

✓ u
①
AD-A243 724



DTIC
S
C
J

91-18930



NORTHROP

91 1223 165

STATEMENT A
Approved for public release;
Distribution Unlimited

NOTICE

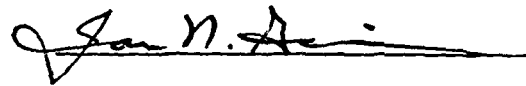
When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility nor any obligation whatsoever. The fact that the government may have formulated, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise in any manner construed, as licensing the holder or any other person or corporation, or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This report is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

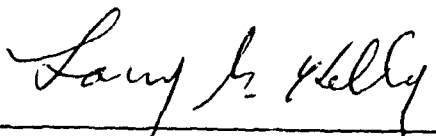
This technical report has been reviewed and is approved for publication.



KEITH B. BOWMAN, Project Engineer
Advanced Composite Structures ADPO



JAN N. GARRISON, Program Manager
Advanced Composite Structures ADPO
Structures ADP Branch



LARRY G. KELLY, Chief
Structures ADP Branch
Structures Division

If your address has changed, if you wish to be removed from our mailing list, or if the addressee is no longer employed by your organization, please notify WL/EIBA, Wright-Patterson AFB, OH 45433-6553 to help us maintain a current mailing list.

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for Public Release; Distribution is Unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NOR 89-101			5. MONITORING ORGANIZATION REPORT NUMBER(S) WL-TR-91-3104		
6a. NAME OF PERFORMING ORGANIZATION NORTHROP CORPORATION AIRCRAFT DIVISION		6b. OFFICE SYMBOL (If applicable) 3855/82	7a. NAME OF MONITORING ORGANIZATION Flight Dynamics Directorate (WL/FIBAC) Wright Laboratory		
6c. ADDRESS (City, State, and ZIP Code) One Northrop Avenue Hawthorne, California 90250			7b. ADDRESS (City, State, and ZIP Code) Wright-Patterson AFB, Ohio 45433-6553		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER Contract No. F33615-88-C-3205		
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO. 63211F	PROJECT NO. 69CW	TASK NO. 01
			WORK UNIT ACCESSION NO. 88		
11. TITLE (Include Security Classification) FINITE ELEMENT ANALYSIS OF AN ASTOVL FIGHTER STRUCTURE					
12. PERSONAL AUTHOR(S) J. A. Hagen					
13a. TYPE OF REPORT Interim		13b. TIME COVERED FROM 10/1/88 to 10/1/89		14. DATE OF REPORT (Year, Month, Day) December 1991	
15. PAGE COUNT 257					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	FINITE ELEMENT MODEL, ULTRALIGHTWEIGHT STRUCTURES, ASTOVL, DESIGN OPTIMIZATION		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report documents the static/dynamic and aeroelastic finite element model development and description used for the preliminary structural design and optimization of an Advanced Short Takeoff and Vertical Landing (ASTOVL) fighter structure. The model defined represents an Automated Structural Optimization System (ASTROS) compatible model initially developed from a NASTRAN finite element model. The generated data are for the purpose of enabling the repeat of the structural analysis and to independently analyze the structure in case of future structural or operational modifications to the aircraft.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED		
22a. NAME OF RESPONSIBLE INDIVIDUAL Mr. Keith Bowman			22b. TELEPHONE (Include Area Code) (513) 255-6639		22c. OFFICE SYMBOL WL/FIBAC



FOREWORD

This report presents the finite element analysis of the Advanced Short Takeoff and Vertical Landing (ASTOVL) fighter structure. It was prepared by the Northrop Corporation, Aircraft Division under Contract F33615-88-C-3205, entitled "Ultralightweight Structures." This report is in full compliance with Contract Data Requirements List (CDRL) Number 1. This contract is administered under the technical direction of Dr. Edvins Demuts (WL/FIBAC), Flight Dynamics Directorate, Wright-Patterson Air Force Base, Dayton, Ohio. The analytical work in this report was conducted from 1 October 1988 to 1 October 1989 by Mr. J. A. Hangen III. The assistance of Mr D. J. Neil is acknowledged during this effort including debugging and enhancing of the ASTROS computer code. The generated data are for the purpose of enabling the repeat of the structural analysis and to independently analyze the structure in case of future structural or operational modifications to the aircraft.

TABLE OF CONTENTS

Section		Page
1	INTRODUCTION	1
2	ASTOVL FIGHTER STRUCTURE DESCRIPTION	3
3	N382-20 ASTOVL FINITE ELEMENT MODEL.	11
	3.1 General Model Description	11
	3.2 ASTROS Finite Element Optimization.	13
	3.3 Finite Element Program and Model Interaction.	15
	3.4 ASTROS Finite Element Optimization Model Development and Description	17
	3.4.1 Loads and Design Criteria.	19
	3.4.2 Flight Loads Criteria.	22
	3.4.3 Ground Loads Criteria.	23
	3.5 Model Generation.	26
	3.5.1 Physical Phenomenon Simulated.	28
	3.5.2 Element Selection Rationale.	28
	3.5.3 Justification for Model Coarseness/Fineness.	29
	3.5.4 Explanation of the Choice of Boundary Conditions	30
	3.5.5 Mechanical Properties and Allowables Development	31
	3.6 Analysis Data Requirements - Static, Dynamic, and Aero- elastic Models.	32
	3.6.1 Static Model	35
	3.6.2 Dynamic Analysis Model	41
	3.6.3 Aeroelastic Analysis Model	46
	3.7 Discussion of Results	48
	3.8 Input Deck Data Format.	64
4	REFERENCES	65
 APPENDIX		
A	ASTROS FULL VEHICLE MODEL DEVELOPMENT AND CHECKOUT HISTORY	67
B	WEIGHT AND BALANCE SPREAD SHEETS FOR NON-STRUCTURAL MASS OF ASTROS MODEL	81
C	COMPLETE ASTROS INPUT DATA FILE.	87
D	COMPLETE SET OF ELEMENT AND GRID NUMBER FIGURES.	197
E	SUMMARY OF LOCAL DESIGN VARIABLE RESULTS	243

LIST OF ILLUSTRATIONS

Figure		Page
1	ASTOVL Fighter Structural Arrangement.	5
2	N382-20 ASTOVL ASTROS/NASTRAN Model.	12
3	Schematic V-N Flight Envelope Diagram.	21
4	Preliminary Ultimate Wing Root Loads	21
5	Design Flight Envelope	22
6	N382-20 3-D NCAD Model (LH Side)	27
7	N382-20 ASTROS Steady Aerodynamics Model, Looking Aft and Inboard (RH Side).	33
8	ASTROS Steady Aerodynamics Model, Looking Aft.	33
9	ASTROS Unsteady Aerodynamic Model.	34
10	Undeformed ASTROS Model, Looking Outboard.	49
11	ASTROS Model Deformations for Mach 1.2 9g Symmetric Pull-Up, Looking Outboard	50
12	Undeformed ASTROS Model, Looking Aft	51
13	ASTROS Model Deformations for Mach 1.2 9g Symmetric Pull-Up, Looking Aft.	52
14	ASTROS Wing Skin Thickness Results	57
15	ASTROS Fuselage Structure Thickness Results.	58

LIST OF TABLES

Table		Page
1	N382-20 ASTOVL Fighter Basic Dimensional Data.	7
2	N382-20 ASTOVL Fighter Basic Characteristics	8
3	Dynamic Masses for Ground Load Conditions.	25
4	Grid and Element Numbering Scheme.	37
5	Typical ASTOVL Model Run Time Statistics	40
6	ASTROS Design Variable Shape Functions	42
7	ASTROS Static Deflection Result Summary.	53
8	ASTROS Static Acceleration Result Summary.	53
9	Fundamental Frequence and Mode Shapes (O2J Run).	55

LIST OF ABBREVIATIONS, SYMBOLS, AND ACRONYMS

ACSYNT	Northrop version of NASA's Aircraft Synthesis computer program
ASTOVL	Advanced Short Takeoff and Vertical Landing
ASTROS	Automated Structural Optimization System
BC	Boundary Conditions
BHD	Bulkhead
CADAM	2-D Computer Augmented Design and Manufacturing graphical software
GDR	Generalized Dynamic Reduction - algorithm to efficiently calculate frequencies and modes shapes
FASTOP	FASTOP3, Strength, Deflection, and Flutter Structural Optimzation Computer System
HATOL	Horizontal Attitude Takeoff and Landing
MLG	Main Landing Gear
NASTRAN	NASA Structual Analysis computer program
NCAD	Northrop 3-D Computer Aided Design
NCASA	Northrop Computer Aided Structural Analysis - NASTRAN pre- and post-processor
NCV	NORLOADS to ASTROS Aerodynamic Model Converter
NLG	Nose Landing Gear
NORLOADS	Northrop Maneuver Loads Analysis computer program
RALS	Remote Augmented Lift System
REVWING	Northrop Rapid Evaluation of Wing computer program
USSAERO	Woodwards unified subsonic and supersonic aerodynamic panel computer program
V/STOL	Vertical or Short Takeoff and Landing
1-D	One-Dimensional
2-D	Two-Dimensional

ABBREVIATED LIST OF NASTRAN/ASTROS COMMANDS, KEYWORDS, ROUTINES

<u>KEY WORD</u>	<u>TYPE</u>	<u>DESCRIPTION</u>
ATTACH	bulk data	connection of aerodynamic panels to a single structural GRID
AUTOSPC	parameter	to request automatic removal of stiffness singularities from the stiffness matrix (NASTRAN only)
CBAR, BAR	bulk data	bending bar element connection
CONM2	bulk data	concentrated mass element
CQDMEM1, QDMEM1	bulk data	quadrilateral membrane element connection
CQUAD4, QUAD4	bulk data	quadrilateral membrane-bending element connection
CROD, ROD	bulk data	rod element connection
CONROD,	bulk data	rod element connection
CTRIA3, TRIA3	bulk data	triangular membrane-bending element connection
CTRMEM, TRMEM	bulk data	triangular membrane element connection
DCONSTR	bulk data	stress/strain design constraint
DCONTHK	bulk data	thickness design constraint
DESELM	bulk data	design variable properties for a single finite element
DESVAR	bulk data	design variable properties for shape function linked elements
DESVARP	bulk data	design variable properties for physically linked elements
GRID	bulk data	geometric location of grid point of the structural model

ABBREVIATED LIST OF NASTRAN/ASTROS COMMANDS, KEYWORDS, ROUTINES (Continued)

<u>KEY WORD</u>	<u>TYPE</u>	<u>DESCRIPTION</u>
MPC	bulk data	multiple point constraint - rigid connection of GRIDs
NDV	variable	number of global design variables
NRFAC	solution control	number of retained constraints = NRFAC * NDV
1COMP	bulk data	plate and shell element properties defined as a composite layed-up ply by ply
PLIST	bulk data	define property entries associated with a design variable
SAERO	solution control	schedule static aeroelastic discipline
SHAPE	bulk data	define elements associated with a design variable and assign linking factor
SPLINE1	bulk data	area spline for connection/load transformation from aerodynamic model to structure model
SPLINE2	bulk data	linear or beam spline for connection/load transformation from aerodynamic model to structure model
STATICS	solution control	schedule Static analysis discipline
SUPPORT	bulk data	define GRID and direction in which to apply determinate reactions on a free body
ZANLYN	routine	complex coupled eigenvalue flutter solver (ASTROS)

SECTION 1

INTRODUCTION

Short takeoff and/or vertical landing capabilities for future fighter aircraft are becoming increasingly important to meet the demands of landing on damaged or improvised runways, to operate from remote and austere sites in challenging environments, and to perform multiple sorties effectively. To achieve ASTOVL capabilities, fully optimized structural concepts are required utilizing advanced materials and innovative manufacturing technologies. Preliminary design of an ASTOVL fighter is needed to assess the potential impact of these advanced materials, manufacturing technologies, structural optimization methods, and preliminary design concepts on an ASTOVL vehicle's performance and mission capabilities.

This report documents the static/dynamic and aeroelastic finite element model development and description used for preliminary structural design and optimization of the N382-20 ASTOVL fighter. The model defined herein represents an ASTROS compatible model initially developed from a NASTRAN finite element model.

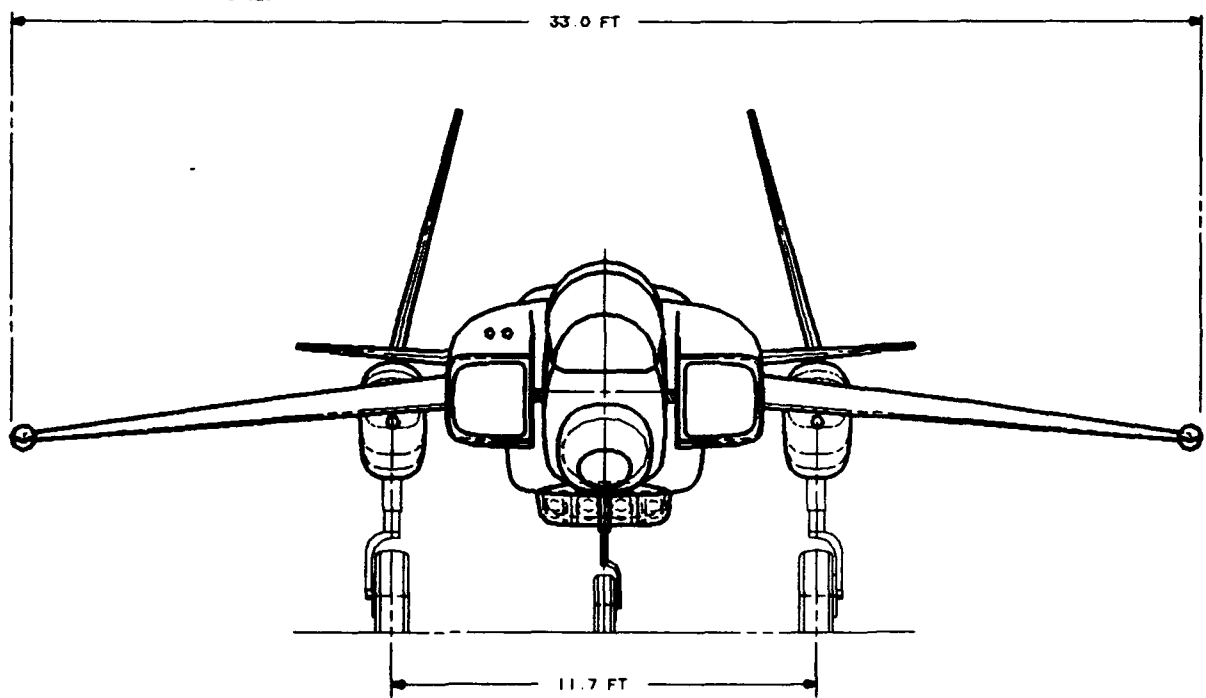
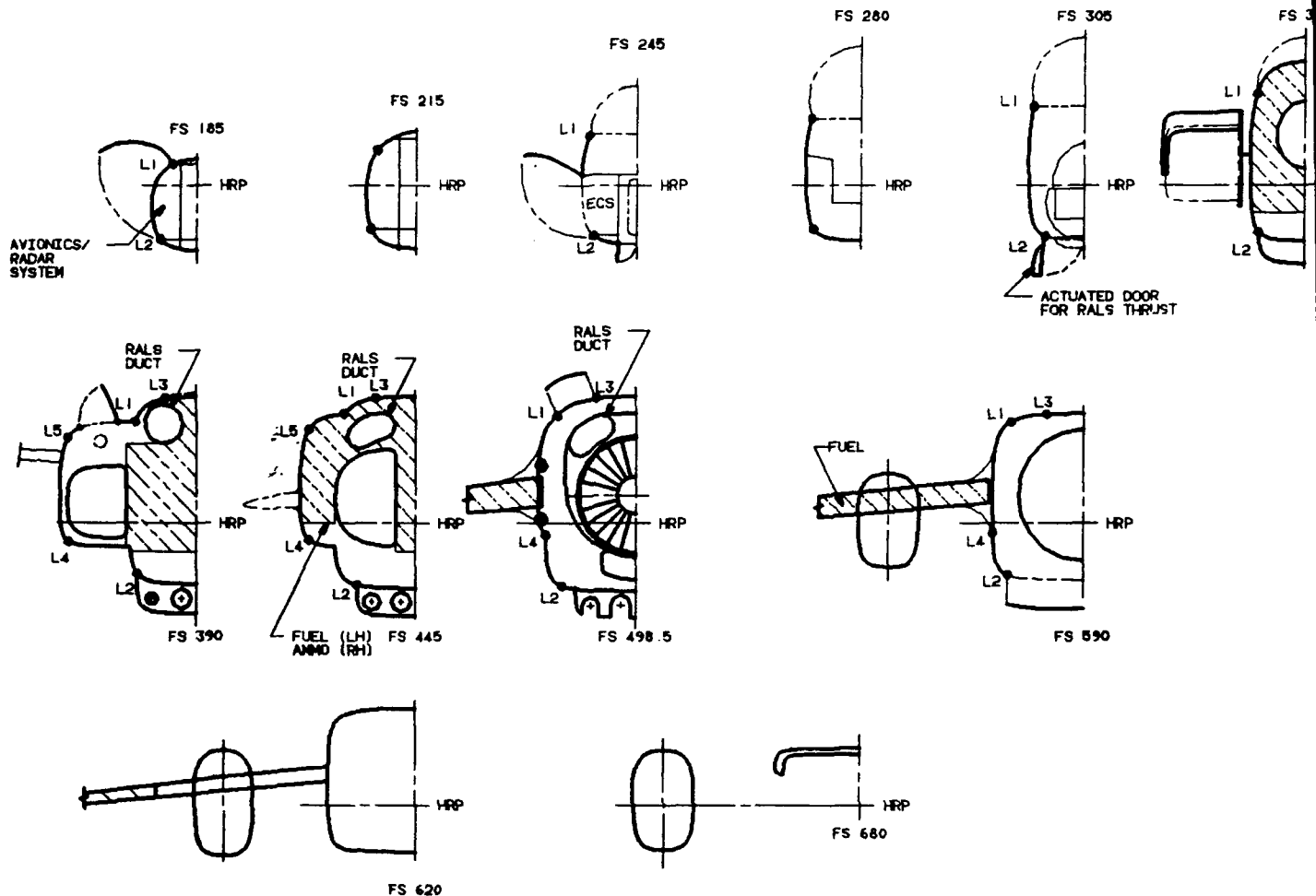
SECTION 2

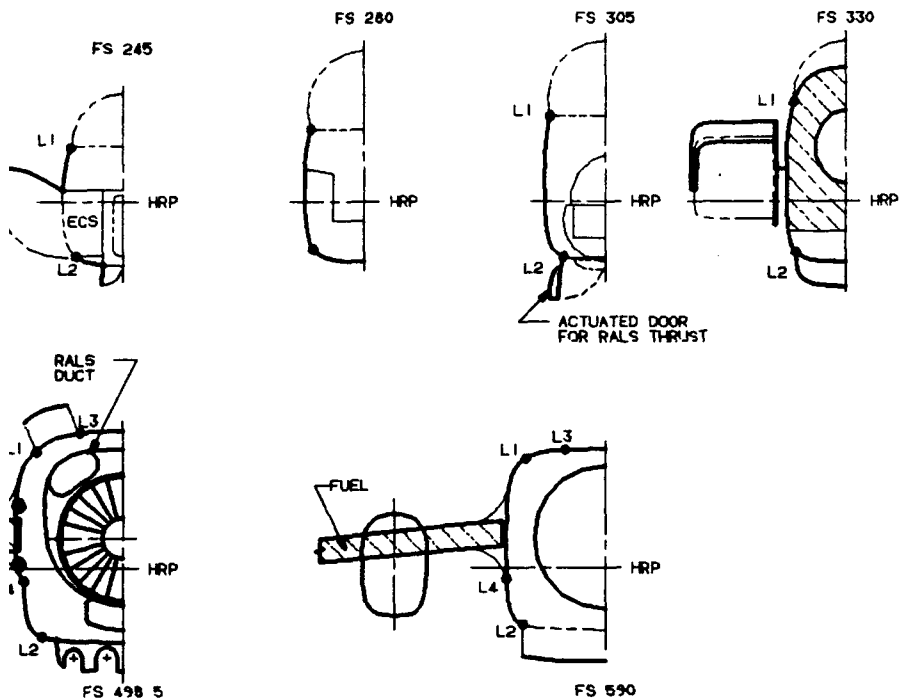
ASTOVL FIGHTER STRUCTURE DESCRIPTION

The Northrop N382-20 ASTOVL fighter is a state-of-the-art descendant of a family of horizontal attitude take-off and landing (HATOL) and vertical/short take-off and landing (V/STOL) aircraft. The N382 aircraft series is a single engine derivative of Northrop's N336 HATOL/VTOL fighter. Predecessors to the N382-20, such as the -12 and -18, were developed to meet basic mission and point performance goals, with the exception of supercruise in dry power. The N382-20 version satisfied the supercruise in dry power requirement through shortening of the fuselage. The configuration adjustments made were accomplished with the aid of Northrop's version of NASA's "Aircraft Synthesis" (ACSYNT) program.

The structural arrangement of the baseline ASTOVL fighter configuration is shown in Figure 1. This is a single-engine aircraft that takes off conventionally (with the addition of vectored thrust) in 600 feet, and can land vertically at the conclusion of the mission. It employs a Remote Augmented Lift System (RALS) turbofan propulsion system with vectorable nozzles aimed at providing the thrust needed for take off, vertical landing, and control during transition and hover. The fighter, designated by Northrop as Model N382-20, is a 28,000 lb class aircraft that carries two AMRAAMs and two ASRAAMs in an underfuselage conformal pod and a 20 mm gun with 500 rounds of ammunition. Basic dimensional data and significant characteristics of the ASTOVL fighter are presented in Tables 1 and 2.

The N382-20 is a canard-delta configuration composed of four major structural assemblies: (1) multiple-spar wings shoulder mounted to the fuselage; (2) fuselage of semimonocoque construction; (3) fully movable canards; and (4) two-wing nacelles that accommodate the landing gear, contain fuel, and support the vertical stabilizers.

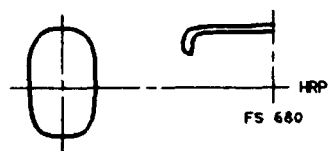




FUEL TANK BOUNDARY

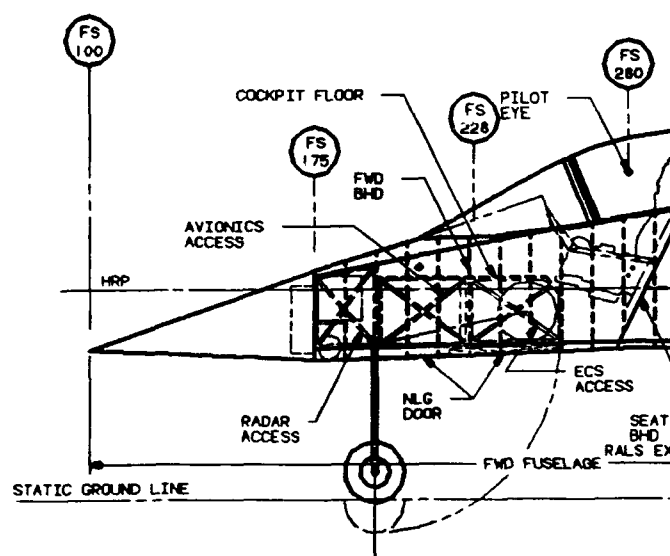
FUEL TANK ACCESS

CANARD ACTUATOR ACCESS



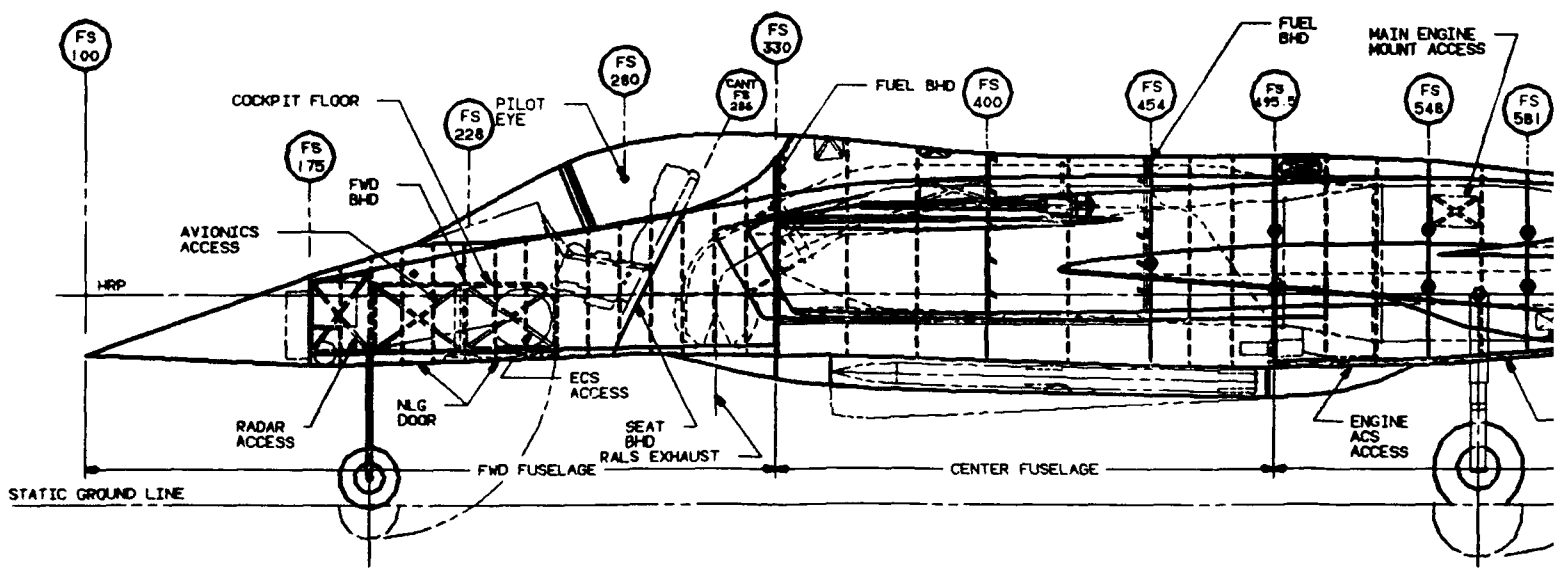
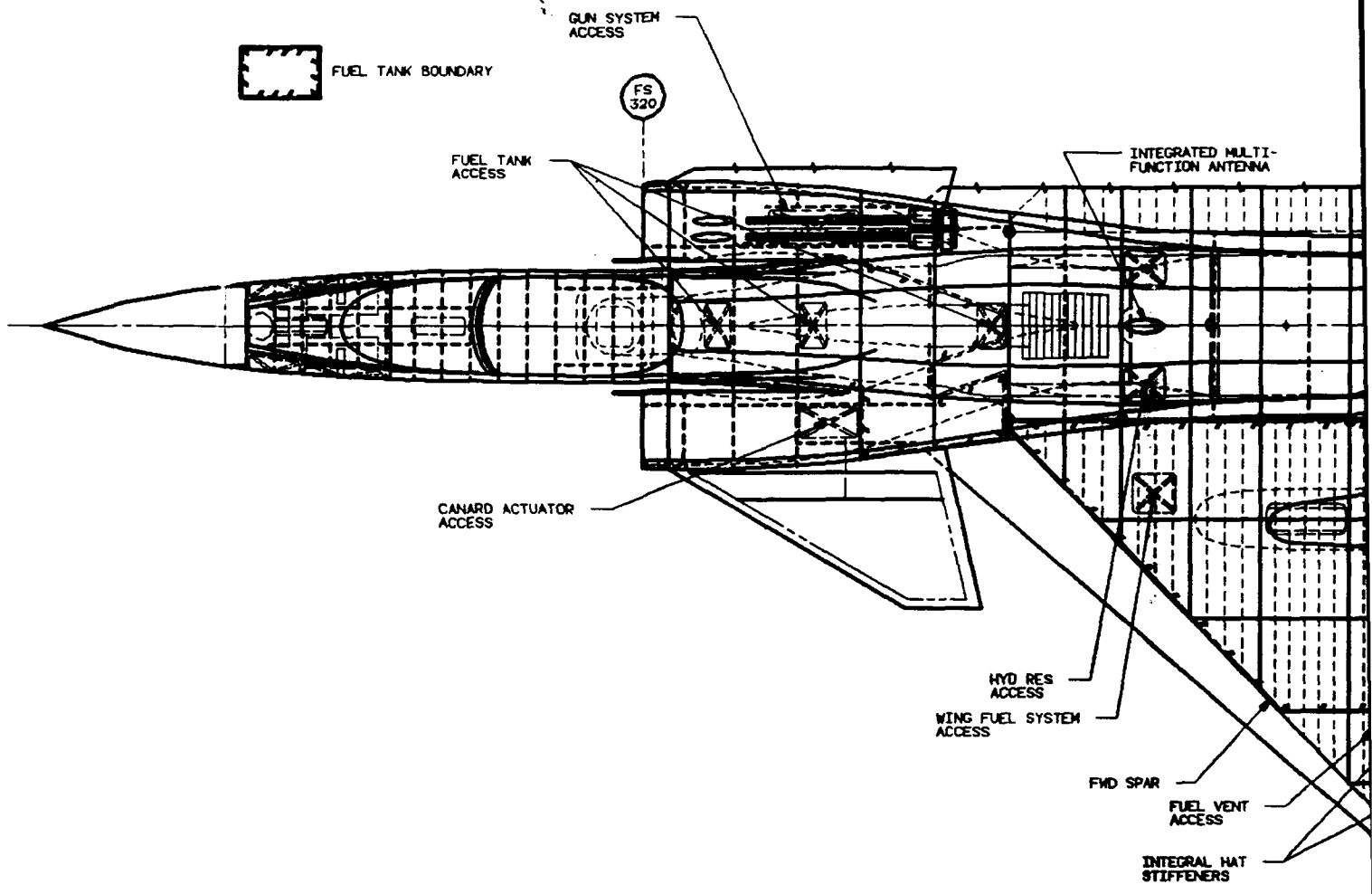
33.0 FT

11.7 FT



0

HRP



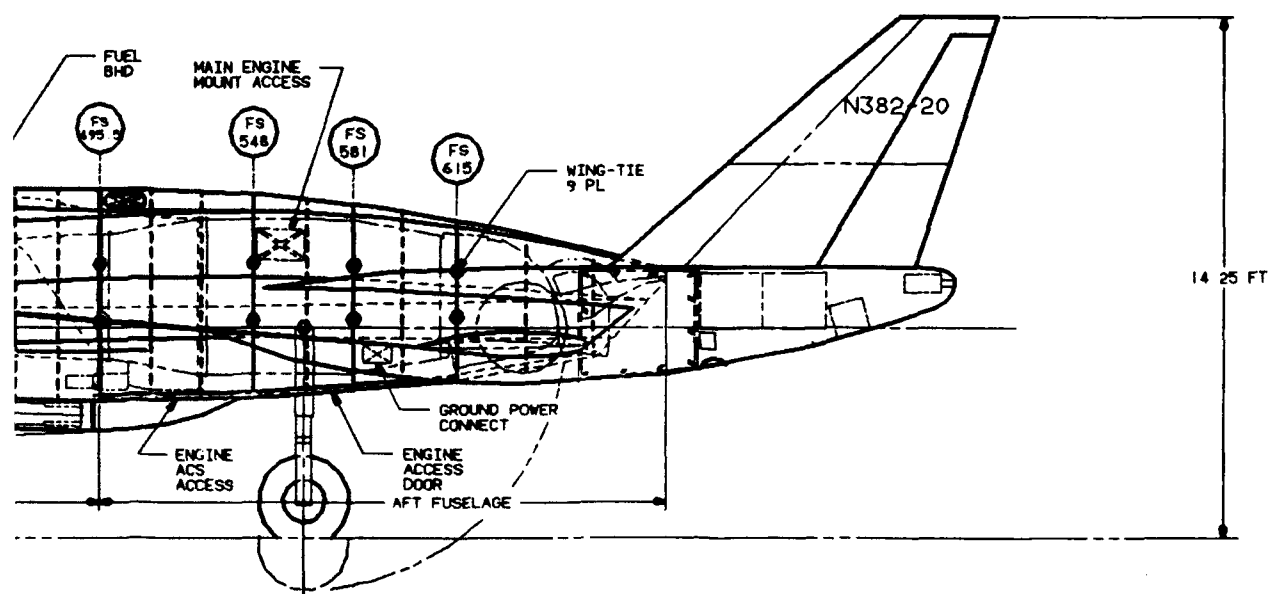
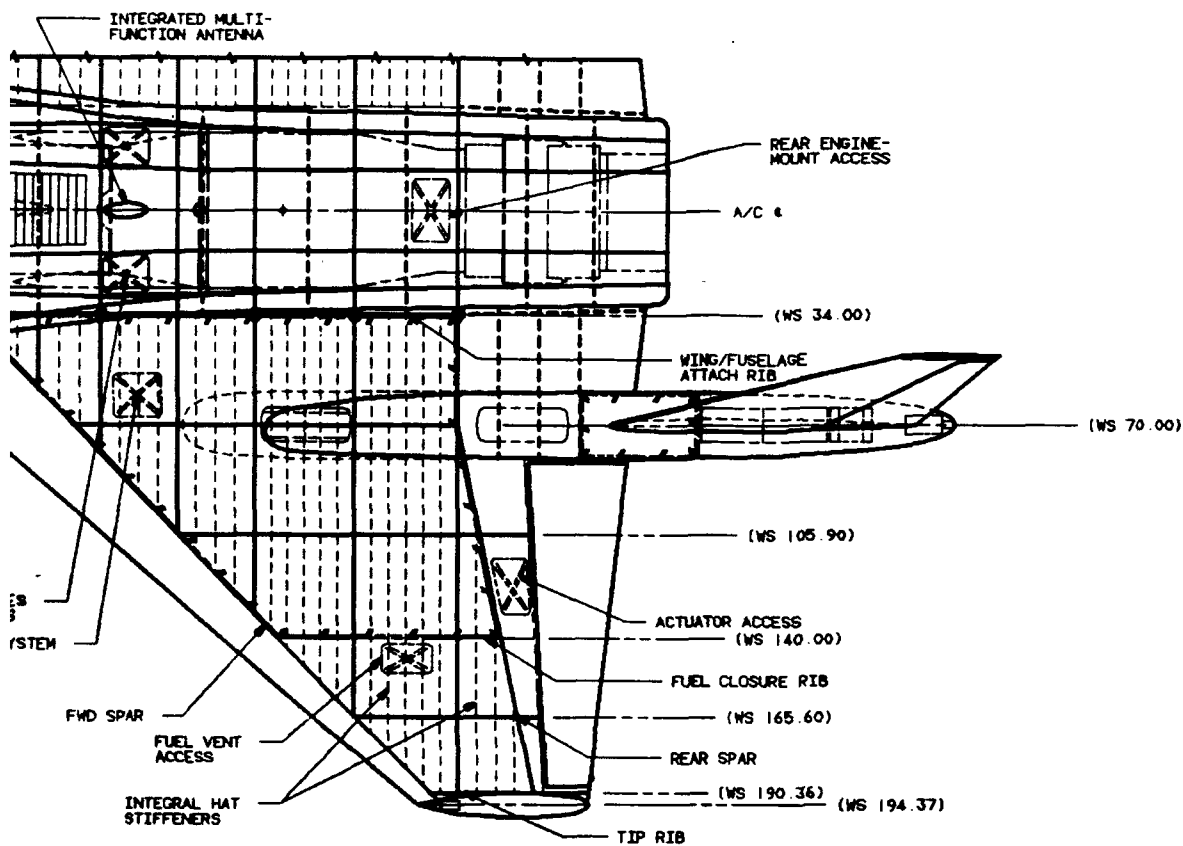


FIGURE 1 ASTOVL FIGHTER STRUCTURAL ARRANGEMENT

TABLE 1. N382-20 ASTOVL FIGHTER BASIC DIMENSIONAL DATA

BASIC SURFACES	UNITS	WING	CANARD	VTAIL
AREA (PROJECTED)	SQ FT	495.3	145.9	52.4
ASPECT RATIO	AR	2.1	2.0	1.4
TAPER RATIO	λ	0.18	0.15	0.28
THICKNESS RATIO, ROOT	T / C _{ROOT}	0.04	0.04	0.04
THICKNESS RATIO, TIP	T / C _{TIP}	0.04	0.04	0.04
L. E. SWEEP ANGLE	DEG.	50	60	47.5
C / 4 SWEEP ANGLE	DEG.	40.8	53.74	41.5
DIHEDRAL / CANT ANGLE	DEG.	-5.0	4.0	15
INCIDENCE ANGLE	DEG.	0	0	0
TWIST ANGLE	DEG.	0	0	0
SPAN (PROJECTED)	FT	32.4	16.9	8.5
ROOT CHORD	FT	25.9	14.9	9.7
TIP CHORD	FT	4.7	2.3	2.7
MEAN AERO. CHORD	FT	17.7	10.2	6.9

TABLE 2. N382-20 ASTOVL FIGHTER BASIC CHARACTERISTICS

PARAMETERS	UNITS	ASTOVL
WING LOADING (W / S)	LB / SQ FT	56.0
THRUST / WEIGHT RATIO (T / W) TAKEOFF, MAX. POWER		1.47
THRUST / WEIGHT RATIO (T / W) LANDING, MIL. POWER		1.37
GROSS TAKEOFF WEIGHT	LB	27,735
WING AREA	SQ FT	495.3
WING SPAN	FT	32.4
FUSELAGE LENGTH	FT	48.7
FUSELAGE EQUIV. DIA	FT	4.1
FUEL WEIGHT	LB	8,246
ENGINE SCALE FACTOR		1.103
ENGINE SL STATIC THRUST	LB	42,349
ENGINE DIAMETER	FT	4.1
ENGINE LENGTH	FT	15.5
CRUISE LEG, SUBSONIC	N. M.	100
CRUISE ALTITUDE (AVG)	FT	43,000
CRUISE LEG, SUPERSONIC	N. M.	50
CRUISE ALTITUDE	FT	35,000

The major wing components consist of a multispar structural torque-box (which also serves as an integral fuel tank), fixed leading edge, and trailing edge flaperons. For the torque box in the current design, the wing attaches to the fuselage carry-through bulkheads by means of clevis lugs and bolts. The attachment at the front spar reacts only the wing vertical shear while the remaining attachments react the wing bending moments as well as vertical shear loads. The wing torque box skins are configured as solid composite laminates integrally stiffened with spanwise hat-section stringers. This design provides the minimum weight for a postbuckled structure. The composite spars are located perpendicular to the aircraft centerline. This design provides efficient load transfer from the wing spars to the fuselage wing lug fittings. The perpendicular spar configuration (at 36-inch nominal spacing) facilitates optimum placement and spacing (approximately 6.0 inches) of the integral hat stiffeners from the root rib to the tip rib. The spanwise stiffeners efficiently reduce the effective panel width of the covers and reduce the number of spars required.

The ribs are provided for additional buckling stability as well as for reacting fuel pressure and air loads. Fuel pressure and vent lines penetrate the ribs and spars through necessary cutouts. Gravity fuel flow holes are also incorporated in the intermediate ribs and spars as required. Peripheral sealing of the integral fuel tank is incorporated in the boundary spars and ribs. The Reaction Control System (RCS) which maintains roll control during hover has ducts running through the leading edges (immediately forward of the front spar) to reaction control valves located in each wing tip.

The center fuselage is joined to the forward and aft sections at Fuselage Station (FS) 330 and FS 495.5, respectively. There are 11 major bulkheads in the fuselage including the five wing carry-through bulkheads in the aft fuselage. There are four major longerons per side. The forward fuselage section is comprised of three areas: the nose cone, the crew station, and the transparencies. The pressurized crew station structure is made up of the cockpit sides, the canopy, the canted FS 286 seat support bulkhead, and the crew station floor. Finally, an integral fuel tank and a spindle mounted canard (located above the engine inlet) are located in the center fuselage.

SECTION 3

N382-20 ASTOVL FINITE ELEMENT MODEL

The following subsections provide a description of the ASTROS model development, guidelines, and assumptions as required for enabling independent repetition of the ASTROS structural optimization and analysis performed during this contract. Appendices A through E give additional details on the model and its execution.

3.1 GENERAL MODEL DESCRIPTION

The N382-20 ASTOVL finite element model is a right half model of the complete vehicle with centerline-plane symmetry boundary conditions (BCs). The initial size target for the model was 1000 GRIDs and 1000 to 1500 elements. The bulk of the model is skin and other light gage structure, so the predominant elements are plate and shell types. Because ASTROS does not resize bending capable plate/shell elements, the model was configured with membrane only quadrilateral and triangular plates. Principal axial load carrying members were idealized as RODs. Figure 2 shows the complete ASTROS/NASTRAN model of the N382-20 ASTOVL vehicle. The key structural components are identified and located relative to the rest of the structure. The sections are broken down according to the major manufacturing joints.

The goal of ultralightweight motivates in seeking minimum weight solutions for the complete structure. Therefore the initial intention was to represent the entire airframe structure as eligible for redesign and request that ASTROS specify the element thickness and areas everywhere. The exceptions to this were the vertical stabilizer, the canard, and the landing gear. Engines and equipment were taken as fixed in size and mass.

The all-moving canard was full-depth honeycomb construction with spindle and assumed the vertical fin was of multi-rib construction. The vertical stabilizer is modeled as a simplified beam structure with the correct

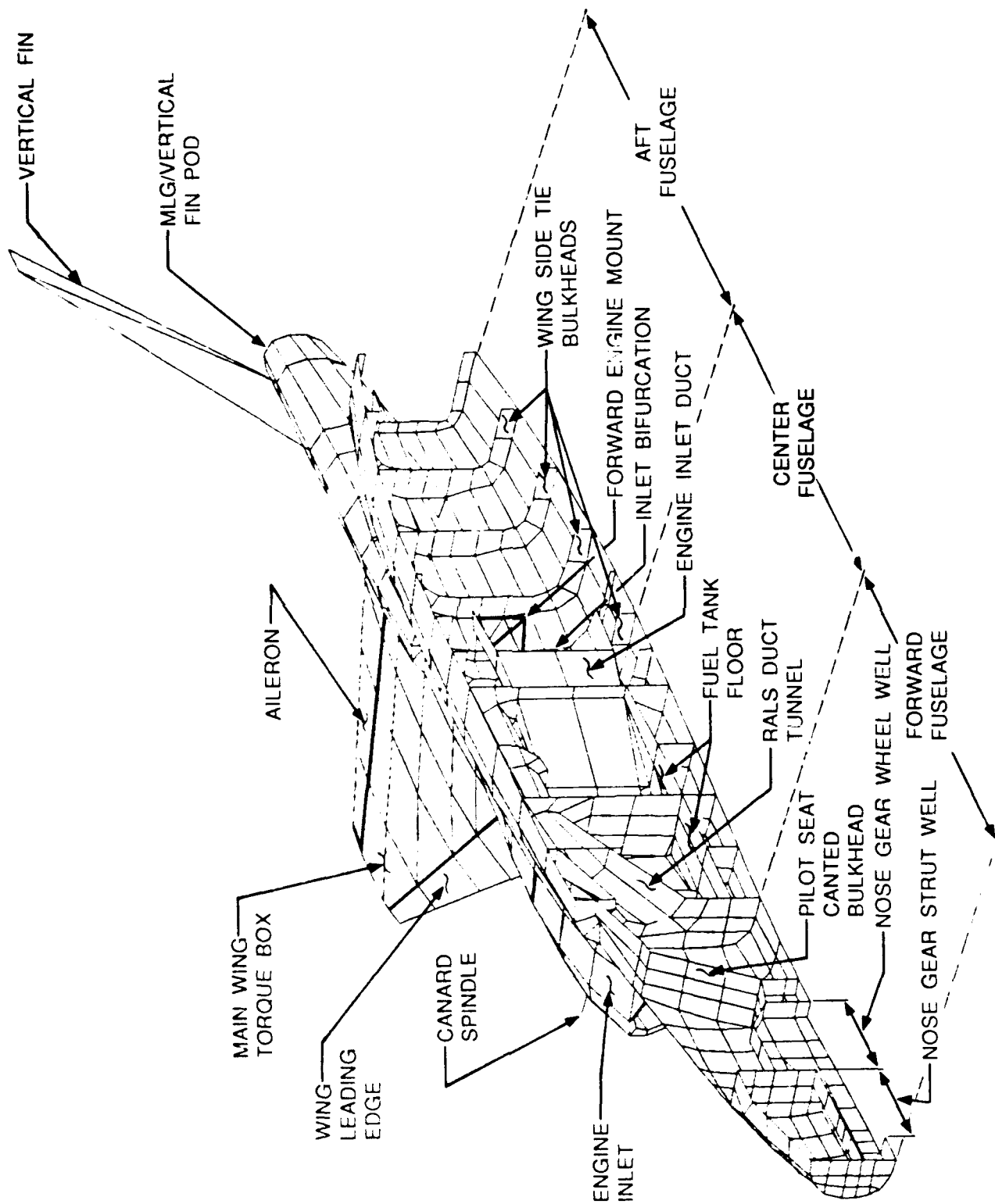


Figure 2. N382-20 ASTOVL ASTROS/NASTRAN Model

mass; while the canard is modeled as the spindle only, with correct mass and with aerodynamic loads applied at the spindle tip. Local design details of either part were assumed to only lightly affect the rest of the vehicle structural design.

The vehicle airframe components defined as primary structure were modeled. This included:

- skins
- longerons
- bulkheads
- spars
- ribs
- inlet ducting

Access panels in the fuselage are typically modeled by shear panels i.e., shear load capability only. For this analysis, to maintain simplicity by minimizing the number of element types in the model, access panels were simulated as QUAD4 membranes (used for the fuselage side skin panels) and defined as $\pm 45^\circ$ layups. This effectively reduces the axial load carrying capability to a minimum. Although the nose gear door is represented as a cutout, the main landing gear door is assumed fully effective. Torsional and bending stiffness of the MLG pod is so critical for flutter resistance that we assumed shear load transfer would be possible through the latch mechanisms.

Some frames and stiffeners were lumped to keep the size of the model within the target range. Although the cost of running the model was negligible in computer charges, the execution time was very long on the government furnished MicroVAX II processor. A large size model may represent the structure more faithfully, but at the expense of truly excessive execution times; as is shown in Appendix A.

3.2 ASTROS FINITE ELEMENT OPTIMIZATION

Some knowledge by the reader of NASTRAN is anticipated. Since ASTROS is still relatively new, however, a brief description follows. It is

noted in this discussion, the terms design and optimization are used interchangeably.

The ASTROS (Automated STRuctural Optimization System) procedure provides a multidisciplinary analysis and design capability for aerospace (and other) structures. The engineering analysis capabilities of the system include structural analysis (static and dynamic), aeroelastic analysis (static and dynamic), and automated design. A specifically designed data base and executive system were implemented to maximize the system's efficiency, flexibility, and maintainability.

The structural portion of the ASTROS system was based on the NASTRAN finite element software with a truncated element library. The static aerodynamic portion was derived from USSAERO and flutter was assembled from NASTRAN, FASTOP, and code developed at Northrop (References 1 through 6). Much of the design related code was developed at Northrop including the design and constraint sensitivities and the design variable linking. The routine which does the optimization, MicroDOT (or simply the optimizer), uses math programming techniques to solve a minimization/maximization problem with design variables and sensitivities, subject to constraints and side constraints (References 7 and 8). The standard executive sequence was written to handle design with multiple analysis disciplines simultaneously.

Northrop's version of the NASA ACSYNT program, an analogous automated design tool for conceptual design, was used to determine the ASTOVL configuration, engine characteristics, fuel weight, and empirical structural weight. These were determined to meet the specified mission and performance requirements. The ACSYNT output of size, details, and weight target formed a part of the input to ASTROS.

ASTROS is a preliminary design tool. Within the sequence of events in the design process for an aerospace vehicle, preliminary design takes the configuration determined in the conceptual design phase and sizes the structure within this envelope. Therefore, preliminary design should not and ASTROS does not do shape optimization. The coordinates of the GRIDs are not changed during redesign. The design quantities are the thicknesses of two-dimensional

plate/shell elements and the areas of one-dimensional RODs and BARs. Three-dimensional elements are available in ASTROS but are not designed since this can only be done with shape optimization.

Structural optimization with ASTROS involves specifying a certain portion of the model as "designed" and constraining the behavior of the model within certain calculated limits for the requested disciplines. The program adjusts the design variable quantities (thickness of 2-D elements, and areas of 1-D elements) for each iteration to yield a minimum weight solution which satisfies all the constraints. The designed weight of the model is calculated by multiplying the densities on the material cards times the volumes (thickness*areas of 2-D elements or areas*lengths of 1-D elements) for the designed elements during execution.

The constraints available in ASTROS include:

- stresses and strains within the strength allowables
- deflections - maximum and minimum
- frequencies - maximum and minimum
- aileron and lift effectiveness for the SAERO discipline, - maximum and minimum
- flutter damping - maximum
- thickness/area - maximum and minimum

The principal strength of ASTROS is that these constraints can be applied over a range of boundary conditions (e.g., symmetric and antisymmetric), flight conditions and load conditions. Hence, the optimum structure does not represent a point optimum but one that is feasible throughout the flight envelope.

3.3 FINITE ELEMENT PROGRAM AND MODEL INTERACTION

The ASTOVL finite element model developed in this study was keyed to the ASTROS optimization solution. The following discussion is for the ASTROS model as opposed to a NASTRAN model. While NASTRAN requires the element thickness be defined ahead of time, with many property type cards (at least one

card for each thickness for a given material), ASTROS can take what could be a single property card for all elements referencing a particular material and specify the thickness variations on separate SHAPE function inputs. This shape function approach allows smooth variation in thickness along directions, rather than the thickness steps resulting from grouping elements into regions of constant thickness.

The compatibility of ASTROS with NASTRAN permits conversion from NASTRAN to ASTROS with relative ease. But the unique features of ASTROS make it difficult to convert back to NASTRAN; particularly the new design after at least one iteration of an optimization run. The shape function design variable linking feature in ASTROS allows the input property definitions of each element to be different from all others, with as few as one property card referenced on all the linked elements.

In anticipation of this situation, only a few nominal-value property cards were defined for the entire vehicle. The ASTROS determined thicknesses are key output results. The shape function form of the thicknesses are not, however, currently tabulated in a NASTRAN readable form so generating a NASTRAN equivalent model is not a trivial problem. Shape functions were chosen because: (1) they represent smoother thickness variations than the physical (PLIST) linking option; and (2) with PLISTs, an a priori knowledge of the final thickness distribution is implied.

The procedure was to set up a model in NASTRAN for the geometry and elements. This permits verification and graphic debugging of the model using Northrop's NCASA pre- and post-processor. NASTRAN also offers capabilities such as AUTOSPC and GRID POINT WEIGHT GENERATOR which are not in ASTROS. The output from AUTOSPC must be manually input to ASTROS to eliminate singularities from the stiffness matrix. The NASTRAN model was transferred to the MicroVAX II computer that has the development version of ASTROS resident. Subsequently, the membrane only PCOMP properties for composite materials, aerodynamic inputs, design variables (DESVARs), SHAPE functions, and flutter inputs were added to complete the model for proper optimization execution.

3.4 ASTROS FINITE ELEMENT OPTIMIZATION MODEL DEVELOPMENT AND DESCRIPTION

The finite element modeling philosophy and development were driven by the requirements of ASTROS optimization. Two rules-of-thumb followed in performing optimization with ASTROS, which strongly influenced the make-up of the model are:

Maximum number of design variables ~200

Maximum retained constraints ~100 + Minimum Gage Constraints

These are not hard and fast rules, but rather guidelines to a smooth and hopefully expeditious execution of the program. Large numbers of design variables and retained constraints not only increase execution time but may also tend to confuse the optimizer. Large magnitude differences in sensitivities of the design variables and constraints can cause numerical ill-conditioning. Too many retained constraints may overly restrict movement of the design point (i.e. the design gets "boxed in").

An infeasible initial design can be handled by math programming, but a feasible design is easier for the optimizer to start from. Generating a feasible initial design is not as simple as thickening all the elements to generate large margins of safety and low deflections if flutter is involved. Flutter is not something we can intuitively eliminate, certainly a stiff structure is not always going to raise the flutter speed.

We wish to supply the optimizer with a general design model that will allow it to find the lowest weight structure. Aircraft construction is in fact a highly optimized operation based on years of practical experience and study. Thickening parts locally for concentrated loads, cutouts, and attachments is standard practice. This kind of small scale detail is not reasonable within ASTROS and it points up the challenge of out-performing the traditional design approach.

The limit on design variables has a major impact on the design model specifications. When composite materials are used, each ply in an element requires a separate design variable. With extensive use of composites in a large

model such as the complete ASTOVL vehicle, the number of design variables can easily exceed the 200 level. To restrict the number of design variables, compromises were made in the assumptions on the use of composites in significant portions of the structure. Having used 74 wing design variables already and remaining within the design variable limit of 200, regions in the all-composite fuselage were divided into just 2 shell/plate element properties:

1. Quasi-isotropic - top and bottom skins, bulkheads & frames
2. 100 percent 45 degree "fabric" - side skins (primary shear structure)

The elements in the fuselage were, as a result, all "single ply" composite layups. Modifications to the input data to deviate from these simplifications can be performed and are recommended to test the sensitivity of the assumptions. The total number of fuselage design variables was 92 when all the elements were summed. Increasing the number of plies in each fuselage element by 1 would add more than 50 percent more design variables.

Fuselage skins are usually buckling critical, and since ASTROS does not consider buckling, minimum gage limits were expected to be critical. Buckled skins would not carry their fair share of the bending loads, so the side skins were defined by $\pm 45^\circ$ plies. This was done to minimize their contribution to the fuselage bending moment of inertia. Longerons loads are carried in pure tension/compression so the required area to carry the load tends to be fairly low. Local crippling, however, is often the critical failure criterion for longerons. Crippling constraints should be accommodated eventually in ASTROS. Fully effective skins (i.e., unbuckled) will tend to over-estimate their load sharing fraction and also make the longeron areas unrealistically low.

The wing structure has 74 design variables and does retain 4 ply directions on each of the upper and lower skins. The substructure is again "single ply" composite elements. The biaxial nature and magnitude of the wing skin loads, including the shear induced from wing twist, make the 4 ply skin elements an effective use of many design variables.

Half the wing skin DESVARs can be eliminated if the skins are specified as having the same layup for the upper and lower surfaces. Likewise 25 percent of the variables can be eliminated if a balanced ± 45 degree layup is specified.

The minimum gage constraints specified on the DCONTHK cards are necessary for shape function linking. The DCONTHK forces retention of the minimum gage constraint on specified elements to prevent the optimizer from driving element thicknesses to negative values. The individual design variable quantities can have negative values as long as the sum of all shapes for a given element is a positive number. In general, to prevent negative thicknesses, one element for each shape associated with that group of elements has a DCONTHK defined. The location of the constrained elements within the group plays an important role; a poor location of elements requires more constraints.

Actual minimum gage values assigned on the PCOMP cards were 0.010-inch for each of 4 ply directions on the wing skins and 0.040-inch for all of the remaining components. The 0.010-inch thickness corresponds to roughly two plies of unidirectional tape and 0.040-inch to eight plies. These minimum gages are realistic for manufacturing/handling but probably are not sufficient for damage tolerance.

3.4.1 Loads and Design Criteria

The Structural Design Criteria (SDC) are based on the traditional factor of safety concept. Here the loads are calculated for limit load factors and are then multiplied by 1.5 to obtain ultimate loads as used for design and static strength testing.

This statically unstable airplane will necessarily depend entirely on a Stability Augmentation System (SAS). No consideration of SAS effects are included in these preliminary static strength load estimates. SAS will modify the load distributions and their random cyclical repetitions and reversals. Providing for service life requirements, repeated loads, damage tolerance analysis, fail-safe, and safe-life will effectively increase the static

strength of the structure and the actual factor of safety. The V-N envelope (Figure 3) and load summaries shown in Figure 4 are conservative estimates and can be used for qualitative comparisons. Figure 5 shows the design flight envelope.

Control lifting surface load calculations are approximated abrupt maneuver and check conditions. These conditions produce more severe loads than those resulting from steady state rolling pull-up turns to the design limit normal load factor. During maneuvers, the wing has to lift the downward canard loads. Military specifications require arbitrary factors on tail loads since pure symmetrical loadings do not occur in practice. Spanwise distributions are available for the exposed surface root shear and bending loads summarized in Figure 4.

These loads (Figure 4) are separate from the applied airloads calculated in ASTROS. The printed output of steady airloads currently available from ASTROS are for a rigid structure, the actual aeroelastically corrected loads are not. Since they do not include the aeroelastic corrections, no load output was requested, nor can the pressure loads be integrated to yield bending moment, shear, and torque diagrams for fuselage or wing.

Converting overall vehicle maneuver accelerations measured at the center of gravity to local accelerations is based on rigid body dynamics: Rigid Body Load Factors at a Remote Point from the Center of Gravity

$$\begin{Bmatrix} M_x \\ M_y \\ M_z \end{Bmatrix} = \begin{Bmatrix} M_{x_{cg}} \\ M_{y_{cg}} \\ M_{z_{cg}} \end{Bmatrix} + \begin{bmatrix} -(Q^2+R^2) & (PQ-\dot{R}) & (PR+\dot{Q}) \\ (PQ+\dot{R}) & (P^2+R^2) & (QR-\dot{P}) \\ (PR-\dot{Q}) & (QR+\dot{P}) & (P^2-Q^2) \end{bmatrix} \begin{Bmatrix} \frac{X}{g} \\ \frac{Y}{g} \\ \frac{Z}{g} \end{Bmatrix}$$

where,

M_x, M_y, M_z - Aircraft Linear Load Factors along body axes, g's

P, Q, R - Angular Velocities: Roll, Pitch, Yaw about body axes, rad/sec

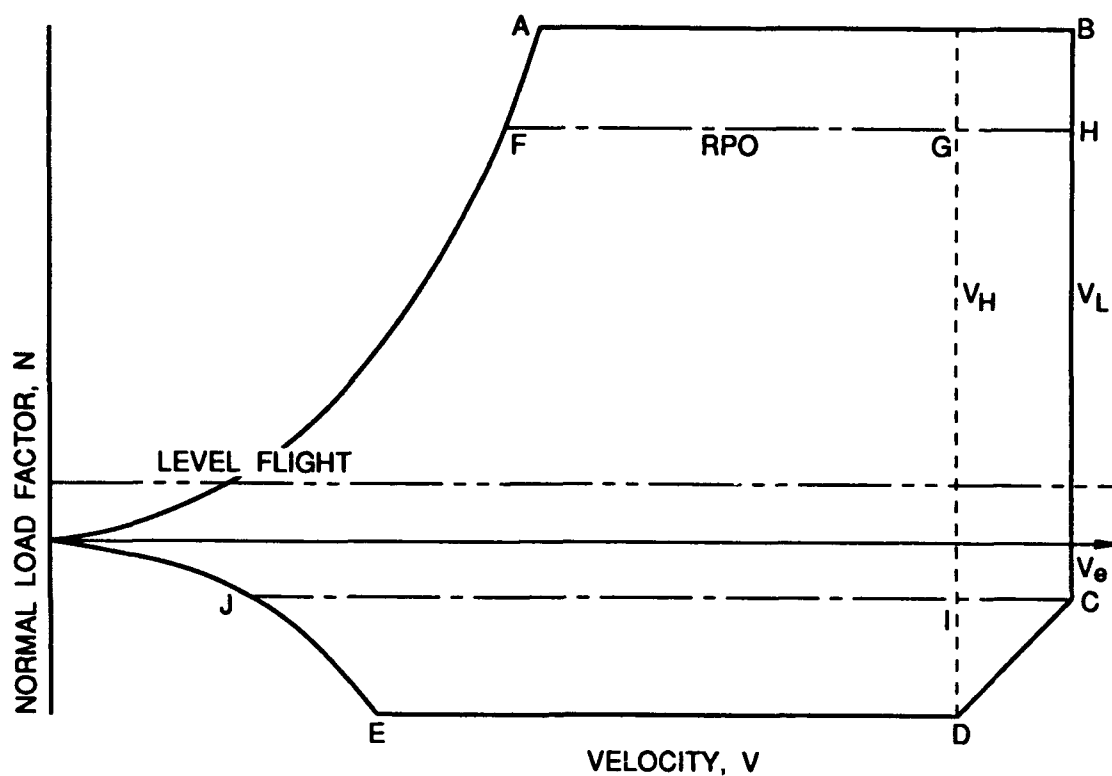


Figure 3. Schematic V-N Flight Envelope Diagram

V-N DIAGRAM POINT	H (1000 FT)	M	LIMIT NORMAL L. F. (G)	SHEAR (LBS)	BENDING (IN-LBS)	EXPOSED SPAN (IN)	SPAN ROOT (IN)
A-WING UPBENDING	5	0.6	9	117,120	7,172,030	151.36	B. P. 44
D-WING DOWNBENDING	5	0.9	-3	-50,810	-3,110,610	151.36	B. P. 44
A-CANARD* DOWNBENDING	5	0.6	9	-9,470	-178,860	50.02	B. P. 41.18
D-CANARD** UPBENDING	5	0.9	-3	9,620	177,150	50.02	B. P. 41.18
A-WING RPO DOWNGOING SIDE UPBENDING	5	0.6	36/5	99,500	6,096,200	151.36	B. P. 44
G-RPO VERT TAIL	0	0.9	36/5	±8,450	±242,770	70	W. P. 25.2

Figure 4. Preliminary Ultimate Wing Root Loads

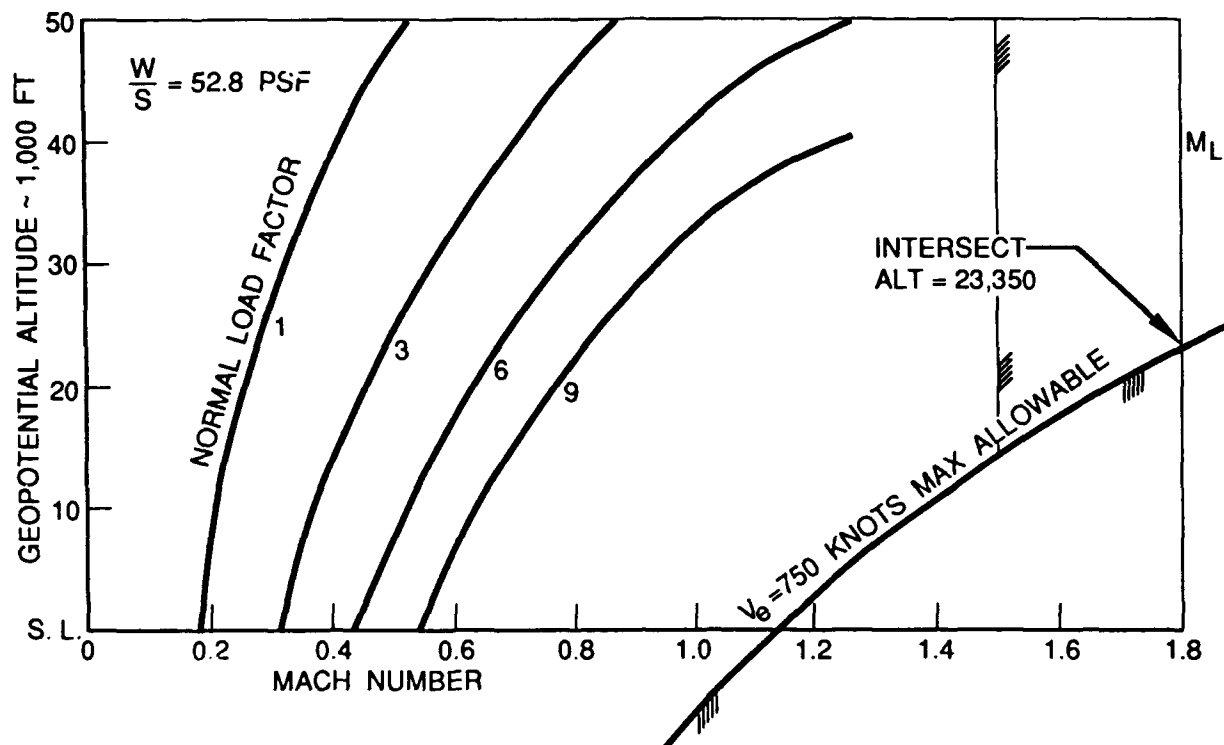


Figure 5. Design Flight Envelope

- $\dot{P}, \dot{Q}, \dot{R}$ - Angular accelerations: Roll, Pitch, Yaw about body axes, rad/sec**2
- X, Y, Z - Linear distances along the body axes to a remote point measured from the C.G.
- g - Acceleration of earth's gravity - 386.09 in/sec**2

This equation is included in the inertia relief formulation within ASTROS and NASTRAN.

3.4.2 Flight Loads Criteria.

Figure 3 showed the flight envelope for the ASTOVL. The corner points of the envelop are defined in Figure 4.

With antisymmetric loads assumed less critical and asymmetric aerodynamic conditions unacceptable to ASTROS, the following flight conditions were chosen for optimization:

Mach	0.7	Sea Level	9g	symmetric pull-up
Mach	1.5	Sea Level	9g	symmetric pull-up
Mach	0.7	Sea Level	-3g	symmetric push-over

Sea level altitude calculations were chosen because they result in the largest aeroelastic corrections.

Subsequent test runs revealed a major ASTROS fault in the supersonic SAERO routines which overestimated the internal loads. Therefore, the Mach 1.5 9g load case was dropped.

3.4.3 Ground Loads Criteria.

ASTOVL aircraft experience higher landing sink speeds than conventional land-based aircraft. They are designed to operate from battle damaged and semi-prepared runways. Consequently, design sink rates fall between those for carrier based and commercial transport airplanes. The following equations are used to determine the loads for various sink rates and landing gear stroke lengths. Landing gear loads vary inversely with stroke length. Loads approach infinity as the stroke decreases to zero.

For vertical takeoff airplanes the design landing weight is the gross takeoff weight because a landing may be a failed takeoff. The main gear and nose gear "support" dynamic effective masses. These masses and impact loads are based on a one-dimensional dynamic model: rigid airframe on gear strut springs.

$$\text{Dynamic Mass} = \frac{\frac{K_{yy}^2}{K_{yy}^2 + \Delta x^2}}{yy} * \text{Static Mass} \quad (1)$$

where,

Kyy - radius of gyration of aircraft about y axis through CG

Δx - distance from CG to gear along the station direction

Landing Impact Force is calculated from the formula:

$$F = \frac{\frac{1}{2}mv^2}{(S*K)} = \frac{\text{Kinetic Energy}}{(\text{Stroke Length} * \text{Constant})} \quad (2)$$

where,

m - Dynamic effective mass

v - landing sink speed

K - 0.7 for typical fighter strut damping levels

To evaluate the landing impact forces we need the vehicle mass and dimensional properties:

N382-20 ASTOVL Mass Properties: per weight statement (Appendix B) and NASTRAN grid point weight generator output for the mass moment of inertia.

Gross Weight: nominal gross (Note: Only the full fuel condition was considered).

$$28134 \text{ lb}_{\text{mass}} = 72.89 \text{ lb}_{\text{force}} \text{ sec}^2/\text{in} = 874.6 \text{ slugs}$$

Static Weight Distribution:

Nose gear	6691 lb	23.8%
Main gear	21443 lb	76.2%

Locations:

	<u>Station</u>	<u>Water Line</u>
Nose Gear	195	0
Center of Gravity	477	67
Main Gear	565	0

Pitch Mass Moment of Inertia: I_{yy}

$$1.25 \times 10^6 \text{ lb}_{\text{force}}\text{-sec}^2\text{-in} = 104,000 \text{ slug-ft}^2$$

Pitch Radius of Gyration: K_{yy}

$$K_{yy}^2 = I_{yy}/M = 17113 \text{ in}^2$$

Dynamic mass (per Equation 1) is shown in Table 3.

TABLE 3. DYNAMIC MASSES FOR GROUND LOAD CONDITIONS

DYNAMIC MASS			
	FRACTION OF GROSS MASS	LB _f SEC ² /IN	SLUGS
NOSE GEAR	.171	12.46	149.6
1/2 NOSE GEAR	.0855	6.23	74.8
MAIN GEARS	.6885	50.18	602.
EACH MAIN GEAR	.3442	25.09	301.

(For the right half symmetric model, there is only one main gear and only half the effective load from the nose gear was applied.)

Using conservative sink speed and stroke parameters defined for limit conditions (per Equation 2):

18 ft/sec landing sink speed (high value for STOVL aircraft corresponds to a glide slope of 4 degrees at 150 knots).

11 inch stroke nose gear -> 19888 lb (limit) on 1/2 aircraft

-> 28331 lb (ultimate) on 1/2 aircraft

17 inch stroke main gear -> 49172 lb (limit) on each strut

-> 73758 lb (ultimate) on each strut

Nose Gear Taxi loads: 3g's bump with simultaneous 0.55g braking

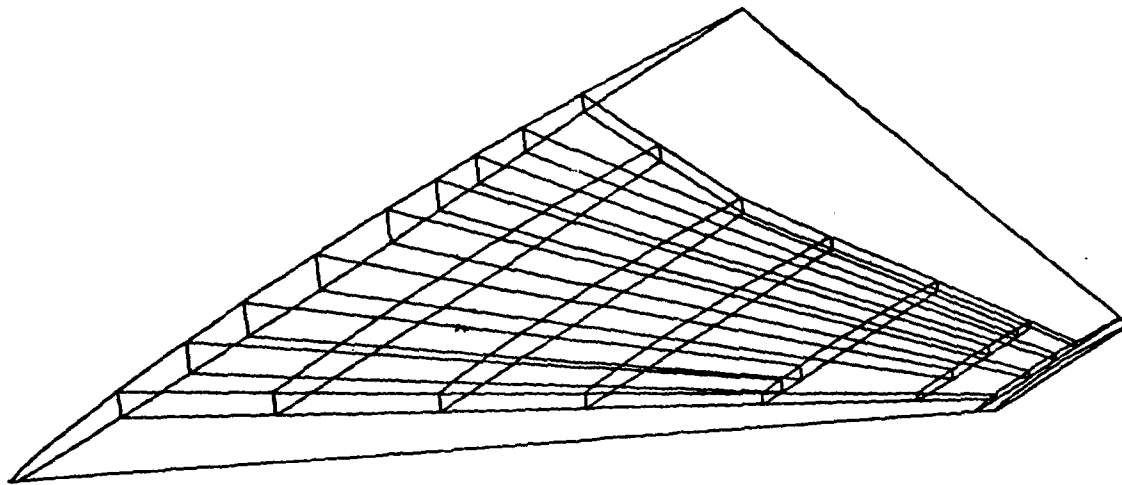
$$3 * \frac{6659}{2} + 0.55 * \frac{(28134)}{2} * \frac{(67)}{370} = 9988.5 + 1401 = 11389 \text{ lb (limit) on } \frac{1}{2} \text{ aircraft}$$

Therefore, taxi loads are less critical than landing impact loads for the nose gear and were not included in the static load cases.

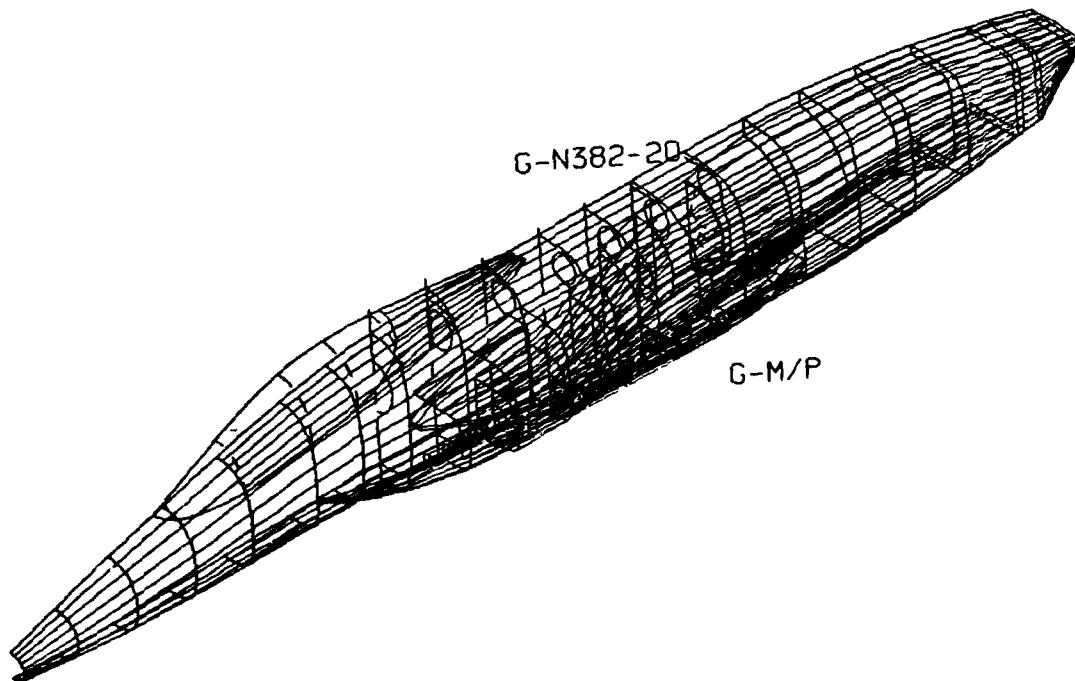
3.5 MODEL GENERATION

The engineering drawings for the N382-20 were generated with CADAM computer aided design software. Figure 1 shows the three view CADAM drawing. All the individual fuselage and pod sections plus the wing and canard airfoil sections were transferred electronically to NCAD, Northrop's three dimensional computer aided design system. OML and internal surfaces were modeled by running parametric cubic splines over the sections. Figure 6 shows a wire frame representation of the NCAD fuselage and wing surfaces.

These surfaces were then used to form the finite element mesh. Planes defining internal structure were intersected with the OML surfaces to locate the nodes and edges of finite elements. The large structures and their intersections were located first - OML skins, longerons, and internal bulkheads, frames, and floors. The regions between the large structure intersections were discretized to give a consistent element size.



G-WING



FUSELAGE

Figure 6. N382-20 3-D NCAD Model (LH Side)

Once the structure was completely surfaced and intersected, the surfaces were converted to rational patch surfaces. In the NCAD system, rational patches are output directly into NASTRAN GRIDS and quadrilateral and triangular finite elements. This geometry is input into NCASA, Northrop's computer aided structural analysis software, where the balance of the geometric data is handled interactively.

3.5.1 Physical Phenomenon Simulated

There were three fundamental physical phenomenon simulated with the ASTROS finite element model:

Steady aerodynamics

- Maneuver loads on wing, fuselage, and canard for symmetric pull-up and push-over with aeroelastic correction.
- Trim angle of attack and elevator deflection.
- Aerodynamic stability coefficients.

Static Loads

- Rigid aeromaneuver loads as checkout only (from REVWING).
- Quasi-static landing impacts on the nose landing gear and the main landing gear.

Flutter at Mach 1.5

- Dynamic analysis: mode shapes and frequencies.
- Unsteady aerodynamic calculations.
- P-K flutter solution of coupled aerostructural equations.

3.5.2 Element Selection Rationale

Semimonocoque airframe structures are built up from thin gage detail parts. Plate and shell type finite elements are the best elements to represent

this construction. Beam and three-dimensional elements are used to simulate the heavier detail parts such as engine mounts and landing gear struts. The N382-20 model was configured to have all of the structure subject to redesign by ASTROS. The entire designed portion of the structure is composed of plate/shell and rod elements. Because the ASTROS implementation of designed shell elements does not support bending stiffness, membrane only properties were required.

The elements selected for the different types of structure are:

1. Fuselage shell structure and wing substructure - QUAD4/TRIA3 - with primary shear loadings, the improved shear accuracy of the QUAD4 element is important for these structures.
2. Fuselage frames and bulkheads - QUAD4/TRIA3 - as shear load and concentrated loading redistributors, the improved shear accuracy of the QUAD4 element is important for these structures.
3. Wing skins - QDMEM1/TRMEM - with primary tension/compression loadings, the improved shear behavior of the QUAD4 is not necessary, plus at this stage of the ASTROS program development, the QDMEM1 element type is more reliable and somewhat faster to execute than the QUAD4.
4. Longerons - ROD - Local bending as available with BAR elements is not critical for large shell structures.
5. Cutouts, doors, and stringers - were not modeled discretely, for simplicity and execution time expediency.

