
14	G	-1.719038-03	-7.911682-03	-2.100304-02	.0	.0	.0
15	G	-1.975753-02	-8.845319-03	-6.046708-02	.0	.0	.0
16	G	8.759458-04	-4.846624-02	-5.928702-02	.0	.0	.0
17	G	2.337609-02	-7.722830-02	-3.953872-02	.0	.0	.0
18	G	-7.862373-06	-2.421004-02	-3.863130-02	.0	.0	.0
19	G	-2.337501-02	-2.465797-02	-8.890931-02	.0	.0	.0
20	G	-1.154399-03	-7.670873-02	-8.798461-02	.0	.0	.0
21	G	2.524820-02	-1.099700-01	-5.851043-02	.0	.0	.0
22	G	2.586679-03	-4.666657-02	-5.742018-02	.0	.0	.0
23	G	-2.569833-02	-4.663386-02	-1.177156-01	.0	.0	.0
24	G	-4.249045-03	-1.099780-01	-1.170125-01	.0	.0	.0
25	G	2.691707-02	-1.483379-01	-7.521807-02	.0	.0	.0
26	G	5.345885-03	-7.457530-02	-7.466317-02	.0	.0	.0
27	G	-2.744954-02	-7.460943-02	-1.441914-01	.0	.0	.0
28	G	-7.489396-03	-1.482817-01	-1.436619-01	.0	.0	.0
29	G	2.795246-02	-1.904010-01	-9.155695-02	.0	.0	.0
30	G	7.934486-03	-1.075763-01	-9.074915-02	.0	.0	.0
31	G	-2.914447-02	-1.075954-01	-1.690522-01	.0	.0	.0
32	G	-1.040860-02	-1.903437-01	-1.679927-01	.0	.0	.0
33	G	2.912243-02	-2.374892-01	-1.068737-01	.0	.0	.0
34	G	1.009445-02	-1.446328-01	-1.060361-01	.0	.0	.0
35	G	-3.070055-02	-1.448545-01	-1.920171-01	.0	.0	.0
36	G	-1.328380-02	-2.374274-01	-1.911783-01	.0	.0	.0
37	G	3.060175-02	-2.884089-01	-1.207733-01	.0	.0	.0
38	G	1.222505-02	-1.878536-01	-1.201455-01	.0	.0	.0
39	G	-3.164108-02	-1.878572-01	-2.131544-01	.0	.0	.0
40	G	-1.627245-02	-2.883468-01	-2.131045-01	.0	.0	.0
41	G	3.198195-02	-3.451012-01	-1.353408-01	.0	.0	.0
42	G	1.554832-02	-2.330576-01	-1.356319-01	.0	.0	.0
43	G	-3.246165-02	-2.330799-01	-2.316478-01	.0	.0	.0
44	G	-1.887229-02	-3.451223-01	-2.316757-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	6	.0	.0	.0	.0	.0	.0
2	6	.0	.0	.0	.0	.0	.0
3	6	.0	.0	.0	.0	.0	.0
4	6	.0	.0	.0	.0	.0	.0
5	6	5.401103-03	-7.302572-03	3.946496-04	.0	.0	.0
6	6	-1.198328-03	3.657666-03	1.294459-03	.0	.0	.0
7	6	-5.288627-03	2.283098-03	-8.827812-03	.0	.0	.0
8	6	1.006949-03	-5.926726-03	-7.830610-03	.0	.0	.0
9	6	9.659174-03	-1.808461-02	-4.933166-03	.0	.0	.0
10	6	-1.527266-03	1.446033-03	-4.146489-03	.0	.0	.0
11	6	-9.706006-03	5.158317-04	-2.264438-02	.0	.0	.0
12	6	1.154376-03	-1.711960-02	-2.184279-02	.0	.0	.0
13	6	1.310690-02	-3.283236-02	-1.440982-02	.0	.0	.0
14	6	-1.084519-03	-5.239063-03	-1.375706-02	.0	.0	.0
15	6	-1.306519-02	-5.850910-03	-4.001381-02	.0	.0	.0
16	6	5.143350-04	-3.222438-02	-3.922930-02	.0	.0	.0
17	6	1.543848-02	-5.132059-02	-2.591715-02	.0	.0	.0
18	6	7.447933-05	-1.605720-02	-2.531549-02	.0	.0	.0
19	6	-1.545040-02	-1.634617-02	-5.876828-02	.0	.0	.0
20	6	-8.602542-04	-5.099040-02	-5.815204-02	.0	.0	.0
21	6	1.666514-02	-7.308003-02	-3.832684-02	.0	.0	.0
22	6	1.823047-03	-3.097260-02	-3.760114-02	.0	.0	.0
23	6	-1.697971-02	-3.094178-02	-7.772112-02	.0	.0	.0
24	6	-2.944162-03	-7.310096-02	-7.725040-02	.0	.0	.0
25	6	1.775880-02	-9.859499-02	-4.918683-02	.0	.0	.0
26	6	3.680367-03	-4.952760-02	-4.881749-02	.0	.0	.0
27	6	-1.813233-02	-4.954203-02	-9.508106-02	.0	.0	.0
28	6	-5.125788-03	-9.857303-02	-9.472551-02	.0	.0	.0
29	6	1.843620-02	-1.265778-01	-5.976685-02	.0	.0	.0
30	6	5.422151-03	-7.148031-02	-5.922723-02	.0	.0	.0
31	6	-1.924920-02	-7.148564-02	-1.113292-01	.0	.0	.0
32	6	-7.088307-03	-1.265547-01	-1.106230-01	.0	.0	.0
33	6	1.920476-02	-1.579131-01	-6.963489-02	.0	.0	.0
34	6	6.877025-03	-9.627356-02	-6.907696-02	.0	.0	.0
35	6	-2.027487-02	-9.628187-02	-1.262873-01	.0	.0	.0
36	6	-9.019688-03	-1.578865-01	-1.257263-01	.0	.0	.0
37	6	2.018002-02	-1.918048-01	-7.853878-02	.0	.0	.0
38	6	8.305113-03	-1.249110-01	-7.812101-02	.0	.0	.0
39	6	-2.089675-02	-1.249092-01	-1.400071-01	.0	.0	.0
40	6	-1.102624-02	-1.917804-01	-1.399702-01	.0	.0	.0
41	6	2.109892-02	-2.295606-01	-8.788695-02	.0	.0	.0
42	6	9.198828-03	-1.549945-01	-8.804872-02	.0	.0	.0
43	6	-2.143307-02	-1.550151-01	-1.519258-01	.0	.0	.0
44	6	-1.276571-02	-2.295722-01	-1.519764-01	.0	.0	.0

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 40

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	1.096420-02	-1.469579-02	6.984184-04	.0	.0	.0
6	G	-2.487121-03	7.367751-03	2.523562-03	.0	.0	.0
7	G	-1.073104-02	4.565494-03	-1.780627-02	.0	.0	.0
8	G	2.110931-03	-1.187691-02	-1.580512-02	.0	.0	.0
9	G	2.004217-02	-3.638981-02	-1.029409-02	.0	.0	.0
10	G	-3.224803-03	2.881837-03	-8.697676-03	.0	.0	.0
11	G	-1.971255-02	9.756505-04	-4.584691-02	.0	.0	.0
12	G	2.496644-03	-3.439400-02	-4.423597-02	.0	.0	.0
13	G	2.668495-02	-6.608486-02	-2.981716-02	.0	.0	.0
14	G	-2.413424-03	-1.062667-02	-2.849552-02	.0	.0	.0
15	G	-2.655981-02	-1.189280-02	-8.122218-02	.0	.0	.0
16	G	1.305582-03	-6.480412-02	-7.964410-02	.0	.0	.0
17	G	3.146380-02	-1.033173-01	-5.360582-02	.0	.0	.0
18	G	-1.679463-04	-3.245814-02	-5.238903-02	.0	.0	.0
19	G	-3.143681-02	-3.307480-02	-1.195619-01	.0	.0	.0
20	G	-1.359779-03	-1.025920-01	-1.183283-01	.0	.0	.0
21	G	3.400341-02	-1.471174-01	-7.937973-02	.0	.0	.0
22	G	3.253897-03	-6.251793-02	-7.792355-02	.0	.0	.0
23	G	-3.457429-02	-6.249245-02	-1.584763-01	.0	.0	.0
24	G	-5.444535-03	-1.470968-01	-1.575426-01	.0	.0	.0
25	G	3.626689-02	-1.984105-01	-1.022158-01	.0	.0	.0
26	G	6.897176-03	-9.983833-02	-1.014746-01	.0	.0	.0
27	G	-3.693942-02	-9.990059-02	-1.943624-01	.0	.0	.0
28	G	-9.722358-03	-1.983045-01	-1.936614-01	.0	.0	.0
29	G	3.767535-02	-2.546222-01	-1.246287-01	.0	.0	.0
30	G	1.031651-02	-1.439430-01	-1.235538-01	.0	.0	.0
31	G	-3.922579-02	-1.439834-01	-2.281658-01	.0	.0	.0
32	G	-1.358183-02	-2.545156-01	-2.267529-01	.0	.0	.0
33	G	3.925623-02	-3.175297-01	-1.457402-01	.0	.0	.0
34	G	1.316653-02	-1.937147-01	[illegible].446224-01	.0	.0	.0
35	G	-4.132415-02	-1.937561-01	[illegible].594938-01	.0	.0	.0
36	G	-1.738620-02	-3.174180-01	-2.583791-01	.0	.0	.0
37	G	4.125649-02	-3.855419-01	-1.650010-01	.0	.0	.0
38	G	1.599185-02	-2.511697-01	-1.641622-01	.0	.0	.0
39	G	-4.256842-02	-2.511627-01	-2.884251-01	.0	.0	.0
40	G	-2.134271-02	-3.854251-01	-2.883660-01	.0	.0	.0
41	G	4.3[illegible]9257-02	-4.612188-01	-1.851539-01	.0	.0	.0
42	G	1.773295-02	-3.115010-01	-1.856070-01	.0	.0	.0
43	G	-4.370124-02	-3.115723-01	-3.139087-01	.0	.0	.0
44	G	-2.479635-02	-4.612520-01	-3.138898-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1*	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	2.513079+03	1.8+01	.0		8	-5.730164+02	6.4+01	.0	
9	-2.414269+03	1.5+01	.0		10	5.012258+02	9.4+01	.0	
11	-5.859145+02	3.1+01	.0		12	1.332449+03	1.7+01	.0	
13	1.611815+03	1.4+01	.0		14	-3.826537+02	5.1+01	.0	
15	8.024666+02	2.8+01	.0		16	-1.541390+03	1.1+01	.0	
17	-1.789568+03	1.0+01	.0		18	5.326748+02	4.6+01	.0	
19	2.084545+02	7.6+01	.0		20	-1.696044+02	7.6+01	.0	
21	-1.812566+02	7.1+01	.0		22	1.472966+02	1.1+02	.0	
23	-4.804175+02	8.4+01	.0		24	-6.584026+02	6.6+01	.0	
25	4.690359+02	1.1+02	.0		26	6.651136+02	8.5+01	.0	
27	5.463867-01	4.9+04	.0		28	-3.218697+00	6.6+03	.0	
29	2.413797+03	2.1+01	.0		30	-2.070356+02	2.1+02	.0	
31	-2.366522+03	1.8+01	.0		32	1.769000+02	3.1+02	.0	
33	-6.684247+02	3.1+01	.0		34	1.319998+03	2.0+01	.0	
35	1.512953+03	1.8+01	.0		36	-7.138011+02	3.1+01	.0	
37	1.037365+03	2.5+01	.0		38	-1.686630+03	1.2+01	.0	
39	-1.603797+03	1.4+01	.0		40	7.910505+02	3.6+01	.0	
41	7.594144+01	2.5+02	.0		42	-1.390335+02	1.1+02	.0	
43	-5.975171+01	2.5+02	.0		44	1.235029+02	1.5+02	.0	
45	-4.808416+02	9.8+01	.0		46	-4.966935+02	1.0+02	.0	
47	4.793735+02	1.2+02	.0		48	4.883556+02	1.4+02	.0	
49	-3.075134+00	8.1+03	.0		50	-1.661591+00	1.5+04	.0	
51	2.184587+03	2.8+01	.0		52	2.079078+02	3.0+02	.0	
53	-2.124558+03	2.3+01	.0		54	-2.442134+02	2.1+02	.0	
55	-7.234236+02	3.4+01	.0		56	1.432937+03	2.1+01	.0	
57	1.494955+03	2.1+01	.0		58	-8.918735+02	2.9+01	.0	
59	1.125940+03	2.7+01	.0		60	-1.832963+03	1.3+01	.0	
61	-1.602568+03	1.6+01	.0		62	9.795283+02	3.4+01	.0	
63	8.157941+01	2.7+02	.0		64	-1.501217+02	1.2+02	.0	
65	-7.891406+01	2.2+02	.0		66	1.514687+02	1.4+02	.0	
67	-5.355593+02	1.0+02	.0		68	-3.395662+02	1.8+02	.0	
69	5.240415+02	1.3+02	.0		70	3.491517+02	2.3+02	.0	
71	-1.054932+00	2.8+04	.0		72	-5.177612-01	5.7+04	.0	
73	1.925554+03	3.7+01	.0		74	6.610580+02	1.1+02	.0	
75	-1.867392+03	3.1+01	.0		76	-6.992236+02	8.4+01	.0	
77	-7.868762+02	3.6+01	.0		78	1.550012+03	2.3+01	.0	
79	1.496589+03	2.5+01	.0		80	-1.108003+03	2.7+01	.0	
81	1.216079+03	2.9+01	.0		82	-1.979158+03	1.4+01	.0	
83	-1.595301+03	1.9+01	.0		84	1.197457+03	3.2+01	.0	
85	9.551575+01	2.7+02	.0		86	-1.611028+02	1.3+02	.0	
87	-8.889575+01	2.3+02	.0		88	1.533651+02	1.7+02	.0	
89	-5.662751+02	1.1+02	.0		90	-1.992517+02	3.5+02	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	5.707593+02	1.4+02	.0		92	1.784789+02	5.2+02	.0	
93	-6.397949+00	5.3+03	.0		94	-9.631348-01	3.5+04	.0	
95	1.651580+03	3.1+01	.0		96	1.144083+03	7.5+01	.0	
97	-1.590996+03	4.2+01	.0		98	-1.171246+03	5.8+01	.0	
99	-8.686906+02	3.9+01	.0		100	1.678153+03	2.5+01	.0	
101	1.479375+03	3.0+01	.0		102	-1.327839+03	2.7+01	.0	
103	1.325091+03	3.2+01	.0		104	-2.147634+03	1.5+01	.0	
105	-1.586388+03	2.2+01	.0		106	1.427854+03	3.2+01	.0	
107	9.443364+01	3.2+02	.0		108	-1.773944+02	1.3+02	.0	
109	-8.870654+01	2.7+02	.0		110	1.614818+02	1.8+02	.0	
111	-6.056536+02	1.2+02	.0		112	1.373535+01	7.6+03	.0	
113	6.023530+02	1.6+02	.0		114	-2.060889+01	4.2+03	.0	
115	-4.101563-01	9.8+04	.0		116	-4.515991+00	8.8+03	.0	
117	1.562786+03	6.4+01	.0		118	1.439171+03	6.9+01	.0	
119	-1.518171+03	5.2+01	.0		120	-1.490877+03	5.3+01	.0	
121	-1.174221+03	3.3+01	.0		122	2.068227+03	2.3+01	.0	
123	1.530281+03	3.4+01	.0		124	-1.502105+03	2.7+01	.0	
125	1.175889+03	4.2+01	.0		126	-2.059461+03	1.9+01	.0	
127	-1.637135+03	2.5+01	.0		128	1.610426+03	3.3+01	.0	
129	-3.067358+01	9.1+02	.0		130	-4.572046+01	6.1+02	.0	
131	4.156128+01	8.5+02	.0		132	3.908972+01	9.0+02	.0	
133	-6.649380+02	1.3+02	.0		134	-1.547363+01	6.2+03	.0	
135	6.554028+02	1.7+02	.0		136	1.045361+01	1.2+04	.0	
137	-1.223633+01	3.8+03	.0		138	4.810547+00	1.2+04	.0	
139	1.706793+03	6.8+01	.0		140	1.561146+03	7.3+01	.0	
141	-1.635831+03	5.6+01	.0		142	-1.619312+03	5.7+01	.0	
143	-1.294241+03	3.5+01	.0		144	2.249318+03	2.5+01	.0	
145	1.640231+03	3.7+01	.0		146	-1.619726+03	3.0+01	.0	
147	1.286183+03	4.4+01	.0		148	-2.251420+03	2.0+01	.0	
149	-1.778448+03	2.7+01	.0		150	1.756503+03	3.5+01	.0	
151	-4.603125+01	7.0+02	.0		152	-5.809705+01	5.7+02	.0	
153	5.495215+01	7.5+02	.0		154	4.388464+01	9.2+02	.0	
155	-7.308437+02	1.4+02	.0		156	-1.782715+01	6.5+03	.0	
157	7.256484+02	1.8+02	.0		158	4.179199+00	3.6+04	.0	
159	3.785156+00	1.3+04	.0		160	-1.290527+01	4.2+03	.0	
161	1.871228+03	7.1+01	.0		162	1.672579+03	8.1+01	.0	
163	-1.750305+03	6.1+01	.0		164	-1.781577+03	6.0+01	.0	
165	-1.395871+03	3.8+01	.0		166	2.467049+03	2.7+01	.0	
167	1.772514+03	4.0+01	.0		168	-1.754500+03	3.2+01	.0	
169	1.400972+03	4.7+01	.0		170	-2.466527+03	2.1+01	.0	
171	-1.929952+03	3.0+01	.0		172	1.906998+03	3.8+01	.0	
173	-3.214160+01	1.2+03	.0		174	-6.097119+01	6.3+02	.0	
175	5.655127+01	6.5+02	.0		176	3.238525+01	1.5+03	.0	
177	-7.890298+02	1.5+02	.0		178	-2.232422+01	6.1+03	.0	
179	7.912764+02	1.4+02	.0		180	7.098633+00	2.5+04	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
181	1.814941+01	4.4+03	.0		182	-2.389746+01	2.7+03	.0	
183	2.137536+03	7.4+01	.0		184	1.756927+03	8.9+01	.0	
185	-1.812439+03	6.9+01	.0		186	-2.034296+03	6.2+01	.0	
187	-1.588130+03	3.9+01	.0		188	2.716524+03	2.8+01	.0	
189	1.844613+03	4.6+01	.0		190	-1.823012+03	3.7+01	.0	
191	1.583730+03	4.9+01	.0		192	-2.729661+03	1.5+01	.0	
193	-1.995350+03	3.4+01	.0		194	1.967314+03	4.3+01	.0	
195	1.691662+01	3.3+03	.0		196	-1.419800+02	3.1+02	.0	
197	1.293525+02	4.3+02	.0		198	-2.707178+01	1.7+03	.0	
199	-8.801348+02	1.5+02	.0		200	-2.213672+01	7.2+03	.0	
201	8.631416+02	2.0+02	.0		202	-1.625000+00	1.0+05	.0	
203	6.003320+01	1.6+03	.0		204	-7.946729+01	9.4+02	.0	
205	2.477996+03	7.3+01	.0		206	1.584727+03	1.2+02	.0	
207	-1.691239+03	8.7+01	.0		208	-2.425800+03	5.9+01	.0	
209	-1.428569+03	5.0+01	.0		210	2.849251+03	3.2+01	.0	
211	2.229136+03	4.4+01	.0		212	-2.205611+03	3.5+01	.0	
213	1.461186+03	5.2+01	.0		214	-2.823113+03	2.5+01	.0	
215	-2.325636+03	3.4+01	.0		216	2.295219+03	4.4+01	.0	
217	-5.131152+02	1.0+02	.0		218	3.121401+02	2.1+02	.0	
219	-2.919414+02	1.8+02	.0		220	5.358247+02	1.2+02	.0	
221	-4.353975+02	3.7+02	.0		222	1.140039+01	2.1+04	.0	
223	5.359141+02	3.7+02	.0		224	2.076758+01	1.2+04	.0	
225	-1.710365+03	5.0+01	.0		226	1.780122+03	6.1+01	.0	