3.5.3 Justification for Model Coarseness/Fineness

For preliminary, full-vehicle multidisciplinary studies, 1000 GRIDS and 1000 elements yield acceptable run times, allow consistent element sizes while representing faithful structural shape, and generate realistic load paths/distribution. At the same time they allow quick changes to the model. This level of mesh refinement does not allow for local detail which is inappropriate for preliminary design.

3.5.4 Explanation of the Choice of Boundary Conditions

We have a half model of the full vehicle. Symmetric maneuvers are the primary load cases; therefore, only mid-plane symmetric loads were analyzed. Antisymmetric loads rarely size significant structure except for local areas. Symmetric pull-ups and push-overs are the largest loads applied in the flight envelope; developing the maximum wing and fuselage vertical bending moments.

Antisymmetric yaw loads size the vertical and rudder areas and antisymmetric rolls design the aileron region. Although maximum fuselage lateral bending occurs from the yaw load, the structure is more critical for vertical bending loads.

The model can accommodate antisymmetric steady aeroelastic and static analyses with only minor additions. This is done by applying SPCs in the 1,3, and 5 directions (i.e., X, Z, and Pitch) along the centerline plane and scheduling a SAERO solution request for the desired aileron deflection.

ASTROS SAERO and Solution Control do not permit analysis of general asymmetric flight loads. Any asymmetric load can be separated into symmetric and antisymmetric portions. Each portion can be applied to a half model structure with the proper boundary conditions. NASTRAN Solution Control then has the option to do a SUBCOM, i.e., subcase combination where left- and right-half internal loads are computed. Right half loads are found by adding the symmetric and antisymmetric parts, while left hand loads result from subtracting the antisymmetric from the symmetric portion. ASTROS does not have the SUBCOM option.

All symmetric conditions use inertia relief to restrain the rigid body modes of the model:

X - fore/aft
Z - vertical
Rotation about Y - pitch

3.5.5 Mechanical Properties and Allowables Development.

Material selection for fighter aircraft must be keyed to service conditions, most critically, temperature. For our study, cool areas (180°F) employ a nominal unidirectional composite material - IM7/PEEK (poly-ether-ether-ketone thermoplastic). Warm areas were assumed to be IM7/BMI (bismaleimide thermoset) unidirectional composite at 350°F. The mechanical properties and allowables of IM7/PEEK and IM7/BMI at 180°F and 350°F are roughly equivalent, which allowed us to use the same basic material modulus for the complete vehicle. This material was used to define equivalent materials for two nominal composite lay-ups. These layups are then used as single ply composite shell properties:

<u>APPLICATION</u>	
Basic material: unidirectional	- wing skin general orthotropic layup with plies at 0/45/-45/90 degrees.
Equivalent: all 45's	- side skins and wing substructure balanced +/-45's.
quasi-isotropic	- fuselage top/bottom skins, frames, and bulkheads.

These values are based on current test data adjusted for projected improvements in fiber to matrix bonding. Improving the fiber/matrix interface properties enhances the translation of fiber to composite properties.

The power of ASTROS and this model is that material substitutes can be quickly performed and the model rerun to get an objective comparison. Therefore, only one composite material was included in the model. Further specialization of the material distribution, however, is eventually warranted. But, once a diverse mixture of materials is incorporated, the easy rerun flexibility is lost. Achieving a feasible design was felt to be more critical than a carefully tailored material assignment.

Nominally, locations with temperatures from 350 to 600°F in the aft engine bay area are not treated in the model as metallic, but are anticipated to be constructed primarily of elevated temperature aluminum and titanium. Locations with temperatures over 600°F are too localized to warrant study in

the preliminary phase, but titanium and Ti-aluminide are the prime candidate materials here.

A key modeling parameter for structural optimization is the non-optimum material density. The value chosen for the ASTOVL fighter was 1.5 times the true density. This quantity must account for the extra weight associated with splices, joints, fasteners, and anything else which is not modeled in detail. Little historical data is available to guide the analyst in this determination. Some studies at Northrop using REVWING on the F-18 wing, indicate a factor of 2.0 for the skins and spars, and 5.0 for the ribs. We chose the 1.5 value because we felt the REVWING results to be case specific and not applicable to this vehicle. This is, however, an area for active research.

Although the non-structural mass terms on element property cards are ignored for designed elements in ASTROS, this might be the proper mechanism to address the non-optimum density issue. A useful option would be to specify a function relating the non-structural mass to the element thickness/area. This allows variation in the effective non-optimum density factor. A higher ratio is anticipated for light gages than for heavy ones.

3.6 ANALYSIS DATA REQUIREMENTS - STATIC, DYNAMIC, AND AEROELASTIC MODELS

The static and dynamic structural models are the same. Finite element simulations modeled with NASTRAN or ASTROS are stiffness models. The stiffness of the overall structure derives from the assemblage of each element's stiffness. Graphic depiction of the model is the best way to assess the correlation with the real article. Local thicknesses and areas, being defined by ASTROS for virtually all structure, change with every iteration and are the primary result rather than input. In addition, when using inertia relief to react the external static loads, a good mass distribution is essential. Once the stiffness and mass models are complete, enough information is available to conduct dynamic analyses as well. The aerodynamic models as shown in Figures 7 and 8 for steady aero, and Figure 9 for unsteady aero are connected to the structure model with SPLINES and ATTACHs.

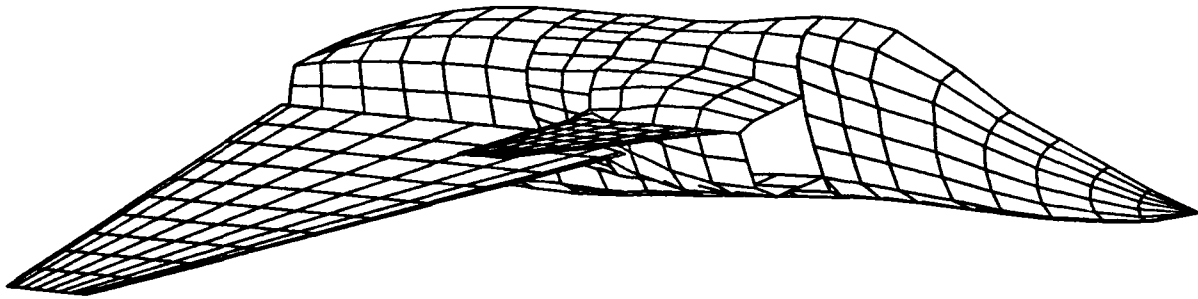


Figure 7. N382-20 ASTROS Steady Aerodynamics Model, Looking Aft and Inboard (RH Side)

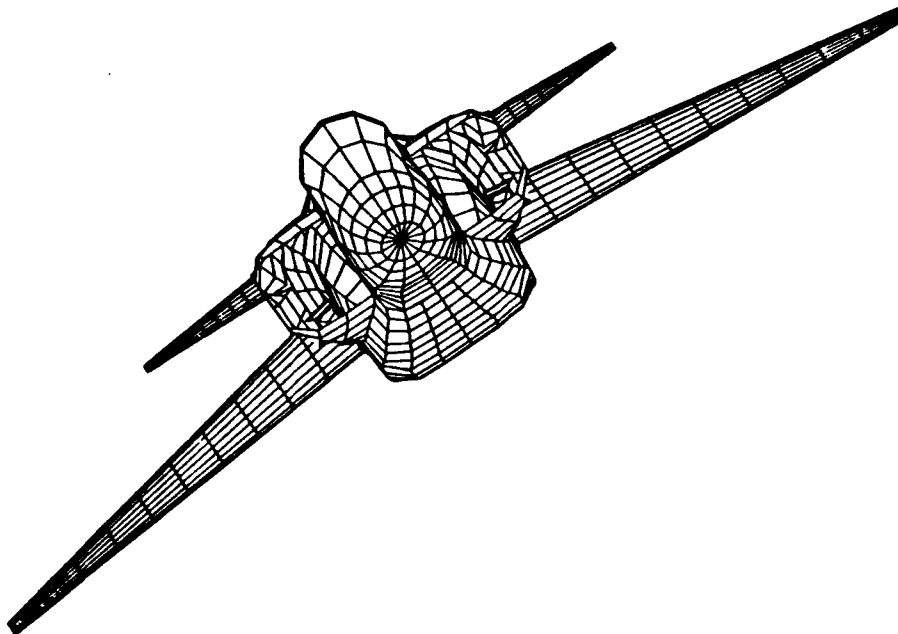


Figure 8. ASTROS Steady Aerodynamics Model, Looking Aft (Both Halves are Shown for Checkout Only)

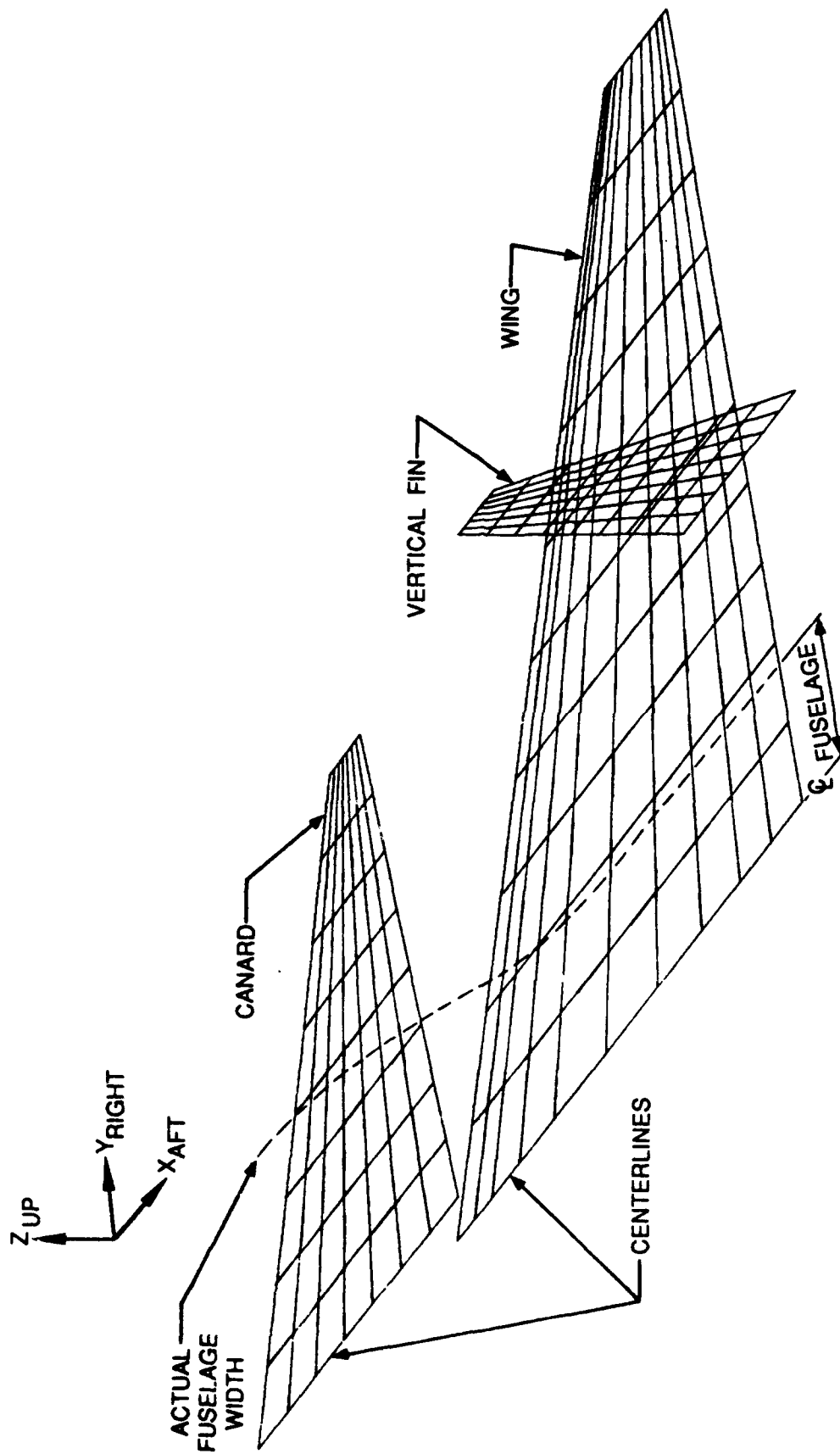


Figure 9. ASTROS Unsteady Aerodynamic Model

3.6.1 Static Model

Working from the stiffness model as the foundation, the mass contributions of structural and non-structural equipment must be accounted for. The mass model for the vehicle is derived from 2 types of sources:

1. Densities on the structural materials and the areas/thicknesses of the property cards. All the structure except for the vertical fin and canard is designed, so this weight changes for each iteration.
2. CONM2 elements which represent the non-structural mass. None of the non-structural mass is designed, so this is a fixed quantity during all iterations.

A copy of the complete input deck, including executive data, solution control data, and bulk data is shown in Appendix C.

The bulk data has extensive internal documentation through comment cards. The arrangement of the structural data is by structural segments. Prior to the grids and elements is a single section containing all the material and property cards.

Following the structural inputs comes the design model specifications. Included in the design section are the design variables and their shape functions, and the design constraints.

Next, are the aerodynamic model descriptions for steady and unsteady aeroelastic computations. Dynamic reduction and eigenvalue extraction data comes next with the flutter data last.

Multi-Point Constraints (MPC). MPCs are used to join the wing, aileron, fuselage, and pod segments. Recovery of the forces of MPC provides the interface forces from segment to segment (especially wing-to-fuselage lug loads).

Single-Point Constraints (SPC). Centerline symmetry in the basic coordinate system has directions 2, 4, and 6 fixed on the nodes lying in the plane of symmetry. The model is a right-half model as is required for the aerodynamic computations. The rotational degrees of freedom of all grids were restrained (SPC in 456) with a GRDSET card with a number of exceptions where bar elements with bending stiffness properties were necessary.

Numbering Scheme for GRIDs and Elements. Since this model is relatively small, a simple numbering scheme was adequate. Larger models often have GRID numbers 5 or 6 digits long, with the first 3 digits being the fuselage station number. This model would not have benefited from such an arrangement. Table 4 lists the grid and element numbering scheme.

The basic coordinate system for the aircraft as required for aerodynamic calculations has:

X	aft
Y	right
Z	up

Table 5 gives run time statistics for a typical ASTROS run.

Loads. The description of the loads incorporated in the final run can be determined from the Solution Control Data Packet in the input data file (Appendix C). Both Steady Aeroelastic (SAERO) and Static disciplines use inertia relief with SUPORT cards. Modes and Flutter disciplines work without SUPORTs for rigid body motion delineation, but Generalized Dynamic Reduction (GDR) permits no SUPORTs to work.

Landing loads are quasi-static equivalent of the actual transient dynamic condition. This assumption is necessary to allow optimization of the structure for these load conditions because ASTROS does not optimize for transient loads (i.e., analysis only).

TABLE 4. GRID AND ELEMENT NUMBERING SCHEME

GRID/ELEMENT NUMBERS

SECTION

1000-1999	WING
2000-2999	FORWARD FUSELAGE
3000-3999	MID FUSELAGE
4000-4999	AFT FUSELAGE
5000-5999	POD & VERTICAL

WING:

GRIDS AND ELEMENTS ARE NUMBERED FORWARD TO AFT IN STRIPS STARTING AT THE WING ROOT AND WORKING TO THE TIP.

LOWER SURFACE-

GRIDS ODD NUMBERS FROM 1001-1159
ELEMENTS ODD NUMBERS FROM 1001-1135

UPPER SURFACE-

GRIDS EVEN NUMBERS FROM 1002-1160 (ADD 1 TO CORRESPONDING LOWER WING GRID)
ELEMENTS EVEN NUMBERS FROM 1202-1336 (ADD 201 TO CORRESPONDING LOWER WING ELEMENT)

RIBS ELEMENTS-

1501-1508 RIB 1 (ROOT)
1511-1518 RIB 2
1521-1522 STUB RIB
1531-1537 RIB 3
1541-1546 RIB 4
1551-1555 RIB 5
1561-1564 RIB 6
1571-1574 RIB 7 (TIP)

1701-1702 MLG RIB

SPAR ELEMENTS-

1601-1607 LEADING EDGE SPAR (SWEPT)
1611-1613 1ST INTERMEDIATE
1621-1624 2ND INTERMEDIATE
1631-1635 3RD INTERMEDIATE
1641-1646 4TH INTERMEDIATE
1651-1657 5TH INTERMEDIATE
1661-1667 TRAILING EDGE SPAR (WITH GAP AT POD)

1674-1677 SPAR ON AILERON

FUSELAGE:

GRIDS ARE NUMBERED STARTING AT THE BOTTOM AND WORKING AROUND THE OUTSIDE OF THE BARREL TO THE TOP, THEN THE INSIDE STRUCTURE IS NUMBERED INBOARD TO OUTBOARD, FROM BOTTOM TO TOP. EACH STATION CUT IS COMPLETED THEN THE NUMBERING MOVES AFT TO THE NEXT FUSELAGE STATION.

ELEMENTS ARE NUMBERED SIMILAR TO THE GRIDS. ALL THE SKINS ARE DONE FIRST, THEN THE BULKHEADS AND FRAMES, THEN ANY FLOORS OR OTHER INTERNAL LONGITUDINAL STRUCTURE. LONGERONS ARE NUMBERED STARTING AT 501 WITHIN THE SEQUENCE FOR THE SEGMENT FROM FRONT TO BACK, THEN FROM BOTTOM TO TOP.

TABLE 4. GRID AND ELEMENT NUMBERING SCHEME (Continued)

FORWARD FUSELAGE:

GRIDS-

2001-2251

ELEMENTS-

2001-2176 OML SKINS
 2201-2251 BHD 175
 2232-2248 BHD 228
 2261-2266 BHD 269
 2271-2285 BHD 282
 2301-2361 COCKPIT AND EQUIPMENT FLOOR, NOSE WHEEL WELL

 2501-2511 LOWER LONGERON
 2521-2531 UPPER LONGERON

 2701-2891 STABILITY BARS

CENTER FUSELAGE:

GRIDS-

3001-3362

ELEMENTS-

3001-3112 OML SKINS
 3121-3138 BHD 330
 3141-3151 FRAME 360
 3161-3188 BHD 390
 3191-3210 FRAME 420
 3221-3238 BHD 454
 3251-3262 FRAME 475
 3271-3283 FUEL TANK FLOOR
 3301-3358 INLET OML SKIN
 3361-3411 INLET FRAMES

 3501-3506 LOWER LONGERON
 3511-3516 UPPER LONGERON
 3521-3526 DORSAL LONGERON
 3551-3557 INLET UPPER LONGERON
 3561-3567 INLET UPPER LONGERON

 3801-3854 RALS DUCT TUNNEL
 3901-3989 INLET IML SKIN

AFT FUSELAGE:

GRIDS-

4001-4176

ELEMENTS-

4001-4092 OML SKINS
 4101-4114 BHD 495
 4121-4132 FRAME 520
 4141-4152 BHD 545
 4161-4172 BHD 581
 4181-4192 BHD 615
 4201-4212 FRAME 648

TABLE 4. GRID AND ELEMENT NUMBERING SCHEME (Concluded)

4501-4505 LOWER LONGERON
4511-4515 UPPER LONGERON
4531-4534 WING LUG LOWER STIFFENER
4541-4544 WING LUG UPPER STIFFENER

MLG/VERTICAL FIN POD:

GRIDS-

5001-5150

ELEMENTS-

5001-5150 OML SKINS
5201-5206 BHD 545
5221-5228 BHD 581
5241-5246 BHD 615
5261-5266 BHD 633
5281-5286 BHD 655
5301-5306 BHD 680
5321-5326 BHD 695
5341-5346 BHD 733
5361-5366 BHD 751

5404, -ROD
5411, 5412, 5415, 5416, -BARS REPRESENT THE VERTICAL FIN
5421, 5426

5501-5508 BOTTOM STIFFENER
5511-5518 TOP STIFFENER
5521-5528 INBOARD STIFFENER
5531-5538 OUTBOARD STIFFENER

TABLE 5. TYPICAL ASTOVL MODEL RUN TIME STATISTICS

TYPICAL RUN-TIME MODEL STATISTICS (RUN 02H) :		
GRIDS	870	
SPCS	258 GRIDS	
MPCS	309 GRIDS	
<u>DEGREES OF FREEDOM</u>		
ORIGINAL	5220	
SPC'D	2557	
MPC'D	147 DEPENDENT	
SUPORT'D	2	
ANALYSIS	2514	
<u>GLOBAL DESIGN VARIABLES</u>		
DESELMS	3	
DESVARS		
SHAPE FUNCTIONS	170	
TOTAL 173		
<u>ELEMENTS</u>	<u>NUMBER</u>	<u>NUMBER</u> <u>OF DESIGNED (LOCAL DESIGN VARIABLES)</u>
TRMEMS	8	32 = 8 X 4 PLIES/ELEMENT
QDMEM1S	76	304 = 76 X 4 PLIES/ELEMENT
RODS	109	103
CONM2S	166	3
BARS	106	0
QUAD4S	867	863
TRIA3S	66	58
TOTAL	1398	1363
<u>STEADY AERO PANELS</u>		
WING	100	
CANARD	56	
FUSELAGE	222	
TOTAL	378	
<u>UNSTEADY AERO PANELS</u>		
WING	100	
CANARD	56	
FUSELAGE	56	
TOTAL	212	

Non-Linear Analysis. ASTROS does not analyze or optimize for buckling or non-linear analysis in the current and anticipated versions. While general buckling instability is typically not a problem for fighter aircraft, local panel buckling is, and for a major fraction of the structure. This is a critical omission by ASTROS which must be addressed by the analyst through separate means after the optimization/analysis and should be incorporated into ASTROS as soon as possible.

Design Model Specification. Intuitively every element would be designed, but this occasionally results in large thickness variations from element to element. Also, with so many design variables (1400 local design variables in this model), mathematical programming techniques become intractable. To overcome these problems, design variable linking is applied to reduce the number of global design variables and to rationalize the design for manufacturing. Shape functions were used to smoothly vary element thicknesses (ply drop-offs) over sizable regions of structure. Each region can have as many shape functions as desired. By combining constant, linear, and quadratic shapes along the span and chord directions of the wing, complex polynomial thickness distributions were created for each wing skin "ply." Each designed ply actually represents the total thickness at a particular ply orientation angle. Similar polynomial functions along the station direction apply to the fuselage elements.

Table 6 lists the complete set of design variable shape functions.

3.6.2 Dynamic Analysis Model

There is no difference between the static and dynamic structural models.

Normal Modes. Generalized Dynamic Reduction (GDR), occasionally known as subspace iteration, was used to calculate 20 to 30 approximate mode shapes. Then Givens factorization was applied to the approximate mode shapes to provide all 20 to 30 frequencies and as many mode shapes as requested. Typically 12 to 15 mode shapes are obtained.

TABLE 6. ASTROS DESIGN VARIABLE SHAPE FUNCTIONS

NUMBER OF DESVARS	STRUCTURE
74	WING
24	FORWARD FUSELAGE
36	MID FUSELAGE
31	AFT FUSELAGE
8	POD
173 TOTAL	

WING DESIGN VARIABLES		
DESELMS	ELEMENT TYPE	DESCRIPTION
3	CONM2S	BALANCE MASSES ON THE LEADING EDGE

SHAPE FUNCTIONS	STRUCTURE	SHAPE DESCRIPTION
20	LOWER SKINS	CONSTANT + LINEAR SPANWISE + QUADRATIC SPANWISE + LINEAR CHORDWISE + QUADRATIC CHORDWISE IN EACH OF 4 PLY DIRECTIONS 0°/+45°/-45°/90° (0° = SPANWISE, 90° = CHORDWISE) MINIMUM GAGE .010 EACH PLY DIR.
20	UPPER SKINS	CONSTANT + LINEAR SPANWISE + QUADRATIC SPANWISE + LINEAR CHORDWISE + QUADRATIC CHORDWISE IN EACH OF 4 PLY DIRECTIONS MINIMUM GAGE .010 EACH PLY DIR.
3	RIBS	CONSTANT RIBS 1 & 2 RIBS 3 & 4 RIBS 5, 6, & 7 MINIMUM GAGE .040
12	SPARS	CONSTANT + LINEAR LENGTHWISE (2 DESVARS EACH SPAR) LEADING EDGE SPAR SPARS 1 & 2 SPAR 3 SPAR 4 SPAR 5 SPAR 6 MINIMUM GAGE .040
8	LEADING EDGE	CONSTANT + LINEAR SPANWISE IN EACH OF 4 PLY DIRECTIONS MINIMUM GAGE .010 EACH PLY DIR.
8	AILERON	CONSTANT + LINEAR SPANWISE IN EACH OF 4 PLY DIRECTIONS MINIMUM GAGE .010 EACH PLY DIR.
74 TOTAL WING		

TABLE 6. ASTROS DESIGN VARIABLE SHAPE FUNCTIONS (Continued)

FUSELAGE DESIGN VARIABLES		
SHAPE FUNCTIONS	FORWARD FUSELAGE STRUCTURE	SHAPE DESCRIPTION
3 2 2 5	BOTTOM SKIN TOP SKIN (FWD OF COCKPIT) TOP SKIN (AFT OF COCKPIT) BHDS & FRAMES STATION 175 195/201 228 269 282	<u>STATION WISE</u> CONSTANT + LINEAR + QUADRATIC CONSTANT + LINEAR CONSTANT + LINEAR CONSTANT
3	COCKPIT FLOOR NOSE WHEEL WELL	CONSTANT + LINEAR + QUADRATIC
ALL : QUASH-ISOTROPIC COMPOSITE MINIMUM GAGE .040		
3	SIDE SKINS	<u>STATION WISE</u> CONSTANT + LINEAR + QUADRATIC ALL 45° FABRIC MINIMUM GAGE .040
3 3	UPPER LONGERON LOWER LONGERON	<u>STATION WISE</u> CONSTANT + LINEAR + QUADRATIC CONSTANT + LINEAR + QUADRATIC ISOTROPIC MATERIAL WITH NOMINAL PROPERTIES FOR 60/30/10 COMPOSITE LAYUP MINIMUM AREA .12
24 TOTAL FORWARD FUSELAGE		

FUSELAGE DESIGN VARIABLES		
SHAPE FUNCTIONS	MIDDLE FUSELAGE STRUCTURE	SHAPE DESCRIPTION
3 3 6	BOTTOM SKIN TOP SKIN BHDS & FRAMES STATION 330 360 390 420 454 475	<u>STATION WISE</u> CONSTANT + LINEAR + QUADRATIC CONSTANT + LINEAR + QUADRATIC CONSTANT
2 3 2	FUEL TANK FLOOR INLET FRAMES INLET OUTER SKIN	CONSTANT + LINEAR CONSTANT CONSTANT + LINEAR
ALL : QUASH-ISOTROPIC COMPOSITE MINIMUM GAGE .040		
3 2 2	SIDE SKIN RALS DUCT TUNNEL INLET INNER SKIN	<u>STATION WISE</u> CONSTANT + LINEAR + QUADRATIC CONSTANT + LINEAR CONSTANT + LINEAR
ALL 45° FABRIC MINIMUM GAGE .040		
6 4	LONGERONS (3) UPPER LOWER DORSAL LONGERONS (2) INLET UPPER LOWER	<u>STATION WISE</u> CONSTANT + LINEAR CONSTANT + LINEAR
ISOTROPIC MATERIAL WITH NOMINAL PROPERTIES FOR 60/30/10 COMPOSITE LAYUP MINIMUM AREA .12		
36 TOTAL MIDDLE FUSELAGE		

TABLE 6. ASTROS DESIGN VARIABLE SHAPE FUNCTIONS (Continued)

FUSELAGE DESIGN VARIABLES		
SHAPE FUNCTIONS	AFT FUSELAGE STRUCTURE	SHAPE DESCRIPTION
3 3 2	BOTTOM SKIN TOP SKIN FRAMES STATION 520 644	<u>STATION WISE</u> CONSTANT + LINEAR + QUADRATIC CONSTANT + LINEAR + QUADRATIC CONSTANT <u>VERTICALLY</u> CONSTANT + LINEAR + QUADRATIC CONSTANT + LINEAR + QUADRATIC CONSTANT + LINEAR + QUADRATIC CONSTANT + LINEAR + QUADRATIC ALL : QUASI-ISOTROPIC COMPOSITE MINIMUM GAGE .040
3	SIDE SKIN	<u>STATION WISE</u> CONSTANT + LINEAR + QUADRATIC ALL 45 DEGREES FABRIC MINIMUM GAGE .040
4 4	LONGERONS (2) UPPER LOWER STIFFENERS (2) WING LUG UPPER LOWER	<u>STATION WISE</u> CONSTANT + LINEAR CONSTANT + LINEAR ISOTROPIC MATERIAL WITH NOMINAL PROPERTIES FOR 60/30/10 COMPOSITE LAYUP MINIMUM AREA .12
31 TOTAL AFT FUSELAGE		

TABLE 6. ASTROS DESIGN VARIABLE SHAPE FUNCTIONS (Concluded)

DESIGN VARIABLE SHAPE FUNCTIONS		
SHAPE FUNCTIONS	VERTICAL FIN & MLG POD STRUCTURE	SHAPE DESCRIPTION
4	SKIN	<u>STATION WISE</u> CONSTANT + LINEAR + QUADRATIC
4	BHDS STATION 545 & 581 615 & 633 655, 680, & 695 735 & 751	<u>VERTICALLY</u> + LINEAR CONSTANT ALL COMPOSITE TOP/BOTTOM : QUASI-ISOTROPIC SIDES : ALL 45° FABRIC MINIMUM GAGE .040
QB		
2	SKIN	<u>STATION WISE</u> CONSTANT + LINEAR
4	BHDS STATION 545 & 581 615 & 633 655, 680, & 695 735 & 751	CONSTANT ALL COMPOSITE TOP/BOTTOM SKINS AND BHDS : QUASI-ISOTROPIC SIDE SKINS : ALL 45 DEGREE FABRIC MINIMUM GAGE .040
1	STIFFENERS (2) UPPER LOWER	CONSTANT
1	STIFFENERS (2) SIDE INBOARD OUTBOARD	CONSTANT ISOTROPIC MATERIAL WITH NOMINAL PROPERTIES FOR 60/30/10 COMPOSITE LAYUP MINIMUM AREA .12
8 TOTAL POD		

The structure mass and stiffness model is as discussed in the static analysis, Subsection 3.6.1, and shown in the figures.

Complex eigenvalue, frequency response, and transient response analysis were not considered for preliminary analysis. The landing impact load cases are transient dynamic events. ASTROS, however, does not optimize for transient load cases so approximate static equivalents were used to account for these load cases which typically generate the maximum up-bending moments on the fuselage.

Random Response Analysis. Acoustic loads near the engine exhaust nozzle were examined parametrically, but were not considered in the overall finite element model.

3.6.3 Aeroelastic Analysis Model

Stiffness and mass matrices were defined in Subsection 3.6.1. The steady aerodynamic model is shown in Figures 7 and 8. ASTROS uses Woodward's USSAERO code (Reference 1). USSAERO uses panel methods for steady aerodynamics. The vertical tail and pod were not considered critical for the symmetric flight loads analyzed because the vertical component of lift due to angle-of-attack is very small compared to the wing, body, and canard. Yaw force on the vertical induces large lateral bending and torsion on the pod. But the flutter tendencies of the vertical fin/pod combination induces enough strength and stiffness in this area that flutter is more critical.

The canard and wing are modeled with lifting surface elements which include thickness and camber effect. The fuselage is composed of body type aero panels.

Connection of Aerodynamics to Structure. Three SPLINEs connect the aero-to-wing structure lower skin nodes: (1) one inboard of the aileron; (2) one forward of the aileron; and (3) one on the aileron. SPLINEs are surface splines, suitable for interpolating loads between two coincident flat surfaces such as wings, but are not suitable for highly curved surfaces as found on fuselages. One ATTACH card connects the canard aero model to the canard spindle tip GRID.

Each macro element on the fuselage connects via ATTACHs to a single GRID point. Because the transfer of load includes moments, these points must have rotational bending stiffness. Since designed QUADs/TRIAs do not have bending stiffness, only grid points with BARs attached were suitable. The scarcity of bending elements in the structure dictated the choice for ATTACHing aero to structure. Many stability BARs were available in the forward fuselage; the center fuselage only has the canard spindle BARs; and the aft fuselage has the engine mount BARs.

Unsteady Aerodynamic Model (Flutter). ASTROS Method of Unsteady Aerodynamics/flutter for supersonic speeds uses the constant pressure method (CPM, Reference 6) for aerodynamics and the P-K modal flutter approach similar to NASTRAN and FASTOP (References 3 and 5). Where,

- P - complex eigenvalue
- K - reduced frequency - $\omega c/2v$
 - ω - circular natural frequency of vibration
 - c - mean aerodynamic chord
 - v - vehicle forward velocity

The ZANLYN routine is employed to solve the coupled flutter equations.

Supersonic body elements are not available in unsteady aerodynamics, so the canard and wing lifting surfaces are extended to the vehicle centerline (maintaining leading and trailing edge sweep angles) to approximate the effect of the body in the vicinity of the wing and canard.

Note, the vertical fin was not included in early versions of the model since it was not considered critical for preliminary design where only symmetric conditions are included. Subsequent results showed large pod lateral dynamic motion and flutter tendencies. Thus, we added a vertical fin to the unsteady aero, hoping to get some aerodynamic damping.

The same wing SPLINES and canard ATTACH were used as applied in steady aero. The vertical fin unsteady aero model was ATTACH'd to its four structural corner GRIDs.

Three rigid body modes were omitted from the flutter analysis in the axial, plunge, and pitch directions because the optimizer had no mechanism to correct any violation of the constraints associated with them.

3.7 RESULTS AND RECOMMENDATIONS

Deflections. SAERO and STATICS results indicated that deflections were within reasonable limits; so no explicit deflection constraints were needed or applied. Comparisons were made between equivalent ASTROS and NASTRAN runs for an all metal airframe. The ASTROS values for deflections and element loads were typically within 2 to 3 percent.

Figures 10 through 13 compare deformed and undeformed shapes for the Mach 1.2 9g symmetric pull-up load case. Tables 7 and 8 list deflection and acceleration results for selected locations on the fuselage and wing.

Element Forces. Printed tables of the element forces are so large that we leave it up to the recipient of the model to exercise it to generate the forces as desired. Also, no graphical output is available with the current version of ASTROS. Detailed loads in key areas are discussed in a separate report for the Ultralightweight Structures program dealing with the structural trade studies.

Wing skin loads of the ASTOVL fighter are somewhat low compared to most fighter aircraft. Typical fighter wings usually have 6000-10,000 lb/in spanwise running load. The maximum wing skin spanwise loads for N382-20 under a 9g symmetric pull-up case are approximately 5000 lb/in (ultimate) with a local concentration of 5700 lb/in at the main landing gear pod attach area. This appears to be the result of a relatively large area delta wing, inertia relief from the wing internal fuel and mass of the MLG/vertical fin pod, and aeroelastic redistribution of the lift to inboard wing region. The redistribution does not change the total wing shear, but it does reduce the effective

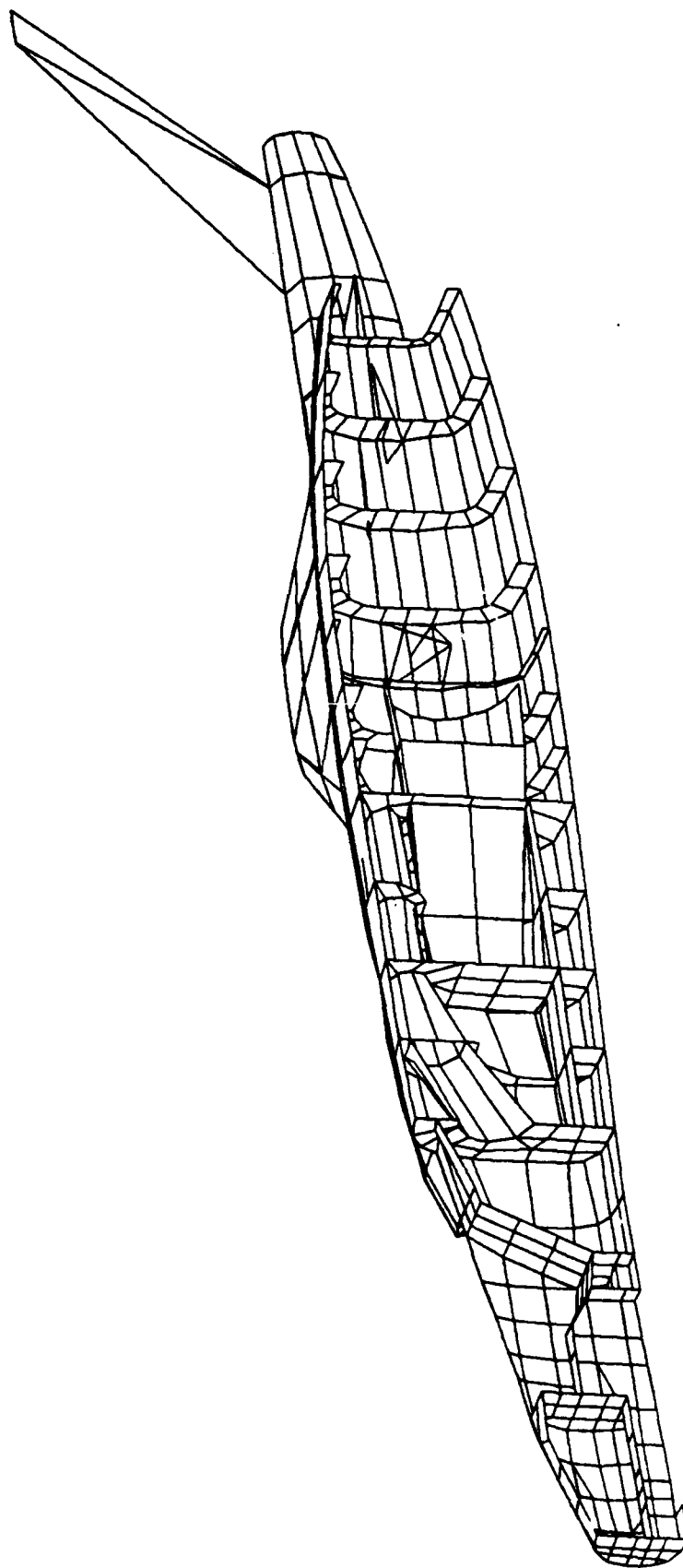


Figure 10. Undeformed ASTROS Model, Looking Outboard

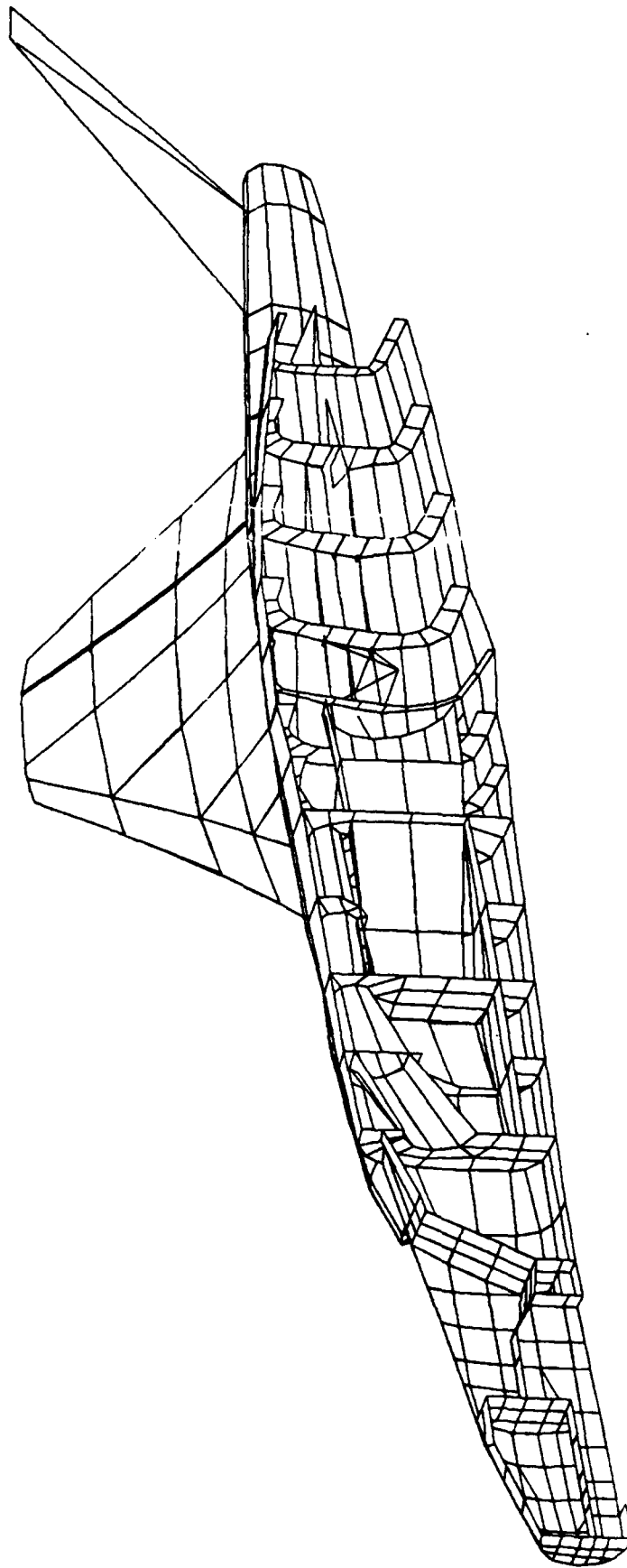


Figure 11. ASTROS Model Deformations for Mach 1.2 9g Symmetric Pull-Up, Looking Outboard

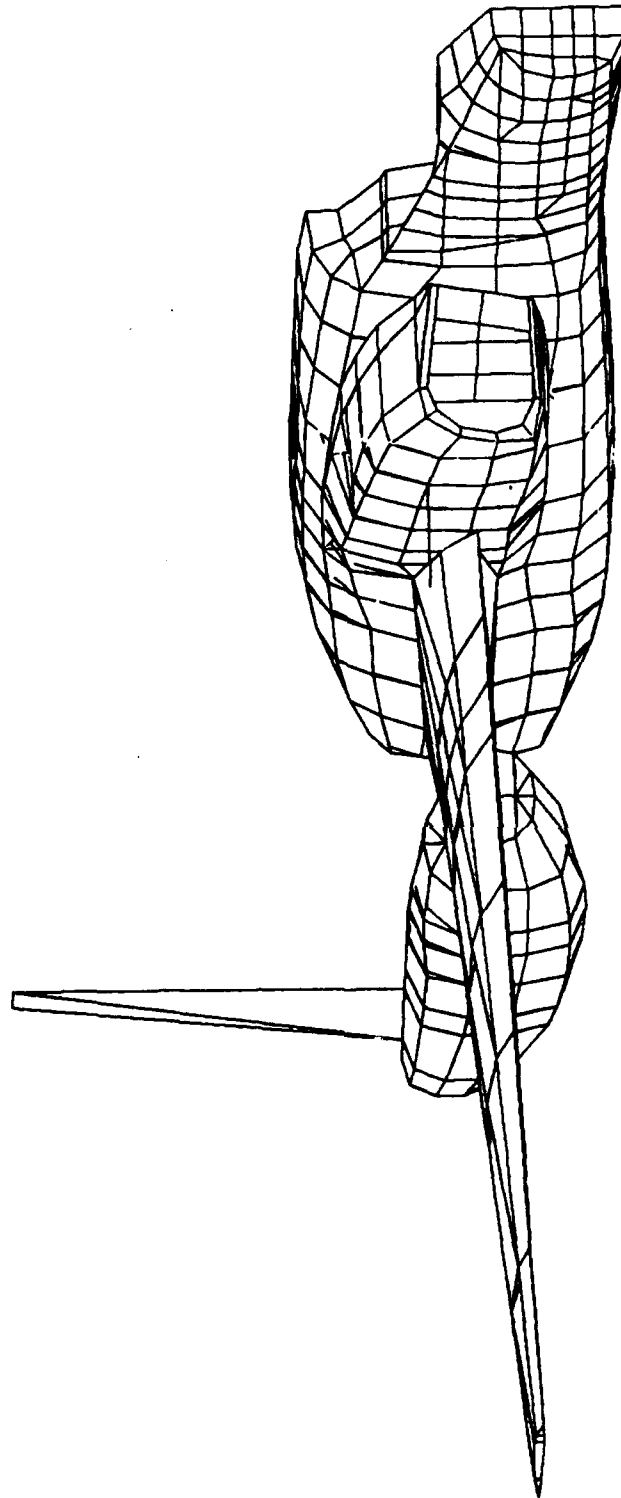


Figure 12. Undeformed ASTROS Model, Looking Aft

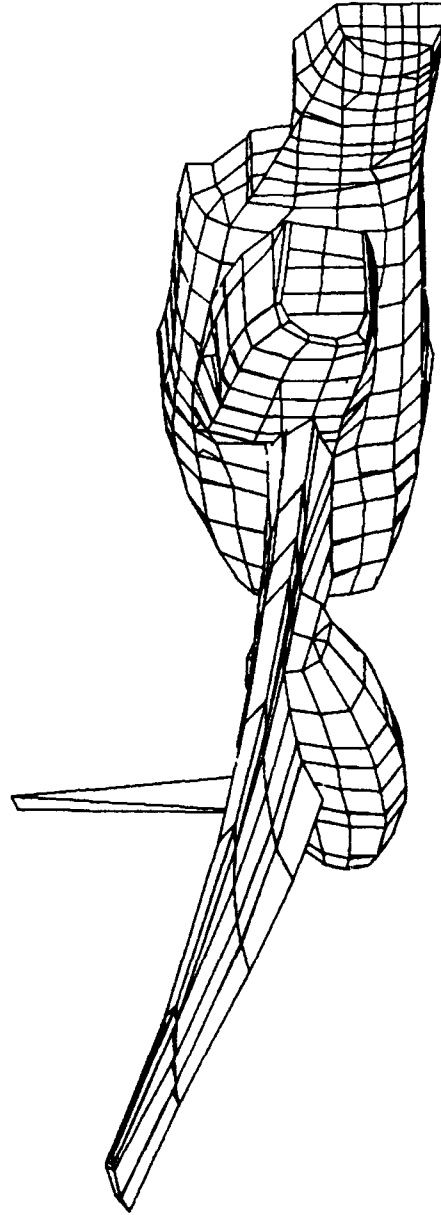


Figure 13. ASTROS Model Deformations for Mach 1.2 9g Symmetric Pull-Up, Looking Aft

TABLE 7. ASTROS STATIC DEFLECTION RESULT SUMMARY

VERTICAL (Z) DEFLECTIONS (IN)							
	FUSELAGE			WING TIP		POD	MLG OR NLG
LOAD CONDITION	FORWARD	MID	AFT	FORWARD	AFT	AFT END	NODE
NLG IMPACT	3.212	0.0	.229	.579	.932	1.126	2.964 NLG
MLG IMPACT	-1.478	0.0	-.023	.550	-.575	-2.443	1.019 MLG
13.5GS SAERO	-1.235	.211	-1.058	16.663	16.120	-3.885	-
1.0GS SAERO	-.070	-.104	-.065	.739	1.454	.041	-
-4.5GS SAERO	.443	-.243	.372	-6.268	-4.999	1.769	-

TABLE 8. ASTROS STATIC ACCELERATION RESULT SUMMARY

VERTICAL (Z) ACCELERATIONS (IN/SEC ²)		
	FUSELAGE	
LOAD CONDITION	FORWARD	AFT
NLG IMPACT	3586.	-1094.
MLG IMPACT	-1240.	4385.
13.5GS SAERO	5211.	5211.
1.0GS SAERO	386.	386.
-4.5GS SAERO	-1737.	-1737.

moment arm. The wing root bending moment is thereby reduced and hence the skin spanwise running loads are lower. In fact, at one iteration during the optimization process, the loads were virtually constant for much of the wing skins.

Spar loads change signs in the root bay due to shear loads carried by the vertical component of the in-plane skin load. The leading edge spar shear loads increase going outboard. Because the intermediate spars terminate on the swept leading edge spar, each outboard portion of the remaining spars must carry a larger percentage of the shear. In this case, the leading edge spar effects the redistribution of load to each spar terminating on it.

Fuselage loads follow the same trends as other fighter aircraft; primary fuselage vertical bending moment and shear load increase as one approaches the wing side-ties from forward and aft ends. The shear load is carried in the side skins and the moment is carried in the longerons and top/bottom skins.

Frequencies. For the mid-plane symmetric boundary conditions there are 10 modes (Table 9) below 20Hz including the rigid body modes (02J run, see Appendix A for description of run summaries).

The FS 520 frame flex mode (FR520) was due to excessive flexibility as the result of inadequate frame depth. No interaction with the aerodynamics occurs due to a single frame flexing, so omitting this mode from the flutter optimization causes no loss of accuracy. Subsequent flutter analysis following optimization proved that there was no coupling of mode 7 with the other modes.

Flutter. Mach 1.5 at 15000 ft was assumed for the flutter calculations. The maximum speed of the N382-20 ASTOVL is Mach 1.5 which crosses the 750 KNOT equivalent never exceed airspeed at an altitude of approximately 15000 ft.

The analysis and optimization for flutter point out the difficulty of dynamically stabilizing a wing with a large mass at the trailing edge. Typical flutter fixes use mass balance at the leading edge to best effect.

TABLE 9. FUNDAMENTAL FREQUENCY AND MODE SHAPES (02J RUN)

Mode	Frequency(Hz)	Mode Description
1	0	Fore/aft rigid body
2	0	Pitch rigid body
3	0	Plunge rigid body
4	7.958	First fuselage bending
5	8.645	First wing bending
6	8.834	First pod/vertical lateral bending
7	10.981	Frame 520 flex (spurious mode - omitted from flutter calculations)
8	14.495	Second fuselage bending
9	16.444	First wing twist, aileron deflection, pod roll
10	18.657	Pod roll + lateral bending, wing twist

The heavy pods with the aftward offset make the N382-20 configuration flutter prone. First mode flutter was found to be a problem at all velocities requested in the P-K flutter analysis (12000 in/sec to 19027 in/sec, 19027 in/sec - Mach 1.5).

The damping ratio at the velocity corresponding to Mach 1.5 at 15000 ft elevation was over three percent (02J). In the optimization, the flutter damping ratio was constrained to 0 percent or less. The optimizer was unable to eliminate this infeasibility. The flutter constraint sensitivity subroutine in ASTROS may have a defect which prevented the optimizer from finding a feasible direction from among the design variables for flutter correction.

Design Model Results. Element thicknesses and areas are the final product of the optimization process. For the N382-20 ASTOVL, the complete structure model for the fuselage, wing, and pod are eligible for redesign. Forward fuselage side skin thicknesses are clearly higher than experience indicates. The cause of this is the method of transferring loads from the

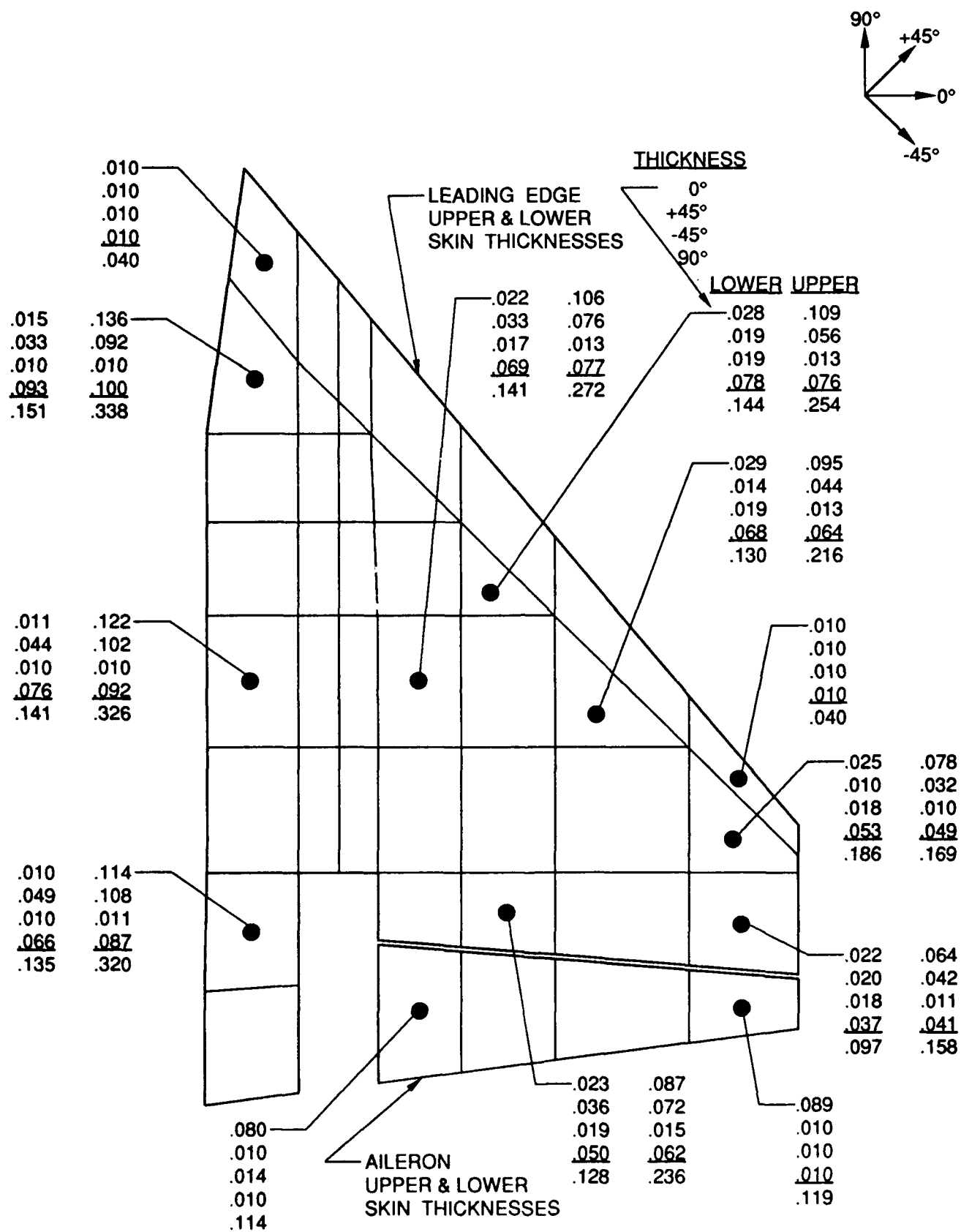
aerodynamic model to the structure model. Only a handful of GRIDs are directly loaded by the ATTACHs used to connect the two models. Large load spikes on these GRIDs overstress the adjacent skin elements and the optimizer increases the thickness to 0.187 to 0.337 in. to maintain a positive margin of safety. Preliminary model checkout runs which used rigid wing airloads but no body airloads demonstrated thicknesses on the order of 0.060 in. which is realistic. Figures 14 and 15 and Appendix E show ASTROS thickness results for selected elements throughout the vehicle. Thicknesses for the elements not listed can be interpolated from these numbers.

The beam spline, SPLINE2 in NASTRAN, provides a better means to transform loads from the aero panels to the structure. SPLINE2s are not currently available in ASTROS.

Satisfaction of Design Criteria. The primary design criteria satisfied with ASTROS simultaneous multidisciplinary optimization are strength, stiffness, and flutter. The stiffness requirement is satisfied by the other conditions without additional weight or displacement constraints. Stress/strain constraints are met by specifying a material stress/strain allowable on the material cards and constraining the material explicitly during optimization for the STATIC and SAERO disciplines. Every element referencing a material so constrained will have margins of safety calculated and reconciled, even if that element is not designed. Flutter is constrained by detailing the maximum allowed flutter damping as a function velocity.

The optimizer routine within ASTROS adjusts the element thicknesses and areas to satisfy all the constraints and concurrently minimizes the weight. The linearized automatic resizing is then checked with another analysis using the design values. Convergence occurs when all the constraints are within limits and the weight cannot be reduced further.

The optimizer will exploit all options the user permits. Omission of any constraint which is critical will allow the optimizer free reign to give unacceptable designs. Therefore inclusion of all constraints is recommended. Some constraints may be accommodated by careful selection of minimum gage values, but this assumes the best design is known ahead of time.



One of the benefits of automated design tools is to arrive at a non-intuitive solution which weighs less than the "obvious" one. Limiting the design with artificial minimum gage settings denies the optimizer the opportunity to find such an answer. Unfortunately for aircraft structures, local buckling is a primary design driver that ASTROS does not currently incorporate; the resulting thin gage skin solution that ASTROS provides will violate the buckling requirements. Nor does ASTROS handle postbuckling type analysis as this is a non-linear problem for which it was never intended, even though postbuckled designs may be lighter.

Recommendations for Further Studies for ASTOVL Model:

1. Loads: Add new load conditions

- A. Subsonic Flutter
- B. Antisymmetric Flight and Flutter
- C. Asymmetric Flight
- D. Cockpit Pressure
- E. Fuel Pressure
- F. Thermal effects
- G. SAERO loads on Pod and Vertical Fin

2. Structure: Add new structure

- A. Detailed Vertical Fin
- B. Cockpit Frames (plate elements)
- C. Canopy
- D. Bulkhead Cap elements
- E. Spar and Rib Cap elements
- F. Run the alternate wing internal configuration which was constructed with spars on percent chords. This wing, known as WING1, has not yet been merged with the fuselage model. We were seeking a feasible solution from the spars

perpendicular to the centerline wing, WING2, first. Merging this wing with the rest of the structure will require new MPCs at the wing lugs and pod interface, and new shape function design variable definitions. The structure model for WING1 will be included in the data file deliverables.

3. Materials/Properties Zoned
 - A. Allowables vs temperature
 - B. Varying density scale up factors for varying structure segments
4. Addition of a control system to the flutter analysis and optimization.
5. Design Model: Add DESVARs and Constrained elements
 - A. Cockpit Frames
 - B. Bulkhead Caps
 - C. Spar and Rib Caps - tied to existing web DESVARs
 - D. SAERO roll rate constraint to meet performance specifications
 - E. Modifications to add more plies to the fuselage can be made easily to test the sensitivity of the quasi-isotropic top/bottom skins and the balanced 45 degree side skins
6. Delete DESVARs (frees up design variables for other areas) - In wing skins:
 - A. By linking the upper and lower skins together
 - B. Calling out balanced +45/-45 degree layup
 - C. Any shape function design variable which has a negligible influence on the final thickness

ASTROS Modeling Guidelines:

1. Maximum number of global design variables - ~200
2. Maximum retained constraints - ~100 + Minimum Gage Constraints (specify the value of $\text{NRFAC} = 100/\text{NDV}$, in the solution control packet, where NDV = number of design variables)
3. Include all constraints. The optimizer will exploit all options the user permits. Omission of any constraints which are important will give the optimizer free reign to violate them.
4. DCONTHK at least one element for each shape associated with that group of elements.
5. The non-optimum material density value chosen must account for the extra weight associated with splices, joints, fasteners, and anything else which is not modeled in detail. Little historical data is available but a rule of thumb is to use a larger factor for coarse models.
6. Use of scaled-up density is not recommended to account for buckling. Studies at Northrop have shown that for a highly loaded composite panel which is buckling critical, changing the allowable strain from 6000 micro strain to 2000 micro strain caused no significant change in thickness and weight. Buckling is a function of the thickness cubed; other approximations to it, such as artificially reducing the strain allowable, will not suffice.
7. Different internal structure arrangements can be modeled for the same overall configuration to get unbiased comparisons of optimum designs
8. Different materials can be substituted for comparison

ASTROS Enhancement Recommendations

1. Graphical pre- and post-processors - particularly for the design data
2. General and panel buckling constraints, both analysis and optimization
3. Local crippling constraints, both analysis and optimization
4. Aerodynamic force output including aeroelastic correction
5. Inertial force output

6. PBAR section property by lengths and widths of stiffener legs, radius and wall thickness of round sections, etc.
7. Model debug and checkout tools:
 - A. Grid Point Weight Generator
 - B. AUTOSPC
 - C. GRID number resequencing for bandwidth minimization
 - D. NASTRAN epsilon and strain energy checks
8. SPC and MPC forces
9. Grid Point Force Balance
10. NASTRAN type PLOAD card inputs for pressure application
11. Some scalar measure of change in the design other than weight. Perhaps a vector norm which accounts for the absolute value magnitude change for each of the design variables.
12. SPCD type cards for subcase selectable forced displacements
13. Rigid elements comparable to NASTRAN's RBAR, RBE1-3, RROD, RSPLINE, RTRPLT
14. Improved three dimensional elements
15. Automatic ROD creation with SHEAR elements
16. Method to generate asymmetric internal loads for symmetric models (similar to SUBCOMs in NASTRAN)
17. Aeroelastic calculations about the center of gravity
18. Generic constraint - user input equations
19. New design constraints on the aeroelastic behavior:
 - A. Maximum/minimum for angle-of-attack
 - B. Control surface deflections
 - C. Instantaneous roll rate
 - D. Steady state roll rate
 - E. Pitch rate
 - F. All flexible stability derivatives
 - G. All flexible/rigid stability derivative ratios

Enhancements Added and Errors Corrected in ASTROS.

1. Incorrect element results for all QUAD4s that were stress or strain constrained; due to internal reordering of GRID point coordinates.
2. Incorrect calculation of MPC transformation matrices in the presence of multiple MPCs chained together.
3. Incorrect spline transformations when using multiple splines in either steady or unsteady aerodynamics models.
4. Incorrect interpretation of the material orientation angle on QUAD4s and TRIA3s during results calculations.
5. Error in decomposing real, asymmetric matrices - as found in steady aeroelastic analysis - which failed with a false insufficient memory message.
6. Incorrect out of core handling of flutter sensitivity values for large numbers of sensitivities.
7. Element sorting error when only one element of a single type occurs in a ELEMLIST.
8. Incorrect QUAD4 stress output coordinate system when PCOMPs and/or material coordinate system is requested. Values were being computed and printed in the local material system for each ply rather than the element system as documented. Summing each ply's contribution to the element force gave erroneous answers. (TRIA3s)
9. Suppressed printing of zero load values when load print is requested.
10. Suppressed printing of zero load values when SPC force print is requested.
11. Excessively long steady aeroelastic computation times were reduced through a new formulation of the equations in the MAPOL sequence.
12. Element force print was modified for designed composite plate elements to give the forces as the sum of all plies rather than ply by ply.
13. Overly strict requirements when projecting the material coordinate systems onto element planes.
14. Printing of the input DEBUG and MAPOL/EDIT packets even if NOLIST was requested.

15. Modules to calculate and print the SPC and MPC forces were developed. These have since been rendered incompatible with ASTROS Version 4 SAERO calculations, although they still work for STATICS.
16. The SHAPEGEN module was updated for Version 4 and installed as described in the ASTROS application manual. This module was used to generate all the shape functions for the fuselage and pod.
17. A module known as P3D was installed to download geometry and deformation data to a personal computer for graphic display using Northrop proprietary software.

3.8 INPUT DECK DATA FORMAT

ASTROS closely follows the COSMIC NASTRAN input with additions and modifications as necessary for optimization and multidisciplinary generality (e.g., aerodynamic input). The NASTRAN input will be for a nominal all metallic vehicle; the intent and primary involvement was to make an optimization model for the full vehicle structure.

Also included is an ASTROS compatible input deck with PCOMP type composites, steady and unsteady aerodynamic input, and full design model shape functions, DESVARs, and constraints.

SECTION 4

REFERENCES

1. Johnson, E. H. and Venkayya, V. B., "Automated Structural Optimization System," Volume 1, Theoretical Manual, AFWAL-TR-88-3028, December 1988.
2. Neill, D. J., Johnson, E. H., and Herendeen, D. L., "Automated Structural Optimization System," Volume 2, User's Manual, AFWAL-TR-88-3028, April 1988.
3. MacNeal, R. H., The NASTRAN Theoretical Manual, NASA SP-221(01), April 1971.
4. The NASTRAN User's Manual, NASA SP-222(06), December 1983.
5. Markowitz, J. and Isakson, G., "FASTOP-3: A Strength, Deflection and Flutter Optimization Program for Metallic and Composite Structures," AFFDL-TR-78-50, Volumes I and II, May 1978.
6. Appa, K., "Constant Pressure Panel Method for Supersonic Unsteady Airloads Analysis," Journal of Aircraft, Volume 24, October 1987, pp 696-702.
7. Vanderplaats, G. N., "An Efficient Feasible Directions Algorithm for Design Synthesis," AIAA Journal, Volume 22, No. 11, November 1984, pp 1633-1640.
8. "MICRO-DOT User's Manual, Version 1.0," Engineering Design Optimization, Inc., Santa Barbara, California, 1985.
9. MIL-A-87221 (USAF), 28 February 1985, General Specification for Aircraft Structures.

10. MIL-A-008860A (USAF), General Specification for Airplane Strength and Rigidity, 31 March 1971.
11. MIL-A-008861A (USAF), Airplane Strength and Rigidity Flight Loads, 31 March 1971.
12. MIL-A-008862A (USAF), Airplane Strength and Rigidity Landing and Ground Handling Loads, 31 March 1971.
13. MIL-A-008870A (USAF), Airplane Strength and Rigidity Flutter, Divergence, and Other Aeroelastic Instabilities, 31 March 1971.

A P P E N D I X A

ASTROS FULL-VEHICLE MODEL DEVELOPMENT
AND CHECK RUN HISTORY


```

DATES      FILE NAME  DESCRIPTION
-----
12-29 JUNE  AA2EN      ANALYZE ONLY
            AA2BN2

STRUCTURE:
Fuselage, wing with spars perpendicular to centerline,
pod, canard (spindle only), and vertical (mass only).
Fuselage & Pod: All 2024 aluminum,
                .05 thick skins
                .10 area longerons

Wing: Composite
    specified by SHAPE type DESVARS (design variables)
        Ribs and Spars .07 fabric all 45's
        4 ply directions 0/+45/90 for:
            Skins .32 --> .04 tapered thickness
                root    tip
                quasi isotropic initially
        Leading edge & Aileron .08 constant thickness
                63 / 25 / 12 percentages initially

Non-Structural Mass: CONM2 elements to reflect all
parts of the aircraft not included in the
structure. Non-structural mass of
57 slinches * 386lb/slinch = 22000lb whole vehicle

STEADY AERODYNAMICS:
Wing, canard, and fuselage (no vertical or pod)
    span chord
    Wing: 10 x 10 = 100 aero panels
    Canard: 8 x 7 = 56
    Fuselage: 256 aero panels
        station circumference
        Fwd      8 x 8 = 64
        Mid(fwd) 4 x 16 = 64
        Mid(aft) 2 x 17 = 34
        Aft      6 x 10 = 60

Connection of Aerodynamics to Structure:
3 SPLINEs connect the aero to wing structure lower skin
nodes: one inboard of the aileron, on forward of the
aileron, and one on the aileron. ATTACHs connect the aero
model of the canard to the spindle tip node. Each macro
aero element on the fuselage connects via ATTACHs to a
single GRID point. Because the transfer of load includes
moments, these points must have rotational (bending)
stiffness. Since designed QUADS/TRIAs do not have
bending stiffness, only grid points with BARS attached
were suitable. The scarcity of bending elements in the
structure dictated the choice for ATTACHing aero to
structure. In the Fwd Fuselage many stability BARS
were available; the Mid Fuselage only has the canard
spindle bars; and the Aft Fuselage has the engine mount
bars.

```

DATES	FILE NAME	DESCRIPTION
-------	-----------	-------------

AA2BN

*** Deleted orthogonality equations from the aero equations for reasonable computation times (2 hours to decompose stiffness matrix vs. >40). This destroys the physical relevance of the trim angle of attack and the flexible stability derivatives. ***

LOADS: All are ultimate = 1.5 * limit.

Static:

Nose landing gear impact

Main landing gear impact

conditions at 18 ft/sec sink rate (limit).

Steady aerodynamic:

Mach No.	Altitude	Load Factor (limit)
----------	----------	---------------------

0.7	Sea Level	9 G's
-----	-----------	-------

0.7	Sea Level	-3
-----	-----------	----

1.5	Sea Level	9
-----	-----------	---

RESULTS:

Supersonic Steady Aerodynamics: is broken; calculates excessively high internal loads.

Subsonic Steady Aeroelasticity:

Trim: M .7 S.L.

	Rigid	Flexible
--	-------	----------

Nz	13.5 G's	13.5 G's	
Alpha	17.65	?	(degrees angle of attack)
Delta	54.56	?	(degrees canard deflection)

Nz	1.0	1.0
Alpha	-0.39	?
Delta	15.66	?

Nz	-4.5	-4.5
Alpha	-8.33	?
Delta	-1.46	?

Displacements and internal loads values appeared to be within acceptable limits.

SPC and MPC Forces (by special subroutines, non-standard ASTROS)

MPC forces show the interface loads from structure to structure, such as the wing to fuselage and forward fuselage to center fuselage, etc.

DATES	FILE NAME	DESCRIPTION
	AA2BN	COMMENTS: Steady aeroelastic results, even for rigid airframe, show that the configuration does not have enough canard lift/effectiveness to trim for reasonable drag at 1 G straight and level flight.
29 JUNE	AA2C	ANALYZE ONLY STRUCTURE: Same as AA2BN STEADY & UNSTEADY AERODYNAMICS: not used. LOADS: Static: One load case only, rigid aerodynamic load corresponding to $N_z = 9$ G's (limit) * 1.5 from REVWING at M 1.5 RESULTS: Internal Loads: significantly higher than for the aeroelastically corrected values from SAERO in AA2BN above for $N_z = 9$.
6-11 JULY	O2D	OPTIMIZE AND ANALYZE STRUCTURE: Similar to AA2BN, with modifications. Fuselage and pod- changed to composite, non-wing carry through BHDs and skins thickness of .10 with all 45 degree fabric; wing carry though BHDs typically .45 thick; longerons changed to composite with 60% 0 degree orientation at 0.15 sq. in. area. Added SHAPE type DESVARs to fuselage and pod structures, generated by the SHAPEGEN function available within ASTROS version 1.0, as updated to work with version 3.0. Essentially all of the structure is assigned to DESVARs. OPTIMIZATION parameters: density of composite material increased by 50% to allow for non-optimum use of materials. CONSTRAINTS: Strain constraints corresponding to 180F notched allowables. Minimum gages - .010 each ply direction in wing skins. .040 total thickness for all other quads/triangles. .12 area for longeron rods. Note: no general or panel buckling constraints in ASTROS. Deflection constraints available but not used.

DATES	FILE NAME	DESCRIPTION																																								
	O2D	LOADS: 3 static loads. Rigid airloads from REVWING as in AA2C above. NLG and MLG landing impact cases. RESULTS: Optimization convergence in 9 iterations. Time(hrs) 53.6 CPU 61.3 elapsed (lbm-sec**2/in = 'slinch' 1 slinch = 386 lb) Weight & Mass for 1/2 aircraft <table border="1"> <thead> <tr> <th>lb</th> <th>slinch</th> <th></th> </tr> </thead> <tbody> <tr> <td>1409</td> <td>3.65</td> <td>Designed (structure, 5.17 slinch initial)</td> </tr> <tr> <td>11000</td> <td>28.52</td> <td>Non-designed (non-structure)</td> </tr> <tr> <td>12409</td> <td>32.17</td> <td>Total</td> </tr> </tbody> </table>	lb	slinch		1409	3.65	Designed (structure, 5.17 slinch initial)	11000	28.52	Non-designed (non-structure)	12409	32.17	Total																												
lb	slinch																																									
1409	3.65	Designed (structure, 5.17 slinch initial)																																								
11000	28.52	Non-designed (non-structure)																																								
12409	32.17	Total																																								
21-26 JULY	O2E	OPTIMIZE AND ANALYZE STRUCTURE and OPTIMIZATION parameters: Same as O2D LOADS: 2 static loads: NLG and MLG landing impact case. 2 Steady Aeroelastic loads: M .7 9 G's limit M .7 -3 G's limit RESULTS: Optimization convergence in 9 iterations. Time(hrs) 44.0 CPU 54.3 elapsed Weight & Mass for 1/2 aircraft <table border="1"> <thead> <tr> <th>lb</th> <th>slinch</th> <th></th> </tr> </thead> <tbody> <tr> <td>1834</td> <td>4.75</td> <td>Designed (structure, 5.19 slinch initial)</td> </tr> <tr> <td>11006</td> <td>28.52</td> <td>Non-designed (non-structure)</td> </tr> <tr> <td>12840</td> <td>33.26</td> <td>Total</td> </tr> </tbody> </table> Subsonic Steady Aeroelasticity: Trim: M .7 S.L. <table border="1"> <thead> <tr> <th></th> <th>Rigid</th> <th>Flexible</th> <th></th> </tr> </thead> <tbody> <tr> <td>Nz</td> <td>13.5 G's</td> <td>13.5 G's</td> <td></td> </tr> <tr> <td>Alpha</td> <td>25.22</td> <td>?</td> <td>(degrees angle of attack)</td> </tr> <tr> <td>Delta</td> <td>55.67</td> <td>?</td> <td>(degrees canard deflection)</td> </tr> <tr> <td>Nz</td> <td>-4.5</td> <td>-4.5</td> <td></td> </tr> <tr> <td>Alpha</td> <td>-10.55</td> <td>?</td> <td></td> </tr> <tr> <td>Delta</td> <td>-1.09</td> <td>?</td> <td></td> </tr> </tbody> </table>	lb	slinch		1834	4.75	Designed (structure, 5.19 slinch initial)	11006	28.52	Non-designed (non-structure)	12840	33.26	Total		Rigid	Flexible		Nz	13.5 G's	13.5 G's		Alpha	25.22	?	(degrees angle of attack)	Delta	55.67	?	(degrees canard deflection)	Nz	-4.5	-4.5		Alpha	-10.55	?		Delta	-1.09	?	
lb	slinch																																									
1834	4.75	Designed (structure, 5.19 slinch initial)																																								
11006	28.52	Non-designed (non-structure)																																								
12840	33.26	Total																																								
	Rigid	Flexible																																								
Nz	13.5 G's	13.5 G's																																								
Alpha	25.22	?	(degrees angle of attack)																																							
Delta	55.67	?	(degrees canard deflection)																																							
Nz	-4.5	-4.5																																								
Alpha	-10.55	?																																								
Delta	-1.09	?																																								

DATES	FILE NAME	DESCRIPTION
	O2E	COMMENTS: Problems with the ATTACH cards that transfer loads from the aerodynamic model to the structure model: over loading the structure locally, inducing high stresses and hence heavy structure. These high local stresses were not anticipated and cannot be accommodated without severe weight impact. e.g. BHD228 thick = 2.75 in. We need the beam spline for the fuselage (part of the ASTROS enhancement package currently under development). Still no flexible trim.
01-04 AUG	O2F	OPTIMIZE AND ANALYZE STRUCTURE and OPTIMIZATION parameters: Similar to O2E. Added coordinate systems to define material orientation in composite elements. (Local x of the material - 0 degrees on PCOMP - is aligned with the x direction of the coordinate system called for on the element card. System 1 X aft Y right Z up (basic system) Wing skins/ribs and fuselage skins System 2 X right Y aft Z up Wing spars and BHDs Added composite material with quasi isotropic properties for use in top and bottom skins of fuselage, floors, and BHDs. Side skins, spars, and ribs remain all +-45 fabric Starting DESVARS values were set equal to the final values of the O2E run. Adjusted thickness of TRIA3 2248 in the SHAPE function to 5 times that of the rest of the elements on BHD228 to allow local thickness to respond to local high loads. Added SHAPE 2503 for fwd fuselage longeron which was inadvertently omitted from previous runs. LOADS: 2 static loads: NLG and MLG landing impact case. 2 Steady Aeroelastic loads: M .7 9 G's limit M .7 -3 G's limit

DATES	FILE NAME	DESCRIPTION
	O2F	RESULTS:
Time(hrs)		Optimization convergence in 7 iterations.
44.2 CPU		
61.1 elapsed		
		Weight & Mass for 1/2 aircraft
		lb slinch
		1278 3.31 Designed (structure, 3.29 slinch initial)
		11006 28.52 Non-designed (fixed, non-structure)
		12280 31.82 Total
		Subsonic Steady Aeroelasticity:
		Trim: M .7 S.L.
		Rigid Flexible
		Nz 13.5 G's 13.5 G's
		Alpha 22.72 ? (degrees angle of attack)
		Delta 50.90 ? (degrees canard deflection)
		Nz -4.5 -4.5
		Alpha -9.71 ?
		Delta -0.77 ?
		COMMENTS:
		Still have problems with the ATTACH cards transferring loads from the aerodynamic model to the structure model.
		Still no flexible trim.
11-21 AUG	O2G	OPTIMIZE AND ANALYZE
		STRUCTURE and OPTIMIZATION parameters:
		Similar to O2F, set NRFAC = .62 to limit number of retained constraints to about 100.
		SPC set added to eliminate SUPORT cards which do no work with generalized dynamic reduction.
		STEADY AERODYNAMICS: Fixed the flexible trim parameter calculations with new ASTROS MAPOL executive sequence which rearranged the aerodynamic equations resulting in acceptable decomposition times without deleteint the orthogonality conditions as discussed in AA2BN run.
		Changed to 8 ATTACHs on Fwd Fuselage to spread aero load over 8 GRIDS instead of 1.