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING

SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	8.563584+02	9.3+01	.0		92	2.766646+02	3.3+02	.0	
93	-1.211914+01	2.6+03	.0		94	-3.129639+00	1.1+04	.0	
95	2.503874+03	3.3+01	.0		96	1.693946+03	5.0+01	.0	
97	-2.413285+03	2.8+01	.0		98	-1.730121+03	3.9+01	.0	
99	-1.294235+03	2.6+01	.0		100	2.522539+03	1.6+01	.0	
101	2.231884+03	1.9+01	.0		102	-1.989594+03	1.7+01	.0	
103	1.992042+03	2.1+01	.0		104	-3.226106+03	9.8+00	.0	
105	-2.390769+03	1.5+01	.0		106	2.134958+03	2.1+01	.0	
107	1.420098+02	2.1+02	.0		108	-2.657806+02	9.0+01	.0	
109	-1.348865+02	1.8+02	.0		110	2.409902+02	1.2+02	.0	
111	-9.100669+02	8.2+01	.0		112	5.246094+00	2.0+04	.0	
113	9.024551+02	1.0+02	.0		114	-2.187427+01	4.0+03	.0	
115	-2.819824+00	1.4+04	.0		116	-8.940918+00	4.5+03	.0	
117	2.374544+03	4.2+01	.0		118	2.133775+03	4.6+01	.0	
119	-2.303374+03	3.4+01	.0		120	-2.207244+03	3.6+01	.0	
121	-1.765076+03	2.2+01	.0		122	3.107073+03	1.5+01	.0	
123	2.308205+03	2.2+01	.0		124	-2.249587+03	1.8+01	.0	
125	1.768982+03	2.8+01	.0		126	-3.094152+03	1.2+01	.0	
127	-2.469725+03	1.6+01	.0		128	2.410490+03	2.2+01	.0	
129	-4.649414+01	6.0+02	.0		130	-6.978052+01	4.0+02	.0	
131	6.114600+01	5.7+02	.0		132	5.817676+01	6.0+02	.0	
133	-9.993750+02	8.6+01	.0		134	-3.957324+01	2.4+03	.0	
135	9.816182+02	1.1+02	.0		136	2.472119+01	5.2+03	.0	
137	-2.102051+01	2.2+03	.0		138	4.619629+00	1.3+04	.0	
139	2.591447+03	4.4+01	.0		140	2.316407+03	4.9+01	.0	
141	-2.479947+03	3.6+01	.0		142	-2.398841+03	3.8+01	.0	
143	-1.930448+03	2.3+01	.0		144	3.379048+03	1.7+01	.0	
145	2.473710+03	2.4+01	.0		146	-2.426299+03	2.0+01	.0	
147	1.935244+03	2.9+01	.0		148	-3.382723+03	1.3+01	.0	
149	-2.682609+03	1.6+01	.0		150	2.629799+03	2.3+01	.0	
151	-6.953961+01	4.6+02	.0		152	-8.861548+01	3.7+02	.0	
153	8.093730+01	5.1+02	.0		154	6.537671+01	6.2+02	.0	
155	-1.098455+03	9.2+01	.0		156	-4.418750+01	2.6+03	.0	
157	1.086801+03	1.2+02	.0		158	1.495410+01	1.0+04	.0	
159	2.578125+00	2.7+04	.0		160	-2.239502+01	2.4+03	.0	
161	2.838501+03	4.6+01	.0		162	2.483339+03	5.4+01	.0	
163	-2.651632+03	4.0+01	.0		164	-2.641626+03	4.0+01	.0	
165	-2.097825+03	2.5+01	.0		166	3.705879+03	1.8+01	.0	
167	2.672932+03	2.6+01	.0		168	-2.628769+03	2.1+01	.0	
169	2.104574+03	3.1+01	.0		170	-3.706188+03	1.4+01	.0	
171	-2.910718+03	1.9+01	.0		172	2.855780+03	2.5+01	.0	
173	-4.859863+01	7.5+02	.0		174	-9.324805+01	4.1+02	.0	
175	8.292440+01	5.0+02	.0		176	4.832275+01	9.8+02	.0	
177	-1.135227+03	9.9+01	.0		178	-5.191406+01	2.6+03	.0	
179	1.185654+03	1.2+02	.0		180	1.655664+01	9.5+03	.0	

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 47
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	3.797478+03	1.2+01	.0		8	-8.752129+02	4.2+01	.0	
9	-3.647329+03	9.3+00	.0		10	7.688577+02	6.1+01	.0	
11	-8.811505+02	2.0+01	.0		12	2.004681+03	1.1+01	.0	
13	2.423597+03	9.0+00	.0		14	-5.672701+02	3.4+01	.0	
15	1.203531+03	1.5+01	.0		16	-2.315942+03	7.2+00	.0	
17	-2.697972+03	6.3+00	.0		18	7.952054+02	3.0+01	.0	
19	3.125762+02	5.1+01	.0		20	-2.557945+02	5.0+01	.0	
21	-2.727904+02	4.7+01	.0		22	2.223576+02	7.1+01	.0	
23	-7.254938+02	5.5+01	.0		24	-9.995728+02	4.3+01	.0	
25	7.043995+02	7.1+01	.0		26	1.007280+03	5.6+01	.0	
27	-1.736420+00	1.2+04	.0		28	-5.503540+00	3.9+03	.0	
29	3.652574+03	1.4+01	.0		30	-3.266145+02	1.3+02	.0	
31	-3.578677+03	1.1+01	.0		32	2.842719+02	1.9+02	.0	
33	-1.004693+03	2.1+01	.0		34	1.985396+03	1.3+01	.0	
35	2.279516+03	1.1+01	.0		36	-1.065935+03	2.0+01	.0	
37	1.557409+03	1.6+01	.0		38	-2.535160+03	7.7+00	.0	
39	-2.417395+03	8.6+00	.0		40	1.183270+03	2.4+01	.0	
41	1.121420+02	1.7+02	.0		42	-2.088716+02	7.2+01	.0	
43	-9.013721+01	1.7+02	.0		44	1.856157+02	1.0+02	.0	
45	-7.258307+02	6.5+01	.0		46	-7.577074+02	6.7+01	.0	
47	7.206125+02	8.2+01	.0		48	7.415224+02	8.9+01	.0	
49	-7.169678+00	3.5+03	.0		50	-3.266418+00	7.7+03	.0	
51	3.310092+03	1.8+01	.0		52	2.949982+02	2.1+02	.0	
53	-3.216269+03	1.5+01	.0		54	-3.460582+02	1.5+02	.0	
55	-1.087029+03	2.2+01	.0		56	2.155097+03	1.4+01	.0	
57	2.253595+03	1.4+01	.0		58	-1.333581+03	1.9+01	.0	
59	1.690990+03	1.6+01	.0		60	-2.754711+03	8.3+00	.0	
61	-2.415609+03	1.0+01	.0		62	1.464707+03	2.2+01	.0	
63	1.212932+02	1.8+02	.0		64	-2.253537+02	7.8+01	.0	
65	-1.193195+02	1.5+02	.0		66	2.272993+02	9.6+01	.0	
67	-8.077521+02	6.7+01	.0		68	-5.228784+02	1.2+02	.0	
69	7.874292+02	8.7+01	.0		70	5.327816+02	1.5+02	.0	
71	-4.089111+00	7.2+03	.0		72	-1.989929+00	1.5+04	.0	
73	2.921486+03	2.4+01	.0		74	9.727913+02	7.6+01	.0	
75	-2.829970+03	2.0+01	.0		76	-1.026086+03	5.7+01	.0	
77	-1.182678+03	2.4+01	.0		78	2.330633+03	1.5+01	.0	
79	2.257688+03	1.6+01	.0		80	-1.658812+03	1.8+01	.0	
81	1.827187+03	1.9+01	.0		82	-2.973885+03	9.1+00	.0	
83	-2.404586+03	1.2+01	.0		84	1.790767+03	2.1+01	.0	
85	1.428909+02	1.8+02	.0		86	-2.416179+02	8.5+01	.0	
87	-1.347888+02	1.5+02	.0		88	2.295203+02	1.1+02	.0	
89	-8.530154+02	7.4+01	.0		90	-3.135308+02	2.3+02	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	5.101056+03	8.3+00	.0		8	-1.187582+03	3.1+01	.0	
9	-4.898210+03	6.7+00	.0		10	1.047549+03	4.4+01	.0	
11	-1.177830+03	1.5+01	.0		12	2.681167+03	7.9+00	.0	
13	3.252208+03	6.5+00	.0		14	-7.473961+02	2.5+01	.0	
15	1.604378+03	1.4+01	.0		16	-3.093311+03	5.1+00	.0	
17	-3.615645+03	4.5+00	.0		18	1.055270+03	2.3+01	.0	
19	4.166331+02	3.8+01	.0		20	-3.429081+02	3.7+01	.0	
21	-3.649494+02	3.5+01	.0		22	2.983596+02	5.3+01	.0	
23	-9.740558+02	4.1+01	.0		24	-1.348798+03	3.2+01	.0	
25	9.404948+02	5.3+01	.0		26	1.355931+03	4.1+01	.0	
27	-5.761383+00	3.7+03	.0		28	-8.237411+00	2.6+03	.0	
29	4.913271+03	1.0+01	.0		30	-4.565922+02	9.5+01	.0	
31	-4.810716+03	8.1+00	.0		32	4.039727+02	1.3+02	.0	
33	-1.342313+03	1.5+01	.0		34	2.654633+03	9.4+00	.0	
35	3.952952+03	8.3+00	.0		36	-1.414921+03	1.5+01	.0	
37	2.078325+03	1.2+01	.0		38	-3.387421+03	5.5+00	.0	
39	-3.233969+03	6.2+00	.0		40	1.573366+03	1.6+01	.0	
41	1.471295+02	1.3+02	.0		42	-2.789336+02	5.3+01	.0	
43	-1.208662+02	1.2+02	.0		44	2.479878+02	7.5+01	.0	
45	-9.740884+02	4.6+01	.0		46	-1.027256+03	4.9+01	.0	
47	9.630522+02	6.1+01	.0		48	1.000748+03	6.6+01	.0	
49	-1.301123+01	1.9+03	.0		50	-5.386261+00	4.6+03	.0	
51	4.458414+03	1.3+01	.0		52	3.711416+02	1.7+02	.0	
53	-4.323220+03	1.1+01	.0		54	-4.346582+02	1.2+02	.0	
55	-1.451903+03	1.6+01	.0		56	2.881327+03	1.0+01	.0	
57	3.019864+03	1.0+01	.0		58	-1.772530+03	1.4+01	.0	
59	2.257431+03	1.3+01	.0		60	-3.680252+03	6.0+00	.0	
61	-3.236694+03	7.3+00	.0		62	1.946927+03	1.7+01	.0	
63	1.602610+02	1.4+02	.0		64	-3.007039+02	5.8+01	.0	
65	-1.603645+02	1.1+02	.0		66	3.032131+02	7.2+01	.0	
67	-1.083105+03	5.0+01	.0		68	-7.153066+02	8.4+01	.0	
69	1.051694+03	6.5+01	.0		70	7.225172+02	1.1+02	.0	
71	-8.836670+00	3.5+03	.0		72	-4.268860+00	6.9+03	.0	
73	3.940192+03	1.8+01	.0		74	1.272265+03	5.8+01	.0	
75	-3.512399+03	1.5+01	.0		76	-1.338010+03	4.3+01	.0	
77	-1.580109+03	1.5+01	.0		78	3.115316+03	1.1+01	.0	
79	3.027567+03	1.2+01	.0		80	-2.207601+03	1.3+01	.0	
81	2.440461+03	1.4+01	.0		82	-3.972358+03	6.6+00	.0	
83	-3.221572+03	3.5+00	.0		84	2.380595+03	1.6+01	.0	
85	1.899875+02	1.3+02	.0		86	-3.221097+02	6.3+01	.0	
87	-1.816555+02	1.1+02	.0		88	3.053400+02	8.3+01	.0	
89	-1.142359+03	5.5+01	.0		90	-4.376880+02	1.6+02	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
181	2.395508+01	3.3+03	.0		182	-3.897070+01	1.6+03	.0	
183	3.239319+03	4.9+01	.0		184	2.611281+03	6.0+01	.0	
185	-2.744052+03	4.5+01	.0		186	-3.018602+03	4.2+01	.0	
187	-2.386809+03	2.6+01	.0		188	4.079921+03	1.9+01	.0	
189	2.780331+03	3.0+01	.0		190	-2.732912+03	2.4+01	.0	
191	2.382835+03	3.2+01	.0		192	-4.101758+03	9.9+00	.0	
193	-3.009968+03	2.2+01	.0		194	2.946871+03	2.9+01	.0	
195	2.414355+01	2.3+03	.0		196	-2.158149+02	2.1+02	.0	
197	1.903701+02	2.9+02	.0		198	-4.125977+01	1.1+03	.0	
199	-1.326468+03	1.0+02	.0		200	-5.622070+01	2.8+03	.0	
201	1.283807+03	1.3+02	.0		202	3.316406+00	6.3+04	.0	
203	8.250781+01	1.1+03	.0		204	-1.261562+02	5.9+02	.0	
205	3.740170+03	4.8+01	.0		206	2.346828+03	7.8+01	.0	
207	-2.569798+03	5.7+01	.0		208	-3.613542+03	3.9+01	.0	
209	-2.140976+03	3.3+01	.0		210	4.286477+03	2.1+01	.0	
211	3.359109+03	2.9+01	.0		212	-3.306238+03	2.3+01	.0	
213	2.203187+03	4.0+01	.0		214	-4.236790+03	1.7+01	.0	
215	-3.503229+03	2.2+01	.0		216	3.435506+03	2.9+01	.0	
217	-7.635715+02	6.7+01	.0		218	4.720903+02	1.4+02	.0	
219	-4.315557+02	1.2+02	.0		220	8.071997+02	7.9+01	.0	
221	-6.109180+02	2.6+02	.0		222	2.096875+01	1.1+04	.0	
223	8.462617+02	2.3+02	.0		224	4.253906+01	5.8+03	.0	
225	-2.533213+03	3.4+01	.0		226	2.691182+03	4.0+01	.0	

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION   OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 52
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 10   SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
181	2.753320+01	2.9+03	.0		182	-5.611230+01	1.1+03	.0	
183	4.363463+03	3.6+01	.0		184	3.449622+03	4.5+01	.0	
185	-3.692930+03	3.3+01	.0		166	-3.980987+03	3.1+01	.0	
187	-3.189072+03	1.9+01	.0		188	5.447357+03	1.4+01	.0	
189	3.726840+03	2.2+01	.0		190	-3.642287+03	1.8+01	.0	
191	3.187266+03	2.4+01	.0		192	-5.479344+03	7.2+00	.0	
193	-4.036521+03	1.6+01	.0		194	3.924226+03	2.1+01	.0	
195	3.050977+01	1.8+03	.0		196	-2.915430+02	1.5+02	.0	
197	2.502441+02	2.2+02	.0		198	-5.584814+01	8.0+02	.0	
199	-1.777078+03	7.6+01	.0		200	-1.057500+02	1.5+03	.0	
201	1.710539+03	1.0+02	.0		202	1.213281+01	1.7+04	.0	
203	9.987695+01	9.4+02	.0		204	-1.774834+02	4.2+02	.0	
205	5.017898+03	3.5+01	.0		206	3.088778+03	5.9+01	.0	
207	-3.470639+03	4.2+01	.0		208	-4.784399+03	3.0+01	.0	
209	-2.852751+03	2.5+01	.0		210	5.732853+03	1.5+01	.0	
211	4.500035+03	2.1+01	.0		212	-4.406020+03	1.7+01	.0	
213	2.956884+03	3.0+01	.0		214	-5.652594+03	1.2+01	.0	
215	-4.704664+03	1.6+01	.0		216	4.571439+03	2.2+01	.0	
217	-1.009607+03	5.0+01	.0		218	6.345557+02	1.0+02	.0	
219	-5.668281+02	4.2+01	.0		220	1.080805+03	5.9+01	.0	
221	-7.581074+02	2.1+02	.0		222	3.311719+01	7.2+03	.0	
223	1.185168+03	1.7+02	.0		224	7.192578+01	3.4+03	.0	
225	-3.333855+03	2.5+01	.0		226	3.615910+03	2.9+01	.0	

* 85.1 CPU-S 320.6 COR-S 977 ELP-S. 158 OFF END

* 65.2 CPU-S 320.6 COR-S 977 ELP-S. 179 EXIT BEGN

* * * END OF JOB * * *

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 51
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	1.143596+03	6.9+01	.0		92	3.808765+02	2.4+02	.0	
93	-1.956758+01	1.7+03	.0		94	-6.420288+00	5.3+03	.0	
95	3.387807+03	2.4+01	.0		96	2.229254+03	3.8+01	.0	
97	-3.253991+03	2.0+01	.0		98	-2.271342+03	2.9+01	.0	
99	-1.730025+03	1.9+01	.0		100	3.370831+03	1.2+01	.0	
101	2.995250+03	1.4+01	.0		102	-2.650071+03	1.3+01	.0	
103	2.662065+03	1.5+01	.0		104	-4.308036+03	7.1+00	.0	
105	-3.202899+03	1.1+01	.0		106	2.837690+03	1.5+01	.0	
107	1.893091+02	1.6+02	.0		108	-3.539541+02	6.7+01	.0	
109	-1.822925+02	1.3+02	.0		110	3.196942+02	9.3+01	.0	
111	-1.215705+03	6.1+01	.0		112	-1.357617+01	6.2+03	.0	
113	1.201986+03	7.7+01	.0		114	-1.704443+01	5.1+03	.0	
115	-6.734375+00	6.9+03	.0		116	-1.480127+01	2.7+03	.0	
117	3.207114+03	3.0+01	.0		118	2.811887+03	3.5+01	.0	
119	-3.106521+03	2.5+01	.0		120	-2.904386+03	2.7+01	.0	
121	-2.358629+03	1.6+01	.0		122	4.149485+03	1.1+01	.0	
123	3.095008+03	1.6+01	.0		124	-2.994922+03	1.3+01	.0	
125	2.365713+03	2.0+01	.0		126	-4.132564+03	8.8+00	.0	
127	-3.312031+03	1.2+01	.0		128	3.207362+03	1.6+01	.0	
129	-6.266064+01	4.5+02	.0		130	-9.464111+01	2.9+02	.0	
131	7.992236+01	4.4+02	.0		132	7.697778+01	4.6+02	.0	
133	-1.335275+03	6.4+01	.0		134	-7.468359+01	1.3+03	.0	
135	1.306969+03	8.2+01	.0		136	4.508789+01	2.8+03	.0	
137	-3.162012+01	1.5+03	.0		138	2.710937+00	2.1+04	.0	
139	3.497457+03	3.2+01	.0		140	3.054913+03	3.7+01	.0	
141	-3.342004+03	2.7+01	.0		142	-3.158396+03	2.9+01	.0	
143	-2.579676+03	1.7+01	.0		144	4.512638+03	1.2+01	.0	
145	3.316531+03	1.8+01	.0		146	-3.230994+03	1.4+01	.0	
147	2.588586+03	2.1+01	.0		148	-4.518240+03	9.5+00	.0	
149	-3.597171+03	1.3+01	.0		150	3.500107+03	1.7+01	.0	
151	-9.355957+01	3.5+02	.0		152	-1.201167+02	2.7+02	.0	
153	1.060498+02	3.9+02	.0		154	8.658984+01	4.7+02	.0	
155	-1.467660+03	6.8+01	.0		156	-8.228125+01	1.4+03	.0	
157	1.446943+03	8.7+01	.0		158	3.158301+01	4.7+03	.0	
159	-7.363281-01	7.4+04	.0		160	-3.389844+01	1.6+03	.0	
161	3.827334+03	3.4+01	.0		162	3.277151+03	4.1+01	.0	
163	-3.570811+03	3.0+01	.0		164	-3.481243+03	3.0+01	.0	
165	-2.802858+03	1.8+01	.0		166	4.948802+03	1.3+01	.0	
167	3.583319+03	1.9+01	.0		168	-3.501463+03	1.6+01	.0	
169	2.821336+03	2.3+01	.0		170	-4.950678+03	1.0+01	.0	
171	-3.902544+03	1.4+01	.0		172	3.801829+03	1.9+01	.0	
173	-6.533867+01	5.8+02	.0		174	-1.267148+02	3.0+02	.0	
175	1.080088+02	4.5+02	.0		176	6.411182+01	7.4+02	.0	
177	-1.582652+03	7.4+01	.0		178	-9.389062+01	1.5+03	.0	
179	1.579355+03	9.2+01	.0		180	3.534180+01	5.0+03	.0	

APPENDIX B

NASTRAN MATHEMATICAL MODEL OF THE UNDAMAGED TRUSS MODEL 2 PLUS OUTPUT OF DISPLACEMENTS, STRESSES AND MARGINS OF SAFETY DUE TO FLIGHT LOADS.

UNIVAC 1100 SERIES
MODEL 1108

RIGID FORMAT SERIES M3

LEVEL 77.1.0

DATE - 7/15/77

SYSTEM GENERATED BY SPERRY SUPPORT SERVICES

24

N A S T R A N   E X E C U T I V E   C O N T R O L   D E C K   E C H O

```
ID ERLINE,MODEL2
APP DISP
$ STATIC ANALYSIS WITH DIFFERENTIAL STIFFNESS RF 4
SOL 4,0
TIME 10
CEND
```

```
                              C A S E   C O N T R O L   D E C K   E C H O
  CARD
  COUNT
    1      TITLE = TRUSS TAIL BOOM  MODEL2  **A 114 ELEMENT VERSION
    2      SUBTITLE = DAMAGE CRITION = NONE
    3      OLOAD = ALL
    4      SPC = 10
    5      SPCFORCES = ALL
    6      DISP = ALL
    7      SET 5 = 1 THRU 138
    8          SUBCASE 1
    9          LABEL = LINEAR CASE
   10          LOAD = 11
   11          SUBCASE 2
   12          LABEL = INCREMENTAL STIFFNESS
   13      DSCOEFFICIENT = 200
   14          STRESS = 5
   15      MAXLINES = 100000
   16      BEGIN BULK
```

*** USER INFORMATION MESSAGE 207, BULK DATA NOT SORTED,XSORT WILL RE-ORDER DECK.

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
1-	CTUBE	1	1	1	2
2-	CTUBE	2	2	1	4
3-	CTUBE	3	3	3	4
4-	CTUBE	4	4	2	3
5-	CTUBE	5	5	1	3
6-	CTUBE	6	6	2	4
7-	CTUBE	7	7	1	5
8-	CTUBE	8	8	2	6
9-	CTUBE	9	9	3	7
10-	CTUBE	10	10	4	8
11-	CTUBE	11	11	1	6
12-	CTUBE	12	12	2	5
13-	CTUBE	13	13	1	8
14-	CTUBE	14	14	4	5
15-	CTUBE	15	15	4	7
16-	CTUBE	16	16	3	8
17-	CTUBE	17	17	2	7
18-	CTUBE	18	18	3	6
19-	CTUBE	23	23	5	6
20-	CTUBE	24	24	5	8
21-	CTUBE	25	25	7	8
22-	CTUBE	26	26	6	7
23-	CTUBE	27	27	5	7
24-	CTUBE	28	28	6	8
25-	CTUBE	29	29	5	9
26-	CTUBE	30	30	6	10
27-	CTUBE	31	31	7	11
28-	CTUBE	32	32	8	12
29-	CTUBE	33	33	5	10
30-	CTUBE	34	34	6	9
31-	CTUBE	35	35	5	12
32-	CTUBE	36	36	8	9
33-	CTUBE	37	37	8	11
34-	CTUBE	38	38	7	12
35-	CTUBE	39	39	6	11
36-	CTUBE	40	40	7	10
37-	CTUBE	45	45	9	10
38-	CTUBE	46	46	9	12
39-	CTUBE	47	47	11	12
40-	CTUBE	48	48	10	11
41-	CTUBE	49	49	9	11
42-	CTUBE	50	50	10	12
43-	CTUBE	51	51	9	13
44-	CTUBE	52	52	10	14
45-	CTUBE	53	53	11	15

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
46-	CTUBE	54	54	12	16
47-	CTUBE	55	55	9	14
48-	CTUBE	56	56	10	13
49-	CTUBE	57	57	9	16
50-	CTUBE	58	58	12	13
51-	CTUBE	59	59	12	15
52-	CTUBE	60	60	11	16
53-	CTUBE	61	61	10	15
54-	CTUBE	62	62	11	14
55-	CTUBE	67	67	13	14
56-	CTUBE	68	68	13	16
57-	CTUBE	69	69	15	16
58-	CTUBE	70	70	14	15
59-	CTUBE	71	71	13	15
60-	CTUBE	72	72	14	16
61-	CTUBE	73	73	13	17
62-	CTUBE	74	74	14	18
63-	CTUBE	75	75	15	19
64-	CTUBE	76	76	16	20
65-	CTUBE	77	77	13	18
66-	CTUBE	78	78	14	17
67-	CTUBE	79	79	13	20
68-	CTUBE	80	80	16	17
69-	CTUBE	81	81	16	19
70-	CTUBE	82	82	15	20
71-	CTUBE	83	83	14	19
72-	CTUBE	84	84	15	18
73-	CTUBE	89	89	17	18
74-	CTUBE	90	90	17	20
75-	CTUBE	91	91	19	20
76-	CTUBE	92	92	18	19
77-	CTUBE	93	93	17	19
78-	CTUBE	94	94	18	20
79-	CTUBE	95	95	17	21
80-	CTUBE	96	96	18	22
81-	CTUBE	97	97	19	23
82-	CTUBE	98	98	20	24
83-	CTUBE	99	99	17	22
84-	CTUBE	100	100	18	21
85-	CTUBE	101	101	17	24
86-	CTUBE	102	102	20	21
87-	CTUBE	103	103	20	23
88-	CTUBE	104	104	19	24
89-	CTUBE	105	105	18	23
90-	CTUBE	106	106	19	22

```
TRUSS TAIL BOOM  MODEL2  **A 114 ELEMENT VERSION                    OCTOBER  26, 1977   NASTRAN  7/15/77     PAGE      5
DAMAGE CRITION = NONE

                                    S O R T E D   B U L K   D A T A   E C H O
    CARD
    COUNT       .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
      91-       CTUBE   111     111     21      22
      92-       CTUBE   112     112     21      24
      93-       CTUBE   113     113     23      24
      94-       CTUBE   114     114     22      23
      95-       CTUBE   115     115     21      23
      96-       CTUBE   116     116     22      24
      97-       CTUBE   117     117     21      25
      98-       CTUBE   118     118     22      26
      99-       CTUBE   119     119     23      27
     100-       CTUBE   120     120     24      28
     101-       CTUBE   121     121     21      26
     102-       CTUBE   122     122     22      25
     103-       CTUBE   123     123     21      28
     104-       CTUBE   124     124     24      25
     105-       CTUBE   125     125     24      27
     106-       CTUBE   126     126     23      28
     107-       CTUBE   127     127     22      27
     108-       CTUBE   128     128     23      26
     109-       CTUBE   133     133     25      26
     110-       CTUBE   134     134     25      28
     111-       CTUBE   135     135     27      28
     112-       CTUBE   136     136     26      27
     113-       CTUBE   137     137     25      27
     114-       CTUBE   138     138     26      28
     115-       USFACT  200     1.60422 2.40632 3.20843
     116-       FORCE   11      13      0       44.2200 .0      0.0     -1.
     117-       FORCE   11      14      0       44.2200 .0      0.0     -1.
     118-       FORCE   11      15      0       44.2200 .0      0.0     -1.
     119-       FORCE   11      16      0       44.2200 .0      0.0     -1.
     120-       FORCE   11      25      0       464.5   1.      .0      .0
     121-       FORCE   11      25      0       527.3   .0      -1.0    .0
     122-       FORCE   11      26      0       464.5   1.0     0.0     .0
     123-       FORCE   11      26      0       527.3   .0      1.      .0
     124-       FORCE   11      27      0       464.5   -1.     0.0     .0
     125-       FORCE   11      27      0       527.5   .0      1.      .0
     126-       FORCE   11      28      0       464.5   -1.     .0      .0
     127-       FORCE   11      28      0       527.3   .0      -1.     .0
     128-       GRDSET                                                  456
     129-       GRID    1               .000    11.95   12.375
     130-       GRID    2               .000    11.75   -12.375
     131-       GRID    3               .000    -11.75  -12.375
     132-       GRID    4               .000    -11.95  12.375
     133-       GRID    5               33.5    10.666  11.105
     134-       GRID    6               33.5    10.485  -11.105
     135-       GRID    7               33.5    -10.485 -11.105
```

S O R T E D   B U L K   D A T A   E C H O

```
 CARD
 COUNT       .   1   ..   2   ..   3   ..   4   ..   5   ..   6   ..   7   ..   8   ..   9   ..  10  .
  136-       GRID    8                       33.5    -10.666 11.105
  137-       GRID    9                       66.5    9.401   9.855
  138-       GRID    10                      66.5    9.239   -9.855
  139-       GRID    11                      66.5    -9.239  -9.855
  140-       GRID    12                      66.5    -9.401  9.855
  141-       GRID    13                      99.5    8.136   8.604
  142-       GRID    14                      99.5    7.994   -8.604
  143-       GRID    15                      99.5    -7.994  -8.604
  144-       GRID    16                      99.5    -8.136  8.604
  145-       GRID    17                      127.5   7.063   7.543
  146-       GRID    18                      127.5   6.937   -7.543
  147-       GRID    19                      127.5   -6.937  -7.543
  148-       GRID    20                      127.5   -7.063  7.543
  149-       GRID    21                      151.5   6.143   6.634
  150-       GRID    22                      151.5   6.031   -6.634
  151-       GRID    23                      151.5   -6.031  -6.634
  152-       GRID    24                      151.5   -6.143  6.634
  153-       GRID    25                      173.5   5.3     5.8
  154-       GRID    26                      173.5   5.2     -5.8
  155-       GRID    27                      173.5   -5.2    -5.8
  156-       GRID    28                      173.5   -5.3    5.800
  157-       MAT1    1               10.5E6  3.8E6   .33     .1                                      +MAT001
  158-       +MAT001 4.38+04 3.51+04
  159-       MAT1    2               10.5E6  3.8E6   .33     .1                                      +MAT002
  160-       +MAT002 4.70+04 3.76+04
  161-       MAT1    3               10.5E6  3.8E6   .33     .1                                      +MAT003
  162-       +MAT003 4.38+04 3.51+04
  163-       MAT1    4               10.5E6  3.8E6   .33     .1                                      +MAT004
  164-       +MAT004 4.86+04 3.89+04
  165-       MAT1    5               10.5E6  3.8E6   .33     .1                                      +MAT005
  166-       +MAT005 2.29+04 1.83+04
  167-       MAT1    6               10.5E6  3.8E6   .33     .1                                      +MAT006
  168-       +MAT006 2.29+04 1.83+04
  169-       MAT1    7               10.5E6  3.8E6   .33     .1                                      +MAT007
  170-       +MAT007 2.38+04 1.91+04
  171-       MAT1    8               10.5E6  3.8E6   .33     .1                                      +MAT008
  172-       +MAT008 2.38+04 1.91+04
  173-       MAT1    9               10.5E6  3.8E6   .33     .1                                      +MAT009
  174-       +MAT009 2.38+04 1.91+04
  175-       MAT1    10              10.5E6  3.8E6   .33     .1                                      +MAT010
  176-       +MAT010 2.38+04 1.91+04
  177-       MAT1    11              10.5E6  3.8E6   .33     .1                                      +MAT011
  178-       +MAT011 1.60+04 1.28+04
  179-       MAT1    12              10.5E6  3.8E6   .33     .1                                      +MAT012
  180-       +MAT012 1.60+04 1.28+04
```

DAMAGE CRITION = NONE

SORTED BULK DATA ECHO

```
CARD
COUNT    .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  181-   MAT1    13       10.5E6  3.8E6   .33     .1                              +MAT013
  182-   +MAT013  1.64+04 1.31+04
  183-   MAT1    14       10.5E6  3.8E6   .33     .1                              +MAT014
  184-   +MAT014  1.64+04 1.31+04
  185-   MAT1    15       10.5E6  3.8E6   .33     .1                              +MAT015
  186-   +MAT015  1.60+04 1.28+04
  187-   MAT1    16       10.5E6  3.8E6   .33     .1                              +MAT016
  188-   +MAT016  1.60+04 1.28+04
  189-   MAT1    17       10.5E6  3.8E6   .33     .1                              +MAT017
  190-   +MAT017  1.66+04 1.33+04
  191-   MAT1    18       10.5E6  3.8E6   .33     .1                              +MAT018
  192-   +MAT018  1.66+04 1.33+04
  193-   MAT1    19       10.5E6  3.8E6   .33     .1                              +MAT019
  194-   +MAT019  1.23+04 9.86+03
  195-   MAT1    20       10.5E6  3.8E6   .33     .1                              +MAT020
  196-   +MAT020  1.23+04 9.87+03
  197-   MAT1    21       10.5E6  3.8E6   .33     .1                              +MAT021
  198-   +MAT021  1.23+04 9.87+03
  199-   MAT1    22       10.5E6  3.8E6   .33     .1                              +MAT022
  200-   +MAT022  1.23+04 9.86+03
  201-   MAT1    23       10.5E6  3.8E6   .33     .1                              +MAT023
  202-   +MAT023  5.44+04 4.35+04
  203-   MAT1    24       10.5E6  3.8E6   .33     .1                              +MAT024
  204-   +MAT024  5.90+04 4.72+04
  205-   MAT1    25       10.5E6  3.8E6   .33     .1                              +MAT025
  206-   +MAT025  5.44+04 4.35+04
  207-   MAT1    26       10.5E6  3.8E6   .33     .1                              +MAT026
  208-   +MAT026  6.10+04 4.88+04
  209-   MAT1    27       10.5E6  3.8E6   .33     .1                              +MAT027
  210-   +MAT027  2.85+04 2.28+04
  211-   MAT1    28       10.5E6  3.8E6   .33     .1                              +MAT028
  212-   +MAT028  2.85+04 2.28+04
  213-   MAT1    29       10.5E6  3.8E6   .33     .1                              +MAT029
  214-   +MAT029  2.46+04 1.97+04
  215-   MAT1    30       10.5E6  3.8E6   .33     .1                              +MAT030
  216-   +MAT030  2.46+04 1.97+04
  217-   MAT1    31       10.5E6  3.8E6   .33     .1                              +MAT031
  218-   +MAT031  2.46+04 1.97+04
  219-   MAT1    32       10.5E6  3.8E6   .33     .1                              +MAT032
  220-   +MAT032  2.46+04 1.97+04
  221-   MAT1    33       10.5E6  3.8E6   .33     .1                              +MAT033
  222-   +MAT033  1.75+04 1.40+04
  223-   MAT1    34       10.5E6  3.8E6   .33     .1                              +MAT034
  224-   +MAT034  1.75+04 1.40+04
  225-   MAT1    35       10.5E6  3.8E6   .33     .1                              +MAT035
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TRUSS TAIL BOOM MODEL2 **A 114 ELEMENT VERSION OCTOBER 26, 1977 NASTRAN 7/15/77 PAGE 8
DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
226-	+MAT035	1.80+04	1.44+04							
227-	MAT1	36	10.5E6	3.8E6	.33	.1				+MAT036
228-	+MAT036	1.80+04	1.44+04							
229-	MAT1	37	10.5E6	3.8E6	.33	.1				+MAT037
230-	+MAT037	1.75+04	1.40+04							
231-	MAT1	38	10.5E6	3.8E6	.33	.1				+MAT038
232-	+MAT038	1.75+04	1.40+04							
233-	MAT1	39	10.5E6	3.8E6	.33	.1				+MAT039
234-	+MAT039	1.81+04	1.45+04							
235-	MAT1	40	10.5E6	3.8E6	.33	.1				+MAT040
236-	+MAT040	1.81+04	1.45+04							
237-	MAT1	41	10.5E6	3.8E6	.33	.1				+MAT041
238-	+MAT041	1.39+04	1.12+04							
239-	MAT1	42	10.5E6	3.8E6	.33	.1				+MAT042
240-	+MAT042	1.40+04	1.12+04							
241-	MAT1	43	10.5E6	3.8E6	.33	.1				+MAT043
242-	+MAT043	1.40+04	1.12+04							
243-	MAT1	44	10.5E6	3.8E6	.33	.1				+MAT044
244-	+MAT044	1.39+04	1.12+04							
245-	MAT1	45	10.5E6	3.8E6	.33	.1				+MAT045
246-	+MAT045	6.91+04	5.53+04							
247-	MAT1	46	10.5E6	3.8E6	.33	.1				+MAT046
248-	+MAT046	7.59+04	6.08+04							
249-	MAT1	47	10.5E6	3.8E6	.33	.1				+MAT047
250-	+MAT047	6.91+04	5.53+04							
251-	MAT1	48	10.5E6	3.8E6	.33	.1				+MAT048
252-	+MAT048	7.86+04	6.29+04							
253-	MAT1	49	10.5E6	3.8E6	.33	.1				+MAT049
254-	+MAT049	3.65+04	2.92+04							
255-	MAT1	50	10.5E6	3.8E6	.33	.1				+MAT050
256-	+MAT050	3.65+04	2.92+04							
257-	MAT1	51	10.5E6	3.8E6	.33	.1				+MAT051
258-	+MAT051	2.46+04	1.97+04							
259-	MAT1	52	10.5E6	3.8E6	.33	.1				+MAT052
260-	+MAT052	2.46+04	1.97+04							
261-	MAT1	53	10.5E6	3.8E6	.33	.1				+MAT053
262-	+MAT053	2.46+04	1.97+04							
263-	MAT1	54	10.5E6	3.8E6	.33	.1				+MAT054
264-	+MAT054	2.46+04	1.97+04							
265-	MAT1	55	10.5E6	3.8E6	.33	.1				+MAT055
266-	+MAT055	1.87+04	1.50+04							
267-	MAT1	56	10.5E6	3.8E6	.33	.1				+MAT056
268-	+MAT056	1.88+04	1.50+04							
269-	MAT1	57	10.5E6	3.8E6	.33	.1				+MAT057
270-	+MAT057	1.92+04	1.54+04							

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
271-	MAT1	58	10.5E6	3.8E6	.33	.1				+MAT058
272-	+MAT058	1.92+04	1.54+04							
273-	MAT1	59	10.5E6	3.8E6	.33	.1				+MAT059
274-	+MAT059	1.87+04	1.50+04							
275-	MAT1	60	10.5E6	3.8E6	.33	.1				+MAT060
276-	+MAT060	1.88+04	1.50+04							
277-	MAT1	61	10.5E6	3.8E6	.33	.1				+MAT061
278-	+MAT061	1.93+04	1.55+04							
279-	MAT1	62	10.5E6	3.8E6	.33	.1				+MAT062
280-	+MAT062	1.93+04	1.55+04							
281-	MAT1	63	10.5E6	3.8E6	.33	.1				+MAT063
282-	+MAT063	1.55+04	1.24+04							
283-	MAT1	64	10.5E6	3.8E6	.33	.1				+MAT064
284-	+MAT064	1.55+04	1.24+04							
285-	MAT1	65	10.5E6	3.8E6	.33	.1				+MAT065
286-	+MAT065	1.55+04	1.24+04							
287-	MAT1	66	10.5E6	3.8E6	.33	.1				+MAT066
288-	+MAT066	1.55+04	1.24+04							
289-	MAT1	67	10.5E6	3.8E6	.33	.1				+MAT067
290-	+MAT067	9.06+04	7.25+04							
291-	MAT1	68	10.5E6	3.8E6	.33	.1				+MAT068
292-	+MAT068	1.01+05	8.11+04							
293-	MAT1	69	10.5E6	3.8E6	.33	.1				+MAT069
294-	+MAT069	9.06+04	7.25+04							
295-	MAT1	70	10.5E6	3.8E6	.33	.1				+MAT070
296-	+MAT070	1.05+05	8.40+04							
297-	MAT1	71	10.5E6	3.8E6	.33	.1				+MAT071
298-	+MAT071	4.82+04	3.86+04							
299-	MAT1	72	10.5E6	3.8E6	.33	.1				+MAT072
300-	+MAT072	4.82+04	3.86+04							
301-	MAT1	73	10.5E6	3.8E6	.33	.1				+MAT073
302-	+MAT073	3.41+04	2.73+04							
303-	MAT1	74	10.5E6	3.8E6	.33	.1				+MAT074
304-	+MAT074	3.41+04	2.73+04							
305-	MAT1	75	10.5E6	3.8E6	.33	.1				+MAT075
306-	+MAT075	3.41+04	2.73+04							
307-	MAT1	76	10.5E6	3.8E6	.33	.1				+MAT076
308-	+MAT076	3.41+04	2.73+04							
309-	MAT1	77	10.5E6	3.8E6	.33	.1				+MAT077
310-	+MAT077	2.57+04	2.05+04							
311-	MAT1	78	10.5E6	3.8E6	.33	.1				+MAT078
312-	+MAT078	2.57+04	2.05+04							
313-	MAT1	79	10.5E6	3.8E6	.33	.1				+MAT079
314-	+MAT079	2.64+04	2.11+04							
315-	MAT1	80	10.5E6	3.8E6	.33	.1				+MAT080

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	1	2	3	4	5	6	7	8	9	10
316-	+MAT080	2.64+04	2.11+04							
317-	MAT1	81	10.5E6	3.8E6	.33	.1				+MAT081
318-	+MAT081	2.57+04	2.05+04							
319-	MAT1	82	10.5E6	3.8E6	.33	.1				+MAT082
320-	+MAT082	2.57+04	2.05+04							
321-	MAT1	83	10.5E6	3.8E6	.33	.1				+MAT083
322-	+MAT083	2.66+04	2.13+04							
323-	MAT1	84	10.5E6	3.8E6	.33	.1				+MAT084
324-	+MAT084	2.66+04	2.13+04							
325-	MAT1	85	10.5E6	3.8E6	.33	.1				+MAT085
326-	+MAT085	2.11+04	1.69+04							
327-	MAT1	86	10.5E6	3.8E6	.33	.1				+MAT086
328-	+MAT086	2.11+04	1.69+04							
329-	MAT1	87	10.5E6	3.8E6	.33	.1				+MAT087
330-	+MAT087	2.11+04	1.69+04							
331-	MAT1	88	10.5E6	3.8E6	.33	.1				+MAT088
332-	+MAT088	2.11+04	1.69+04							
333-	MAT1	89	10.5E6	3.8E6	.33	.1				+MAT089
334-	+MAT089	1.18+05	9.43+04							
335-	MAT1	90	10.5E6	3.8E6	.33	.1				+MAT090
336-	+MAT090	1.34+05	1.08+05							
337-	MAT1	91	10.5E6	3.8E6	.33	.1				+MAT091
338-	+MAT091	1.18+05	9.43+04							
339-	MAT1	92	10.5E6	3.8E6	.33	.1				+MAT092
340-	+MAT092	1.40+05	1.12+05							
341-	MAT1	93	10.5E6	3.8E6	.33	.1				+MAT093
342-	+MAT093	6.34+04	5.07+04							
343-	MAT1	94	10.5E6	3.8E6	.33	.1				+MAT094
344-	+MAT094	6.34+04	5.07+04							
345-	MAT1	95	10.5E6	3.8E6	.33	.1				+MAT095
346-	+MAT095	4.65+04	3.72+04							
347-	MAT1	96	10.5E6	3.8E6	.33	.1				+MAT096
348-	+MAT096	4.65+04	3.72+04							
349-	MAT1	97	10.5E6	3.8E6	.33	.1				+MAT097
350-	+MAT097	4.65+04	3.72+04							
351-	MAT1	98	10.5E6	3.8E6	.33	.1				+MAT098
352-	+MAT098	4.65+04	3.72+04							
353-	MAT1	99	10.5E6	3.8E6	.33	.1				+MAT099
354-	+MAT099	3.45+04	2.76+04							
355-	MAT1	100	10.5E6	3.8E6	.33	.1				+MAT100
356-	+MAT100	3.45+04	2.76+04							
357-	MAT1	101	10.5E6	3.8E6	.33	.1				+MAT101
358-	+MAT101	3.57+04	2.86+04							
359-	MAT1	102	10.5E6	3.8E6	.33	.1				+MAT102
360-	+MAT102	3.57+04	2.86+04							

S O R T E D   B U L K   D A T A   E C H O