DATE	FILE NAME	DESCRIPTION															
02G		UNSTEADY AERODYNAMICS: Flutter considered. Supersonic body elements are not available in Unsteady Aerodynamics, so the lifting surfaces are extended to the vehicle centerline to approximate their effect. span chord Wing: 10 x 10 = 100 aero panels Canard: 8 x 7 = 56 (No vertical, not considered critical for preliminary design where only symmetric conditions are included.) Similar SPLINES and ATTACHs as found in steady aero. EIGENSOLUTION: Generalized Dynamic Reduction (GDR) was used to solve for the subspace corresponding to frequencies below 15 Hz. Givens factorization yielded the actual frequencies and mode shapes for 12 modes, including 3 rigid body modes (pitch, plunge, and fore/aft directions.) LOADS: 2 static loads: NLG and MLG landing impact case. 2 Steady Aeroelastic loads: M .7 9 G's limit M .7 -3 G's limit FLUTTER: M 1.5 at sea level, constraint is damping <= 0. at 20080 in/sec velocity (M 1.5). Delete 3 rigid body modes from flutter analysis. RESULTS: Optimization no convergence in 16 iterations (maxiter). ***** Flutter: Final iteration still had damping > 0. at 20080 in/sec. <table border="1"> <thead> <tr> <th>Mode</th> <th>Damping</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2.06%</td> </tr> <tr> <td>2</td> <td>.43%</td> </tr> </tbody> </table> Weight & Mass for 1/2 aircraft lb slinch <table border="1"> <tbody> <tr> <td>1722</td> <td>4.46</td> <td>Designed (structure, 3.29 slinch initial)</td> </tr> <tr> <td>11006</td> <td>28.51</td> <td>Non-designed (fixed, non-structure)</td> </tr> <tr> <td>12728</td> <td>32.97</td> <td>Total</td> </tr> </tbody> </table>	Mode	Damping	1	2.06%	2	.43%	1722	4.46	Designed (structure, 3.29 slinch initial)	11006	28.51	Non-designed (fixed, non-structure)	12728	32.97	Total
Mode	Damping																
1	2.06%																
2	.43%																
1722	4.46	Designed (structure, 3.29 slinch initial)															
11006	28.51	Non-designed (fixed, non-structure)															
12728	32.97	Total															

DATES	FILE NAME	DESCRIPTION												
	O2G	Subsonic Steady Aeroelasticity: Trim: M .7 S.L. Rigid Flexible												
		<table><tr><td>Nz</td><td>13.5 G's</td><td>13.5 G's</td><td></td></tr><tr><td>Alpha</td><td>14.39</td><td>13.53</td><td>(degrees angle of attack)</td></tr><tr><td>Delta</td><td>48.22</td><td>60.00</td><td>(degrees canard deflection)</td></tr></table>	Nz	13.5 G's	13.5 G's		Alpha	14.39	13.53	(degrees angle of attack)	Delta	48.22	60.00	(degrees canard deflection)
Nz	13.5 G's	13.5 G's												
Alpha	14.39	13.53	(degrees angle of attack)											
Delta	48.22	60.00	(degrees canard deflection)											
		<table><tr><td>Nz</td><td>1.0</td><td>1.0</td><td></td></tr><tr><td>Alpha</td><td>-.42</td><td>-.45</td><td></td></tr><tr><td>Delta</td><td>15.60</td><td>17.75</td><td></td></tr></table>	Nz	1.0	1.0		Alpha	-.42	-.45		Delta	15.60	17.75	
Nz	1.0	1.0												
Alpha	-.42	-.45												
Delta	15.60	17.75												
		<table><tr><td>Nz</td><td>-4.5</td><td>-4.5</td><td></td></tr><tr><td>Alpha</td><td>-6.94</td><td>-6.60</td><td></td></tr><tr><td>Delta</td><td>1.29</td><td>-0.84</td><td></td></tr></table>	Nz	-4.5	-4.5		Alpha	-6.94	-6.60		Delta	1.29	-0.84	
Nz	-4.5	-4.5												
Alpha	-6.94	-6.60												
Delta	1.29	-0.84												
		COMMENTS:												
		Still have problems with the ATTACH cards transferring loads from the aerodynamic model to the structure model.												
		The dynamic mode shapes where flutter is a problem show large motions at the aft end of the pod; apparently the pod design variables are unable to provide sufficient authority to ASTROS to correct the flutter situation.												
28 AUG -07 SEP	O2H	OPTIMIZE AND ANALYZE												
		STRUCTURE and OPTIMIZATION parameters: Similar to O2G, convert RODs in vertical to BARS to allow lateral motion at the tip of the vertical - the previous models were restrained laterally. Density on the quasi-isotropic composite material MAT8 150 were corrected to include the 1.5 density factor. Added RODs on the top, bottom, and sides of the pod along with 2 DESVARS to allow the optimizer to stiffen the pod horizontally and vertically for flutter benefit. Also added ROD to connect the aft most fuselage frame to the pod to help stiffen it in lateral motion.												
		STEADY AERODYNAMICS: Same as O2G.												
		UNSTEADY AERODYNAMICS: Add vertical fin to model. span chord Vertical: 8 x 7 = 56 aero panels												
		EIGENSOLUTION: Givens executed for 15 modes.												

DATES	FILE NAME	DESCRIPTION
-------	-----------	-------------

O2H

LOADS:

2 static loads:

 NLG and MLG landing impact case.

2 Steady Aeroelastic loads:

 M .7 9 G's limit

 M .7 -3 G's limit

FLUTTER: Similar to O2G, set GFAC to .4 to keep from getting gage thickness less than 0. as a consequence of excessively violated flutter constraints

RESULTS:

Optimization no convergence in 16 iterations (maxiter).

Flutter:

Final iteration still had damping > 0. at 20080 in/sec.

Mode	Damping
------	---------

2	4.0%
---	------

3	3.3%
---	------

4	53.7%
---	-------

Weight & Mass for 1/2 aircraft

lb	slinch
----	--------

1266	3.28	Designed (structure, 3.75 slinch initial)
------	------	---

11006	28.51	Non-designed (fixed, non-structure)
-------	-------	-------------------------------------

12272	31.79	Total
-------	-------	-------

Subsonic Steady Aeroelasticity:

Trim: M .7 S.L.

	Rigid	Flexible
--	-------	----------

Nz	13.5 G's	13.5 G's
----	----------	----------

Alpha	13.24	13.11	(degrees angle of attack)
-------	-------	-------	---------------------------

Delta	53.35	61.62	(degrees canard deflection)
-------	-------	-------	-----------------------------

Nz	1.0	1.0
----	-----	-----

Alpha	-.50	-.31
-------	------	------

Delta	15.95	16.88
-------	-------	-------

Nz	-4.5	-4.5
----	------	------

Alpha	-6.55	-6.62
-------	-------	-------

Delta	-0.50	-2.81
-------	-------	-------

DATES	FILE NAME	DESCRIPTION
	O2H	COMMENTS: Still have problems with the ATTACH cards transferring loads from the aerodynamic model to the structure model. The flutter problem is so severe that the aircraft configuration is now in question. Small improvements can clearly be made, but reducing the 50%+ damping value to zero will require a major structural change.
07 OCT -12 OCT	O2J	OPTIMIZE AND ANALYZE STRUCTURE and OPTIMIZATION parameters: Similar to O2H, changed landing impact load to 28000 lb, changed flutter altitude to 15000 ft because that is the minimum altitude for Mach 1.5 within the flight envelop, corrected (stiffened) the vertical fin to more accurately represent the torque box stiffness in bending and torsion. STEADY AERODYNAMICS: Same as O2H. UNSTEADY AERODYNAMICS: Same as O2H. EIGENSOLUTION: Same as O2H. LOADS: Same as O2H. FLUTTER: Similar to O2H, omitted undamped modes 7 & 11 since they were not influencing the flutter behavior but were interfering with the flutter optimization. RESULTS: Optimization was conducted 1 iteration at a time to allow adjusting parameters between iterations to fine tune the optimization process. After adding 35% weight in 3 iterations the optimizer was unable to find a feasible direction to move the design point. Maybe the optimizer is confused.

Time:
Days Hours CPU
3 7.8
5+ elapsed

DATES	FILE NAME	DESCRIPTION																								
O2J		Flutter: Mode 1 is the only one with positive damping. Final iteration still had damping > 0. at 19027 in/sec.																								
		<table border="1"> <thead> <tr> <th>Mode</th> <th>Damping</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>3.1%</td> </tr> </tbody> </table>	Mode	Damping	1	3.1%																				
Mode	Damping																									
1	3.1%																									
		Weight & Mass for 1/2 aircraft																								
		lb slinch																								
		<table border="1"> <tbody> <tr> <td>2007</td> <td>5.18</td> <td>Designed (structure, 3.75 slinch initial)</td> </tr> <tr> <td>11006</td> <td>28.51</td> <td>Non-designed (fixed, non-structure)</td> </tr> <tr> <td>13013</td> <td>33.67</td> <td>Total</td> </tr> </tbody> </table>	2007	5.18	Designed (structure, 3.75 slinch initial)	11006	28.51	Non-designed (fixed, non-structure)	13013	33.67	Total															
2007	5.18	Designed (structure, 3.75 slinch initial)																								
11006	28.51	Non-designed (fixed, non-structure)																								
13013	33.67	Total																								
		Subsonic Steady Aeroelasticity:																								
		Trim: M .7 S.L.																								
		Rigid Flexible																								
		<table border="1"> <tbody> <tr> <td>Nz</td> <td>13.5 G's</td> <td>13.5 G's</td> <td></td> </tr> <tr> <td>Alpha</td> <td>14.51</td> <td>14.71</td> <td>(degrees angle of attack)</td> </tr> <tr> <td>Delta</td> <td>50.29</td> <td>53.77</td> <td>(degrees canard deflection)</td> </tr> <tr> <td>Nz</td> <td>-4.5</td> <td>-4.5</td> <td></td> </tr> <tr> <td>Alpha</td> <td>-6.98</td> <td>-6.94</td> <td></td> </tr> <tr> <td>Delta</td> <td>0.55</td> <td>-0.58</td> <td></td> </tr> </tbody> </table>	Nz	13.5 G's	13.5 G's		Alpha	14.51	14.71	(degrees angle of attack)	Delta	50.29	53.77	(degrees canard deflection)	Nz	-4.5	-4.5		Alpha	-6.98	-6.94		Delta	0.55	-0.58	
Nz	13.5 G's	13.5 G's																								
Alpha	14.51	14.71	(degrees angle of attack)																							
Delta	50.29	53.77	(degrees canard deflection)																							
Nz	-4.5	-4.5																								
Alpha	-6.98	-6.94																								
Delta	0.55	-0.58																								

COMMENTS:

Still have problems with the ATTACH cards transferring loads from the aerodynamic model to the structure model.

The flutter problem helped uncover the software error in the flutter sensitivity spill logic. Correction of the logic did not help in eliminating mode 1 flutter from the N382-20. Some excessively flexible locations in the fuselage were uncovered in the mode shapes.

DATES	FILE NAME	DESCRIPTION
-------	-----------	-------------

13 OCT	O2K	OPTIMIZE AND ANALYZE
-25 OCT		

STRUCTURE and OPTIMIZATION parameters:
 Similar to O2J, deepened the fuselage frames at stations 520 and 648 and stiffened the forward fuselage upper longeron in lateral bending to correct the low frequency mode shapes.

STEADY AERODYNAMICS: Was omitted from the early iterations to avoid confusing the optimizer.

UNSTEADY AERODYNAMICS: Same as O2J.

EIGENSOLUTION: Same as O2J.

LOADS: Took out SAERO put the rigid air loads from REVWING back in.

FLUTTER: Similar to O2J, omitted undamped modes 9 & 10 since they were not influencing the flutter behavior but were interfering with the flutter optimization.

Time:	RESULTS: This version was also run 1 iteration at a time.
4hrs/iteration	The runs have not finished yet, but microDOT parameter
(flutter only)	changes appear to resolve the search direction
	difficulties.

A P P E N D I X B

WEIGHT AND BALANCE SPREAD SHEETS FOR
NON-STRUCTURAL MASS OF ASTROS MODEL

DESCRIPTION	weight	KLS	ACTUAL	SHIFT	WT*X(KLS)	WT*X(ACL)	NODES	WT/NODE	STA	NODES	WT RECON	SLIN/NODE	SLIN/STA	WT*STA	WT*STA	SUM WT
		X(IN)	STA X(IN)	50.0	X IN-IB	X IN-IB								INPUT	INPUT	INPUT
RADOME	123	105	155		1.292E+4	1.907E+4	9	13.67	175.00	2001-2009	123.03	0.0177	0.1594	21530	19065	123
NLG (UP)	115	171	221		1.967E+4	2.542E+4	1	55.00	194.88	2057-	55.00	0.0712	0.0712	10718	25415	238
NLG (DOWN)		146	196									0.0000	0.0000			
TOW BAR (FUR)	5	195	245		9.750E+2	1.225E+3	1	65.00	245.00	2140-	65.00	0.0842	0.0842	15925	1225	243
AVIONICS	0	155	205		0.000E+0	0.000E+0					0.00	0.0000	0.0000	0	0	243
INSTRUMENTS	90	205	255		1.845E+4	2.295E+4	1	90.00	255.08	2165-	90.00	0.1166	0.1166	22957	22950	333
CANOPY/WING	240	227	277		5.448E+4	6.648E+4	1	24.00	215.00	2089-	24.00	0.0311	0.0311	5160	66480	573
							1	24.00	210.00	2090-	24.00	0.0311	0.0311	5040	0	573
							1	24.00	228.40	2109-	24.00	0.0311	0.0311	5482	0	573
							1	24.00	245.00	2139-	24.00	0.0311	0.0311	5880	0	573
							1	24.00	255.08	2159-	24.00	0.0311	0.0311	6122	0	573
							1	24.00	268.75	2178-	24.00	0.0311	0.0311	6450	0	573
							1	24.00	282.23	2198-	24.00	0.0311	0.0311	6774	0	573
							1	24.00	299.00	2216-	24.00	0.0311	0.0311	7176	0	573
							1	24.00	305.00	2228-	24.00	0.0311	0.0311	7320	0	573
							1	24.00	330.00	2248-	24.00	0.0311	0.0311	7920	0	573
CREW	230	227	277		5.221E+4	6.371E+4	3	76.67	268.75	2182-3-4	230.01	0.0993	0.2979	61815	63710	803
FURNISH-SEAT	230	227	277		5.221E+4	6.371E+4	3	76.67	282.23	2202-3-4	230.00	0.0993	0.2979	64913	63710	1033
											0.00	0.0000	0.0000	0	0	1033
FURN/ARM-46	0	240	290		0.000E+0	0.000E+0					0.00	0.0000	0.0000	0	0	1033
NOZZLE CNTL	436	260	310		1.134E+5	1.352E+5	3	204.70	305.00	2224-5-6	614.10	0.2652	0.7955	187301	135160	1469
RALS NOZZLE	178	260	310		4.628E+4	5.518E+4					0.00	0.0000	0.0000	0	55180	1647
RALS DUCT B	100	320	370		3.200E+4	3.700E+4	3	13.30	330.00	3018-20-26	39.90	0.0172	0.0517	13167	37000	1747
RALS DUCTS	100	320	370		3.200E+4	3.700E+4	3	13.30	360.00	3108-10-13	39.90	0.0172	0.0517	14364	37000	1847
							3	13.30	390.00	3179-81-84	39.90	0.0172	0.0517	15561	0	1847
							3	13.30	420.00	3225-27-30	39.90	0.0172	0.0517	16758	0	1847
							3	13.30	454.00	3268-72-74	39.90	0.0172	0.0517	18115	0	1847
FUS FUEL	5412	340	390		1.840E+6	2.111E+6					0.0000	0.0000	0.0000	0	2110680	7259
AIR INDUCTOR	694	350	400		2.429E+5	2.776E+5	1	0.00	400.00		0.00	0.0000	0.0000	0	277600	7953
CANARD	319	319	369		1.018E+5	1.177E+5	1	319.00	369.00	3138-	319.00	0.4132	0.4132	117711	117711	8272
GUN SYSTEM	602	355	405		2.137E+5	2.438E+5	1	186.00	365.00	3132-	186.00	0.2409	0.2409	67890	243810	8874
GUN BAY-FUR	88	355	405		3.124E+4	3.564E+4	1	504.00	420.00	3217-	504.00	0.6528	0.6528	211680	35640	8962
MISSILE	934	370	420		3.456E+5	3.923E+5	2	369.50	360.00	3091-2	739.00	0.4786	0.9573	266040	392280	9896
MSL SUSP EC	300	370	420		1.110E+5	1.260E+5	2	369.50	474.50	3291-2	739.00	0.4786	0.9573	350656	126000	10196
WEAPONS PAL	100	370	420		3.700E+4	4.200E+4					0.00	0.0000	0.0000	0	42000	10296
MSL ARMING	144	370	420		5.328E+4	6.048E+4					0.00	0.0000	0.0000	0	60480	10440
FUSELAGE	2636	380	430		1.002E+6	1.133E+6	1	0.00	430.00		0.00	0.0000	0.0000	0	1133480	13076
AMMO	278	382	432		1.062E+5	1.201E+5	1	0.00	432.00		0.00	0.0000	0.0000	0	120096	13354
ELECTRICAL	220	400	450		8.800E+4	9.900E+4	1	191.00	201.50	2075-	191.00	0.2474	0.2474	38487	99000	13574
HYDR & PNEU	123	400	450		4.920E+4	5.535E+4	1	152.00	648.50	4165-	152.00	0.1969	0.1969	98572	55350	13697
FLIGHT CNTL	521	420	470		2.188E+5	2.449E+5	1	40.00	245.00	2141-	40.00	0.0518	0.0518	9800	244870	14218
							1	160.00	268.75	2180-	160.00	0.2073	0.2073	43000	0	14218
							1	160.00	581.00	4105-	160.00	0.2073	0.2073	92960	0	14218
							1	161.00	637.00	1115-	161.00	0.2085	0.2085	102557	0	14218
SCROLL	338	430	480		1.453E+5	1.622E+5	1	224.00	454.00	3270-	224.00	0.2902	0.2902	101696	162240	14556
							1	114.00	531.00	4058-	114.00	0.1477	0.1477	60534	0	14556
FUEL SYSTEM	347	440	490		1.527E+5	1.700E+5	1	174.00	330.00	3013-	174.00	0.2254	0.2254	57420	170030	14903
							1	173.00	640.00	1135-	173.00	0.2241	0.2241	110720	0	14903
ENG ACCESSO	340	460	510		1.564E+5	1.734E+5	3	94.30	495.50	4014-5-8	282.90	0.1222	0.3665	140177	173400	15243

AVIONICS				0.902	FACTOR		NODES	WT/NODE	STA		slin/node	slin/sta		
ESA RADAR	131	118	168.00	118.2			2	59.10	175.00	2015-2021	0.0766	0.1531	2.069E+4	2.069E+4
laser track etc							2	49.40	175.00	2012-2013	0.0640	0.1280	1.729E+4	3.798E+4
LASER TRACK	72	130	180.00	64.9			2	24.60	188.25	2057-2058	0.0319	0.0637	9.262E+3	4.724E+4
RF EQUIP	114	140	190.00	102.8			2	10.00	194.88	2044-2045	0.0130	0.0259	3.898E+3	5.113E+4
CNTL/DISPL	72	200	250.00	64.9			1	32.50	245.00	2145-	0.0421	0.0421	7.963E+3	5.910E+4
							1	32.50	255.08	2165-	0.0421	0.0421	8.290E+3	6.739E+4
VENTRAL ANT	22	370	420.00	19.8			1	19.80	420.00	3191-	0.0256	0.0256	8.316E+3	7.570E+4
DORSAL ANTE	33	450	500.00	29.8			1	35.20	495.50	3341-	0.0456	0.0456	1.744E+4	9.314E+4
LPI ALTIMETE	6	450	500.00	5.4			0	0.00	495.50	-	0.0000	0.0000	0.000E+0	9.314E+4
PAVE PILLAR	396	660	710.00	357.2			3	137.56	695.00	5122-26-31	0.1782	0.5346	2.868E+5	3.800E+5
PAVE PILLAR	336	660	710.00	303.1			3	82.54	735.00	5142-46-51	0.1059	0.3208	1.820E+5	5.620E+5
ECM DISP/SEN	101	700	750.00	91.1			1	56.85	751.00	5171-	0.0736	0.0736	4.269E+4	6.047E+5
CHAFF	25	700	750.00	22.6			1	56.85	751.00	5172-	0.0736	0.0736	4.269E+4	6.473E+5
SUM(UNFCTR)	1308		SUM(FCTR)	1179.8	SUM(LB)							1.5288	6.473E+5	
				3.0565	SLIN TOTAL	548.615	OG							
RUELAJE FUE	6332			1.5283	SLIN 1/2									
POD FUEL	-920													
NET FUS FUEL	5412													
AMMO-ADD TO	278													
RUELAJE FUE	5890	350	400.00		3.990E-2									
STA	LENGTH	WIDTH	DEPTH	VOL	WT	WT*STA	NODES	WT/NODE			slin/node	slin/sta		
330	15	19.35	55.00	15964	638.9	2.102E+5	4	159.2	330.0	3012-13-14-	0.2053	0.9250	2.102E+5	
360	30	20.80	55.00	34320	1369.3	4.930E+5	4	342.3	360.0	3102-3-4-98	0.4434	1.7737	4.930E+5	
390	30	24.08	55.00	39732	1585.3	6.183E+5	4	396.3	390.0	3157-8-9-45	0.5134	2.0534	6.183E+5	
390	15	4.11	33.00	2034	81.2	3.166E+4	2	40.6	390.0	3162-3147	0.0526	0.1051	3.166E+4	
420	32	16.74	55.00	29462	1175.5	4.937E+5	3	391.8	420.0	3206-07-08	0.5076	1.5227	4.937E+5	
420	32	8.20	33.00	8659	345.5	1.451E+5	2	172.7	420.0	3214-3197	0.2238	0.4475	1.451E+5	
454	17	4.97	55.00	4647	185.4	8.417E+4	2	92.7	454.0	3254-3255	0.1201	0.2402	8.417E+4	
454	17	13.89	33.00	7792	310.9	1.411E+5	2	155.5	454.0	3258-3246	0.2014	0.4027	1.411E+5	
				142611	5690	2.217E+6						7.3705	2.217E+6	
					14.7409	389.67								
					7.3705									

A P P E N D I X C

COMPLETE ASTROS INPUT DATA FILE

ASSIGN DATABASE 02K KIMBERLY NEW

DEBUG

LOGBEGIN

SOLUTION

\$

TITLE - N382 STOVL FUS/WING2/POD STRUC // WING CANARD FUSELAGE AERO (02K)

SUBTITLE - RH HALF MODEL SPARS PERPENDICULAR TO CENTERLINE - CANARD 24IN FWD

\$

OPTIMIZE STRATEGY - MP, NRFAC - 0.62, MAXITER - 1

\$

BOUNDARY SPC = 9910, MPC = 5510, DYNRED = 440, METHOD = 441

PRINT ROOT = 455, DISP = 997, MODES = 448, DESIGN, DCON

MODES

LABEL = MODAL ANALYSIS

FLUTTER (FLCOND = 102, DCON = 100)

LABEL = FLUTTER M = 1.5 15000 FT ADD VERTICAL AERO BARS ON PODS

\$

BOUNDARY SPC = 5510, MPC = 5510, SUPPORT = 10

PRINT DISP = 997, ACCE = 995, DCON, DESIGN, TRIM

\$

STATICS (MECH = 28000)

LABEL = NOSE GEAR LANDING IMPACT 8.51G'S ULT 28331 LB

STATICS (MECH = 74000)

LABEL = MAIN GEAR LANDING IMPACT 6.91G'S ULT 73758 LB

\$

SAERO (TRIM = 70)

LABEL = MACH .7 SL 13.5G SYMM

SAERO (TRIM = 74)

LABEL = MACH .7 SL -4.5G SYMM

\$

END

\$

ANALYZE

BOUNDARY SPC = 5510, MPC = 5510, SUPPORT = 10

PRINT DISP = 997, ACCE = 995, FORC = ALL, SPCF = ALL, TRIM, LOAD = ALL

\$

STATICS (MECH = 28000)

LABEL = NOSE GEAR LANDING IMPACT 8.51G'S ULT 28331 LB

STATICS (MECH = 74000)

LABEL = MAIN GEAR LANDING IMPACT 6.91G'S ULT 73758 LB

\$

SAERO (TRIM = 70)

LABEL = MACH .7 SL 13.5G SYMM

SAERO (TRIM = 71)

LABEL = MACH .7 SL 1.0G SYMM

SAERO (TRIM = 74)

LABEL = MACH .7 SL -4.5G SYMM

\$

BOUNDARY SPC = 9910, MPC = 5510, DYNRED = 440, METHOD = 441

PRINT ROOT = 455, DISP = 997, MODES = 448, DESIGN, DCON

MODES

LABEL = MODAL ANALYSIS

FLUTTER (FLCOND = 100)

```

LABEL - FLUTTER M - 1.5 15000 FT ADD VERTICAL AERO BARS ON PODS
$
END
BEGIN BULK
$-----2-----3-----4-----5-----6-----7-----8-----9-----
$
$
$ BOUNDARY SPC = 5510, MPC = 5510, SUPPORT = 10
$ PRINT TRIM, DISP = 997, FORC = ALL, ACCE = 995, SPCF = ALL
$ SAERO ( TRIM = 150 )
$ LABEL = MACH 1.5 SL 13.5G SYMM
$
$ STATICS ( MECH = 13 )
$ PRINT DISP = 997, FORC = ALL, SPCF = ALL, LOAD = ALL
$ LABEL = M 1.2 SEA LEVEL SYMM PULL UP 13G.S=12G.S * 1.125 FROM REVWING
$
$ BOUNDARY SPC = 11, MPC = 5511, SUPPORT = 11, REDUCE=11
$ SAERO ( TRIM = 444, DCON = 444 )
$ PRINT DCON, TRIM, DISP = 998
$
$:CORD2R-CID---RID-----A1-----A2-----A3-----B1-----B2-----B3-----
$
$ CORD 1 CORD SYSTEM FOR MAT SYSTEM ON FUSELAGE SKINS, WING RIBS
$ LOCAL X - AFT (PARALLEL TO BASIC SYSTEM)
CORD2R 1 0. 0. 0. 0. 0.0 1.0 +CORD1
+CORD1 1. 0. 0.
$
$ CORD 2 CORD SYSTEM FOR WING SKINS & SPARS, FUSELAGE BHDS/FRMS
$ LOCAL X - INBD/OUTBD (BASIC Y)
CORD2R 2 0. 0. 0. 0. 0.0 1.0 +CORD2
+CORD2 0. 1. 0.
$
$ CORD 45 CORD SYSTEM FOR LEADING EDGE SKIN
$ LOCAL X - 45 DEGRS AFT FROM HORIZONTAL TO RIGHT
CORD2R 45 0. 0. 0. 0. 0.0 1.0 +CORD45
+CORD45 0.707 0.707 0.
$
$ --- MATERIAL CARDS COLLECTED TOGETHER
$ --- FOR ALL FUSELAGE / WING / POD SEGMENTS
$
$:MAT8--MID-----E1-----E2-----NU12---G12---G1Z---G2Z---RHO-----+
$
$ --- GRAPHITE PROPERTIES UNI NOMINAL ULW MATL IM7/PEEK PER H.R.ZAMANI 89/5/31
$ --- 180F PROPERTIES - NOTCHED ALLOWABLES - DENSITY = 1.5* NOMINAL
$
$MAT8 50 21.50E6 1.3E6 .35 0.510E6 .51E6 .51E6 .148-3 +M50
MAT8 50 21.50E6 1.3E6 .35 0.510E6 .51E6 .51E6 .225-3 +M50
+M50 .33-6 16.-6 70. 5800. 4200. 5800. 10000. 13100.
$:+MAT8-A1-----A2-----TREF---STX---SCX---STY---SCY---TAU-----+
$
$ --- GRAPHITE PROPERTIES 133 STYLE FABRIC (APPROX PROP'S FOR IM7/PEEK)
$
$MAT8 133 10.50+6 10.50+6 .05 0.510E6 .51E6 .51E6 .148-3 +M133
MAT8 133 10.50+6 10.50+6 .05 0.510E6 .51E6 .51E6 .225-3 +M133

```

```

+M133          70.      5800.   4200.   5800.   4200.  13100.
$
$ --- KEVLAR 49      PROPERTIES UNI   UNNOTCHED
$
$MAT8      49      9.900E6 .72E6   .34      0.270E6 .27E6   .27E6   .124-3 +M49
MAT8      49      9.900E6 .72E6   .34      0.270E6 .27E6   .27E6   .186-3 +M49
+M49
16160.   3230.   5340.  22230.  25770.
$
$ --- KEVLAR 49      PROPERTIES 120 STYLE CLOTH
$
$MAT8      120      4.05+6 4.05+6   .10      0.270E6 .27E6   .27E6   .124-3 +M120
MAT8      120      4.05+6 4.05+6   .10      0.270E6 .27E6   .27E6   .186-3 +M120
+M120
14800.   4500.  14800.   4500.  20400.
$
$ --- AS4/BMI 375DEG F
MAT8      5250      18.65+6 1.15+6   .32      .37+6   .37+6   .37+6   .148-3 +M5250
+M5250      -2.-6   12.1-6   70.
$
$
$:MAT1--MID-----E-----G-----NU-----RHO-----A-----TREF----GE-----
$ --- MAT 150
$ --- QUASI ISO APPROX FOR IM7-PEEK
$
$MAT1      150      7.30+6           .3      .148-3 2.-6   70.      +M150
MAT1      150      7.30+6           .3      .225-3 2.-6   70.      +M150
+M150      42000.  31000.  20000.
$
$ --- MAT 409 IS FOR RODS - DESIGNED GRAPHITE COMPOSITE
$ --- NOMINAL MCDULUS/STRENGTHS
$MAT1      409      15.0+6           0.33   .148-3 2.-6   70.      +M409
MAT1      409      15.0+6           0.33   .225-3 2.-6   70.      +M409
+M409      75000.  63000.
$
$ --- NOMINAL ALUMINUM PROPETIES WITH AND WITHOUT MASS DENSITY
$
MAT1      2023      10.4+6           0.33           13.-6   70.
MAT1      2024      10.4+6           0.33   .259-3 13.-6   70.
$
$ --- NOMINAL TITANIUM PROPETIES WITH AND WITHOUT MASS DENSITY
$
MAT1      7163      16.0+6           0.33           5.-6   70.
MAT1      7164      16.0+6           0.33   .400-3 5.-6   70.
$
$ --- NOMINAL STEEL PROPETIES WITH AND WITHOUT MASS DENSITY
$
MAT1      4339      29.0+6           0.33           6.-6   70.
MAT1      4340      29.0+6           0.33   .733-3 6.-6   70.
MAT1      1410      30.0+6           0.33   .733-3 6.-6   70.
$
$ --- PROPERTY CARDS COLLECTED TOGETHER
$ --- FOR ALL FUSELAGE / WING / POD SEGMENTS
$
$:PROD--PID-----MID-----A-----J-----C-----NSM-----TMIN----
$

```

\$ --- PROD 1 IS FOR THE DESIGNED COMPOSITE RODS

\$PROD	1	2024	.1	
PROD	1	409	.15	.12

\$				
PROD	3599	4340	.11	

\$				
\$PROD	4114	2024	.5	.12
PROD	4114	409	.5	.12

\$							
\$:PBAR--PID----	MID-----	A-----	I1-----	I2-----	J-----	NSM-----	TMIN-----
PBAR	71	2023	.3	.62	.62	.62	
PBAR	113	2023	.3	.62	.62		
PBAR	2010	2023	0.	0.05	.05	.05	
PBAR	2710	2023	0.	0.5	2.5	.2	
PBAR	3701	4339	0.5	2.5	2.5	5.	
PBAR	4655	4339	0.3	1.	1.	.1	
PBAR	5411	2023	13.5	100.	600.	30.	

\$							
\$:PSHELL	PID----	MID1----	T-----	MID2----	12I/T**3-	MID3----	TS/T-----
\$							
\$PSHELL	1	2024	0.050				
\$PSHELL	50	2024	0.05				
PSHELL	70	2024	0.07				
PSHELL	80	2024	0.08				
PSHELL	100	2024	0.1				

\$				
\$PQDMEM1	ID----	MID-----	T-----	NSM-----
\$PQDMEM1	50	2024	0.050	
\$				
\$PTRMEM	1	2024	0.050	
\$PTRMEM	50	2024	0.050	

\$							
\$PCOMP--PID----	Z0-----	NSM-----	SB-----	F.T.-----	TMIN-----	GE-----	

\$ --- WING SKINS - ALL UNI - 0/+45/-45/90 4 PLY ORIENTATIONS

\$							
PCOMP	1001				.010		MEM +P1001A
+P1001A	50	.012	0.	YES	50	.012 45.	YES +P1001B
+P1001B	50	.012	-45.	YES	50	.012 90.	YES

\$ --- WING SPARS & RIBS, FUSELAGE SIDE SKINS, DUCTS - 100% 45'S (FABRIC)

\$							
PCOMP	1				.040		MEM +P1
+P1	133	.050	45.	YES			
\$							
PCOMP	50				.040		MEM +P50
+P50	133	.050	45.	YES			
\$							
PCOMP	1002				.040		MEM +P1002A
+P1002A	133	.050	45.	YES			

\$ --- FUSELAGE TOP & BOTTOM SKINS, BHDS, FRAMES, FLOORS - QUASI ISO

\$							
PCOMP	1003				.040		MEM +P1003A

+P1003A 150 .050 0. YES

\$

\$

\$ - - - - -

\$

\$GRIDLIST SID----GID1----GID2----GID3----GID4----GID5----GID6----GID7

GRIDLIST 998 1 THRU 17

GRIDLIST 998 99

GRIDLIST 998 1001 THRU 1017

GRIDLIST 998 1141 THRU 1159

\$

\$GRIDLIST SID----GID1----GID2----GID3----GID4----GID5----GID6----GID7

GRIDLIST 997 99

GRIDLIST 997 1001 THRU 1017

GRIDLIST 997 1141 THRU 1159

GRIDLIST 997 1701 1049 1051 2057 2044 2074

GRIDLIST 997 3120 3133 3138 3149

GRIDLIST 997 4058 4036 4038 4066 4068

GRIDLIST 997 2001 2052 2082 2132 2171 2221

GRIDLIST 997 3001 3091 3141 3191 3241 3291

GRIDLIST 997 4001 4031 4061 4091 4121 4151

GRIDLIST 997 5001 5021 5061 5101 5121 5141 5161

GRIDLIST 997 5133 5153

\$

\$GRIDLIST SID----GID1----GID2----GID3----GID4----GID5----GID6----GID7

GRIDLIST 995 99

GRIDLIST 995 1003 1065 1109 1151

GRIDLIST 995 1013 1075 1115 1155

GRIDLIST 995 2001 2052 2082 2132 2171 2221

GRIDLIST 995 3001 3091 3141 3191 3241 3291

GRIDLIST 995 4001 4031 4061 4091 4121 4151

GRIDLIST 995 5001 5021 5061 5101 5121 5141 5161

\$

\$MODELST SID----GID1----GID2----GID3----GID4----GID5----GID6----GID7

MODELST 440 1 THRU 6

MODELST 446 1 THRU 6

MODELST 447 1 THRU 7

MODELST 448 1 THRU 8

MODELST 455 1 THRU 15

\$

\$ RESEQUENCING DATA FROM MSC/NASTRAN BASED ON ASTROS AA2B MODEL

\$ 08-JUNE-1989

\$

\$SEQGP 2011 10001 2001 10002 2031 10003 2002 10004

\$SEQGP 2003 10005 2012 10006 2013 10007 2004 10008

\$SEQGP 2014 10009 2015 10010 2016 10011 2005 10012

\$SEQGP 2017 10013 2018 10014 2019 10015 2006 10016

\$SEQGP 2042 10017 2043 10018 2032 10019 2033 10020

\$SEQGP 2044 10021 2034 10022 2045 10023 2020 10024

\$SEQGP 2021 10025 2022 10026 2007 10027 2055 10028

\$SEQGP 2056 10029 2057 10030 2052 10031 2053 10032

\$SEQGP 2058 10033 2054 10034 2035 10035 2036 10036

\$SEQGP 2037 10037 2010 10038 2009 10039 2008 10040

\$SEQGP 2038 10041 2039 10042 2040 10043 2041 10044

\$SEQGP	2072	10045	2073	10046	2074	10047	2062	10048
\$SEQGP	2075	10049	2063	10050	2064	10051	2065	10052
\$SEQGP	2066	10053	2067	10054	2068	10055	2069	10056
\$SEQGP	2070	10057	2071	10058	2091	10059	2092	10060
\$SEQGP	2093	10061	2082	10062	2094	10063	2083	10064
\$SEQGP	2084	10065	2085	10066	2086	10067	2087	10068
\$SEQGP	2088	10069	2089	10070	2090	10071	2114	10072
\$SEQGP	2111	10073	2110	10074	2109	10075	2108	10076
\$SEQGP	2125	10077	2117	10078	2123	10079	2124	10080
\$SEQGP	2122	10081	2107	10082	2139	10083	2138	10084
\$SEQGP	2137	10085	2120	10086	2121	10087	2115	10088
\$SEQGP	2116	10089	2118	10090	2119	10091	2106	10092
\$SEQGP	2105	10093	2113	10094	2112	10095	2102	10096
\$SEQGP	2103	10097	2104	10098	2136	10099	2143	10100
\$SEQGP	2135	10101	2159	10102	2158	10103	2157	10104
\$SEQGP	2156	10105	2155	10106	2163	10107	2144	10108
\$SEQGP	2145	10109	2142	10110	2141	10111	2140	10112
\$SEQGP	2134	10113	2132	10114	2133	10115	2162	10116
\$SEQGP	2164	10117	2165	10118	2161	10119	2154	10120
\$SEQGP	2160	10121	2152	10122	2153	10123	2178	10124
\$SEQGP	2177	10125	2176	10126	2175	10127	2184	10128
\$SEQGP	2174	10129	2181	10130	2173	10131	2201	10132
\$SEQGP	2183	10133	2182	10134	2180	10135	2179	10136
\$SEQGP	2172	10137	2171	10138	2200	10139	2199	10140
\$SEQGP	2198	10141	2197	10142	2196	10143	2204	10144
\$SEQGP	2203	10145	2202	10146	2191	10147	2192	10148
\$SEQGP	2193	10149	2194	10150	2195	10151	2208	10152
\$SEQGP	2207	10153	2206	10154	2205	10155	2212	10156
\$SEQGP	2216	10157	2211	10158	2210	10159	2209	10160
\$SEQGP	2215	10161	2214	10162	2213	10163	2221	10164
\$SEQGP	2241	10165	2222	10166	2242	10167	2223	10168
\$SEQGP	2243	10169	2224	10170	2244	10171	2225	10172
\$SEQGP	2245	10173	2226	10174	2246	10175	2227	10176
\$SEQGP	2247	10177	2228	10178	2248	10179	2231	10180
\$SEQGP	2251	10181	2230	10182	2229	10183	2250	10184
\$SEQGP	2249	10185	3001	10186	3002	10187	3003	10188
\$SEQGP	3004	10189	3005	10190	3006	10191	3007	10192
\$SEQGP	3008	10193	3014	10194	3012	10195	3013	10196
\$SEQGP	3091	10197	3092	10198	3093	10199	3094	10200
\$SEQGP	3017	10201	3021	10202	3023	10203	3025	10204
\$SEQGP	3009	10205	3016	10206	3015	10207	3027	10208
\$SEQGP	3028	10209	3010	10210	3011	10211	3102	10212
\$SEQGP	3103	10213	3104	10214	3095	10215	3105	10216
\$SEQGP	3141	10217	3142	10218	3143	10219	3144	10220
\$SEQGP	3018	10221	3019	10222	3020	10223	3022	10224
\$SEQGP	3024	10225	3026	10226	3106	10227	3107	10228
\$SEQGP	3101	10229	3099	10230	3100	10231	3098	10232
\$SEQGP	3096	10233	3097	10234	3110	10235	3109	10236
\$SEQGP	3111	10237	3112	10238	3108	10239	3113	10240
\$SEQGP	3114	10241	3156	10242	3177	10243	3155	10244
\$SEQGP	3154	10245	3184	10246	3183	10247	3182	10248
\$SEQGP	3185	10249	3178	10250	3181	10251	3180	10252
\$SEQGP	3179	10253	3169	10254	3163	10255	3171	10256
\$SEQGP	3170	10257	3164	10258	3165	10259	3157	10260

\$SEQGP	3158	10261	3159	10262	3191	10263	3192	10264
\$SEQGP	3193	10265	3194	10266	3206	10267	3207	10268
\$SEQGP	3241	10269	3242	10270	3243	10271	3244	10272
\$SEQGP	3254	10273	3265	10274	3264	10275	3267	10276
\$SEQGP	3205	10277	3231	10278	3275	10279	3204	10280
\$SEQGP	3203	10281	3230	10282	3274	10283	3229	10284
\$SEQGP	3228	10285	3223	10286	3273	10287	3272	10288
\$SEQGP	3222	10289	3224	10290	3268	10291	3221	10292
\$SEQGP	3225	10293	3269	10294	3226	10295	3227	10296
\$SEQGP	3202	10297	3270	10298	3271	10299	3172	10300
\$SEQGP	3166	10301	3219	10302	3220	10303	3208	10304
\$SEQGP	3211	10305	3153	10306	3253	10307	3252	10308
\$SEQGP	3251	10309	3250	10310	3249	10311	3218	10312
\$SEQGP	3201	10313	3152	10314	3212	10315	3195	10316
\$SEQGP	3145	10317	3255	10318	3256	10319	3266	10320
\$SEQGP	3325	10321	3263	10322	3262	10323	3261	10324
\$SEQGP	3200	10325	3217	10326	3151	10327	3150	10328
\$SEQGP	3316	10329	3354	10330	3317	10331	3355	10332
\$SEQGP	3324	10333	3362	10334	3323	10335	3361	10336
\$SEQGP	3322	10337	3360	10338	3356	10339	3318	10340
\$SEQGP	3257	10341	3245	10342	3196	10343	3213	10344
\$SEQGP	3146	10345	3359	10346	3357	10347	3358	10348
\$SEQGP	3321	10349	3319	10350	3320	10351	3260	10352
\$SEQGP	3258	10353	3259	10354	3248	10355	3246	10356
\$SEQGP	3199	10357	3197	10358	3198	10359	3216	10360
\$SEQGP	3214	10361	3215	10362	3149	10363	3147	10364
\$SEQGP	3148	10365	3247	10366	3167	10367	3173	10368
\$SEQGP	3160	10369	3161	10370	3174	10371	3175	10372
\$SEQGP	3176	10373	3162	10374	3168	10375	3134	10376
\$SEQGP	3124	10377	3123	10378	3122	10379	3121	10380
\$SEQGP	3135	10381	3125	10382	3115	10383	3116	10384
\$SEQGP	3117	10385	3118	10386	3119	10387	3120	10388
\$SEQGP	3138	10389	3126	10390	3136	10391	3133	10392
\$SEQGP	3132	10393	3127	10394	3128	10395	3131	10396
\$SEQGP	3130	10397	3129	10398	3073	10399	3083	10400
\$SEQGP	3084	10401	3072	10402	3071	10403	3070	10404
\$SEQGP	3069	10405	3074	10406	3064	10407	3065	10408
\$SEQGP	3066	10409	3067	10410	3068	10411	3075	10412
\$SEQGP	3076	10413	3085	10414	3082	10415	3081	10416
\$SEQGP	3080	10417	3048	10418	3058	10419	3077	10420
\$SEQGP	3078	10421	3079	10422	3047	10423	3046	10424
\$SEQGP	3045	10425	3055	10426	3057	10427	3056	10428
\$SEQGP	3050	10429	3051	10430	3049	10431	3059	10432
\$SEQGP	3036	10433	3061	10434	3060	10435	3035	10436
\$SEQGP	3062	10437	3053	10438	3063	10439	3034	10440
\$SEQGP	3052	10441	3042	10442	3043	10443	3044	10444
\$SEQGP	3054	10445	3033	10446	3032	10447	3291	10448
\$SEQGP	3304	10449	3341	10450	3305	10451	3306	10452
\$SEQGP	3307	10453	3308	10454	3309	10455	3310	10456
\$SEQGP	3311	10457	3312	10458	3313	10459	3292	10460
\$SEQGP	3342	10461	3293	10462	3343	10463	3294	10464
\$SEQGP	3344	10465	3295	10466	3345	10467	3296	10468
\$SEQGP	3346	10469	3297	10470	3347	10471	3298	10472
\$SEQGP	3348	10473	3299	10474	3349	10475	3300	10476

\$SEQGP	3350	10477	3301	10478	3351	10479	3314	10480
\$SEQGP	3315	10481	3302	10482	3303	10483	3352	10484
\$SEQGP	3353	10485	99	10486	4028	10487	4027	10488
\$SEQGP	4026	10489	4025	10490	4024	10491	4023	10492
\$SEQGP	4022	10493	4021	10494	4013	10495	4012	10496
\$SEQGP	4011	10497	4010	10498	4009	10499	4007	10500
\$SEQGP	4020	10501	4005	10502	4004	10503	4003	10504
\$SEQGP	4016	10505	4019	10506	4015	10507	4014	10508
\$SEQGP	4001	10509	4002	10510	4018	10511	4017	10512
\$SEQGP	4043	10513	4056	10514	4055	10515	4042	10516
\$SEQGP	4054	10517	4041	10518	4053	10519	4040	10520
\$SEQGP	4052	10521	4039	10522	4051	10523	4050	10524
\$SEQGP	4049	10525	4048	10526	4047	10527	4046	10528
\$SEQGP	4045	10529	4044	10530	4038	10531	4037	10532
\$SEQGP	4058	10533	4036	10534	4035	10535	4034	10536
\$SEQGP	4033	10537	4032	10538	4031	10539	4073	10540
\$SEQGP	4086	10541	4085	10542	4072	10543	4084	10544
\$SEQGP	4071	10545	4083	10546	4070	10547	4082	10548
\$SEQGP	4069	10549	4081	10550	4080	10551	4079	10552
\$SEQGP	4078	10553	4077	10554	4076	10555	4075	10556
\$SEQGP	4074	10557	4067	10558	4065	10559	4064	10560
\$SEQGP	4063	10561	4062	10562	4061	10563	4103	10564
\$SEQGP	4116	10565	4115	10566	4102	10567	4114	10568
\$SEQGP	4101	10569	4113	10570	4100	10571	4112	10572
\$SEQGP	4099	10573	4111	10574	4110	10575	4109	10576
\$SEQGP	4108	10577	4107	10578	4106	10579	4105	10580
\$SEQGP	4104	10581	4097	10582	4095	10583	4094	10584
\$SEQGP	4093	10585	4092	10586	4091	10587	4133	10588
\$SEQGP	4146	10589	4145	10590	4132	10591	4144	10592
\$SEQGP	4131	10593	4143	10594	4130	10595	4142	10596
\$SEQGP	4129	10597	4141	10598	4140	10599	4139	10600
\$SEQGP	4138	10601	4137	10602	4136	10603	4135	10604
\$SEQGP	4134	10605	4127	10606	4125	10607	4124	10608
\$SEQGP	4123	10609	4122	10610	4121	10611	4163	10612
\$SEQGP	4176	10613	4162	10614	4175	10615	4161	10616
\$SEQGP	4174	10617	4160	10618	4173	10619	4159	10620
\$SEQGP	4172	10621	4158	10622	4171	10623	4157	10624
\$SEQGP	4170	10625	4156	10626	4169	10627	4155	10628
\$SEQGP	4168	10629	4154	10630	4167	10631	4153	10632
\$SEQGP	4166	10633	4152	10634	4151	10635	4165	10636
\$SEQGP	4164	10637	1004	10638	1001	10639	1003	10640
\$SEQGP	4006	10641	1005	10642	4008	10643	1006	10644
\$SEQGP	1021	10645	1023	10646	1024	10647	1026	10648
\$SEQGP	1025	10649	1008	10650	1007	10651	1028	10652
\$SEQGP	1027	10653	1041	10654	1043	10655	1044	10656
\$SEQGP	1045	10657	1046	10658	1048	10659	1047	10660
\$SEQGP	1061	10661	1065	10662	1066	10663	1067	10664
\$SEQGP	1068	10665	1081	10666	1087	10667	1088	10668
\$SEQGP	1101	10669	1109	10670	1110	10671	1089	10672
\$SEQGP	1090	10673	1070	10674	1069	10675	5007	10676
\$SEQGP	5006	10677	5005	10678	5009	10679	5004	10680
\$SEQGP	5003	10681	5002	10682	4066	10683	1009	10684
\$SEQGP	4068	10685	1010	10686	1030	10687	1029	10688
\$SEQGP	5001	10689	1050	10690	1049	10691	5008	10692

\$SEQGP	1702	10693	1701	10694	1121	10695	1141	10696
\$SEQGP	1151	10697	1152	10698	1131	10699	1132	10700
\$SEQGP	1111	10701	1112	10702	1091	10703	1092	10704
\$SEQGP	1071	10705	5027	10706	5033	10707	5026	10708
\$SEQGP	5025	10709	5024	10710	5023	10711	5022	10712
\$SEQGP	1051	10713	5034	10714	4096	10715	1011	10716
\$SEQGP	4098	10717	5021	10718	1012	10719	1031	10720
\$SEQGP	1072	10721	1052	10722	1032	10723	1053	10724
\$SEQGP	1054	10725	5054	10726	5053	10727	5028	10728
\$SEQGP	5035	10729	5032	10730	5055	10731	5029	10732
\$SEQGP	5030	10733	5031	10734	4128	10735	1014	10736
\$SEQGP	4126	10737	1033	10738	1013	10739	1034	10740
\$SEQGP	5041	10741	5042	10742	5043	10743	5044	10744
\$SEQGP	5045	10745	5046	10746	5052	10747	5051	10748
\$SEQGP	5050	10749	5049	10750	1015	10751	1016	10752
\$SEQGP	1036	10753	1035	10754	1017	10755	1037	10756
\$SEQGP	1153	10757	1154	10758	1156	10759	1133	10760
\$SEQGP	1134	10761	1135	10762	1136	10763	1113	10764
\$SEQGP	1114	10765	1093	10766	1094	10767	1073	10768
\$SEQGP	5047	10769	1074	10770	5048	10771	1095	10772
\$SEQGP	1096	10773	1076	10774	5072	10775	5075	10776
\$SEQGP	5071	10777	5070	10778	5069	10779	5068	10780
\$SEQGP	5061	10781	5073	10782	5074	10783	5062	10784
\$SEQGP	5063	10785	5064	10786	5065	10787	5066	10788
\$SEQGP	5067	10789	5090	10790	5089	10791	5088	10792
\$SEQGP	5092	10793	5091	10794	5081	10795	5087	10796
\$SEQGP	5082	10797	5083	10798	5084	10799	5085	10800
\$SEQGP	5086	10801	5109	10802	5110	10803	5108	10804
\$SEQGP	5112	10805	5111	10806	5101	10807	5107	10808
\$SEQGP	5102	10809	5106	10810	5103	10811	5104	10812
\$SEQGP	5105	10813	5128	10814	5132	10815	5131	10816
\$SEQGP	5127	10817	5126	10818	5125	10819	5124	10820
\$SEQGP	5123	10821	5122	10822	5130	10823	5121	10824
\$SEQGP	5129	10825	5133	10826	5153	10827	5148	10828
\$SEQGP	5149	10829	5150	10830	5152	10831	5151	10832
\$SEQGP	5147	10833	5146	10834	5145	10835	5144	10836
\$SEQGP	5143	10837	5142	10838	5141	10839	5168	10840
\$SEQGP	5169	10841	5170	10842	5167	10843	5161	10844
\$SEQGP	5166	10845	5165	10846	5164	10847	5163	10848
\$SEQGP	5162	10849	5172	10850	5171	10851	1155	10852
\$SEQGP	1157	10853	1158	10854	1159	10855	1137	10856
\$SEQGP	1138	10857	1139	10858	1115	10859	1116	10860
\$SEQGP	1117	10861	1118	10862	1119	10863	1075	10864
\$SEQGP	1097	10865	1098	10866	1099	10867	1077	10868
\$SEQGP	1078	10869	1079	10870				

\$

\$ - - - - -

\$ --- FROM NASTRAN MODEL WITHOUT REF GRID 99

\$ --- AXIAL SUPORT AT FWD BHD

\$ --- PITCH AND PLUNGE SUPORT DIRECTIONS - VERTICAL FWD AND AFT

\$

\$SUPORT-SID-----ID1-----C1-----ID2-----C2-----ID3-----C3-----

SUPORT 222 2004 1

SUPORT 222 2001 3 4155 3

```

$
$:NASTRAN NO SET ID SPECIFIER, ONLY ONE SET PER RUN ALLOWED
$:SUPORT ID-----C-----ID-----C-----ID-----C-----
$SUPORT 99 35
$SUPORT 99 4
$
$:ASTROS
$:SUPORT SID----ID-----C-----ID-----C-----ID-----C-----
SUPORT 10 99 35
SUPORT 11 99 4
$
$:SPCADD SID----S1-----S2-----S3-----S4-----S5-----S6-----
$ --- SPC 5510 FOR SYMMETRIC BC'S 246 FOR SAERO W/ SUPORTS 3 & 5
SPCADD 5510 55 10
$
$ --- SPC 9910 FOR SYMMETRIC BC'S 246 FOR GDR W/O SUPORTS
SPCADD 9910 99 10
$
$
$:SPC1--SID----C-----G1-----G2-----G3-----G4-----G5-----G6-----
$ --- SPC 55 FOR SYMMETRIC BC'S 246 FOR SAERO W/ SUPORTS 3 & 5
SPC1 55 1246 99
$
$ --- SPC 99 FOR SYMMETRIC BC'S 246 FOR GDR W/O SUPORTS
SPC1 99 246 99
$
$ --- SPC 11 FOR ANTISYMMETRIC BC'S 135
SPC1 11 12356 99
$
$:MPCADD SID----S1-----S2-----S3-----S4-----S5-----S6-----
$
$ --- MPC 55 CONNECT STRUCTURE SEGMENTS TOGETHER INTERNALLY
$
MPCADD 5510 55 10
MPCADD 5511 55 11
$
$ --- MPC'S BELOW CONNECT CENTERLINE NODES TO THE SUPORT PT/AERO REF PT
$ --- MPC 10 FOR SYMMETRIC BC'S FOR SUPORT POINT
$ --- MPC 11 FOR ANTISYMMETRIC BC'S FOR SUPORT POINT
$
$:MPC---SID----GO-----CO-----AO-----G-----C-----A-----
MPC 10 3315 3 -1. 99 3 1. +MP10A
+MP10A 99 5 2.25
MPC 10 4028 3 -1. 99 3 1. +MP10B
+MP10B 99 5 -18.5
MPC 10 4013 1 -1. 99 1 1. +MP10C
+MP10C 99 5 35.007
$
$
MPC 11 3304 2 -1. 99 2 1. +MP11A
+MP11A 99 4 29.273
MPC 11 3315 2 -1. 99 2 1. +MP11B
+MP11B 99 4 -29.911
MPC 11 2159 6 -1. 99 6 1.

```

```

$
$
$
$ --- WING2 SECTION
$ --- SPARS PERPENDICULAR TO CENTERLINE
$
$
$ --- MPC'S BELOW CONNECT AILERON TO MAIN BOX
$ --- 3 HINGE POINTS      1 ACTUATOR AT INBOARD HINGE
$   GRID  BUTT LINE
$   1077   81.
$   1117  128.685
$   1157  194.366
$:MPC---SID---G0---C0---A0---G---C---A-----      CONTINUE
MPC      55      1077   1   -1.    1075   1   1.
MPC      55      1077   2   -1.    1075   2   1.      +MP551
+MP551           1075   6    1.
MPC      55      1077   3   -1.    1075   3   1.      +MP552
+MP552           1075   5   -1.
$
MPC      55      1117   1   -1.    1115   1   1.
MPC      55      1117   3   -1.    1115   3   1.      +MP553
+MP553           1115   5   -1.
$
MPC      55      1118   1   -1.    1116   1   1.
$
MPC      55      1157   1   -1.    1155   1   1.
MPC      55      1157   3   -1.    1155   3   1.      +MP554
+MP554           1155   5   -1.
$
$
$ ALL GRIDS SPC'D IN ROTATIONAL DIRECTIONS WITH PERMANENT SPC'S
$ INCLUSION OF ROTATIONAL STIFFNESS MUST BE ALLOWED BY OVERRIDES
$ ON RELEVANT GRID PS FIELDS
$:GRDSET ID-----CP-----X1-----X2 -----X3-----CD-----PS-----SEID-----
GRDSET                                           456
$
$:GRID-- ID-----CP-----X1-----X2 -----X3-----CD-----PS-----SEID-----
$ --- GRID 99 IS THE REFERENCE GRID FOR AERO
$ --- GRID 99 IS THE SUPORT POINT FOR INERTIA RELIEF
$ --- GRID 99 IS CONNECTED TO THE STRUCTURE WITH MPC'S
$
GRID      99           490.    0.    10.           0
$
$ --- WING SKIN GRIDS
$ ---   ODD  LOWER SKIN
$ ---   EVEN UPPER SKIN
$
GRID      1001           423.603 44.347  6.745
GRID      1003           454.    40.958  5.881
GRID      1004           454.    40.958 14.266
GRID      1005           495.5   34.909  1.435
GRID      1006           495.5   34.909 19.45
GRID      1007           520.25  35.067  1.438

```

GRID	1008	520.25	35.067	18.616				
GRID	1009	545.	34.909	1.44				
GRID	1010	545.	34.909	17.783				
GRID	1011	581.	34.909	1.44				
GRID	1012	581.	34.909	16.578				
GRID	1013	615.	34.909	1.44				
GRID	1014	615.	34.909	15.44				
GRID	1015	646.266	34.	8.563				
GRID	1016	646.277	34.	11.611				
GRID	1017	677.534	34.	8.881				
\$								
GRID	1021	440.952	59.	5.463				
GRID	1023	476.007	59.	3.912				
GRID	1024	476.007	59.	11.264				
GRID	1025	495.5	59.	3.963				
GRID	1026	495.5	59.	12.761				
GRID	1027	520.25	59.	4.03				
GRID	1028	520.25	59.	13.769				
GRID	1029	545.	59.	4.23				
GRID	1030	545.	59.	13.987				
GRID	1031	581.	59.	4.834				
GRID	1032	581.	59.	13.24				
GRID	1033	615.	59.	5.71				
GRID	1034	615.	59.	11.406				
GRID	1035	644.71	59.	6.238				
GRID	1036	644.724	59.	9.128				
GRID	1037	674.423	59.	6.542				
\$								
GRID	1041	454.046	70.	4.5				
GRID	1043	486.898	70.	3.045				
GRID	1044	486.898	70.	9.944				
GRID	1045	495.5	70.	3.064				
GRID	1046	495.5	70.	10.757				
GRID	1047	520.25	70.	3.125				
GRID	1048	520.25	70.	12.123				
GRID	1049	545.	70.	3.276				
GRID	1050	545.	70.	12.537				
GRID	1051	581.	70.	3.813				
GRID	1052	581.	70.	11.925				
GRID	1053	615.	70.	4.673				
GRID	1054	615.	70.	10.23				
\$								
GRID	1061	464.358	78.688	3.74				
GRID	1065	495.5	78.688	2.361				
GRID	1066	495.5	78.688	9.161				
GRID	1067	520.25	79.844	2.325				
GRID	1068	520.25	79.844	10.427				
GRID	1069	545.	81.	2.336				
GRID	1070	545.	81.	10.993				
GRID	1071	581.	81.	2.801				
GRID	1072	581.	81.	10.607				
\$:GRID-- ID-----CP-----X1-----X2-----X3-----CD-----PS-----SEID-----								
GRID	1073	615.	81.	3.635			0	
GRID	1074	615.	81.	9.054				

GRID	1075	633.	81.	4.045	0
GRID	1076	633.	81.	7.813	0
GRID	1077	634.	81.	4.045	
GRID	1078	634.	81.	7.813	
GRID	1079	671.562	81.	4.39	
\$					
GRID	1081	494.019	103.68	1.554	
GRID	1087	520.25	103.68	0.336	
GRID	1088	520.25	103.68	5.899	
GRID	1089	545.	103.68	0.449	
GRID	1090	544.999	103.68	7.595	
GRID	1091	581.	103.68	0.748	
GRID	1092	581.	103.68	7.883	
GRID	1093	615.	103.68	1.491	
GRID	1094	615.	103.68	6.604	
GRID	1095	635.	103.68	1.967	
GRID	1096	635.	103.68	5.274	
GRID	1097	636.	103.68	1.981	
GRID	1098	636.	103.68	5.189	
GRID	1099	668.863	103.68	2.362	
\$					
GRID	1101	523.69	128.685	-0.634	
GRID	1109	545.	128.685	-1.578	
GRID	1110	545.	128.685	2.897	
GRID	1111	581.	128.685	-1.443	
GRID	1112	581.	128.685	4.59	
GRID	1113	615.	128.685	-0.861	
GRID	1114	615.	128.685	3.806	
\$:GRID-- ID-----CP-----X1-----X2-----X3-----CD-----PS-----SEID-----					
GRID	1115	637.206	128.685	-0.313	6
GRID	1116	637.206	128.685	2.474	6
GRID	1117	638.206	128.685	-0.313	
GRID	1118	638.206	128.685	2.474	
GRID	1119	665.752	128.685	0.023	
\$					
GRID	1121	566.842	165.046	-3.815	
GRID	1131	581.	165.046	-4.442	
GRID	1132	581.	165.046	-1.469	
GRID	1133	615.	165.046	-4.229	
GRID	1134	615.	165.046	-0.43	
GRID	1135	640.414	165.046	-3.646	
GRID	1136	640.415	165.046	-1.608	
GRID	1137	641.418	165.046	-3.622	
GRID	1138	641.418	165.046	-1.682	
GRID	1139	661.227	165.046	-3.379	
\$					
GRID	1141	601.637	194.366	-6.38	
GRID	1151	610.029	194.366	-6.752	
GRID	1152	610.029	194.366	-4.99	
GRID	1153	615.	194.366	-6.739	
GRID	1154	615.	194.366	-4.615	
\$:GRID-- ID-----CP-----X1-----X2-----X3-----CD-----PS-----SEID-----					
GRID	1155	643.	194.366	-6.33	6
GRID	1156	643.	194.366	-4.934	6

```

GRID    1157          644.    194.366 -6.33
GRID    1158          644.    194.366 -4.934
GRID    1159          657.578 194.366 -6.122
$
$ --- MAIN LANDING GEAR (MLG)
$ --- MLG PICK UP GRID POINTS FOR MASS AND LOAD APPLICATION
$
$:GRID-- ID-----CP-----X1-----X2 -----X3-----CD-----PS-----SEID-----
GRID    1701          565.     70.     3.574
GRID    1702          565.     70.    12.197
$
$:CBAR--EID-----PID-----GA-----GB-----X1,G0---X2-----X3-----
$
$ --- BARS BELOW PROVIDE ROTATIONAL STIFFNESS FOR MPC'S AT AILERON HINGES
$ --- AILERON LEADING EDGE GRIDS ARE OFFSET 1. INCH AFT OF CORRESPONDING
$ -- GRIDS ON MAIN TORQUE BOX.
$ --- THE OFFSET ELIMINATES THE PROBLEMS OF COINCIDENT GRIDS IN AERO SPLINES
$ --- BUT ALSO REQUIRES BENDING STIFFNESS TO REACT THE ECCENTRIC MOMENTS
$
CBAR      73      71    1073    1075    -1.     1.     0.
CBAR      75      71    1075    1076    -1.     1.     0.
CBAR     115     113    1115    1116    -1.     1.     0.
CBAR     155     113    1155    1156    -1.     1.     0.
$
$:QDMEM1 EID-----PID-----G1-----G2-----G3-----G4-----THETA---ZOFFS---
$ --- QDMEMS FOR WING SKINS
$
$ --- MATL COORD SYSTEM REFERENCE IS 2 EXCEPT FOR LEADING EDGES WHICH HAS 45
$ --- LOCAL X DIRECTION FOR MATERIAL IS OUTBOARD, PERPENDICULAR TO CENTERLINE
$
$ --- QDMEM'S FASTER THAN QUAD4'S, PRIMARY LOAD IS TENSION/COMPRESSION,
$ --- LESS CRITICAL FOR SHEAR. PRIMARY SHEAR LOAD WOULD REQUIRE THE IMPROVED
$ --- SHEAR ACCURACY OF QUAD4'S.
$
$ --- LOWER SKINS ODD NUMBERS STARTING AT 1001
$
CQDMEM1 1001    1001    1003    1023    1021    1001    45
CQDMEM1 1003    1001    1005    1025    1023    1003     2
CQDMEM1 1005    1001    1007    1027    1025    1005     2
CQDMEM1 1007    1001    1009    1029    1027    1007     2
CQDMEM1 1009    1001    1011    1031    1029    1009     2
CQDMEM1 1011    1001    1013    1033    1031    1011     2
CQDMEM1 1013    1001    1015    1035    1033    1013     2
CQDMEM1 1015    1001    1017    1037    1035    1015     2
$
CQDMEM1 1021    1001    1023    1043    1041    1021    45
CQDMEM1 1023    1001    1025    1045    1043    1023     2
CQDMEM1 1025    1001    1027    1047    1045    1025     2
CQDMEM1 1027    1001    1029    1049    1047    1027     2
CQDMEM1 1029    1001    1031    1051    1049    1029     2
CQDMEM1 1031    1001    1033    1053    1051    1031     2
$
CQDMEM1 1041    1001    1043    1065    1061    1041    45
CQDMEM1 1045    1001    1047    1067    1065    1045     2

```

CQDMEM1	1047	1001	1049	1069	1067	1047	2
CQDMEM1	1049	1001	1051	1071	1069	1049	2
CQDMEM1	1051	1001	1053	1073	1071	1051	2
\$							
CQDMEM1	1061	1001	1065	1087	1081	1061	45
CQDMEM1	1067	1001	1069	1089	1087	1067	2
CQDMEM1	1069	1001	1071	1091	1089	1069	2
CQDMEM1	1071	1001	1073	1093	1091	1071	2
CQDMEM1	1073	1001	1075	1095	1093	1073	2
CQDMEM1	1075	1001	1079	1099	1097	1077	2
\$							
CQDMEM1	1081	1001	1087	1109	1101	1081	45
CQDMEM1	1089	1001	1091	1111	1109	1089	2
CQDMEM1	1091	1001	1093	1113	1111	1091	2
CQDMEM1	1093	1001	1095	1115	1113	1093	2
CQDMEM1	1095	1001	1099	1119	1117	1097	2
\$							
CQDMEM1	1101	1001	1109	1131	1121	1101	45
CQDMEM1	1111	1001	1113	1133	1131	1111	2
CQDMEM1	1113	1001	1115	1135	1133	1113	2
CQDMEM1	1115	1001	1119	1139	1137	1117	2
\$							
CQDMEM1	1121	1001	1131	1151	1141	1121	45
CQDMEM1	1131	1001	1133	1153	1151	1131	2
CQDMEM1	1133	1001	1135	1155	1153	1133	2
CQDMEM1	1135	1001	1139	1159	1157	1137	2
\$							
\$ --- UPPER SKINS EVEN NUMBERS STARTING AT 1202							
\$							
CQDMEM1	1202	1001	1004	1024	1021	1001	45
CQDMEM1	1204	1001	1006	1026	1024	1004	2
CQDMEM1	1206	1001	1008	1028	1026	1006	2
CQDMEM1	1208	1001	1010	1030	1028	1008	2
CQDMEM1	1210	1001	1012	1032	1030	1010	2
CQDMEM1	1212	1001	1014	1034	1032	1012	2
CQDMEM1	1214	1001	1016	1036	1034	1014	2
CQDMEM1	1216	1001	1017	1037	1036	1016	2
\$							
CQDMEM1	1222	1001	1024	1044	1041	1021	45
CQDMEM1	1224	1001	1026	1046	1044	1024	2
CQDMEM1	1226	1001	1028	1048	1046	1026	2
CQDMEM1	1228	1001	1030	1050	1048	1028	2
CQDMEM1	1230	1001	1032	1052	1050	1030	2
CQDMEM1	1232	1001	1034	1054	1052	1032	2
\$							
CQDMEM1	1242	1001	1044	1066	1061	1041	45
CQDMEM1	1246	1001	1048	1068	1066	1046	2
CQDMEM1	1248	1001	1050	1070	1068	1048	2
CQDMEM1	1250	1001	1052	1072	1070	1050	2
CQDMEM1	1252	1001	1054	1074	1072	1052	2
\$							
CQDMEM1	1262	1001	1066	1088	1081	1061	45
CQDMEM1	1268	1001	1070	1090	1088	1068	2
CQDMEM1	1270	1001	1072	1092	1090	1070	2

CQDMEM1	1272	1001	1074	1094	1092	1072	2
CQDMEM1	1274	1001	1076	1096	1094	1074	2
CQDMEM1	1276	1001	1079	1099	1098	1078	2
\$							
CQDMEM1	1282	1001	1088	1110	1101	1081	45
CQDMEM1	1290	1001	1092	1112	1110	1090	2
CQDMEM1	1292	1001	1094	1114	1112	1092	2
CQDMEM1	1294	1001	1096	1116	1114	1094	2
CQDMEM1	1296	1001	1099	1119	1118	1098	2
\$							
CQDMEM1	1302	1001	1110	1132	1121	1101	45
CQDMEM1	1312	1001	1114	1134	1132	1112	2
CQDMEM1	1314	1001	1116	1136	1134	1114	2
CQDMEM1	1316	1001	1119	1139	1138	1118	2
\$							
CQDMEM1	1322	1001	1132	1152	1141	1121	45
CQDMEM1	1332	1001	1134	1154	1152	1132	2
CQDMEM1	1334	1001	1136	1156	1154	1134	2
CQDMEM1	1336	1001	1139	1159	1158	1138	2
\$							
\$							
\$:CTRMEM-EID----PID-----G1-----G2-----G3-----THETA---ZOFFS-----							
\$							
\$ --- LOWER WING SKIN							
\$							
CTRMEM	1043	1001	1045	1065	1043	2	
CTRMEM	1065	1001	1067	1087	1065	2	
CTRMEM	1087	1001	1089	1109	1087	2	
CTRMEM	1109	1001	1111	1131	1109	2	
\$							
\$ --- UPPER WING SKIN							
\$							
CTRMEM	1244	1001	1046	1066	1044	2	
CTRMEM	1266	1001	1068	1088	1066	2	
CTRMEM	1288	1001	1090	1110	1088	2	
CTRMEM	1310	1001	1112	1132	1110	2	
\$							
\$ --- RIBS/SPARS							
\$ --- PRIMARY SHEAR LOAD - QUAD4'S NECESSARY							
\$							
\$ --- RIBS 1500'S (NUMBERED FORE TO AFT -- ROOT TO TIP)							
\$ --- MATERIAL COORDINATE SYSTEM IS THE BASIC SYSTEM							
\$							
CQUAD4	1502	1002	1003	1005	1006	1004	1
CQUAD4	1503	1002	1005	1007	1008	1006	1
CQUAD4	1504	1002	1007	1009	1010	1008	1
CQUAD4	1505	1002	1009	1011	1012	1010	1
CQUAD4	1506	1002	1011	1013	1014	1012	1
CQUAD4	1507	1002	1013	1015	1016	1014	1
\$							
CQUAD4	1512	1002	1023	1025	1026	1024	1
CQUAD4	1513	1002	1025	1027	1028	1026	1
CQUAD4	1514	1002	1027	1029	1030	1028	1
CQUAD4	1515	1002	1029	1031	1032	1030	1

CQUAD4	1516	1002	1031	1033	1034	1032	1
CQUAD4	1517	1002	1033	1035	1036	1034	1
\$							
CQUAD4	1522	1002	1043	1045	1046	1044	1
\$							
CQUAD4	1532	1002	1065	1067	1068	1066	1
CQUAD4	1533	1002	1067	1069	1070	1068	1
CQUAD4	1534	1002	1069	1071	1072	1070	1
CQUAD4	1535	1002	1071	1073	1074	1072	1
CQUAD4	1536	1002	1073	1075	1076	1074	1
\$							
CQUAD4	1542	1002	1087	1089	1090	1088	1
CQUAD4	1543	1002	1089	1091	1092	1090	1
CQUAD4	1544	1002	1091	1093	1094	1092	1
CQUAD4	1545	1002	1093	1095	1096	1094	1
\$							
CQUAD4	1552	1002	1109	1111	1112	1110	1
CQUAD4	1553	1002	1111	1113	1114	1112	1
CQUAD4	1554	1002	1113	1115	1116	1114	1
\$							
CQUAD4	1562	1002	1131	1133	1134	1132	1
CQUAD4	1563	1002	1133	1135	1136	1134	1
\$							
CQUAD4	1572	1002	1151	1153	1154	1152	1
CQUAD4	1573	1002	1153	1155	1156	1154	1
\$							
\$ --- SPARS 1600'S (ROOT TO TIP -- FORE TO AFT)							
\$ --- MATERIAL COORDINATE SYSTEM HAS LOCAL X OUTBOARD							
\$							
\$ --- LEADING EDGE SPAR							
\$							
CQUAD4	1601	1002	1003	1023	1024	1004	2
CQUAD4	1602	1002	1023	1043	1044	1024	2
CQUAD4	1603	1002	1043	1065	1066	1044	2
CQUAD4	1604	1002	1065	1087	1088	1066	2
CQUAD4	1605	1002	1087	1109	1110	1088	2
CQUAD4	1606	1002	1109	1131	1132	1110	2
CQUAD4	1607	1002	1131	1151	1152	1132	2
\$							
\$ --- INTERMEDIATE SPARS							
\$							
CQUAD4	1611	1002	1005	1025	1026	1006	2
CQUAD4	1612	1002	1025	1045	1046	1026	2
CQUAD4	1613	1002	1045	1065	1066	1046	2
\$							
CQUAD4	1621	1002	1007	1027	1028	1008	2
CQUAD4	1622	1002	1027	1047	1048	1028	2
CQUAD4	1623	1002	1047	1067	1068	1048	2
CQUAD4	1624	1002	1067	1087	1088	1068	2
\$							
CQUAD4	1631	1002	1009	1029	1030	1010	2
CQUAD4	1632	1002	1029	1049	1050	1030	2
CQUAD4	1633	1002	1049	1069	1070	1050	2
CQUAD4	1634	1002	1069	1089	1090	1070	2

CQUAD4	1635	1002	1089	1109	1110	1090	2
\$							
CQUAD4	1641	1002	1011	1031	1032	1012	2
CQUAD4	1642	1002	1031	1051	1052	1032	2
CQUAD4	1643	1002	1051	1071	1072	1052	2
CQUAD4	1644	1002	1071	1091	1092	1072	2
CQUAD4	1645	1002	1091	1111	1112	1092	2
CQUAD4	1646	1002	1111	1131	1132	1112	2
\$							
CQUAD4	1651	1002	1013	1033	1034	1014	2
CQUAD4	1652	1002	1033	1053	1054	1034	2
CQUAD4	1653	1002	1053	1073	1074	1054	2
CQUAD4	1654	1002	1073	1093	1094	1074	2
CQUAD4	1655	1002	1093	1113	1114	1094	2
CQUAD4	1656	1002	1113	1133	1134	1114	2
CQUAD4	1657	1002	1133	1153	1154	1134	2
\$							
\$ --- AFT MOST SPAR ON TORQUE BOX							
\$							
CQUAD4	1661	1002	1015	1035	1036	1016	2
CQUAD4	1664	1002	1075	1095	1096	1076	2
CQUAD4	1665	1002	1095	1115	1116	1096	2
CQUAD4	1666	1002	1115	1135	1136	1116	2
CQUAD4	1667	1002	1135	1155	1156	1136	2
\$							
\$ - - - - -							
\$ --- AILERON SPAR							
\$							
CQUAD4	1674	1002	1077	1097	1098	1078	2
CQUAD4	1675	1002	1097	1117	1118	1098	2
CQUAD4	1676	1002	1117	1137	1138	1118	2
CQUAD4	1677	1002	1137	1157	1158	1138	2
\$							
\$ - - - - -							
\$ --- MLG STRUCTURE							
\$ --- MLG RIB							
CQUAD4	1701	1002	1049	1701	1702	1050	1
CQUAD4	1702	1002	1701	1051	1052	1702	1
\$							
\$: CROD--EID-----PID-----G1-----G2-----TMAX----							
\$							
CROD	1751	1	1701	1029			
CROD	1752	1	1702	1030			
\$							
\$ - - - - -							
\$							
\$: CTRIA3-EID-----PID-----G1-----G2-----G3-----THETA---ZOFFS-----							
\$							
\$ --- RIB TRIANGLES AT LEADING AND TRAILING EDGES							
\$							
CTRIA3	1501	1002	1001	1003	1004	1	
CTRIA3	1508	1002	1015	1017	1016	1	
\$							
CTRIA3	1511	1002	1021	1023	1024	1	

CTRIA3	1518	1002	1035	1037	1036	1
\$						
CTRIA3	1531	1002	1061	1065	1066	1
CTRIA3	1537	1002	1077	1079	1078	1
\$						
CTRIA3	1541	1002	1081	1087	1088	1
CTRIA3	1546	1002	1097	1099	1098	1
\$						
CTRIA3	1551	1002	1101	1109	1110	1
CTRIA3	1555	1002	1117	1119	1118	1
\$						
CTRIA3	1561	1002	1121	1131	1132	1
CTRIA3	1564	1002	1137	1139	1138	1
\$						
CTRIA3	1571	1002	1141	1151	1152	1
CTRIA3	1574	1002	1157	1159	1158	1

\$

\$:CONM2-EID-----G-----CID-----M-----X1-----X2-----X3-----

\$ --- CONM2'S FOR NON-STRUCTURAL MASSES IN WING

\$ --- PRIMARILY FUEL

\$

CONM2	10031	1003	.0633
CONM2	10051	1005	.1266
CONM2	10071	1007	.1266
CONM2	10091	1009	.1266
CONM2	10111	1011	.1266
CONM2	10131	1013	.0633

\$

CONM2	10231	1023	.1266
CONM2	10251	1025	.2532
CONM2	10271	1027	.2532
CONM2	10291	1029	.2532
CONM2	10311	1031	.2532
CONM2	10331	1033	.1266

\$

CONM2	10651	1065	.1266
CONM2	10671	1067	.2532
CONM2	10691	1069	.2532
CONM2	10711	1071	.2532
CONM2	10731	1073	.1266

\$

CONM2	10871	1087	.1266
CONM2	10891	1089	.2532
CONM2	10911	1091	.2532
CONM2	10931	1093	.1266

\$

CONM2	11091	1109	.0633
CONM2	11111	1111	.1266
CONM2	11131	1113	.0633

\$

CONM2	11151	1115	.2085
CONM2	11351	1135	.2241

\$

CONM2	17011	1701	.5894
-------	-------	------	-------

\$
 \$
 \$FORCE--SID-----G-----CID-----SF-----FX-----FY-----FZ-----
 \$
 \$ --- 89-6-5
 \$ --- SCALED UP TO 13.5G'S FROM 12 AS IN ORIGINAL REVWING RUN
 \$
 \$ --- FORCE ON 3138 GIVES CANARD/BODY LIFT ON CANARD MID-NODE
 \$ --- SHOULD REDUCE PITCH MOMENT TO LOW VALUE - SIMULATED TRIM
 \$

FORCE	13	3138	1.1250	0.0	0.0	51100.
\$						
FORCE	13	1141	1.1250	0.0	0.0	318.9
FORCE	13	1151	1.1250	0.0	0.0	1642.6
FORCE	13	1153	1.1250	0.0	0.0	3304.6
FORCE	13	1155	1.1250	0.0	0.0	-356.7
FORCE	13	1157	1.1250	0.0	0.0	-805.3
FORCE	13	1159	1.1250	0.0	0.0	-361.3
FORCE	13	1121	1.1250	0.0	0.0	429.8
FORCE	13	1131	1.1250	0.0	0.0	4346.0
FORCE	13	1133	1.1250	0.0	0.0	6078.8
FORCE	13	1135	1.1250	0.0	0.0	2054.2
FORCE	13	1137	1.1250	0.0	0.0	1301.0
FORCE	13	1139	1.1250	0.0	0.0	498.5
FORCE	13	1101	1.1250	0.0	0.0	795.5
FORCE	13	1109	1.1250	0.0	0.0	6653.0
FORCE	13	1111	1.1250	0.0	0.0	7767.3
FORCE	13	1113	1.1250	0.0	0.0	2177.6
FORCE	13	1115	1.1250	0.0	0.0	-18.5
FORCE	13	1117	1.1250	0.0	0.0	303.6
FORCE	13	1119	1.1250	0.0	0.0	66.9
FORCE	13	1081	1.1250	0.0	0.0	1146.1
FORCE	13	1087	1.1250	0.0	0.0	6880.0
FORCE	13	1089	1.1250	0.0	0.0	9481.9
FORCE	13	1091	1.1250	0.0	0.0	4597.5
FORCE	13	1093	1.1250	0.0	0.0	-2107.4
FORCE	13	1095	1.1250	0.0	0.0	-1456.9
FORCE	13	1097	1.1250	0.0	0.0	-1510.8
FORCE	13	1099	1.1250	0.0	0.0	-571.8
FORCE	13	1061	1.1250	0.0	0.0	646.3
FORCE	13	1065	1.1250	0.0	0.0	3375.8
FORCE	13	1067	1.1250	0.0	0.0	3913.3
FORCE	13	1069	1.1250	0.0	0.0	3887.7
FORCE	13	1071	1.1250	0.0	0.0	1729.7
FORCE	13	1073	1.1250	0.0	0.0	-326.6
FORCE	13	1075	1.1250	0.0	0.0	-258.3
FORCE	13	1077	1.1250	0.0	0.0	-300.2
FORCE	13	1079	1.1250	0.0	0.0	-72.1
FORCE	13	1041	1.1250	0.0	0.0	-202.5
FORCE	13	1043	1.1250	0.0	0.0	-573.6
FORCE	13	1045	1.1250	0.0	0.0	-636.8
FORCE	13	1047	1.1250	0.0	0.0	-176.9
FORCE	13	1049	1.1250	0.0	0.0	1460.2
FORCE	13	1051	1.1250	0.0	0.0	2403.0

FORCE	13	1053	1.1250	0.0	0.0	441.7
FORCE	13	1021	1.1250	0.0	0.0	1119.4
FORCE	13	1023	1.1250	0.0	0.0	4806.5
FORCE	13	1025	1.1250	0.0	0.0	5431.8
FORCE	13	1027	1.1250	0.0	0.0	5798.8
FORCE	13	1029	1.1250	0.0	0.0	4671.7
FORCE	13	1031	1.1250	0.0	0.0	1161.1
FORCE	13	1033	1.1250	0.0	0.0	-1373.8
FORCE	13	1035	1.1250	0.0	0.0	-1105.8
FORCE	13	1037	1.1250	0.0	0.0	-61.2
FORCE	13	1001	1.1250	0.0	0.0	264.2
FORCE	13	1003	1.1250	0.0	0.0	1604.3
FORCE	13	1005	1.1250	0.0	0.0	1704.2
FORCE	13	1007	1.1250	0.0	0.0	1121.7
FORCE	13	1009	1.1250	0.0	0.0	1032.7
FORCE	13	1011	1.1250	0.0	0.0	695.5
FORCE	13	1013	1.1250	0.0	0.0	340.1
FORCE	13	1015	1.1250	0.0	0.0	258.9
FORCE	13	1017	1.1250	0.0	0.0	63.2

\$

\$

\$

\$-----2-----3-----4-----5-----6-----7-----8-----9-----

\$ --- LOAD CASE 1000

\$ --- UNIT 10000 LIFT ON WING TIP

\$

FORCE	1000	1153	1.0000	0.0	0.0	10000.
-------	------	------	--------	-----	-----	--------

\$

\$ --- LOAD CASE 20000

\$ --- 19829 LB ON NOSE GEAR PICKUP (1/2 PLANE) 5.95G ULT NOSE IMPACT LAND

\$

FORCE	20000	2057	1.0000	0.0	0.0	19829.
-------	-------	------	--------	-----	-----	--------

\$

\$ --- LOAD CASE 28000

\$ --- 28331 LB ON NOSE GEAR PICKUP (1/2 PLANE) 8.51G ULT NOSE IMPACT LAND

\$

FORCE	28000	2057	1.0000	0.0	0.0	28331.
-------	-------	------	--------	-----	-----	--------

\$

\$ --- LOAD CASE 74000

\$ --- 73758 LB ON MAIN GEAR PICKUP (1/2 PLANE) 6.91G ULT MAIN IMPACT LAND

\$

FORCE	74000	1701	1.0000	0.0	0.0	73758.
-------	-------	------	--------	-----	-----	--------

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$ --- FORWARD FUSELAGE SECTION

\$ --- GRIDS AND ELEMENTS 2000'S

\$

\$:MAT1--MID-----E-----G-----NU-----RHO-----A-----TREF-----GE-----

\$MAT1 2024 1.04E7 0.3 2.59-4

\$

\$:PBAR--PID----MID-----A-----I1-----I2-----J-----NSM-----

\$PBAR 2010 2023 0. 0.05 .05 .05

\$PBAR 2710 2023 0. 0.5 2.5 .2

\$

\$:PSHELL-PID----MID1----T-----MID2----12I/T**3-MID3---TS/T----NSM-----

\$

\$PSHELL 1 2024 0.05

\$

\$ --- MPC BELOW ATTACH THE FORWARD FUSELAGE TO (COINCIDENT GRIDS)

\$ --- THE MID FUSELAGE AT FUS STN 330 (FS330)

\$

\$:MPC---SID-----GO-----CO-----AO-----G-----C-----A----- CONTINUE

MPC 55 2241 1 -1. 3001 1 1.