```
 CARD
 COUNT      .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
  361-      MAT1    103     10.5E6  3.8E6   .33     .1                                      +MAT103
  362-      +MAT103 3.45+04 2.76+04
  363-      MAT1    104     10.5E6  3.8E6   .33     .1                                      +MAT104
  364-      +MAT104 3.45+04 2.76+04
  365-      MAT1    105     10.5E6  3.8E6   .33     .1                                      +MAT105
  366-      +MAT105 3.60+04 2.88+04
  367-      MAT1    106     10.5E6  3.8E6   .33     .1                                      +MAT106
  368-      +MAT106 3.60+04 2.88+04
  369-      MAT1    107     10.5E6  3.8E6   .33     .1                                      +MAT107
  370-      +MAT107 2.83+04 2.26+04
  371-      MAT1    108     10.5E6  3.8E6   .33     .1                                      +MAT108
  372-      +MAT108 2.83+04 2.27+04
  373-      MAT1    109     10.5E6  3.8E6   .33     .1                                      +MAT109
  374-      +MAT109 2.83+04 2.27+04
  375-      MAT1    110     10.5E6  3.8E6   .33     .1                                      +MAT110
  376-      +MAT110 2.83+04 2.26+04
  377-      MAT1    111     10.5E6  3.8E6   .33     .1                                      +MAT111
  378-      +MAT111 1.52+05 1.22+05
  379-      MAT1    112     10.5E6  3.8E6   .33     .1                                      +MAT112
  380-      +MAT112 1.78+05 1.42+05
  381-      MAT1    113     10.5E6  3.8E6   .33     .1                                      +MAT113
  382-      +MAT113 1.52+05 1.22+05
  383-      MAT1    114     10.5E6  3.8E6   .33     .1                                      +MAT114
  384-      +MAT114 1.85+05 1.48+05
  385-      MAT1    115     10.5E6  3.8E6   .33     .1                                      +MAT115
  386-      +MAT115 8.28+04 6.62+04
  387-      MAT1    116     10.5E6  3.8E6   .33     .1                                      +MAT116
  388-      +MAT116 8.28+04 6.62+04
  389-      MAT1    117     10.5E6  3.8E6   .33     .1                                      +MAT117
  390-      +MAT117 5.53+04 4.42+04
  391-      MAT1    118     10.5E6  3.8E6   .33     .1                                      +MAT118
  392-      +MAT118 5.53+04 4.42+04
  393-      MAT1    119     10.5E6  3.8E6   .33     .1                                      +MAT119
  394-      +MAT119 5.53+04 4.42+04
  395-      MAT1    120     10.5E6  3.8E6   .33     .1                                      +MAT120
  396-      +MAT120 5.53+04 4.42+04
  397-      MAT1    121     10.5E6  3.8E6   .33     .1                                      +MAT121
  398-      +MAT121 4.20+04 3.36+04
  399-      MAT1    122     10.5E6  3.8E6   .33     .1                                      +MAT122
  400-      +MAT122 4.20+04 3.36+04
  401-      MAT1    123     10.5E6  3.8E6   .33     .1                                      +MAT123
  402-      +MAT123 4.36+04 3.49+04
  403-      MAT1    124     10.5E6  3.8E6   .33     .1                                      +MAT124
  404-      +MAT124 4.36+04 3.49+04
  405-      MAT1    125     10.5E6  3.8E6   .33     .1                                      +MAT125
```

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	1	2	3	4	5	6	7	8	9	10
406-	+MAT125	4.20+04	3.36+04							
407-	MAT1	126	10.5E6	3.8E6	.33	.1				+MAT126
408-	+MAT126	4.20+04	3.36+04							
409-	MAT1	127	10.5E6	3.8E6	.33	.1				+MAT127
410-	+MAT127	4.40+04	3.52+04							
411-	MAT1	128	10.5E6	3.8E6	.33	.1				+MAT128
412-	+MAT128	4.40+04	3.52+04							
413-	MAT1	129	10.5E6	3.8E6	.33	.1				+MAT129
414-	+MAT129	3.50+04	2.80+04							
415-	MAT1	130	10.5E6	3.8E6	.33	.1				+MAT130
416-	+MAT130	3.50+04	2.80+04							
417-	MAT1	131	10.5E6	3.8E6	.33	.1				+MAT131
418-	+MAT131	3.50+04	2.80+04							
419-	MAT1	132	10.5E6	3.8E6	.33	.1				+MAT132
420-	+MAT132	3.50+04	2.80+04							
421-	MAT1	133	10.5E6	3.8E6	.33	.1				+MAT133
422-	+MAT133	1.99+05	1.60+05							
423-	MAT1	134	10.5E6	3.8E6	.33	.1				+MAT134
424-	+MAT134	2.39+05	1.91+05							
425-	MAT1	135	10.5E6	3.8E6	.33	.1				+MAT135
426-	+MAT135	1.99+05	1.60+05							
427-	MAT1	136	10.5E6	3.8E6	.33	.1				+MAT136
428-	+MAT136	2.48+05	1.99+05							
429-	MAT1	137	10.5E6	3.8E6	.33	.1				+MAT137
430-	+MAT137	1.10+05	8.77+04							
431-	MAT1	138	10.5E6	3.8E6	.33	.1				+MAT138
432-	+MAT138	1.10+05	8.77+04							
433-	PARAM	GRDPNT	0							
434-	PTUBE	1	1	1.5	.0625					
435-	PTUBE	2	2	1.5	.0625					
436-	PTUBE	3	3	1.5	.0625					
437-	PTUBE	4	4	1.5	.0625					
438-	PTUBE	5	5	1.5	.0625					
439-	PTUBE	6	6	1.5	.0625					
440-	PTUBE	7	7	1.5	.0625					
441-	PTUBE	8	8	1.5	.0625					
442-	PTUBE	9	9	1.5	.0625					
443-	PTUBE	10	10	1.5	.0625					
444-	PTUBE	11	11	1.5	.0625					
445-	PTUBE	12	12	1.5	.0625					
446-	PTUBE	13	13	1.5	.0625					
447-	PTUBE	14	14	1.5	.0625					
448-	PTUBE	15	15	1.5	.0625					
449-	PTUBE	16	16	1.5	.0625					
450-	PTUBE	17	17	1.5	.0625					

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
451-	PTUBE	18	18	1.5	.0625					
452-	PTUBE	19	19	1.5	.0625					
453-	PTUBE	20	20	1.5	.0625					
454-	PTUBE	21	21	1.5	.0625					
455-	PTUBE	22	22	1.5	.0625					
456-	PTUBE	23	23	1.5	.0625					
457-	PTUBE	24	24	1.5	.0625					
458-	PTUBE	25	25	1.5	.0625					
459-	PTUBE	26	26	1.5	.0625					
460-	PTUBE	27	27	1.5	.0625					
461-	PTUBE	28	28	1.5	.0625					
462-	PTUBE	29	29	1.5	.0625					
463-	PTUBE	30	30	1.5	.0625					
464-	PTUBE	31	31	1.5	.0625					
465-	PTUBE	32	32	1.5	.0625					
466-	PTUBE	33	33	1.5	.0625					
467-	PTUBE	34	34	1.5	.0625					
468-	PTUBE	35	35	1.5	.0625					
469-	PTUBE	36	36	1.5	.0625					
470-	PTUBE	37	37	1.5	.0625					
471-	PTUBE	38	38	1.5	.0625					
472-	PTUBE	39	39	1.5	.0625					
473-	PTUBE	40	40	1.5	.0625					
474-	PTUBE	41	41	1.5	.0625					
475-	PTUBE	42	42	1.5	.0625					
476-	PTUBE	43	43	1.5	.0625					
477-	PTUBE	44	44	1.5	.0625					
478-	PTUBE	45	45	1.5	.0625					
479-	PTUBE	46	46	1.5	.0625					
480-	PTUBE	47	47	1.5	.0625					
481-	PTUBE	48	48	1.5	.0625					
482-	PTUBE	49	49	1.5	.0625					
483-	PTUBE	50	50	1.5	.0625					
484-	PTUBE	51	51	1.5	.0625					
485-	PTUBE	52	52	1.5	.0625					
486-	PTUBE	53	53	1.5	.0625					
487-	PTUBE	54	54	1.5	.0625					
488-	PTUBE	55	55	1.5	.0625					
489-	PTUBE	56	56	1.5	.0625					
490-	PTUBE	57	57	1.5	.0625					
491-	PTUBE	58	58	1.5	.0625					
492-	PTUBE	59	59	1.5	.0625					
493-	PTUBE	60	60	1.5	.0625					
494-	PTUBE	61	61	1.5	.0625					
495-	PTUBE	62	62	1.5	.0625					

DAMAGE CRITION = NONE

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
496-	PTUBE	63	63	1.5	.0625					
497-	PTUBE	64	64	1.5	.0625					
498-	PTUBE	65	65	1.5	.0625					
499-	PTUBE	66	66	1.5	.0625					
500-	PTUBE	67	67	1.5	.0625					
501-	PTUBE	68	68	1.5	.0625					
502-	PTUBE	69	69	1.5	.0625					
503-	PTUBE	70	70	1.5	.0625					
504-	PTUBE	71	71	1.5	.0625					
505-	PTUBE	72	72	1.5	.0625					
506-	PTUBE	73	73	1.5	.0625					
507-	PTUBE	74	74	1.5	.0625					
508-	PTUBE	75	75	1.5	.0625					
509-	PTUBE	76	76	1.5	.0625					
510-	PTUBE	77	77	1.5	.0625					
511-	PTUBE	78	78	1.5	.0625					
512-	PTUBE	79	79	1.5	.0625					
513-	PTUBE	80	80	1.5	.0625					
514-	PTUBE	81	81	1.5	.0625					
515-	PTUBE	82	82	1.5	.0625					
516-	PTUBE	83	83	1.5	.0625					
517-	PTUBE	84	84	1.5	.0625					
518-	PTUBE	85	85	1.5	.0625					
519-	PTUBE	86	86	1.5	.0625					
520-	PTUBE	87	87	1.5	.0625					
521-	PTUBE	88	88	1.5	.0625					
522-	PTUBE	89	89	1.5	.0625					
523-	PTUBE	90	90	1.5	.0625					
524-	PTUBE	91	91	1.5	.0625					
525-	PTUBE	92	92	1.5	.0625					
526-	PTUBE	93	93	1.5	.0625					
527-	PTUBE	94	94	1.5	.0625					
528-	PTUBE	95	95	1.5	.0625					
529-	PTUBE	96	96	1.5	.0625					
530-	PTUBE	97	97	1.5	.0625					
531-	PTUBE	98	98	1.5	.0625					
532-	PTUBE	99	99	1.5	.0625					
533-	PTUBE	100	100	1.5	.0625					
534-	PTUBE	101	101	1.5	.0625					
535-	PTUBE	102	102	1.5	.0625					
536-	PTUBE	103	103	1.5	.0625					
537-	PTUBE	104	104	1.5	.0625					
538-	PTUBE	105	105	1.5	.0625					
539-	PTUBE	106	106	1.5	.0625					
540-	PTUBE	107	107	1.5	.0625					

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
541-	PTUBE	108	108	1.5	.0625					
542-	PTUBE	109	109	1.5	.0625					
543-	PTUBE	110	110	1.5	.0625					
544-	PTUBE	111	111	1.5	.0625					
545-	PTUBE	112	112	1.5	.0625					
546-	PTUBE	113	113	1.5	.0625					
547-	PTUBE	114	114	1.5	.0625					
548-	PTUBE	115	115	1.5	.0625					
549-	PTUBE	116	116	1.5	.0625					
550-	PTUBE	117	117	1.5	.0625					
551-	PTUBE	118	118	1.5	.0625					
552-	PTUBE	119	119	1.5	.0625					
553-	PTUBE	120	120	1.5	.0625					
554-	PTUBE	121	121	1.5	.0625					
555-	PTUBE	122	122	1.5	.0625					
556-	PTUBE	123	123	1.5	.0625					
557-	PTUBE	124	124	1.5	.0625					
558-	PTUBE	125	125	1.5	.0625					
559-	PTUBE	126	126	1.5	.0625					
560-	PTUBE	127	127	1.5	.0625					
561-	PTUBE	128	128	1.5	.0625					
562-	PTUBE	129	129	1.5	.0625					
563-	PTUBE	130	130	1.5	.0625					
564-	PTUBE	131	131	1.5	.0625					
565-	PTUBE	132	132	1.5	.0625					
566-	PTUBE	133	133	1.5	.0625					
567-	PTUBE	134	134	1.5	.0625					
568-	PTUBE	135	135	1.5	.0625					
569-	PTUBE	136	136	1.5	.0625					
570-	PTUBE	137	137	1.5	.0625					
571-	PTUBE	138	138	1.5	.0625					
572-	SPC	10	1	123456	2	123456				
573-	SPC	10	3	123456	4	123456				
	ENDDATA									

* 11.4 CPU-S 60.4 COR-S 20 ELP-S. XGPI

NO ERRORS FOUND - EXECUTE NASTRAN PROGRAM

* 14.6 CPU-S 64.6 COR-S 25 ELP-S. SEM1 END

* 14.6 CPU-S 64.6 COR-S 25 ELP-S. ---- LINK END ---

DAMAGE CRITERION = NONE

LINEAR CASE 30 % LOADING SUBCASE 1

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	3.808960-03	-8.003385-03	5.592414-04	.0	.0	.0
6	G	-6.060912-04	3.930867-03	1.190927-03	.0	.0	.0
7	G	-3.676434-03	3.140641-03	-1.009343-02	.0	.0	.0
8	G	4.968146-04	-7.199159-03	-9.451740-03	.0	.0	.0
9	G	6.587249-03	-2.157185-02	-3.772064-03	.0	.0	.0
10	G	-1.843186-04	2.479580-03	-3.280151-03	.0	.0	.0
11	G	-6.407310-03	2.128899-03	-2.620921-02	.0	.0	.0
12	G	4.528371-05	-2.121480-02	-2.571272-02	.0	.0	.0
13	G	8.108101-03	-4.351839-02	-1.062160-02	.0	.0	.0
14	G	1.290961-03	-4.270602-03	-1.025311-02	.0	.0	.0
15	G	-7.890126-03	-4.350141-03	-4.736535-02	.0	.0	.0
16	G	-1.462164-03	-4.344037-02	-4.699647-02	.0	.0	.0
17	G	9.022580-03	-6.906972-02	-1.564162-02	.0	.0	.0
18	G	2.960545-03	-1.722768-02	-1.537139-02	.0	.0	.0
19	G	-8.760307-03	-1.722553-02	-6.383362-02	.0	.0	.0
20	G	-3.176044-03	-6.907189-02	-6.356338-02	.0	.0	.0
21	G	9.934891-03	-9.789615-02	-2.028055-02	.0	.0	.0
22	G	4.301572-03	-3.529501-02	-2.008361-02	.0	.0	.0
23	G	-9.399123-03	-3.529508-02	-7.764830-02	.0	.0	.0
24	G	-4.790581-03	-9.789609-02	-7.745137-02	.0	.0	.0
25	G	1.061690-02	-1.330094-01	-2.448695-02	.0	.0	.0
26	G	5.548152-03	-5.775276-02	-2.483351-02	.0	.0	.0
27	G	-1.000189-02	-5.775245-02	-8.988068-02	.0	.0	.0
28	G	-6.116372-03	-1.330094-01	-9.022717-02	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	6.255592-03	-1.290247-02	7.447220-04	.0	.0	.0
6	G	-1.076665-03	6.356675-03	1.775518-03	.0	.0	.0
7	G	-6.033014-03	5.046518-03	-1.638145-02	.0	.0	.0
8	G	9.087669-04	-1.154819-02	-1.535603-02	.0	.0	.0
9	G	1.085260-02	-3.477493-02	-6.742868-03	.0	.0	.0
10	G	-4.875443-04	3.973119-03	-5.937379-03	.0	.0	.0
11	G	-1.053797-02	3.383438-03	-4.283017-02	.0	.0	.0
12	G	2.900520-04	-3.413987-02	-4.204186-02	.0	.0	.0
13	G	1.339756-02	-7.019109-02	-1.872231-02	.0	.0	.0
14	G	1.802321-03	-7.002152-03	-1.811730-02	.0	.0	.0
15	G	-1.299832-02	-7.145443-03	-7.783044-02	.0	.0	.0
16	G	-2.029264-03	-7.000571-02	-7.725334-02	.0	.0	.0
17	G	1.493055-02	-1.113359-01	-2.801512-02	.0	.0	.0
18	G	4.429339-03	-2.789172-02	-2.756883-02	.0	.0	.0
19	G	-1.443700-02	-2.789467-02	-1.055399-01	.0	.0	.0
20	G	-4.704782-03	-1.112835-01	-1.051230-01	.0	.0	.0
21	G	1.643311-02	-1.577144-01	-3.683409-02	.0	.0	.0
22	G	6.559625-03	-5.696797-02	-3.649950-02	.0	.0	.0
23	G	-1.547599-02	-5.696326-02	-1.291162-01	.0	.0	.0
24	G	-7.246980-03	-1.576620-01	-1.288238-01	.0	.0	.0
25	G	1.753051-02	-2.141573-01	-4.502065-02	.0	.0	.0
26	G	8.560392-03	-9.308011-02	-4.569347-02	.0	.0	.0
27	G	-1.643499-02	-9.306449-02	-1.503643-01	.0	.0	.0
28	G	-9.362262-03	-2.141306-01	-1.508090-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	6	.0	.0	.0	.0	.0	.0
2	6	.0	.0	.0	.0	.0	.0
3	6	.0	.0	.0	.0	.0	.0
4	6	.0	.0	.0	.0	.0	.0
5	6	9.494084-03	-1.940388-02	1.002610-03	.0	.0	.0
6	6	-1.692481-03	9.572472-03	2.562577-03	.0	.0	.0
7	6	-9.152616-03	7.575185-03	-2.471574-02	.0	.0	.0
8	6	1.446179-03	-1.732417-02	-2.318028-02	.0	.0	.0
9	6	1.649621-02	-5.229925-02	-1.063383-02	.0	.0	.0
10	6	-8.737777-04	5.951338-03	-9.412849-03	.0	.0	.0
11	6	-1.600451-02	5.046369-03	-6.483904-02	.0	.0	.0
12	6	5.968494-04	-5.129968-02	-6.366249-02	.0	.0	.0
13	6	2.039370-02	-1.055932-01	-2.934786-02	.0	.0	.0
14	6	2.503719-03	-1.062868-02	-2.842971-02	.0	.0	.0
15	6	-1.975715-02	-1.085544-02	-1.181421-01	.0	.0	.0
16	6	-2.808020-03	-1.052697-01	-1.172873-01	.0	.0	.0
17	6	2.274316-02	-1.674441-01	-4.421894-02	.0	.0	.0
18	6	6.405707-03	-4.204874-02	-4.353985-02	.0	.0	.0
19	6	-2.194762-02	-4.205800-02	-1.606827-01	.0	.0	.0
20	6	-6.765771-03	-1.673204-01	-1.600697-01	.0	.0	.0
21	6	2.502630-02	-2.371250-01	-5.848265-02	.0	.0	.0
22	6	9.585249-03	-8.574011-02	-5.796680-02	.0	.0	.0
23	6	-2.351677-02	-8.572942-02	-1.971170-01	.0	.0	.0
24	6	-1.054286-02	-2.370068-01	-1.966963-01	.0	.0	.0
25	6	2.667450-02	-3.218895-01	-7.184347-02	.0	.0	.0
26	6	1.258687-02	-1.399797-01	-7.294101-02	.0	.0	.0
27	6	-2.494889-02	-1.399448-01	-2.302184-01	.0	.0	.0
28	6	-1.370677-02	-3.218294-01	-2.308019-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	1.280817-02	-2.594144-02	1.183984-03	.0	.0	.0
6	G	-2.359331-03	1.281287-02	3.282948-03	.0	.0	.0
7	G	-1.234264-02	1.010685-02	-3.314748-02	.0	.0	.0
8	G	2.038312-03	-2.310383-02	-3.110345-02	.0	.0	.0
9	G	2.228807-02	-6.992449-02	-1.487235-02	.0	.0	.0
10	G	-1.353839-03	7.919747-03	-1.322693-02	.0	.0	.0
11	G	-2.160590-02	6.685727-03	-8.724951-02	.0	.0	.0
12	G	1.010485-03	-6.852884-02	-8.568846-02	.0	.0	.0
13	G	2.759259-02	-1.412214-01	-4.081963-02	.0	.0	.0
14	G	3.073342-03	-1.434981-02	-3.958100-02	.0	.0	.0
15	G	-2.669315-02	-1.466845-02	-1.593978-01	.0	.0	.0
16	G	-3.430614-03	-1.407294-01	-1.582725-01	.0	.0	.0
17	G	3.079236-02	-2.238735-01	-6.189306-02	.0	.0	.0
18	G	8.224595-03	-5.636504-02	-6.097465-02	.0	.0	.0
19	G	-2.965747-02	-5.638389-02	-2.174290-01	.0	.0	.0
20	G	-8.633497-03	-2.236561-01	-2.166283-01	.0	.0	.0
21	G	3.387570-02	-3.169543-01	-8.229487-02	.0	.0	.0
22	G	1.244271-02	-1.147303-01	-8.158848-02	.0	.0	.0
23	G	-3.176392-02	-1.147113-01	-2.674441-01	.0	.0	.0
24	G	-1.362108-02	-3.167440-01	-2.669072-01	.0	.0	.0
25	G	3.607581-02	-4.301218-01	-1.015535-01	.0	.0	.0
26	G	1.644532-02	-1.871523-01	-1.031353-01	.0	.0	.0
27	G	-3.366455-02	-1.870905-01	-3.132290-01	.0	.0	.0
28	G	-1.782735-02	-4.300146-01	-3.138955-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	2.100756+03	1.0+01	.0		8	-3.904817+02	4.8+01	.0	
9	-2.020083+03	8.5+00	.0		10	3.276187+02	7.2+01	.0	
11	-5.455815+02	2.2+01	.0		12	1.511202+03	9.6+00	.0	
13	1.997594+03	7.2+00	.0		14	-5.341067+02	2.4+01	.0	
15	1.190064+03	1.2+01	.0		16	-2.148195+03	5.0+00	.0	
17	-2.174410+03	5.1+00	.0		18	6.976864+02	2.3+01	.0	
23	-5.614824+02	7.6+01	.0		24	-6.665977+02	7.0+01	.0	
25	5.486782+02	9.8+01	.0		26	6.560154+02	9.2+01	.0	
27	8.185547+00	3.5+03	.0		28	-1.993307+01	1.1+03	.0	
29	1.814436+03	1.3+01	.0		30	1.227732+02	2.0+02	.0	
31	-1.767088+03	1.0+01	.0		32	-1.503503+02	1.3+02	.0	
33	-7.310417+02	1.8+01	.0		34	1.782890+03	8.8+00	.0	
35	1.988491+03	8.1+00	.0		36	-1.045684+03	1.3+01	.0	
37	1.505494+03	1.1+01	.0		38	-2.551441+03	4.5+00	.0	
39	-2.195208+03	5.6+00	.0		40	1.241067+03	1.4+01	.0	
45	-5.987239+02	9.1+01	.0		46	-3.546543+02	1.7+02	.0	
47	5.842102+02	1.2+02	.0		48	3.350825+02	2.3+02	.0	
49	1.237793-01	2.9+05	.0		50	-1.702484+01	1.7+03	.0	
51	1.382209+03	1.7+01	.0		52	7.113932+02	3.4+01	.0	
53	-1.327605+03	1.4+01	.0		54	-7.485229+02	2.5+01	.0	
55	-9.370841+02	1.5+01	.0		56	2.230792+03	7.4+00	.0	
57	2.109965+03	8.1+00	.0		58	-1.718732+03	8.0+00	.0	
59	1.907438+03	8.8+00	.0		60	-3.196176+03	3.7+00	.0	
61	-2.354866+03	5.6+00	.0		62	1.961231+03	8.8+00	.0	
67	-6.872863+02	1.0+02	.0		68	-1.196187+02	6.8+02	.0	
69	6.686064+02	1.3+02	.0		70	9.409235+01	1.1+03	.0	
71	3.891846+00	1.2+04	.0		72	-2.577368+01	1.5+03	.0	
73	1.294431+03	2.5+01	.0		74	1.143274+03	2.9+01	.0	
75	-1.223482+03	2.1+01	.0		76	-1.197003+03	2.2+01	.0	
77	-1.595655+03	1.2+01	.0		78	3.061902+03	7.4+00	.0	
79	2.163459+03	1.1+01	.0		80	-2.123941+03	8.9+00	.0	
81	1.604046+03	1.5+01	.0		82	-3.067136+03	5.7+00	.0	
83	-2.453084+03	7.7+00	.0		84	2.411720+03	1.0+01	.0	
89	-7.956382+02	1.2+02	.0		90	-3.895215+01	2.8+03	.0	
91	7.749082+02	1.5+02	.0		92	2.227783+00	6.3+04	.0	
93	3.378076+01	1.9+03	.0		94	-6.191101+01	8.2+02	.0	
95	1.576733+03	2.8+01	.0		96	1.260624+03	3.6+01	.0	
97	-1.321531+03	2.7+01	.0		98	-1.492953+03	2.4+01	.0	
99	-1.845161+03	1.4+01	.0		100	3.508241+03	8.8+00	.0	
101	2.392293+03	1.4+01	.0		102	-2.347227+03	1.1+01	.0	
103	1.858308+03	1.8+01	.0		104	-3.518415+03	6.8+00	.0	
105	-2.720641+03	9.6+00	.0		106	2.672993+03	1.2+01	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
111	-9.377385+02	1.3+02	.0		112	-4.484180+01	3.2+03	.0	
113	9.040322+02	1.7+02	.0		114	-4.105469+00	3.6+04	.0	
115	-6.950195+01	9.5+02	.0		116	2.883008+01	2.9+03	.0	
117	1.699178+03	3.2+01	.0		118	1.435480+03	3.8+01	.0	
119	-1.488711+03	2.9+01	.0		120	-1.639735+03	2.6+01	.0	
121	-2.035861+03	1.6+01	.0		122	4.112227+03	9.2+00	.0	
123	2.952771+03	1.4+01	.0		124	-2.920976+03	1.1+01	.0	
125	2.078911+03	1.9+01	.0		126	-4.109003+03	7.2+00	.0	
127	-3.359635+03	9.5+00	.0		128	3.313254+03	1.2+01	.0	
133	-3.357437+02	4.8+02	.0		134	-2.641211+01	7.2+03	.0	
135	5.421074+02	3.7+02	.0		136	-1.577051+01	1.3+04	.0	
137	-2.122560+03	4.0+01	.0		138	2.217000+03	4.9+01	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	3.187686+03	6.5+00	.0		8	-6.115744+02	3.0+01	.0	
9	-3.063983+03	5.2+00	.0		10	5.190866+02	4.5+01	.0	
11	-8.201653+02	1.5+01	.0		12	2.273543+03	6.0+00	.0	
13	3.015715+03	4.4+00	.0		14	-7.837040+02	1.6+01	.0	
15	1.794626+03	8.0+00	.0		16	-3.226393+03	3.0+00	.0	
17	-3.285988+03	3.0+00	.0		18	1.034262+03	1.5+01	.0	
23	-8.490722+02	5.0+01	.0		24	-1.023673+03	4.5+01	.0	
25	8.217820+02	6.5+01	.0		26	1.000072+03	6.0+01	.0	
27	6.365417+00	4.5+03	.0		28	-3.190088+01	7.1+02	.0	
29	2.761400+03	7.9+00	.0		30	1.592125+02	1.5+02	.0	
31	-2.686425+03	6.3+00	.0		32	-1.961643+02	9.9+01	.0	
33	-1.097874+03	1.2+01	.0		34	2.682151+03	5.5+00	.0	
35	3.004455+03	5.0+00	.0		36	-1.553130+03	8.3+00	.0	
37	2.258808+03	6.7+00	.0		38	-3.833500+03	2.7+00	.0	
39	-3.316035+03	3.4+00	.0		40	1.847235+03	8.8+00	.0	
45	-9.054391+02	6.0+01	.0		46	-5.582087+02	1.1+02	.0	
47	8.734326+02	7.8+01	.0		48	5.142428+02	1.5+02	.0	
49	-7.670166+00	3.8+03	.0		50	-2.998175+01	9.7+02	.0	
51	2.109731+03	1.1+01	.0		52	1.041327+03	2.3+01	.0	
53	-2.022066+03	6.7+00	.0		54	-1.091643+03	1.7+01	.0	
55	-1.407286+03	9.7+00	.0		56	3.352483+03	4.6+00	.0	
57	3.194263+03	5.0+00	.0		58	-2.566785+03	5.0+00	.0	
59	2.866532+03	5.5+00	.0		60	-4.801383+03	2.1+00	.0	
61	-3.553174+03	3.4+00	.0		62	2.922444+03	5.6+00	.0	
67	-1.038335+03	6.9+01	.0		68	-2.087119+02	3.9+02	.0	
69	9.968916+02	9.0+01	.0		70	1.489202+02	7.0+02	.0	
71	-2.793945+00	1.4+04	.0		72	-4.722998+01	8.2+02	.0	
73	1.975413+03	1.6+01	.0		74	1.688493+03	1.9+01	.0	
75	-1.862303+03	1.4+01	.0		76	-1.762807+03	1.4+01	.0	
77	-2.395710+03	7.6+00	.0		78	4.596776+03	4.6+00	.0	
79	3.269676+03	7.1+00	.0		80	-3.172676+03	5.7+00	.0	
81	2.414694+03	9.6+00	.0		82	-4.608497+03	3.4+00	.0	
83	-3.704849+03	4.7+00	.0		84	3.603595+03	6.4+00	.0	
89	-1.201492+03	7.7+01	.0		90	-8.974121+01	1.2+03	.0	
91	1.154734+03	1.0+02	.0		92	7.005859+00	2.0+04	.0	
93	3.989160+01	1.6+03	.0		94	-1.032948+02	4.9+02	.0	
95	2.396922+03	1.8+01	.0		96	1.868239+03	2.4+01	.0	
97	-2.005754+03	1.8+01	.0		98	-2.207851+03	1.6+01	.0	
99	-2.769247+03	9.0+00	.0		100	5.265283+03	5.6+00	.0	
101	3.612022+03	8.9+00	.0		102	-3.510689+03	7.1+00	.0	
103	2.798879+03	1.1+01	.0		104	-5.288227+03	4.2+00	.0	
105	-4.105455+03	6.0+00	.0		106	3.998314+03	8.0+00	.0	

DAMAGE CRITION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S   I N   R O D   E L E M E N T S   (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
111	-1.419422+03	8.5+01	.0		112	-1.009668+02	1.4+03	.0	
113	1.343428+03	1.1+02	.0		114	-9.303711+00	1.6+04	.0	
115	-1.194492+02	5.5+02	.0		116	2.778809+01	3.0+03	.0	
117	2.571103+03	2.1+01	.0		118	2.133381+03	2.5+01	.0	
119	-2.253350+03	1.9+01	.0		120	-2.437149+03	1.7+01	.0	
121	-3.045770+03	1.0+01	.0		122	6.177823+03	5.8+00	.0	
123	4.449080+03	8.8+00	.0		124	-4.377426+03	7.0+00	.0	
125	3.142815+03	1.2+01	.0		126	-6.170614+03	4.4+00	.0	
127	-5.064699+03	6.0+00	.0		128	4.960231+03	7.9+00	.0	
133	-4.259883+02	3.7+02	.0		134	-5.958594+01	3.2+03	.0	
135	8.910059+02	2.2+02	.0		136	-3.518750+01	5.7+03	.0	
137	-3.142594+03	2.7+01	.0		138	3.355533+03	3.2+01	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING   SUBCASE 2

S T R E S S E S   I N   R O D   E L E M E N T S   (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	4.299580+03	4.5+00	.0		8	-8.496977+02	2.1+01	.0	
9	-4.131011+03	3.6+00	.0		10	7.287840+02	3.2+01	.0	
11	-1.095876+03	1.1+01	.0		12	3.040742+03	4.3+00	.0	
13	4.046948+03	3.1+00	.0		14	-1.021666+03	1.2+01	.0	
15	2.378773+03	5.7+00	.0		16	-4.307687+03	2.0+00	.0	
17	-4.414108+03	2.0+00	.0		18	1.362744+03	1.1+01	.0	
23	-1.141541+03	3.7+01	.0		24	-1.396721+03	3.3+01	.0	
25	1.094213+03	4.9+01	.0		26	1.354944+03	4.4+01	.0	
27	4.954224-01	5.8+04	.0		28	-4.518335+01	5.0+02	.0	
29	3.735461+03	5.6+00	.0		30	1.792187+02	1.4+02	.0	
31	-3.630174+03	4.4+00	.0		32	-2.225599+02	8.8+01	.0	
33	-1.465632+03	8.6+00	.0		34	3.587078+03	3.9+00	.0	
35	4.035245+03	3.5+00	.0		36	-2.050409+03	6.0+00	.0	
37	3.012535+03	4.8+00	.0		38	-5.120242+03	1.7+00	.0	
39	-4.452714+03	2.3+00	.0		40	2.443989+03	6.4+00	.0	
45	-1.217320+03	4.4+01	.0		46	-7.794019+02	7.7+01	.0	
47	1.160861+03	5.9+01	.0		48	7.012236+02	1.1+02	.0	
49	-2.084058+01	1.4+03	.0		50	-4.587115+01	6.4+02	.0	
51	2.862065+03	7.6+00	.0		52	1.354219+03	1.7+01	.0	
53	-2.737424+03	6.2+00	.0		54	-1.414088+03	1.3+01	.0	
55	-1.878810+03	7.0+00	.0		56	4.478988+03	3.2+00	.0	
57	4.298674+03	3.5+00	.0		58	-3.407583+03	3.5+00	.0	
59	3.829468+03	3.9+00	.0		60	-6.411950+03	1.3+00	.0	
61	-4.765922+03	2.3+00	.0		62	3.871020+03	4.0+00	.0	
67	-1.394518+03	5.1+01	.0		68	-3.174795+02	2.5+02	.0	
69	1.321283+03	6.8+01	.0		70	2.090032+02	5.0+02	.0	
71	-1.536084+01	2.5+03	.0		72	-7.435474+01	5.2+02	.0	
73	2.679344+03	1.2+01	.0		74	2.216158+03	1.4+01	.0	
75	-2.519567+03	9.8+00	.0		76	-2.306856+03	1.1+01	.0	
77	-3.197721+03	5.4+00	.0		78	6.135022+03	3.2+00	.0	
79	4.392954+03	5.0+00	.0		80	-4.213091+03	4.0+00	.0	
81	3.231589+03	7.0+00	.0		82	-6.155830+03	2.3+00	.0	
83	-4.974166+03	3.3+00	.0		84	4.786650+03	4.6+00	.0	
89	-1.612864+03	5.7+01	.0		90	-1.615684+02	6.7+02	.0	
91	1.529549+03	7.6+01	.0		92	1.426807+01	9.8+03	.0	
93	3.867090+01	1.6+03	.0		94	-1.515894+02	3.3+02	.0	
95	3.238653+03	1.3+01	.0		96	2.460750+03	1.8+01	.0	
97	-2.705912+03	1.3+01	.0		98	-2.901663+03	1.2+01	.0	
99	-3.695076+03	6.5+00	.0		100	7.025193+03	3.9+00	.0	
101	4.848444+03	6.4+00	.0		102	-4.668152+03	5.1+00	.0	
103	3.747856+03	8.2+00	.0		104	-7.066084+03	2.9+00	.0	
105	-5.507550+03	4.2+00	.0		106	5.316936+03	5.8+00	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
111	-1.909799+03	6.3+01	.0		112	-1.797109+02	7.9+02	.0	
113	1.774391+03	3.5+01	.0		114	-1.659277+01	8.9+03	.0	
115	-1.796172+02	3.7+02	.0		116	1.637744+01	5.1+03	.0	
117	3.458084+03	1.5+01	.0		118	2.818036+03	1.9+01	.0	
119	-3.031671+03	1.4+01	.0		120	-3.219545+03	1.3+01	.0	
121	-4.051315+03	7.3+00	.0		122	8.250880+03	4.1+00	.0	
123	5.959820+03	6.3+00	.0		124	-5.832223+03	5.0+00	.0	
125	4.224214+03	8.9+00	.0		126	-8.238140+03	3.1+00	.0	
127	-6.787707+03	4.2+00	.0		128	6.601729+03	5.7+00	.0	
133	-4.641445+02	3.4+02	.0		134	-1.061953+02	1.8+03	.0	
135	1.292254+03	1.5+02	.0		136	-6.237305+01	3.2+03	.0	
137	-4.134330+03	2.0+01	.0		138	4.513631+03	2.3+01	.0	

* 53.2 CPU-S 262.5 COR-S 182 ELP-S. 158 OFP END

* 53.2 CPU-S 263.4 COR-S 182 ELP-S. 179 EXIT BEGN

APPENDIX C

NASTRAN MATHEMATICAL MODEL OF THE UNDAMAGED TRUSS MODEL 3 PLUS OUTPUT OF DISPLACEMENTS, STRESSES AND MARGINS OF SAFETY DUE TO FLIGHT LOADS

PRECEDING PAGE NOT FILMED BLANK

UNIVAC 1100 SERIES
MODEL 1108

RIGID FORMAT SERIES M3

LEVEL 77.1.0

DATE - 7/15/77

SYSTEM GENERATED BY SPERRY SUPPORT SERVICES

24

N A S T R A N   E X E C U T I V E   C O N T R O L   D E C K   E C H O