\$MPC 55 2241 2 -1. 3001 2 1. \$ SPC'D DIRECTION

MPC 55 2241 3 -1. 3001 3 1.

\$

MPC 55 2242 1 -1. 3002 1 1.

MPC 55 2242 2 -1. 3002 2 1.

MPC 55 2242 3 -1. 3002 3 1.

\$

MPC 55 2243 1 -1. 3003 1 1.

MPC 55 2243 2 -1. 3003 2 1.

MPC 55 2243 3 -1. 3003 3 1.

\$

MPC 55 2244 1 -1. 3004 1 1.

MPC 55 2244 2 -1. 3004 2 1.

MPC 55 2244 3 -1. 3004 3 1.

\$

MPC 55 2245 1 -1. 3005 1 1.

MPC 55 2245 2 -1. 3005 2 1.

MPC 55 2245 3 -1. 3005 3 1.

\$

MPC 55 2246 1 -1. 3006 1 1.

MPC 55 2246 2 -1. 3006 2 1.

MPC 55 2246 3 -1. 3006 3 1.

\$

MPC 55 2247 1 -1. 3007 1 1.

MPC 55 2247 2 -1. 3007 2 1.

MPC 55 2247 3 -1. 3007 3 1.

\$

MPC 55 2248 1 -1. 3008 1 1.

MPC 55 2248 2 -1. 3008 2 1.

MPC 55 2248 3 -1. 3008 3 1.

\$

MPC 55 2249 1 -1. 3028 1 1.

\$MPC 55 2249 2 -1. 3028 2 1. \$ SPC'D DIRECTION

MPC 55 2249 3 -1. 3028 3 1.

\$

MPC 55 2250 1 -1. 3027 1 1.

MPC 55 2250 2 -1. 3027 2 1.

MPC 55 2250 3 -1. 3027 3 1.

\$

MPC 55 2251 1 -1. 3025 1 1.

MPC 55 2251 2 -1. 3025 2 1.

MPC 55 2251 3 -1. 3025 3 1.

\$

\$

\$:GRID---ID-----CP-----X1-----X2 -----X3-----CD-----PS-----SEID----

\$

GRID	2001		175.	0.	-23.074			
GRID	2002		175.	6.333	-22.455			
GRID	2003		175.	11.946	-19.6			
GRID	2004		175.	14.263	-16.082			
GRID	2005		175.	15.297	-11.633			
GRID	2006		175.	15.391	-7.058			
GRID	2007		175.	13.642	-0.643			
GRID	2008		175.	8.951	4.023			
GRID	2009		175.	6.103	5.214			
GRID	2010		175.	0.	6.048			
GRID	2011		175.	0.	-16.082			
GRID	2012		175.	6.5	-16.082			
GRID	2013		175.	11.028	-16.082			
GRID	2014		175.	0.	-11.633			
GRID	2015		175.	6.5	-11.633			
GRID	2016		175.	10.898	-11.633			
GRID	2017		175.	0.	-7.058			
GRID	2018		175.	6.4	-7.058			
GRID	2019		175.	10.895	-7.058			
GRID	2020		175.	0.	-0.643			
GRID	2021		175.	6.3	-0.643			
GRID	2022		175.	9.971	-0.643			

\$

\$:GRID---ID-----CP-----X1-----X2 -----X3-----CD-----PS-----SEID----

GRID	2031		188.25	0.	-23.05		0	
GRID	2032		188.25	6.366	-22.409		0	
GRID	2033		188.25	12.543	-19.6		0	
GRID	2034		188.25	15.062	-15.921		0	
GRID	2035		188.25	16.431	-11.227		0	
GRID	2036		188.25	16.703	-6.308		0	
GRID	2037		188.25	16.087	-0.839		0	
GRID	2038		188.25	13.888	4.185		0	
GRID	2039		188.25	11.03	6.865		0	
GRID	2040		188.25	7.669	8.804		0	
GRID	2041		188.25	0.	9.978		0	
GRID	2042		188.25	0.	-11.367		0	
GRID	2043		188.25	6.5	-11.367		0	
GRID	2044		188.25	6.5	-15.922		0	
GRID	2045		188.25	10.781	-15.921		0	

\$

GRID	2052		194.88	6.364	-22.321		0	
GRID	2053		194.88	12.84	-19.6			
GRID	2054		194.88	15.546	-15.879			

\$:GRID---ID-----CP-----X1-----X2 -----X3-----CD-----PS-----SEID----

GRID	2055		194.88	0.	-11.231		0	
GRID	2056		194.88	6.5	-11.233		0	
GRID	2057		194.88	6.5	-15.841		0	
GRID	2058		194.88	11.023	-15.86			

\$

GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID	2062		201.5	6.362	-22.233		0	
GRID	2063		201.5	13.138	-19.6			
\$: GRID	--ID--	--CP--	--X1--	--X2--	--X3--	--CD--	--PS--	--SEID--
GRID	2064		201.5	16.03	-15.837		0	
GRID	2065		201.5	17.365	-10.791		0	
GRID	2066		201.5	17.748	-5.571		0	
GRID	2067		201.5	17.538	-0.678		0	
GRID	2068		201.5	16.495	4.1		0	
GRID	2069		201.5	13.108	9.707		0	
GRID	2070		201.5	9.235	12.393		0	
GRID	2071		201.5	0.	14.029		0	
GRID	2072		201.5	0.	-11.1		0	
GRID	2073		201.5	6.5	-11.1		0	
GRID	2074		201.5	6.5	-15.76		0	
GRID	2075		201.5	11.265	-15.799			
\$								
GRID	2082		215.	6.335	-21.923		0	
GRID	2083		215.	13.32	-19.6			
GRID	2084		215.	16.671	-15.595		0	
GRID	2085		215.	17.701	-10.676		0	
GRID	2086		215.	18.569	-4.811		0	
GRID	2087		215.	18.041	3.992		0	
GRID	2088		215.	14.694	12.057		0	
GRID	2089		215.	8.743	16.519		0	
GRID	2090		210.	0.	16.667		0	
GRID	2091		215.	0.	-10.831		0	
GRID	2092		215.	6.5	-10.831		0	
GRID	2093		215.	6.5	-15.595		0	
GRID	2094		215.	11.586	-15.595		0	
\$								
GRID	2102		228.4	6.296	-21.497			
GRID	2103		228.4	13.148	-19.6			
GRID	2104		228.4	16.958	-15.595			
GRID	2105		228.4	18.038	-10.56			
GRID	2106		228.4	18.861	-4.747			
GRID	2107		228.4	19.036	3.672			
\$: GRID	--ID--	--CP--	--X1--	--X2--	--X3--	--CD--	--PS--	--SEID--
GRID	2108		228.4	15.882	14.57		0	
GRID	2109		228.4	14.023	16.646			
GRID	2110		228.4	6.5	16.646			
GRID	2111		228.4	0.	16.646			
GRID	2112		228.4	6.5	-15.595			
GRID	2113		228.4	13.129	-15.595			
GRID	2114		228.4	0.	-10.56			
GRID	2115		228.4	6.5	-10.56			
GRID	2116		228.4	13.119	-10.56			
GRID	2117		228.4	0.	-4.747			
GRID	2118		228.4	6.5	-4.747			
GRID	2119		228.4	13.119	-4.747			
GRID	2120		228.4	0.	3.672			
GRID	2121		228.4	6.5	3.672			
GRID	2122		228.4	13.119	3.672			
GRID	2123		228.4	0.	10.159			
GRID	2124		228.4	6.5	10.159			

GRID	2125		228.4	13.119	10.159			
\$								
GRID	2132		245.	6.24	-20.823			
GRID	2133		245.	12.987	-19.277			
\$:GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID	2134		245.	17.04	-15.644		0	
GRID	2135		245.	18.87	-10.5		0	
GRID	2136		245.	19.531	-4.687		0	
GRID	2137		245.	19.666	3.672		0	
GRID	2138		245.	17.776	15.261		0	
GRID	2139		245.	16.767	17.636		0	
GRID	2140		245.	6.5	-15.595			
GRID	2141		245.	12.3	-15.595			
GRID	2142		245.	6.5	-4.668		0	
GRID	2143		245.	13.119	-4.668		0	
GRID	2144		245.	0.	3.672		0	
GRID	2145		245.	6.5	3.672		0	
\$								
GRID	2152		255.08	6.209	-20.395			
GRID	2153		255.08	12.871	-19.02			
\$:GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID	2154		255.08	17.02	-15.635		0	
GRID	2155		255.08	18.705	-10.331		0	
GRID	2156		255.08	19.441	-4.621		0	
GRID	2157		255.08	19.865	3.675		0	
GRID	2158		255.08	18.569	15.261		0	
GRID	2159		255.08	17.162	19.38		0	
GRID	2160		255.08	6.5	-15.595		0	
GRID	2161		255.08	11.763	-15.595		0	
GRID	2162		255.08	6.5	-4.621		0	
GRID	2163		255.08	13.119	-4.621		0	
GRID	2164		255.08	0.	3.672			
GRID	2165		255.08	6.5	3.672			
\$								
GRID	2171		268.75	0.	-20.068			
GRID	2172		268.75	6.177	-19.874			
GRID	2173		268.75	12.73	-18.683			
GRID	2174		268.75	16.965	-15.598			
\$:GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID	2175		268.75	19.738	-4.556		0	
GRID	2176		268.75	19.99	3.672		0	
GRID	2177		268.75	19.222	15.261		0	
GRID	2178		268.75	17.372	21.527		0	
GRID	2179		268.75	0.	-15.595			
GRID	2180		268.75	6.5	-15.595			
GRID	2181		268.75	12.815	-15.595			
GRID	2182		268.75	0.	-4.556			
GRID	2183		268.75	6.5	-4.556			
GRID	2184		268.75	13.119	-4.556			
\$								
GRID	2191		282.23	0.	-19.684			
GRID	2192		282.23	6.499	-19.823			
GRID	2193		282.23	12.537	-18.503			
GRID	2194		282.23	16.926	-15.595			

\$:GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID	2195		282.23	19.554	-6.824		0	
GRID	2196		282.23	20.022	3.672		0	
GRID	2197		282.23	19.578	15.261		0	
GRID	2198		282.23	17.823	23.954		0	
GRID	2199		282.23	0.	-15.595			
GRID	2200		282.23	6.499	-15.595			
GRID	2201		282.23	12.577	-15.595			
\$:GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID	2202		282.23	0.	-6.815		0	
GRID	2203		282.23	6.5	-6.812		0	
GRID	2204		282.23	12.577	-6.818		0	
GRID	2205		287.44	0.	3.611		0	
GRID	2206		287.44	6.499	3.605		0	
GRID	2207		287.44	12.577	3.599		0	
GRID	2208		287.44	20.02	3.592			
GRID	2209		293.25	0.	15.249		0	
GRID	2210		293.25	6.499	15.243		0	
GRID	2211		293.25	12.577	15.237		0	
GRID	2212		293.25	19.745	15.231			
GRID	2213		299.	0.	26.776		0	
GRID	2214		299.	6.5	26.783		0	
GRID	2215		299.	12.577	26.787		0	
GRID	2216		299.	18.005	26.79		0	
\$								
GRID	2221		305.	0.	-19.545		0	
GRID	2222		305.	6.157	-19.399		0	
GRID	2223		305.	12.584	-18.501		0	
GRID	2224		305.	16.869	-15.595		0	
GRID	2225		305.	19.367	-8.403		0	
GRID	2226		305.	19.978	3.672		0	
GRID	2227		305.	19.833	15.261		0	
GRID	2228		305.	18.081	27.785		0	
GRID	2229		305.	0.	27.773		0	
GRID	2230		305.	6.507	27.777		0	
GRID	2231		305.	12.584	27.781		0	
\$								
GRID	2241		330.	0.	-19.873			
GRID	2242		330.	7.959	-19.637			
GRID	2243		330.	13.198	-18.835			
GRID	2244		330.	18.214	-14.656			
GRID	2245		330.	19.348	-10.			
GRID	2246		330.	19.969	3.255			
GRID	2247		330.	19.662	20.716			
GRID	2248		330.	17.813	32.19			
GRID	2249		330.	0.	36.612			
GRID	2250		330.	6.194	35.639			
GRID	2251		330.	9.064	33.658			

\$:CBAR--EID-----PID-----GA-----GB-----X1,G0---X2-----X3-----

\$

\$ --- BAR'S ARE FOR MATHEMATICAL STABILITY IN THE FORWARD FUSELAGE, UNDESIGNED.

\$

\$ --- WHEN THE COCKPIT PRESSURIZATION LOAD CASES ARE AVAILABLE

\$ --- THEN THESE SHOULD BECOME DESIGNED ELEMENTS.

\$							
CBAR	2701	2710	2108	2139	0.	0.	1.
CBAR	2702	2710	2139	2159	0.	0.	1.
CBAR	2703	2710	2159	2178	0.	0.	1.
CBAR	2704	2710	2178	2198	0.	0.	1.
CBAR	2705	2710	2198	2216	0.	0.	1.
CBAR	2706	2710	2216	2228	0.	0.	1.
CBAR	2711	2010	2031	2032	0.	1.	0.
CBAR	2712	2010	2032	2033	0.	1.	0.
CBAR	2713	2010	2033	2034	0.	1.	0.
CBAR	2714	2010	2034	2035	0.	1.	0.
CBAR	2715	2010	2035	2036	0.	1.	0.
CBAR	2716	2010	2036	2037	0.	1.	0.
CBAR	2717	2010	2037	2038	0.	1.	0.
CBAR	2718	2010	2038	2039	0.	1.	0.
CBAR	2719	2010	2039	2040	0.	1.	0.
CBAR	2720	2010	2040	2041	0.	1.	0.
CBAR	2721	2010	2042	2043	0.	0.	1.
CBAR	2722	2010	2043	2044	0.	1.	0.
CBAR	2723	2010	2032	2044	0.	1.	0.
CBAR	2724	2010	2044	2045	0.	0.	1.
CBAR	2725	2010	2045	2034	0.	0.	1.
CBAR	2731	2010	2055	2056	0.	0.	1.
CBAR	2732	2010	2056	2057	0.	1.	0.
CBAR	2733	2010	2057	2052	0.	1.	0.
CBAR	2744	2010	2064	2065	0.	1.	0.
CBAR	2745	2010	2065	2066	0.	1.	0.
CBAR	2746	2010	2066	2067	0.	1.	0.
CBAR	2747	2010	2067	2068	0.	1.	0.
CBAR	2748	2010	2068	2069	0.	1.	0.
CBAR	2749	2010	2069	2070	0.	1.	0.
CBAR	2750	2010	2070	2071	0.	1.	0.
CBAR	2751	2010	2072	2073	0.	0.	1.
CBAR	2752	2010	2073	2074	0.	1.	0.
CBAR	2753	2010	2074	2062	0.	1.	0.
CBAR	2764	2010	2084	2085	0.	1.	0.
CBAR	2765	2010	2085	2086	0.	1.	0.
CBAR	2766	2010	2086	2087	0.	1.	0.
CBAR	2767	2010	2087	2088	0.	1.	0.
CBAR	2768	2010	2088	2089	0.	1.	0.
CBAR	2769	2010	2089	2090	0.	1.	0.
CBAR	2771	2010	2091	2092	0.	0.	1.
CBAR	2772	2010	2092	2093	0.	1.	0.
CBAR	2773	2010	2093	2082	0.	1.	0.
CBAR	2774	2010	2093	2094	0.	0.	1.
CBAR	2775	2010	2094	2084	0.	0.	1.
CBAR	2783	2010	2134	2135	0.	1.	0.
CBAR	2784	2010	2135	2136	0.	1.	0.
CBAR	2785	2010	2136	2137	0.	1.	0.
CBAR	2786	2010	2137	2138	0.	1.	0.
CBAR	2787	2010	2138	2139	0.	1.	0.
CBAR	2791	2010	2144	2145	0.	0.	1.
CBAR	2792	2010	2145	2142	0.	1.	0.

CBAR	2794	2010	2142	2143	0.	0.	1.
CBAR	2795	2010	2143	2136	0.	0.	1.
CBAR	2803	2010	2154	2155	0.	1.	0.
CBAR	2804	2010	2155	2156	0.	1.	0.
CBAR	2805	2010	2156	2157	0.	1.	0.
CBAR	2806	2010	2157	2158	0.	1.	0.
CBAR	2807	2010	2158	2159	0.	1.	0.
CBAR	2814	2010	2162	2163	0.	0.	1.
CBAR	2815	2010	2163	2156	0.	0.	1.
CBAR	2816	2010	2160	2161	0.	0.	1.
CBAR	2817	2010	2161	2154	0.	0.	1.
CBAR	2825	2010	2175	2176	0.	1.	0.
CBAR	2826	2010	2176	2177	0.	1.	0.
CBAR	2827	2010	2177	2178	0.	1.	0.
CBAR	2845	2010	2195	2196	0.	1.	0.
CBAR	2846	2010	2196	2197	0.	1.	0.
CBAR	2847	2010	2197	2198	0.	1.	0.
CBAR	2861	2010	2221	2222	0.	1.	0.
CBAR	2862	2010	2222	2223	0.	1.	0.
CBAR	2863	2010	2223	2224	0.	1.	0.
CBAR	2864	2010	2224	2225	0.	1.	0.
CBAR	2865	2010	2225	2226	0.	1.	0.
CBAR	2866	2010	2226	2227	0.	1.	0.
CBAR	2867	2010	2227	2228	0.	1.	0.
CBAR	2868	2010	2228	2231	0.	0.	1.
CBAR	2869	2010	2231	2230	0.	0.	1.
CBAR	2870	2010	2230	2229	0.	0.	1.
CBAR	2881	2010	2202	2205	0.	1.	0.
CBAR	2882	2010	2205	2209	0.	1.	0.
CBAR	2883	2010	2209	2213	0.	1.	0.
CBAR	2884	2010	2206	2203	0.	1.	0.
CBAR	2885	2010	2210	2206	0.	1.	0.
CBAR	2886	2010	2214	2210	0.	1.	0.
CBAR	2887	2010	2207	2204	0.	1.	0.
CBAR	2888	2010	2211	2207	0.	1.	0.
CBAR	2889	2010	2215	2211	0.	1.	0.
CBAR	2890	2010	2213	2214	0.	0.	1.
CBAR	2891	2010	2214	2215	0.	0.	1.

\$

\$: CONROD-EID----G1-----G2-----MID-----A-----J-----C-----NSM-----

\$: CROD--EID----PID-----G1-----G2-----TMAX----

\$

\$ --- LOWER LONGERON FWD FUS.

\$

CROD	2501	1	2003	2033
CROD	2502	1	2033	2053
CROD	2503	1	2053	2063
CROD	2504	1	2063	2083
CROD	2505	1	2083	2103
CROD	2506	1	2103	2133
CROD	2507	1	2133	2153
CROD	2508	1	2153	2173
CROD	2509	1	2173	2193
CROD	2510	1	2193	2223

CROD 2511 1 2223 2243

\$

\$ --- UPPER LONGERON FWD FUS.

\$

CROD 2521 1 2008 2039

CROD 2522 1 2039 2069

CROD 2523 1 2069 2088

CROD 2524 1 2088 2108

CROD 2525 1 2108 2139

CROD 2526 1 2139 2159

CROD 2527 1 2159 2178

CROD 2528 1 2178 2198

CROD 2529 1 2198 2216

CROD 2530 1 2216 2228

CROD 2531 1 2228 2248

\$

\$:CQUAD4-EID----PID-----G1-----G2-----G3-----G4-----THETA---ZOFFS---

\$

\$ --- FORWARD FUSELAGE SKINS

\$

CQUAD4 2001 1003 2031 2001 2002 2032 1

CQUAD4 2002 1003 2032 2002 2003 2033 1

CQUAD4 2003 1 2033 2003 2004 2034 1

CQUAD4 2004 1 2034 2004 2005 2035 1

CQUAD4 2005 1 2035 2005 2006 2036 1

CQUAD4 2006 1 2036 2006 2007 2037 1

CQUAD4 2007 1 2037 2007 2008 2038 1

CQUAD4 2009 1003 2039 2008 2009 2040 1

CQUAD4 2010 1003 2040 2009 2010 2041 1

\$

CQUAD4 2022 1003 2052 2032 2033 2053 1

CQUAD4 2023 1 2053 2033 2034 2054 1

\$

CQUAD4 2042 1003 2062 2052 2053 2063 1

CQUAD4 2043 1 2063 2053 2054 2064 1

CQUAD4 2044 1 2064 2054 2035 2065 1

CQUAD4 2045 1 2065 2035 2036 2066 1

CQUAD4 2046 1 2066 2036 2037 2067 1

CQUAD4 2047 1 2067 2037 2038 2068 1

CQUAD4 2048 1 2068 2038 2039 2069 1

CQUAD4 2049 1003 2069 2039 2040 2070 1

CQUAD4 2050 1003 2070 2040 2041 2071 1

\$

CQUAD4 2062 1003 2082 2062 2063 2083 1

CQUAD4 2063 1 2083 2063 2064 2084 1

CQUAD4 2064 1 2084 2064 2065 2085 1

CQUAD4 2065 1 2085 2065 2066 2086 1

CQUAD4 2066 1 2086 2066 2067 2087 1

CQUAD4 2068 1 2087 2068 2069 2088 1

CQUAD4 2069 1003 2088 2069 2070 2089 1

CQUAD4 2070 1003 2089 2070 2071 2090 1

\$

CQUAD4 2082 1003 2102 2082 2083 2103 1

CQUAD4 2083 1 2103 2083 2084 2104 1

CQUAD4	2084	1	2104	2084	2085	2105	1
CQUAD4	2085	1	2105	2085	2086	2106	1
CQUAD4	2086	1	2106	2086	2087	2107	1
CQUAD4	2087	1	2107	2087	2088	2108	1
CQUAD4	2088	1	2108	2088	2089	2109	1
CQUAD4	2090	1003	2089	2110	2111	2090	1
\$							
CQUAD4	2102	1003	2132	2102	2103	2133	1
CQUAD4	2103	1	2133	2103	2104	2134	1
CQUAD4	2104	1	2134	2104	2105	2135	1
CQUAD4	2105	1	2135	2105	2106	2136	1
CQUAD4	2106	1	2136	2106	2107	2137	1
CQUAD4	2107	1	2137	2107	2108	2138	1
CQUAD4	2108	1	2138	2108	2109	2139	1
\$							
CQUAD4	2112	1003	2152	2132	2133	2153	1
CQUAD4	2113	1	2153	2133	2134	2154	1
CQUAD4	2114	1	2154	2134	2135	2155	1
CQUAD4	2115	1	2155	2135	2136	2156	1
CQUAD4	2116	1	2156	2136	2137	2157	1
CQUAD4	2117	1	2157	2137	2138	2158	1
CQUAD4	2118	1	2158	2138	2139	2159	1
\$							
CQUAD4	2122	1003	2172	2152	2153	2173	1
CQUAD4	2123	1	2173	2153	2154	2174	1
CQUAD4	2124	1	2174	2154	2155	2175	1
CQUAD4	2126	1	2175	2156	2157	2176	1
CQUAD4	2127	1	2176	2157	2158	2177	1
CQUAD4	2128	1	2177	2158	2159	2178	1
\$							
CQUAD4	2131	1003	2191	2171	2172	2192	1
CQUAD4	2132	1003	2192	2172	2173	2193	1
CQUAD4	2133	1	2193	2173	2174	2194	1
CQUAD4	2134	1	2194	2174	2175	2195	1
CQUAD4	2135	1	2195	2175	2176	2196	1
CQUAD4	2136	1	2196	2176	2177	2197	1
CQUAD4	2137	1	2197	2177	2178	2198	1
\$							
CQUAD4	2146	1	2208	2196	2197	2212	1
CQUAD4	2147	1	2212	2197	2198	2216	1
\$							
CQUAD4	2151	1003	2221	2191	2192	2222	1
CQUAD4	2152	1003	2222	2192	2193	2223	1
CQUAD4	2153	1	2223	2193	2194	2224	1
CQUAD4	2154	1	2224	2194	2195	2225	1
CQUAD4	2155	1	2225	2195	2208	2226	1
CQUAD4	2156	1	2226	2208	2212	2227	1
CQUAD4	2157	1	2227	2212	2216	2228	1
\$							
CQUAD4	2161	1003	2241	2221	2222	2242	1
CQUAD4	2162	1003	2242	2222	2223	2243	1
CQUAD4	2163	1	2243	2223	2224	2244	1
CQUAD4	2164	1	2244	2224	2225	2245	1
CQUAD4	2165	1	2245	2225	2226	2246	1

CQUAD4	2166	1	2246	2226	2227	2247	1
CQUAD4	2167	1	2247	2227	2228	2248	1
\$							
CQUAD4	2171	1003	2229	2213	2214	2230	1
CQUAD4	2172	1003	2230	2214	2215	2231	1
CQUAD4	2173	1003	2231	2215	2216	2228	1
CQUAD4	2174	1003	2249	2229	2230	2250	1
CQUAD4	2175	1003	2250	2230	2231	2251	1
CQUAD4	2176	1003	2251	2231	2228	2248	1
\$							
\$ --- BHD 175							
\$							
CQUAD4	2201	1003	2001	2002	2012	2011	2
CQUAD4	2202	1003	2013	2012	2002	2003	2
CQUAD4	2204	1003	2011	2012	2015	2014	2
CQUAD4	2205	1003	2012	2013	2016	2015	2
CQUAD4	2206	1003	2013	2004	2005	2016	2
CQUAD4	2207	1003	2014	2015	2018	2017	2
CQUAD4	2208	1003	2015	2016	2019	2018	2
CQUAD4	2209	1003	2016	2005	2006	2019	2
CQUAD4	2210	1003	2017	2018	2021	2020	2
CQUAD4	2211	1003	2018	2019	2022	2021	2
CQUAD4	2212	1003	2019	2006	2007	2022	2
CQUAD4	2213	1003	2020	2021	2009	2010	2
CQUAD4	2214	1003	2021	2022	2008	2009	2
\$							
\$ --- EQUIPMENT SHELF SUPPORTS							
\$							
CQUAD4	2221	1003	2052	2053	2058	2057	2
CQUAD4	2223	1003	2062	2063	2075	2074	2
\$							
\$ --- BHD 228							
\$							
CQUAD4	2232	1003	2103	2102	2112	2113	2
CQUAD4	2235	1003	2113	2112	2115	2116	2
CQUAD4	2236	1003	2104	2113	2116	2105	2
CQUAD4	2237	1003	2115	2114	2117	2118	2
CQUAD4	2238	1003	2116	2115	2118	2119	2
CQUAD4	2239	1003	2105	2116	2119	2106	2
CQUAD4	2240	1003	2118	2117	2120	2121	2
CQUAD4	2241	1003	2119	2118	2121	2122	2
CQUAD4	2242	1003	2106	2119	2122	2107	2
CQUAD4	2243	1003	2121	2120	2123	2124	2
CQUAD4	2244	1003	2122	2121	2124	2125	2
CQUAD4	2245	1003	2107	2122	2125	2108	2
CQUAD4	2246	1003	2124	2123	2111	2110	2
CQUAD4	2247	1003	2125	2124	2110	2109	2
\$							
\$ --- SHELF SUPPORT							
\$							
CQUAD4	2252	1003	2132	2133	2141	2140	2
\$							
\$ --- AFT NOSE WHEEL WELL WALL							
\$							

CQUAD4	2261	1003	2171	2172	2180	2179	2
CQUAD4	2262	1003	2172	2173	2181	2180	2
CQUAD4	2264	1003	2179	2180	2183	2182	2
CQUAD4	2265	1003	2180	2181	2184	2183	2
CQUAD4	2266	1003	2181	2174	2175	2184	2

\$

\$ --- CANT BHD 286

\$

CQUAD4	2271	1003	2191	2192	2200	2199	2
CQUAD4	2272	1003	2192	2193	2201	2200	2
CQUAD4	2274	1003	2199	2200	2203	2202	2
CQUAD4	2275	1003	2200	2201	2204	2203	2
CQUAD4	2276	1003	2201	2194	2195	2204	2
CQUAD4	2277	1003	2202	2203	2206	2205	2
CQUAD4	2278	1003	2203	2204	2207	2206	2
CQUAD4	2279	1003	2204	2195	2208	2207	2
CQUAD4	2280	1003	2205	2206	2210	2209	2
CQUAD4	2281	1003	2206	2207	2211	2210	2
CQUAD4	2282	1003	2207	2208	2212	2211	2
CQUAD4	2283	1003	2209	2210	2214	2213	2
CQUAD4	2284	1003	2210	2211	2215	2214	2
CQUAD4	2285	1003	2211	2212	2216	2215	2

\$

\$ --- EQUIPMENT SHELVES

\$

CQUAD4	2301	1003	2044	2012	2013	2045	1
CQUAD4	2302	1003	2045	2013	2004	2034	1
CQUAD4	2303	1003	2057	2044	2045	2058	1
CQUAD4	2304	1003	2058	2045	2034	2054	1
CQUAD4	2305	1003	2074	2057	2058	2075	1
CQUAD4	2306	1003	2075	2058	2054	2064	1
CQUAD4	2307	1003	2093	2074	2075	2094	1
CQUAD4	2308	1003	2094	2075	2064	2084	1
CQUAD4	2309	1003	2112	2093	2094	2113	1
CQUAD4	2310	1003	2113	2094	2084	2104	1
CQUAD4	2311	1003	2112	2113	2141	2140	1
CQUAD4	2312	1003	2113	2104	2134	2141	1
CQUAD4	2313	1003	2160	2140	2141	2161	1
CQUAD4	2314	1003	2161	2141	2134	2154	1
CQUAD4	2315	1003	2180	2160	2161	2181	1
CQUAD4	2316	1003	2181	2161	2154	2174	1
CQUAD4	2317	1003	2200	2180	2181	2201	1
CQUAD4	2318	1003	2201	2181	2174	2194	1

\$

\$ --- COCKPIT FLOOR

\$

CQUAD4	2321	1003	2142	2118	2119	2143	1
CQUAD4	2322	1003	2143	2119	2106	2136	1
CQUAD4	2323	1003	2162	2142	2143	2163	1
CQUAD4	2324	1003	2163	2143	2136	2156	1
CQUAD4	2325	1003	2183	2162	2163	2184	1
CQUAD4	2326	1003	2184	2163	2156	2175	1
CQUAD4	2327	1003	2202	2182	2183	2203	1
CQUAD4	2328	1003	2203	2183	2184	2204	1

CQUAD4	2329	1003	2204	2184	2175	2195	1
CQUAD4	2331	1003	2042	2014	2015	2043	1
CQUAD4	2332	1003	2055	2042	2043	2056	1
CQUAD4	2333	1003	2072	2055	2056	2073	1
CQUAD4	2334	1003	2091	2072	2073	2092	1
CQUAD4	2335	1003	2114	2091	2092	2115	1
CQUAD4	2336	1003	2121	2145	2144	2120	1
CQUAD4	2337	1003	2145	2165	2164	2144	1
CQUAD4	2338	1003	2165	2183	2182	2164	1

\$

\$ -- NOSE WHEEL WELL SIDE WALL

\$

CQUAD4	2341	1003	2002	2032	2044	2012	1
CQUAD4	2342	1003	2012	2044	2043	2015	1
CQUAD4	2343	1003	2032	2052	2057	2044	1
CQUAD4	2344	1003	2044	2057	2056	2043	1
CQUAD4	2345	1003	2052	2062	2074	2057	1
CQUAD4	2346	1003	2057	2074	2073	2056	1
CQUAD4	2347	1003	2062	2082	2093	2074	1
CQUAD4	2348	1003	2074	2093	2092	2073	1
CQUAD4	2349	1003	2082	2102	2112	2093	1
CQUAD4	2350	1003	2093	2112	2115	2092	1
CQUAD4	2351	1003	2102	2132	2140	2112	1
CQUAD4	2352	1003	2112	2140	2142	2115	1
CQUAD4	2354	1003	2118	2142	2145	2121	1
CQUAD4	2355	1003	2160	2140	2132	2152	1
CQUAD4	2356	1003	2140	2160	2162	2142	1
CQUAD4	2357	1003	2142	2162	2165	2145	1
CQUAD4	2358	1003	2180	2160	2152	2172	1
CQUAD4	2359	1003	2160	2180	2183	2162	1
CQUAD4	2361	1003	2172	2192	2200	2180	1

\$

\$:CTRIA3-EID----PID-----G1-----G2-----G3-----THETA---ZOFFS-----

\$

\$ --- FUSELAGE SKIN/BHDS/ ETC

\$

CTRIA3	2008	1	2038	2008	2039	1
CTRIA3	2024	1	2054	2034	2035	1
CTRIA3	2067	1	2087	2067	2068	1
CTRIA3	2089	1003	2089	2109	2110	1
CTRIA3	2125	1	2156	2175	2155	1
CTRIA3	2145	1	2196	2208	2195	1

\$

CTRIA3	2203	1003	2004	2013	2003	2
CTRIA3	2215	1003	2022	2007	2008	2
CTRIA3	2222	1003	2054	2058	2053	2
CTRIA3	2224	1003	2064	2075	2063	2
CTRIA3	2233	1003	2104	2103	2113	2
CTRIA3	2248	1003	2109	2108	2125	2
CTRIA3	2253	1003	2133	2134	2141	2
CTRIA3	2263	1003	2174	2181	2173	2
CTRIA3	2273	1003	2194	2201	2193	2

\$

CTRIA3	2353	1003	2115	2142	2118	1
--------	------	------	------	------	------	---

CTRIA3	2360	1003	2162	2183	2165	1	
\$							
\$: CONM2	EID	G	CID	M	X1	X2	X3
\$							
CONM2	20011	2001		.0177			
CONM2	20021	2002		.0177			
CONM2	20031	2003		.0177			
CONM2	20041	2004		.0177			
CONM2	20051	2005		.0177			
CONM2	20061	2006		.0177			
CONM2	20071	2007		.0177			
CONM2	20081	2008		.0177			
CONM2	20091	2009		.0177			
\$							
CONM2	20571	2057		.0712			
CONM2	21401	2140		.0842			
CONM2	21651	2165		.1166			
\$							
CONM2	20891	2089		.0311			
CONM2	20901	2090		.0311			
CONM2	21091	2109		.0311			
CONM2	21391	2139		.0311			
CONM2	21591	2159		.0311			
CONM2	21781	2178		.0311			
CONM2	21981	2198		.0311			
CONM2	22161	2216		.0311			
CONM2	22281	2228		.0311			
CONM2	22481	2248		.0311			
\$							
CONM2	21821	2182		.0993			
CONM2	21831	2183		.0993			
CONM2	21841	2184		.0993			
\$							
CONM2	22021	2202		.0993			
CONM2	22031	2203		.0993			
CONM2	22041	2204		.0993			
\$							
CONM2	22241	2224		.2652			
CONM2	22251	2225		.2652			
CONM2	22261	2226		.2652			
\$							
CONM2	20751	2075		.2474			
CONM2	21411	2141		.0518			
CONM2	21801	2180		.2073			
\$							
CONM2	20151	2015		.0766			
CONM2	20211	2021		.0766			
\$							
CONM2	20121	2012		.064			
CONM2	20131	2013		.064			
\$							
CONM2	20572	2057		.0319			
CONM2	20581	2058		.0319			
\$							

```

CONM2  20441  2044      .013
CONM2  20451  2045      .013
$
CONM2  21451  2145      .0421
CONM2  21652  2165      .0421
$
$:SPC1--SID-----C-----G1-----G2-----G3-----G4-----G5-----G6-----
$
SPC1    10      246      2114      2117      2120      2123      2111      2144
SPC1    10      246      2031      2042      2041      2055      2072      2071
SPC1    10      246      2001      2011      2014      2017      2020      2010
SPC1    10      246      2229      2221      2241      2249
SPC1    10      246      2091      2090
SPC1    10      246      2191      2199      2202      2205      2209      2213
SPC1    10      246      2164      2171      2179      2182
$
$ --- BHD'S MODELED AS  MEMBRANE ONLY REQUIRE FORE/AFT SPC'S
$
SPC1    10      1      2011      2016      2017      2018      2019      2020
SPC1    10      1      2021      2022
SPC1    10      1      2116      2117      2122      2123      2124      2125
SPC1    10      1      2179      2199
$
$ --- 3 DIR SPC'S BELOW WERE ELIMINATED BECAUSE STABILITY BARS WERE USED
$
$SPC1    10      3      2042      2055      2072      2091      2094      2143
$SPC1    10      3      2144      2161      2163
$SPC1    10      3      2221      2222
$SPC1    10      3      2229      2230      2231
$
$ - - - - -
$ - - - - -
$ - - - - -
$
$ --- MID FUSEL SECTION
$
$ --- PBAR BELOW IS FOR NONDESIGNED CANARD SPINDLE/TORQUE ARM PROPS
$
$:PBAR--PID-----MID-----A-----I1-----I2-----J-----NSM-----
$PBAR    3701    4340    0.5      2.5      2.5      5.
$
$ --- PROD IS FOR LINK AT FWD SPAR TO FUS ATTACH
$
$:PROD--PID-----MID-----A-----J-----C-----NSM-----TMIN-----
$PROD    3599    4340      .11
$
$ --- MPC BELOW CONNECT MID FUSELAGE TO AFT FUSELAGE AT FUS STN 495.5
$
$:MPC---SID-----GO-----CO-----AO-----G-----C-----A-----
MPC      55      3341    1      -1.      4001    1      1.
$MPC      55      3341    2      -1.      4001    2      1. $ SPC'D DIRECTION
MPC      55      3341    3      -1.      4001    3      1.
$
MPC      55      3342    1      -1.      4002    1      1.

```

MPC	55	3342	2	-1.	4002	2	1.
MPC	55	3342	3	-1.	4002	3	1.
\$							
MPC	55	3343	1	-1.	4003	1	1.
MPC	55	3343	2	-1.	4003	2	1.
MPC	55	3343	3	-1.	4003	3	1.
\$							
MPC	55	3344	1	-1.	4004	1	1.
MPC	55	3344	2	-1.	4004	2	1.
MPC	55	3344	3	-1.	4004	3	1.
\$							
MPC	55	3345	1	-1.	4005	1	1.
MPC	55	3345	2	-1.	4005	2	1.
MPC	55	3345	3	-1.	4005	3	1.
\$							
MPC	55	3346	1	-1.	4006	1	1.
MPC	55	3346	2	-1.	4006	2	1.
MPC	55	3346	3	-1.	4006	3	1.
\$							
MPC	55	3347	1	-1.	4007	1	1.
MPC	55	3347	2	-1.	4007	2	1.
MPC	55	3347	3	-1.	4007	3	1.
\$							
MPC	55	3348	1	-1.	4008	1	1.
MPC	55	3348	2	-1.	4008	2	1.
MPC	55	3348	3	-1.	4008	3	1.
\$							
MPC	55	3349	1	-1.	4009	1	1.
MPC	55	3349	2	-1.	4009	2	1.
MPC	55	3349	3	-1.	4009	3	1.
\$							
MPC	55	3350	1	-1.	4010	1	1.
MPC	55	3350	2	-1.	4010	2	1.
MPC	55	3350	3	-1.	4010	3	1.
\$							
MPC	55	3351	1	-1.	4011	1	1.
MPC	55	3351	2	-1.	4011	2	1.
MPC	55	3351	3	-1.	4011	3	1.
\$							
MPC	55	3352	1	-1.	4012	1	1.
MPC	55	3352	2	-1.	4012	2	1.
MPC	55	3352	3	-1.	4012	3	1.
\$							
MPC	55	3353	1	-1.	4013	1	1.
\$MPC	55	3353	2	-1.	4013	2	1.\$ SPC'D DIRECTION
MPC	55	3353	3	-1.	4013	3	1.

\$:GRID---ID-----CP-----X1-----X2 -----X3-----CD-----PS-----SEID-----

\$

\$ --- BHD 330

\$

GRID	3001	330.	0.	-19.873
GRID	3002	330.	7.959	-19.637
GRID	3003	330.	13.198	-18.835

GRID	3004	330.	18.214	-14.656
GRID	3005	330.	19.348	-10.
GRID	3006	330.	19.969	3.255
GRID	3007	330.	19.662	20.716
GRID	3008	330.	17.813	32.19
GRID	3009	330.	14.64	38.316
GRID	3010	330.	8.917	42.322
GRID	3011	330.	0.001	43.535
GRID	3012	330.	0.	-10.
GRID	3013	330.	7.833	-10.
GRID	3014	330.	13.59	-10.
GRID	3015	330.	0.	-2.196
GRID	3016	330.	7.705	-0.219
GRID	3017	330.	13.221	3.332
GRID	3018	330.	0.	5.609
GRID	3019	330.	7.577	9.563
GRID	3020	330.	10.458	17.649
GRID	3021	330.	15.127	18.618
GRID	3022	330.	8.655	24.407
GRID	3023	330.	13.02	28.781
GRID	3024	330.	3.489	29.
GRID	3025	330.	9.064	33.658
GRID	3026	330.	0.	29.69
GRID	3027	330.	6.194	35.639
GRID	3028	330.	0.	36.612

\$

\$ --- INLET

\$

GRID	3032	323.15	22.169	-4.357
GRID	3033	322.581	22.169	-3.379
GRID	3034	316.972	22.169	6.26
GRID	3035	311.363	22.169	15.899
GRID	3036	310.409	22.169	17.537

\$

GRID	3042	335.589	22.169	-5.849
GRID	3043	335.589	26.28	-5.849
GRID	3044	335.589	40.917	-5.849
GRID	3045	334.62	49.925	-4.184
GRID	3046	330.	51.88	3.754
GRID	3047	325.371	51.733	11.707
GRID	3048	321.175	48.767	18.917
GRID	3049	320.249	42.597	20.508
GRID	3050	320.013	26.297	20.912
GRID	3051	320.	22.169	20.936
GRID	3052	335.019	22.169	-4.871
GRID	3053	335.019	26.28	-4.871
GRID	3054	334.834	40.671	-4.551
GRID	3055	333.249	47.136	-1.828
GRID	3056	329.922	49.798	3.887
GRID	3057	325.51	49.702	11.469
GRID	3058	322.461	46.565	16.707
GRID	3059	321.298	42.048	18.705
GRID	3060	320.954	26.28	19.297
GRID	3061	320.954	22.169	19.297

GRID	3062	327.987	22.169	7.213
GRID	3063	327.987	26.28	7.213
\$				
GRID	3064	341.67	22.169	-6.578
GRID	3065	341.67	26.28	-6.578
GRID	3066	341.67	40.901	-6.578
GRID	3067	341.67	49.879	-4.63
GRID	3068	341.67	52.114	4.489
GRID	3069	341.67	51.977	15.93
GRID	3070	341.67	48.581	26.411
GRID	3071	341.67	42.597	28.058
GRID	3072	341.67	28.597	28.578
GRID	3073	341.67	22.169	28.612
GRID	3074	341.67	22.169	-4.871
GRID	3075	341.67	26.28	-4.871
GRID	3076	341.67	40.608	-4.518
GRID	3077	341.67	47.233	-1.767
GRID	3078	341.67	49.817	4.632
GRID	3079	341.67	48.754	14.23
GRID	3080	341.67	44.717	17.823
GRID	3081	341.67	41.084	18.873
GRID	3082	341.67	26.28	19.297
GRID	3083	341.67	22.169	19.297
GRID	3084	341.67	22.169	7.213
GRID	3085	341.67	26.28	7.213
\$				
GRID	3091	360.	0.	-20.698
GRID	3092	360.	8.773	-20.472
GRID	3093	360.	14.571	-19.75
GRID	3094	360.	19.941	-15.209
GRID	3095	360.	20.827	-10.
GRID	3096	360.	21.353	2.588
GRID	3097	360.	21.127	21.486
GRID	3098	360.	19.374	33.946
GRID	3099	360.	15.905	40.318
GRID	3100	360.	9.491	43.967
GRID	3101	360.	0.	44.927
GRID	3102	360.	0.	-10.
GRID	3103	360.	7.918	-10.
GRID	3104	360.	17.6	-10.
GRID	3105	360.	17.126	2.588
GRID	3106	360.	9.235	19.381
GRID	3107	360.	0.	19.362
GRID	3108	360.	0.	23.534
GRID	3109	360.	7.727	23.7
GRID	3110	360.	13.131	28.637
GRID	3111	360.	13.663	34.187
GRID	3112	360.	9.491	40.765
GRID	3113	360.	0.	41.242
GRID	3114	360.	0.	32.388
\$				
GRID	3115	365.	22.169	-8.076
GRID	3116	365.	26.747	-8.037
GRID	3117	365.	41.653	-7.585

GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID 3118			365.	50.26	-3.658			
GRID 3119			365.	51.562	5.959			
\$:GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID 3120			365.	51.309	18.027		0	
GRID 3121			365.	47.979	29.396			
GRID 3122			365.	42.597	31.927			
GRID 3123			365.	28.597	32.924			
GRID 3124			365.	22.169	32.988			
GRID 3125			365.	22.169	-4.894			
GRID 3126			365.	26.747	-4.894			
GRID 3127			365.	41.123	-4.472			
GRID 3128			365.	47.621	-1.285			
GRID 3129			365.	49.792	5.993			
GRID 3130			365.	47.985	15.391			
GRID 3131			365.	43.863	18.217			
GRID 3132			365.	40.711	18.99			
\$:GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID 3133			365.	26.746	19.367		0	
GRID 3134			365.	22.169	19.367			
GRID 3135			365.	22.169	7.237			
GRID 3136			365.	26.747	7.236			
\$								
\$ --- CANARD GRID POINT FOR MASS AND LOAD APPLICATION								
\$:GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID 3138			369.	73.	18.0		0	
\$								
GRID 3141			390.	0.	-21.523			
GRID 3142			390.	9.587	-21.307			
GRID 3143			390.	15.944	-20.664			
GRID 3144			390.	22.242	-15.924			
GRID 3145			390.	24.008	-8.242			
GRID 3146			390.	42.577	-7.626			
GRID 3147			390.	49.149	-1.75			
GRID 3148			390.	49.713	7.535			
\$:GRID	ID	CP	X1	X2	X3	CD	PS	SEID
GRID 3149			390.	49.314	19.699		0	
GRID 3150			390.	45.981	31.27			
GRID 3151			390.	42.597	33.735			
GRID 3152			390.	28.597	35.867			
GRID 3153			390.	22.155	35.989			
GRID 3154			390.	17.671	41.592			
GRID 3155			390.	11.088	44.294			
GRID 3156			390.	0.001	44.999			
GRID 3157			390.	0.	-10.			
GRID 3158			390.	8.003	-10.			
GRID 3159			390.	16.005	-10.001			
GRID 3160			390.	25.548	-5.282			
GRID 3161			390.	40.903	-3.77			
GRID 3162			390.	45.608	0.27			
GRID 3163			390.	5.-4	5.998			
GRID 3164			390.	7.806	6.431			
GRID 3165			390.	15.611	6.864			
GRID 3166			390.	23.416	7.297			
GRID 3167			390.	25.549	7.534			

GRID	3168	390.	46.998	7.538
GRID	3169	390.	0.001	20.237
GRID	3170	390.	7.609	20.237
GRID	3171	390.	15.216	20.237
GRID	3172	390.	22.824	20.237
GRID	3173	390.	25.549	20.35
GRID	3174	390.	38.969	19.485
GRID	3175	390.	40.802	18.878
GRID	3176	390.	44.797	15.988
GRID	3177	390.	0.001	32.618
GRID	3178	390.	5.351	35.681
GRID	3179	390.	6.39	31.408
GRID	3180	390.	11.512	28.378
GRID	3181	390.	17.111	30.392
GRID	3182	390.	19.131	35.989
GRID	3183	390.	15.627	40.668
GRID	3184	390.	11.433	41.884
GRID	3185	390.	6.813	39.828
\$				
GRID	3191	420.	0.	-22.481
GRID	3192	420.	9.668	-22.341
GRID	3193	420.	19.284	-21.435
GRID	3194	420.	25.617	-16.28
GRID	3195	420.	27.47	-8.326
GRID	3196	420.	38.819	-7.65
GRID	3197	420.	45.679	0.
GRID	3198	420.	45.983	8.268
GRID	3199	420.	45.638	20.867
GRID	3200	420.	42.598	32.952
GRID	3201	420.	28.598	37.857
GRID	3202	420.	25.514	37.997
GRID	3203	420.	20.587	42.936
GRID	3204	420.	13.612	44.489
GRID	3205	420.	0.	45.
GRID	3206	420.	0.	-10.
GRID	3207	420.	8.371	-10.
GRID	3208	420.	16.741	-10.
GRID	3211	420.	16.741	-6.496
GRID	3212	420.	27.095	-5.7
GRID	3213	420.	32.507	-3.877
GRID	3214	420.	36.434	0.
GRID	3215	420.	38.628	8.729
GRID	3216	420.	37.09	15.492
GRID	3217	420.	34.583	19.478
GRID	3218	420.	26.397	22.332
GRID	3219	420.	16.741	25.86
GRID	3220	420.	16.741	8.265
GRID	3221	420.	9.751	26.138
GRID	3222	420.	4.847	29.739
GRID	3223	420.	0.	37.979
GRID	3224	420.	7.756	33.767
GRID	3225	420.	11.131	29.25
GRID	3226	420.	16.741	28.693
GRID	3227	420.	20.655	31.9

GRID	3228	420.	21.379	36.908
GRID	3229	420.	18.535	41.093
GRID	3230	420.	13.612	42.262
GRID	3231	420.	8.812	39.305
\$				
GRID	3241	454.	0.	-23.395
GRID	3242	454.	10.972	-23.221
GRID	3243	454.	21.905	-22.004
GRID	3244	454.	28.409	-16.393
GRID	3245	454.	30.228	-7.998
GRID	3246	454.	40.391	0.
\$GRID	1004	454.	40.958	14.266
GRID	3247	454.	40.958	9.26
GRID	3248	454.	40.601	22.045
GRID	3249	454.	37.266	34.194
GRID	3250	454.	26.862	39.03
GRID	3251	454.	21.471	42.972
GRID	3252	454.	14.871	44.356
GRID	3253	454.	0.	44.996
GRID	3254	454.	0.	-8.858
GRID	3255	454.	4.792	-8.858
GRID	3256	454.	12.76	-7.838
GRID	3257	454.	20.008	-4.563
GRID	3258	454.	24.976	1.546
GRID	3259	454.	26.465	9.363
GRID	3260	454.	24.903	17.175
GRID	3261	454.	19.949	23.32
GRID	3262	454.	12.743	26.678
GRID	3263	454.	4.742	27.701
GRID	3264	454.	0.	27.701
GRID	3265	454.	0.	8.85
GRID	3266	454.	4.742	8.85
GRID	3267	454.	0.	36.348
GRID	3268	454.	7.132	34.219
GRID	3269	454.	11.985	29.796
GRID	3270	454.	15.684	28.203
GRID	3271	454.	22.222	26.303
GRID	3272	454.	25.122	31.195
GRID	3273	454.	22.032	36.25
GRID	3274	454.	14.871	39.16
GRID	3275	454.	10.576	38.67
\$				
GRID	3291	474.75	0.	-23.767
GRID	3292	474.75	11.928	-23.614
GRID	3293	474.75	23.783	-22.468
GRID	3294	474.75	30.101	-16.131
GRID	3295	474.75	31.465	-6.9
GRID	3296	474.75	37.31	0.206
GRID	3297	474.75	38.033	9.837
GRID	3298	474.75	37.526	22.763
GRID	3299	474.75	34.055	35.085
GRID	3300	474.75	28.204	38.88
GRID	3301	474.75	22.085	42.988
GRID	3302	474.75	14.805	44.487

GRID	3303	474.75	0.	45.007
GRID	3304	474.75	0.	-19.273
GRID	3305	474.75	10.686	-18.746
GRID	3306	474.75	20.988	-16.614
GRID	3307	474.75	26.111	-6.237
GRID	3308	474.75	31.635	0.733
GRID	3309	474.75	32.796	9.828
GRID	3310	474.75	31.85	21.132
GRID	3311	474.75	27.858	31.538
GRID	3312	474.75	23.957	34.068
GRID	3313	474.75	17.458	38.142
GRID	3314	474.75	10.047	39.313
GRID	3315	474.75	0.	39.911
GRID	3316	474.75	0.	-10.284
GRID	3317	474.75	8.202	-9.011
GRID	3318	474.75	15.399	-4.906
GRID	3319	474.75	20.284	1.785
GRID	3320	474.75	22.323	9.809
GRID	3321	474.75	20.497	17.87
GRID	3322	474.75	15.463	24.443
GRID	3323	474.75	8.205	28.449
GRID	3324	474.75	0.	29.72
GRID	3325	474.75	0.	9.718

\$

GRID	3341	495.5	0.	-23.913
GRID	3342	495.5	12.286	-23.8
GRID	3343	495.5	25.088	-22.556
GRID	3344	495.5	31.342	-14.809
GRID	3345	495.5	32.303	-4.502
GRID	3346	495.5	34.909	1.435
GRID	3347	495.5	34.909	9.993
GRID	3348	495.5	34.909	19.45
GRID	3349	495.5	32.87	32.96
GRID	3350	495.5	28.258	38.37
GRID	3351	495.5	21.755	42.668
GRID	3352	495.5	14.119	44.431
GRID	3353	495.5	0.	45.007
GRID	3354	498.5	0.	-11.179
GRID	3355	498.5	8.018	-9.392
GRID	3356	498.5	14.79	-4.794
GRID	3357	498.5	19.389	1.975
GRID	3358	498.5	21.179	9.994
GRID	3359	498.5	19.393	18.018
GRID	3360	498.5	14.789	24.795
GRID	3361	498.5	8.021	29.391
GRID	3362	498.5	0.	31.179

\$

\$: CONROD-EID-----G1-----G2-----MID-----A-----J-----C-----NSM-----

\$: CROD--EID-----PID-----G1-----G2-----TMAX-----

\$

CROD	3501	1	3003	3093
CROD	3502	1	3093	3143
CROD	3503	1	3143	3193
CROD	3504	1	3193	3243

CROD	3505	1	3243	3293			
CROD	3506	1	3293	3343			
\$							
CROD	3511	1	3008	3098			
CROD	3512	1	3098	3153			
CROD	3513	1	3153	3202			
CROD	3514	1	3202	3250			
CROD	3515	1	3250	3300			
CROD	3516	1	3300	3350			
\$							
CROD	3521	1	3010	3100			
CROD	3522	1	3100	3155			
CROD	3523	1	3155	3204			
CROD	3524	1	3204	3252			
CROD	3525	1	3252	3302			
CROD	3526	1	3302	3352			
\$							
CROD	3551	1	3045	3067			
CROD	3552	1	3067	3118			
CROD	3553	1	3118	3147			
CROD	3554	1	3147	3197			
CROD	3555	1	3197	3246			
CROD	3556	1	3246	3296			
CROD	3557	1	3296	3346			
\$							
CROD	3561	1	3048	3070			
CROD	3562	1	3070	3121			
CROD	3563	1	3121	3150			
CROD	3564	1	3150	3200			
CROD	3565	1	3200	3249			
CROD	3566	1	3249	3299			
CROD	3567	1	3299	3350			
\$							
\$ --- CROD BELOW IS THE LINK AT THE FWD SPAR TO FUSELAGE ATTACHMENT							
\$							
CROD	3599	3599	3247	1004			
\$							
\$:CBAR--EID-----PID-----GA-----GB-----X1,G0---X2-----X3-----							
\$							
\$ --- CANARD SPINDLE BARS (GRID 3138 IS SPINDLE TIP)							
\$							
CBAR	3701	3701	3133	3120	0.	0.	1.
CBAR	3702	3701	3120	3138	0.	0.	1.
CBAR	3703	3701	3120	3149	0.	0.	1.
\$							
\$:CQUAD4-EID-----PID-----G1-----G2-----G3-----G4-----THETA---ZOFFS---							
\$							
CQUAD4	3001	1003	3091	3001	3002	3092	1
CQUAD4	3002	1003	3092	3002	3003	3093	1
CQUAD4	3003	1	3093	3003	3004	3094	1
CQUAD4	3004	1	3094	3004	3005	3095	1
CQUAD4	3005	1	3095	3005	3006	3096	1
CQUAD4	3006	1	3096	3006	3007	3097	1
CQUAD4	3007	1	3097	3007	3008	3098	1

CQUAD4	3008	1	3098	3008	3009	3099	1
CQUAD4	3009	1003	3099	3009	3010	3100	1
CQUAD4	3010	1003	3100	3010	3011	3101	1
\$							
CQUAD4	3021	1003	3141	3091	3092	3142	1
CQUAD4	3022	1003	3142	3092	3093	3143	1
CQUAD4	3023	1	3143	3093	3094	3144	1
CQUAD4	3024	1	3144	3094	3095	3145	1
CQUAD4	3025	1	3145	3095	3096	3166	1
CQUAD4	3026	1	3166	3096	3097	3172	1
CQUAD4	3027	1	3172	3097	3098	3153	1
CQUAD4	3028	1	3153	3098	3099	3154	1
CQUAD4	3029	1003	3154	3099	3100	3155	1
CQUAD4	3030	1003	3155	3100	3101	3156	1
\$							
CQUAD4	3041	1003	3191	3141	3142	3192	1
CQUAD4	3042	1003	3192	3142	3143	3193	1
CQUAD4	3043	1	3193	3143	3144	3194	1
CQUAD4	3044	1	3194	3144	3145	3195	1
CQUAD4	3045	1	3195	3145	3146	3196	1
CQUAD4	3046	1	3196	3146	3147	3197	1
CQUAD4	3047	1	3197	3147	3148	3198	1
CQUAD4	3048	1	3198	3148	3149	3199	1
CQUAD4	3049	1	3199	3149	3150	3200	1
CQUAD4	3051	1	3200	3151	3152	3201	1
CQUAD4	3052	1	3201	3152	3153	3202	1
CQUAD4	3053	1	3202	3153	3154	3203	1
CQUAD4	3054	1003	3203	3154	3155	3204	1
CQUAD4	3055	1003	3204	3155	3156	3205	1
\$							
CQUAD4	3061	1003	3241	3191	3192	3242	1
CQUAD4	3062	1003	3242	3192	3193	3243	1
CQUAD4	3063	1	3243	3193	3194	3244	1
CQUAD4	3064	1	3244	3194	3195	3245	1
CQUAD4	3066	1	3245	3196	3197	3246	1
CQUAD4	3067	1	3246	3197	3198	3247	1
CQUAD4	3068	1	3247	3198	3199	3248	1
CQUAD4	3069	1	3248	3199	3200	3249	1
CQUAD4	3070	1	3249	3200	3201	3250	1
CQUAD4	3072	1	3250	3202	3203	3251	1
CQUAD4	3073	1003	3251	3203	3204	3252	1
CQUAD4	3074	1003	3252	3204	3205	3253	1
\$							
CQUAD4	3081	1003	3291	3241	3242	3292	1
CQUAD4	3082	1003	3292	3242	3243	3293	1
CQUAD4	3083	1	3293	3243	3244	3294	1
CQUAD4	3084	1	3294	3244	3245	3295	1
CQUAD4	3085	1	3295	3245	3246	3296	1
CQUAD4	3086	1	3296	3246	3247	3297	1
CQUAD4	3087	1	3297	3247	3248	3298	1
CQUAD4	3088	1	3298	3248	3249	3299	1
CQUAD4	3089	1	3299	3249	3250	3300	1
CQUAD4	3090	1	3300	3250	3251	3301	1
CQUAD4	3091	1003	3301	3251	3252	3302	1

CQUAD4	3092	1003	3302	3252	3253	3303	1
\$							
CQUAD4	3101	1003	3341	3291	3292	3342	1
CQUAD4	3102	1003	3342	3292	3293	3343	1
CQUAD4	3103	1	3343	3293	3294	3344	1
CQUAD4	3104	1	3344	3294	3295	3345	1
CQUAD4	3105	1	3345	3295	3296	3346	1
CQUAD4	3106	1	3346	3296	3297	3347	1
CQUAD4	3107	1	3347	3297	3298	3348	1
CQUAD4	3108	1	3348	3298	3299	3349	1
CQUAD4	3109	1	3349	3299	3300	3350	1
CQUAD4	3110	1	3350	3300	3301	3351	1
CQUAD4	3111	1003	3351	3301	3302	3352	1
CQUAD4	3112	1003	3352	3302	3303	3353	1
\$							
\$ --- BHD 330							
\$							
CQUAD4	3121	1003	3002	3001	3012	3013	2
CQUAD4	3122	1003	3003	3002	3013	3014	2
CQUAD4	3123	1003	3004	3003	3014	3005	2
CQUAD4	3124	1003	3013	3012	3015	3016	2
CQUAD4	3125	1003	3014	3013	3016	3017	2
CQUAD4	3126	1003	3005	3014	3017	3006	2
CQUAD4	3127	1003	3016	3015	3018	3019	2
CQUAD4	3129	1003	3020	3021	3017	3019	2
CQUAD4	3130	1003	3006	3017	3021	3007	2
CQUAD4	3131	1003	3021	3020	3022	3023	2
CQUAD4	3132	1003	3007	3021	3023	3008	2
CQUAD4	3133	1003	3024	3025	3023	3022	2
CQUAD4	3134	1003	3025	3009	3008	3023	2
CQUAD4	3136	1003	3025	3027	3010	3009	2
CQUAD4	3137	1003	3024	3026	3028	3027	2
CQUAD4	3138	1003	3027	3028	3011	3010	2
\$							
\$ --- FRAME 360							
\$							
CQUAD4	3141	1003	3091	3092	3103	3102	2
CQUAD4	3142	1003	3092	3093	3104	3103	2
CQUAD4	3143	1003	3093	3094	3095	3104	2
CQUAD4	3144	1003	3104	3095	3096	3105	2
CQUAD4	3145	1003	3105	3096	3097	3106	2
CQUAD4	3146	1003	3107	3106	3109	3108	2
CQUAD4	3147	1003	3106	3097	3110	3109	2
CQUAD4	3148	1003	3098	3111	3110	3097	2
CQUAD4	3149	1003	3099	3112	3111	3098	2
CQUAD4	3151	1003	3113	3112	3100	3101	2
\$							
\$ --- BHD 390							
\$							
CQUAD4	3161	1003	3141	3142	3158	3157	2
CQUAD4	3162	1003	3142	3143	3159	3158	2
CQUAD4	3163	1003	3145	3159	3143	3144	2
CQUAD4	3164	1003	3157	3158	3164	3163	2
CQUAD4	3165	1003	3158	3159	3165	3164	2

CQUAD4	3166	1003	3159	3145	3166	3165	2
CQUAD4	3167	1003	3167	3166	3145	3160	2
CQUAD4	3168	1003	3145	3146	3161	3160	2
CQUAD4	3169	1003	3162	3161	3146	3147	2
CQUAD4	3170	1003	3148	3168	3162	3147	2
CQUAD4	3171	1003	3168	3148	3149	3176	2
CQUAD4	3172	1003	3175	3176	3149	3150	2
CQUAD4	3173	1003	3174	3175	3150	3151	2
CQUAD4	3174	1003	3173	3174	3151	3152	2
CQUAD4	3175	1003	3172	3173	3152	3153	2
CQUAD4	3176	1003	3163	3164	3170	3169	2
CQUAD4	3177	1003	3164	3165	3171	3170	2
CQUAD4	3178	1003	3165	3166	3172	3171	2
CQUAD4	3179	1003	3166	3167	3173	3172	2
CQUAD4	3180	1003	3169	3170	3180	3179	2
CQUAD4	3182	1003	3171	3172	3181	3180	2
CQUAD4	3183	1003	3153	3182	3181	3172	2
CQUAD4	3184	1003	3154	3183	3182	3153	2
CQUAD4	3185	1003	3154	3155	3184	3183	2
CQUAD4	3186	1003	3155	3156	3185	3184	2
CQUAD4	3187	1003	3185	3156	3177	3178	2
CQUAD4	3188	1003	3178	3177	3169	3179	2

\$

\$ --- FRAME 420

\$

CQUAD4	3191	1003	3191	3192	3207	3206	2
CQUAD4	3192	1003	3192	3193	3208	3207	2
CQUAD4	3193	1003	3195	3208	3193	3194	2
CQUAD4	3194	1003	3208	3195	3212	3211	2
CQUAD4	3195	1003	3195	3196	3213	3212	2
CQUAD4	3196	1003	3197	3214	3213	3196	2
CQUAD4	3197	1003	3214	3197	3198	3215	2
CQUAD4	3198	1003	3215	3198	3199	3216	2
CQUAD4	3199	1003	3216	3199	3200	3217	2
CQUAD4	3200	1003	3218	3217	3200	3201	2
CQUAD4	3201	1003	3201	3202	3227	3218	2
CQUAD4	3203	1003	3229	3228	3202	3203	2
CQUAD4	3204	1003	3203	3204	3230	3229	2
CQUAD4	3205	1003	3204	3205	3231	3230	2
CQUAD4	3206	1003	3223	3224	3231	3205	2
CQUAD4	3208	1003	3222	3221	3225	3224	2
CQUAD4	3209	1003	3221	3219	3226	3225	2
CQUAD4	3210	1003	3219	3218	3227	3226	2

\$

\$ --- BHD 454

\$

CQUAD4	3221	1003	3241	3242	3255	3254	2
CQUAD4	3222	1003	3242	3243	3256	3255	2
CQUAD4	3223	1003	3257	3256	3243	3244	2
CQUAD4	3225	1003	3246	3258	3257	3245	2
CQUAD4	3226	1003	3258	3246	3247	3259	2
CQUAD4	3227	1003	3259	3247	3248	3260	2
CQUAD4	3228	1003	3248	3271	3261	3260	2
CQUAD4	3229	1003	3271	3248	3249	3272	2

CQUAD4	3230	1003	3249	3250	3273	3272	2
CQUAD4	3232	1003	3251	3252	3274	3273	2
CQUAD4	3233	1003	3275	3274	3252	3253	2
CQUAD4	3234	1003	3267	3268	3275	3253	2
CQUAD4	3235	1003	3264	3263	3268	3267	2
CQUAD4	3236	1003	3263	3262	3269	3268	2
CQUAD4	3238	1003	3271	3270	3262	3261	2
CQUAD4	3239	1003	3265	3266	3263	3264	2
CQUAD4	3240	1003	3254	3255	3266	3265	2