```
ID ERLINE,MODEL3
APP DISP
$ STATIC ANALYSIS WITH DIFFERENTIAL STIFFNESS RF 4
SOL 4,0
TIME 10
CEND
```

```
                         C A S E   C O N T R O L   D E C K   E C H O
     CARD
     COUNT
       1      TITLE = TRUSS TAIL BOOM  MODEL3  **A 138 ELEMENT VERSION
       2      SUBTITLE = DAMAGE CRITION = NONE
       3      OLOAD = ALL
       4      SPC = 10
       5      DISP = ALL
       6      SPCFORCES = ALL
       7      SET 5 = 1 THRU 138
       8          SUBCASE 1
       9          LABEL = LINEAR CASE
      10          LOAD = 11
      11          SUBCASE 2
      12          LABEL = INCREMENTAL STIFFNESS
      13      DSCOEFFICIENT = 200
      14          STRESS = 5
      15      MAXLINES = 100000
      16      BEGIN BULK

*** USER INFORMATION MESSAGE 207, BULK DATA NOT SORTED,XSORT WILL RE-ORDER DECK.
```

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
1-	CTUBE	1	1	1	2
2-	CTUBE	2	2	1	4
3-	CTUBE	3	3	3	4
4-	CTUBE	4	4	2	3
5-	CTUBE	5	5	1	3
6-	CTUBE	6	6	2	4
7-	CTUBE	7	7	1	5
8-	CTUBE	8	8	2	6
9-	CTUBE	9	9	3	7
10-	CTUBE	10	10	4	8
11-	CTUBE	11	11	1	6
12-	CTUBE	12	12	2	5
13-	CTUBE	13	13	1	8
14-	CTUBE	14	14	4	5
15-	CTUBE	15	15	4	7
16-	CTUBE	16	16	3	8
17-	CTUBE	17	17	2	7
18-	CTUBE	18	18	3	6
19-	CTUBE	19	19	1	7
20-	CTUBE	20	20	2	8
21-	CTUBE	21	21	3	5
22-	CTUBE	22	22	4	6
23-	CTUBE	23	23	5	6
24-	CTUBE	24	24	5	8
25-	CTUBE	25	25	7	8
26-	CTUBE	26	26	6	7
27-	CTUBE	27	27	5	7
28-	CTUBE	28	28	6	8
29-	CTUBE	29	29	5	9
30-	CTUBE	30	30	6	10
31-	CTUBE	31	31	7	11
32-	CTUBE	32	32	8	12
33-	CTUBE	33	33	5	10
34-	CTUBE	34	34	6	9
35-	CTUBE	35	35	5	12
36-	CTUBE	36	36	8	9
37-	CTUBE	37	37	8	11
38-	CTUBE	38	38	7	12
39-	CTUBE	39	39	6	11
40-	CTUBE	40	40	7	10
41-	CTUBE	41	41	5	11
42-	CTUBE	42	42	6	12
43-	CTUBE	43	43	7	9
44-	CTUBE	44	44	8	10
45-	CTUBE	45	45	9	10

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
46-	CTUBE	46	46	9	12					
47-	CTUBE	47	47	11	12					
48-	CTUBE	48	48	10	11					
49-	CTUBE	49	49	9	11					
50-	CTUBE	50	50	10	12					
51-	CTUBE	51	51	9	13					
52-	CTUBE	52	52	10	14					
53-	CTUBE	53	53	11	15					
54-	CTUBE	54	54	12	16					
55-	CTUBE	55	55	9	14					
56-	CTUBE	56	56	10	13					
57-	CTUBE	57	57	9	16					
58-	CTUBE	58	58	12	13					
59-	CTUBE	59	59	12	15					
60-	CTUBE	60	60	11	16					
61-	CTUBE	61	61	10	15					
62-	CTUBE	62	62	11	14					
63-	CTUBE	63	63	9	15					
64-	CTUBE	64	64	10	16					
65-	CTUBE	65	65	11	13					
66-	CTUBE	66	66	12	14					
67-	CTUBE	67	67	13	14					
68-	CTUBE	68	68	13	16					
69-	CTUBE	69	69	15	16					
70-	CTUBE	70	70	14	15					
71-	CTUBE	71	71	13	15					
72-	CTUBE	72	72	14	16					
73-	CTUBE	73	73	13	17					
74-	CTUBE	74	74	14	18					
75-	CTUBE	75	75	15	19					
76-	CTUBE	76	76	16	20					
77-	CTUBE	77	77	13	18					
78-	CTUBE	78	78	14	17					
79-	CTUBE	79	79	13	20					
80-	CTUBE	80	80	16	17					
81-	CTUBE	81	81	16	19					
82-	CTUBE	82	82	15	20					
83-	CTUBE	83	83	14	19					
84-	CTUBE	84	84	15	18					
85-	CTUBE	85	85	13	19					
86-	CTUBE	86	86	14	20					
87-	CTUBE	87	87	15	17					
88-	CTUBE	88	88	16	18					
89-	CTUBE	89	89	17	18					
90-	CTUBE	90	90	17	20					

DAMAGE CRITION = NONE

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
91-	CTUBE	91	91	19	20
92-	CTUBE	92	92	18	19
93-	CTUBE	93	93	17	19
94-	CTUBE	94	94	18	20
95-	CTUBE	95	95	17	21
96-	CTUBE	96	96	18	22
97-	CTUBE	97	97	19	23
98-	CTUBE	98	98	20	24
99-	CTUBE	99	99	17	22
100-	CTUBE	100	100	18	21
101-	CTUBE	101	101	17	24
102-	CTUBE	102	102	20	21
103-	CTUBE	103	103	20	23
104-	CTUBE	104	104	19	24
105-	CTUBE	105	105	18	23
106-	CTUBE	106	106	19	22
107-	CTUBE	107	107	17	23
108-	CTUBE	108	108	18	24
109-	CTUBE	109	109	19	21
110-	CTUBE	110	110	20	22
111-	CTUBE	111	111	21	22
112-	CTUBE	112	112	21	24
113-	CTUBE	113	113	23	24
114-	CTUBE	114	114	22	23
115-	CTUBE	115	115	21	23
116-	CTUBE	116	116	22	24
117-	CTUBE	117	117	21	25
118-	CTUBE	118	118	22	26
119-	CTUBE	119	119	23	27
120-	CTUBE	120	120	24	28
121-	CTUBE	121	121	21	26
122-	CTUBE	122	122	22	25
123-	CTUBE	123	123	21	28
124-	CTUBE	124	124	24	25
125-	CTUBE	125	125	24	27
126-	CTUBE	126	126	23	28
127-	CTUBE	127	127	22	27
128-	CTUBE	128	128	23	26
129-	CTUBE	129	129	21	27
130-	CTUBE	130	130	22	28
131-	CTUBE	131	131	23	25
132-	CTUBE	132	132	24	26
133-	CTUBE	133	133	25	26
134-	CTUBE	134	134	25	28
135-	CTUBE	135	135	27	28

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
136-	CTUBE	136	136	26	27					
137-	CTUBE	137	137	25	27					
138-	CTUBE	138	138	26	28					
139-	DSFACT	200	1.60422	2.40632	3.20843					
140-	FORCE	11	13	0	44.2200	.0	0.0	-1.		
141-	FORCE	11	14	0	44.2200	.0	0.0	-1.		
142-	FORCE	11	15	0	44.2200	.0	0.0	-1.		
143-	FORCE	11	16	0	44.2200	.0	0.0	-1.		
144-	FORCE	11	25	0	464.5	1.	.0	.0		
145-	FORCE	11	25	0	527.3	.0	-1.0	.0		
146-	FORCE	11	26	0	464.5	1.0	0.0	.0		
147-	FORCE	11	26	0	527.3	.0	1.	.0		
148-	FORCE	11	27	0	464.5	-1.	0.0	.0		
149-	FORCE	11	27	0	527.5	.0	1.	.0		
150-	FORCE	11	28	0	464.5	-1.	.0	.0		
151-	FORCE	11	28	0	527.3	.0	-1.	.0		
152-	GRDSET							456		
153-	GRID	1		.000	11.95	12.375				
154-	GRID	2		.000	11.75	-12.375				
155-	GRID	3		.000	-11.75	-12.375				
156-	GRID	4		.000	-11.95	12.375				
157-	GRID	5		33.5	10.666	11.105				
158-	GRID	6		33.5	10.485	-11.105				
159-	GRID	7		33.5	-10.485	-11.105				
160-	GRID	8		33.5	-10.666	11.105				
161-	GRID	9		66.5	9.401	9.855				
162-	GRID	10		66.5	9.239	-9.855				
163-	GRID	11		66.5	-9.239	-9.855				
164-	GRID	12		66.5	-9.401	9.855				
165-	GRID	13		99.5	8.136	8.604				
166-	GRID	14		99.5	7.994	-8.604				
167-	GRID	15		99.5	-7.994	-8.604				
168-	GRID	16		99.5	-8.136	8.604				
169-	GRID	17		127.5	7.063	7.543				
170-	GRID	18		127.5	6.937	-7.543				
171-	GRID	19		127.5	-6.937	-7.543				
172-	GRID	20		127.5	-7.063	7.543				
173-	GRID	21		151.5	6.143	6.634				
174-	GRID	22		151.5	6.031	-6.634				
175-	GRID	23		151.5	-6.031	-6.634				
176-	GRID	24		151.5	-6.143	6.634				
177-	GRID	25		173.5	5.3	5.8				
178-	GRID	26		173.5	5.2	-5.8				
179-	GRID	27		173.5	-5.2	-5.8				
180-	GRID	28		173.5	-5.3	5.800				