\$

\$ --- FRAME 475

\$

CQUAD4	3251	1003	3305	3304	3291	3292	2
CQUAD4	3252	1003	3306	3305	3292	3293	2
CQUAD4	3254	1003	3306	3294	3295	3307	2
CQUAD4	3255	1003	3307	3295	3296	3308	2
CQUAD4	3256	1003	3308	3296	3297	3309	2
CQUAD4	3257	1003	3309	3297	3298	3310	2
CQUAD4	3258	1003	3310	3298	3299	3311	2
CQUAD4	3259	1003	3312	3311	3299	3300	2
CQUAD4	3260	1003	3313	3312	3300	3301	2
CQUAD4	3261	1003	3314	3313	3301	3302	2
CQUAD4	3262	1003	3315	3314	3302	3303	2
CQUAD4	3271	1003	3102	3012	3013	3103	1
CQUAD4	3272	1003	3103	3013	3014	3104	1
CQUAD4	3273	1003	3104	3014	3005	3095	1
CQUAD4	3274	1003	3157	3102	3103	3158	1
CQUAD4	3275	1003	3158	3103	3104	3159	1
CQUAD4	3276	1003	3159	3104	3095	3145	1
CQUAD4	3277	1003	3206	3157	3158	3207	1
CQUAD4	3279	1003	3207	3159	3145	3208	1
CQUAD4	3280	1003	3208	3145	3160	3211	1
CQUAD4	3281	1003	3254	3206	3207	3255	1

\$

\$ --- SHEAR CONNECTION FROM INLET TO MAIN FUSELAGE

\$

CQUAD4	3299	1003	3096	3135	3134	3097	1
--------	------	------	------	------	------	------	---

\$

\$ --- INLET OUTER MOLD LINE SKINS

\$

CQUAD4	3303	1	3035	3061	3051	3036	1
CQUAD4	3304	1	3034	3062	3061	3035	1
CQUAD4	3305	1	3033	3052	3062	3034	1
CQUAD4	3306	1	3032	3042	3052	3033	1
CQUAD4	3311	1	3064	3042	3043	3065	1
CQUAD4	3312	1	3065	3043	3044	3066	1
CQUAD4	3313	1	3066	3044	3045	3067	1
CQUAD4	3314	1	3067	3045	3046	3068	1
CQUAD4	3315	1	3068	3046	3047	3069	1
CQUAD4	3316	1	3069	3047	3048	3070	1
CQUAD4	3317	1	3070	3048	3049	3071	1
CQUAD4	3318	1	3071	3049	3050	3072	1
CQUAD4	3319	1	3072	3050	3051	3073	1

CQUAD4	3320	1	3061	3083	3073	3051	1
CQUAD4	3321	1	3062	3084	3083	3061	1
CQUAD4	3322	1	3052	3074	3084	3062	1
CQUAD4	3323	1	3074	3052	3042	3064	1
\$							
CQUAD4	3331	1	3115	3064	3065	3116	1
CQUAD4	3332	1	3116	3065	3066	3117	1
CQUAD4	3333	1	3117	3066	3067	3118	1
CQUAD4	3334	1	3118	3067	3068	3119	1
CQUAD4	3335	1	3119	3068	3069	3120	1
CQUAD4	3336	1	3120	3069	3070	3121	1
CQUAD4	3337	1	3121	3070	3071	3122	1
CQUAD4	3338	1	3122	3071	3072	3123	1
CQUAD4	3339	1	3123	3072	3073	3124	1
CQUAD4	3340	1	3124	3073	3083	3134	1
CQUAD4	3341	1	3134	3083	3084	3135	1
CQUAD4	3342	1	3135	3084	3074	3125	1
CQUAD4	3343	1	3125	3074	3064	3115	1
\$							
CQUAD4	3352	1	3145	3116	3117	3146	1
CQUAD4	3353	1	3146	3117	3118	3147	1
CQUAD4	3354	1	3147	3118	3119	3148	1
CQUAD4	3355	1	3148	3119	3120	3149	1
CQUAD4	3356	1	3149	3120	3121	3150	1
CQUAD4	3357	1	3150	3121	3122	3151	1
CQUAD4	3358	1	3151	3122	3123	3152	1
CQUAD4	3359	1	3152	3123	3124	3153	1
\$							
\$ --- INLET FRAMES							
\$							
CQUAD4	3361	1003	3035	3059	3049	3036	2
CQUAD4	3362	1003	3032	3044	3054	3033	2
CQUAD4	3363	1003	3042	3043	3053	3052	2
CQUAD4	3364	1003	3043	3044	3054	3053	2
CQUAD4	3365	1003	3044	3045	3055	3054	2
CQUAD4	3366	1003	3046	3056	3055	3045	2
CQUAD4	3367	1003	3056	3046	3047	3057	2
CQUAD4	3368	1003	3057	3047	3048	3058	2
CQUAD4	3369	1003	3048	3049	3059	3058	2
CQUAD4	3370	1003	3060	3059	3049	3050	2
CQUAD4	3371	1003	3061	3060	3050	3051	2
CQUAD4	3372	1003	3062	3063	3060	3061	2
CQUAD4	3373	1003	3052	3053	3063	3062	2
\$							
CQUAD4	3381	1003	3064	3065	3075	3074	2
CQUAD4	3382	1003	3065	3066	3076	3075	2
CQUAD4	3383	1003	3066	3067	3077	3076	2
CQUAD4	3384	1003	3068	3078	3077	3067	2
CQUAD4	3385	1003	3078	3068	3069	3079	2
CQUAD4	3386	1003	3079	3069	3070	3080	2
CQUAD4	3387	1003	3081	3080	3070	3071	2
CQUAD4	3388	1003	3082	3081	3071	3072	2
CQUAD4	3389	1003	3083	3082	3072	3073	2
CQUAD4	3390	1003	3084	3085	3082	3083	2

CQUAD4	3391	1003	3074	3075	3085	3084	2
\$							
CQUAD4	3401	1003	3115	3116	3126	3125	2
CQUAD4	3402	1003	3116	3117	3127	3126	2
CQUAD4	3403	1003	3117	3118	3128	3127	2
CQUAD4	3404	1003	3119	3129	3128	3118	2
CQUAD4	3405	1003	3129	3119	3120	3130	2
CQUAD4	3406	1003	3131	3130	3120	3121	2
CQUAD4	3407	1003	3132	3131	3121	3122	2
CQUAD4	3408	1003	3133	3132	3122	3123	2
CQUAD4	3409	1003	3134	3133	3123	3124	2
CQUAD4	3410	1003	3135	3136	3133	3134	2
CQUAD4	3411	1003	3125	3126	3136	3135	2

\$

\$ --- RALS DUCT TUNNEL SKIN

\$

CQUAD4	3801	1	3108	3018	3019	3109	1
CQUAD4	3802	1	3109	3019	3020	3110	1
CQUAD4	3803	1	3110	3020	3022	3111	1
CQUAD4	3804	1	3111	3022	3024	3112	1
CQUAD4	3805	1	3112	3024	3026	3113	1

\$

CQUAD4	3811	1	3179	3108	3109	3180	1
CQUAD4	3812	1	3180	3109	3110	3181	1
CQUAD4	3813	1	3181	3110	3111	3182	1
CQUAD4	3814	1	3182	3111	3112	3183	1
CQUAD4	3816	1	3184	3112	3113	3185	1
CQUAD4	3817	1	3185	3113	3114	3178	1
CQUAD4	3818	1	3178	3114	3108	3179	1

\$

CQUAD4	3821	1	3225	3179	3180	3226	1
CQUAD4	3822	1	3226	3180	3181	3227	1
CQUAD4	3823	1	3227	3181	3182	3228	1
CQUAD4	3824	1	3228	3182	3183	3229	1
CQUAD4	3825	1	3229	3183	3184	3230	1
CQUAD4	3826	1	3230	3184	3185	3231	1
CQUAD4	3827	1	3231	3185	3178	3224	1
CQUAD4	3828	1	3224	3178	3179	3225	1

\$

CQUAD4	3831	1	3269	3225	3226	3270	1
CQUAD4	3832	1	3270	3226	3227	3271	1
CQUAD4	3833	1	3271	3227	3228	3272	1
CQUAD4	3834	1	3272	3228	3229	3273	1
CQUAD4	3835	1	3273	3229	3230	3274	1
CQUAD4	3836	1	3274	3230	3231	3275	1
CQUAD4	3837	1	3275	3231	3224	3268	1
CQUAD4	3838	1	3268	3224	3225	3269	1

\$

CQUAD4	3851	1	3153	3098	3111	3182	1
CQUAD4	3852	1	3184	3112	3100	3155	1
CQUAD4	3853	1	3230	3184	3155	3204	1
CQUAD4	3854	1	3204	3252	3274	3230	1

\$

\$ --- INLET DUCT INNER SKIN

\$							
CQUAD4	3902	1	3034	3063	3060	3035	1
CQUAD4	3903	1	3033	3053	3063	3034	1
\$							
CQUAD4	3911	1	3075	3053	3054	3076	1
CQUAD4	3912	1	3076	3054	3055	3077	1
CQUAD4	3913	1	3077	3055	3056	3078	1
CQUAD4	3914	1	3078	3056	3057	3079	1
CQUAD4	3915	1	3079	3057	3058	3080	1
CQUAD4	3916	1	3080	3058	3059	3081	1
CQUAD4	3917	1	3081	3059	3060	3082	1
CQUAD4	3918	1	3063	3085	3082	3060	1
CQUAD4	3919	1	3053	3075	3085	3063	1
\$							
CQUAD4	3921	1	3126	3075	3076	3127	1
CQUAD4	3922	1	3127	3076	3077	3128	1
CQUAD4	3923	1	3128	3077	3078	3129	1
CQUAD4	3924	1	3129	3078	3079	3130	1
CQUAD4	3925	1	3130	3079	3080	3131	1
CQUAD4	3926	1	3131	3080	3081	3132	1
CQUAD4	3927	1	3132	3081	3082	3133	1
CQUAD4	3928	1	3133	3082	3085	3136	1
CQUAD4	3929	1	3136	3085	3075	3126	1
\$							
CQUAD4	3931	1	3160	3126	3127	3161	1
CQUAD4	3932	1	3161	3127	3128	3162	1
CQUAD4	3933	1	3162	3128	3129	3168	1
CQUAD4	3934	1	3168	3129	3130	3176	1
CQUAD4	3935	1	3176	3130	3131	3175	1
CQUAD4	3936	1	3175	3131	3132	3174	1
CQUAD4	3937	1	3174	3132	3133	3173	1
CQUAD4	3938	1	3173	3133	3136	3167	1
CQUAD4	3939	1	3167	3136	3126	3160	1
\$							
CQUAD4	3941	1	3211	3160	3161	3212	1
CQUAD4	3943	1	3213	3161	3162	3214	1
CQUAD4	3944	1	3214	3162	3168	3215	1
CQUAD4	3945	1	3215	3168	3176	3216	1
CQUAD4	3946	1	3216	3176	3175	3217	1
CQUAD4	3948	1	3217	3174	3173	3218	1
CQUAD4	3950	1	3220	3167	3173	3219	1
CQUAD4	3951	1	3211	3160	3167	3220	1
\$							
CQUAD4	3961	1	3255	3211	3212	3256	1
CQUAD4	3962	1	3256	3212	3213	3257	1
CQUAD4	3963	1	3257	3213	3214	3258	1
CQUAD4	3964	1	3258	3214	3215	3259	1
CQUAD4	3965	1	3259	3215	3216	3260	1
CQUAD4	3966	1	3260	3216	3217	3261	1
CQUAD4	3967	1	3261	3217	3218	3262	1
CQUAD4	3968	1	3262	3218	3219	3263	1
CQUAD4	3969	1	3266	3220	3219	3263	1
CQUAD4	3970	1	3255	3211	3220	3266	1
\$							

CQUAD4	3971	1	3316	3255	3256	3317	1
CQUAD4	3972	1	3317	3256	3257	3318	1
CQUAD4	3973	1	3318	3257	3258	3319	1
CQUAD4	3974	1	3319	3258	3259	3320	1
CQUAD4	3975	1	3320	3259	3260	3321	1
CQUAD4	3976	1	3321	3260	3261	3322	1
CQUAD4	3977	1	3322	3261	3262	3323	1
CQUAD4	3978	1	3323	3262	3263	3324	1
CQUAD4	3979	1	3324	3263	3266	3325	1
CQUAD4	3980	1	3325	3266	3255	3316	1
\$							
CQUAD4	3981	1	3354	3316	3317	3355	1
CQUAD4	3982	1	3355	3317	3318	3356	1
CQUAD4	3983	1	3356	3318	3319	3357	1
CQUAD4	3984	1	3357	3319	3320	3358	1
CQUAD4	3985	1	3358	3320	3321	3359	1
CQUAD4	3986	1	3359	3321	3322	3360	1
CQUAD4	3987	1	3360	3322	3323	3361	1
CQUAD4	3988	1	3361	3323	3324	3362	1
\$							
\$:CTRIA3-EID----PID-----G1-----G2-----G3-----THETA---ZOFFS-----							
\$							
CTRIA3	3050	1	3200	3150	3151	1	
CTRIA3	3065	1	3245	3195	3196	1	
CTRIA3	3071	1	3250	3201	3202	1	
\$							
CTRIA3	3128	1003	3017	3016	3019	2	
CTRIA3	3135	1003	3027	3025	3024	2	
CTRIA3	3150	1003	3112	3099	3100	2	
CTRIA3	3181	1003	3170	3171	3180	2	
CTRIA3	3202	1003	3202	3228	3227	2	
CTRIA3	3207	1003	3224	3223	3222	2	
CTRIA3	3224	1003	3245	3257	3244	2	
CTRIA3	3231	1003	3250	3251	3273	2	
CTRIA3	3237	1003	3270	3269	3262	2	
CTRIA3	3253	1003	3294	3306	3293	2	
\$							
CTRIA3	3278	1003	3207	3158	3159	1	
CTRIA3	3282	1003	3255	3207	3208	1	
CTRIA3	3283	1003	3255	3208	3211	1	
\$							
CTRIA3	3301	1	3036	3050	3049	1	
CTRIA3	3302	1	3036	3051	3050	1	
CTRIA3	3307	1	3042	3032	3043	1	
CTRIA3	3308	1	3043	3032	3044	1	
CTRIA3	3351	1	3145	3115	3116	1	
\$							
CTRIA3	3815	1	3183	3112	3184	1	
\$							
CTRIA3	3901	1	3035	3060	3059	1	
CTRIA3	3904	1	3053	3033	3054	1	
CTRIA3	3942	1	3212	3161	3213	1	
CTRIA3	3947	1	3217	3175	3174	1	
CTRIA3	3949	1	3218	3173	3219	1	

\$
 \$: CONM2-EID-----G-----CID-----M-----X1-----X2-----X3-----
 \$
 CONM2 30181 3018 .0172
 CONM2 30201 3020 .0172
 CONM2 30261 3026 .0172
 \$
 CONM2 31081 3108 .0172
 CONM2 31101 3110 .0172
 CONM2 31131 3113 .0172
 \$
 CONM2 31791 3179 .0172
 CONM2 31811 3181 .0172
 CONM2 31841 3184 .0172
 \$
 CONM2 32251 3225 .0172
 CONM2 32271 3227 .0172
 CONM2 32301 3230 .0172
 \$
 CONM2 32681 3263 .0172
 CONM2 32721 3272 .0172
 CONM2 32741 3274 .0172
 \$
 CONM2 31381 3138 .4132
 CONM2 31321 3132 .2409
 CONM2 32171 3217 .6528
 \$
 CONM2 30911 3091 .4786
 CONM2 30921 3092 .4786
 \$
 CONM2 32911 3291 .4786
 CONM2 32921 3292 .4786
 \$
 CONM2 32701 3270 .2902
 CONM2 30131 3013 .2254
 \$
 CONM2 31911 3191 .0256
 CONM2 33411 3341 .0456
 \$
 CONM2 30121 3012 .2062
 CONM2 30132 3013 .2062
 CONM2 30141 3014 .2062
 CONM2 30051 3005 .2062
 \$
 CONM2 31021 3102 .4434
 CONM2 31032 3103 .4434
 CONM2 31041 3104 .4434
 CONM2 30951 3095 .4434
 \$
 CONM2 31571 3157 .5133
 CONM2 31582 3158 .5133
 CONM2 31591 3159 .5133
 CONM2 31451 3145 .5133
 \$

```

CONM2  31621  3162      .0526
CONM2  31471  3147      .0526
$
CONM2  32061  3206      .5075
CONM2  32071  3207      .5075
CONM2  32081  3208      .5075
$
CONM2  32141  3214      .2238
CONM2  31971  3197      .2238
$
CONM2  32541  3254      .1201
CONM2  32551  3255      .1201
$
CONM2  32581  3258      .2014
CONM2  32461  3246      .2014
$
$:SPC1--SID-----C-----G1-----G2-----G3-----G4-----G5-----G6-----
$
SPC1    10      246      3001      3012      3015      3018      3026      3028
SPC1    10      246      3011      3042      3036      3049      3063      3062
SPC1    10      246      3091      3102      3107      3108      3114      3113
SPC1    10      246      3101      3094      3121
SPC1    10      246      3141      3157      3163      3169      3177      3156
SPC1    10      246      3191      3206      3223      3205      3174
SPC1    10      246      3241      3254      3265      3264      3267      3253
SPC1    10      246      3291      3304      3316      3325      3324      3315
SPC1    10      246      3303      3341      3354      3362      3353
$
$ --- GRIDS FIXED IN FORE/AFT DIRECTION DUE TO MEMBRANE ONLY STIFFNESS
$ --- OF BULKHEADS AND FRAMES
$
SPC1    10      1      3015      3016      3017      3021      3023
SPC1    10      1      3105      3106      3107
SPC1    10      1      3163      3164      3165      3169      3170      3171
SPC1    10      1      3177      3221      3222      3223
SPC1    10      1      3264      3265      3267
SPC1    10      1      3304      3305      3306      3307      3308      3309
SPC1    10      1      3310      3311      3312      3313      3314      3315
$
$ - - - - -
$
$ --- AFT FUSEL SECTION
$
$ --- PBAR BELOW IS FOR NONDESIGNED FWD ENGINE MOUNT
$
$:PBAR--PID-----MID-----A-----I1-----I2-----J-----NSM-----
$PBAR    4655    4340    0.3    1.    1.    .1
$
$ --- PROD BELOW IS FOR THE ROD ABOVE THE CUTOUT IN BHD 495
$
$:PROD--PID-----MID-----A-----J-----C-----NSM-----TMIN-----
$PROD    4114    2024    .5
$
$

```

\$ --- MPC BELOW: CONNECT AFT BODY TO WING
 \$ --- (ALL LUGS HAVE VERTICAL AND LATERAL FORCE +
 \$ --- DRAG LOAD AT LWR STA 495.5 ONLY)

\$
 \$:MPC---SID-----GO-----CO-----AO-----G-----C-----A----- CONTINUE

\$ --- STA 495.5

MPC	55	1005	1	-1.	4006	1	1.
MPC	55	1005	2	-1.	4006	2	1.
MPC	55	1005	3	-1.	4006	3	1.

MPC	55	1006	2	-1.	4008	2	1.
MPC	55	1006	3	-1.	4008	3	1.

\$
 \$ --- STA 545.

MPC	55	1009	2	-1.	4066	2	1.
MPC	55	1009	3	-1.	4066	3	1.

MPC	55	1010	2	-1.	4068	2	1.
MPC	55	1010	3	-1.	4068	3	1.

\$
 \$ --- STA 581.

MPC	55	1011	2	-1.	4096	2	1.
MPC	55	1011	3	-1.	4096	3	1.

MPC	55	1012	2	-1.	4098	2	1.
MPC	55	1012	3	-1.	4098	3	1.

\$
 \$ --- STA 615.

MPC	55	1013	2	-1.	4126	2	1.
MPC	55	1013	3	-1.	4126	3	1.

MPC	55	1014	2	-1.	4128	2	1.
MPC	55	1014	3	-1.	4128	3	1.

\$
 \$:GRID---ID-----CP-----X1-----X2-----X3-----CD-----PS-----SEID-----

GRID	4001		495.5	0.	-23.913		
GRID	4002		495.5	12.286	-23.8		
GRID	4003		495.5	25.088	-22.556		
GRID	4004		495.5	31.342	-14.809		
GRID	4005		495.5	32.303	-4.502		
GRID	4006		495.5	34.909	1.435		
GRID	4007		495.5	34.909	9.993		
GRID	4008		495.5	34.909	19.45		
GRID	4009		495.5	32.87	32.96		
GRID	4010		495.5	28.258	38.37		
GRID	4011		495.5	21.755	42.668		
GRID	4012		495.5	14.119	44.431		
GRID	4013		495.5	0.	45.007		
GRID	4014		495.5	0.	-17.692		
GRID	4015		495.5	12.287	-17.636		
GRID	4016		495.5	20.859	-14.966		
GRID	4017		495.5	0.	-11.472		
GRID	4018		495.5	12.287	-11.472		
GRID	4019		495.5	16.631	-7.376		

GRID	4020	495.5	23.361	0.966
GRID	4021	495.5	24.749	5.712
GRID	4022	495.5	25.188	10.14
GRID	4023	495.5	25.322	19.59
GRID	4024	495.5	25.152	27.613
GRID	4025	495.5	22.673	32.751
GRID	4026	495.5	18.141	36.633
GRID	4027	495.5	13.899	38.607
GRID	4028	495.5	0.	38.807

\$

GRID	4031	520.25	0.	-23.725
GRID	4032	520.25	13.252	-23.606
GRID	4033	520.25	26.109	-22.345
GRID	4034	520.25	31.476	-14.809
GRID	4035	520.25	32.52	-5.861
GRID	4036	520.25	34.923	1.438
GRID	4037	520.25	34.995	9.993
GRID	4038	520.25	35.067	18.616
GRID	4039	520.25	31.614	30.899
GRID	4040	520.25	28.46	37.22
GRID	4041	520.25	20.871	42.381
GRID	4042	520.25	13.29	44.14
GRID	4043	520.25	0.	44.788
GRID	4044	520.25	0.	-19.73
GRID	4045	520.25	13.25	-19.61
GRID	4046	520.25	25.11	-18.05
GRID	4047	520.25	27.48	-14.81
GRID	4048	520.25	28.81	-5.852
GRID	4049	520.25	29.15	1.44
GRID	4050	520.25	29.41	9.99
GRID	4051	520.25	29.19	18.58
GRID	4052	520.25	27.48	30.29
GRID	4053	520.25	26.04	33.54
GRID	4054	520.25	19.39	38.70
GRID	4055	520.25	12.98	40.16
GRID	4056	520.25	0.0	40.79

\$

\$ --- ENGINE MOUNT GRID POINT FOR MASS AND LOAD APPLICATION

\$:GRID--ID-----CP-----X1-----X2-----X3-----CD-----PS-----SEID--

GRID	4058	530.	24.	0.	0
------	------	------	-----	----	---

\$

GRID	4061	545.	0.	-23.067
GRID	4062	545.	13.026	-22.954
GRID	4063	545.	25.976	-21.785
GRID	4064	545.	31.764	-15.947
GRID	4065	545.	32.738	-7.22
GRID	4066	545.	34.909	1.44
GRID	4067	545.	34.909	9.969
GRID	4068	545.	34.909	17.783
GRID	4069	545.	31.736	27.883
GRID	4070	545.	28.665	36.062
GRID	4071	545.	21.777	41.31
GRID	4072	545.	13.222	43.246
GRID	4073	545.	0.	43.85

GRID	4074	545.	0.	-17.067
GRID	4075	545.	12.695	-16.425
GRID	4076	545.	22.213	-14.511
GRID	4077	545.	24.744	-11.401
GRID	4078	545.	26.248	-6.795
GRID	4079	545.	26.448	1.611
GRID	4080	545.	26.627	10.494
GRID	4081	545.	26.777	17.947
GRID	4082	545.	25.723	25.625
GRID	4083	545.	22.631	30.811
GRID	4084	545.	18.03	34.529
GRID	4085	545.	12.242	36.475
GRID	4086	545.	0.	36.65
\$				
GRID	4091	581.	0.	-20.924
GRID	4092	581.	12.349	-20.818
GRID	4093	581.	24.655	-19.911
GRID	4094	581.	31.183	-15.271
GRID	4095	581.	32.49	-6.953
GRID	4096	581.	34.909	1.44
GRID	4097	581.	34.909	9.935
GRID	4098	581.	34.909	16.578
GRID	4099	581.	31.817	26.781
GRID	4100	581.	28.698	34.539
GRID	4101	581.	21.55	38.741
GRID	4102	581.	13.222	40.005
GRID	4103	581.	0.	40.403
GRID	4104	581.	0.	-14.924
GRID	4105	581.	12.213	-14.818
GRID	4106	581.	20.79	-13.511
GRID	4107	581.	23.537	-10.741
GRID	4108	581.	24.655	-6.663
GRID	4109	581.	24.655	1.44
GRID	4110	581.	24.655	9.935
GRID	4111	581.	24.655	16.578
GRID	4112	581.	24.655	21.93
GRID	4113	581.	22.089	29.345
GRID	4114	581.	18.267	32.536
GRID	4115	581.	12.655	33.93
GRID	4116	581.	0.	33.93
\$				
GRID	4121	615.	0.	-17.374
GRID	4122	615.	11.76	-17.306
GRID	4123	615.	23.5	-16.672
GRID	4124	615.	30.226	-13.464
GRID	4125	615.	31.952	-6.015
GRID	4126	615.	34.909	1.44
GRID	4127	615.	34.909	9.903
GRID	4128	615.	34.909	15.44
GRID	4129	615.	31.513	24.804
GRID	4130	615.	27.962	31.457
GRID	4131	615.	20.901	34.202
GRID	4132	615.	13.222	34.928
GRID	4133	615.	0.	35.164

GRID	4134	615.	0.	-11.374
GRID	4135	615.	11.651	-11.306
GRID	4136	615.	20.633	-10.594
GRID	4137	615.	22.73	-8.738
GRID	4138	615.	23.5	-6.051
GRID	4139	615.	23.5	1.44
GRID	4140	615.	23.5	9.409
GRID	4141	615.	23.5	15.44
GRID	4142	615.	22.955	22.133
GRID	4143	615.	20.946	25.96
GRID	4144	615.	17.682	28.844
GRID	4145	615.	11.5	30.559
GRID	4146	615.	0.	30.559

\$

GRID	4151	648.5	0.	-12.081
GRID	4152	648.5	11.698	-11.831
GRID	4153	648.5	23.4	-11.601
GRID	4154	648.5	29.436	-9.654
GRID	4155	648.5	31.188	-3.536
GRID	4156	648.5	31.463	2.94
GRID	4157	648.5	31.506	9.422
GRID	4158	648.5	31.383	15.903
GRID	4159	648.5	30.44	22.296
GRID	4160	648.5	26.082	26.724
GRID	4161	648.5	19.695	27.764
GRID	4162	648.5	13.223	28.136
GRID	4163	648.5	0.	28.227

\$

GRID	4164	648.5	0.	-8.028
GRID	4165	648.5	11.65	-7.962
GRID	4166	648.5	23.23	-7.666
GRID	4167	648.5	26.71	-6.414
GRID	4168	648.5	27.14	-4.421
GRID	4169	648.5	27.14	2.898
GRID	4170	648.5	27.14	9.397
GRID	4171	648.5	27.14	15.955
GRID	4172	648.5	26.72	21.06
GRID	4173	648.5	24.25	23.19
GRID	4174	648.5	19.70	23.76
GRID	4175	648.5	13.22	24.14
GRID	4176	648.5	0.	24.23

\$

\$: CONROD-EID----G1-----G2-----MID-----A-----J-----C-----NSM-----

\$: CROD--EID-----PID-----G1-----G2-----TMAX-----

\$

\$ --- BHD 495.5 ROD ABOVE ENGINE ACCESSORY DRIVE

CROD	4114	4114	4018	4017
------	------	------	------	------

\$

\$ --- AFT FUSELAGE LONGERONS

\$

\$ --- LOWER

\$

CROD	4501	1	4003	4033
CROD	4502	1	4033	4063

CROD	4503	1	4063	4093
CROD	4504	1	4093	4123
CROD	4505	1	4123	4153

\$
\$ --- UPPER
\$

CROD	4511	1	4010	4040
CROD	4512	1	4040	4070
CROD	4513	1	4070	4100
CROD	4514	1	4100	4130
CROD	4515	1	4130	4160
CROD	4521	1	4012	4042

\$
\$ --- WING LUG STIFFENERS
\$ --- LOWER
\$

CROD	4531	1	4006	4036
CROD	4532	1	4036	4066
CROD	4533	1	4066	4096
CROD	4534	1	4096	4126

\$
\$ --- UPPER
\$

CROD	4541	1	4008	4038
CROD	4542	1	4038	4068
CROD	4543	1	4068	4098
CROD	4544	1	4098	4128

\$
\$ --- CBARS BELOW CONNECT FWD ENGINE MOUNT GRID 4058 TO THE FUSELAGE STRUCTURE
\$ --- NON-DESIGNED WITH PIN ENDS AT THE FRAME CONNECTION GRIDS
\$

\$:CBAR--EID----	PID-----	GA-----	GB-----	X1,G0----	X2-----	X3-----	
CBAR 4655	4655	4036	4058	0.	1.	0.	+CB4655
+CB4655 456							
CBAR 4656	4655	4038	4058	0.	1.	0.	+CB4656
+CB4656 456							
CBAR 4657	4655	4066	4058	0.	1.	0.	+CB4657
+CB4657 456							
CBAR 4658	4655	4068	4058	0.	1.	0.	+CB4658
+CB4658 456							

\$: +CBAR-PA-----PB-----W1A-----W2A-----W3A-----W1B-----W2B-----W3B-----

\$
\$:CQUAD4-EID----PID-----G1-----G2-----G3-----G4-----THETA---ZOFFS---

CQUAD4	4001	1003	4031	4001	4002	4032	1
CQUAD4	4002	1003	4032	4002	4003	4033	1
CQUAD4	4003	1	4033	4003	4004	4034	1
CQUAD4	4004	1	4034	4004	4005	4035	1
CQUAD4	4005	1	4035	4005	4006	4036	1
CQUAD4	4006	1	4036	4006	4007	4037	1
CQUAD4	4007	1	4037	4007	4008	4038	1
CQUAD4	4008	1	4038	4008	4009	4039	1
CQUAD4	4009	1	4039	4009	4010	4040	1
CQUAD4	4010	1	4040	4010	4011	4041	1

CQUAD4	4011	1003	4041	4011	4012	4042	1
CQUAD4	4012	1003	4042	4012	4013	4043	1
\$							
CQUAD4	4021	1003	4061	4031	4032	4062	1
CQUAD4	4022	1003	4062	4032	4033	4063	1
CQUAD4	4023	1	4063	4033	4034	4064	1
CQUAD4	4024	1	4064	4034	4035	4065	1
CQUAD4	4025	1	4065	4035	4036	4066	1
CQUAD4	4026	1	4066	4036	4037	4067	1
CQUAD4	4027	1	4067	4037	4038	4068	1
CQUAD4	4028	1	4068	4038	4039	4069	1
CQUAD4	4029	1	4069	4039	4040	4070	1
CQUAD4	4030	1	4070	4040	4041	4071	1
CQUAD4	4031	1003	4071	4041	4042	4072	1
CQUAD4	4032	1003	4072	4042	4043	4073	1
\$							
CQUAD4	4041	1003	4091	4061	4062	4092	1
CQUAD4	4042	1003	4092	4062	4063	4093	1
CQUAD4	4043	1	4093	4063	4064	4094	1
CQUAD4	4044	1	4094	4064	4065	4095	1
CQUAD4	4045	1	4095	4065	4066	4096	1
CQUAD4	4046	1	4096	4066	4067	4097	1
CQUAD4	4047	1	4097	4067	4068	4098	1
CQUAD4	4048	1	4098	4068	4069	4099	1
CQUAD4	4049	1	4099	4069	4070	4100	1
CQUAD4	4050	1	4100	4070	4071	4101	1
CQUAD4	4051	1003	4101	4071	4072	4102	1
CQUAD4	4052	1003	4102	4072	4073	4103	1
\$							
CQUAD4	4061	1003	4121	4091	4092	4122	1
CQUAD4	4062	1003	4122	4092	4093	4123	1
CQUAD4	4063	1	4123	4093	4094	4124	1
CQUAD4	4064	1	4124	4094	4095	4125	1
CQUAD4	4065	1	4125	4095	4096	4126	1
CQUAD4	4066	1	4126	4096	4097	4127	1
CQUAD4	4067	1	4127	4097	4098	4128	1
CQUAD4	4068	1	4128	4098	4099	4129	1
CQUAD4	4069	1	4129	4099	4100	4130	1
CQUAD4	4070	1	4130	4100	4101	4131	1
CQUAD4	4071	1003	4131	4101	4102	4132	1
CQUAD4	4072	1003	4132	4102	4103	4133	1
\$							
CQUAD4	4081	1003	4151	4121	4122	4152	1
CQUAD4	4082	1003	4152	4122	4123	4153	1
CQUAD4	4083	1	4153	4123	4124	4154	1
CQUAD4	4084	1	4154	4124	4125	4155	1
CQUAD4	4085	1	4155	4125	4126	4156	1
CQUAD4	4086	1	4156	4126	4127	4157	1
CQUAD4	4087	1	4157	4127	4128	4158	1
CQUAD4	4088	1	4158	4128	4129	4159	1
CQUAD4	4089	1	4159	4129	4130	4160	1
CQUAD4	4090	1	4160	4130	4131	4161	1
CQUAD4	4091	1003	4161	4131	4132	4162	1
CQUAD4	4092	1003	4162	4132	4133	4163	1

\$
\$ --- BHD 495.5

\$
CQUAD4 4101 1003 4001 4002 4015 4014 2
CQUAD4 4102 1003 4002 4003 4016 4015 2
CQUAD4 4103 1003 4003 4004 4005 4016 2
CQUAD4 4104 1003 4015 4016 4019 4018 2
CQUAD4 4105 1003 4005 4020 4019 4016 2
CQUAD4 4106 1003 4006 4021 4020 4005 2
CQUAD4 4107 1003 4007 4022 4021 4006 2
CQUAD4 4108 1003 4022 4007 4008 4023 2
CQUAD4 4109 1003 4023 4008 4009 4024 2
CQUAD4 4110 1003 4024 4009 4010 4025 2
CQUAD4 4111 1003 4010 4011 4026 4025 2
CQUAD4 4112 1003 4011 4012 4027 4026 2
CQUAD4 4113 1003 4028 4027 4012 4013 2

\$
\$ --- FRAME 520.25

\$
CQUAD4 4121 1003 4031 4032 4045 4044 2
CQUAD4 4122 1003 4032 4033 4046 4045 2
CQUAD4 4123 1003 4034 4047 4046 4033 2
CQUAD4 4124 1003 4047 4034 4035 4048 2
CQUAD4 4125 1003 4048 4035 4036 4049 2
CQUAD4 4126 1003 4049 4036 4037 4050 2
CQUAD4 4127 1003 4050 4037 4038 4051 2
CQUAD4 4128 1003 4051 4038 4039 4052 2
CQUAD4 4129 1003 4052 4039 4040 4053 2
CQUAD4 4130 1003 4054 4053 4040 4041 2
CQUAD4 4131 1003 4055 4054 4041 4042 2
CQUAD4 4132 1003 4056 4055 4042 4043 2

\$
\$ --- BHD 545

\$
CQUAD4 4141 1003 4061 4062 4075 4074 2
CQUAD4 4142 1003 4062 4063 4076 4075 2
CQUAD4 4143 1003 4063 4064 4077 4076 2
CQUAD4 4144 1003 4065 4078 4077 4064 2
CQUAD4 4145 1003 4066 4079 4078 4065 2
CQUAD4 4146 1003 4067 4080 4079 4066 2
CQUAD4 4147 1003 4068 4081 4080 4067 2
CQUAD4 4148 1003 4069 4082 4081 4068 2
CQUAD4 4149 1003 4070 4083 4082 4069 2
CQUAD4 4150 1003 4070 4071 4084 4083 2
CQUAD4 4151 1003 4071 4072 4085 4084 2
CQUAD4 4152 1003 4086 4085 4072 4073 2

\$
\$ --- BHD 581

\$
CQUAD4 4161 1003 4091 4092 4105 4104 2
CQUAD4 4162 1003 4092 4093 4106 4105 2
CQUAD4 4163 1003 4093 4094 4107 4106 2
CQUAD4 4164 1003 4095 4108 4107 4094 2
CQUAD4 4165 1003 4108 4095 4096 4109 2

CQUAD4	4166	1003	4109	4096	4097	4110	2
CQUAD4	4167	1003	4110	4097	4098	4111	2
CQUAD4	4168	1003	4111	4098	4099	4112	2
CQUAD4	4169	1003	4112	4099	4100	4113	2
CQUAD4	4170	1003	4113	4100	4101	4114	2
CQUAD4	4171	1003	4115	4114	4101	4102	2
CQUAD4	4172	1003	4116	4115	4102	4103	2

\$

\$ --- BHD 615

\$

CQUAD4	4181	1003	4121	4122	4135	4134	2
CQUAD4	4182	1003	4122	4123	4136	4135	2
CQUAD4	4183	1003	4123	4124	4137	4136	2
CQUAD4	4184	1003	4125	4138	4137	4124	2
CQUAD4	4185	1003	4126	4139	4138	4125	2
CQUAD4	4186	1003	4127	4140	4139	4126	2
CQUAD4	4187	1003	4128	4141	4140	4127	2
CQUAD4	4188	1003	4129	4142	4141	4128	2
CQUAD4	4189	1003	4130	4143	4142	4129	2
CQUAD4	4190	1003	4130	4131	4144	4143	2
CQUAD4	4191	1003	4131	4132	4145	4144	2
CQUAD4	4192	1003	4146	4145	4132	4133	2

\$

\$ --- BHD 645.5

\$

CQUAD4	4201	1003	4151	4152	4165	4164	2
CQUAD4	4202	1003	4152	4153	4166	4165	2
CQUAD4	4203	1003	4153	4154	4167	4166	2
CQUAD4	4204	1003	4155	4168	4167	4154	2
CQUAD4	4205	1003	4156	4169	4168	4155	2
CQUAD4	4206	1003	4157	4170	4169	4156	2
CQUAD4	4207	1003	4158	4171	4170	4157	2
CQUAD4	4208	1003	4159	4172	4171	4158	2
CQUAD4	4209	1003	4172	4159	4160	4173	2
CQUAD4	4210	1003	4160	4161	4174	4173	2
CQUAD4	4211	1003	4175	4174	4161	4162	2
CQUAD4	4212	1003	4176	4175	4162	4163	2

\$

\$: CONM2 - EID - - - - G - - - - - CID - - - - - M - - - - - X1 - - - - - X2 - - - - - X3 - - - - -

\$

CONM2	41651	4165	.1969
CONM2	41051	4105	.2073
CONM2	40581	4058	.1477

\$

CONM2	40141	4014	.1222
CONM2	40151	4015	.1222
CONM2	40181	4018	.1222

\$

CONM2	40441	4044	.2591
CONM2	40451	4045	.2591

\$

CONM2	40051	4005	.0764
CONM2	40061	4006	.0764

\$

CONM2	40351	4035		.2267					
CONM2	40361	4036		.2267					
\$									
CONM2	40582	4058		2.7021					
CONM2	41391	4139		.035					
\$									
CONM2	41091	4109		.1049					
CONM2	41101	4110		.1049					
\$									
CONM2	41392	4139		.169					
CONM2	41401	4140		.169					
\$									
CONM2	41691	4169		.094					
CONM2	41701	4170		.094					
CONM2	41711	4171		.094					
\$									
\$:SPC1	--SID	-----C	-----G1	-----G2	-----G3	-----G4	-----G5	-----G6	-----
\$									
SPC1	10	3	4017						
\$									
SPC1	10	246	4001	4014	4017	4028	4013		
SPC1	10	246	4031	4044	4056	4043			
SPC1	10	246	4061	4074	4086	4073			
SPC1	10	246	4091	4104	4116	4103			
SPC1	10	246	4121	4134	4146	4133			
SPC1	10	246	4151	4164	4176	4163			
\$									
SPC1	10	1	4014	4015	4016	4017	4018	4019	
SPC1	10	1	4020	4021	4022	4023	4024	4025	
SPC1	10	1	4026	4027	4028				
SPC1	10	1	4044	4045	4046	4047	4048	4049	
SPC1	10	1	4050	4051	4052	4053	4054	4055	
SPC1	10	1	4056						
SPC1	10	1	4074	4075	4076	4077	4078	4079	
SPC1	10	1	4080	4081	4082	4083	4084	4085	
SPC1	10	1	4086						
SPC1	10	1	4104	4105	4106	4107	4108	4109	
SPC1	10	1	4110	4111	4112	4113	4114	4115	
SPC1	10	1	4116						
SPC1	10	1	4134	4135	4136	4137	4138	4139	
SPC1	10	1	4140	4141	4142	4143	4144	4145	
SPC1	10	1	4146						
SPC1	10	1	4164	4165	4166	4167	4168	4169	
SPC1	10	1	4170	4171	4172	4173	4174	4175	
SPC1	10	1	4176						
\$									
\$									
\$									
\$	---	MAIN LANDING GEAR / VERTICAL FIN		POD SECTION					
\$									
\$:MAT1	--MID	-----E	-----G	-----NU	-----RHO	-----A	-----TREF	-----GE	-----
\$MAT1	2024	1.03E7		0.3	2.59-4				
\$									
\$:PBAR	--PID	-----MID	-----A	-----I1	-----I2	-----J	-----NSM	-----	-----

\$ --- PBAR BELOW IS FOR NONDESIGNED VERTICAL TAIL SPARS

\$PBAR 5411 2023 13.5 100. 600. 30.

\$

\$

\$:PSHELL-PID----MID1----T-----MID2----12I/T**3-MID3---TS/T---NSM-----

\$PSHELL 1 2024 0.05

\$PSHELL 50 2024 0.05

\$

\$

\$ --- MPC BELOW CONNECT POD TO WING

\$

\$:MPC---SID-----GO-----CO-----AO-----G-----C-----A-----

CONTINUE

MPC 55 1029 1 -1. 5001 1 1.

MPC 55 1029 2 -1. 5001 2 1.

MPC 55 1029 3 -1. 5001 3 1.

\$

MPC 55 1049 1 -1. 5008 1 1.

MPC 55 1049 2 -1. 5008 2 1.

MPC 55 1049 3 -1. 5008 3 1.

\$

MPC 55 1069 1 -1. 5007 1 1.

MPC 55 1069 2 -1. 5007 2 1.

MPC 55 1069 3 -1. 5007 3 1.

\$

\$

MPC 55 1031 1 -1. 5021 1 1.

MPC 55 1031 2 -1. 5021 2 1.

MPC 55 1031 3 -1. 5021 3 1.

\$

MPC 55 1051 1 -1. 5034 1 1.

MPC 55 1051 2 -1. 5034 2 1.

MPC 55 1051 3 -1. 5034 3 1.

\$

MPC 55 1071 1 -1. 5027 1 1.

MPC 55 1071 2 -1. 5027 2 1.

MPC 55 1071 3 -1. 5027 3 1.

\$

\$

MPC 55 1032 1 -1. 5032 1 1.

MPC 55 1032 2 -1. 5032 2 1.

MPC 55 1032 3 -1. 5032 3 1.

\$

MPC 55 1052 1 -1. 5035 1 1.

MPC 55 1052 2 -1. 5035 2 1.

MPC 55 1052 3 -1. 5035 3 1.

\$

MPC 55 1072 1 -1. 5028 1 1.

MPC 55 1072 2 -1. 5028 2 1.

MPC 55 1072 3 -1. 5028 3 1.

\$

\$

MPC 55 1033 1 -1. 5041 1 1.

MPC 55 1033 2 -1. 5041 2 1.

MPC 55 1033 3 -1. 5041 3 1.

\$							
MPC	55	1053	1	-1.	5054	1	1.
MPC	55	1053	2	-1.	5054	2	1.
MPC	55	1053	3	-1.	5054	3	1.
\$							
MPC	55	1073	1	-1.	5047	1	1.
MPC	55	1073	2	-1.	5047	2	1.
MPC	55	1073	3	-1.	5047	3	1.
\$							
\$							
MPC	55	1034	1	-1.	5052	1	1.
MPC	55	1034	2	-1.	5052	2	1.
MPC	55	1034	3	-1.	5052	3	1.
\$							
MPC	55	1054	1	-1.	5055	1	1.
MPC	55	1054	2	-1.	5055	2	1.
MPC	55	1054	3	-1.	5055	3	1.
\$							
MPC	55	1074	1	-1.	5048	1	1.
MPC	55	1074	2	-1.	5048	2	1.
MPC	55	1074	3	-1.	5048	3	1.
\$							
\$							
MPC	55	1075	1	-1.	5067	1	1.
MPC	55	1075	2	-1.	5067	2	1.
MPC	55	1075	3	-1.	5067	3	1.
\$							
MPC	55	1076	1	-1.	5068	1	1.
MPC	55	1076	2	-1.	5068	2	1.
MPC	55	1076	3	-1.	5068	3	1.

\$									
\$									
\$:GRID---	ID---	CP---	X1---	X2---	X3---	CD---	PS---	SEID---	
GRID	5001		545.	59.	4.23				
GRID	5002		545.	60.578	-2.167				
GRID	5003		545.	64.535	-5.689				
GRID	5004		545.	69.999	-6.317				
GRID	5005		545.	75.41	-5.672				
GRID	5006		545.	79.364	-2.188				
GRID	5007		545.	81.	2.336				
GRID	5008		545.	70.	3.276				
GRID	5009		545.	69.971	-2.178				
\$									
GRID	5021		581.	59.	4.834				
GRID	5022		581.	59.271	-3.893				
GRID	5023		581.	61.795	-12.09				
GRID	5024		581.	69.998	-14.332				
GRID	5025		581.	77.691	-12.534				
GRID	5026		581.	80.588	-5.241				
GRID	5027		581.	81.	2.801				
GRID	5028		581.	81.	10.607				
GRID	5029		581.	76.331	15.532				
GRID	5030		581.	70.238	16.877				
GRID	5031		581.	64.982	16.222				

GRID	5032	581.	59.	13.24
GRID	5033	581.	69.929	-4.567
GRID	5034	581.	70.	3.813
GRID	5035	581.	70.	11.925
\$				
GRID	5041	615.	59.	5.71
GRID	5042	615.	59.519	-4.306
GRID	5043	615.	61.318	-14.108
GRID	5044	615.	69.999	-17.902
GRID	5045	615.	78.305	-14.687
GRID	5046	615.	80.381	-5.682
GRID	5047	615.	81.	3.635
GRID	5048	615.	81.	9.054
GRID	5049	615.	77.445	16.495
GRID	5050	615.	69.999	19.187
GRID	5051	615.	63.429	17.219
GRID	5052	615.	59.	11.406
GRID	5053	615.	69.95	-4.994
GRID	5054	615.	70.	4.673
GRID	5055	615.	70.	10.23
\$				
GRID	5061	633.	58.999	6.066
GRID	5062	633.	59.423	-4.249
GRID	5063	633.	61.22	-14.356
GRID	5064	633.	70.001	-18.474
GRID	5065	633.	78.433	-14.932
GRID	5066	633.	80.477	-5.59
GRID	5067	633.	81.	4.045
GRID	5068	633.	81.	7.813
GRID	5069	633.	78.003	16.218
GRID	5070	633.	69.998	19.512
GRID	5071	633.	62.735	17.045
GRID	5072	633.	59.436	10.067
GRID	5073	633.	69.95	-4.919
GRID	5074	633.	69.999	5.055
GRID	5075	633.	70.101	8.953
\$				
GRID	5081	655.	59.082	6.122
GRID	5082	655.	59.246	-4.165
GRID	5083	655.	61.046	-14.227
GRID	5084	655.	69.999	-17.977
GRID	5085	655.	78.942	-14.246
GRID	5086	655.	80.749	-4.206
GRID	5087	655.	80.915	6.06
GRID	5088	655.	78.643	15.558
GRID	5089	655.	69.999	19.523
GRID	5090	655.	61.376	15.591
GRID	5091	655.	69.998	-4.185
GRID	5092	655.	69.998	6.091
\$				
GRID	5101	680.	59.084	6.468
GRID	5102	680.	59.308	-3.249
GRID	5103	680.	61.328	-12.665
GRID	5104	680.	70.	-15.912

GRID	5105	680.	78.67	-12.665
GRID	5106	680.	80.69	-3.249
GRID	5107	680.	80.914	6.468
GRID	5108	680.	78.522	15.732
GRID	5109	680.	70.	19.522
GRID	5110	680.	61.476	15.732
GRID	5111	680.	69.999	-3.249
GRID	5112	680.	69.999	6.468

\$

GRID	5121	695.	59.347	7.258
GRID	5122	695.	59.479	-2.018
GRID	5123	695.	61.643	-10.948
GRID	5124	695.	69.999	-13.918
GRID	5125	695.	78.355	-10.948
GRID	5126	695.	80.519	-2.011
GRID	5127	695.	80.651	7.257
GRID	5128	695.	78.251	16.07

\$

\$:GRID	--ID--	---CP---	-X1-	-X2-	-X3-	---CD---	PS---	SEID---
GRID	5129		695.	69.999	19.523		0	
GRID	5130		695.	61.746	16.07			
GRID	5131		695.	69.999	-2.015		0	
GRID	5132		695.	69.999	7.257			
GRID	5133		770.	47.96	101.78		0	

\$

GRID	5141	735.	60.8	10.494
GRID	5142	735.	60.921	3.28
GRID	5143	735.	63.453	-3.391
GRID	5144	735.	69.999	-5.745
GRID	5145	735.	76.526	-3.364
GRID	5146	735.	79.039	3.308
GRID	5147	735.	79.155	10.502
GRID	5148	735.	76.55	17.148

\$

\$:GRID	--ID--	---CP---	-X1-	-X2-	-X3-	---CD---	PS---	SEID---
GRID	5149		735.	69.958	19.523		0	
GRID	5150		735.	63.402	17.144			
GRID	5151		735.	69.98	3.294		0	
GRID	5152		735.	69.977	10.498			
GRID	5153		782.6	47.96	101.78		0	

\$

GRID	5161	751.	62.103	12.231
GRID	5162	751.	62.035	6.206
GRID	5163	751.	64.452	0.782
GRID	5164	751.	69.999	-1.255
GRID	5165	751.	75.548	0.785
GRID	5166	751.	77.963	6.205
GRID	5167	751.	77.895	12.231
GRID	5168	751.	75.608	17.75
GRID	5169	751.	69.999	19.523
GRID	5170	751.	64.388	17.748
GRID	5171	751.	69.999	6.205
GRID	5172	751.	69.999	12.231

\$

```

$:CONROD EID----G1-----G2-----MID-----A-----J-----C-----NSM-----
$
$ --- THIS UNDESIGNED ROD CONNECTS THE POD Laterally TO THE AFT MOST FUSL FRAME
$ ---
$ ---          STA 655  BL 31.2          STA 648.5  BL 59
$ ---          MATL - 409 FOR COMPOSITE RODS
$
CONROD   5400      5081      4158      409      .12
$
$:CROD--EID----PID-----G1-----G2-----TMAX-----
$
$CROD   5401        1      5129      5133      $
$CROD   5402        1      5149      5153      $ --- SEE BELOW FOR REPLACEMENTS
$CROD   5403        1      5133      5153      $
CROD    5404        1      5149      5133
$
$:CBAR--EID----PID-----GA-----GB-----X1,GO---X2-----X3-----
$ --- CBARS BELOW CRUDELY MODEL VERTICAL - H-PATTERN ( OVERLAPS ON BHDS )
$ --- FIRST AND LAST SPARS ONLY - SAME FOUR NODES AS PREVIOUS ROD VERSION
$
CBAR    5411      5411      5131      5129      0.      1.      0.
CBAR    5412      5411      5129      5133      0.      1.      0.
CBAR    5415      5411      5129      5149      0.      1.      0.
CBAR    5416      5411      5133      5153      0.      1.      0.
CBAR    5421      5411      5151      5149      0.      1.      0.
CBAR    5422      5411      5149      5153      0.      1.      0.
$
$:CROD--EID----PID-----G1-----G2-----TMAX-----
$
$ --- TOP STIFFENER
CROD    5502        1      5035      5050
CROD    5503        1      5050      5070
CROD    5504        1      5070      5089
CROD    5505        1      5089      5109
CROD    5506        1      5109      5129
CROD    5507        1      5129      5149
CROD    5508        1      5149      5169
$
$ --- BOT STIFFENER
CROD    5511        1      5009      5024
CROD    5512        1      5024      5044
CROD    5513        1      5044      5064
CROD    5514        1      5064      5084
CROD    5515        1      5084      5104
CROD    5516        1      5104      5124
CROD    5517        1      5124      5144
CROD    5518        1      5144      5164
$
$ --- INBD STIFFENER
CROD    5522        1      5021      5041
CROD    5523        1      5041      5061
CROD    5524        1      5061      5081
CROD    5525        1      5081      5101
CROD    5526        1      5101      5121
CROD    5527        1      5121      5141

```

CROD 5528 1 5141 5161

\$

\$ --- OUTBD STIFFENER

CROD 5532 1 5027 5047
 CROD 5533 1 5047 5067
 CROD 5534 1 5067 5087
 CROD 5535 1 5087 5107
 CROD 5536 1 5107 5127
 CROD 5537 1 5127 5147
 CROD 5538 1 5147 5167

\$

\$: CQUAD4 EID-----PID-----G1-----G2-----G3-----G4-----THETA---ZOFFS---

\$

CQUAD4 5001 1 5001 5002 5022 5021 1
 CQUAD4 5002 1 5002 5003 5023 5022 1
 CQUAD4 5003 1003 5003 5004 5024 5023 1
 CQUAD4 5004 1003 5005 5004 5024 5025 1
 CQUAD4 5005 1 5006 5005 5025 5026 1
 CQUAD4 5006 1 5007 5006 5026 5027 1

\$

CQUAD4 5021 1 5021 5022 5042 5041 1
 CQUAD4 5022 1 5022 5023 5043 5042 1
 CQUAD4 5023 1003 5023 5024 5044 5043 1
 CQUAD4 5024 1003 5025 5024 5044 5045 1
 CQUAD4 5025 1 5026 5025 5045 5046 1
 CQUAD4 5026 1 5027 5026 5046 5047 1
 CQUAD4 5027 1 5029 5028 5048 5049 1
 CQUAD4 5028 1003 5030 5029 5049 5050 1
 CQUAD4 5029 1003 5030 5031 5051 5050 1
 CQUAD4 5030 1 5031 5032 5052 5051 1

\$

CQUAD4 5041 1 5041 5042 5062 5061 1
 CQUAD4 5042 1 5042 5043 5063 5062 1
 CQUAD4 5043 1003 5043 5044 5064 5063 1
 CQUAD4 5044 1003 5045 5044 5064 5065 1
 CQUAD4 5045 1 5046 5045 5065 5066 1
 CQUAD4 5046 1 5047 5046 5066 5067 1
 CQUAD4 5047 1 5049 5048 5068 5069 1
 CQUAD4 5048 1003 5050 5049 5069 5070 1
 CQUAD4 5049 1003 5050 5051 5071 5070 1
 CQUAD4 5050 1 5051 5052 5072 5071 1

\$

CQUAD4 5061 1 5061 5062 5082 5081 1
 CQUAD4 5062 1 5062 5063 5083 5082 1
 CQUAD4 5063 1003 5063 5064 5084 5083 1
 CQUAD4 5064 1003 5065 5064 5084 5085 1
 CQUAD4 5065 1 5066 5065 5085 5086 1
 CQUAD4 5066 1 5067 5066 5086 5087 1
 CQUAD4 5067 1 5069 5068 5087 5088 1
 CQUAD4 5068 1003 5070 5069 5088 5089 1
 CQUAD4 5069 1003 5070 5071 5090 5089 1
 CQUAD4 5070 1 5071 5072 5081 5090 1

\$

CQUAD4 5081 1 5081 5082 5102 5101 1

CQUAD4	5082	1	5082	5083	5103	5102	1
CQUAD4	5083	1003	5083	5084	5104	5103	1
CQUAD4	5084	1003	5085	5084	5104	5105	1
CQUAD4	5085	1	5086	5085	5105	5106	1
CQUAD4	5086	1	5087	5086	5106	5107	1
CQUAD4	5087	1	5088	5087	5107	5108	1
CQUAD4	5088	1003	5089	5088	5108	5109	1
CQUAD4	5089	1003	5089	5090	5110	5109	1
CQUAD4	5090	1	5090	5081	5101	5110	1
\$							
CQUAD4	5101	1	5101	5102	5122	5121	1
CQUAD4	5102	1	5102	5103	5123	5122	1
CQUAD4	5103	1003	5103	5104	5124	5123	1
CQUAD4	5104	1003	5105	5104	5124	5125	1
CQUAD4	5105	1	5106	5105	5125	5126	1
CQUAD4	5106	1	5107	5106	5126	5127	1
CQUAD4	5107	1	5108	5107	5127	5128	1
CQUAD4	5108	1003	5109	5108	5128	5129	1
CQUAD4	5109	1003	5109	5110	5130	5129	1
CQUAD4	5110	1	5110	5101	5121	5130	1
\$							
CQUAD4	5121	1	5121	5122	5142	5141	1
CQUAD4	5122	1	5122	5123	5143	5142	1
CQUAD4	5123	1003	5123	5124	5144	5143	1
CQUAD4	5124	1003	5125	5124	5144	5145	1
CQUAD4	5125	1	5126	5125	5145	5146	1
CQUAD4	5126	1	5127	5126	5146	5147	1
CQUAD4	5127	1	5128	5127	5147	5148	1
CQUAD4	5128	1003	5129	5128	5148	5149	1
CQUAD4	5129	1003	5129	5130	5150	5149	1
CQUAD4	5130	1	5130	5121	5141	5150	1
\$							
CQUAD4	5141	1	5141	5142	5162	5161	1
CQUAD4	5142	1	5142	5143	5163	5162	1
CQUAD4	5143	1003	5143	5144	5164	5163	1
CQUAD4	5144	1003	5145	5144	5164	5165	1
CQUAD4	5145	1	5146	5145	5165	5166	1
CQUAD4	5146	1	5147	5146	5166	5167	1
CQUAD4	5147	1	5148	5147	5167	5168	1
CQUAD4	5148	1003	5149	5148	5168	5169	1
CQUAD4	5149	1003	5149	5150	5170	5169	1
CQUAD4	5150	1	5150	5141	5161	5170	1
\$							
\$ --- BHD 545							
\$							
CQUAD4	5201	1003	5008	5001	5002	5009	2
CQUAD4	5206	1003	5008	5007	5006	5009	2
\$							
\$ --- BHD 581							
\$							
CQUAD4	5221	1003	5034	5021	5022	5033	2
CQUAD4	5222	1003	5033	5022	5023	5024	2
CQUAD4	5223	1003	5033	5026	5025	5024	2
CQUAD4	5224	1003	5027	5034	5033	5026	2

\$
 \$ --- BHD 615
 \$
 CQUAD4 5241 1003 5054 5041 5042 5053 2
 CQUAD4 5242 1003 5053 5042 5043 5044 2
 CQUAD4 5243 1003 5053 5046 5045 5044 2
 CQUAD4 5244 1003 5047 5054 5053 5046 2
 CQUAD4 5245 1003 5050 5049 5048 5055 2
 CQUAD4 5246 1003 5050 5051 5052 5055 2
 \$
 \$ --- BHD 633
 \$
 CQUAD4 5261 1003 5074 5061 5062 5073 2
 CQUAD4 5262 1003 5064 5063 5062 5073 2
 CQUAD4 5263 1003 5073 5066 5065 5064 2
 CQUAD4 5264 1003 5067 5074 5073 5066 2
 CQUAD4 5265 1003 5070 5069 5068 5075 2
 CQUAD4 5266 1003 5070 5071 5072 5075 2
 \$
 \$ --- BHD 655
 \$
 CQUAD4 5281 1003 5092 5081 5082 5091 2
 CQUAD4 5282 1003 5084 5083 5082 5091 2
 CQUAD4 5283 1003 5091 5086 5085 5084 2
 CQUAD4 5284 1003 5087 5092 5091 5086 2
 CQUAD4 5285 1003 5089 5088 5087 5092 2
 CQUAD4 5286 1003 5089 5090 5081 5092 2
 \$
 \$ --- BHD 680
 \$
 CQUAD4 5301 1003 5112 5101 5102 5111 2
 CQUAD4 5302 1003 5111 5102 5103 5104 2
 CQUAD4 5303 1003 5111 5106 5105 5104 2
 CQUAD4 5304 1003 5107 5112 5111 5106 2
 CQUAD4 5305 1003 5109 5108 5107 5112 2
 CQUAD4 5306 1003 5109 5110 5101 5112 2
 \$
 \$ --- BHD 695
 \$
 CQUAD4 5321 1003 5132 5121 5122 5131 2
 CQUAD4 5322 1003 5131 5122 5123 5124 2
 CQUAD4 5323 1003 5131 5126 5125 5124 2
 CQUAD4 5324 1003 5127 5132 5131 5126 2
 CQUAD4 5325 1003 5129 5128 5127 5132 2
 CQUAD4 5326 1003 5129 5130 5121 5132 2
 \$
 \$ --- BHD 735
 \$
 CQUAD4 5341 1003 5152 5141 5142 5151 2
 CQUAD4 5342 1003 5151 5142 5143 5144 2
 CQUAD4 5343 1003 5151 5146 5145 5144 2
 CQUAD4 5344 1003 5147 5152 5151 5146 2
 CQUAD4 5345 1003 5149 5148 5147 5152 2
 CQUAD4 5346 1003 5149 5150 5141 5152 2

```

$
$ --- BHD 751
$
CQUAD4  5361    1003    5172    5161    5162    5171    2
CQUAD4  5362    1003    5171    5162    5163    5164    2
CQUAD4  5363    1003    5171    5166    5165    5164    2
CQUAD4  5364    1003    5167    5172    5171    5166    2
CQUAD4  5365    1003    5169    5168    5167    5172    2
CQUAD4  5366    1003    5169    5170    5161    5172    2
$
$:CTRIA3-EID----PID----G1-----G2-----G3-----THETA---ZOFFS-----
$
CTRIA3  5202    1003    5009    5002    5003
CTRIA3  5203    1003    5009    5003    5004
CTRIA3  5204    1003    5009    5004    5005
CTRIA3  5205    1003    5009    5005    5006
$
CTRIA3  5225    1003    5035    5029    5028
CTRIA3  5226    1003    5035    5030    5029
CTRIA3  5227    1003    5035    5031    5030
CTRIA3  5228    1003    5035    5032    5031
$
$
$:CONM2-EID----G-----CID-----M-----X1-----X2-----X3-----
$
CONM2    50531    5053                .7202
$
CONM2    50831    5083                .1136
CONM2    50841    5084                .1136
CONM2    50851    5085                .1136
$
CONM2    51031    5103                .2271
CONM2    51041    5104                .2271
CONM2    51051    5105                .2271
$
CONM2    51231    5123                .0568
CONM2    51241    5124                .0568
CONM2    51251    5125                .0568
$
CONM2    51291    5129                .1684
CONM2    51491    5149                .1684
CONM2    51331    5133                .0712
CONM2    51531    5153                .0725
$
CONM2    51221    5122                .1782
CONM2    51261    5126                .1782
CONM2    51311    5131                .1782
$
CONM2    51421    5142                .1069
CONM2    51461    5146                .1069
CONM2    51511    5151                .1069
$
CONM2    51711    5171                .0736
CONM2    51721    5172                .0736

```

\$
 \$:SPC1--SID-----C-----G1-----G2-----G3-----G4-----G5-----G6-----
 \$\$\$\$SPC1 10 2 5133 5153 \$ --- SEE BARS FOR VERTICAL
 \$\$\$\$SPC1 10 1 5009 5131 5151 \$ --- NOW HAVE F/A STIFFNESS
 \$
 SPC1 10 1 5033 5053 5073 5074 5075
 SPC1 10 1 5091 5092 5111 5112
 SPC1 10 1 5132 5152
 SPC1 10 1 5171 5172
 \$

\$
 \$ - - - - -
 \$
 \$ --- DESIGN CONSTRAINTS - EXCEPT DCONFLT WHICH IS WITH FLUTTER
 \$

\$DCONSTR	MID	TYP	MID	TYP	MID	TYP
DCONSTR	49	STRAIN				
DCONSTR	50	STRAIN				
DCONSTR	120	STRAIN				
DCONSTR	133	STRAIN				
DCONSTR	150	VMISES				
DCONSTR	409	VMISES				

\$
 \$DCONTHK-ETYP--ELEM1--ELEM2--ELEM3--ELEM4--ELEM5--ELEM6--ELEM7--
 DCONTHK QDMEM1 1001 1121

\$
 DCONTHK QDMEM1 1003 1131 1009 1069
 DCONTHK QDMEM1 1013 1093 1133
 DCONTHK QDMEM1 1204 1332 1210 1270
 DCONTHK QDMEM1 1214 1294 1334
 DCONTHK TRMEM 1087 1288 1109 1310
 DCONTHK QUAD4 1502 1532 1552
 DCONTHK QUAD4 1601 1607 1611 1624 1631 1635
 DCONTHK QUAD4 1641 1646 1651 1657 1664 1667

\$
 DCONTHK QDMEM1 1075 1135
 \$
 DCONTHK QUAD4 2001 2102 2161 2004 2104 2164
 DCONTHK QUAD4 2010 2090 2171 2174
 DCONTHK QUAD4 2201 2221 2232 2261 2271
 DCONTHK QUAD4 2301 2311 2317
 DCONTHK ROD 2501 2511 2521 2531

\$
 DCONTHK QUAD4 3001 3041 3101 3005 3045 3105
 DCONTHK QUAD4 3008 3053 3112
 DCONTHK QUAD4 3121 3141 3161 3191 3221 3251
 DCONTHK QUAD4 3271 3281 3304 3352
 DCONTHK QUAD4 3361 3381 3401
 DCONTHK ROD 3501 3506 3511 3516 3521 3526
 DCONTHK ROD 3551 3557 3561 3567
 DCONTHK QUAD4 3801 3831 3902 3981

\$
 \$234567 2234567 323567 4234567 5234567 6234567 7234567 8234567 9234567 +CONTINUE
 DCONTHK QUAD4 4001 4041 4081 4004 4044 4084
 DCONTHK QUAD4 4010 4050 4090

DCONTHK	QUAD4	4101	4107	4113	4121	4141	4146	4152
DCONTHK	QUAD4	4161	4166	4172				
DCONTHK	QUAD4	4181	4186	4192	4201			
DCONTHK	ROD	4501	4505	4511	4515			
DCONTHK	ROD	4531	4534	4541	4544			
\$								
DCONTHK	QUAD4	5001	5061	5141	5063	5069		
DCONTHK	QUAD4	5201	5241	5281	5341			
DCONTHK	ROD	5502	5522					
\$								
\$ - - - - -								
\$								
\$ --- BALANCE MASSES L/E SPAR								
\$CONM2--EID-----G-----CID-----M-----X1-----X2-----X3-----								
CONM2	91003	1003		.01				
CONM2	91109	1109		.01				
CONM2	91151	1151		.01				
\$								
\$ - - - - -								
\$								
\$ --- DESELEMS FOR MASSES BALANCE AT LEADING EDGE SPAR AT ROOT MID AND TIP								
\$								
\$DESELM-DVID----EID-----ETYP-----VMIN-----VMAX-----VINIT---PLY-----LABEL								
DESELM	91003	91003	CONM2			1.		BAL1
DESELM	91109	91109	CONM2			1.		BAL2
DESELM	91151	91151	CONM2			1.		BAL3
\$								
\$ --- DESELEM FOR INLET TO CENTER FUSELAGE TIE								
DESELM	3299	3299	CQUAD4			1.	1	INLETIE
\$								
\$ --- DESELEM FOR ROD ABOVE ENGINE ACCESSORY CUTOUT BHD 495								
DESELM	4114	4114	CROD			1.		BH495RD
\$								
\$ --- DESVARS WING								
\$								
\$DESVARS DVID---SHAPID--VMIN-----VMAX-----INIT-----PLY-----PLYLIST-LABEL								
\$								
\$ --- WING SKIN LABEL MNEMONICS:								
\$ --- 1,2,3, OR 4 - PLY NUMBER								
\$ --- NO TRAILING LETTER - CONSTANT SHAPE								
\$ --- S - SPANWISE LINEAR SHAPE								
\$ --- C - CHORDWISE LINEAR SHAPE								
\$ --- SS - SPANWISE QUADRATIC SHAPE								
\$ --- CC - CHORDWISE QUADRATIC SHAPE								
\$								
\$ --- DESVARS UPPER SKIN								
\$								
DESVARS	101	100	-1000.	1000.	.016	1		LWRS1
DESVARS	102	100	-1000.	1000.	.009	2		LWRS2
DESVARS	103	100	-1000.	1000.	.009	3		LWRS3
DESVARS	104	100	-1000.	1000.	.015	4		LWRS4
\$								
DESVARS	111	110	-1000.	1000.	.034	1		LWRS1S
DESVARS	112	110	-1000.	1000.	.026	2		LWRS2S

DESVARs	113	110	-1000.	1000.	.026	3	LWRS3S
DESVARs	114	110	-1000.	1000.	.03	4	LWRS4S
\$							
DESVARs	115	120	-1000.	1000.	.0	1	LWRS1C
DESVARs	116	120	-1000.	1000.	.0	2	LWRS2C
DESVARs	117	120	-1000.	1000.	.0	3	LWRS3C
DESVARs	118	120	-1000.	1000.	.0	4	LWRS4C
\$							
\$							
DESVARs	121	130	-1000.	1000.	-.024	1	LWRS1SS
DESVARs	122	130	-1000.	1000.	-.026	2	LWRS2SS
DESVARs	123	130	-1000.	1000.	-.026	3	LWRS3SS
DESVARs	124	130	-1000.	1000.	-.029	4	LWRS4SS
\$							
DESVARs	125	140	-1000.	1000.	.005	1	LWRS1CC
DESVARs	126	140	-1000.	1000.	.003	2	LWRS2CC
DESVARs	127	140	-1000.	1000.	.003	3	LWRS3CC
DESVARs	128	140	-1000.	1000.	.003	4	LWRS4CC
\$							
\$ --- DESVARs UPPER SKIN							
\$							
DESVARs	201	200	-1000.	1000.	.029	1	UPRS1
DESVARs	202	200	-1000.	1000.	.016	2	UPRS2
DESVARs	203	200	-1000.	1000.	.009	3	UPRS3
DESVARs	204	200	-1000.	1000.	.016	4	UPRS4
\$							
DESVARs	211	210	-1000.	1000.	.046	1	UPRS1S
DESVARs	212	210	-1000.	1000.	.029	2	UPRS2S
DESVARs	213	210	-1000.	1000.	.025	3	UPRS3S
DESVARs	214	210	-1000.	1000.	.035	4	UPRS4S
\$							
DESVARs	215	220	-1000.	1000.	-.008	1	UPRS1C
DESVARs	216	220	-1000.	1000.	-.005	2	UPRS2C
DESVARs	217	220	-1000.	1000.	-.003	3	UPRS3C
DESVARs	218	220	-1000.	1000.	-.002	4	UPRS4C
\$							
\$							
DESVARs	221	230	-1000.	1000.	-.015	1	UPRS1SS
DESVARs	222	230	-1000.	1000.	-.026	2	UPRS2SS
DESVARs	223	230	-1000.	1000.	-.024	3	UPRS3SS
DESVARs	224	230	-1000.	1000.	-.024	4	UPRS4SS
\$							
DESVARs	225	240	-1000.	1000.	-.005	1	UPRS1CC
DESVARs	226	240	-1000.	1000.	.002	2	UPRS2CC
DESVARs	227	240	-1000.	1000.	.004	3	UPRS3CC
DESVARs	228	240	-1000.	1000.	.0	4	UPRS4CC
\$							
\$ --- DESVARs RIBS							
\$							
DESVARs	500	500	-1000.	1000.	.07	1	RIB1-2
DESVARs	510	510	-1000.	1000.	.07	1	RIB3-4
DESVARs	520	520	-1000.	1000.	.07	1	RIB567
\$							
\$ --- LABEL MNEMONICS							

\$ --- C - CONSTANT SHAPE
 \$ --- L - LINEAR SHAPE SPAN WISE

\$
 \$ --- DESVARS SPARS
 \$

DESVARS	600	600	-1000.	1000.	.07	1	SPLE-C
DESVARS	610	610	-1000.	1000.	.07	1	SP12-C
DESVARS	630	630	-1000.	1000.	.07	1	SP3-C
DESVARS	640	640	-1000.	1000.	.07	1	SP4-C
DESVARS	650	650	-1000.	1000.	.064	1	SP5-C
DESVARS	660	660	-1000.	1000.	.064	1	SP6-C

\$
 \$

DESVARS	601	601	-1000.	1000.	.00	1	SPLE-L
DESVARS	611	611	-1000.	1000.	.00	1	SP12-L
DESVARS	631	631	-1000.	1000.	.00	1	SP3-L
DESVARS	641	641	-1000.	1000.	.00	1	SP4-L
DESVARS	651	651	-1000.	1000.	.00	1	SP5-L
DESVARS	661	661	-1000.	1000.	.00	1	SP6-L

\$
 \$
 \$ --- DESVARS LEADING EDGE
 \$

DESVARS	701	700	-1000.	1000.	.02	1	LE-C1
DESVARS	702	700	-1000.	1000.	.01	2	LE-C2
DESVARS	703	700	-1000.	1000.	.02	3	LE-C3
DESVARS	704	700	-1000.	1000.	.02	4	LE-C4
DESVARS	711	710	-1000.	1000.	.0	1	LE-L1
DESVARS	712	710	-1000.	1000.	.0	2	LE-L2
DESVARS	713	710	-1000.	1000.	.0	3	LE-L3
DESVARS	714	710	-1000.	1000.	.0	4	LE-L4

\$
 \$ --- DESVARS AILERON
 \$

DESVARS	801	800	-1000.	1000.	.053	1	AIL-C1
DESVARS	802	800	-1000.	1000.	.02	2	AIL-C2
DESVARS	803	800	-1000.	1000.	.018	3	AIL-C3
DESVARS	804	800	-1000.	1000.	.02	4	AIL-C4
DESVARS	811	810	-1000.	1000.	.0	1	AIL-L1
DESVARS	812	810	-1000.	1000.	.0	2	AIL-L2
DESVARS	813	810	-1000.	1000.	.0	3	AIL-L3
DESVARS	814	810	-1000.	1000.	.0	4	AIL-L4

\$
 \$
 \$
 \$-----2-----3-----4-----5-----6-----7-----8-----9-----
 \$

\$ --- SHAPE FUNCTION DEFINITIONS FOR THE WING STRUCTURE
 \$

\$ --- SHAPE LOWER SKIN FOR CONSTANT

SHAPE	100	CQDMEM1	1003	1.0	1005	1.0	1007	1.0	+S100A
+S100A	1009	1.0	1011	1.0	1013	1.0	1015	1.0	+S100B
+S100B	1023	1.0	1025	1.0	1027	1.0	1029	1.0	+S100C
+S100C	1031	1.0	1045	1.0	1047	1.0	1049	1.0	+S100D