```
                          S O R T E D   B U L K   D A T A   E C H O
CARD
COUNT         .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 181-         MAT1    1        10.5E6  3.8E6   .33     .1                                 +MAT001
 182-         +MAT001  4.38+04 3.51+04
 183-         MAT1    2        10.5E6  3.8E6   .33     .1                                 +MAT002
 184-         +MAT002  4.70+04 3.76+04
 185-         MAT1    3        10.5E6  3.8E6   .33     .1                                 +MAT003
 186-         +MAT003  4.38+04 3.51+04
 187-         MAT1    4        10.5E6  3.8E6   .33     .1                                 +MAT004
 188-         +MAT004  4.86+04 3.89+04
 189-         MAT1    5        10.5E6  3.8E6   .33     .1                                 +MAT005
 190-         +MAT005  2.29+04 1.83+04
 191-         MAT1    6        10.5E6  3.8E6   .33     .1                                 +MAT006
 192-         +MAT006  2.29+04 1.83+04
 193-         MAT1    7        10.5E6  3.8E6   .33     .1                                 +MAT007
 194-         +MAT007  2.38+04 1.91+04
 195-         MAT1    8        10.5E6  3.8E6   .33     .1                                 +MAT008
 196-         +MAT008  2.38+04 1.91+04
 197-         MAT1    9        10.5E6  3.8E6   .33     .1                                 +MAT009
 198-         +MAT009  2.38+04 1.91+04
 199-         MAT1    10       10.5E6  3.8E6   .33     .1                                 +MAT010
 200-         +MAT010  2.38+04 1.91+04
 201-         MAT1    11       10.5E6  3.8E6   .33     .1                                 +MAT011
 202-         +MAT011  1.60+04 1.28+04
 203-         MAT1    12       10.5E6  3.8E6   .33     .1                                 +MAT012
 204-         +MAT012  1.60+04 1.28+04
 205-         MAT1    13       10.5E6  3.8E6   .33     .1                                 +MAT013
 206-         +MAT013  1.64+04 1.31+04
 207-         MAT1    14       10.5E6  3.8E6   .33     .1                                 +MAT014
 208-         +MAT014  1.64+04 1.31+04
 209-         MAT1    15       10.5E6  3.8E6   .33     .1                                 +MAT015
 210-         +MAT015  1.60+04 1.28+04
 211-         MAT1    16       10.5E6  3.8E6   .33     .1                                 +MAT016
 212-         +MAT016  1.60+04 1.28+04
 213-         MAT1    17       10.5E6  3.8E6   .33     .1                                 +MAT017
 214-         +MAT017  1.66+04 1.33+04
 215-         MAT1    18       10.5E6  3.8E6   .33     .1                                 +MAT018
 216-         +MAT018  1.66+04 1.33+04
 217-         MAT1    19       10.5E6  3.8E6   .33     .1                                 +MAT019
 218-         +MAT019  1.23+04 9.86+03
 219-         MAT1    20       10.5E6  3.8E6   .33     .1                                 +MAT020
 220-         +MAT020  1.23+04 9.87+03
 221-         MAT1    21       10.5E6  3.8E6   .33     .1                                 +MAT021
 222-         +MAT021  1.23+04 9.87+03
 223-         MAT1    22       10.5E6  3.8E6   .33     .1                                 +MAT022
 224-         +MAT022  1.23+04 9.86+03
 225-         MAT1    23       10.5E6  3.8E6   .33     .1                                 +MAT023
```

S C R T E D B U L K D A T A E C H O

CARD COUNT	1	2	3	4	5	6	7	8	9	10
226-	+MAT023	5.44+04	4.35+04							
227-	MAT1	24	10.5E6	3.8E6	.33	.1				+MAT024
228-	+MAT024	5.90+04	4.72+04							
229-	MAT1	25	10.5E6	3.8E6	.33	.1				+MAT025
230-	+MAT025	5.44+04	4.35+04							
231-	MAT1	26	10.5E6	3.8E6	.33	.1				+MAT026
232-	+MAT026	6.10+04	4.88+04							
233-	MAT1	27	10.5E6	3.8E6	.33	.1				+MAT027
234-	+MAT027	2.85+04	2.28+04							
235-	MAT1	28	10.5E6	3.8E6	.33	.1				+MAT028
236-	+MAT028	2.85+04	2.28+04							
237-	MAT1	29	10.5E6	3.8E6	.33	.1				+MAT029
238-	+MAT029	2.46+04	1.97+04							
239-	MAT1	30	10.5E6	3.8E6	.33	.1				+MAT030
240-	+MAT030	2.46+04	1.97+04							
241-	MAT1	31	10.5E6	3.8E6	.33	.1				+MAT031
242-	+MAT031	2.46+04	1.97+04							
243-	MAT1	32	10.5E6	3.8E6	.33	.1				+MAT032
244-	+MAT032	2.46+04	1.97+04							
245-	MAT1	33	10.5E6	3.8E6	.33	.1				+MAT033
246-	+MAT033	1.75+04	1.40+04							
247-	MAT1	34	10.5E6	3.8E6	.33	.1				+MAT034
248-	+MAT034	1.75+04	1.40+04							
249-	MAT1	35	10.5E6	3.8E6	.33	.1				+MAT035
250-	+MAT035	1.80+04	1.44+04							
251-	MAT1	36	10.5E6	3.8E6	.33	.1				+MAT036
252-	+MAT036	1.80+04	1.44+04							
253-	MAT1	37	10.5E6	3.8E6	.33	.1				+MAT037
254-	+MAT037	1.75+04	1.40+04							
255-	MAT1	38	10.5E6	3.8E6	.33	.1				+MAT038
256-	+MAT038	1.75+04	1.40+04							
257-	MAT1	39	10.5E6	3.8E6	.33	.1				+MAT039
258-	+MAT039	1.81+04	1.45+04							
259-	MAT1	40	10.5E6	3.8E6	.33	.1				+MAT040
260-	+MAT040	1.81+04	1.45+04							
261-	MAT1	41	10.5E6	3.8E6	.33	.1				+MAT041
262-	+MAT041	1.39+04	1.12+04							
263-	MAT1	42	10.5E6	3.8E6	.33	.1				+MAT042
264-	+MAT042	1.40+04	1.12+04							
265-	MAT1	43	10.5E6	3.8E6	.33	.1				+MAT043
266-	+MAT043	1.40+04	1.12+04							
267-	MAT1	44	10.5E6	3.8E6	.33	.1				+MAT044
268-	+MAT044	1.39+04	1.12+04							
269-	MAT1	45	10.5E6	3.8E6	.33	.1				+MAT045
270-	+MAT045	6.91+04	5.53+04							

S O R T E D   B U L K   D A T A   E C H O

```
 CARD
 COUNT     .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  271-     MAT1    46      10.5E6  3.8E6   .33     .1                              +MAT046
  272-     +MAT046 7.59+04 6.08+04
  273-     MAT1    47      10.5E6  3.8E6   .33     .1                              +MAT047
  274-     +MAT047 6.91+04 5.53+04
  275-     MAT1    48      10.5E6  3.8E6   .33     .1                              +MAT048
  276-     +MAT048 7.86+04 6.29+04
  277-     MAT1    49      10.5E6  3.8E6   .33     .1                              +MAT049
  278-     +MAT049 3.65+04 2.92+04
  279-     MAT1    50      10.5E6  3.8E6   .33     .1                              +MAT050
  280-     +MAT050 3.65+04 2.92+04
  281-     MAT1    51      10.5E6  3.8E6   .33     .1                              +MAT051
  282-     +MAT051 2.46+04 1.97+04
  283-     MAT1    52      10.5E6  3.8E6   .33     .1                              +MAT052
  284-     +MAT052 2.46+04 1.97+04
  285-     MAT1    53      10.5E6  3.8E6   .33     .1                              +MAT053
  286-     +MAT053 2.46+04 1.97+04
  287-     MAT1    54      10.5E6  3.8E6   .33     .1                              +MAT054
  288-     +MAT054 2.46+04 1.97+04
  289-     MAT1    55      10.5E6  3.8E6   .33     .1                              +MAT055
  290-     +MAT055 1.87+04 1.50+04
  291-     MAT1    56      10.5E6  3.8E6   .33     .1                              +MAT056
  292-     +MAT056 1.88+04 1.50+04
  293-     MAT1    57      10.5E6  3.8E6   .33     .1                              +MAT057
  294-     +MAT057 1.92+04 1.54+04
  295-     MAT1    58      10.5E6  3.8E6   .33     .1                              +MAT058
  296-     +MAT058 1.92+04 1.54+04
  297-     MAT1    59      10.5E6  3.8E6   .33     .1                              +MAT059
  298-     +MAT059 1.87+04 1.50+04
  299-     MAT1    60      10.5E6  3.8E6   .33     .1                              +MAT060
  300-     +MAT060 1.88+04 1.50+04
  301-     MAT1    61      10.5E6  3.8E6   .33     .1                              +MAT061
  302-     +MAT061 1.93+04 1.55+04
  303-     MAT1    62      10.5E6  3.8E6   .33     .1                              +MAT062
  304-     +MAT062 1.93+04 1.55+04
  305-     MAT1    63      10.5E6  3.8E6   .33     .1                              +MAT063
  306-     +MAT063 1.55+04 1.24+04
  307-     MAT1    64      10.5E6  3.8E6   .33     .1                              +MAT064
  308-     +MAT064 1.55+04 1.24+04
  309-     MAT1    65      10.5E6  3.8E6   .33     .1                              +MAT065
  310-     +MAT065 1.55+04 1.24+04
  311-     MAT1    66      10.5E6  3.8E6   .33     .1                              +MAT066
  312-     +MAT066 1.55+04 1.24+04
  313-     MAT1    67      10.5E6  3.8E6   .33     .1                              +MAT067
  314-     +MAT067 9.06+04 7.25+04
  315-     MAT1    68      10.5E6  3.8E6   .33     .1                              +MAT068
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S O R T E D   B U L K   D A T A   E C H O

```
CARD
COUNT     .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 316-     +MAT068  1.01+05 8.11+04
 317-     MAT1    69      10.5E6  3.8E6   .33     .1                              +MAT069
 318-     +MAT069  9.06+04 7.25+04
 319-     MAT1    70      10.5E6  3.8E6   .33     .1                              +MAT070
 320-     +MAT070  1.05+05 8.40+04
 321-     MAT1    71      10.5E6  3.8E6   .33     .1                              +MAT071
 322-     +MAT071  4.82+04 3.86+04
 323-     MAT1    72      10.5E6  3.8E6   .33     .1                              +MAT072
 324-     +MAT072  4.82+04 3.86+04
 325-     MAT1    73      10.5E6  3.8E6   .33     .1                              +MAT073
 326-     +MAT073  3.41+04 2.73+04
 327-     MAT1    74      10.5E6  3.8E6   .33     .1                              +MAT074
 328-     +MAT074  3.41+04 2.73+04
 329-     MAT1    75      10.5E6  3.8E6   .33     .1                              +MAT075
 330-     +MAT075  3.41+04 2.73+04
 331-     MAT1    76      10.5E6  3.8E6   .33     .1                              +MAT076
 332-     +MAT076  3.41+04 2.73+04
 333-     MAT1    77      10.5E6  3.8E6   .33     .1                              +MAT077
 334-     +MAT077  2.57+04 2.05+04
 335-     MAT1    78      10.5E6  3.8E6   .33     .1                              +MAT078
 336-     +MAT078  2.57+04 2.05+04
 337-     MAT1    79      10.5E6  3.8E6   .33     .1                              +MAT079
 338-     +MAT079  2.64+04 2.11+04
 339-     MAT1    80      10.5E6  3.8E6   .33     .1                              +MAT080
 340-     +MAT080  2.64+04 2.11+04
 341-     MAT1    81      10.5E6  3.8E6   .33     .1                              +MAT081
 342-     +MAT081  2.57+04 2.05+04
 343-     MAT1    82      10.5E6  3.8E6   .33     .1                              +MAT082
 344-     +MAT082  2.57+04 2.05+04
 345-     MAT1    83      10.5E6  3.8E6   .33     .1                              +MAT083
 346-     +MAT083  2.66+04 2.13+04
 347-     MAT1    84      10.5E6  3.8E6   .33     .1                              +MAT084
 348-     +MAT084  2.66+04 2.13+04
 349-     MAT1    85      10.5E6  3.8E6   .33     .1                              +MAT085
 350-     +MAT085  2.11+04 1.69+04
 351-     MAT1    86      10.5E6  3.8E6   .33     .1                              +MAT086
 352-     +MAT086  2.11+04 1.69+04
 353-     MAT1    87      10.5E6  3.8E6   .33     .1                              +MAT087
 354-     +MAT087  2.11+04 1.69+04
 355-     MAT1    88      10.5E6  3.8E6   .33     .1                              +MAT088
 356-     +MAT088  2.11+04 1.69+04
 357-     MAT1    89      10.5E6  3.8E6   .33     .1                              +MAT089
 358-     +MAT089  1.18+05 9.43+04
 359-     MAT1    90      10.5E6  3.8E6   .33     .1                              +MAT090
 360-     +MAT090  1.34+05 1.08+05
```

S O R T E D   B U L K   D A T A   E C H O

```
CARD
COUNT    .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 361-    MAT1    91      10.5E6  3.8E6   .33     .1                              +MAT091
 362-    +MAT091 1.18+05 9.43+04
 363-    MAT1    92      10.5E6  3.8E6   .33     .1                              +MAT092
 364-    +MAT092 1.40+05 1.12+05
 365-    MAT1    93      10.5E6  3.8E6   .33     .1                              +MAT093
 366-    +MAT093 6.34+04 5.07+04
 367-    MAT1    94      10.5E6  3.8E6   .33     .1                              +MAT094
 368-    +MAT094 6.34+04 5.07+04
 369-    MAT1    95      10.5E6  3.8E6   .33     .1                              +MAT095
 370-    +MAT095 4.65+04 3.72+04
 371-    MAT1    96      10.5E6  3.8E6   .33     .1                              +MAT096
 372-    +MAT096 4.65+04 3.72+04
 373-    MAT1    97      10.5E6  3.8E6   .33     .1                              +MAT097
 374-    +MAT097 4.65+04 3.72+04
 375-    MAT1    98      10.5E6  3.8E6   .33     .1                              +MAT098
 376-    +MAT098 4.65+04 3.72+04
 377-    MAT1    99      10.5E6  3.8E6   .33     .1                              +MAT099
 378-    +MAT099 3.45+04 2.76+04
 379-    MAT1    100     10.5E6  3.8E6   .33     .1                              +MAT100
 380-    +MAT100 3.45+04 2.76+04
 381-    MAT1    101     10.5E6  3.8E6   .33     .1                              +MAT101
 382-    +MAT101 3.57+04 2.86+04
 383-    MAT1    102     10.5E6  3.8E6   .33     .1                              +MAT102
 384-    +MAT102 3.57+04 2.86+04
 385-    MAT1    103     10.5E6  3.8E6   .33     .1                              +MAT103
 386-    +MAT103 3.45+04 2.76+04
 387-    MAT1    104     10.5E6  3.8E6   .33     .1                              +MAT104
 388-    +MAT104 3.45+04 2.76+04
 389-    MAT1    105     10.5E6  3.8E6   .33     .1                              +MAT105
 390-    +MAT105 3.60+04 2.88+04
 391-    MAT1    106     10.5E6  3.8E6   .33     .1                              +MAT106
 392-    +MAT106 3.60+04 2.88+04
 393-    MAT1    107     10.5E6  3.8E6   .33     .1                              +MAT107
 394-    +MAT107 2.83+04 2.26+04
 395-    MAT1    108     10.5E6  3.8E6   .33     .1                              +MAT108
 396-    +MAT108 2.83+04 2.27+04
 397-    MAT1    109     10.5E6  3.8E6   .33     .1                              +MAT109
 398-    +MAT109 2.83+04 2.27+04
 399-    MAT1    110     10.5E6  3.8E6   .33     .1                              +MAT110
 400-    +MAT110 2.83+04 2.26+04
 401-    MAT1    111     10.5E6  3.8E6   .33     .1                              +MAT111
 402-    +MAT111 1.52+05 1.22+05
 403-    MAT1    112     10.5E6  3.8E6   .33     .1                              +MAT112
 404-    +MAT112 1.78+05 1.42+05
 405-    MAT1    113     10.5E6  3.8E6   .33     .1                              +MAT113
```

S O R T E D B U L K D A T A E C H O

```
CARD
COUNT   .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 406-   +MAT113  1.52+05 1.22+05
 407-   MAT1    114     10.5E6  3.8E6   .33     .1                              +MAT114
 408-   +MAT114  1.85+05 1.48+05
 409-   MAT1    115     10.5E6  3.8E6   .33     .1                              +MAT115
 410-   +MAT115  8.28+04 6.62+04
 411-   MAT1    116     10.5E6  3.8E6   .33     .1                              +MAT116
 412-   +MAT116  8.28+04 6.62+04
 413-   MAT1    117     10.5E6  3.8E6   .33     .1                              +MAT117
 414-   +MAT117  5.53+04 4.42+04
 415-   MAT1    118     10.5E6  3.8E6   .33     .1                              +MAT118
 416-   +MAT118  5.53+04 4.42+04
 417-   MAT1    119     10.5E6  3.8E6   .33     .1                              +MAT119
 418-   +MAT119  5.53+04 4.42+04
 419-   MAT1    120     10.5E6  3.8E6   .33     .1                              +MAT120
 420-   +MAT120  5.53+04 4.42+04
 421-   MAT1    121     10.5E6  3.8E6   .33     .1                              +MAT121
 422-   +MAT121  4.20+04 3.36+04
 423-   MAT1    122     10.5E6  3.8E6   .33     .1                              +MAT122
 424-   +MAT122  4.20+04 3.36+04
 425-   MAT1    123     10.5E6  3.8E6   .33     .1                              +MAT123
 426-   +MAT123  4.36+04 3.49+04
 427-   MAT1    124     10.5E6  3.8E6   .33     .1                              +MAT124
 428-   +MAT124  4.36+04 3.49+04
 429-   MAT1    125     10.5E6  3.8E6   .33     .1                              +MAT125
 430-   +MAT125  4.20+04 3.36+04
 431-   MAT1    126     10.5E6  3.8E6   .33     .1                              +MAT126
 432-   +MAT126  4.20+04 3.[illegible]6+04
 433-   MAT1    127     10.5E6  3.8E6   .33     .1                              +MAT127
 434-   +MAT127  4.40+04 3.52+04
 435-   MAT1    128     10.5E6  3.8E6   .33     .1                              +MAT128
 436-   +MAT128  4.40+04 3.52+04
 437-   MAT1    129     10.5E6  3.8E6   .33     .1                              +MAT129
 438-   +MAT129  3.50+04 2.80+04
 439-   MAT1    130     10.5E6  3.8E6   .33     .1                              +MAT130
 440-   +MAT130  3.50+04 2.80+04
 441-   MAT1    131     10.5E6  3.8E6   .33     .1                              +MAT131
 442-   +MAT131  3.50+04 2.80+04
 443-   MAT1    132     10.5E6  3.8E6   .33     .1                              +MAT132
 444-   +MAT132  3.50+04 2.80+04
 445-   MAT1    133     10.5E6  3.8E6   .33     .1                              +MAT133
 446-   +MAT133  1.99+05 1.60+05
 447-   MAT1    134     10.5E6  3.8E6   .33     .1                              +MAT134
 448-   +MAT134  2.39+05 1.91+05
 449-   MAT1    135     10.5E6  3.8E6   .33     .1                              +MAT135
 450-   +MAT135  1.99+05 1.60+05
```