+S100D	1051	1.0	1067	1.0	1069	1.0	1071	1.0	+S100E
+S100E	1073	1.0	1089	1.0	1091	1.0	1093	1.0	+S100F
+S100F	1111	1.0	1113	1.0	1131	1.0	1133	1.0	
\$									
SHAPE	100	CTRMEM	1043	1.0	1065	1.0	1087	1.0	+S100G
+S100G	1109	1.0							
\$									
\$	--- SHAPE LOWER SKIN FOR LINEAR SPANWISE								
SHAPE	110	CQDMEM1	1003	.93	1005	.93	1007	.93	+S110A
+S110A	1009	.93	1011	.93	1013	.93	1015	.93	+S110B
+S110B	1023	.80	1025	.80	1027	.80	1029	.80	+S110C
+S110C	1031	.80	1045	.73	1047	.73	1049	.73	+S110D
+S110D	1051	.73	1067	.64	1069	.64	1071	.64	+S110E
+S110E	1073	.64	1089	.49	1091	.49	1093	.49	+S110F
+S110F	1111	.30	1113	.30	1131	.09	1133	.09	
\$									
SHAPE	110	CTRMEM	1043	.73	1065	.64	1087	.49	+S110G
+S110G	1109	.30							
\$									
\$	--- SHAPE LOWER SKIN FOR LINEAR CHORDWISE								
SHAPE	120	CQDMEM1	1003	.91	1005	.76	1007	.62	+S120A
+S120A	1009	.45	1011	.26	1013	.09	1015	.09	+S120B
+S120B	1023	.96	1025	.84	1027	.68	1029	.49	+S120C
+S120C	1031	.26	1045	.84	1047	.68	1049	.49	+S120D
+S120D	1051	.26	1067	.80	1069	.56	1071	.28	+S120E
+S120E	1073	.074	1089	.69	1091	.36	1093	.10	+S120F
+S120F	1111	.52	1113	.15	1131	.77	1133	.28	
\$									
SHAPE	120	CTRMEM	1043	.95	1065	.96	1087	.94	+S120G
+S120G	1109	.89							
\$									
\$	--- SHAPE LOWER SKIN FOR QUADRATIC SPANWISE								
SHAPE	130	CQDMEM1	1003	.86	1005	.86	1007	.86	+S130A
+S130A	1009	.86	1011	.86	1013	.86	1015	.86	+S130B
+S130B	1023	.64	1025	.64	1027	.64	1029	.64	+S130C
+S130C	1031	.64	1045	.53	1047	.53	1049	.53	+S130D
+S130D	1051	.53	1067	.41	1069	.41	1071	.41	+S130E
+S130E	1073	.41	1089	.24	1091	.24	1093	.24	+S130F
+S130F	1111	.09	1113	.09	1131	.008	1133	.008	
\$									
SHAPE	130	CTRMEM	1043	.53	1065	.41	1087	.24	+S130G
+S130G	1109	.09							
\$									
\$	--- SHAPE LOWER SKIN FOR QUADRATIC CHORDWISE								
SHAPE	140	CQDMEM1	1003	.84	1005	.58	1007	.39	+S140A
+S140A	1009	.21	1011	.07	1013	.007	1015	.007	+S140B
+S140B	1023	.92	1025	.71	1027	.46	1029	.24	+S140C
+S140C	1031	.07	1045	.71	1047	.46	1049	.24	+S140D
+S140D	1051	.07	1067	.64	1069	.31	1071	.08	+S140E
+S140E	1073	.005	1089	.48	1091	.13	1093	.009	+S140F
+S140F	1111	.27	1113	.023	1131	.59	1133	.08	
\$									
SHAPE	140	CTRMEM	1043	.90	1065	.93	1087	.88	+S140G
+S140G	1109	.79							

\$
 \$
 \$
 \$ --- SHAPE UPPER SKIN FOR CONSTANT
 SHAPE 200 CQDMEM1 1204 1.0 1206 1.0 1208 1.0 +S200A
 +S200A 1210 1.0 1212 1.0 1214 1.0 1216 1.0 +S200B
 +S200B 1224 1.0 1226 1.0 1228 1.0 1230 1.0 +S200C
 +S200C 1232 1.0 1246 1.0 1248 1.0 1250 1.0 +S200D
 +S200D 1252 1.0 1268 1.0 1270 1.0 1272 1.0 +S200E
 +S200E 1274 1.0 1290 1.0 1292 1.0 1294 1.0 +S200F
 +S200F 1312 1.0 1314 1.0 1332 1.0 1334 1.0
 \$
 SHAPE 200 CTRMEM 1244 1.0 1266 1.0 1288 1.0 +S200G
 +S200G 1310 1.0
 \$
 \$ --- SHAPE UPPER SKIN FOR LINEAR SPANWISE
 SHAPE 210 CQDMEM1 1204 .93 1206 .93 1208 .93 +S210A
 +S210A 1210 .93 1212 .93 1214 .93 1216 .93 +S210B
 +S210B 1224 .80 1226 .80 1228 .80 1230 .80 +S210C
 +S210C 1232 .80 1246 .73 1248 .73 1250 .73 +S210D
 +S210D 1252 .73 1268 .64 1270 .64 1272 .64 +S210E
 +S210E 1274 .64 1290 .49 1292 .49 1294 .49 +S210F
 +S210F 1312 .30 1314 .30 1332 .09 1334 .09
 \$
 SHAPE 210 CTRMEM 1244 .73 1266 .64 1288 .49 +S210G
 +S210G 1310 .30
 \$
 \$ --- SHAPE UPPER SKIN FOR LINEAR CHORDWISE
 SHAPE 220 CQDMEM1 1204 .91 1206 .76 1208 .62 +S220A
 +S220A 1210 .45 1212 .26 1214 .09 1216 .09 +S220B
 +S220B 1224 .96 1226 .84 1228 .68 1230 .49 +S220C
 +S220C 1232 .26 1246 .84 1248 .68 1250 .49 +S220D
 +S220D 1252 .26 1268 .80 1270 .56 1272 .28 +S220E
 +S220E 1274 .074 1290 .69 1292 .36 1294 .10 +S220F
 +S220F 1312 .52 1314 .15 1332 .77 1334 .28
 \$
 SHAPE 220 CTRMEM 1244 .95 1266 .96 1288 .94 +S220G
 +S220G 1310 .89
 \$
 \$ --- SHAPE UPPER SKIN FOR QUADRATIC SPANWISE
 SHAPE 230 CQDMEM1 1204 .86 1206 .86 1208 .86 +S230A
 +S230A 1210 .86 1212 .86 1214 .86 1216 .86 +S230B
 +S230B 1224 .64 1226 .64 1228 .64 1230 .64 +S230C
 +S230C 1232 .64 1246 .53 1248 .53 1250 .53 +S230D
 +S230D 1252 .53 1268 .41 1270 .41 1272 .41 +S230E
 +S230E 1274 .41 1290 .24 1292 .24 1294 .24 +S230F
 +S230F 1312 .09 1314 .09 1332 .008 1334 .008
 \$
 SHAPE 230 CTRMEM 1244 .53 1266 .41 1288 .24 +S230G
 +S230G 1310 .09
 \$
 \$ --- SHAPE UPPER SKIN FOR QUADRATIC CHORDWISE
 SHAPE 240 CQDMEM1 1204 .84 1206 .58 1208 .39 +S240A
 +S240A 1210 .21 1212 .07 1214 .007 1216 .007 +S240B

+S240B	1224	.92	1226	.71	1228	.46	1230	.24	+S240C
+S240C	1232	.07	1246	.71	1248	.46	1250	.24	+S240D
+S240D	1252	.07	1268	.64	1270	.31	1272	.08	+S240E
+S240E	1274	.005	1290	.48	1292	.13	1294	.009	+S240F
+S240F	1312	.27	1314	.023	1332	.59	1334	.08	
\$									
SHAPE	240	CTRMEM	1244	.90	1266	.93	1288	.88	+S240G
+S240G	1310	.79							
\$									
\$									
\$	---	SHAPE RIBS	INBD PAIR (1 & 2)						
SHAPE	500	CQUAD4	1502	1.0	1503	1.0	1504	1.0	+S500A
+S500A	1505	1.0	1506	1.0	1507	1.0	1512	1.0	+S500B
+S500B	1513	1.0	1514	1.0	1515	1.0	1516	1.0	+S500C
+S500C	1517	1.0	1522	1.0					
\$									
SHAPE	500	CTRIA3	1501	1.0	1508	1.0	1511	1.0	+S500G
+S500G	1518	1.0	1521	1.0					
\$									
\$	---	SHAPE RIBS	INTMEDIATE PAIR (3 & 4)						
SHAPE	510	CQUAD4	1532	1.0	1533	1.0	1534	1.0	+S510A
+S510A	1535	1.0	1536	1.0	1542	1.0	1543	1.0	+S510B
+S510B	1544	1.0	1545	1.0					
\$									
SHAPE	510	CTRIA3	1531	1.0	1537	1.0	1541	1.0	+S510G
+S510G	1546	1.0							
\$									
\$	---	SHAPE RIBS	OUTBD THREE (5, 6 & 7)						
SHAPE	520	CQUAD4	1552	1.0	1553	1.0	1554	1.0	+S520A
+S520A	1562	1.0	1563	1.0	1572	1.0	1573	1.0	
\$									
SHAPE	520	CTRIA3	1551	1.0	1555	1.0	1561	1.0	+S520G
+S520G	1564	1.0	1571	1.0	1574	1.0			
\$									
\$									
\$	---	SHAPE SPARS	LEADING EDGE CONSTANT						
SHAPE	600	CQUAD4	1601	1.0	1602	1.0	1603	1.0	+S600A
+S600A	1604	1.0	1605	1.0	1606	1.0	1607	1.0	
\$									
\$	---	SHAPE SPARS	LEADING EDGE LINEAR						
SHAPE	601	CQUAD4	1601	.92	1602	.81	1603	.75	+S601A
+S601A	1604	.65	1605	.49	1606	.29	1607	.094	
\$									
\$									
\$	---	SHAPE SPARS	1ST & 2ND INTERMEDIATE CONSTANT						
SHAPE	610	CQUAD4	1611	1.0	1612	1.0	1613	1.0	+S610A
+S610A	1621	1.0	1622	1.0	1623	1.0	1624	1.0	
\$									
\$	---	SHAPE SPARS	1ST & 2ND INTERMEDIATE LINEAR						
SHAPE	611	CQUAD4	1601	.72	1612	.34	1613	.10	+S611A
+S611A	1621	.82	1622	.56	1623	.27	1624	.18	
\$									
\$	---	SHAPE SPARS	3RD INTERMEDIATE CONSTANT						

SHAPE	630	CQUAD4	1631	1.0	1632	1.0	1633	1.0	+S630A
+S630A	1634	1.0	1635	1.0					
\$									
\$ --- SHAPE SPARS 3RD INTERMEDIATE LINEAR									
SHAPE	631	CQUAD4	1631	.85	1632	.68	1633	.56	+S631A
+S631A	1634	.38	1635	.15					
\$									
\$ --- SHAPE SPARS 4TH INTERMEDIATE CONSTANT									
SHAPE	640	CQUAD4	1641	1.0	1642	1.0	1643	1.0	+S640A
+S640A	1644	1.0	1645	1.0	1646	1.0			
\$									
\$ --- SHAPE SPARS 4TH INTERMEDIATE LINEAR									
SHAPE	641	CQUAD4	1641	.90	1642	.77	1643	.68	+S641A
+S641A	1644	.55	1645	.37	1646	.14			
\$									
\$ --- SHAPE SPARS 5TH INTERMEDIATE CONSTANT									
SHAPE	650	CQUAD4	1651	1.0	1652	1.0	1653	1.0	+S650A
+S650A	1654	1.0	1655	1.0	1656	1.0	1657	1.0	
\$									
\$ --- SHAPE SPARS 5TH INTERMEDIATE LINEAR									
SHAPE	651	CQUAD4	1651	.93	1652	.80	1653	.73	+S651A
+S651A	1654	.64	1655	.49	1656	.30	1657	.09	
\$									
\$ --- SHAPE SPARS AT AILERON CONSTANT									
SHAPE	660	CQUAD4	1661	1.0	1664	1.0	1665	1.0	+S660A
+S660A	1666	1.0	1667	1.0					
\$									
\$ --- SHAPE SPARS AT AILERON LINEAR									
SHAPE	661	CQUAD4	1661	.93	1664	.64	1665	.49	+S661A
+S661A	1666	.30	1667	.09					
\$									
\$ - - - - -									
\$									
\$ --- SHAPE LEADING EGDE CONSTANT (UPR & LWR SKIN)									
SHAPE	700	CQDMEM1	1001	1.0	1021	1.0	1041	1.0	+S700A
+S700A	1061	1.0	1081	1.0	1101	1.0	1121	1.0	+S700B
+S700B	1202	1.0	1222	1.0	1242	1.0	1262	1.0	+S700C
+S700C	1282	1.0	1302	1.0	1322	1.0			
\$									
\$ --- SHAPE LEADING EDGE LINEAR									
SHAPE	710	CQDMEM1	1001	.90	1021	.70	1041	.45	+S710A
+S710A	1061	.15	1081	.90	1101	.70	1121	.45	+S710B
+S710B	1202	.15	1222	.90	1242	.70	1262	.45	+S710C
+S710C	1282	.15	1302	.90	1322	.70			
\$									
\$ - - - - -									
\$									
\$ --- SHAPE AILERON CONSTANT (UPR & LWR SKIN & SPAR)									
SHAPE	800	CQDMEM1	1075	1.0	1095	1.0	1115	1.0	+S800A
+S800A	1135	1.0	1276	1.0	1296	1.0	1316	1.0	+S800B
+S800B	1336	1.0							
SHAPE	800	CQUAD4	1674	1.0	1675	1.0	1676	1.0	+S800C
+S800C	1677	1.0							
\$									

\$ --- SHAPE AILERON LINEAR

SHAPE	810	CQDMEM1	1075	.90	1095	.70	1115	.45	+S810A
+S810A	1135	.15	1276	.90	1296	.70	1316	.45	+S810B
+S810B	1336	.15							
SHAPE	810	CQUAD4	1674	.90	1675	.70	1676	.45	+S810C
+S810C	1677	.15							

\$
\$DESVARs DVID---SHAPID--VMIN----VMAX----INIT----PLY-----PLYLIST LABEL

\$ --- FWD FUSELAGE SKIN

\$ --- FWD FUSELAGE BOTTOM SKIN

DESVARs	2001	2001	-1000.	1000.	.07	1	FFBS0
DESVARs	2002	2002	-1000.	1000.	-.015	1	FFBS1
DESVARs	2003	2003	-1000.	1000.	-.014	1	FFBS2

\$ --- FWD FUSELAGE SIDE SKIN

DESVARs	2011	2011	-1000.	1000.	.20	1	FFSS0
DESVARs	2012	2012	-1000.	1000.	.10	1	FFSS1
DESVARs	2013	2013	-1000.	1000.	.0	1	FFSS2

\$ --- FWD FUSELAGE TOP SKIN FWD OF COCKPIT

DESVARs	2021	2021	-1000.	1000.	.12	1	FFTS0
DESVARs	2022	2022	-1000.	1000.	.0	1	FFTS1

\$ --- FWD FUSELAGE TOP SKIN BEHIND COCKPIT

DESVARs	2171	2171	-1000.	1000.	.10	1	FF TSA0
DESVARs	2172	2172	-1000.	1000.	.0	1	FF TSA1

\$ --- BHDS 175 195/201 228 245 269 282

DESVARs	2201	2201	-1000.	1000.	.10	1	BH175
DESVARs	2221	2221	-1000.	1000.	.10	1	BH195
DESVARs	2232	2232	-1000.	1000.	.10	1	BH228
DESVARs	2261	2261	-1000.	1000.	.13	1	BH269
DESVARs	2271	2271	-1000.	1000.	.10	1	BH282

\$ --- FWD FUSELAGE FLOOR/NOSE WELL WALLS

DESVARs	2301	2301	-1000.	1000.	.10	1	FFFL0
DESVARs	2302	2302	-1000.	1000.	.03	1	FFFL1
DESVARs	2303	2303	-1000.	1000.	.03	1	FFFL2

\$ --- FWD FUSELAGE LONGERONS

\$ --- LOWER

DESVARs	2501	2501	-1000.	1000.	.167	1	FFLL0
DESVARs	2502	2502	-1000.	1000.	.0	1	FFLL1
DESVARs	2503	2503	-1000.	1000.	.0	1	FFLL2

\$ --- UPPER

DESVARs	2521	2521	-1000.	1000.	.5	1	FFUL0
DESVARs	2522	2522	-1000.	1000.	.10	1	FFUL1
DESVARs	2523	2523	-1000.	1000.	.0	1	FFUL2

\$ --- MID FUSELAGE SKINS

\$ --- MID BOTTOM SKIN

DESVARs	3001	3001	-1000.	1000.	.067	1	MFBS0
DESVARs	3002	3002	-1000.	1000.	-.016	1	MFBS1
DESVARs	3003	3003	-1000.	1000.	-.005	1	MFBS2

\$

\$ --- MID SIDE SKIN

DESVARs	3011	3011	-1000.	1000.	.058	1	MFSS0
DESVARs	3012	3012	-1000.	1000.	-.016	1	MFSS1
DESVARs	3013	3013	-1000.	1000.	.0	1	MFSS2

\$

\$ --- MID TOP SKIN

DESVARs	3021	3021	-1000.	1000.	.079	1	MFTS0
DESVARs	3022	3022	-1000.	1000.	.003	1	MFTS1
DESVARs	3023	3023	-1000.	1000.	.011	1	MFTS2

\$

\$ --- BHD/FRM 330 360 390 420 454 475

DESVARs	3121	3121	-1000.	1000.	.10	1	BH330
DESVARs	3141	3141	-1000.	1000.	.10	1	BH360
DESVARs	3161	3161	-1000.	1000.	.10	1	BH390
DESVARs	3191	3191	-1000.	1000.	.10	1	BH420
DESVARs	3221	3221	-1000.	1000.	.10	1	BH454
DESVARs	3251	3251	-1000.	1000.	.15	1	BH475

\$

\$ --- FUEL TANK FLOOR

DESVARs	3271	3271	-1000.	1000.	.086	1	MFFLO
DESVARs	3272	3272	-1000.	1000.	.02	1	MFFL1

\$

\$ --- INLET SKIN

DESVARs	3301	3301	-1000.	1000.	.076	1	INFS0
DESVARs	3302	3302	-1000.	1000.	.024	1	INFS1

\$

\$ --- INLET FRMS

DESVARs	3361	3361	-1000.	1000.	.10	1	INFR1
DESVARs	3381	3381	-1000.	1000.	.10	1	INFR2
DESVARs	3401	3401	-1000.	1000.	.15	1	INFR3

\$

\$ --- MID FUSELAGE LONGERONS

\$ --- LOWER

DESVARs	3501	3501	-1000.	1000.	.17	1	MFLLO
DESVARs	3502	3502	-1000.	1000.	.0	1	MFL11

\$

\$ --- UPPER

DESVARs	3511	3511	-1000.	1000.	.17	1	MFULO
DESVARs	3512	3512	-1000.	1000.	.0	1	MFUL1

\$

\$ --- DORSAL

DESVARs	3521	3521	-1000.	1000.	.15	1	MFDLO
DESVARs	3522	3522	-1000.	1000.	.0	1	MFDL1

\$

\$ --- INLET LOWER

DESVARs	3551	3551	-1000.	1000.	.15	1	INLLO
DESVARs	3552	3552	-1000.	1000.	.0	1	INLL1

\$

\$ --- INLET UPPER

DESVARs	3561	3561	-1000.	1000.	.15	1	INULO
DESVARs	3562	3562	-1000.	1000.	.0	1	INUL1
\$							
\$ --- END OF MID FUSELAGE LONGERONS							
\$							
\$ --- RALS DUCT TUNNEL							
DESVARs	3801	3801	-1000.	1000.	.047	1	RALSO
DESVARs	3802	3802	-1000.	1000.	.0	1	RALS1
\$							
\$ --- INLET INNER SKIN							
DESVARs	3901	3901	-1000.	1000.	.042	1	INSKO
DESVARs	3902	3902	-1000.	1000.	.018	1	INSK1
\$							
\$ --- AFT FUSELAGE							
\$ --- BOT SKIN							
DESVARs	4001	4001	-1000.	1000.	.047	1	AFBSO
DESVARs	4002	4002	-1000.	1000.	.0	1	AFBS1
DESVARs	4003	4003	-1000.	1000.	.0	1	AFBS2
\$							
\$ --- SIDE SKIN							
DESVARs	4011	4011	-1000.	1000.	.064	1	AFSSO
DESVARs	4012	4012	-1000.	1000.	.0	1	AFSS1
DESVARs	4013	4013	-1000.	1000.	.0	1	AFSS2
\$							
\$ --- TOP SKIN							
DESVARs	4021	4021	-1000.	1000.	.062	1	AFTSO
DESVARs	4022	4022	-1000.	1000.	.015	1	AFTS1
DESVARs	4023	4023	-1000.	1000.	.0	1	AFTS2
\$							
\$ --- BHD 495							
DESVARs	4101	4101	-1000.	1000.	.33	1	BH495-0
DESVARs	4102	4102	-1000.	1000.	.0	1	BH495-1
DESVARs	4103	4103	-1000.	1000.	.0	1	BH495-2
\$							
\$ --- FRM 520							
DESVARs	4121	4121	-1000.	1000.	.27	1	FR520
\$							
\$ --- BHD 545							
DESVARs	4141	4141	-1000.	1000.	.40	1	BH545-0
DESVARs	4142	4142	-1000.	1000.	.0	1	BH545-1
DESVARs	4143	4143	-1000.	1000.	.0	1	BH545-2
\$							
\$ --- BHD 581							
DESVARs	4161	4161	-1000.	1000.	.52	1	BH581-0
DESVARs	4162	4162	-1000.	1000.	.0	1	BH581-1
DESVARs	4163	4163	-1000.	1000.	.0	1	BH581-2
\$							
\$ --- BHD 615							
DESVARs	4181	4181	-1000.	1000.	.32	1	BH615-0
DESVARs	4182	4182	-1000.	1000.	.0	1	BH615-1
DESVARs	4183	4183	-1000.	1000.	.0	1	BH615-2
\$							
\$ --- FRM 649							
DESVARs	4201	4201	-1000.	1000.	.10	1	FR649

\$
 \$ --- AFT FUSELAGE LONGERONS
 \$ --- LOWER
 DESVARS 4501 4501 -1000. 1000. .15 1 AFLLO
 DESVARS 4502 4502 -1000. 1000. .0 1 AFLL1
 \$
 \$ --- UPPER
 DESVARS 4511 4511 -1000. 1000. .15 1 AFULO
 DESVARS 4512 4512 -1000. 1000. .0 1 AFUL1
 \$
 \$ --- WING LUG LOWER STIFFENER
 DESVARS 4531 4531 -1000. 1000. .15 1 AFWLLO
 DESVARS 4532 4532 -1000. 1000. .0 1 AFWLL1
 \$
 \$ --- WING LUG UPPER STIFFENER
 DESVARS 4541 4541 -1000. 1000. .15 1 AFWULO
 DESVARS 4542 4542 -1000. 1000. .0 1 AFWUL1
 \$
 \$ --- POD SKINS
 DESVARS 5001 5001 -1000. 1000. .11 1 PODS
 DESVARS 5002 5002 -1000. 1000. -.014 1 PODSX
 \$\$DESVARS 5003 5003 -1000. 1000. -.019 1 PODSXX
 \$\$DESVARS 5004 5004 -1000. 1000. -.028 1 PODSZ
 \$
 \$ --- POD BHDS
 DESVARS 5201 5201 -1000. 1000. .10 1 PBHD1
 DESVARS 5241 5241 -1000. 1000. .15 1 PBHD2
 DESVARS 5281 5281 -1000. 1000. .07 1 PBHD3
 DESVARS 5341 5341 -1000. 1000. .09 1 PBHD4
 \$
 \$ --- POD RODS TOP/BOT & SIDE
 DESVARS 5501 5501 -1000. 1000. .15 1 PTOPR
 DESVARS 5521 5521 -1000. 1000. .15 1 PSIDER
 \$
 \$ - - - - -
 \$ --- FUSELAGE / POD SHAPES
 \$
 SHAPE 2001CQUAD4 2001 1.00000 2002 1.00000 2003 1.00000+A
 +A 2022 1.00000 2023 1.00000 2042 1.00000 2043 1.00000+A2
 +A2 2062 1.00000 2063 1.00000 2082 1.00000 2083 1.00000+A3
 +A3 2102 1.00000 2103 1.00000 2112 1.00000 2113 1.00000+A4
 +A4 2122 1.00000 2123 1.00000 2131 1.00000 2132 1.00000+A5
 +A5 2133 1.00000 2151 1.00000 2152 1.00000 2153 1.00000+A6
 +A6 2161 1.00000 2162 1.00000 2163 1.00000
 \$
 SHAPE 2002CQUAD4 2001 0.04649 2002 0.04649 2003 0.04649+A
 +A 2022 0.11625 2023 0.11625 2042 0.16274 2043 0.16274+A2
 +A2 2062 0.23333 2063 0.23333 2082 0.32772 2083 0.32772+A3
 +A3 2102 0.43298 2103 0.43298 2112 0.52660 2113 0.52660+A4
 +A4 2122 0.60993 2123 0.60993 2131 0.70519 2132 0.70519+A5
 +A5 2133 0.70519 2151 0.83239 2152 0.83239 2153 0.83239+A6
 +A6 2161 1.00000 2162 1.00000 2163 1.00000
 \$
 SHAPE 2003CQUAD4 2001 0.00216 2002 0.00216 2003 0.00216+A

+A	2022 0.01351	2023 0.01351	2042 0.02648	2043 0.02648+A2
+A2	2062 0.05444	2063 0.05444	2082 0.10740	2083 0.10740+A3
+A3	2102 0.18747	2103 0.18747	2112 0.27730	2113 0.27730+A4
+A4	2122 0.37201	2123 0.37201	2131 0.49730	2132 0.49730+A5
+A5	2133 0.49730	2151 0.69287	2152 0.69287	2153 0.69287+A6
+A6	2161 1.00000	2162 1.00000	2163 1.00000	
\$				
SHAPE	2011CQUAD4	2004 1.00000	2005 1.00000	2006 1.00000+A
+A	2007 1.00000	2044 1.00000	2045 1.00000	2046 1.00000+A2
+A2	2047 1.00000	2048 1.00000	2064 1.00000	2065 1.00000+A3
+A3	2066 1.00000	2068 1.00000	2084 1.00000	2085 1.00000+A4
+A4	2086 1.00000	2087 1.00000	2088 1.00000	2104 1.00000+A5
+A5	2105 1.00000	2106 1.00000	2107 1.00000	2108 1.00000+A6
+A6	2114 1.00000	2115 1.00000	2116 1.00000	2117 1.00000+A7
+A7	2118 1.00000	2124 1.00000	2126 1.00000	2127 1.00000+A8
+A8	2128 1.00000	2134 1.00000	2135 1.00000	2136 1.00000+A9
+A9	2137 1.00000	2146 1.00000	2147 1.00000	2154 1.00000+A10
+A10	2155 1.00000	2156 1.00000	2157 1.00000	2164 1.00000+A11
+A11	2165 1.00000	2166 1.00000	2167 1.00000	
\$				
SHAPE	2011CTRIA3	2008 1.00000	2024 1.00000	2067 1.00000+A
+A	2125 1.00000	2145 1.00000		
\$				
SHAPE	2012CQUAD4	2004 0.04649	2005 0.04649	2006 0.04649+A
+A	2007 0.04649	2044 0.15111	2045 0.13947	2046 0.13947+A2
+A2	2047 0.13947	2048 0.13947	2064 0.23333	2065 0.23333+A3
+A3	2066 0.23333	2068 0.23333	2084 0.32772	2085 0.32772+A4
+A4	2086 0.32772	2087 0.32772	2088 0.32772	2104 0.43298+A5
+A5	2105 0.43298	2106 0.43298	2107 0.43298	2108 0.43298+A6
+A6	2114 0.52660	2115 0.52660	2116 0.52660	2117 0.52660+A7
+A7	2118 0.52660	2124 0.60993	2126 0.60993	2127 0.60993+A8
+A8	2128 0.60993	2134 0.70519	2135 0.70519	2136 0.70519+A9
+A9	2137 0.70519	2146 0.78097	2147 0.80125	2154 0.83239+A10
+A10	2155 0.84153	2156 0.86086	2157 0.88114	2164 1.00000+A11
+A11	2165 1.00000	2166 1.00000	2167 1.00000	
\$				
SHAPE	2012CTRIA3	2008 0.06199	2024 0.10849	2067 0.21754+A
+A	2125 0.59394	2145 0.76468		
\$				
SHAPE	2013CQUAD4	2004 0.00216	2005 0.00216	2006 0.00216+A
+A	2007 0.00216	2044 0.02283	2045 0.01945	2046 0.01945+A2
+A2	2047 0.01945	2048 0.01945	2064 0.05444	2065 0.05444+A3
+A3	2066 0.05444	2068 0.05444	2084 0.10740	2085 0.10740+A4
+A4	2086 0.10740	2087 0.10740	2088 0.10740	2104 0.18747+A5
+A5	2105 0.18747	2106 0.18747	2107 0.18747	2108 0.18747+A6
+A6	2114 0.27730	2115 0.27730	2116 0.27730	2117 0.27730+A7
+A7	2118 0.27730	2124 0.37201	2126 0.37201	2127 0.37201+A8
+A8	2128 0.37201	2134 0.49730	2135 0.49730	2136 0.49730+A9
+A9	2137 0.49730	2146 0.60991	2147 0.64199	2154 0.69287+A10
+A10	2155 0.70817	2156 0.74108	2157 0.77641	2164 1.00000+A11
+A11	2165 1.00000	2166 1.00000	2167 1.00000	
\$				
SHAPE	2013CTRIA3	2008 0.00384	2024 0.01177	2067 0.04732+A
+A	2125 0.35276	2145 0.58473		

\$					
SHAPE	2021CQUAD4	2009 1.00000	2010 1.00000	2049 1.00000+A	
+A	2050 1.00000	2069 1.00000	2070 1.00000	2090 1.00000	
SHAPE	2021CTRIA3	2089 1.00000			
\$					
SHAPE	2022CQUAD4	2009 0.13539	2010 0.13539	2049 0.40617+A	
+A	2050 0.40617	2069 0.67950	2070 0.65395	2090 0.92882	
SHAPE	2022CTRIA3	2089 1.00000			
\$					
SHAPE	2171CQUAD4	2171 1.00000	2172 1.00000	2173 1.00000+A	
+A	2174 1.00000	2175 1.00000	2176 1.00000		
\$					
SHAPE	2172CQUAD4	2171 0.89123	2172 0.89123	2173 0.89123+A	
+A	2174 1.00000	2175 1.00000	2176 1.00000		
\$					
SHAPE	2201CQUAD4	2201 1.00000	2202 1.00000	2204 1.00000+A	
+A	2205 1.00000	2206 1.00000	2207 1.00000	2208 1.00000+A2	
+A2	2209 1.00000	2210 1.00000	2211 1.00000	2212 1.00000+A3	
+A3	2213 1.00000	2214 1.00000			
\$					
SHAPE	2201CTRIA3	2203 1.00000	2215 1.00000		
\$					
SHAPE	2221CQUAD4	2221 1.00000	2223 1.00000		
\$					
SHAPE	2221CTRIA3	2222 1.00000	2224 1.00000		
\$					
SHAPE	2232CQUAD4	2232 1.00000	2235 1.00000	2236 1.00000+A	
+A	2237 1.00000	2238 1.00000	2239 1.00000	2240 1.00000+A2	
+A2	2241 1.00000	2242 1.00000	2243 1.00000	2244 1.00000+A3	
+A3	2245 1.00000	2246 1.00000	2247 1.00000	2252 1.00000	
\$					
SHAPE	2232CTRIA3	2233 1.00000	2248 5.	2253 1.00000	
\$					
SHAPE	2261CQUAD4	2261 1.00000	2262 1.00000	2263 1.00000+A	
+A	2264 1.00000	2265 1.00000	2266 1.00000		
\$					
SHAPE	2261CTRIA3	2263 1.00000			
\$					
SHAPE	2271CQUAD4	2271 1.00000	2272 1.00000	2273 1.00000+A	
+A	2274 1.00000	2275 1.00000	2276 1.00000	2277 1.00000+A2	
+A2	2278 1.00000	2279 1.00000	2280 1.00000	2281 1.00000+A3	
+A3	2282 1.00000	2283 1.00000	2284 1.00000	2285 1.00000	
\$					
SHAPE	2271CTRIA3	2273 1.00000			
\$					
SHAPE	2301CQUAD4	2301 1.00000	2302 1.00000	2303 1.00000+A	
+A	2304 1.00000	2305 1.00000	2306 1.00000	2307 1.00000+A2	
+A2	2308 1.00000	2309 1.00000	2310 1.00000	2311 1.00000+A3	
+A3	2312 1.00000	2313 1.00000	2314 1.00000	2315 1.00000+A4	
+A4	2316 1.00000	2317 1.00000	2318 1.00000	2321 1.00000+A5	
+A5	2322 1.00000	2323 1.00000	2324 1.00000	2325 1.00000+A6	
+A6	2326 1.00000	2327 1.00000	2328 1.00000	2329 1.00000+A7	
+A7	2331 1.00000	2332 1.00000	2333 1.00000	2334 1.00000+A8	
+A8	2335 1.00000	2336 1.00000	2337 1.00000	2338 1.00000+A9	

+A9	2341 1.00000	2342 1.00000	2343 1.00000	2344 1.00000+A10
+A10	2345 1.00000	2346 1.00000	2347 1.00000	2348 1.00000+A11
+A11	2349 1.00000	2350 1.00000	2351 1.00000	2352 1.00000+A12
+A12	2354 1.00000	2355 1.00000	2356 1.00000	2357 1.00000+A13
+A13	2358 1.00000	2359 1.00000	2361 1.00000	
\$				
SHAPE	2301CTRIA3	2353 1.00000	2360 1.00000	
\$				
SHAPE	2302CQUAD4	2301 0.06593	2302 0.06593	2303 0.16484+A
+A	2304 0.16484	2305 0.23077	2306 0.23077	2307 0.33088+A2
+A2	2308 0.33088	2309 0.46472	2310 0.46472	2311 0.61399+A3
+A3	2312 0.61399	2313 0.74674	2314 0.74674	2315 0.86491+A4
+A4	2316 0.86491	2317 1.00000	2318 1.00000	2321 0.61399+A5
+A5	2322 0.61399	2323 0.74674	2324 0.74674	2325 0.86491+A6
+A6	2326 0.86491	2327 1.00000	2328 1.00000	2329 1.00000+A7
+A7	2331 0.06593	2332 0.16484	2333 0.23077	2334 0.33088+A8
+A8	2335 0.46472	2336 0.61399	2337 0.74674	2338 0.86491+A9
+A9	2341 0.06593	2342 0.06593	2343 0.16484	2344 0.16484+A10
+A10	2345 0.23077	2346 0.23077	2347 0.33088	2348 0.33088+A11
+A11	2349 0.46472	2350 0.46472	2351 0.61399	2352 0.61399+A12
+A12	2354 0.61399	2355 0.74674	2356 0.74674	2357 0.74674+A13
+A13	2358 0.86491	2359 0.86491	2361 1.00000	
\$				
SHAPE	2302CTRIA3	2353 0.58646	2360 0.84224	
\$				
SHAPE	2303CQUAD4	2301 0.00435	2302 0.00435	2303 0.02717+A
+A	2304 0.02717	2305 0.05325	2306 0.05325	2307 0.10948+A2
+A2	2308 0.10948	2309 0.21597	2310 0.21597	2311 0.37699+A3
+A3	2312 0.37699	2313 0.55762	2314 0.55762	2315 0.74807+A4
+A4	2316 0.74807	2317 1.00000	2318 1.00000	2321 0.37699+A5
+A5	2322 0.37699	2323 0.55762	2324 0.55762	2325 0.74807+A6
+A6	2326 0.74807	2327 1.00000	2328 1.00000	2329 1.00000+A7
+A7	2331 0.00435	2332 0.02717	2333 0.05325	2334 0.10948+A8
+A8	2335 0.21597	2336 0.37699	2337 0.55762	2338 0.74807+A9
+A9	2341 0.00435	2342 0.00435	2343 0.02717	2344 0.02717+A10
+A10	2345 0.05325	2346 0.05325	2347 0.10948	2348 0.10948+A11
+A11	2349 0.21597	2350 0.21597	2351 0.37699	2352 0.37699+A12
+A12	2354 0.37699	2355 0.55762	2356 0.55762	2357 0.55762+A13
+A13	2358 0.74807	2359 0.74807	2361 1.00000	
\$				
SHAPE	2303CTRIA3	2353 0.34393	2360 0.70936	
\$				
SHAPE	2501CROD	2501 1.00000	2502 1.00000	2503 1.00000+A
+A	2504 1.00000	2505 1.00000	2506 1.00000	2507 1.00000+A2
+A2	2508 1.00000	2509 1.00000	2510 1.00000	2511 1.00000
\$				
SHAPE	2502CROD	2501 0.04649	2502 0.11625	2503 0.16274+A
+A	2504 0.23333	2505 0.32772	2506 0.43298	2507 0.52660+A2
+A2	2508 0.60993	2509 0.70519	2510 0.83239	2511 1.00000
\$				
SHAPE	2503CROD	2501 0.002	2502 0.02	2503 0.06 +A
+A	2504 0.10	2505 0.16	2506 0.24	2507 0.36 +A2
+A2	2508 0.50	2509 0.65	2510 0.80	2511 1.00000
\$				

SHAPE	2521CROD	2521 1.00000	2522 1.00000	2523 1.00000+A
+A	2524 1.00000	2525 1.00000	2526 1.00000	2527 3. +A2
+A2	2528 1.00000	2529 1.00000	2530 1.00000	2531 1.00000
\$				
SHAPE	2522CROD	2521 0.04649	2522 0.13947	2523 0.23333+A
+A	2524 0.32772	2525 0.43298	2526 0.52660	2527 0.60993+A2
+A2	2528 0.70519	2529 0.81133	2530 0.89123	2531 1.00000
\$				
SHAPE	2523CROD	2521 0.002	2522 0.02	2523 0.06 +A
+A	2524 0.10	2525 0.16	2526 0.24	2527 0.36 +A2
+A2	2528 0.50	2529 0.65	2530 0.80	2531 1.00000
\$				
SHAPE	3001CQUAD4	3001 1.00000	3002 1.00000	3003 1.00000+A
+A	3004 1.00000	3021 1.00000	3022 1.00000	3023 1.00000+A2
+A2	3024 1.00000	3041 1.00000	3042 1.00000	3043 1.00000+A3
+A3	3044 1.00000	3061 1.00000	3062 1.00000	3063 1.00000+A4
+A4	3064 1.00000	3081 1.00000	3082 1.00000	3083 1.00000+A5
+A5	3084 1.00000	3101 1.00000	3102 1.00000	3103 1.00000+A6
+A6	3104 1.00000			
\$				
SHAPE	3002CQUAD4	3001 0.09670	3002 0.09670	3003 0.09670+A
+A	3004 0.09670	3021 0.29009	3022 0.29009	3023 0.29009+A2
+A2	3024 0.29009	3041 0.48348	3042 0.48348	3043 0.48348+A3
+A3	3044 0.48348	3061 0.68977	3062 0.68977	3063 0.68977+A4
+A4	3064 0.68977	3081 0.86624	3082 0.86624	3083 0.86624+A5
+A5	3084 0.86624	3101 1.00000	3102 1.00000	3103 1.00000+A6
+A6	3104 1.00000			
\$				
SHAPE	3003CQUAD4	3001 0.00935	3002 0.00935	3003 0.00935+A
+A	3004 0.00935	3021 0.08415	3022 0.08415	3023 0.08415+A2
+A2	3024 0.08415	3041 0.23375	3042 0.23375	3043 0.23375+A3
+A3	3044 0.23375	3061 0.47578	3062 0.47578	3063 0.47578+A4
+A4	3064 0.47578	3081 0.75037	3082 0.75037	3083 0.75037+A5
+A5	3084 0.75037	3101 1.00000	3102 1.00000	3103 1.00000+A6
+A6	3104 1.00000			
\$				
SHAPE	3011CQUAD4	3005 1.00000	3006 1.00000	3007 1.00000+A
+A	3025 1.00000	3026 1.00000	3027 1.00000	3045 1.00000+A2
+A2	3046 1.00000	3047 1.00000	3048 1.00000	3049 1.00000+A3
+A3	3051 1.00000	3052 1.00000	3066 1.00000	3067 1.00000+A4
+A4	3068 1.00000	3069 1.00000	3070 1.00000	3085 1.00000+A5
+A5	3086 1.00000	3087 1.00000	3088 1.00000	3089 1.00000+A6
+A6	3105 1.00000	3106 1.00000	3107 1.00000	3108 1.00000+A7
+A7	3109 1.00000			
\$				
SHAPE	3011CTRIA3	3050 1.00000	3065 1.00000	3071 1.00000
\$				
SHAPE	3012CQUAD4	3005 0.09670	3006 0.09670	3007 0.09670+A
+A	3025 0.29009	3026 0.29009	3027 0.29009	3045 0.48348+A2
+A2	3046 0.48348	3047 0.48348	3048 0.48348	3049 0.48348+A3
+A3	3051 0.48348	3052 0.48348	3066 0.68977	3067 0.68977+A4
+A4	3068 0.68977	3069 0.68977	3070 0.68977	3085 0.86624+A5
+A5	3086 0.86624	3087 0.86624	3088 0.86624	3089 0.86624+A6
+A6	3105 1.00000	3106 1.00000	3107 1.00000	3108 1.00000+A7

+A7	3109 1.00000			
\$				
SHAPE	3012CTRIA3	3050 0.45125	3065 0.65323	3071 0.65323
\$				
SHAPE	3013CQUAD4	3005 0.00935	3006 0.00935	3007 0.00935+A
+A	3025 0.08415	3026 0.08415	3027 0.08415	3045 0.23375+A2
+A2	3046 0.23375	3047 0.23375	3048 0.23375	3049 0.23375+A3
+A3	3051 0.23375	3052 0.23375	3066 0.47578	3067 0.47578+A4
+A4	3068 0.47578	3069 0.47578	3070 0.47578	3085 0.75037+A5
+A5	3086 0.75037	3087 0.75037	3088 0.75037	3089 0.75037+A6
+A6	3105 1.00000	3106 1.00000	3107 1.00000	3108 1.00000+A7
+A7	3109 1.00000			
\$				
SHAPE	3013CTRIA3	3050 0.20362	3065 0.42671	3071 0.42671
\$				
SHAPE	3021CQUAD4	3008 1.00000	3009 1.00000	3010 1.00000+A
+A	3028 1.00000	3029 1.00000	3030 1.00000	3053 1.00000+A2
+A2	3054 1.00000	3055 1.00000	3072 1.00000	3073 1.00000+A3
+A3	3074 1.00000	3090 1.00000	3091 1.00000	3092 1.00000+A4
+A4	3110 1.00000	3111 1.00000	3112 1.00000	
\$				
SHAPE	3022CQUAD4	3008 0.09670	3009 0.09670	3010 0.09670+A
+A	3028 0.29009	3029 0.29009	3030 0.29009	3053 0.48348+A2
+A2	3054 0.48348	3055 0.48348	3072 0.68977	3073 0.68977+A3
+A3	3074 0.68977	3090 0.86624	3091 0.86624	3092 0.86624+A4
+A4	3110 1.00000	3111 1.00000	3112 1.00000	
\$				
SHAPE	3023CQUAD4	3008 0.00935	3009 0.00935	3010 0.00935+A
+A	3028 0.08415	3029 0.08415	3030 0.08415	3053 0.23375+A2
+A2	3054 0.23375	3055 0.23375	3072 0.47578	3073 0.47578+A3
+A3	3074 0.47578	3090 0.75037	3091 0.75037	3092 0.75037+A4
+A4	3110 1.00000	3111 1.00000	3112 1.00000	
\$				
SHAPE	3121CQUAD4	3121 1.00000	3122 1.00000	3123 1.00000+A
+A	3124 1.00000	3125 1.00000	3126 1.00000	3127 1.00000+A2
+A2	3129 1.00000	3130 1.00000	3131 1.00000	3132 1.00000+A3
+A3	3133 1.00000	3134 1.00000	3136 1.00000	3137 1.00000+A4
+A4	3138 1.00000			
\$				
SHAPE	3121CTRIA3	3128 1.00000	3135 1.00000	
\$				
SHAPE	3141CQUAD4	3141 1.00000	3142 1.00000	3143 1.00000+A
+A	3144 1.00000	3145 1.00000	3146 1.00000	3147 1.00000+A2
+A2	3148 1.00000	3149 1.00000	3151 1.00000	
\$				
SHAPE	3141CTRIA3	3150 1.00000		
\$				
SHAPE	3161CQUAD4	3161 1.00000	3162 1.00000	3163 1.00000+A
+A	3164 1.00000	3165 1.00000	3166 1.00000	3167 1.00000+A2
+A2	3168 1.00000	3169 1.00000	3170 1.00000	3171 1.00000+A3
+A3	3172 1.00000	3173 1.00000	3174 1.00000	3175 1.00000+A4
+A4	3176 1.00000	3177 1.00000	3178 1.00000	3179 1.00000+A5
+A5	3180 1.00000	3181 1.00000	3182 1.00000	3183 1.00000+A6
+A6	3184 1.00000	3185 1.00000	3186 1.00000	3187 1.00000+A7

+A7	3188 1.00000			
SHAPE	3161CTRIA3	3181 1.00000		
\$				
SHAPE	3191CQUAD4	3191 1.00000	3192 1.00000	3193 1.00000+A
+A	3194 1.00000	3195 1.00000	3196 1.00000	3197 1.00000+A2
+A2	3198 1.00000	3199 1.00000	3200 1.00000	3201 1.00000+A3
+A3	3203 1.00000	3204 1.00000	3205 1.00000	3206 1.00000+A4
+A4	3208 1.00000	3209 1.00000	3210 1.00000	
\$				
SHAPE	3191CTRIA3	3202 1.00000	3207 1.00000	
\$				
SHAPE	3221CQUAD4	3221 1.00000	3222 1.00000	3223 1.00000+A
+A	3225 1.00000	3226 1.00000	3227 1.00000	3228 1.00000+A2
+A2	3229 1.00000	3230 1.00000	3232 1.00000	3233 1.00000+A3
+A3	3234 1.00000	3235 1.00000	3236 1.00000	3238 1.00000+A4
+A4	3239 1.00000	3240 1.00000		
\$				
SHAPE	3221CTRIA3	3224 1.00000	3231 1.00000	3237 1.00000
\$				
SHAPE	3251CQUAD4	3251 1.00000	3252 1.00000	3253 1.00000+A
+A	3254 1.00000	3255 1.00000	3256 1.00000	3257 1.00000+A2
+A2	3258 1.00000	3259 1.00000	3260 1.00000	3261 1.00000+A3
+A3	3262 1.00000			
SHAPE	3251CTRIA3	3253 1.00000		
\$				
SHAPE	3271CQUAD4	3271 1.00000	3272 1.00000	3273 1.00000+A
+A	3274 1.00000	3275 1.00000	3276 1.00000	3277 1.00000+A2
+A2	3279 1.00000	3280 1.00000	3281 1.00000	
\$				
SHAPE	3271CTRIA3	3278 1.00000	3282 1.00000	3283 1.00000
\$				
SHAPE	3272CQUAD4	3271 0.14019	3272 0.14019	3273 0.14019+A
+A	3274 0.42056	3275 0.42056	3276 0.42056	3277 0.70093+A2
+A2	3279 0.70093	3280 0.70093	3281 1.00000	
\$				
SHAPE	3272CTRIA3	3278 0.65420	3282 0.94704	3283 0.94704
\$				
SHAPE	3301CQUAD4	3304 1.00000	3305 1.00000	3306 1.00000+A
+A	3311 1.00000	3312 1.00000	3313 1.00000	3314 1.00000+A2
+A2	3315 1.00000	3316 1.00000	3317 1.00000	3318 1.00000+A3
+A3	3319 1.00000	3320 1.00000	3321 1.00000	3322 1.00000+A4
+A4	3323 1.00000	3331 1.00000	3332 1.00000	3333 1.00000+A5
+A5	3334 1.00000	3335 1.00000	3336 1.00000	3337 1.00000+A6
+A6	3338 1.00000	3339 1.00000	3340 1.00000	3341 1.00000+A7
+A7	3342 1.00000	3343 1.00000	3352 1.00000	3353 1.00000+A8
+A8	3354 1.00000	3355 1.00000	3356 1.00000	3357 1.00000+A9
+A9	3358 1.00000	3359 1.00000	3303 1.0	
\$				
SHAPE	3301CTRIA3	3301 1.00000	3302 1.00000	3307 1.00000+A
+A	3308 1.00000	3351 1.00000		
\$				
SHAPE	3302CQUAD4	3304 0.13806	3305 0.23170	3306 0.28274+A
+A	3311 0.42414	3312 0.42414	3313 0.42055	3314 0.39985+A2
+A2	3315 0.36560	3316 0.33291	3317 0.31394	3318 0.30964+A3

+A3	3319 0.30871	3320 0.31220	3321 0.34178	3322 0.39387+A4
+A4	3323 0.42203	3331 0.64200	3332 0.64200	3333 0.64200+A5
+A5	3334 0.64200	3335 0.64200	3336 0.64200	3337 0.64200+A6
+A6	3338 0.64200	3339 0.64200	3340 0.64200	3341 0.64200+A7
+A7	3342 0.64200	3343 0.64200	3352 1.00000	3353 1.00000+A8
+A8	3354 1.00000	3355 1.00000	3356 1.00000	3357 1.00000+A9
+A9	3358 1.00000	3359 1.00000	3303 .138	
\$				
SHAPE	3302CTRIA3	3301 0.10207	3302 0.10084	3307 0.31766+A
+A	3308 0.31766	3351 0.93827		
\$				
SHAPE	3361CQUAD4	3361 1.00000	3362 1.00000	3363 1.00000+A
+A	3364 1.00000	3365 1.00000	3366 1.00000	3367 1.00000+A2
+A2	3368 1.00000	3369 1.00000	3370 1.00000	3371 1.00000+A3
+A3	3372 1.00000	3373 1.00000		
\$				
SHAPE	3381CQUAD4	3381 1.00000	3382 1.00000	3383 1.00000+A
+A	3384 1.00000	3385 1.00000	3386 1.00000	3387 1.00000+A2
+A2	3388 1.00000	3389 1.00000	3390 1.00000	3391 1.00000
\$				
SHAPE	3401CQUAD4	3401 1.00000	3402 1.00000	3403 1.00000+A
+A	3404 1.00000	3405 1.00000	3406 1.00000	3407 1.00000+A2
+A2	3408 1.00000	3409 1.00000	3410 1.00000	3411 1.00000
\$				
SHAPE	3501CROD	3501 1.00000	3502 1.00000	3503 1.00000+A
+A	3504 1.00000	3505 1.00000	3506 1.00000	
\$				
SHAPE	3502CROD	3501 0.09670	3502 0.29009	3503 0.48348+A
+A	3504 0.68977	3505 0.86624	3506 1.00000	
\$				
SHAPE	3511CROD	3511 1.00000	3512 1.00000	3513 1.00000+A
+A	3514 1.00000	3515 1.00000	3516 1.00000	
\$				
SHAPE	3512CROD	3511 0.09670	3512 0.29009	3513 0.48348+A
+A	3514 0.68977	3515 0.86624	3516 1.00000	
\$				
SHAPE	3521CROD	3521 1.00000	3522 1.00000	3523 1.00000+A
+A	3524 1.00000	3525 1.00000	3526 1.00000	4521 1.00000
\$				
SHAPE	3522CROD	3521 0.08433	3522 0.25299	3523 0.42164+A
+A	3524 0.60155	3525 0.75545	3526 0.87210	4521 1.00000
\$				
SHAPE	3551CROD	3551 1.00000	3552 1.00000	3553 1.00000+A
+A	3554 1.00000	3555 1.00000	3556 1.00000	3557 1.00000
\$				
SHAPE	3552CROD	3551 0.05251	3552 0.15043	3553 0.30620+A
+A	3554 0.48348	3555 0.68977	3556 0.86624	3557 1.00000
\$				
SHAPE	3561CROD	3561 1.00000	3562 1.00000	3563 1.00000+A
+A	3564 1.00000	3565 1.00000	3566 1.00000	3567 1.00000
\$				
SHAPE	3562CROD	3561 0.00917	3562 0.15043	3563 0.30620+A
+A	3564 0.48348	3565 0.68977	3566 0.86624	3567 1.00000
\$				

SHAPE	3801CQUAD4	3801 1.00000	3802 1.00000	3803 1.00000+A
+A	3804 1.00000	3805 1.00000	3811 1.00000	3812 1.00000+A2
+A2	3813 1.00000	3814 1.00000	3815 1.00000	3816 1.00000+A3
+A3	3817 1.00000	3818 1.00000	3821 1.00000	3822 1.00000+A4
+A4	3823 1.00000	3824 1.00000	3825 1.00000	3826 1.00000+A5
+A5	3827 1.00000	3828 1.00000	3831 1.00000	3832 1.00000+A6
+A6	3833 1.00000	3834 1.00000	3835 1.00000	3836 1.00000+A7
+A7	3837 1.00000	3838 1.00000	3851 1.00000	3852 1.00000+A8
+A8	3853 1.00000	3854 1.00000		
\$				
SHAPE	3801CTRIA3	3815 1.00000		
\$				
SHAPE	3802CQUAD4	3801 0.14019	3802 0.14019	3803 0.14019+A
+A	3804 0.14019	3805 0.14019	3811 0.42056	3812 0.42056+A2
+A2	3813 0.42056	3814 0.42056	3815 0.46729	3816 0.42056+A3
+A3	3817 0.42056	3818 0.42056	3821 0.70093	3822 0.70093+A4
+A4	3823 0.70093	3824 0.70093	3825 0.70093	3826 0.70093+A5
+A5	3827 0.70093	3828 0.70093	3831 1.00000	3832 1.00000+A6
+A6	3833 1.00000	3834 1.00000	3835 1.00000	3836 1.00000+A7
+A7	3837 1.00000	3838 1.00000	3851 0.42056	3852 0.42056+A8
+A8	3853 0.70093	3854 1.00000		
\$				
SHAPE	3802CTRIA3	3815 1.00000		
\$				
SHAPE	3901CQUAD4	3902 1.00000	3903 1.00000	3911 1.00000+A
+A	3912 1.00000	3913 1.00000	3914 1.00000	3915 1.00000+A2
+A2	3916 1.00000	3917 1.00000	3918 1.00000	3919 1.00000+A3
+A3	3921 1.00000	3922 1.00000	3923 1.00000	3924 1.00000+A4
+A4	3925 1.00000	3926 1.00000	3927 1.00000	3928 1.00000+A5
+A5	3929 1.00000	3931 1.00000	3932 1.00000	3933 1.00000+A6
+A6	3934 1.00000	3935 1.00000	3936 1.00000	3937 1.00000+A7
+A7	3938 1.00000	3939 1.00000	3943 1.00000	3944 1.00000+A8
+A8	3945 1.00000	3946 1.00000	3948 1.00000	3950 1.00000+A9
+A9	3951 1.00000	3961 1.00000	3962 1.00000	3963 1.00000+A10
+A10	3964 1.00000	3965 1.00000	3966 1.00000	3967 1.00000+A11
+A11	3968 1.00000	3969 1.00000	3970 1.00000	3971 1.00000+A12
+A12	3972 1.00000	3973 1.00000	3974 1.00000	3975 1.00000+A13
+A13	3976 1.00000	3977 1.00000	3978 1.00000	3979 1.00000+A14
+A14	3980 1.00000	3981 1.00000	3982 1.00000	3983 1.00000+A15
+A15	3984 1.00000	3985 1.00000	3986 1.00000	3987 1.00000+A16
+A16	3988 1.00000	3941 1.00000		
\$				
SHAPE	3901CTRIA3	3901 1.00000	3904 1.00000	3942 1.00000+A
+A	3947 1.00000	3949 1.00000		
\$				
SHAPE	3902CQUAD4	3902-0.06819	3903-0.02784	3911 0.05298+A
+A	3912 0.05016	3913 0.04232	3914 0.02996	3915 0.01805+A2
+A2	3916 0.01133	3917 0.00893	3918 0.01960	3919 0.04205+A3
+A3	3921 0.14899	3922 0.14899	3923 0.14899	3924 0.14899+A4
+A4	3925 0.14899	3926 0.14899	3927 0.14899	3928 0.14899+A5
+A5	3929 0.14899	3931 0.30327	3932 0.30327	3933 0.30327+A6
+A6	3934 0.30327	3935 0.30327	3936 0.30327	3937 0.30327+A7
+A7	3938 0.30327	3939 0.30327	3943 0.47885	3944 0.47885+A8
+A8	3945 0.47885	3946 0.47885	3948 0.47885	3950 0.47885+A9

+A9	3951 0.47885	3961 0.68316	3962 0.68316	3963 0.68316+A10
+A10	3964 0.68316	3965 0.68316	3966 0.68316	3967 0.68316+A11
+A11	3968 0.68316	3969 0.68316	3970 0.68316	3971 0.85794+A12
+A12	3972 0.85794	3973 0.85794	3974 0.85794	3975 0.85794+A13
+A13	3976 0.85794	3977 0.85794	3978 0.85794	3979 0.85794+A14
+A14	3980 0.85794	3981 1.00000	3982 1.00000	3983 1.00000+A15
+A15	3984 1.00000	3985 1.00000	3986 1.00000	3987 1.00000+A16
+A16	3988 1.00000	3941 0.47885		
\$				
SHAPE	3902CTRIA3	3901-0.07744	3904 0.00518	3942 0.51077+A
+A	3947 0.44692	3949 0.51077		
\$				
SHAPE	4001CQUAD4	4001 1.00000	4002 1.00000	4003 1.00000+A
+A	4021 1.00000	4022 1.00000	4023 1.00000	4041 1.00000+A2
+A2	4042 1.00000	4043 1.00000	4061 1.00000	4062 1.00000+A3
+A3	4063 1.00000	4081 1.00000	4082 1.00000	4083 1.00000
\$				
SHAPE	4002CQUAD4	4001 0.09415	4002 0.09415	4003 0.09415+A
+A	4021 0.27514	4022 0.27514	4023 0.27514	4041 0.49726+A2
+A2	4042 0.49726	4043 0.49726	4061 0.75320	4062 0.75320+A3
+A3	4063 0.75320	4081 1.00000	4082 1.00000	4083 1.00000
\$				
SHAPE	4003CQUAD4	4001 0.00886	4002 0.00886	4003 0.00886+A
+A	4021 0.07570	4022 0.07570	4023 0.07570	4041 0.24727+A2
+A2	4042 0.24727	4043 0.24727	4061 0.56731	4062 0.56731+A3
+A3	4063 0.56731	4081 1.00000	4082 1.00000	4083 1.00000
\$				
SHAPE	4011CQUAD4	4004 1.00000	4005 1.00000	4006 1.00000+A
+A	4007 1.00000	4008 1.00000	4009 1.00000	4024 1.00000+A2
+A2	4025 1.00000	4026 1.00000	4027 1.00000	4028 1.00000+A3
+A3	4029 1.00000	4044 1.00000	4045 1.00000	4046 1.00000+A4
+A4	4047 1.00000	4048 1.00000	4049 1.00000	4064 1.00000+A5
+A5	4065 1.00000	4066 1.00000	4067 1.00000	4068 1.00000+A6
+A6	4069 1.00000	4084 1.00000	4085 1.00000	4086 1.00000+A7
+A7	4087 1.00000	4088 1.00000	4089 1.00000	
\$				
SHAPE	4012CQUAD4	4004 0.09415	4005 0.09415	4006 0.09415+A
+A	4007 0.09415	4008 0.09415	4009 0.09415	4024 0.27514+A2
+A2	4025 0.27514	4026 0.27514	4027 0.27514	4028 0.27514+A3
+A3	4029 0.27514	4044 0.49726	4045 0.49726	4046 0.49726+A4
+A4	4047 0.49726	4048 0.49726	4049 0.49726	4064 0.75320+A5
+A5	4065 0.75320	4066 0.75320	4067 0.75320	4068 0.75320+A6
+A6	4069 0.75320	4084 1.00000	4085 1.00000	4086 1.00000+A7
+A7	4087 1.00000	4088 1.00000	4089 1.00000	
\$				
SHAPE	4013CQUAD4	4004 0.00886	4005 0.00886	4006 0.00886+A
+A	4007 0.00886	4008 0.00886	4009 0.00886	4024 0.07570+A2
+A2	4025 0.07570	4026 0.07570	4027 0.07570	4028 0.07570+A3
+A3	4029 0.07570	4044 0.24727	4045 0.24727	4046 0.24727+A4
+A4	4047 0.24727	4048 0.24727	4049 0.24727	4064 0.56731+A5
+A5	4065 0.56731	4066 0.56731	4067 0.56731	4068 0.56731+A6
+A6	4069 0.56731	4084 1.00000	4085 1.00000	4086 1.00000+A7
+A7	4087 1.00000	4088 1.00000	4089 1.00000	
\$				

SHAPE	4021CQUAD4	4010 1.00000	4011 1.00000	4012 1.00000+A
+A	4030 1.00000	4031 1.00000	4032 1.00000	4050 1.00000+A2
+A2	4051 1.00000	4052 1.00000	4070 1.00000	4071 1.00000+A3
+A3	4072 1.00000	4090 1.00000	4091 1.00000	4092 1.00000
\$				
SHAPE	4022CQUAD4	4010 0.09415	4011 0.09415	4012 0.09415+A
+A	4030 0.27514	4031 0.27514	4032 0.27514	4050 0.49726+A2
+A2	4051 0.49726	4052 0.49726	4070 0.75320	4071 0.75320+A3
+A3	4072 0.75320	4090 1.00000	4091 1.00000	4092 1.00000
\$				
SHAPE	4023CQUAD4	4010 0.00886	4011 0.00886	4012 0.00886+A
+A	4030 0.07570	4031 0.07570	4032 0.07570	4050 0.24727+A2
+A2	4051 0.24727	4052 0.24727	4070 0.56731	4071 0.56731+A3
+A3	4072 0.56731	4090 1.00000	4091 1.00000	4092 1.00000
\$				
SHAPE	4101CQUAD4	4101 1.00000	4102 1.00000	4103 1.00000+A
+A	4104 1.00000	4105 1.00000	4106 1.00000	4107 1.00000+A2
+A2	4108 1.00000	4109 1.00000	4110 1.00000	4111 1.00000+A3
+A3	4112 1.00000	4113 1.00000		
\$				
SHAPE	4102CQUAD4	4101 0.03461	4102 0.05038	4103 0.13586+A
+A	4104 0.15665	4105 0.25544	4106 0.36937	4107 0.46080+A2
+A2	4108 0.58401	4109 0.74024	4110 0.86418	4111 0.93653+A3
+A3	4112 0.98257	4113 1.00000		
\$				
SHAPE	4103CQUAD4	4101 0.00120	4102 0.00254	4103 0.01846+A
+A	4104 0.02454	4105 0.06525	4106 0.13643	4107 0.21234+A2
+A2	4108 0.34107	4109 0.54796	4110 0.74680	4111 0.87708+A3
+A3	4112 0.96543	4113 1.00000		
\$				
SHAPE	4121CQUAD4	4121 1.00000	4122 1.00000	4123 1.00000+A
+A	4124 1.00000	4125 1.00000	4126 1.00000	4127 1.00000+A2
+A2	4128 1.00000	4129 1.00000	4130 1.00000	4131 1.00000+A3
+A3	4132 1.00000			
\$				
SHAPE	4141CQUAD4	4141 1.00000	4142 1.00000	4143 1.00000+A
+A	4144 1.00000	4145 1.00000	4146 1.00000	4147 1.00000+A2
+A2	4148 1.00000	4149 1.00000	4150 1.00000	4151 1.00000+A3
+A3	4152 1.00000			
\$				
SHAPE	4142CQUAD4	4141 0.04951	4142 0.06472	4143 0.11243+A
+A	4144 0.20076	4145 0.32129	4146 0.45799	4147 0.58755+A2
+A2	4148 0.71857	4149 0.84204	4150 0.93058	4151 0.98152+A3
+A3	4152 1.00000			
\$				
SHAPE	4143CQUAD4	4141 0.00245	4142 0.00419	4143 0.01264+A
+A	4144 0.04031	4145 0.10323	4146 0.20975	4147 0.34522+A2
+A2	4148 0.51634	4149 0.70904	4150 0.86598	4151 0.96338+A3
+A3	4152 1.00000			
\$				
SHAPE	4161CQUAD4	4161 1.00000	4162 1.00000	4163 1.00000+A
+A	4164 1.00000	4165 1.00000	4166 1.00000	4167 1.00000+A2
+A2	4168 1.00000	4169 1.00000	4170 1.00000	4171 1.00000+A3
+A3	4172 1.00000			

\$				
SHAPE	4162CQUAD4	4161 0.08539	4162 0.09549	4163 0.13554+A
+A	4164 0.21797	4165 0.33822	4166 0.47759	4167 0.60360+A2
+A2	4168 0.72364	4169 0.85153	4170 0.94545	4171 0.98728+A3
+A3	4172 1.00000			
\$				
SHAPE	4163CQUAD4	4161 0.00729	4162 0.00912	4163 0.01837+A
+A	4164 0.04751	4165 0.11439	4166 0.22809	4167 0.36433+A2
+A2	4168 0.52365	4169 0.72510	4170 0.89387	4171 0.97472+A3
+A3	4172 1.00000			
\$				
SHAPE	4181CQUAD4	4181 1.00000	4182 1.00000	4183 1.00000+A
+A	4184 1.00000	4185 1.00000	4186 1.00000	4187 1.00000+A2
+A2	4188 1.00000	4189 1.00000	4190 1.00000	4191 1.00000+A3
+A3	4192 1.00000			
\$				
SHAPE	4182CQUAD4	4181 0.15519	4182 0.16183	4183 0.19055+A
+A	4184 0.25864	4185 0.37101	4186 0.51159	4187 0.63703+A2
+A2	4188 0.76079	4189 0.87968	4190 0.95185	4191 0.98801+A3
+A3	4192 1.00000			
\$				
SHAPE	4183CQUAD4	4181 0.02408	4182 0.02619	4183 0.03631+A
+A	4184 0.06690	4185 0.13765	4186 0.26172	4187 0.40581+A2
+A2	4188 0.57881	4189 0.77384	4190 0.90602	4191 0.97616+A3
+A3	4192 1.00000			
\$				
SHAPE	4201CQUAD4	4201 1.00000	4202 1.00000	4203 1.00000+A
+A	4204 1.00000	4205 1.00000	4206 1.00000	4207 1.00000+A2
+A2	4208 1.00000	4209 1.00000	4210 1.00000	4211 1.00000+A3
+A3	4212 1.00000			
\$				
SHAPE	4501CROD	4501 1.00000	4502 1.00000	4503 1.00000+A
+A	4504 1.00000	4505 1.00000		
\$				
SHAPE	4502CROD	4501 0.09415	4502 0.27514	4503 0.49726+A
+A	4504 0.75320	4505 1.00000		
\$				
SHAPE	4511CROD	4511 1.00000	4512 1.00000	4513 1.00000+A
+A	4514 1.00000	4515 1.00000		
\$				
SHAPE	4512CROD	4511 0.09415	4512 0.27514	4513 0.49726+A
+A	4514 0.75320	4515 1.00000		
\$				
SHAPE	4531CROD	4531 1.00000	4532 1.00000	4533 1.00000+A
+A	4534 1.00000			
\$				
SHAPE	4532CROD	4531 0.12500	4532 0.36529	4533 0.66019+A
+A	4534 1.00000			
\$				
SHAPE	4541CROD	4541 1.00000	4542 1.00000	4543 1.00000+A
+A	4544 1.00000			
\$				
SHAPE	4542CROD	4541 0.12500	4542 0.36529	4543 0.66019+A
+A	4544 1.00000			

\$				
SHAPE	5001CQUAD4	5001 1.00000	5002 1.00000	5003 1.00000+A
+A	5004 1.00000	5005 1.00000	5006 1.00000	5021 1.00000+A2
+A2	5022 1.00000	5023 1.00000	5024 1.00000	5025 1.00000+A3
+A3	5026 1.00000	5027 1.00000	5028 1.00000	5029 1.00000+A4
+A4	5030 1.00000	5041 1.00000	5042 1.00000	5043 1.00000+A5
+A5	5044 1.00000	5045 1.00000	5046 1.00000	5047 1.00000+A6
+A6	5048 1.00000	5049 1.00000	5050 1.00000	5061 1.00000+A7
+A7	5062 1.00000	5063 1.00000	5064 1.00000	5065 1.00000+A8
+A8	5066 1.00000	5067 1.00000	5068 1.00000	5069 1.00000+A9
+A9	5070 1.00000	5081 1.00000	5082 1.00000	5083 1.00000+A10
+A10	5084 1.00000	5085 1.00000	5086 1.00000	5087 1.00000+A11
+A11	5088 1.00000	5089 1.00000	5090 1.00000	5101 1.00000+A12
+A12	5102 1.00000	5103 1.00000	5104 1.00000	5105 1.00000+A13
+A13	5106 1.00000	5107 1.00000	5108 1.00000	5109 1.00000+A14
+A14	5110 1.00000	5121 1.00000	5122 1.00000	5123 1.00000+A15
+A15	5124 1.00000	5125 1.00000	5126 1.00000	5127 1.00000+A16
+A16	5128 1.00000	5129 1.00000	5130 1.00000	5141 1.00000+A17
+A17	5142 1.00000	5143 1.00000	5144 1.00000	5145 1.00000+A18
+A18	5146 1.00000	5147 1.00000	5148 1.00000	5149 1.00000+A19
+A19	5150 1.00000			
\$				
SHAPE	5002CQUAD4	5001 0.09091	5002 0.09091	5003 0.09091+A
+A	5004 0.09091	5005 0.09091	5006 0.09091	5021 0.26768+A2
+A2	5022 0.26768	5023 0.26768	5024 0.26768	5025 0.26768+A3
+A3	5026 0.26768	5027 0.26768	5028 0.26768	5029 0.26768+A4
+A4	5030 0.26768	5041 0.39899	5042 0.39899	5043 0.39899+A5
+A5	5044 0.39899	5045 0.39899	5046 0.39899	5047 0.39899+A6
+A6	5048 0.39899	5049 0.39899	5050 0.39899	5061 0.50000+A7
+A7	5062 0.50000	5063 0.50000	5064 0.50000	5065 0.50000+A8
+A8	5066 0.50000	5067 0.50000	5068 0.50000	5069 0.50000+A9
+A9	5070 0.50000	5081 0.61869	5082 0.61869	5083 0.61869+A10
+A10	5084 0.61869	5085 0.61869	5086 0.61869	5087 0.61869+A11
+A11	5088 0.61869	5089 0.61869	5090 0.61869	5101 0.71970+A12
+A12	5102 0.71970	5103 0.71970	5104 0.71970	5105 0.71970+A13
+A13	5106 0.71970	5107 0.71970	5108 0.71970	5109 0.71970+A14
+A14	5110 0.71970	5121 0.85859	5122 0.85859	5123 0.85859+A15
+A15	5124 0.85859	5125 0.85859	5126 0.85859	5127 0.85859+A16
+A16	5128 0.85859	5129 0.85859	5130 0.85859	5141 1.00000+A17
+A17	5142 1.00000	5143 1.00000	5144 1.00000	5145 1.00000+A18
+A18	5146 1.00000	5147 1.00000	5148 1.00000	5149 1.00000+A19
+A19	5150 1.00000			
\$				
SHAPE	5003CQUAD4	5001 0.00826	5002 0.00826	5003 0.00826+A
+A	5004 0.00826	5005 0.00826	5006 0.00826	5021 0.07165+A2
+A2	5022 0.07165	5023 0.07165	5024 0.07165	5025 0.07165+A3
+A3	5026 0.07165	5027 0.07165	5028 0.07165	5029 0.07165+A4
+A4	5030 0.07165	5041 0.15919	5042 0.15919	5043 0.15919+A5
+A5	5044 0.15919	5045 0.15919	5046 0.15919	5047 0.15919+A6
+A6	5048 0.15919	5049 0.15919	5050 0.15919	5061 0.25000+A7
+A7	5062 0.25000	5063 0.25000	5064 0.25000	5065 0.25000+A8
+A8	5066 0.25000	5067 0.25000	5068 0.25000	5069 0.25000+A9
+A9	5070 0.25000	5081 0.38277	5082 0.38277	5083 0.38277+A10
+A10	5084 0.38277	5085 0.38277	5086 0.38277	5087 0.38277+A11

+A11	5088 0.38277	5089 0.38277	5090 0.38277	5101 0.51796+A12
+A12	5102 0.51796	5103 0.51796	5104 0.51796	5105 0.51796+A13
+A13	5106 0.51796	5107 0.51796	5108 0.51796	5109 0.51796+A14
+A14	5110 0.51796	5121 0.73717	5122 0.73717	5123 0.73717+A15
+A15	5124 0.73717	5125 0.73717	5126 0.73717	5127 0.73717+A16
+A16	5128 0.73717	5129 0.73717	5130 0.73717	5141 1.00000+A17
+A17	5142 1.00000	5143 1.00000	5144 1.00000	5145 1.00000+A18
+A18	5146 1.00000	5147 1.00000	5148 1.00000	5149 1.00000+A19
+A19	5150 1.00000			
\$				
SHAPE	5004CQUAD4	5001 0.04063	5002-0.32239	5003-0.51969+A
+A	5004-0.52547	5005-0.34668	5006-0.03100	5021 0.03171+A2
+A2	5022-0.46518	5023-0.79022	5024-0.80405	5025-0.51585+A3
+A3	5026-0.06068	5027 0.69902	5028 0.92085	5029 0.93997+A4
+A4	5030 0.78555	5041 0.04356	5042-0.50064	5043-0.87688+A5
+A5	5044-0.89250	5045-0.55300	5046-0.04858	5047 0.67051+A6
+A6	5048 0.96576	5049 0.98673	5050 0.75377	5061 0.05104+A7
+A7	5062-0.50034	5063-0.87950	5064-0.88755	5065-0.52707+A8
+A8	5066 0.00418	5067 0.61735	5068 0.95763	5069 0.96926+A9
+A9	5070 0.66030	5081 0.07000	5082-0.46395	5083-0.82199+A10
+A10	5084-0.82224	5085-0.46476	5086 0.06861	5087 0.59258+A11
+A11	5088 0.95119	5089 0.95164	5090 0.59387	5101 0.11440+A12
+A12	5102-0.39057	5103-0.72275	5104-0.72275	5105-0.39047+A13
+A13	5106 0.11448	5107 0.61570	5108 0.95812	5109 0.95812+A14
+A14	5110 0.61571	5121 0.25714	5122-0.17685	5123-0.45983+A15
+A15	5124-0.45947	5125-0.17601	5126 0.25771	5127 0.68940+A16
+A16	5128 0.97728	5129 0.97723	5130 0.68925	5141 0.43561+A17
+A17	5142 0.09300	5143-0.12995	5144-0.12954	5145 0.09377+A18
+A18	5146 0.43609	5147 0.77939	5148 1.00000	5149 0.99992+A19
+A19	5150 0.77920			
\$				
SHAPE	5201CQUAD4	5201 1.00000	5206 1.00000	5221 1.00000+A
+A	5222 1.00000	5223 1.00000	5224 1.00000	
\$				
SHAPE	5201CTRIA3	5202 1.00000	5203 1.00000	5204 1.00000+A
+A	5205 1.00000	5225 1.00000	5226 1.00000	5227 1.00000+A2
+A2	5228 1.00000			
\$				
SHAPE	5241CQUAD4	5241 1.00000	5242 1.00000	5243 1.00000+A
+A	5244 1.00000	5245 1.00000	5246 1.00000	5261 1.00000+A2
+A2	5262 1.00000	5263 1.00000	5264 1.00000	5265 1.00000+A3
+A3	5266 1.00000			
\$				
SHAPE	5281CQUAD4	5281 1.00000	5282 1.00000	5283 1.00000+A
+A	5284 1.00000	5285 1.00000	5286 1.00000	5301 1.00000+A2
+A2	5302 1.00000	5303 1.00000	5304 1.00000	5305 1.00000+A3
+A3	5306 1.00000	5321 1.00000	5322 1.00000	5323 1.00000+A4
+A4	5324 1.00000	5325 1.00000	5326 1.00000	
\$				
SHAPE	5341CQUAD4	5341 1.00000	5342 1.00000	5343 1.00000+A
+A	5344 1.00000	5345 1.00000	5346 1.00000	5361 1.00000+A2
+A2	5362 1.00000	5363 1.00000	5364 1.00000	5365 1.00000+A3
+A3	5366 1.00000			
\$				

```

SHAPE      5501CROD      5502 1.00000      5503 1.00000      5504 1.00000+A
+A         5505 1.00000      5506 1.00000      5507 1.00000      5508 1.00000+A2
+A2        5511 1.00000      5512 1.00000      5513 1.00000      5514 1.00000+A3
+A3        5515 1.00000      5516 1.          5517 1.          5518 1.
$
SHAPE      5521CROD      5522 1.00000      5523 1.00000      5524 1.00000+A
+A         5525 1.00000      5526 1.00000      5527 1.00000      5528 1.00000+A2
+A2        5532 1.00000      5533 1.00000      5534 1.00000      5535 1.      +A3
+A3        5536 1.00000      5537 1.          5538 1.
$
$ - - - - -
$
$ --- EIGENSOLUTION DATA
$
$DYNRED-SID-----FMAX-----NVEC-----
DYNRED   440      15.      20
$
$EIGR---SID-----METH-----FMIN-----FMAX-----NE-----ND-----
EIGR     440      INV      0.      15.      12      12
EIGR     441      GIV                      15
EIGR     442      MGIV                      12
$
$ --- OMITS ( NOT USED AS OF 1989-AUG-5 )
$
$OMIT---SID-----ID-----C-----ID-----C-----ID-----C-----
OMIT     440      1073      456      1075      456      1076      456
OMIT     440      1115      45      1116      45
OMIT     440      1155      45      1156      45
$
$
$ - - - - -
$
$ --- STEADY AERO DATA
$
$AEROS--AERCID--REFCID--REFC----REFB----REFS----GREF----REFD----REFL----
AEROS                212.9   388.7   71280.   99
$
$AIRFOIL ACID---CMPNT---CP-----ICHORD--IUST----ILST----ICAM----RADIUS--
AIRFOIL   10001   WING                1001   1002   1003                0.5   +AF1A
+AF1A     411.32   34.      7.65   266.21
$+AF1---X1-----Y1-----Z1-----X12-----
$
AIRFOIL   10001   WING                1001   1002   1003                0.5   +AF1B
+AF1B     601.637 194.366  -6.38   55.94
$
$ --- PERCENT CHORD FOR WING AIRFOIL DEFN
$
AEFACT    1001      0.0      2.5      5.0      10.      15.0      20.      25.      +AE1001A
+AE1001A   30.      35.      40.      45.      50.      55.      60.      65.      +AE1001B
+AE1001B   70.      75.      80.      85.      90.      95.      100.
$
$ --- UPPER SURFACE PERCENT CHORD OFFSET FROM PLANE OF WING AIRFOIL
$
AEFACT    1002      0.0      .970      1.370      2.019      2.542      2.952      3.261 +AE1002A

```

+AE1002A	3.480	3.617	3.681	3.679	3.617	3.5	3.332	3.114	+AE1002B
+AE1002B	2.850	2.539	2.181	1.777	1.3417	0.9015	0.4624		

\$

\$ --- LOWER SURFACE PERCENT CHORD OFFSET FROM PLANE OF WING AIRFOIL

\$

AEFACT	1003	0.0	.4597	.5321	.6013	.6395	.6520	.6459	+AE1003A
+AE1003A	.6297	.6063	.5724	.5239	.4576	.3725	.2690	.1473	+AE1003B
+AE1003B	.0140	-.1162	-.2283	-.3082	-.3614	-.4112	-.4624		

\$

\$CAERO6 ACID---CMPNT---CP-----IGRP----LCHORD--LSPAN---

CAERO6	10001	WING		101	1011	1012
--------	-------	------	--	-----	------	------

\$

\$

\$ --- PERCENT CHORD CUTS FOR WING AERO PANELS 11 CUTS 10 PANELS

\$

AEFACT	1011	0.0	5.0	10.	18.0	28.	43.0	58.	+AE1011A
+AE1011A	71.	82.	91.	100.					