S O R T E D   B U L K   D A T A   E C H O

```
 CARD
 COUNT      .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  451-      MAT1    136       10.5E6  3.8E6   .33     .1                              +MAT136
  452-      +MAT136 2.48+05 1.99+05
  453-      MAT1    137       10.5E6  3.8E6   .33     .1                              +MAT137
  454-      +MAT137 1.10+05 8.77+04
  455-      MAT1    138       10.5E6  3.8E6   .33     .1                              +MAT138
  456-      +MAT138 1.10+05 8.77+04
  457-      PARAM   GRDPNT  0
  458-      PTUBE   1       1       1.5     .0625
  459-      PTUBE   2       2       1.5     .0625
  460-      PTUBE   3       3       1.5     .0625
  461-      PTUBE   4       4       1.5     .0625
  462-      PTUBE   5       5       1.5     .0625
  463-      PTUBE   6       6       1.5     .0625
  464-      PTUBE   7       7       1.5     .0625
  465-      PTUBE   8       8       1.5     .0625
  466-      PTUBE   9       9       1.5     .0625
  467-      PTUBE   10      10      1.5     .0625
  468-      PTUBE   11      11      1.5     .0625
  469-      PTUBE   12      12      1.5     .0625
  470-      PTUBE   13      13      1.5     .0625
  471-      PTUBE   14      14      1.5     .0625
  472-      PTUBE   15      15      1.5     .0625
  473-      PTUBE   16      16      1.5     .0625
  474-      PTUBE   17      17      1.5     .0625
  475-      PTUBE   18      18      1.5     .0625
  476-      PTUBE   19      19      1.5     .0625
  477-      PTUBE   20      20      1.5     .0625
  478-      PTUBE   21      21      1.5     .0625
  479-      PTUBE   22      22      1.5     .0625
  480-      PTUBE   23      23      1.5     .0625
  481-      PTUBE   24      24      1.5     .0625
  482-      PTUBE   25      25      1.5     .0625
  483-      PTUBE   26      26      1.5     .0625
  484-      PTUBE   27      27      1.5     .0625
  485-      PTUBE   28      28      1.5     .0625
  486-      PTUBE   29      29      1.5     .0625
  487-      PTUBE   30      30      1.5     .0625
  488-      PTUBE   31      31      1.5     .0625
  489-      PTUBE   32      32      1.5     .0625
  490-      PTUBE   33      33      1.5     .0625
  491-      PTUBE   34      34      1.5     .0625
  492-      PTUBE   35      35      1.5     .0625
  493-      PTUBE   36      36      1.5     .0625
  494-      PTUBE   37      37      1.5     .0625
  495-      PTUBE   38      38      1.5     .0625
```

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
496-	PTUBE	39	39	1.5	.0625					
497-	PTUBE	40	40	1.5	.0625					
498-	PTUBE	41	41	1.5	.0625					
499-	PTUBE	42	42	1.5	.0625					
500-	PTUBE	43	43	1.5	.0625					
501-	PTUBE	44	44	1.5	.0625					
502-	PTUBE	45	45	1.5	.0625					
503-	PTUBE	46	46	1.5	.0625					
504-	PTUBE	47	47	1.5	.0625					
505-	PTUBE	48	48	1.5	.0625					
506-	PTUBE	49	49	1.5	.0625					
507-	PTUBE	50	50	1.5	.0625					
508-	PTUBE	51	51	1.5	.0625					
509-	PTUBE	52	52	1.5	.0625					
510-	PTUBE	53	53	1.5	.0625					
511-	PTUBE	54	54	1.5	.0625					
512-	PTUBE	55	55	1.5	.0625					
513-	PTUBE	56	56	1.5	.0625					
514-	PTUBE	57	57	1.5	.0625					
515-	PTUBE	58	58	1.5	.0625					
516-	PTUBE	59	59	1.5	.0625					
517-	PTUBE	60	60	1.5	.0625					
518-	PTUBE	61	61	1.5	.0625					
519-	PTUBE	62	62	1.5	.0625					
520-	PTUBE	63	63	1.5	.0625					
521-	PTUBE	64	64	1.5	.0625					
522-	PTUBE	65	65	1.5	.0625					
523-	PTUBE	66	66	1.5	.0625					
524-	PTUBE	67	67	1.5	.0625					
525-	PTUBE	68	68	1.5	.0625					
526-	PTUBE	69	69	1.5	.0625					
527-	PTUBE	70	70	1.5	.0625					
528-	PTUBE	71	71	1.5	.0625					
529-	PTUBE	72	72	1.5	.0625					
530-	PTUBE	73	73	1.5	.0625					
531-	PTUBE	74	74	1.5	.0625					
532-	PTUBE	75	75	1.5	.0625					
533-	PTUBE	76	76	1.5	.0625					
534-	PTUBE	77	77	1.5	.0625					
535-	PTUBE	78	78	1.5	.0625					
536-	PTUBE	79	79	1.5	.0625					
537-	PTUBE	80	80	1.5	.0625					
538-	PTUBE	81	81	1.5	.0625					
539-	PTUBE	82	82	1.5	.0625					
540-	PTUBE	83	83	1.5	.0625					

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 .. 7 .. 8 .. 9 .. 10 .
541-	PTUBE	84	84	1.5	.0625	
542-	PTUBE	85	85	1.5	.0625	
543-	PTUBE	86	86	1.5	.0625	
544-	PTUBE	87	87	1.5	.0625	
545-	PTUBE	88	88	1.5	.0625	
546-	PTUBE	89	89	1.5	.0625	
547-	PTUBE	90	90	1.5	.0625	
548-	PTUBE	91	91	1.5	.0625	
549-	PTUBE	92	92	1.5	.0625	
550-	PTUBE	93	93	1.5	.0625	
551-	PTUBE	94	94	1.5	.0625	
552-	PTUBE	95	95	1.5	.0625	
553-	PTUBE	96	96	1.5	.0625	
554-	PTUBE	97	97	1.5	.0625	
555-	PTUBE	98	98	1.5	.0625	
556-	PTUBE	99	99	1.5	.0625	
557-	PTUBE	100	100	1.5	.0625	
558-	PTUBE	101	101	1.5	.0625	
559-	PTUBE	102	102	1.5	.0625	
560-	PTUBE	103	103	1.5	.0625	
561-	PTUBE	104	104	1.5	.0625	
562-	PTUBE	105	105	1.5	.0625	
563-	PTUBE	106	106	1.5	.0625	
564-	PTUBE	107	107	1.5	.0625	
565-	PTUBE	108	108	1.5	.0625	
566-	PTUBE	109	109	1.5	.0625	
567-	PTUBE	110	110	1.5	.0625	
568-	PTUBE	111	111	1.5	.0625	
569-	PTUBE	112	112	1.5	.0625	
570-	PTUBE	113	113	1.5	.0625	
571-	PTUBE	114	114	1.5	.0625	
572-	PTUBE	115	115	1.5	.0625	
573-	PTUBE	116	116	1.5	.0625	
574-	PTUBE	117	117	1.5	.0625	
575-	PTUBE	118	118	1.5	.0625	
576-	PTUBE	119	119	1.5	.0625	
577-	PTUBE	120	120	1.5	.0625	
578-	PTUBE	121	121	1.5	.0625	
579-	PTUBE	122	122	1.5	.0625	
580-	PTUBE	123	123	1.5	.0625	
581-	PTUBE	124	124	1.5	.0625	
582-	PTUBE	125	125	1.5	.0625	
583-	PTUBE	126	126	1.5	.0625	
584-	PTUBE	127	127	1.5	.0625	
585-	PTUBE	128	128	1.5	.0625	

DAMAGE CRITION = NONE

SORTED BULK DATA ECHO

```
CARD
COUNT      .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  586-     PTUBE   129     129     1.5     .0625
  587-     PTUBE   130     130     1.5     .0625
  588-     PTUBE   131     131     1.5     .0625
  589-     PTUBE   132     132     1.5     .0625
  590-     PTUBE   133     133     1.5     .0625
  591-     PTUBE   134     134     1.5     .0625
  592-     PTUBE   135     135     1.5     .0625
  593-     PTUBE   136     136     1.5     .0625
  594-     PTUBE   137     137     1.5     .0625
  595-     PTUBE   138     138     1.5     .0625
  596-     SPC     10      1       123456          2       123456
  597-     SPC     10      3       123456          4       123456
           ENDDATA

*  12.0 CPU-S  61.0 COR-S   83 ELP-S.    XGPI

       **NO ERRORS FOUND - EXECUTE NASTRAN PROGRAM**

*  15.3 CPU-S  65.3 COR-S   87 ELP-S.    SEM1  END

*  15.3 CPU-S  65.6 COR-S   87 ELP-S.    ----  LINK   END  ---
```

DAMAGE CRITERION = NONE

LINEAR CASE 30 % LOADING SUBCASE 1

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	3.824586-03	-8.002697-03	1.239147-03	.0	.0	.0
6	G	-6.296042-04	3.914426-03	1.846044-03	.0	.0	.0
7	G	-3.698554-03	3.156076-03	-9.398228-03	.0	.0	.0
8	G	5.239937-04	-7.229598-03	-8.782766-03	.0	.0	.0
9	G	6.610921-03	-2.175839-02	-2.567162-03	.0	.0	.0
10	G	-2.368843-04	2.303234-03	-2.075979-03	.0	.0	.0
11	G	-6.435060-03	1.945657-03	-2.499642-02	.0	.0	.0
12	G	9.741511-05	-2.139398-02	-2.450107-02	.0	.0	.0
13	G	8.146073-03	-4.387943-02	-8.707179-03	.0	.0	.0
14	G	1.206440-03	-4.716482-03	-8.338110-03	.0	.0	.0
15	G	-7.925483-03	-4.710570-03	-4.543954-02	.0	.0	.0
16	G	-1.385646-03	-4.388691-02	-4.507126-02	.0	.0	.0
17	G	9.036864-03	-6.966224-02	-1.391069-02	.0	.0	.0
18	G	2.886190-03	-1.779398-02	-1.364049-02	.0	.0	.0
19	G	-8.772825-03	-1.779401-02	-6.206533-02	.0	.0	.0
20	G	-3.109049-03	-6.966215-02	-6.179508-02	.0	.0	.0
21	G	9.857841-03	-9.855769-02	-1.861497-02	.0	.0	.0
22	G	4.305520-03	-3.607603-02	-1.843069-02	.0	.0	.0
23	G	-9.480291-03	-3.607603-02	-7.607050-02	.0	.0	.0
24	G	-4.641886-03	-9.855770-02	-7.588623-02	.0	.0	.0
25	G	1.072468-02	-1.339295-01	-2.298322-02	.0	.0	.0
26	G	5.354045-03	-5.878662-02	-2.328369-02	.0	.0	.0
27	G	-9.875625-03	-5.878632-02	-8.844667-02	.0	.0	.0
28	G	-6.161880-03	-1.339296-01	-8.874706-02	.0	.0	.0

TRUSS TAIL BOOM MODEL3 **A 138 ELEMENT VERSION OCTOBER 26, 1977 NASTRAN 7/15/77 PAGE 30

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	6.281367-03	-1.290758-02	1.840769-03	.0	.0	.0
6	G	-1.113541-03	6.320952-03	2.833394-03	.0	.0	.0
7	G	-6.069280-03	5.062479-03	-1.526184-02	.0	.0	.0
8	G	9.526196-04	-1.160466-02	-1.427592-02	.0	.0	.0
9	G	1.089392-02	-3.508677-02	-4.808997-03	.0	.0	.0
10	G	-5.700293-04	3.676014-03	-4.001624-03	.0	.0	.0
11	G	-1.058286-02	3.073215-03	-4.088399-02	.0	.0	.0
12	G	3.735691-04	-3.443918-02	-4.009303-02	.0	.0	.0
13	G	1.346446-02	-7.077503-02	-1.564776-02	.0	.0	.0
14	G	1.670188-03	-7.724496-03	-1.504323-02	.0	.0	.0
15	G	-1.305685-02	-7.732561-03	-7.473497-02	.0	.0	.0
16	G	-1.906340-03	-7.072629-02	-7.415868-02	.0	.0	.0
17	G	1.496082-02	-1.123012-01	-2.523106-02	.0	.0	.0
18	G	4.313699-03	-2.881596-02	-2.478546-02	.0	.0	.0
19	G	-1.445805-02	-2.882510-02	-1.026948-01	.0	.0	.0
20	G	-4.594557-03	-1.122454-01	-1.022772-01	.0	.0	.0
21	G	1.631946-02	-1.588013-01	-3.414978-02	.0	.0	.0
22	G	6.570183-03	-5.824551-02	-3.383663-02	.0	.0	.0
23	G	-1.560526-02	-5.824007-02	-1.265726-01	.0	.0	.0
24	G	-7.003218-03	-1.587456-01	-1.262994-01	.0	.0	.0
25	G	1.770963-02	-2.156645-01	-4.258951-02	.0	.0	.0
26	G	8.250180-03	-9.476994-02	-4.318600-02	.0	.0	.0
27	G	-1.623571-02	-9.475413-02	-1.480426-01	.0	.0	.0
28	G	-9.431505-03	-2.156395-01	-1.484158-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	9.533282-03	-1.941618-02	2.650673-03	.0	.0	.0
6	G	-1.747135-03	9.511817-03	4.154578-03	.0	.0	.0
7	G	-9.267624-03	7.592465-03	-2.303305-02	.0	.0	.0
8	G	1.512604-03	-1.741457-02	-2.155492-02	.0	.0	.0
9	G	1.656074-02	-5.277652-02	-7.732364-03	.0	.0	.0
10	G	-9.960997-04	5.494815-03	-6.506245-03	.0	.0	.0
11	G	-1.607215-02	4.568615-03	-6.191937-02	.0	.0	.0
12	G	7.220333-04	-5.175763-02	-6.073546-02	.0	.0	.0
13	G	2.049857-02	-1.064728-01	-2.473355-02	.0	.0	.0
14	G	2.308141-03	-1.171781-02	-2.381716-02	.0	.0	.0
15	G	-1.984633-02	-1.174316-02	-1.134944-01	.0	.0	.0
16	G	-2.623525-03	-1.063539-01	-1.126407-01	.0	.0	.0
17	G	2.279416-02	-1.689005-01	-4.003750-02	.0	.0	.0
18	G	6.235000-03	-4.344740-02	-3.935992-02	.0	.0	.0
19	G	-2.197997-02	-4.346799-02	-1.564087-01	.0	.0	.0
20	G	-6.598385-03	-1.687749-01	-1.557942-01	.0	.0	.0
21	G	2.486342-02	-2.387751-01	-5.444707-02	.0	.0	.0
22	G	9.604235-03	-8.767548-02	-5.396424-02	.0	.0	.0
23	G	-2.370997-02	-8.766325-02	-1.932925-01	.0	.0	.0
24	G	-1.017334-02	-2.386495-01	-1.928997-01	.0	.0	.0
25	G	2.694789-02	-3.241742-01	-6.818286-02	.0	.0	.0
26	G	1.212250-02	-1.425386-01	-6.916410-02	.0	.0	.0
27	G	-2.465255-02	-1.425034-01	-2.267200-01	.0	.0	.0
28	G	-1.380776-02	-3.241178-01	-2.271980-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	1.286115-02	-2.596397-02	3.386742-03	.0	.0	.0
6	G	-2.431297-03	1.272251-02	5.412542-03	.0	.0	.0
7	G	-1.241681-02	1.012095-02	-3.089950-02	.0	.0	.0
8	G	2.127547-03	-2.323194-02	-2.892935-02	.0	.0	.0
9	G	2.237754-02	-7.057362-02	-1.100286-02	.0	.0	.0
10	G	-1.515039-03	7.296367-03	-9.347485-03	.0	.0	.0
11	G	-2.169648-02	6.031951-03	-8.335608-02	.0	.0	.0
12	G	1.177268-03	-6.915148-02	-8.178067-02	.0	.0	.0
13	G	2.773650-02	-1.423995-01	-3.466389-02	.0	.0	.0
14	G	2.816091-03	-1.580974-02	-3.342902-02	.0	.0	.0
15	G	-2.681393-02	-1.586134-02	-1.531947-01	.0	.0	.0
16	G	-3.184492-03	-1.421796-01	-1.520707-01	.0	.0	.0
17	G	3.086790-02	-2.258348-01	-5.631068-02	.0	.0	.0
18	G	8.000676-03	-5.824678-02	-5.539491-02	.0	.0	.0
19	G	-2.970165-02	-5.828346-02	-2.117218-01	.0	.0	.0
20	G	-8.407594-03	-2.256113-01	-2.109185-01	.0	.0	.0
21	G	3.366880-02	-3.191812-01	-7.690203-02	.0	.0	.0
22	G	1.247221-02	-1.173368-01	-7.624082-02	.0	.0	.0
23	G	-3.202059-02	-1.173151-01	-2.623322-01	.0	.0	.0
24	G	-1.312326-02	-3.189575-01	-2.618314-01	.0	.0	.0
25	G	3.644662-02	-4.332005-01	-9.665431-02	.0	.0	.0
26	G	1.582748-02	-1.905973-01	-9.807861-02	.0	.0	.0
27	G	-3.327300-02	-1.905348-01	-3.085431-01	.0	.0	.0
28	G	-1.795811-02	-4.330999-01	-3.090712-01	.0	.0	.0