\$

\$ --- DIMENSIONED SPAN CUTS FOR WING AERO PANELS 11 CUTS 10 PANELS

\$

AEFACT	1012	34.0	50.04	66.07	82.11	98.15	114.18	130.22	+AE1012A
+AE1012A	146.26	162.29	178.33	194.366					

\$

\$ - - - - -

\$

\$ --- CANARD AERO DEFINITION

\$ --- MOVED FORWARD 24 INCHES RELATIVE TO INITIAL DESIGN TO IMPROVE

\$ --- CONTROL EFFECTIVENESS

\$AIRFOIL ACID---CMPNT---CP-----ICHORD--IUST----ILST----ICAM----RADIUS--

AIRFOIL	12001	CANARD		1201	1202	1202		0.5	+AF2A
---------	-------	--------	--	------	------	------	--	-----	-------

+AF2A	315.538	52.	23.135	102.892
-------	---------	-----	--------	---------

\$+AF2A	339.538	52.	23.135	102.892
---------	---------	-----	--------	---------

\$+AF---X1-----Y1-----Z1-----X12-----

\$

AIRFOIL	12001	CANARD		1201	1202	1202		0.5	+AF2B
---------	-------	--------	--	------	------	------	--	-----	-------

+AF2B	402.248	102.062	26.62	27.982
-------	---------	---------	-------	--------

\$+AF2B	426.248	102.062	26.62	27.982
---------	---------	---------	-------	--------

\$

\$ --- PERCENT CHORD FOR WING AIRFOIL DEFN

\$

AEFACT	1201	0.0	2.	4.0	10.	20.0	30.	40.	+AE1201A
--------	------	-----	----	-----	-----	------	-----	-----	----------

+AE1201A	50.	60.	70.	80.	90.	100.
----------	-----	-----	-----	-----	-----	------

\$

\$ --- SYMMETRIC SURFACE PERCENT CHORD OFFSET FROM PLANE OF CANARD AIRFOIL

\$

AEFACT	1202	0.0	.993	1.274	1.663	1.899	1.981	1.999	+AE1202A
--------	------	-----	------	-------	-------	-------	-------	-------	----------

+AE1202A	1.921	1.715	1.393	.983	.515	0.0
----------	-------	-------	-------	------	------	-----

\$

\$

\$CAERO6 ACID ---CMPNT---CP-----IGRP----LCHORD--LSPAN---

CAERO6	12001	CANARD		101	1211	1212
--------	-------	--------	--	-----	------	------

\$

\$

\$ --- PERCENT CHORD CUTS FOR CANARD AERO PANELS 9 CUTS 8 PANELS

\$
 AEFAC 1211 0.0 6.0 12. 25.0 40. 55.0 70. +AE1211A
 +AE1211A 85. 100.
 \$
 \$ --- DIMENSIONED SPAN CUTS FOR CANARD AERO PANELS 8 CUTS 7 PANELS
 \$
 AEFAC 1212 52.0 61. 66. 71. 81. 88. 95. +AE1212A
 +AE1212A 102.062
 \$
 \$ --- ATTACH CANARD AIRLOADS TO CANARD CENTER OF PRESSURE POINT - GRID 3138
 \$ATTACH-EID-----CAEROID-BOX1ST--BOXLAST-REFGID
 ATTACH 12001 12001 12001 12056 3138
 \$
 \$
 \$ --- CONTROL SURFACE DEFINITION FOR CANARD 333
 \$
 \$ --- ASTROS VERSION 3 AESURF
 \$AESURF-SETID---LABEL---ACID1---CID1---FBOXID1-LBOXID1-
 \$AESURF 333 ELEV 12001 12001 12056
 \$
 \$ --- ASTROS VERSION 4 VERSION OF AESURF:
 \$AESURF-LABEL---SYMM---ACID1---CID1---FBOXID1-LBOXID1-
 AESURF ELEV SYM 12001 12001 12056
 \$
 \$ --- CONTROL SURFACE DEFINITION FOR AILERON 444
 \$
 \$ --- ASTROS VERSION 3 AESURF
 \$AESURF-SETID---LABEL---ACID1---CID1---FBOXID1-LBOXID1-
 \$AESURF 444 AILERON 10001 10049 10100
 \$
 \$ --- ASTROS VERSION 4 VERSION OF AESURF:
 \$AESURF-LABEL---SYMM---ACID1---CID1---FBOXID1-LBOXID1-
 AESURF AILERON ANTISYM 10001 10049 10100
 \$
 \$ --- TRIM CONDITIONS (QRATE = G(NZ-1)/VO)
 \$ --- SYMMETRIC PULLUP
 \$ --- ASTROS VERSION 3 TRIM STYLE
 \$

\$TRIM	TID	MACH	QDP	SYMXZ	TRMTYP	NZ	QRATE	VO
\$TRIM	74	.70	5.04	+1	2	-1737.	.2265	9374.
\$TRIM	84	.80	6.58	+1	2	-1737.	.1982	10713.
\$TRIM	71	.70	5.04	+1	2	386.	.0	9374.
\$TRIM	70	.70	5.04	+1	2	5211.	.5147	9374.
\$TRIM	80	.80	6.58	+1	2	5211.	.4504	10713.
\$TRIM	120	1.20	14.82	+1	2	5211.	.3002	16070.
\$TRIM	150	1.50	23.15	+1	2	5211.	.2402	20088.

 \$
 \$ --- TRIM CONDITIONS (QRATE = G(NZ-1)/VO)
 \$ --- SYMMETRIC PULLUP
 \$ --- ASTROS VERSION 4 TRIM STYLE
 \$
 \$TRIM---TID-----MACH-----QDP-----TRMTYP--EFFID---VO-----+CONT

TRIM	70	.70	5.04	PITCH		9374.			+TRIM
+TRIM	NZ	5211.	QRATE	.5147	ELEV	FREE	ALPHA	FREE	+TRIM
+TRIM	THKCAM	1.0							
\$									
TRIM	71	.70	5.04	PITCH		9374.			+TRIM
+TRIM	NZ	386.	QRATE	0.0	ELEV	FREE	ALPHA	FREE	+TRIM
+TRIM	THKCAM	1.0							
\$									
TRIM	74	.70	5.04	PITCH		9374.			+TRIM
+TRIM	NZ	-1737.	QRATE	-.2265	ELEV	FREE	ALPHA	FREE	+TRIM
+TRIM	THKCAM	1.0							
\$									
\$TRIM	150	1.50	23.15	PITCH		20088.			+TRIM
\$+TRIM	NZ	5211.	QRATE	.2402	ELEV	FREE	ALPHA	FREE	+TRIM
\$+TRIM	THKCAM	1.0							
\$									

\$CONT---LABEL---VALUE---LABEL---VALUE---LABEL---VALUE---LABEL---VALUE---ETC

\$

\$ --- SPLINE SET FOR STEADY AERO

\$ --- LOWER WING SURFACE GRIDS 3 SPLINES:

\$ --- INBOARD OF AILERON

\$ --- FORWARD OF AILERON

\$ --- AILERON

\$

\$SPLINE1	EID----	CP-----	CAERO---	BOX1----	BOX2----	SETG----	DZ-----
SPLINE1	101		10001	10001	10040	101	
SPLINE1	102		10001	10041	10098	102	
SPLINE1	103		10001	10049	10100	103	
\$							

\$SET1---	SID----	G1-----	G2-----	G3-----	G4-----	G5-----	G6-----	G7-----
SET1	101	1001	1003	1005	1007	1009	1011	1013
SET1	101	1015	1017					
SET1	101	1021	1023	1025	1027	1029	1031	1033
SET1	101	1035	1037					
SET1	101	1041	1043	1045	1047	1049	1051	1053
SET1	101	1061	1065	1067	1069	1071	1073	1075
\$								
SET1	102	1061	1065	1067	1069	1071	1073	1075
SET1	102	1081	1087	1089	1091	1093	1095	
SET1	102	1101	1109	1111	1113	1115		
SET1	102	1121	1131	1133	1135			
SET1	102	1141	1151	1153	1155			
\$								
SET1	103	1077	1079					
SET1	103	1097	1099					
SET1	103	1117	1119					
SET1	103	1137	1139					
SET1	103	1157	1159					
\$								

\$ - - - - -

\$

\$ --- DATA FOR BODY SEGMENT 1 FORWARD FUSELAGE

\$

\$PAERO6- BCID---CMPNT---CP-----IGRP---NRAD---LRAD---LAXIAL--

PAERO6	100	FUSEL	101
BODY	100	FUSEL	

\$

\$AXSTA	--BCID----	XS TA----	CBOD----	ABOD----	LYRAD----	LZRAD----
---------	------------	-----------	----------	----------	-----------	-----------

AXSTA	100	100.000		101	151
AXSTA	100	130.000		102	152
AXSTA	100	155.000		103	153
AXSTA	100	185.000		104	154
AXSTA	100	215.000		105	155
AXSTA	100	245.000		106	156
AXSTA	100	280.000		107	157
AXSTA	100	305.000		108	158
AXSTA	100	330.000		109	159

\$

\$ --- STA 100 X AND Y

\$

AEFACT	101	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000+101A
+101A		0.0000	0.0000						

\$

AEFACT	151	-20.000	-20.000	-20.000	-20.000	-20.000	-20.000	-20.000	-20.000 +151A
+151A		-20.000	-20.000						

\$

\$ --- STA 130 X AND Y

\$

AEFACT	102	0.0000	3.2340	6.1790	8.1660	8.4220	6.6570	4.6450+102A
+102A		2.3780	0.0000					

\$

AEFACT	152	-21.6300	-21.2360	-19.8680	-17.3250	-14.1220	-11.4360	-10.1490+152A
+152A		-9.3890	-9.1330					

\$

\$ --- STA 155 X AND Y

\$

AEFACT	103	0.0000	5.3430	10.0710	12.6450	12.8600	10.7230	7.6520+103A
+103A		3.9300	0.0000					

\$

AEFACT	153	-22.6940	-22.0830	-19.6090	-14.9550	-9.5960	-4.7190	-2.2650+153A
+153A		-0.9640	-0.5880					

\$

\$ --- STA 185 X AND Y

\$

AEFACT	104	0.0000	7.3310	13.5490	16.1080	16.2570	14.0570	10.3350+104A
+104A		5.3730	0.0000					

\$

AEFACT	154	-23.0790	-22.3150	-18.5810	-11.7390	-4.3640	2.6260	6.5100+154A
+154A		8.6250	9.2150					

\$

\$ --- STA 215 X AND Y

\$

AEFACT	105	0.0000	9.1000	16.3140	18.4110	18.3720	15.7980	11.6220+105A
+105A		6.1290	0.0000					

\$

AEFACT	155	-22.3490	-21.4830	-16.3150	-7.4620	1.6900	10.4160	15.0470+155A
+155A		18.0850	19.3020					

\$

\$ --- STA 245 X AND Y
 \$
 AEFACT 106 0.000 10.5680 18.1400 19.6540 19.4370 16.6660 14.6310+106A
 +106A 8.5050 0.000
 \$
 AEFACT 156-21.0360-20.0740-13.3340 -2.8400 7.7870 17.9970 26.5780+156A
 +156A 32.9210 35.2520
 \$
 \$ --- STA 280 X AND Y
 \$
 AEFACT 107 0.000 11.5160 18.9250 19.9710 19.8210 17.7600 18.2370+107A
 +107A 11.4040 0.000
 ^
 AEFACT 157-19.7340-18.8080-10.8940 0.6210 12.1940 23.5560 35.5690+157A
 +157A 45.4600 49.2660
 \$
 \$ --- STA 305 X AND Y
 \$
 AEFACT 108 0.000 12.3590 19.2440 19.9710 19.8210 18.0810 18.0210+108A
 +108A 11.1200 0.000
 \$
 AEFACT 158-19.5450-18.5630 -9.3200 3.0780 15.5030 27.7850 39.4740+158A
 +158A 48.9090 52.5090
 \$
 \$ --- STA 330 X AND Y
 \$
 AEFACT 109 0.000 13.4170 19.5440 19.9900 19.7730 17.7930 16.2140+109A
 +109A 9.5980 0.000
 \$
 AEFACT 159-19.8730-18.8680 -8.0340 5.4480 18.9450 32.2550 42.1240+159A
 +159A 49.6140 52.3990
 \$
 \$ --- DATA FOR BODY SEGMENT 2 CENTER FUSELAGE FWD AT CANARD
 \$
 \$PAERO6- BCID---CMPNT---CP-----IGRP----NRAD----LRAD----LAXIAL--
 PAERO6 200 FUSEL 101
 BODY 200 FUSEL
 \$
 \$AXSTA--BCID---XSTA---CBOD----ABOD----LYRAD---LZRAD---
 AXSTA 200 330.000 201 251
 AXSTA 200 360.000 202 252
 AXSTA 200 390.000 203 253
 AXSTA 200 420.000 204 254
 AXSTA 200 445.000 205 255
 \$
 \$ --- STA 330 X AND Y
 \$
 AEFACT 201 0.000 6.8270 13.5800 18.3930 19.5730 31.3960 43.1990+201A
 +201A 51.5170 51.9590 52.0010 44.2020 35.8500 27.4940 19.1380 17.5810+201B
 +201B 11.3650 0.000
 \$
 AEFACT 251-19.8730 19.7350-18.8210-14.4020 -7.6950 -7.6210 -6.9930+251A
 +251A -0.2590 11.5440 23.1350 25.5920 25.8140 25.8570 25.8580 37.9910+251B
 +251B 48.3370 52.3990

\$
 \$ --- STA 360 X AND Y
 \$
 AEFACT 202 0.000 7.3130 14.5770 19.8660 20.9850 32.5750 44.1340+202A
 +202A 51.4930 51.7900 52.0010 46.7580 37.9200 28.8650 19.8010 17.1440+202B
 +202B 9.1630 0.000
 \$
 AEFACT 252-20.5970-20.4870-19.7200-15.2380 -8.0300 -7.9290 -7.1700+252A
 +252A 0.2580 11.8360 23.1350 30.1000 31.7990 32.1400 32.1930 38.9460+252B
 +252B 47.4160 49.7740
 \$
 \$ --- STA 390 X AND Y
 \$
 AEFACT 203 0.000 8.1070 16.1700 22.5000 24.0080 35.0540 45.9760+203A
 +203A 49.6510 49.6410 52.0010 47.3020 40.1920 31.2140 22.1550 16.7580+203B
 +203B 8.5960 0.000
 \$
 AEFACT 253-21.5230-21.4050-20.6330-16.1740 -8.2420 -8.0960 -6.7850+253A
 +253A 2.9400 13.9850 23.1350 29.5400 34.6330 35.7560 35.9890 42.5360+253B
 +253B 45.5100 46.5670
 \$
 \$ --- STA 420 X AND Y
 \$
 AEFACT 204 0.000 9.1530 18.2770 25.7950 27.4690 37.6840 45.3010+204A
 +204A 45.9820 45.7990 52.0010 45.1050 41.9720 34.1870 25.5130 18.5510+204B
 +204B 9.3200 0.000
 \$
 AEFACT 254-22.4810-22.3820-21.7190-17.2780 -8.3260 -7.8240 -2.3730+254A
 +254A 7.8180 18.0490 23.1350 25.7280 33.7270 37.2600 37.9970 43.6300+254B
 +254B 44.8100 45.0000
 \$
 \$ --- STA 445 X AND Y
 \$
 AEFACT 205 0.000 9.7640 19.4930 27.6170 29.5980 38.8840 42.1160+205A
 +205A 42.2800 42.4980 52.0010 43.1990 40.4090 34.8810 26.2960 18.5400+205B
 +205B 9.3110 0.000
 \$
 AEFACT 255-23.1850-23.0680-22.3170-17.6550 -8.1550 -6.0220 2.7260+255A
 +255A 12.3600 21.5260 23.1350 23.3850 30.6650 37.1560 38.9060 43.6430+255B
 +255B 44.7920 44.9990
 \$
 \$ --- DATA FOR BODY SEGMENT 3 CENTER FUELAGE AFT AT WING
 \$
 \$PAERO6- BCID---CMPNT---CP-----IGRP-----NRAD-----LRAD-----LAXIAL--
 PAERO6 300 FUSEL 101
 BODY 300 FUSEL
 \$
 \$AXSTA--BCID---XSTA---CBOD---ABOD---LYRAD---LZRAD---
 AXSTA 300 445.000 301 351
 AXSTA 300 470.000 302 352
 AXSTA 300 498.500 303 353
 \$
 \$ --- STA 445 X AND Y
 \$

AEFACT 301 0.000 9.7640 19.4930 27.6170 29.5980 37.1990 41.6390+301A
 +301A 41.5660 34.0000 42.2970 42.0860 40.9270 35.7330 26.2960 20.7710+301B
 +301B 13.9520 6.9850 0.000

\$

AEFACT 351-23.1850-23.0680-22.3170-17.6550 -8.1540 -6.9070 -1.0590+351A
 +351A 6.0690 7.6500 9.3920 19.1490 28.8270 36.7270 38.9050 42.9790+351B
 +351B 44.4190 44.8950 44.9990

\$

\$ --- STA 470 X AND Y

\$

AEFACT 302 0.000 10.5430 21.0560 29.5710 31.2220 35.8780 37.9990+302A
 +302A 38.5810 34.0000 38.6610 38.4390 37.5800 34.7660 28.0420 22.1110+302B
 +302B 14.8250 7.4190 0.000

\$

AEFACT 352-23.7000-23.5960-22.8860-17.6710 -7.3020 -4.6850 0.2440+352A
 +352A 5.6340 7.6500 11.5620 19.5680 27.5260 34.9510 38.9680 43.1660+352B
 +352B 44.4920 44.9110 45.0000

\$

\$ --- STA 498.5 X AND Y

\$

AEFACT 303 0.000 11.7420 23.4490 31.4310 32.4000 33.8980 34.6840+303A
 +303A 35.0670 34.0000 35.2090 34.9620 34.2580 32.4910 28.2100 22.2490+303B
 +303B 14.9590 7.4910 0.000

\$

AEFACT 353-23.9270-23.8250-23.0160-15.7770 -4.0880 -1.2870 1.7990+353A
 +353A 4.9640 7.6500 13.6840 20.3360 26.9520 33.3510 38.2940 42.6480+353B
 +353B 44.3010 44.8710 45.0000

\$

\$ --- DATA FOR BODY SEGMENT 4 AFT FUSELAGE

\$

\$PAERO6- BCID---CMPNT---CP-----IGRP----NRAD----LRAD----LAXIAL--

PAERO6 400 FUSEL 101

BODY 400 FUSEL

\$

\$AXSTA--BCID---XSTA---CBOD----ABOD----LYRAD---LZRAD---

AXSTA 400 498.500 401 451

AXSTA 400 530.000 402 452

AXSTA 400 560.000 403 453

AXSTA 400 590.000 404 454

AXSTA 400 620.000 405 455

AXSTA 400 650.000 406 456

AXSTA 400 672.732 407 457

\$

\$ --- STA 498.5 X AND Y

\$

AEFACT 401 0.000 11.9000 23.7580 31.5220 32.7680 34.0000 34.9890+401A
 +401A 32.9340 24.7020 12.5870 0.000

\$

AEFACT 451-23.9270-23.8210-22.9620-15.3150 -3.5780 7.6500 19.8780+451A
 +451A 32.2650 41.4780 44.5540 45.0000

\$

\$ --- STA 530. X AND Y

\$

AEFACT 402 0.000 11.8370 23.6450 31.8920 32.8470 34.0000 32.7250+402A

+402A 30.8720 23.7700 12.1230 0.000
 \$
 AEFACT 452-23.5420-23.4510-22.7270-15.7150 -3.9300 7.6500 19.5500+452A
 +452A 31.5200 40.9710 44.0950 44.6220
 \$
 \$ --- STA 560. X AND Y
 \$
 AEFACT 403 0.000 11.6020 23.1820 31.7430 32.8140 34.0000 32.7220+403A
 +403A 30.8840 23.4290 11.8730 0.000
 \$
 AEFACT 453-22.3500-22.2640-21.6050-15.2210 -3.6850 7.6500 19.2850+453A
 +453A 30.9940 39.7590 42.2730 42.6870
 \$
 \$ --- STA 590. X AND Y
 \$
 AEFACT 404 0.000 11.1580 22.2990 31.2480 32.5510 34.0000 32.5310+404A
 +404A 30.8290 22.7680 11.4470 0.000
 \$
 AEFACT 454-20.1440-20.0660-19.5010-14.1590 -3.1080 7.6500 18.7370+454A
 +454A 30.0230 37.4200 38.9570 39.1980
 \$
 \$ --- STA 620. X AND Y
 \$
 AEFACT 405 0.0000 10.5340 21.0600 30.4090 32.0550 34.0000 32.0660+405A
 +405A 30.1390 21.3050 10.6720 0.0000
 \$
 AEFACT 455-16.7060-16.6500-16.2560-12.4960 -2.1640 7.6500 17.6880+455A
 +455A 28.1170 33.2710 34.1050 34.2390
 \$
 \$ --- STA 650. X AND Y
 \$
 AEFACT 406 0.0000 9.7280 19.4510 28.9330 31.3160 34.0000 31.3320+406A
 +406A 28.5470 19.3140 9.6610 0.000
 \$
 AEFACT 456-11.8410-11.8070-11.5520 -9.8970 -0.7540 7.6500 16.1610+456A
 +456A 25.1430 27.4800 27.8240 27.8820
 \$
 \$ --- STA 672.732 X AND Y
 \$
 AEFACT 407 0.0000 9.0460 18.0900 27.0680 30.3590 34.0000 30.5180+407A
 +407A 26.4540 17.6550 8.8280 0.0000
 \$
 AEFACT 457 -8.1550 -8.1240 -7.9620 -6.9860 0.7550 7.6500 14.6750+457A
 +457A 21.4790 22.0810 22.1890 22.1670
 \$
 \$ATTACH-EID-----CAEROID-BOX1ST--BOXLAST-REFGID--
 \$ --- ATTACH AERO BOXES FOR FWD FUSELAGE TO SEVERAL GRIDS TO SPREAD OUT LOAD
 \$ATTACH 100 100 100 163 2157 \$ OLD ATTACH FOR FWD FUSEL
 \$
 ATTACH 100 100 100 107 2004
 ATTACH 100 100 108 115 2006
 ATTACH 100 100 116 123 2036
 ATTACH 100 100 124 131 2066
 ATTACH 100 100 132 139 2108

ATTACH	100	100	140	147	2157
ATTACH	100	100	148	155	2211
ATTACH	100	100	156	163	2226

\$

\$ --- MID FUSELAGE FORWARD ATTACHES TO ROOT END OF CANARD SPINDLE

\$

ATTACH	200	200	200	263	3120
--------	-----	-----	-----	-----	------

\$

\$ --- MID FUSELAGE AFT AND AFT FUSELAGE ATTACHES AT THE FWD ENGINE MOUNT

\$

ATTACH	300	300	300	333	4058
--------	-----	-----	-----	-----	------

ATTACH	400	400	400	459	4058
--------	-----	-----	-----	-----	------

\$

\$

\$ --- UNSTEADY AERO MODEL DATA

\$

\$ --- WING UNSTEADY AERO

\$ --- - EXTENDS TO CENTERLINE BECAUSE NO BODIES IN SUPERSONIC UNSTEADY AERO

\$ --- SAME SPLINE SET AS STEADY AERO

\$ --- LOWER WING SURFACE GRIDS 3 SPLINES:

\$ --- INBOARD OF AILERON

\$ --- FORWARD OF AILERON

\$ --- AILERON

\$

\$CAERO1 EID----BID----CP-----NSPAN---NCHORD--LSPAN---LCHORD--IGID

CAERO1	20001			10			2002	1	+CA2001
--------	-------	--	--	----	--	--	------	---	---------

+CA2001	370.975	0.	10.625	310.791	601.637	194.366	-6.38	55.94	
---------	---------	----	--------	---------	---------	---------	-------	-------	--

\$+CA2001	411.324	34.	7.65	266.21	601.637	194.366	-6.38	55.94	
-----------	---------	-----	------	--------	---------	---------	-------	-------	--

\$+CA1---X1-----Y1-----Z1-----X12-----X4-----Y4-----Z4-----X43-----

\$

\$ --- DIVISION VALUES CHORD CUTS - CHOSEN TO MATCH POSITION OF AILERON AT 82%

\$

AEFACT	2002	.0	.05	.10	.18	.28	.43	.58	+AE2002A
--------	------	----	-----	-----	-----	-----	-----	-----	----------

+AE2002A	.71	.82	.91	1.0					
----------	-----	-----	-----	-----	--	--	--	--	--

\$

\$SPLINE1 EID----CP-----CAERO---BOX1---BOX2---SETG---DZ-----

SPLINE1	2001		20001	20001	20040	201			
---------	------	--	-------	-------	-------	-----	--	--	--

SPLINE1	2002		20001	20041	20098	202			
---------	------	--	-------	-------	-------	-----	--	--	--

SPLINE1	2003		20001	20049	20100	203			
---------	------	--	-------	-------	-------	-----	--	--	--

\$

\$SET1---SID-----G1-----G2-----G3-----G4-----G5-----G6-----G7-----

SET1	201	1001	1003	1005	1007	1009	1011	1013	
------	-----	------	------	------	------	------	------	------	--

SET1	201	1015	1017						
------	-----	------	------	--	--	--	--	--	--

SET1	201	1021	1023	1025	1027	1029	1031	1033	
------	-----	------	------	------	------	------	------	------	--

SET1	201	1035	1037						
------	-----	------	------	--	--	--	--	--	--

SET1	201	1041	1043	1045	1047	1049	1051	1053	
------	-----	------	------	------	------	------	------	------	--

SET1	201	1061	1065	1067	1069	1071	1073	1075	
------	-----	------	------	------	------	------	------	------	--

\$

SET1	202	1061	1065	1067	1069	1071	1073	1075	
------	-----	------	------	------	------	------	------	------	--

SET1	202	1081	1087	1089	1091	1093	1095		
------	-----	------	------	------	------	------	------	--	--

SET1	202	1101	1109	1111	1113	1115			
------	-----	------	------	------	------	------	--	--	--

SET1	202	1121	1131	1133	1135				
------	-----	------	------	------	------	--	--	--	--

SET1	202	1141	1151	1153	1155				
------	-----	------	------	------	------	--	--	--	--

```

$
SET1      203      1077      1079
SET1      203      1097      1099
SET1      203      1117      1119
SET1      203      1137      1139
SET1      203      1157      1159
$
$ - - - - -
$ --- CANARD UNSTEADY AERO
$ ---   MOVED FWD 24. INCHES TO MATCH STEADY AERO
$ ---   - EXTENDS TO CENTERLINE BECAUSE NO BODIES IN SUPERSONIC UNSTEADY AERO
$ ---   ATTACHED TO CANARD SPINDLE TIP GRID
$
$CAERO1 EID-----BID-----CP-----NSPAN---NCHORD--LSPAN---LCHORD--IGID
CAERO1  22001              8       7              1      +CA2201
+CA2201  225.466  0.      19.515 180.708 402.248 102.062 26.620 27.982
$+CA2201  249.466  0.      19.515 180.708 426.248 102.062 26.620 27.982
$+CA1---X1-----Y1-----Z1-----X12-----X4-----Y4-----Z4-----X43-----
$
$ATTACH-EID-----CAEROID-BOX1ST--BOXLAST-REFGID--
ATTACH  22001  22001  22001  22056  3133
$
$ - - - - -
$ --- VERTICAL FIN UNSTEADY AERO
$ ---   56 AERO BOXES
$ ---   SPLINED TO 4 CORNER GRIDS ONLY
$
$CAERO1 EID-----BID-----CP-----NSPAN---NCHORD--LSPAN---LCHORD--IGID
CAERO1  24001              8       7              1      +CA2401
+CA2401  665.     70.     19.     102.     761.93  47.96   101.78  32.29
$+CA1---X1-----Y1-----Z1-----X12-----X4-----Y4-----Z4-----X43-----
$
$SPLINE1 EID----CP-----CAERO---BOX1---BOX2---SETG----DZ-----
SPLINE1  2401              24001  24001  24056  241
$
$SET1---SID-----G1-----G2-----G3-----G4-----G5-----G6-----G7-----
SET1      241      5129      5133      5149      5153
$
$ - - - - -
$ --- FLUTTER DATA
$ ---   REF CHORD = MEAN AERODYNAMIC CHORD OF WING
$ ---   REF DENSITY IS AT SEA LEVEL IN CONSISTENT MASS UNITS LBM-SEC**2/IN**4
$AERO---CP-----CHORD---RHOREF--
AERO      212.9      .1147-6
$
$MKAERO1 SYMXZ--SYMXY--M1-----M2-----M3-----M4-----M5-----M6-----
MKAERO1  1              1.5              +MK1
+MK1      .2      0.40      .8      1.60      3.00      6.
$+MKA1--K1-----K2-----K3-----K4-----K5-----K6-----K7-----
$
$FLUTTR SID----METH----DENS----MACH----VEL----MODE-DEL KLIST--EFF SET-+CONT
$FLUTTER 100      PK      120      1.5      140              +FL100
FLUTTER 100      PK      120      1.5      140      150      +FL100
+FL100  1

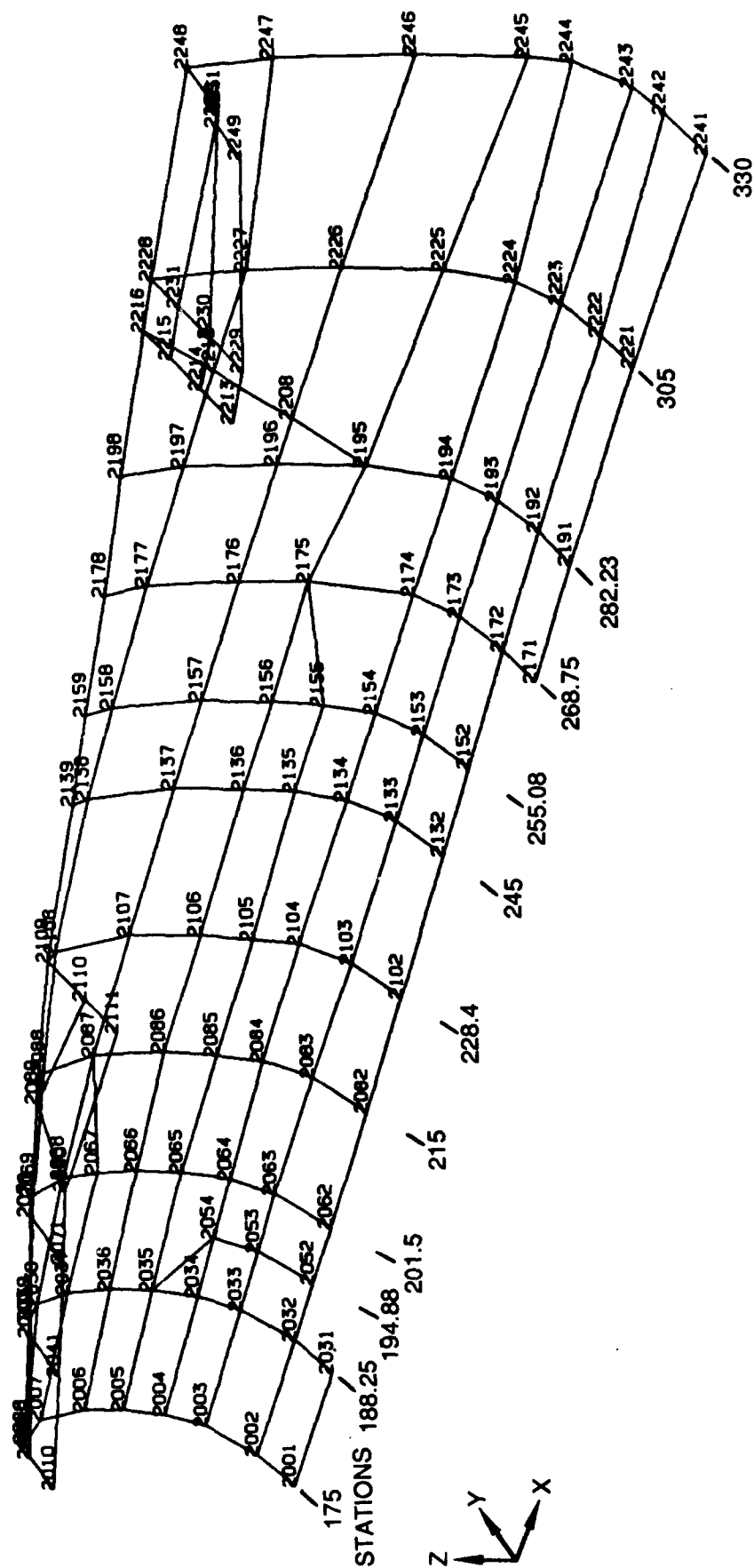
```

\$
 FLUTTER 101 PK 120 1.5 140 151 +FL101
 +FL101 1
 \$
 FLUTTER 102 PK 120 1.5 142 151 +FL102
 +FL102 1
 \$
 FLUTTER 103 PK 120 1.5 143 151 +FL103
 +FL103 1
 \$
 \$FLUTTER 444 PK 120 1.5 140 150 +FL444
 FLUTTER 444 PK 120 1.5 140 +FL444
 +FL444 -1
 \$
 \$FLTFACT SID----F1-----F2-----F3-----F4-----F5-----F6-----F7-----
 FLFACT 120 .629
 FLFACT 130 1.5
 FLFACT 140 12000. 14000. 15000. 16000. 17000. 18000. 19027. +FL140
 +FL140 20000. 21000. 22000. 23000.
 FLFACT 142 18000. 19027.
 FLFACT 143 15000. 18000. 19027.
 \$
 SET1 150 1 2 3
 SET1 151 1 2 3 9 10
 \$
 \$
 \$DCONFLT SID---GFACT---V1-----GAM1---V2-----GAM2---V3-----GAM3-----
 \$DCONFLT 100 0.40 0.0 0.0 19027. 0.0 20000. 1.0 +FLT100
 DCONFLT 100 0.0 0.0 19027. 0.0 20000. 1.0 +FLT100
 +FLT100 20001. 10. 30000. 10.
 \$
 ENDDATA

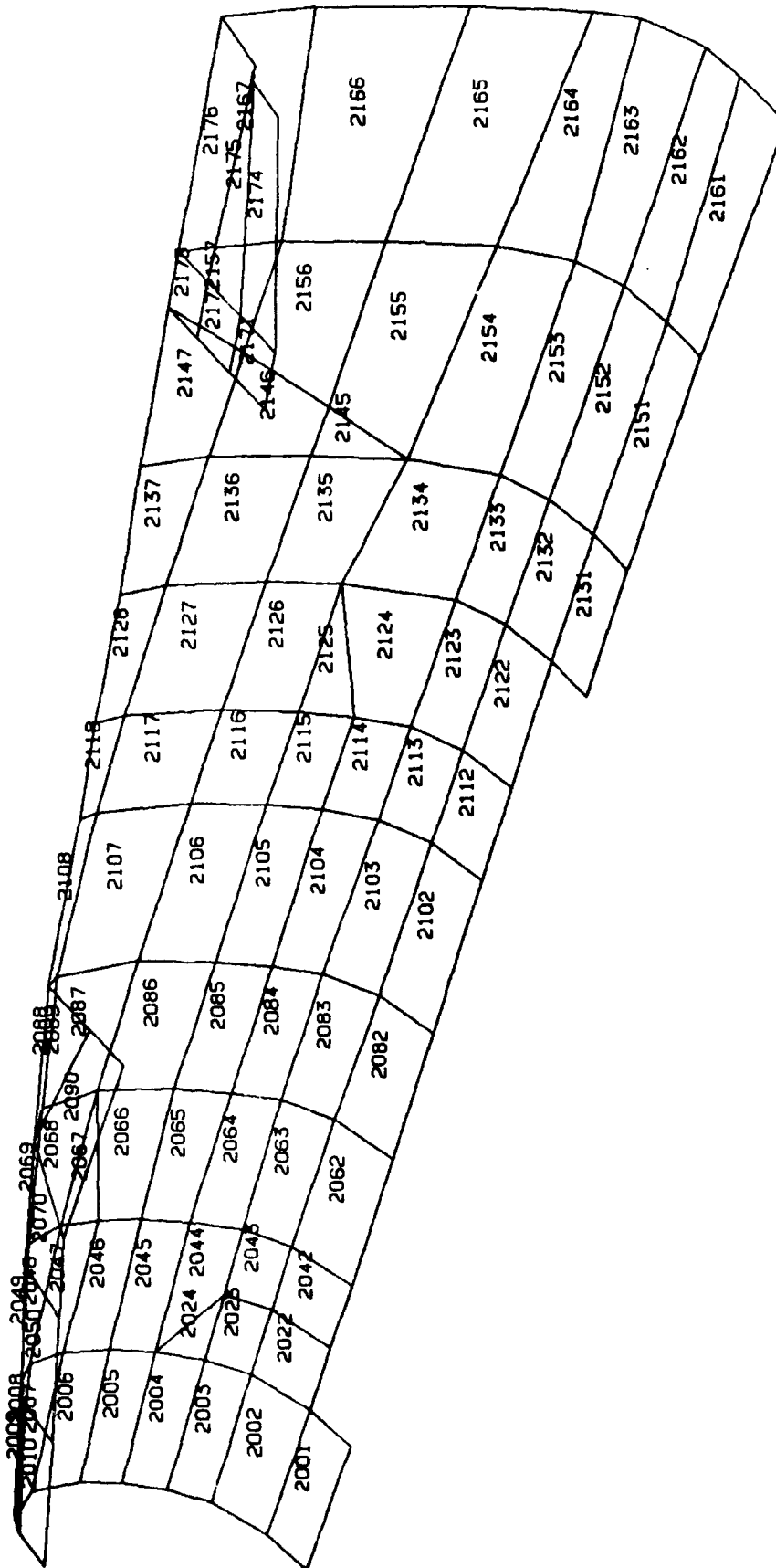
A P P E N D I X D

COMPLETE SET OF ELEMENT AND GRID
NUMBER FIGURES

FORWARD FUSELAGE OML SKIN AND TOP DECK GRIDS



FORWARD FUSELAGE OML SKIN AND TOP DECK ELEMENTS



RADOME
BHD
175

2008
2010
2022
2021
2008
2020
2019
2018
2015
2013
2011
2003
2002
2001

175

194.88
201.5

2052
2058
2054
2053
2075
2063
2062

FWD COCKPIT
BHD
228

2108
2106
2105
2104
2103

2110
2115
2112
2113
2111
2123
2120
2117
2116
2118
2119
2121
2122
2124
2125

2107
2102

228.4

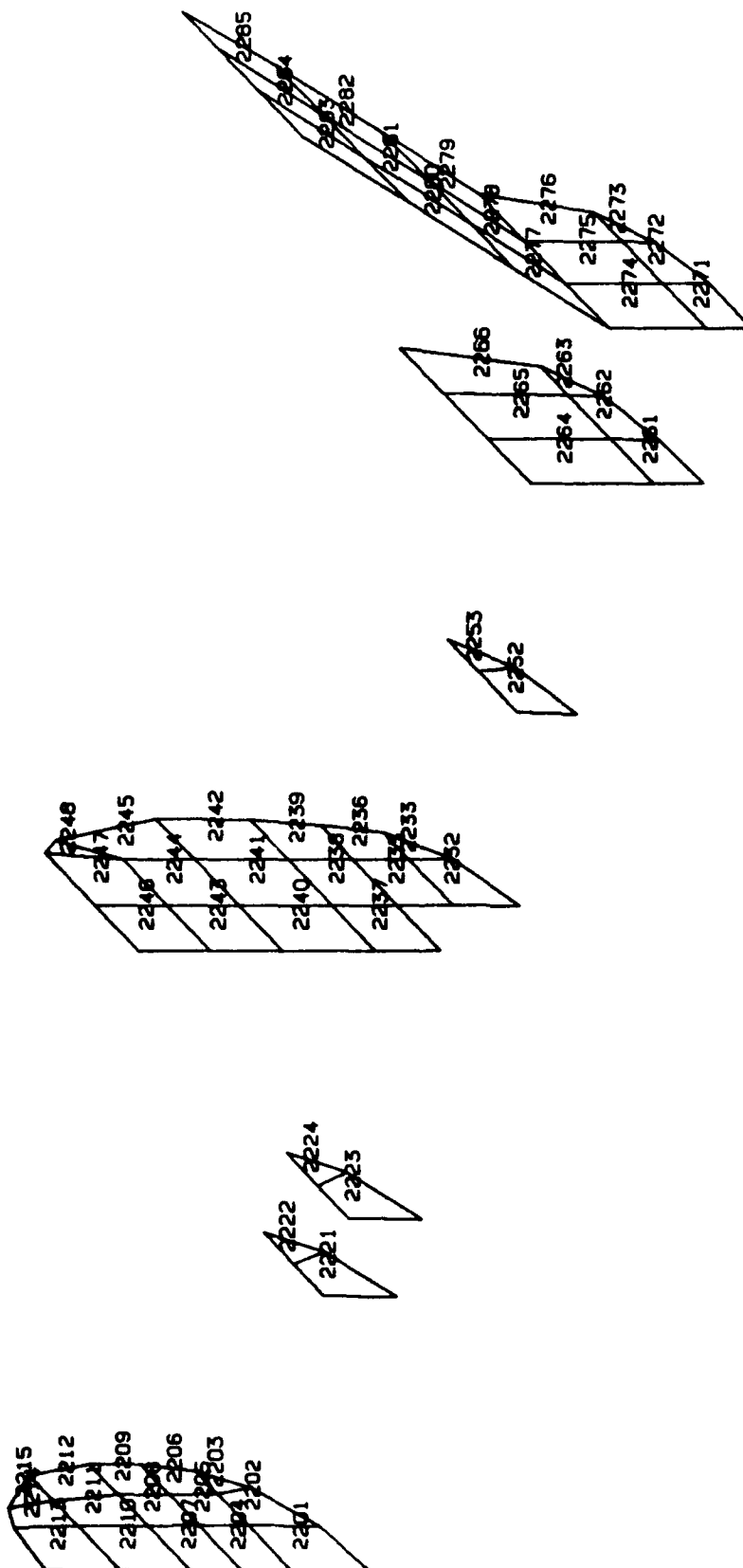
AFT COCKPIT/BHD
286

2216
2215
2214
2212
2211
2208
2207
2206
2205
2204
2203
2202
2201
2199
2198
2197
2196
2195
2194
2193
2192
2191

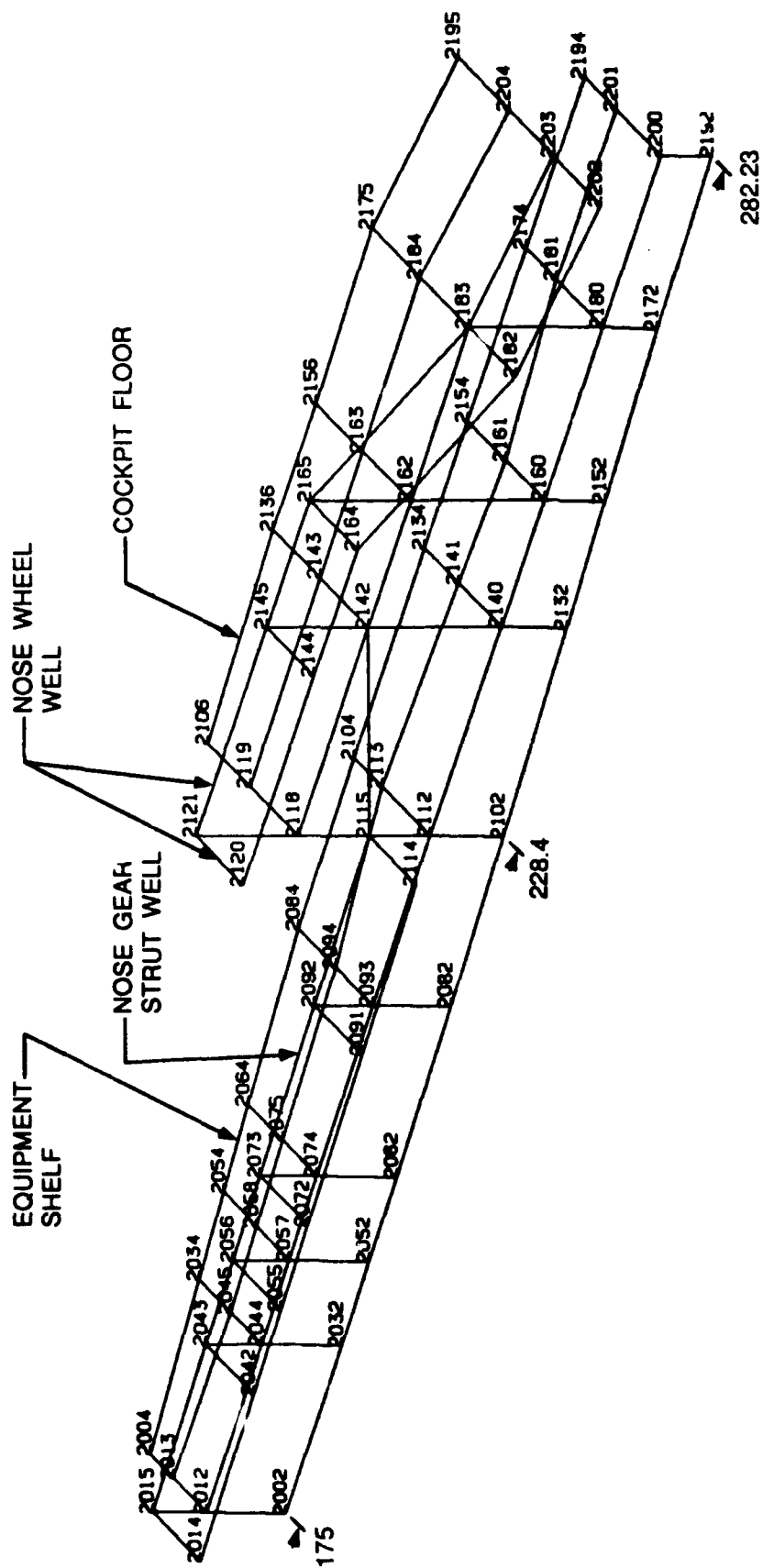
2175
2184
2183
2182
2174
2181
2173
2172
2171

268.75
282.23

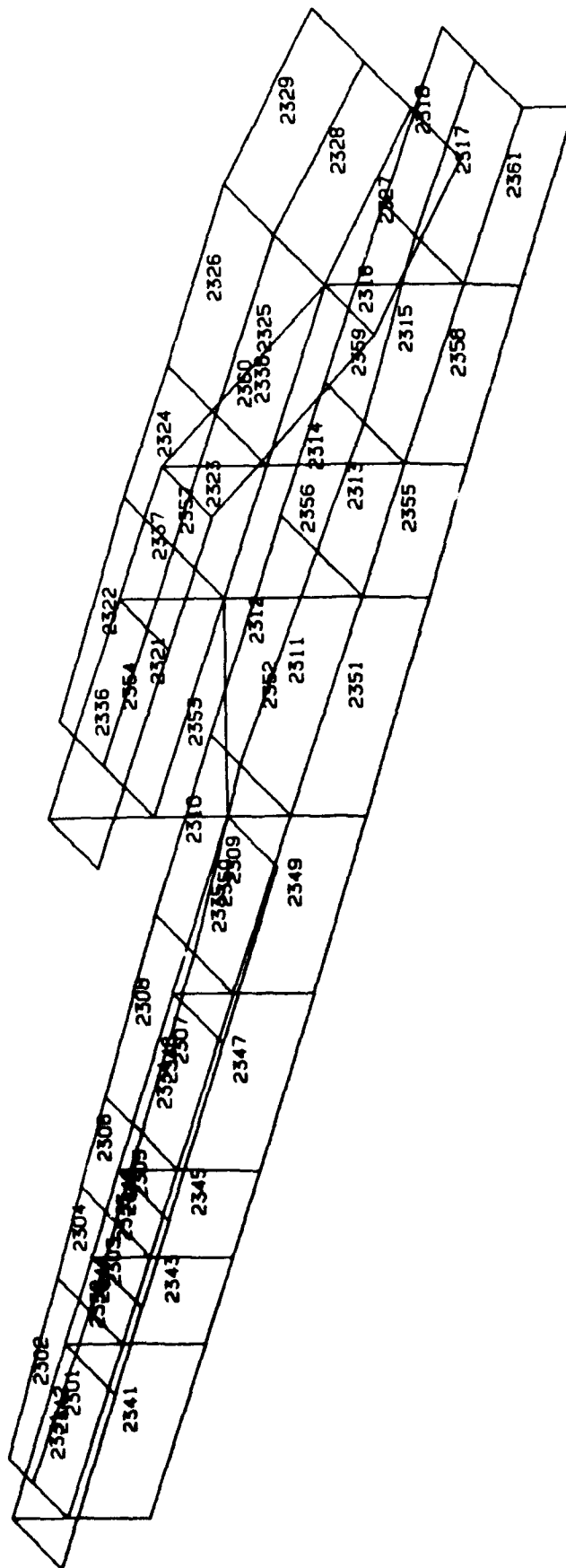
FORWARD FUSELAGE BULKHEAD AND FRAME ELEMENTS

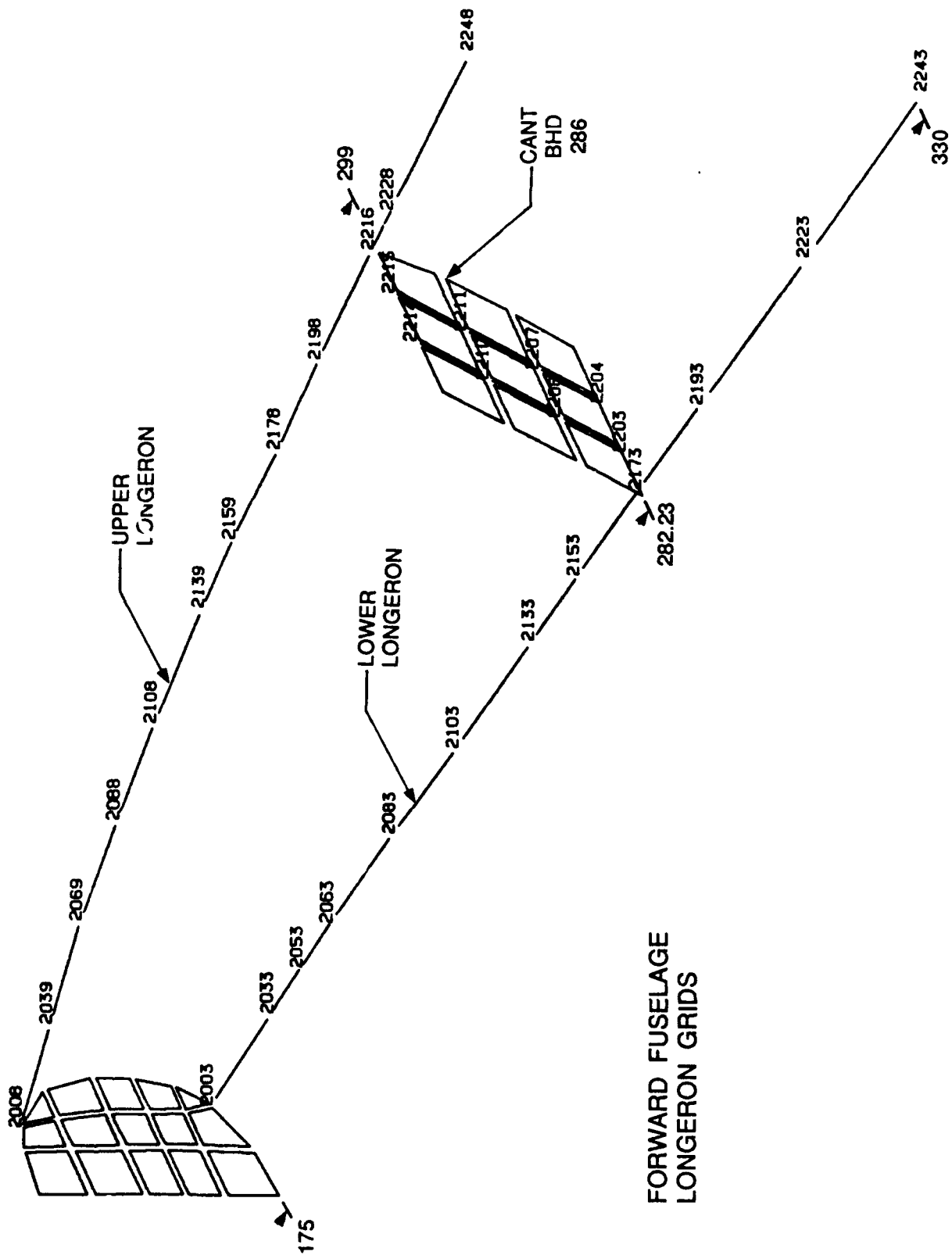


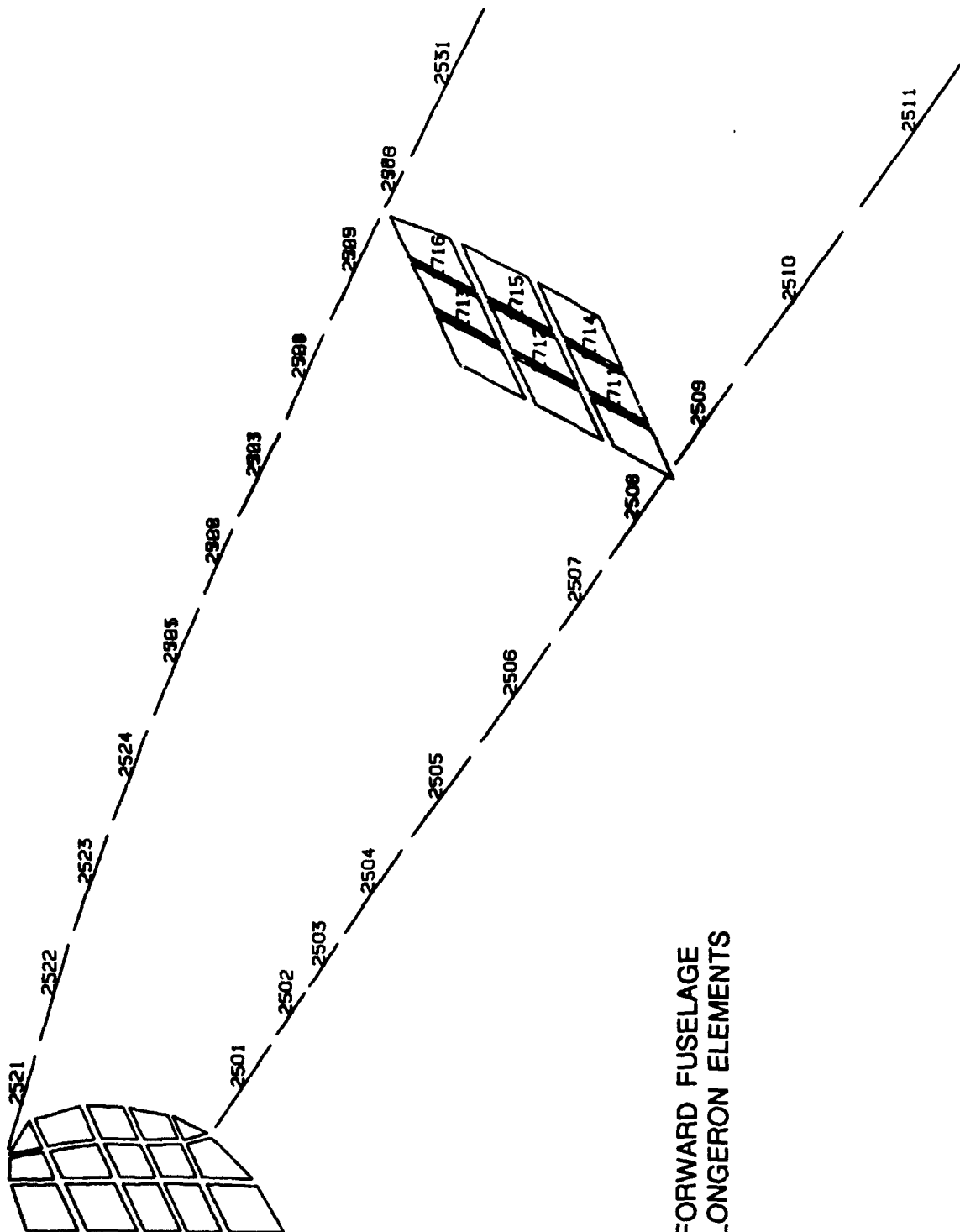
FORWARD FUSELAGE FLOORS AND WHEEL WELL GRIDS



FORWARD FUSELAGE FLOORS AND WHEEL WELL ELEMENTS





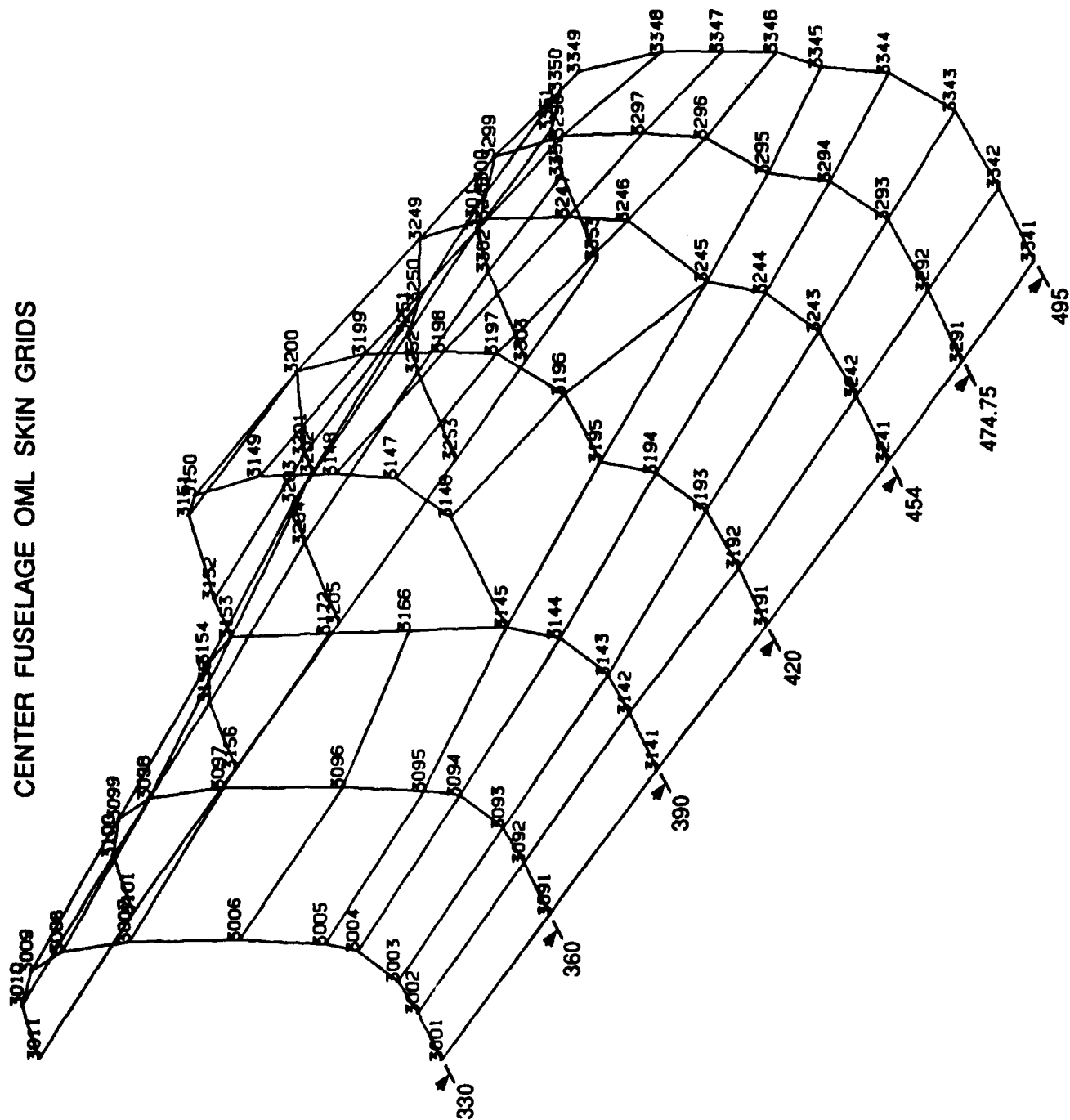


FORWARD FUSELAGE
LONGERON ELEMENTS

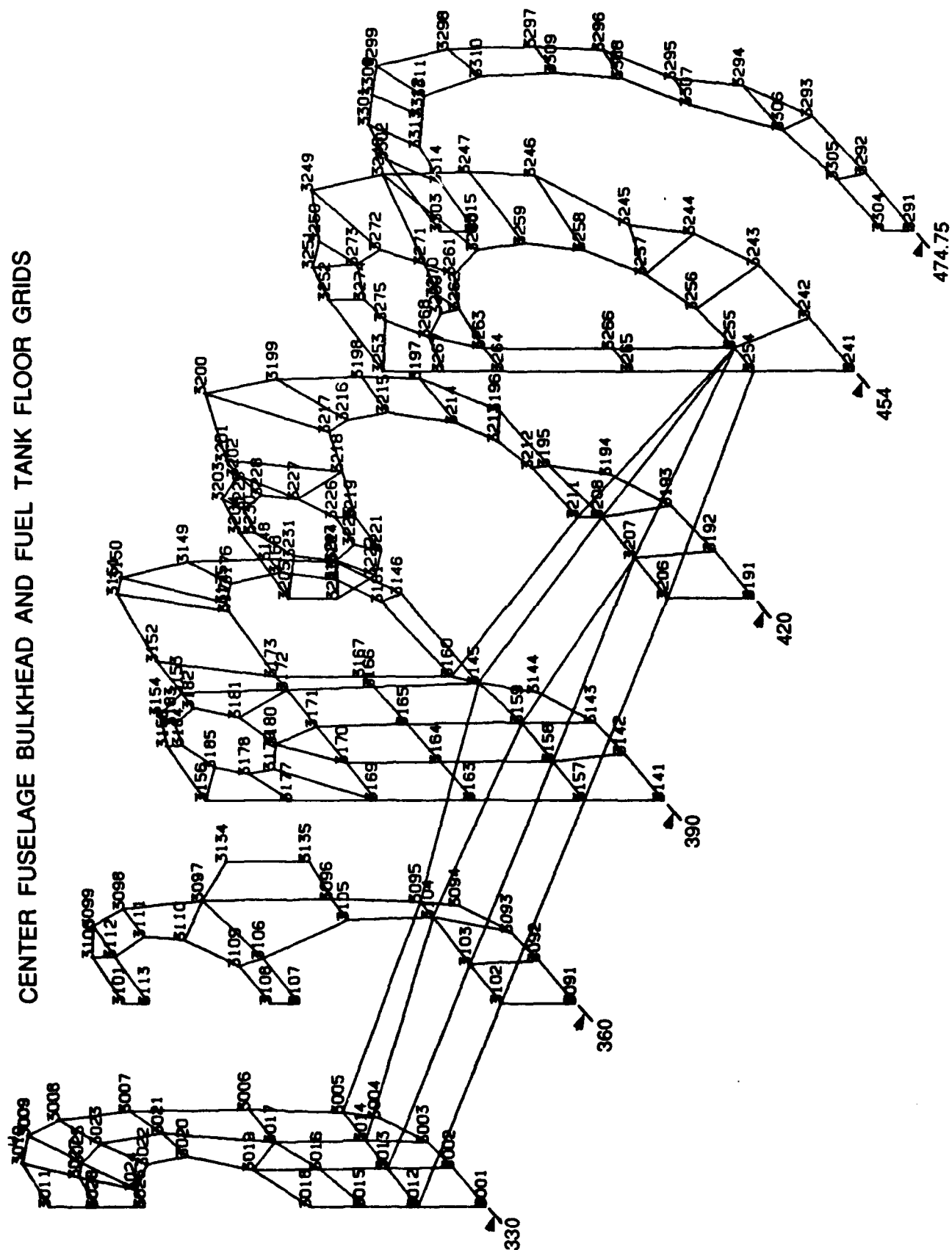
CENTER FUSELAGE OML SKIN ELEMENTS

The diagram illustrates the center fuselage OML skin elements, showing a complex grid of numbered elements (3001 to 3109) and boundary points (330 to 495.5). The elements are arranged in a series of interconnected quadrilaterals and triangles, forming the outer mold line (OML) of the fuselage. The numbering sequence starts at the bottom left (3001) and proceeds generally upwards and to the right, ending at the top right (3109). Boundary points are marked along the edges, including 330, 360, 390, 420, 454, 474.75, and 495.5.