TRUSS TAIL BOOM MODELS **A 138 ELEMENT VERSION OCTOBER 26, 1977 NASTRAN 7/15/77 PAGE 36

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	2.095886+03	1.0+01	.0		8	-3.890512+02	4.8+01	.0	
9	-2.017964+03	8.5+00	.0		10	3.279128+02	7.2+01	.0	
11	-7.086355+02	1.7+01	.0		12	1.678001+03	8.5+00	.0	
13	2.006461+03	7.2+00	.0		14	-5.382429+02	2.3+01	.0	
15	1.017874+03	1.5+01	.0		16	-1.980322+03	5.5+00	.0	
17	-2.175370+03	5.1+00	.0		18	6.932344+02	2.3+01	.0	
19	1.999312+02	6.1+01	.0		20	-2.082070+02	4.6+01	.0	
21	-1.722111+02	5.6+01	.0		22	1.831870+02	6.6+01	.0	
23	-5.433204+02	7.9+01	.0		24	-6.413224+02	7.3+01	.0	
25	5.302805+02	1.0+02	.0		26	6.301366+02	9.6+01	.0	
27	-2.633026+00	8.7+03	.0		28	-9.525177+00	2.4+03	.0	
29	1.813031+03	1.3+01	.0		30	1.219843+02	2.0+02	.0	
31	-1.763800+03	1.0+01	.0		32	-1.512231+02	1.3+02	.0	
33	-8.734526+02	1.5+01	.0		34	1.928708+03	8.1+00	.0	
35	2.035907+03	7.8+00	.0		36	-1.089855+03	1.2+01	.0	
37	1.358321+03	1.2+01	.0		38	-2.407334+03	4.8+00	.0	
39	-2.150784+03	5.7+00	.0		40	1.193662+03	1.4+01	.0	
41	1.139936+02	1.2+02	.0		42	-2.189064+02	5.0+01	.0	
43	-1.065987+02	1.0+02	.0		44	2.103704+02	6.5+01	.0	
45	-5.997918+02	9.1+01	.0		46	-3.616479+02	1.7+02	.0	
47	5.855759+02	1.2+02	.0		48	3.425364+02	2.3+02	.0	
49	-3.765503+00	7.8+03	.0		50	-1.276120+01	2.3+03	.0	
51	1.379911+03	1.7+01	.0		52	7.144226+02	3.3+01	.0	
53	-1.321422+03	1.4+01	.0		54	-7.549249+02	2.5+01	.0	
55	-1.129183+03	1.2+01	.0		56	2.423532+03	6.8+00	.0	
57	2.173116+03	7.8+00	.0		58	-1.770916+03	7.7+00	.0	
59	1.714863+03	9.9+00	.0		60	-3.003300+03	4.0+00	.0	
61	-2.300082+03	5.7+00	.0		62	1.896380+03	9.2+00	.0	
63	1.488735+02	1.0+02	.0		64	-2.812774+02	4.3+01	.0	
65	-1.438065+02	8.5+01	.0		66	2.733373+02	5.6+01	.0	
67	-6.862996+02	1.0+02	.0		68	-3.145312+01	2.6+03	.0	
69	6.687827+02	1.3+02	.0		70	5.296387+00	2.0+04	.0	
71	-1.930908+00	2.0+04	.0		72	-1.962646+01	2.0+03	.0	
73	1.290318+03	2.5+01	.0		74	1.148172+03	2.9+01	.0	
75	-1.217862+03	2.1+01	.0		76	-1.201685+03	2.2+01	.0	
77	-1.595667+03	1.2+01	.0		78	3.062812+03	7.4+00	.0	
79	2.257876+03	1.1+01	.0		80	-2.185781+03	8.7+00	.0	
81	1.601493+03	1.5+01	.0		82	-3.063670+03	5.7+00	.0	
83	-2.390856+03	7.9+00	.0		84	2.339188+03	1.0+01	.0	
85	-7.093945+01	2.4+02	.0		86	-8.429602+01	2.0+02	.0	
87	7.717090+01	2.7+02	.0		88	7.137585+01	2.9+02	.0	
89	-7.953979+02	1.2+02	.0		90	-4.143457+01	2.6+03	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	7.755576+02	1.5+02	.0		92	6.912109+00	2.0+04	.0	
93	-1.174805+00	4.3+04	.0		94	-2.545911+01	2.0+03	.0	
95	1.517651+03	3.0+01	.0		96	1.319505+03	3.4+01	.0	
97	-1.379430+03	2.6+01	.0		98	-1.431422+03	2.5+01	.0	
99	-1.824011+03	1.4+01	.0		100	3.491667+03	8.9+00	.0	
101	2.489045+03	1.3+01	.0		102	-2.443332+03	1.1+01	.0	
103	1.834190+03	1.8+01	.0		104	-3.495652+03	6.9+00	.0	
105	-2.663865+03	9.8+00	.0		106	2.617911+03	1.3+01	.0	
107	-5.250098+01	4.3+02	.0		108	-1.250378+02	1.8+02	.0	
109	1.144460+02	2.5+02	.0		110	5.255762+01	5.4+02	.0	
111	-9.194983+02	1.3+02	.0		112	-4.764453+01	3.0+03	.0	
113	8.875625+02	1.7+02	.0		114	-4.732910+00	3.1+04	.0	
115	6.586035+01	1.3+03	.0		116	-1.071396+02	6.2+02	.0	
117	1.850741+03	2.9+01	.0		118	1.287430+03	4.2+01	.0	
119	-1.343775+03	3.2+01	.0		120	-1.794080+03	2.4+01	.0	
121	-2.061425+03	1.5+01	.0		122	4.128576+03	9.2+00	.0	
123	3.055926+03	1.3+01	.0		124	-3.026574+03	1.1+01	.0	
125	2.094837+03	1.9+01	.0		126	-4.120793+03	7.2+00	.0	
127	-3.213598+03	1.0+01	.0		128	3.164576+03	1.3+01	.0	
129	-3.634321+02	7.6+01	.0		130	9.194763+01	3.8+02	.0	
131	-9.038428+01	3.1+02	.0		132	3.806885+02	9.1+01	.0	
133	-4.034072+02	4.0+02	.0		134	-2.479297+01	7.7+03	.0	
135	6.054766+02	3.3+02	.0		136	-1.595508+01	1.2+04	.0	
137	-1.985935+03	4.3+01	.0		138	2.078661+03	5.2+01	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	3.180557+03	6.5+00	.0		8	-6.090774+02	3.0+01	.0	
9	-3.061034+03	5.2+00	.0		10	5.195061+02	4.5+01	.0	
11	-1.065306+03	1.1+01	.0		12	2.524473+03	5.3+00	.0	
13	3.029875+03	4.4+00	.0		14	-7.904973+02	1.6+01	.0	
15	1.525671+03	9.5+00	.0		16	-2.973785+03	3.3+00	.0	
17	-3.286572+03	3.0+00	.0		18	1.026750+03	1.5+01	.0	
19	2.991644+02	4.0+01	.0		20	-3.139926+02	3.0+01	.0	
21	-2.587820+02	3.7+01	.0		22	2.764727+02	4.3+01	.0	
23	-8.223837+02	5.2+01	.0		24	-9.852325+02	4.7+01	.0	
25	7.950940+02	6.7+01	.0		26	9.610486+02	6.2+01	.0	
27	-9.202881+00	2.5+03	.0		28	-1.660980+01	1.4+03	.0	
29	2.760029+03	7.9+00	.0		30	1.582844+02	1.5+02	.0	
31	-2.681496+03	6.3+00	.0		32	-1.976353+02	9.9+01	.0	
33	-1.311085+03	9.7+00	.0		34	2.900671+03	5.0+00	.0	
35	3.076049+03	4.9+00	.0		36	-1.619376+03	7.9+00	.0	
37	2.038528+03	7.6+00	.0		38	-3.617165+03	2.9+00	.0	
39	-3.248916+03	3.5+00	.0		40	1.776009+03	9.2+00	.0	
41	1.690861+02	8.1+01	.0		42	-3.286189+02	3.3+01	.0	
43	-1.606795+02	6.9+01	.0		44	3.153705+02	4.3+01	.0	
45	-9.082664+02	6.0+01	.0		46	-5.690024+02	1.1+02	.0	
47	8.772700+02	7.8+01	.0		48	5.263073+02	1.5+02	.0	
49	-1.266028+01	2.3+03	.0		50	-2.385867+01	1.2+03	.0	
51	2.106822+03	1.1+01	.0		52	1.046175+03	2.3+01	.0	
53	-2.013024+03	8.8+00	.0		54	-1.101124+03	1.7+01	.0	
55	-1.695562+03	7.8+00	.0		56	3.642226+03	4.2+00	.0	
57	3.287532+03	4.8+00	.0		58	-2.643214+03	4.8+00	.0	
59	2.577278+03	6.3+00	.0		60	-4.511325+03	2.3+00	.0	
61	-3.472183+03	3.5+00	.0		62	2.826793+03	5.8+00	.0	
63	2.245847+02	6.8+01	.0		64	-4.212401+02	2.8+01	.0	
65	-2.188875+02	5.6+01	.0		66	4.082813+02	3.7+01	.0	
67	-1.036204+03	6.9+01	.0		68	-7.672949+01	1.1+03	.0	
69	9.972158+02	9.0+01	.0		70	1.665448+01	6.3+03	.0	
71	-1.113945+01	3.4+03	.0		72	-3.766003+01	1.0+03	.0	
73	1.969708+03	1.6+01	.0		74	1.696032+03	1.9+01	.0	
75	-1.853718+03	1.4+01	.0		76	-1.769254+03	1.4+01	.0	
77	-2.396512+03	7.6+00	.0		78	4.599665+03	4.6+00	.0	
79	3.381771+03	6.8+00	.0		80	-3.265125+03	5.5+00	.0	
81	2.410217+03	9.7+00	.0		82	-4.602005+03	3.5+00	.0	
83	-3.611081+03	4.9+00	.0		84	3.495187+03	6.6+00	.0	
85	-1.065981+02	1.6+02	.0		86	-1.288851+02	1.3+02	.0	
87	1.133459+02	1.9+02	.0		88	1.070165+02	2.0+02	.0	
89	-1.200795+03	7.8+01	.0		90	-9.330469+01	1.2+03	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	1.156034+03	1.0+02	.0		92	1.558154+01	9.0+03	.0	
93	-1.186914+01	4.3+03	.0		94	-4.814172+01	1.1+03	.0	
95	2.309225+03	1.9+01	.0		96	1.956901+03	2.3+01	.0	
97	-2.091982+03	1.7+01	.0		98	-2.114908+03	1.7+01	.0	
99	-2.738761+03	9.1+00	.0		100	5.242883+03	5.6+00	.0	
101	3.757562+03	8.5+00	.0		102	-3.654515+03	6.8+00	.0	
103	2.761693+03	1.1+01	.0		104	-5.251874+03	4.3+00	.0	
105	-4.019805+03	6.2+00	.0		106	3.916175+03	8.2+00	.0	
107	-7.886230+01	2.9+02	.0		108	-1.914911+02	1.2+02	.0	
109	1.676157+02	1.7+02	.0		110	7.899951+01	3.6+02	.0	
111	-1.391391+03	8.7+01	.0		112	-1.073594+02	1.3+03	.0	
113	1.319391+03	1.1+02	.0		114	-1.064844+01	1.4+04	.0	
115	8.306836+01	1.0+03	.0		116	-1.760957+02	3.7+02	.0	
117	2.797051+03	1.9+01	.0		118	1.910486+03	2.8+01	.0	
119	-2.037488+03	2.1+01	.0		120	-2.669357+03	1.6+01	.0	
121	-3.087795+03	9.9+00	.0		122	6.204114+03	5.8+00	.0	
123	4.603016+03	8.5+00	.0		124	-4.536874+03	6.7+00	.0	
125	3.163083+03	1.2+01	.0		126	-6.186600+03	4.4+00	.0	
127	-4.846732+03	6.3+00	.0		128	4.736312+03	8.3+00	.0	
129	-5.380937+02	5.1+01	.0		130	1.379353+02	2.5+02	.0	
131	-1.344390+02	2.1+02	.0		132	5.770344+02	6.0+01	.0	
133	-5.291074+02	3.0+02	.0		134	-5.592969+01	3.4+03	.0	
135	9.844414+02	2.0+02	.0		136	-3.560937+01	5.6+03	.0	
137	-2.938574+03	2.9+01	.0		138	3.147651+03	3.4+01	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

S T R E S S E S   I N   R O D   E L E M E N T S   (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	4.293310+03	4.5+00	.0		8	-8.458912+02	2.2+01	.0	
9	-4.127390+03	3.6+00	.0		10	7.293166+02	3.2+01	.0	
11	-1.423472+03	8.0+00	.0		12	3.376294+03	3.7+00	.0	
13	4.066972+03	3.8+00	.0		14	-1.031504+03	1.2+01	.0	
15	2.032598+03	8.9+00	.0		16	-3.969805+03	2.2+00	.0	
17	-4.413740+03	2.0+00	.0		18	1.351614+03	1.1+01	.0	
19	3.979003+02	3.0+01	.0		20	-4.208998+02	2.2+01	.0	
21	-3.456797+02	2.8+01	.0		22	3.708930+02	3.2+01	.0	
23	-1.106695+03	3.8+01	.0		24	-1.344760+03	3.4+01	.0	
25	1.059840+03	5.0+01	.0		26	1.302639+03	4.6+01	.0	
27	-1.935426+01	1.2+03	.0		28	-2.523804+01	9.0+02	.0	
29	3.734626+03	5.6+00	.0		30	1.783222+02	1.4+02	.0	
31	-3.623606+03	4.4+00	.0		32	-2.247424+02	8.7+01	.0	
33	-1.749367+03	7.0+00	.0		34	3.878163+03	3.5+00	.0	
35	4.131343+03	3.4+00	.0		36	-2.138730+03	5.7+00	.0	
37	2.719465+03	5.4+00	.0		38	-4.831562+03	1.9+00	.0	
39	-4.362564+03	2.3+00	.0		40	2.348850+03	6.7+00	.0	
41	2.228667+02	6.1+01	.0		42	-4.385020+02	2.5+01	.0	
43	-2.152928+02	5.1+01	.0		44	4.202727+02	3.2+01	.0	
45	-1.222733+03	4.4+01	.0		46	-7.941973+02	7.6+01	.0	
47	1.168376+03	5.8+01	.0		48	7.184955+02	1.1+02	.0	
49	-2.633716+01	1.1+03	.0		50	-3.809613+01	7.7+02	.0	
51	2.858908+03	7.6+00	.0		52	1.361091+03	1.7+01	.0	
53	-2.725686+03	6.2+00	.0		54	-1.426571+03	1.3+01	.0	
55	-2.263349+03	5.6+00	.0		56	4.866162+03	2.9+00	.0	
57	4.421090+03	3.3+00	.0		58	-3.507026+03	3.4+00	.0	
59	3.443265+03	4.4+00	.0		60	-6.024208+03	1.5+00	.0	
61	-4.659512+03	2.5+00	.0		62	3.745650+03	4.2+00	.0	
63	3.011299+02	5.0+01	.0		64	-5.607360+02	2.1+01	.0	
65	-2.961062+02	4.1+01	.0		66	5.421022+02	2.8+01	.0	
67	-1.393809+03	5.1+01	.0		68	-1.418672+02	5.7+02	.0	
69	1.321798+03	6.8+01	.0		70	3.388843+01	3.1+03	.0	
71	-2.607666+01	1.5+03	.0		72	-6.115771+01	6.3+02	.0	
73	2.672370+03	1.2+01	.0		74	2.226468+03	1.4+01	.0	
75	-2.507913+03	9.9+00	.0		76	-2.314683+03	1.1+01	.0	
77	-3.193837+03	5.4+00	.0		78	6.140916+03	3.2+00	.0	
79	4.543046+03	4.[illegible]+00	.0		80	-4.335938+03	3.9+00	.0	
81	3.224751+03	7.0+00	.0		82	-6.145446+03	2.3+00	.0	
83	-4.843562+03	3.4+00	.0		84	4.642612+03	4.7+00	.0	
85	-1.4241[illegible]5+02	1.2+02	.0		86	-1.750981+02	9.6+01	.0	
87	1.473870+02	1.4+02	.0		88	1.426525+02	1.5+02	.0	
89	-1.6114[illegible]+03	5.[illegible]+01	.0		90	-1.661094+02	6.5+02	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS _ 100% LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	1.531721+03	7.6+01	.0		92	2.777783+01	5.0+03	.0	
93	-2.941113+01	1.7+03	.0		94	-7.744897+01	6.5+02	.0	
95	3.123028+03	1.4+01	.0		96	2.579405+03	1.7+01	.0	
97	-2.820045+03	1.2+01	.0		98	-2.776889+03	1.2+01	.0	
99	-3.656088+03	6.5+00	.0		100	6.998632+03	3.9+00	.0	
101	5.043096+03	6.1+00	.0		102	-4.859465+03	4.9+00	.0	
103	3.696921+03	8.3+00	.0		104	-7.014665+03	2.9+00	.0	
105	-5.392645+03	4.3+00	.0		106	5.208050+03	5.9+00	.0	
107	-1.053232+02	2.1+02	.0		108	-2.605734+02	8.6+01	.0	
109	2.180469+02	1.3+02	.0		110	1.055802+02	2.7+02	.0	
111	-1.871523+03	6.4+01	.0		112	-1.911719+02	7.4+02	.0	
113	1.743232+03	8.6+01	.0		114	-1.892187+01	7.8+03	.0	
115	8.967383+01	9.2+02	.0		116	-2.553506+02	2.6+02	.0	
117	3.757447+03	1.4+01	.0		118	2.519782+03	2.1+01	.0	
119	-2.745965+03	1.5+01	.0		120	-3.530040+03	1.2+01	.0	
121	-4.112268+03	7.2+00	.0		122	8.288303+03	4.1+00	.0	
123	6.163988+03	6.1+00	.0		124	-6.046208+03	4.8+00	.0	
125	4.246366+03	8.9+00	.0		126	-8.257161+03	3.1+00	.0	
127	-6.498541+03	4.4+00	.0		128	6.301957+03	6.0+00	.0	
129	-7.079434+02	3.9+01	.0		130	1.838745+02	1.9+02	.0	
131	-1.776914+02	1.6+02	.0		132	7.773601+02	4.4+01	.0	
133	-6.038027+02	2.6+02	.0		134	-9.966016+01	1.9+03	.0	
135	1.414676+03	1.4+02	.0		136	-6.313672+01	3.2+03	.0	
137	-3.863580+03	2.2+01	.0		138	4.235999+03	2.5+01	.0	

* 57.8 CPU-S 266.3 COR-S 1345 ELP-S. 158 OFP END

* 57.9 CPU-S 266.3 COR-S 1345 ELP-S. 179 EXIT BEGN

APPENDIX D

Element Identification Table for All Models

Type	Element ID	Node-Node	Type	Element ID	Node-Node
Vertical	1	1-2	Vertical	25	7-8
Horizontal	2	1-4	Horizontal	26	6-7
Vertical	3	3-4	Transverse	27	5-7
Horizontal	4	2-3	Diagonals	28	6-8
Transverse	5	1-3	Longerons	29	5-9
Diagonals	6	2-4	"	30	6-10
Longerons	7	1-5	"	31	7-11
"	8	2-6	"	32	8-12
"	9	3-7	Outside	33	5-10
"	10	4-8	Diagonals	34	6-9
Outside	11	1-6	"	35	5-12
Diagonals	12	2-5	"	36	8-9
"	13	1-8	"	37	8-11
"	14	4-5	"	38	7-12
"	15	4-7	"	39	6-11
"	16	3-8	"	40	7-10
"	17	2-7	Interior	41	5-11
"	18	3-6	Diagonals	42	6-12
Interior	19	1-7	"	43	7-9
Diagonals	20	2-8	"	44	8-10
"	21	3-5	Vertical	45	9-10
"	22	4-6	Horizontal	46	9-12
Vertical	23	5-6	Vertical	47	11-12
Horizontal	24	5-8	Horizontal	48	10-11

Type	Element ID	Node-Node	Type	Element ID	Node-Node
Transverse	49	9-11	Diagonals	80	16-17
Diagonals	50	10-12	"	81	16-19
Longerons	51	9-13	"	82	15-20
"	52	10-14	"	83	14-19
"	53	11-13	"	84	15-18
"	54	12-16	Interior	85	13-19
Outside	55	9-14	Diagonals	86	14-20
Diagonals	56	10-13	"	87	15-17
"	57	9-16	"	88	16-18
"	58	12-13	Vertical	89	17-18
"	59	12-15	Horizontal	90	17-20
"	60	11-16	Vertical	91	19-20
"	61	10-15	Horizontal	92	18-19
"	62	11-14	Transverse	93	17-19
Interior	63	9-15	Diagonals	94	18-20
Diagonals	64	10-16	Longerons	95	17-21
"	65	11-13	"	96	18-22
"	66	12-14	"	97	19-23
Vertical	67	13-14	"	98	20-24
Horizontal	68	13-16	Outside	99	17-22
Vertical	69	15-16	Diagonals	100	18-21
Horizontal	70	14-15	"	101	17-24
Transverse	71	13-15	"	102	20-21
Diagonals	72	14-16	"	103	20-23
Longerons	73	13-17	"	104	19-24
Longerons	74	14-18	"	105	18-23
"	75	15-19	"	106	19-22
"	76	16-20	Interior	107	17-23
Outside	77	13-18	Diagonals	108	18-24
Diagonals	78	14-17	"	109	19-21
"	79	13-20	"	110	20-22

Type	Element ID	Node-Node	Type	Element ID	Node-Node
Vertical	111	21-22	Longerons	142	28-32
Horizontal	112	21-24	Outside	143	25-30
Vertical	113	23-24	Diagonals	144	26-29
Horizontal	114	22-23	"	145	25-32
Transverse	115	21-23	"	146	28-29
Diagonals	116	22-24	"	147	28-31
Longerons	117	21-25	"	148	27-32
"	118	22-26	"	149	26-31
"	119	23-27	"	150	27-30
"	120	24-28	Interior	151	25-31
Outside	121	21-26	Diagonals	152	26-32
Diagonals	122	22-25	"	153	27-29
"	123	21-28	"	154	28-30
Diagonals	124	24-25	Vertical	155	29-30
"	125	24-27	Horizontal	156	29-32
"	126	23-28	Vertical	157	31-32
"	127	22-27	Horizontal	158	30-31
"	128	23-26	Transverse	159	29-31
Interior	129	21-27	Diagonals	160	30-32
Diagonals	130	22-28	Longerons	161	29-33
"	131	23-25	"	162	30-34
"	132	24-26	"	163	31-35
Vertical	133	25-26	"	164	32-36
Horizontal	134	25-28	Outside	165	29-34
Vertical	135	27-28	Diagonals	166	30-33
Horizontal	136	26-27	"	167	29-36
Transverse	137	25-27	"	168	32-33
Diagonals	138	26-28*	"	169	32-35
*Note models 2 & 3 end 138			"	170	31-36
Longerons	139	25-29	"	171	3-35
"	140	26-30	"	172	31-34
"	141	27-31	Interior	173	29-35

Type	Element ID	Node-Node	Type	Element ID	Node-Node
Diagonals	174	30-36	Longerons	206	38-42
"	175	31-33	"	207	39-43
"	176	32-34	"	208	40-44
Vertical	177	33-34	Outside	209	37-42
Horizontal	178	33-36	Diagonals	210	38-41
Vertical	179	35-36	"	211	37-44
Horizontal	180	34-35	"	212	40-41
Transverse	181	33-35	"	213	40-43
Diagonals	182	34-36	"	214	39-44
Longerons	183	33-37	"	215	38-43
"	184	34-38	"	216	39-42
"	185	35-39	Interior	217	37-43
"	186	36-40	Diagonals	218	38-44
Outside	187	33-38	"	219	39-41
Diagonals	188	34-37	"	220	40-42
"	189	33-40	Vertical	221	41-42
"	190	36-37	Horizontal	222	41-44
"	191	36-39	Vertical	223	43-44
"	192	35-40	Horizontal	225	42-43
"	193	34-39	Transverse	225	41-43
"	194	35-38	Diagonals	226	42-44
Interior	195	33-39			
Diagonals	196	34-40			
"	197	35-37			
"	198	36-38			
Vertical	199	37-38			
Horizontal	200	37-40			
ertical	201	39-40			
Horizontal	202	38-39			
Transverse	203	37-39			
Diagonals	204	38-40			
Longerons	205	37-41			

Appendix E

Grid Point Locations Model 1

Point #	X	Y	Z
1	.000	12.300	13.300
2	.000	12.100	-11.500
3	.000	-11.400	-11.500
4	.000	-11.600	13.300
5	23.700	11.300	12.300
6	23.900	11.100	-10.700
7	23.900	-10.600	-10.700
8	23.750	-10.800	12.300
9	45.950	10.400	11.300
10	45.950	10.200	-9.900
11	45.950	-9.800	-9.900
12	45.950	-10.000	11.300
13	66.400	9.500	10.500
14	66.500	9.300	-9.200
15	66.500	-9.100	-9.200
16	66.400	-9.300	10.500
17	85.400	8.800	9.700
18	85.400	8.600	-8.600
19	85.400	-8.400	-8.600
20	85.400	-8.600	9.700
21	103.000	8.000	8.900
22	103.000	7.900	-8.000
23	103.000	-7.800	-8.000
24	103.000	-8.000	8.900
25	119.300	7.400	8.300
26	119.300	7.200	-7.400
27	119.300	-7.300	-7.400
28	119.300	-7.500	8.300
29	134.400	6.700	7.600

Appendix E (continued)

Point #	X	Y	Z
30	134.500	6.600	-6.900
31	134.500	-6.800	-6.900
32	134.400	-6.900	7.600
33	148.500	6.100	7.000
34	148.500	6.000	-6.500
35	148.500	-6.300	-6.500
36	148.500	-6.400	7.000
37	161.400	5.600	6.500
38	161.500	5.500	-6.000
39	161.500	-5.800	-6.000
40	161.400	-6.000	6.500
41	173.500	5.100	6.000
42	173.500	5.000	-5.600
43	173.500	-5.400	-5.600
44	173.500	-5.500	6.000

Appendix F

Grid Point Locations Models 2 and 3

Point #	X	Y	Z
1	.000	11.95	12.375
2	.000	11.75	-12.375
3	.000	-11.75	-12.375
4	.000	-11.95	12.375
5	33.5	10.666	11.105
6	33.5	10.485	-11.105
7	33.5	-10.485	-11.105
8	33.5	-10.666	11.105
9	66.5	9.401	9.855
10	66.5	9.239	-9.855
11	66.5	-9.239	-9.855
12	66.5	-9.401	9.855
13	99.5	8.136	8.604
14	99.5	7.994	-8.604
15	99.5	-7.994	-8.604
16	99.5	-8.136	8.604
17	127.5	7.063	7.543
18	127.5	6.937	-7.543
19	127.5	-6.937	-7.543
20	127.5	-7.063	7.543
21	151.5	6.143	6.634
22	151.5	6.031	-6.634
23	151.5	-6.031	-6.634
24	151.5	-6.143	6.634
25	173.5	5.3	5.8
26	173.5	5.2	-5.8
27	173.5	-5.2	-5.8
28	173.5	-5.3	5.800

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