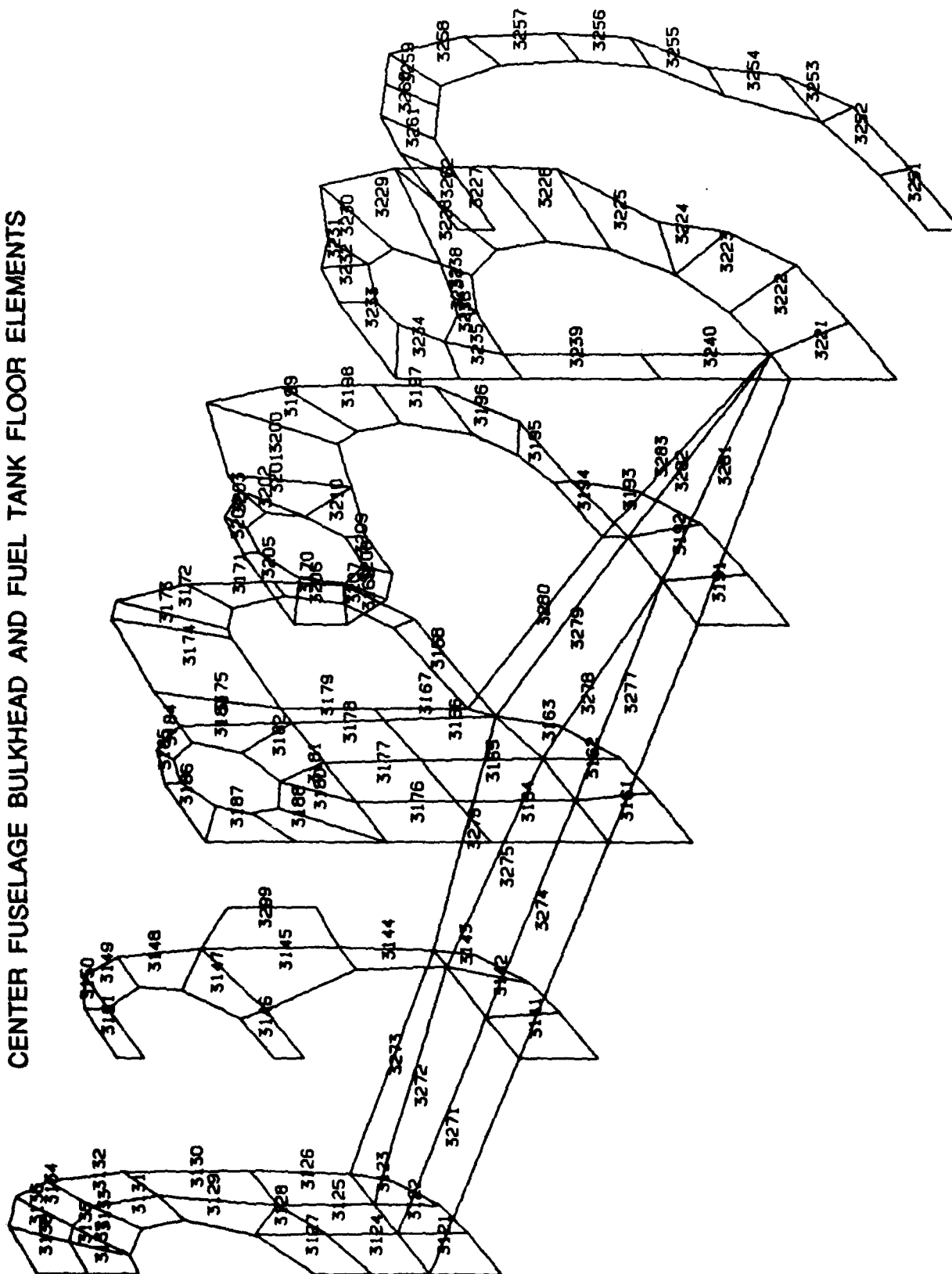
CENTER FUSELAGE OML SKIN GRIDS



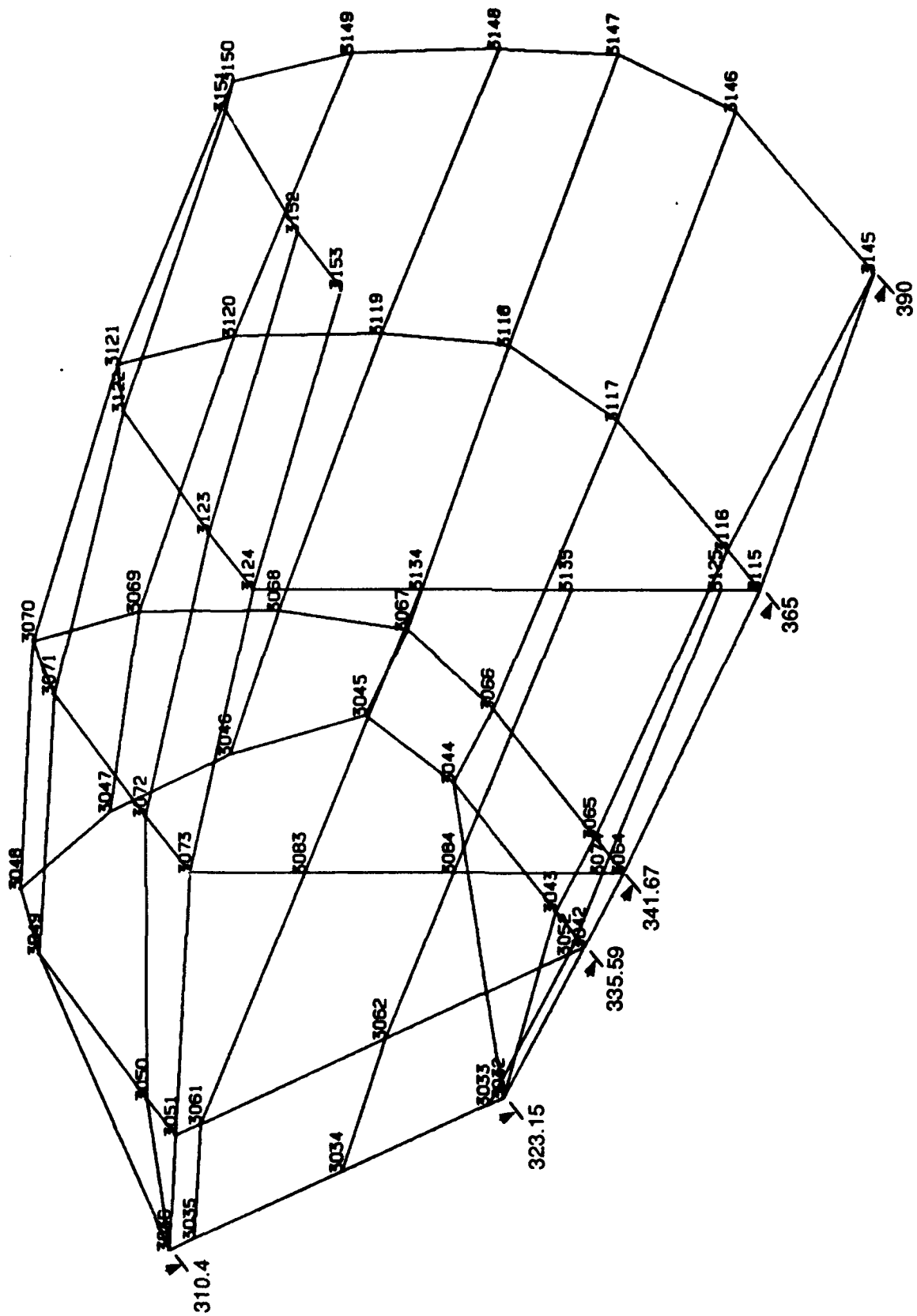
CENTER FUSELAGE BULKHEAD AND FUEL TANK FLOOR GRIDS



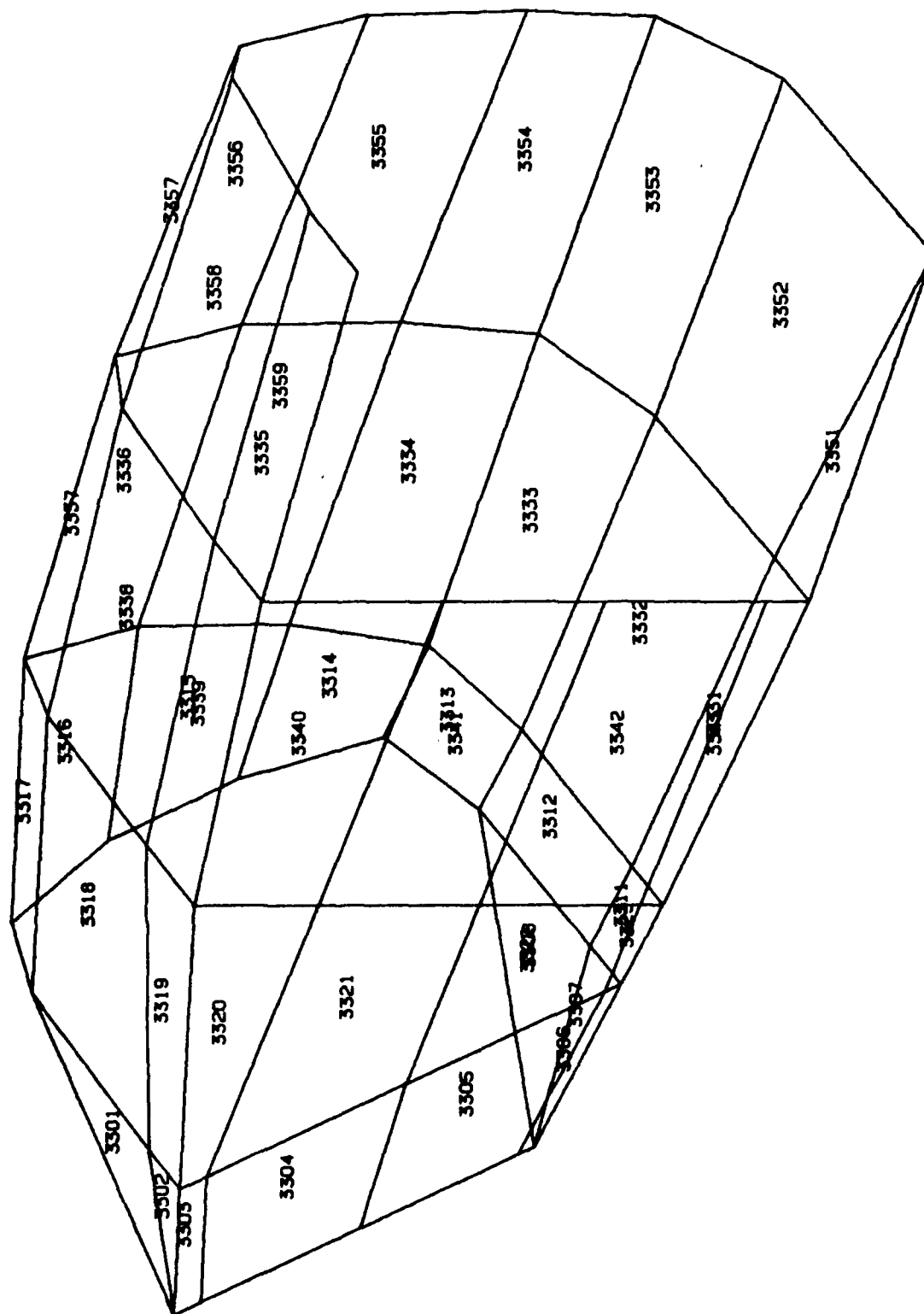
CENTER FUSELAGE BULKHEAD AND FUEL TANK FLOOR ELEMENTS



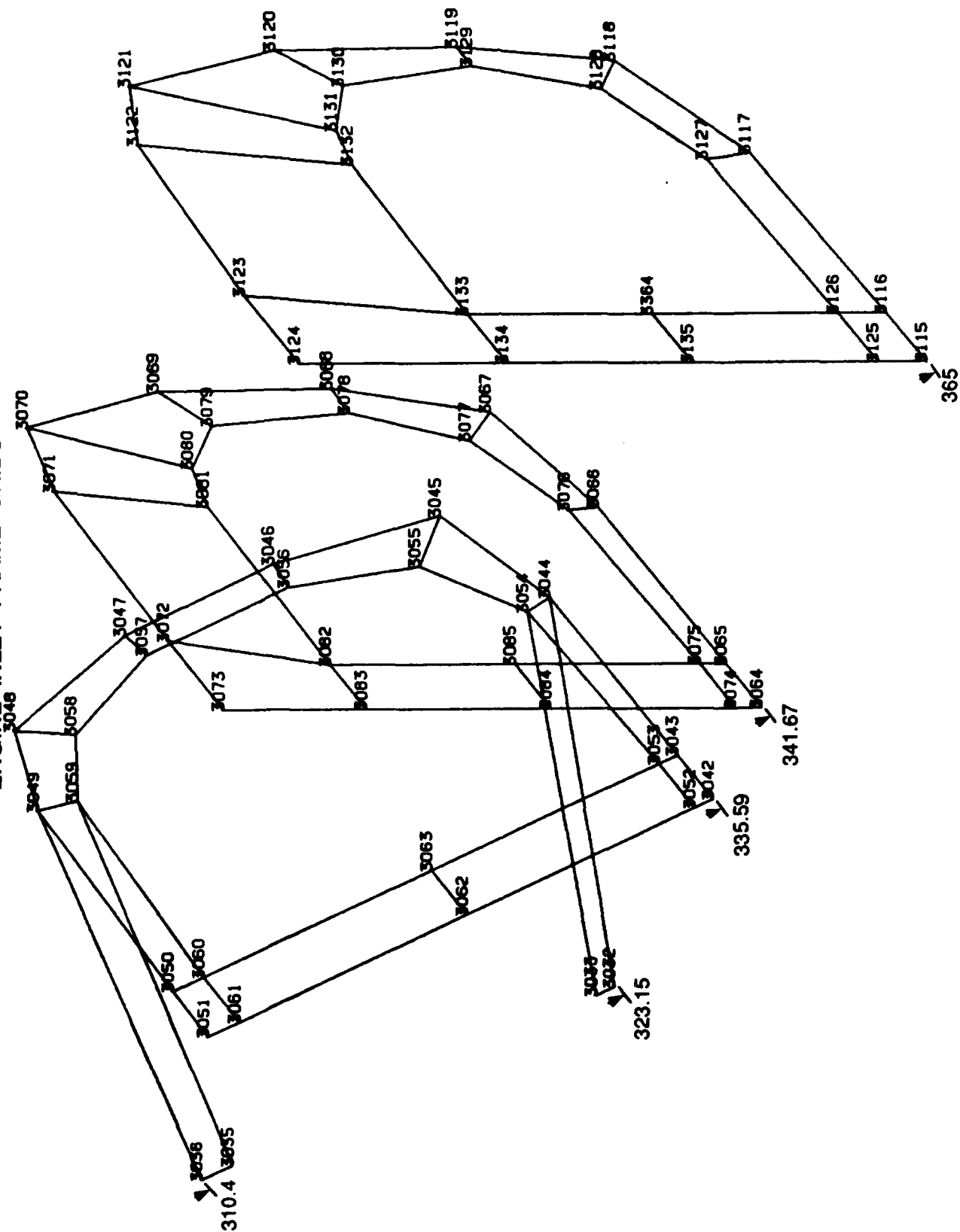
ENGINE INLET OML SKIN



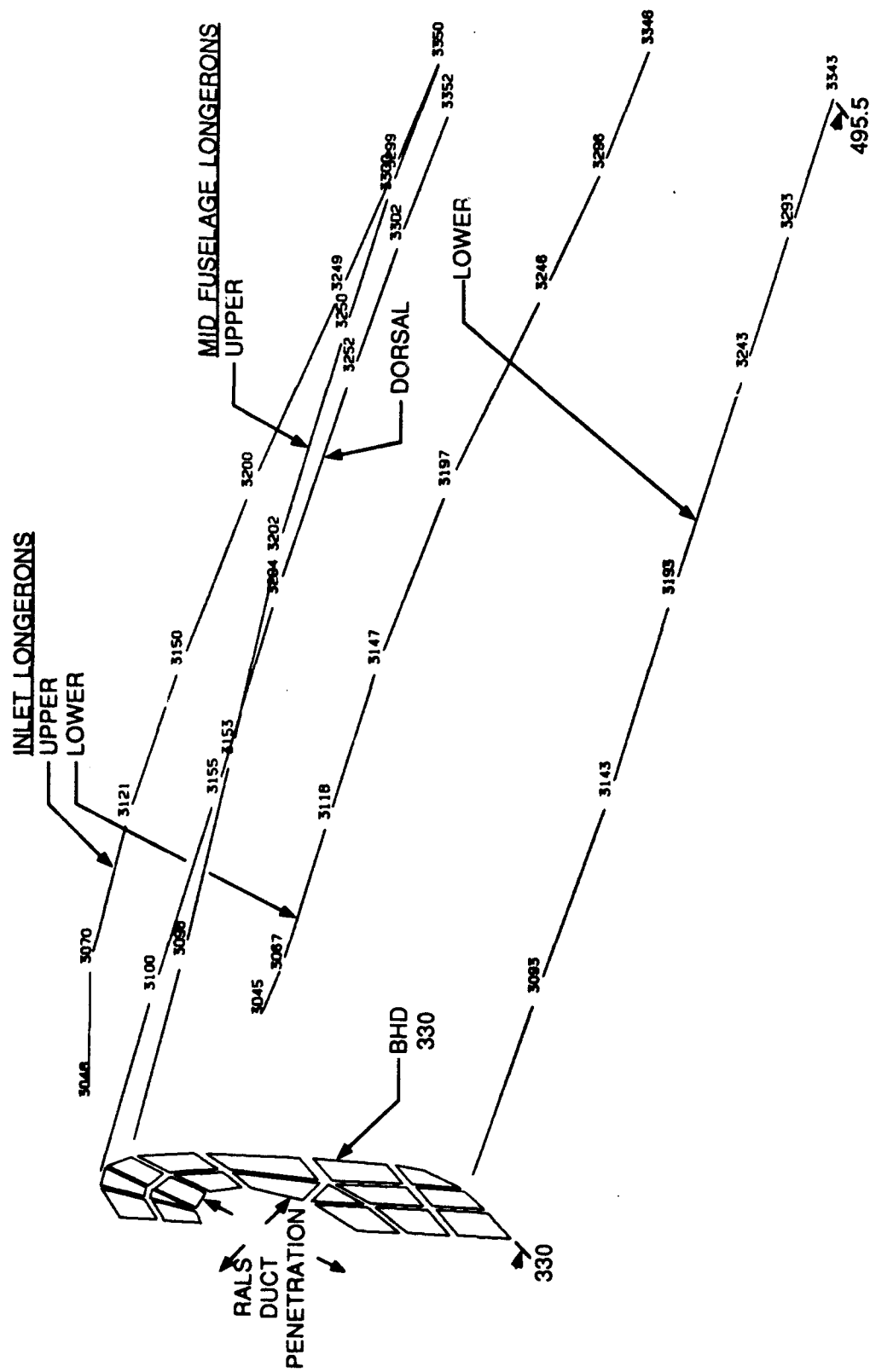
ENGINE INLET OML SKIN ELEMENTS



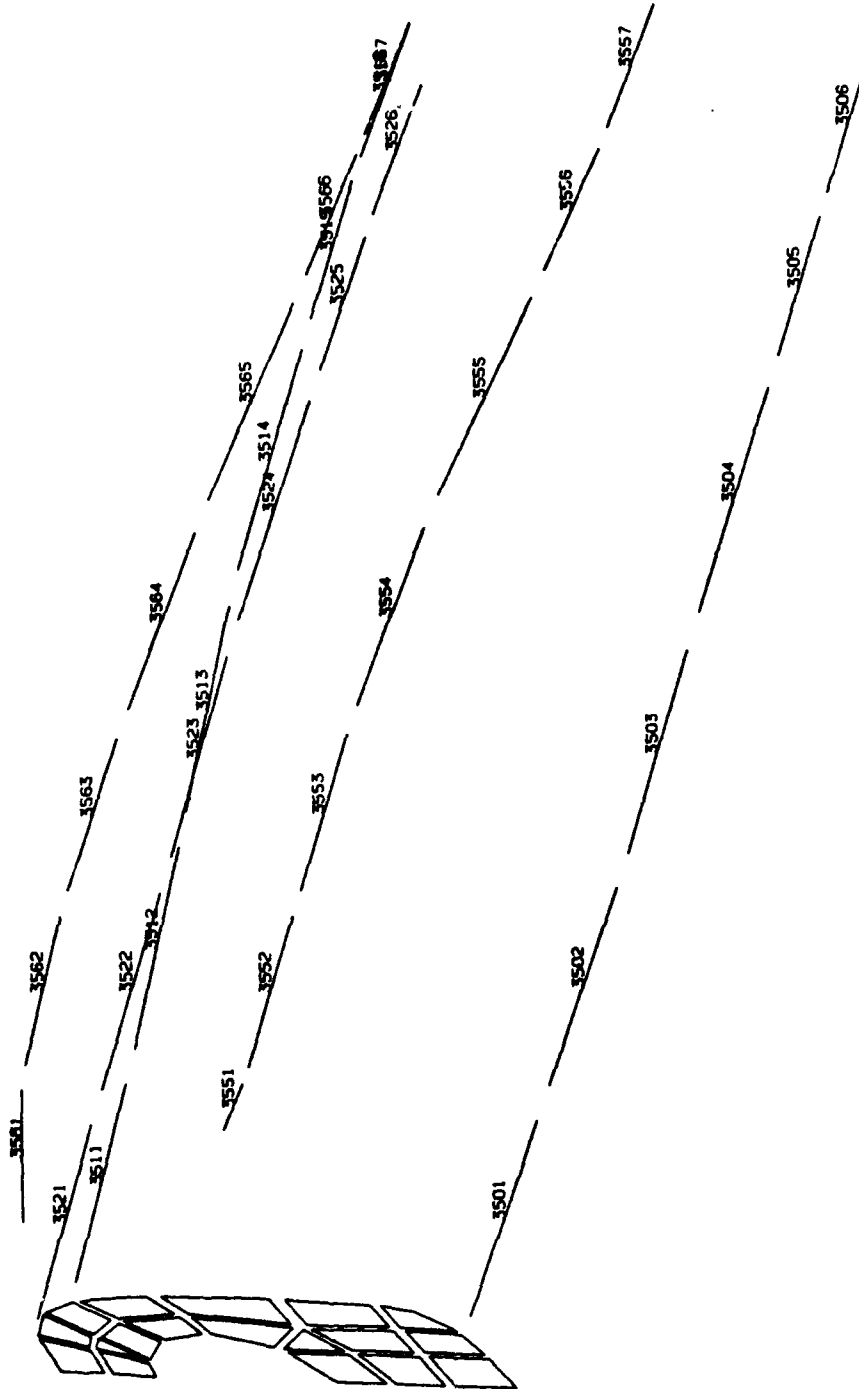
ENGINE INLET FRAME GRIDS



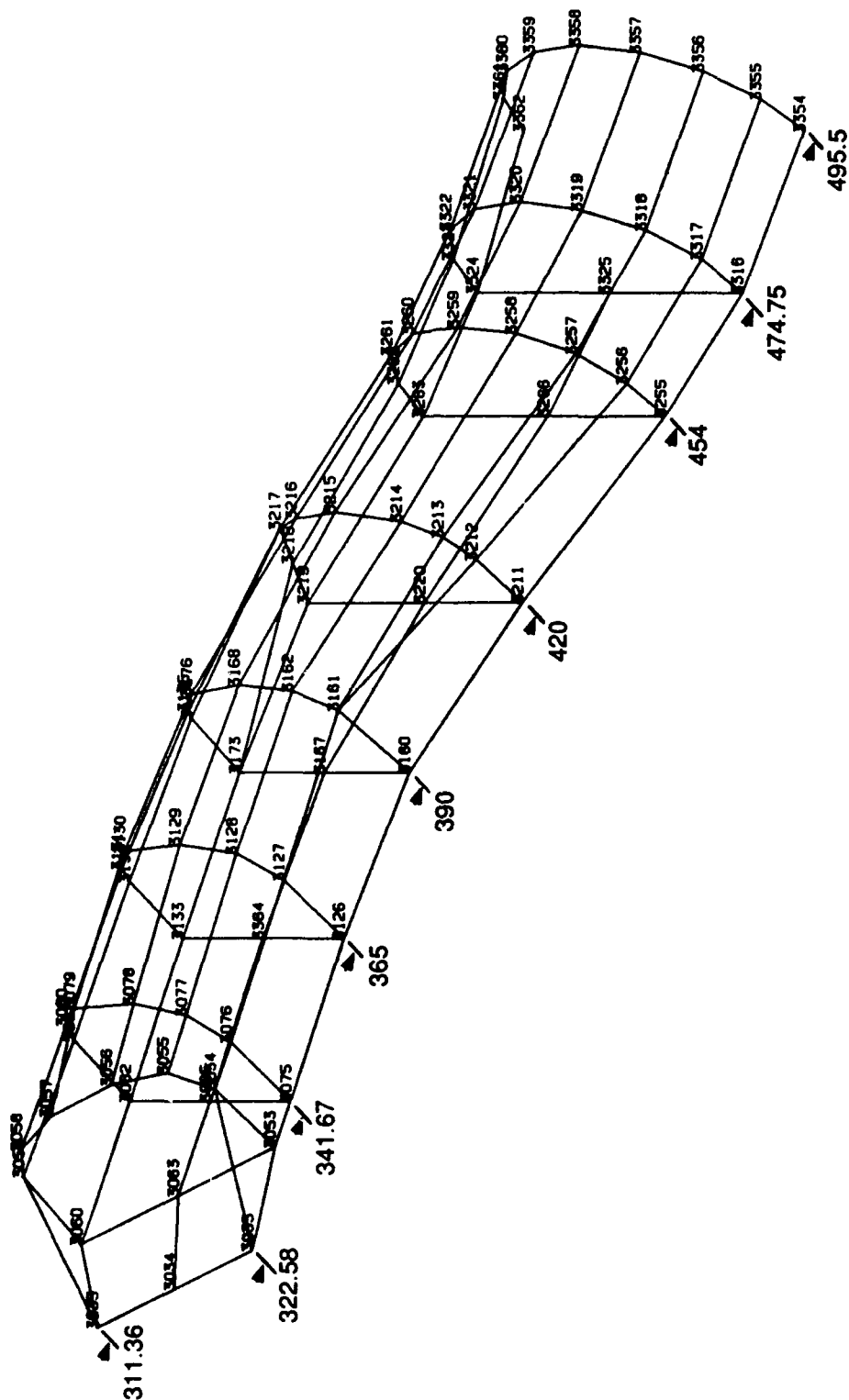
CENTER FUSELAGE LONGERON GRIDS



CENTER FUSELAGE LONGERON GRIDS



ENGINE INLET DUCT IML SKIN GRIDS



RAIS DUCT TUNNEL ELEMENTS

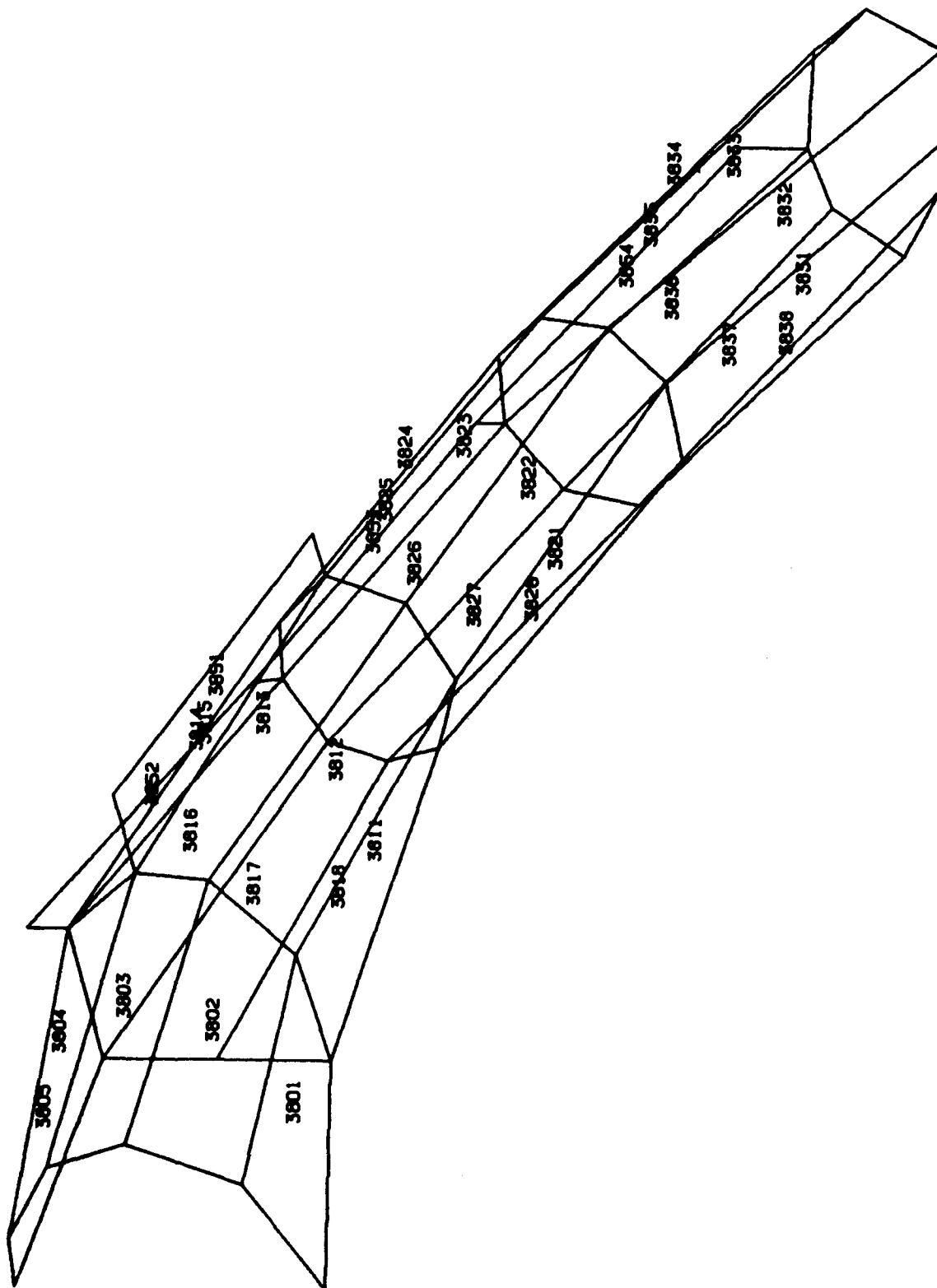
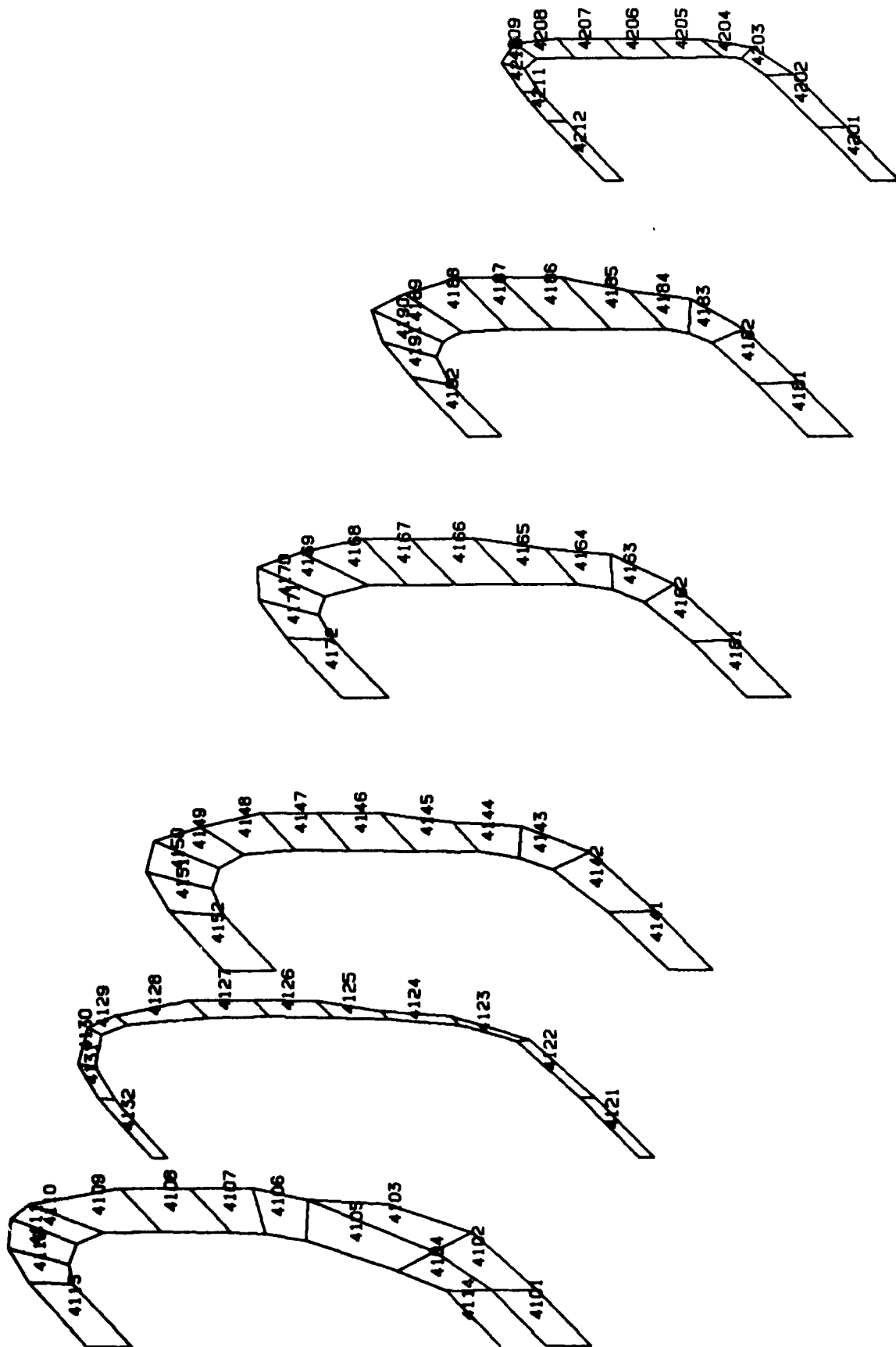
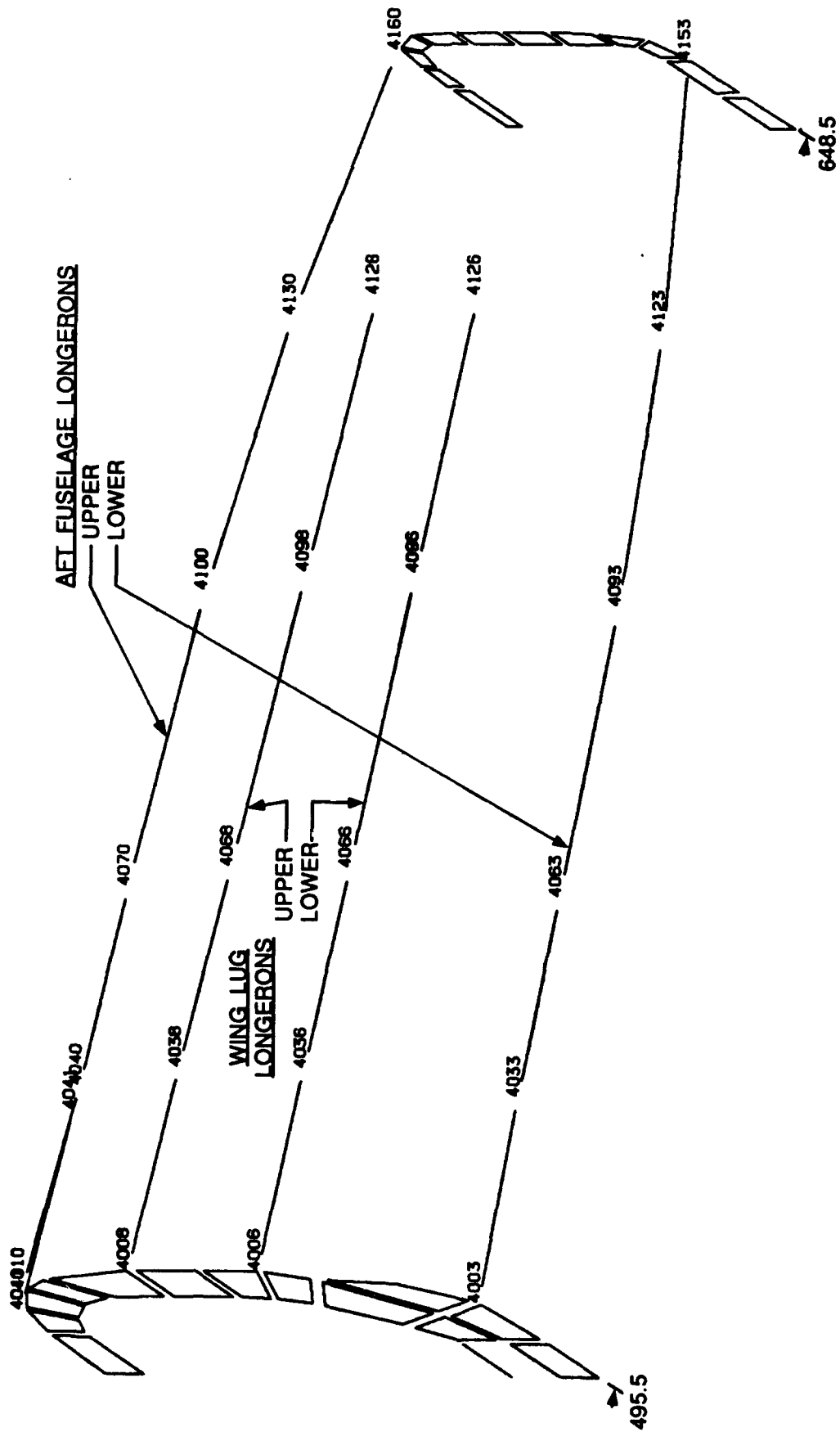


Figure 1 is a detailed topographic map of a terrain section. The map shows a series of contour lines representing elevation. The left boundary is a straight line with elevations ranging from 495.5 to 648.5. The right boundary is a curved line with elevations ranging from 520.25 to 615. The interior of the map is divided into a grid of small triangles, each labeled with a number representing its elevation. The numbers range from 1001 to 1160. The map is oriented with the left boundary on the left and the right boundary on the right.

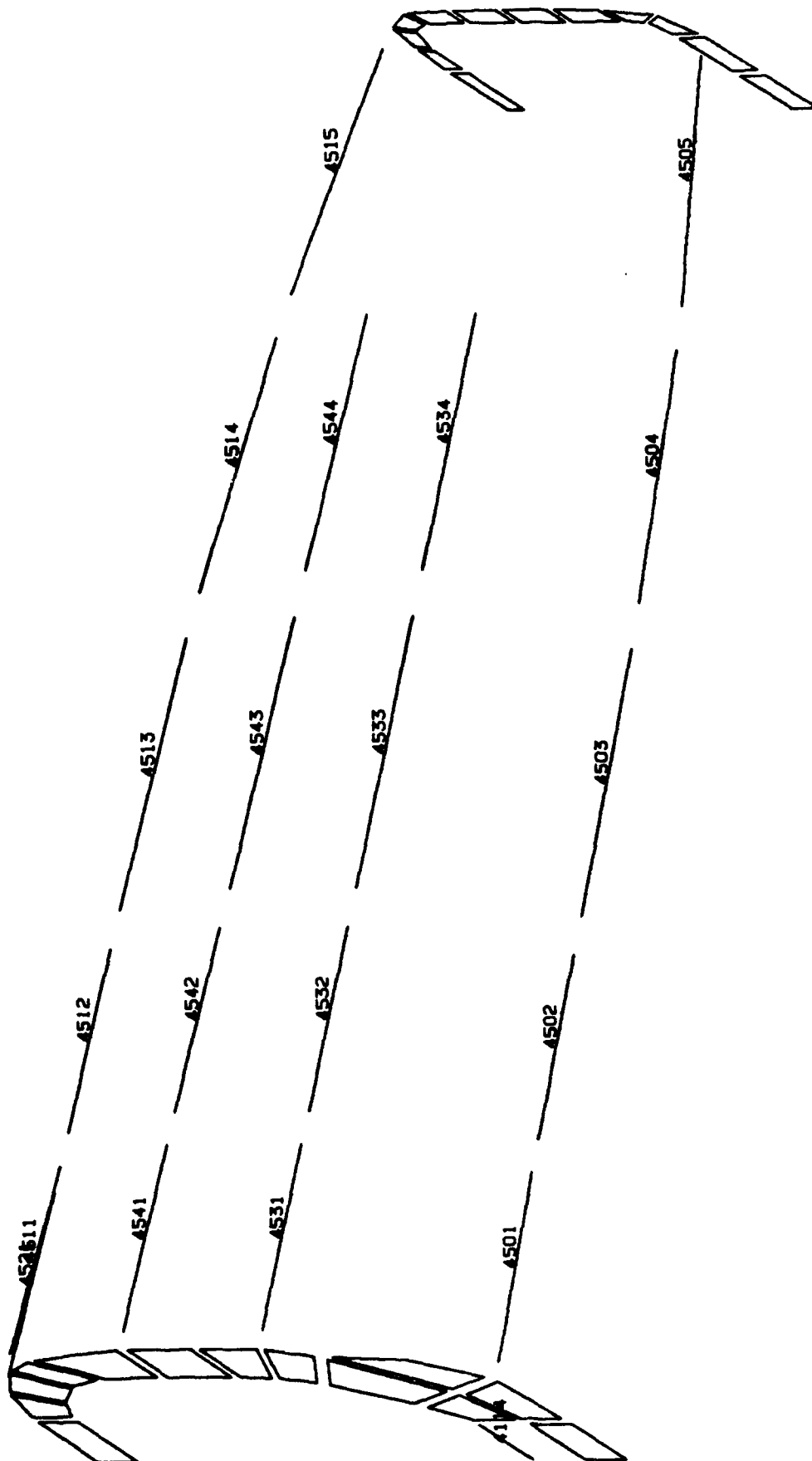
AFT FUSELAGE BULKHEAD AND FRAME ELEMENTS



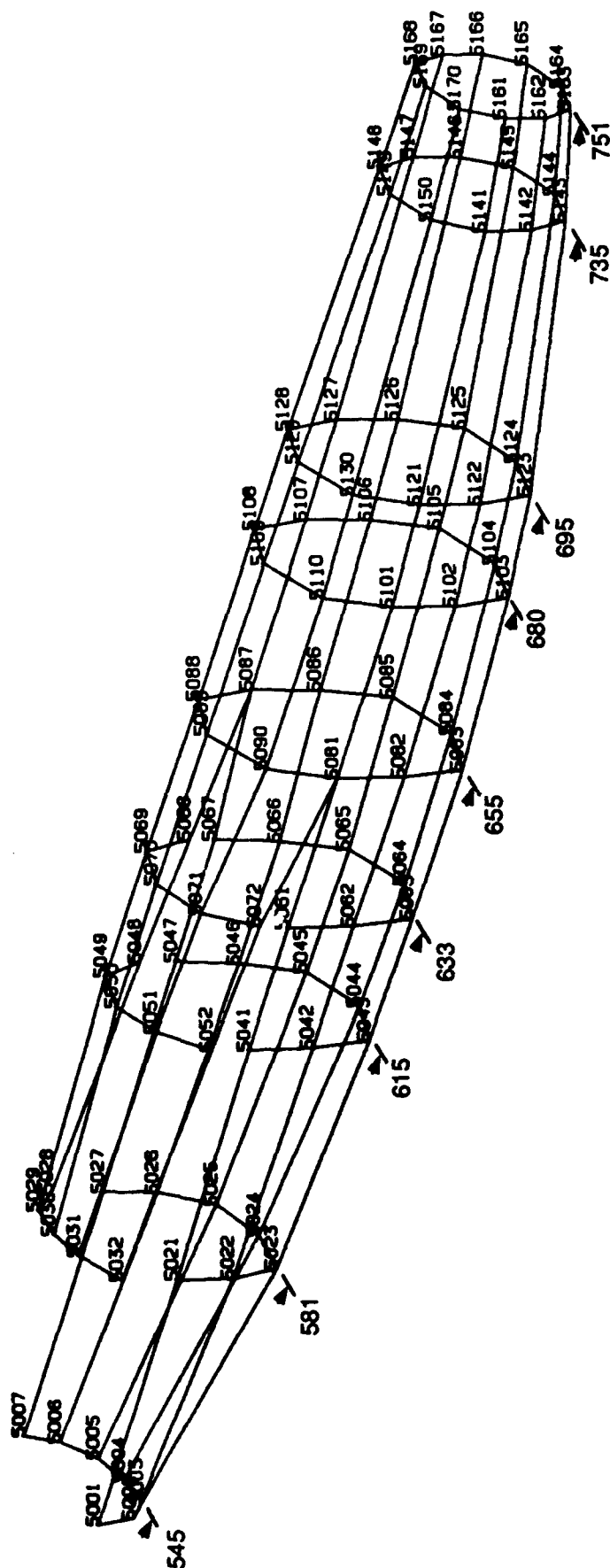
AFT FUSELAGE LONGERON GRIDS



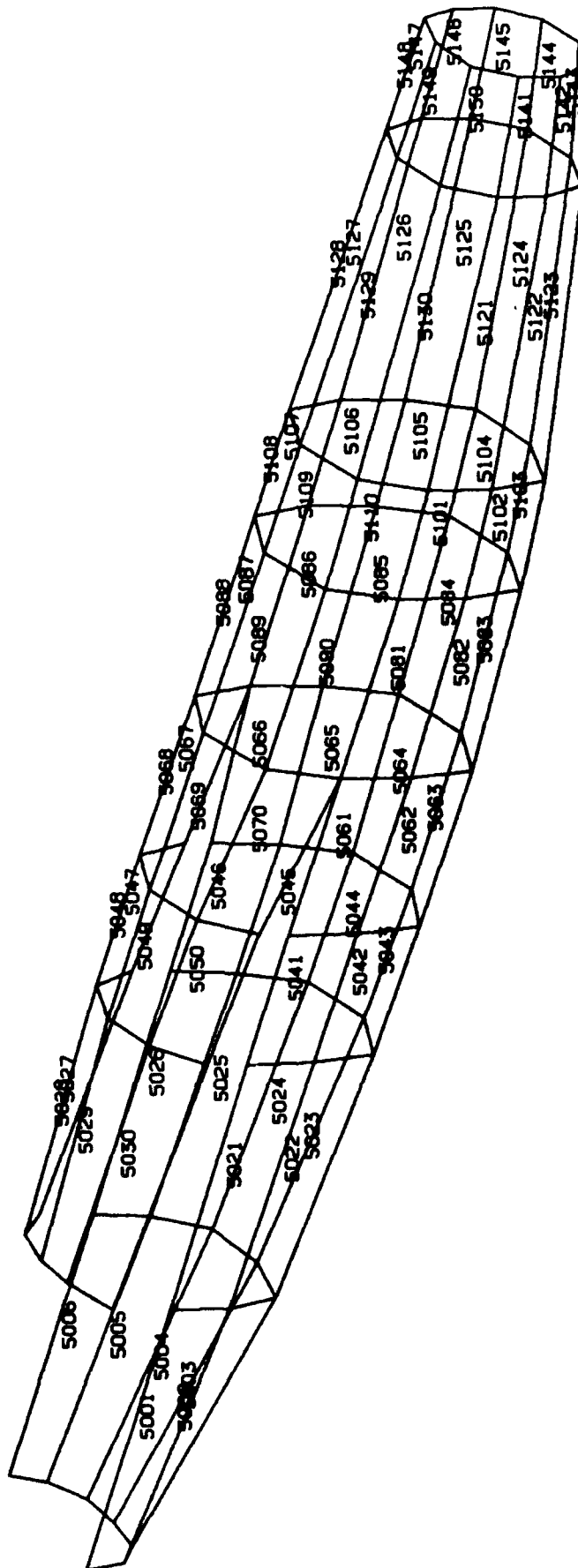
AFT FUSELAGE LONGERON GRIDS



MLG/VERTICAL FIN POD OML SKIN GRIDS

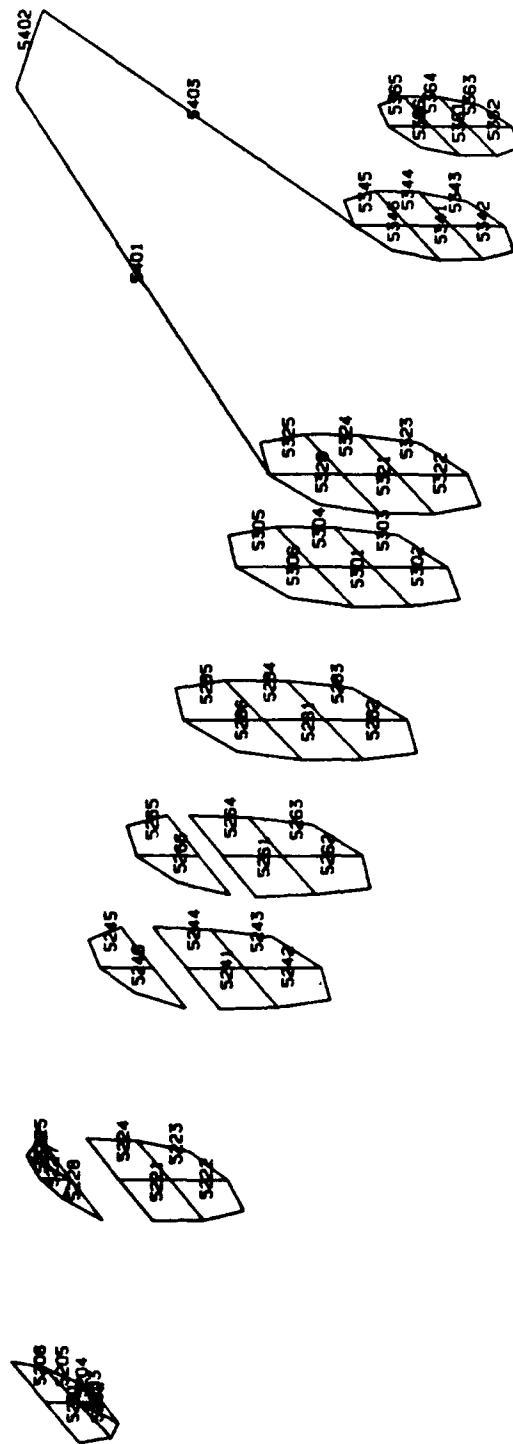


MLG/VERTICAL FIN POD OML SKIN ELEMENTS

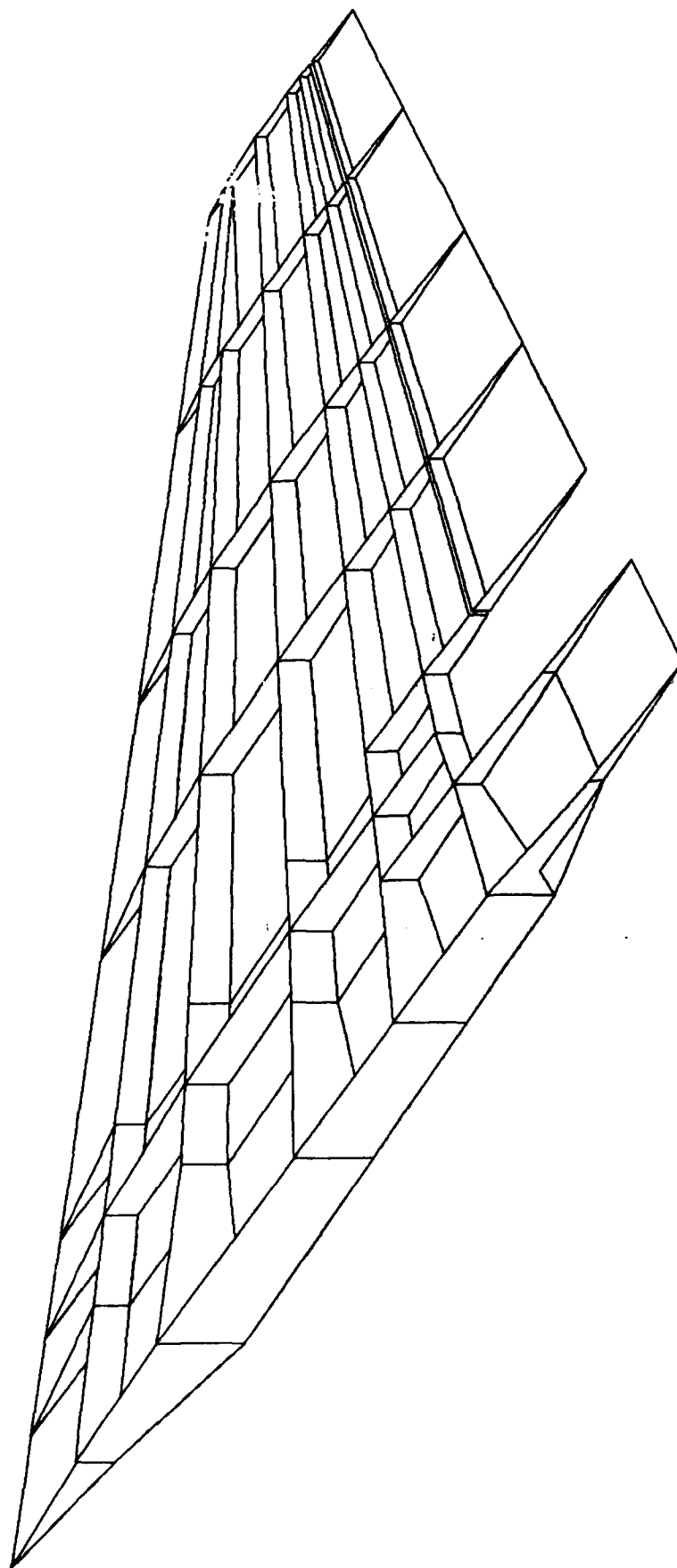


The graph in Figure 1 consists of numerous nodes, each labeled with a number. The nodes are interconnected by a series of edges, forming a complex network. The structure is characterized by several large, interconnected loops and paths. The nodes are distributed across the image, with some clusters and some isolated nodes. The edges are represented by solid black lines connecting the nodes. The overall shape of the graph is irregular, with many internal connections and a few external ones. The nodes are labeled with numbers, some of which are repeated, indicating multiple occurrences of the same node or a specific labeling scheme. The edges form a dense web in some areas and are more sparse in others, creating a varied topological structure.

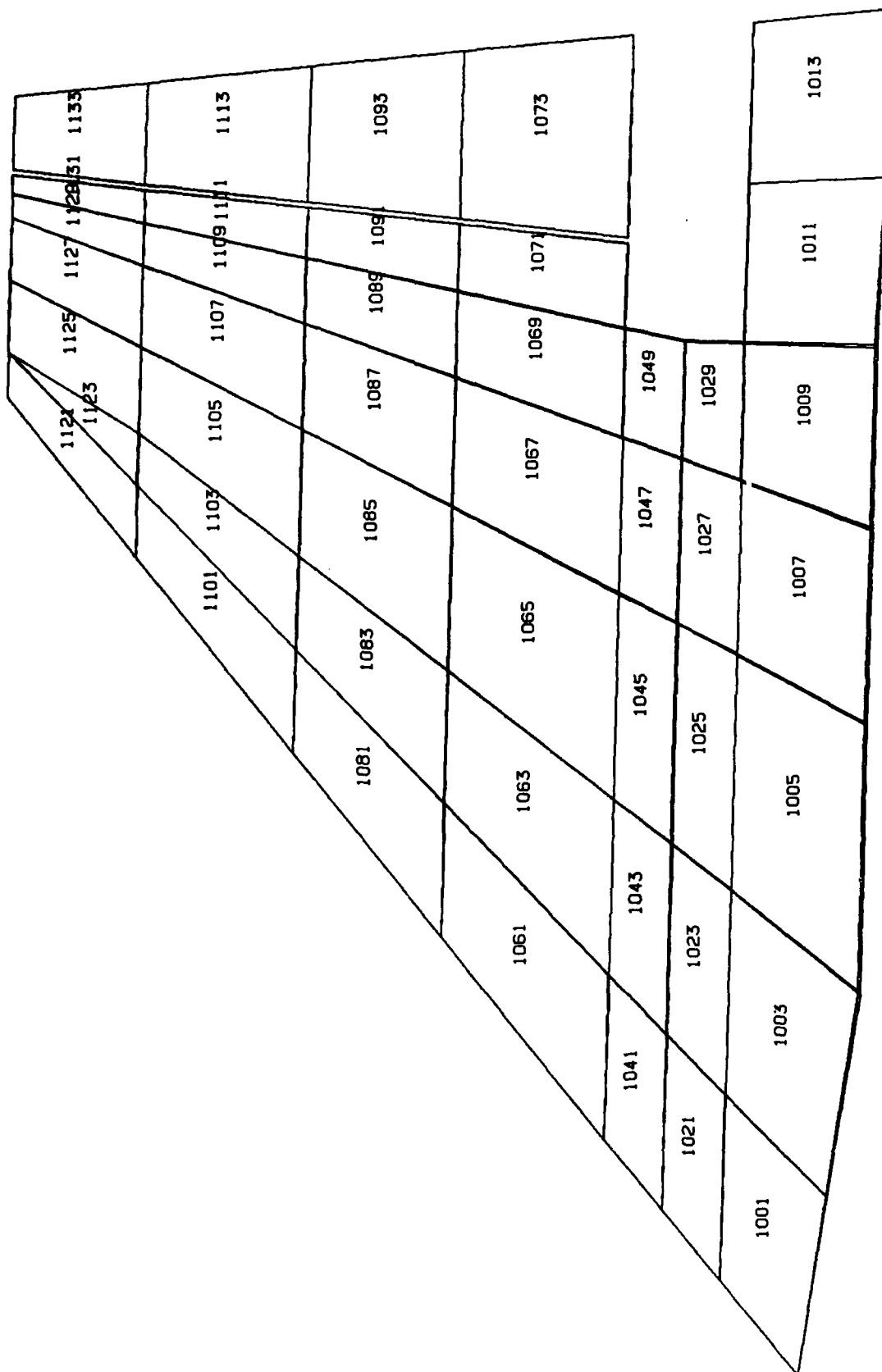
MLG/VERTICAL FIN POD BULKHEAD ELEMENTS



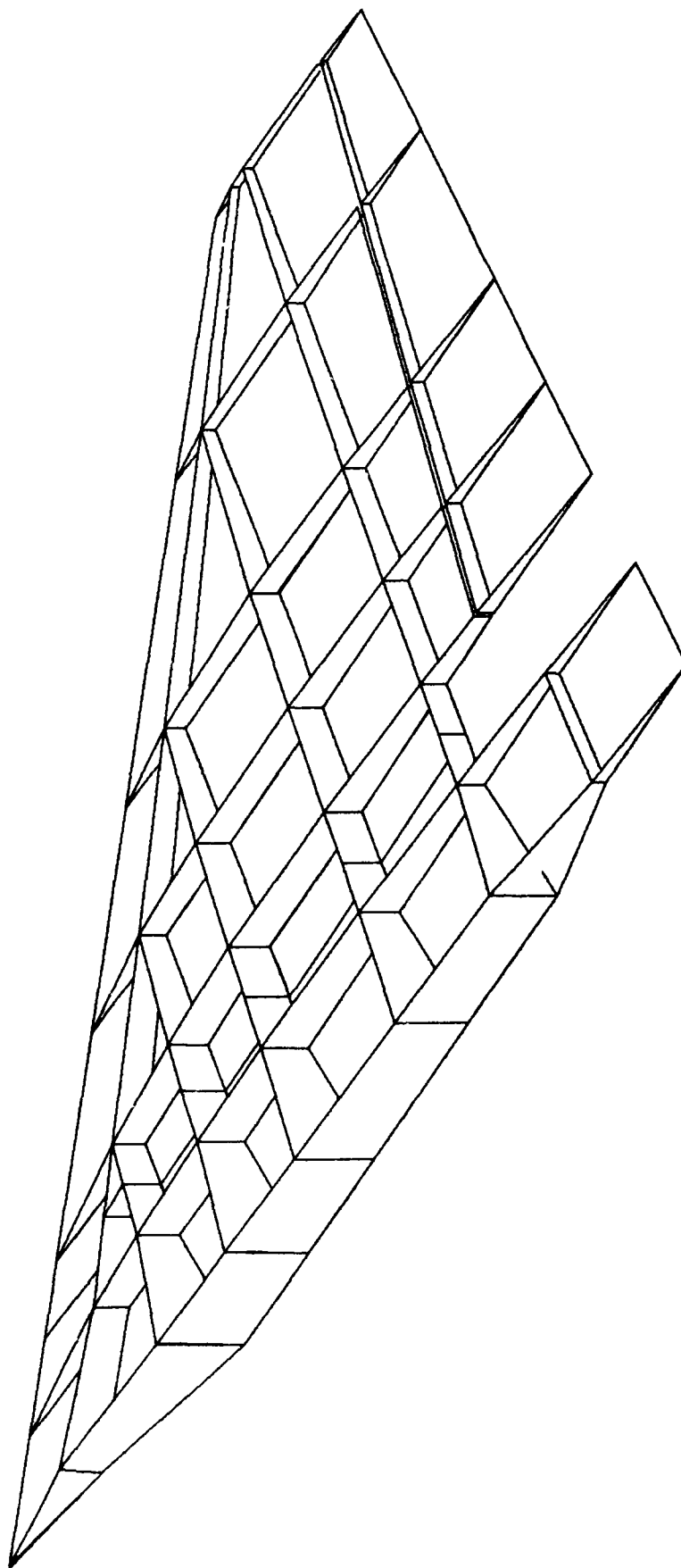
WING1 WITH UPPER SKIN REMOVED



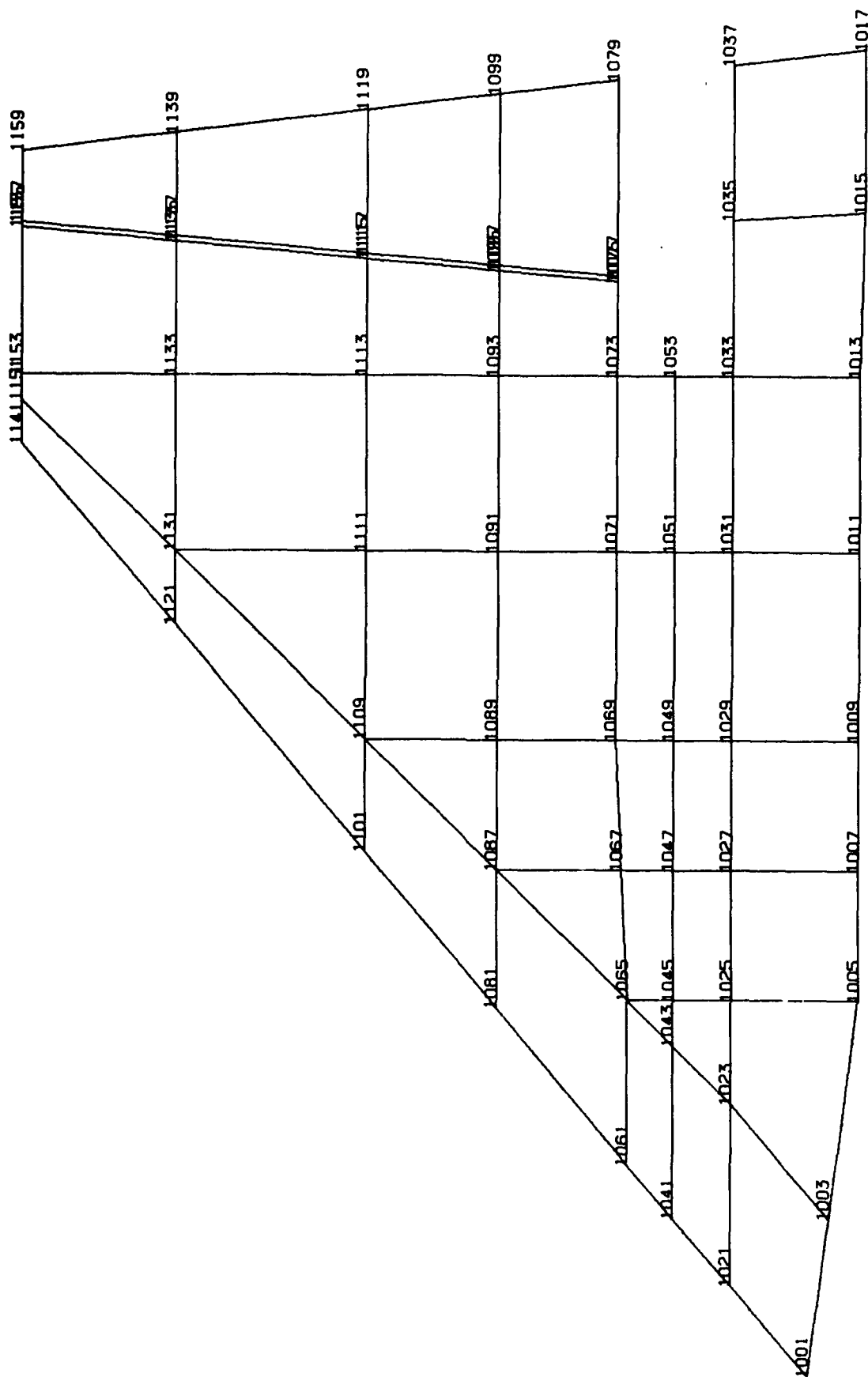
WING1 LOWER SKIN ELEMENTS



WING2 WITH UPPER SKIN REMOVED



WING2 LOWER SKIN GRIDS

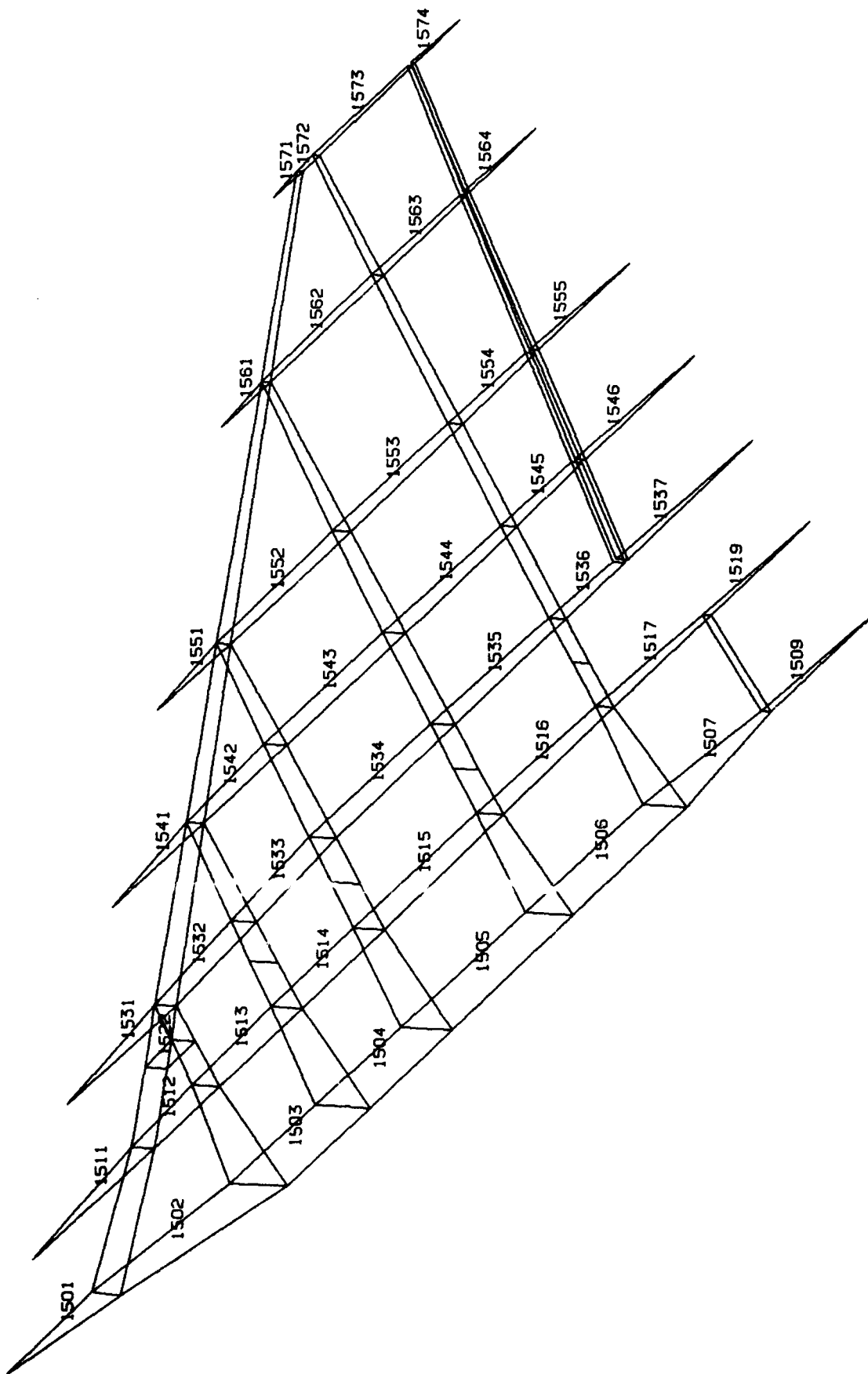


WING2 LOWER SKIN ELEMENTS

1121		1131	1133	1135
1101		1111	1113	1115
1081		1089	1093	1095
1061		1067	1071	1075
1041	1043	1047	1049	1051
1021	1023	1027	1029	1031
1001	1003	1007	1009	1011
		1005	1013	1017

1336	1334	1332	1322	1302	1310	1312	1314	1316
1296	1294	1292	1290	1288	1282	1272	1274	1276
1252	1250	1248	1262	1266	1268	1270	1272	1274
1232	1230	1228	1242	1244	1246	1262	1264	1266
1212	1210	1208	1222	1224	1226	1242	1244	1246
1216	1214	1212	1202	1204	1206	1222	1224	1226

WING2 RIB ELEMENTS



A P P E N D I X E

SUMMARY OF LOCAL DESIGN VARIABLE RESULTS

N382 STOVL FUS/WING2/POD STRUC // WING CANARD FUSELAGE AERO (02K)
 RH HALF MODEL SPARS PERPENDICULAR TO CENTERLINE - CANARD 24IN FWD
 FLUTTER M = 1.5 15000 FT ADD VERTICAL AERO BARS ON PODS

ASTROS VERSION 4 10/14/89 P. 52
 ASTROS ITERATION 5

SUMMARY OF LOCAL DESIGN VARIABLES - ITERATION 5

	EID	LAYER	LINKING OPTION	THICKNESS	T/TMIN	MINIMUM	MAXIMUM
ACTIVE QD MEM 1 & TR MEM ELEMENTS							
WING LEADING EDGE INBOARD	1001	1	SHAPE FUNCTION	2.89970748E-02	2.900E+00	1.000E-02	1.000E+04
	1001	2	SHAPE FUNCTION	3.02337501E-02	3.023E+00	1.000E-02	1.000E+04
	1001	3	SHAPE FUNCTION	2.90128272E-02	2.901E+00	1.000E-02	1.000E+04
	1001	4	SHAPE FUNCTION	1.08251553E-02	1.083E+00	1.000E-02	1.000E+04
	1121	1	SHAPE FUNCTION	2.57077292E-02	2.571E+00	1.000E-02	1.000E+04
	1121	2	SHAPE FUNCTION	2.72987355E-02	2.730E+00	1.000E-02	1.000E+04
OUTBOARD	1121	3	SHAPE FUNCTION	2.61155516E-02	2.612E+00	1.000E-02	1.000E+04
	1121	4	SHAPE FUNCTION	1.24117611E-02	1.241E+00	1.000E-02	1.000E+04
LOWER WING SKIN							
FWD INBOARD	1003	1	SHAPE FUNCTION	3.02816201E-02	3.028E+00	1.000E-02	1.000E+04
	1003	2	SHAPE FUNCTION	2.87847184E-02	2.878E+00	1.000E-02	1.000E+04
	1003	3	SHAPE FUNCTION	1.00812204E-02	1.008E+00	1.000E-02	1.000E+04
	1003	4	SHAPE FUNCTION	1.00739144E-01	1.007E+01	1.000E-02	1.000E+04
	1009	1	SHAPE FUNCTION	2.72156205E-02	2.722E+00	1.000E-02	1.000E+04
	1009	2	SHAPE FUNCTION	3.24278399E-02	3.243E+00	1.000E-02	1.000E+04
	1009	3	SHAPE FUNCTION	1.35423681E-02	1.354E+00	1.000E-02	1.000E+04
	1009	4	SHAPE FUNCTION	8.44028071E-02	8.440E+00	1.000E-02	1.000E+04
	1013	1	SHAPE FUNCTION	2.66102981E-02	2.661E+00	1.000E-02	1.000E+04
	1013	2	SHAPE FUNCTION	3.44499722E-02	3.445E+00	1.000E-02	1.000E+04
	1013	3	SHAPE FUNCTION	1.56959426E-02	1.570E+00	1.000E-02	1.000E+04
	1013	4	SHAPE FUNCTION	7.57323951E-02	7.573E+00	1.000E-02	1.000E+04
AFT INBOARD	1069	1	SHAPE FUNCTION	2.93239262E-02	2.932E+00	1.000E-02	1.000E+04
	1069	2	SHAPE FUNCTION	2.82925218E-02	2.829E+00	1.000E-02	1.000E+04
	1069	3	SHAPE FUNCTION	1.72812399E-02	1.728E+00	1.000E-02	1.000E+04
	1069	4	SHAPE FUNCTION	7.83018693E-02	7.830E+00	1.000E-02	1.000E+04
	1087	1	SHAPE FUNCTION	3.14333178E-02	3.143E+00	1.000E-02	1.000E+04
	1087	2	SHAPE FUNCTION	2.24210452E-02	2.242E+00	1.000E-02	1.000E+04
	1087	3	SHAPE FUNCTION	1.49598559E-02	1.496E+00	1.000E-02	1.000E+04
	1087	4	SHAPE FUNCTION	8.69629681E-02	8.696E+00	1.000E-02	1.000E+04
	1093	1	SHAPE FUNCTION	2.75630672E-02	2.756E+00	1.000E-02	1.000E+04
	1093	2	SHAPE FUNCTION	2.82750204E-02	2.828E+00	1.000E-02	1.000E+04
	1093	3	SHAPE FUNCTION	2.07453668E-02	2.075E+00	1.000E-02	1.000E+04
	1093	4	SHAPE FUNCTION	6.10954352E-02	6.110E+00	1.000E-02	1.000E+04
FWD OUTBOARD	1109	1	SHAPE FUNCTION	2.83731669E-02	2.837E+00	1.000E-02	1.000E+04
	1109	2	SHAPE FUNCTION	1.84365623E-02	1.844E+00	1.000E-02	1.000E+04
	1109	3	SHAPE FUNCTION	1.44306235E-02	1.443E+00	1.000E-02	1.000E+04
	1109	4	SHAPE FUNCTION	7.71053359E-02	7.711E+00	1.000E-02	1.000E+04
	1131	1	SHAPE FUNCTION	2.23454032E-02	2.235E+00	1.000E-02	1.000E+04
	1131	2	SHAPE FUNCTION	1.33015122E-02	1.330E+00	1.000E-02	1.000E+04
	1131	3	SHAPE FUNCTION	1.21136243E-02	1.211E+00	1.000E-02	1.000E+04
	1131	4	SHAPE FUNCTION	6.27645105E-02	6.276E+00	1.000E-02	1.000E+04
	1133	1	SHAPE FUNCTION	2.00759023E-02	2.008E+00	1.000E-02	1.000E+04
	1133	2	SHAPE FUNCTION	1.67218074E-02	1.672E+00	1.000E-02	1.000E+04
	1133	3	SHAPE FUNCTION	1.54921738E-02	1.549E+00	1.000E-02	1.000E+04
	1133	4	SHAPE FUNCTION	4.76479344E-02	4.765E+00	1.000E-02	1.000E+04
AILERON INBOARD	1075	1	SHAPE FUNCTION	5.99399731E-02	5.994E+00	1.000E-02	1.000E+04
	1075	2	SHAPE FUNCTION	2.54514255E-02	2.545E+00	1.000E-02	1.000E+04
	1075	3	SHAPE FUNCTION	2.17562374E-02	2.176E+00	1.000E-02	1.000E+04
	1075	4	SHAPE FUNCTION	2.64778994E-02	2.648E+00	1.000E-02	1.000E+04
OUTBOARD	1135	1	SHAPE FUNCTION	5.80431446E-02	5.804E+00	1.000E-02	1.000E+04
	1135	2	SHAPE FUNCTION	2.40453724E-02	2.405E+00	1.000E-02	1.000E+04
	1135	3	SHAPE FUNCTION	2.10027713E-02	2.100E+00	1.000E-02	1.000E+04
	1135	4	SHAPE FUNCTION	2.46874746E-02	2.469E+00	1.000E-02	1.000E+04
UPPER WING SKIN							
FWD INBOARD	1204	1	SHAPE FUNCTION	3.18988040E-02	3.190E+00	1.000E-02	1.000E+04
	1204	2	SHAPE FUNCTION	5.74621074E-02	5.746E+00	1.000E-02	1.000E+04
	1204	3	SHAPE FUNCTION	1.02566732E-02	1.026E+00	1.000E-02	1.000E+04
	1204	4	SHAPE FUNCTION	1.04608662E-01	1.046E+01	1.000E-02	1.000E+04
	1210	1	SHAPE FUNCTION	4.13883142E-02	4.139E+00	1.000E-02	1.000E+04
	1210	2	SHAPE FUNCTION	5.86006679E-02	5.860E+00	1.000E-02	1.000E+04
	1210	3	SHAPE FUNCTION	1.53195160E-02	1.532E+00	1.000E-02	1.000E+04
	1210	4	SHAPE FUNCTION	9.54787210E-02	9.548E+00	1.000E-02	1.000E+04
	1214	1	SHAPE FUNCTION	4.68544848E-02	4.685E+00	1.000E-02	1.000E+04
	1214	2	SHAPE FUNCTION	5.97199090E-02	5.972E+00	1.000E-02	1.000E+04
	1214	3	SHAPE FUNCTION	1.83139592E-02	1.831E+00	1.000E-02	1.000E+04
	1214	4	SHAPE FUNCTION	9.02916640E-02	9.029E+00	1.000E-02	1.000E+04
AFT INBOARD	1270	1	SHAPE FUNCTION	3.57796662E-02	3.578E+00	1.000E-02	1.000E+04
	1270	2	SHAPE FUNCTION	5.23134582E-02	5.231E+00	1.000E-02	1.000E+04
	1270	3	SHAPE FUNCTION	2.64419969E-02	2.644E+00	1.000E-02	1.000E+04
	1270	4	SHAPE FUNCTION	8.41365829E-02	8.414E+00	1.000E-02	1.000E+04

W382 STOVL FUS/WING2/POD STRUC // WING CANARD FUSELAGE AERO (O2K)
 RH HALF MODEL SPARS PERPENDICULAR TO CENTERLINE - CANARD 24IN FWD
 FLUTTER M = 1.5 15000 FT ADD VERTICAL AERO BARS ON PODS

ASTROS VERSION 4 10/14/89 P. 53
 ASTROS ITERATION 5

SUMMARY OF LOCAL DESIGN VARIABLES - ITERATION 5
 ACTIVE QD MEM 1 & TR MEM ELEMENTS

	EID	LAYER	LINKING OPTION	THICKNESS	T/TMIN	MINIMUM	MAXIMUM
	1288	1	SHAPE FUNCTION	2.45045722E-02	2.450E+00	1.000E-02	1.000E+04
	1288	2	SHAPE FUNCTION	4.74175736E-02	4.742E+00	1.000E-02	1.000E+04
	1288	3	SHAPE FUNCTION	2.60954760E-02	2.61E+00	1.000E-02	1.000E+04
	1288	4	SHAPE FUNCTION	8.47576559E-02	8.476E+00	1.000E-02	1.000E+04
	1294	1	SHAPE FUNCTION	3.99445407E-02	3.994E+00	1.000E-02	1.000E+04
	1294	2	SHAPE FUNCTION	4.97165797E-02	4.972E+00	1.000E-02	1.000E+04
	1294	3	SHAPE FUNCTION	3.44082825E-02	3.441E+00	1.000E-02	1.000E+04
	1294	4	SHAPE FUNCTION	6.99720830E-02	6.997E+00	1.000E-02	1.000E+04
	1310	1	SHAPE FUNCTION	2.05080248E-02	2.051E+00	1.000E-02	1.000E+04
	1310	2	SHAPE FUNCTION	4.15240750E-02	4.152E+00	1.000E-02	1.000E+04
	1310	3	SHAPE FUNCTION	2.94012111E-02	2.940E+00	1.000E-02	1.000E+04
	1310	4	SHAPE FUNCTION	7.39749372E-02	7.397E+00	1.000E-02	1.000E+04
FWD OUTBOARD	1332	1	SHAPE FUNCTION	1.59089323E-02	1.591E+00	1.000E-02	1.000E+04
	1332	2	SHAPE FUNCTION	3.39544713E-02	3.395E+00	1.000E-02	1.000E+04
	1332	3	SHAPE FUNCTION	3.07488199E-02	3.075E+00	1.000E-02	1.000E+04
	1332	4	SHAPE FUNCTION	6.01092614E-02	6.011E+00	1.000E-02	1.000E+04
AFT OUTBOARD	1334	1	SHAPE FUNCTION	2.49285363E-02	2.493E+00	1.000E-02	1.000E+04
	1334	2	SHAPE FUNCTION	3.52940261E-02	3.529E+00	1.000E-02	1.000E+04
	1334	3	SHAPE FUNCTION	3.56043540E-02	3.560E+00	1.000E-02	1.000E+04
	1334	4	SHAPE FUNCTION	5.14714047E-02	5.147E+00	1.000E-02	1.000E+04

	ELEMENT-ID	LAYER	LINKING OPTION	THICKNESS	T/TMIN	MINIMUM	MAXIMUM
RIBS 1 & 2	1502	1	SHAPE FUNCTION	7.45861679E-02	1.865E+00	4.000E-02	1.000E+04
RIBS 3 & 4	1532	1	SHAPE FUNCTION	7.39873946E-02	1.850E+00	4.000E-02	1.000E+04
RIBS 5 & 6 & 7	1552	1	SHAPE FUNCTION	7.03093112E-02	1.758E+00	4.000E-02	1.000E+04
LEADING EDGE SPAR	1601	1	SHAPE FUNCTION	6.88691884E-02	1.722E+00	4.000E-02	1.000E+04
	1607	1	SHAPE FUNCTION	6.97002932E-02	1.743E+00	4.000E-02	1.000E+04
INTERMEDIATE SPARS 1 & 2	1611	1	SHAPE FUNCTION	6.98277503E-02	1.746E+00	4.000E-02	1.000E+04
	1624	1	SHAPE FUNCTION	6.96658343E-02	1.742E+00	4.000E-02	1.000E+04
INTERMEDIATE SPAR 3	1631	1	SHAPE FUNCTION	6.14664555E-02	1.537E+00	4.000E-02	1.000E+04
	1635	1	SHAPE FUNCTION	6.41137287E-02	1.603E+00	4.000E-02	1.000E+04
INTERMEDIATE SPAR 4	1641	1	SHAPE FUNCTION	7.19065145E-02	1.798E+00	4.000E-02	1.000E+04
	1646	1	SHAPE FUNCTION	7.11065307E-02	1.778E+00	4.000E-02	1.000E+04
INTERMEDIATE SPAR 5	1651	1	SHAPE FUNCTION	1.45168245E-01	3.629E+00	4.000E-02	1.000E+04
	1657	1	SHAPE FUNCTION	1.11664914E-01	2.792E+00	4.000E-02	1.000E+04
INTERMEDIATE SPAR 6	1664	1	SHAPE FUNCTION	6.48106262E-02	1.620E+00	4.000E-02	1.000E+04
	1667	1	SHAPE FUNCTION	6.46348521E-02	1.616E+00	4.000E-02	1.000E+04
FWD FUSELAGE BOTTOM SKIN	2001	1	SHAPE FUNCTION	7.67434016E-02	1.919E+00	4.000E-02	1.000E+04
	2102	1	SHAPE FUNCTION	7.30452016E-02	1.826E+00	4.000E-02	1.000E+04
	2161	1	SHAPE FUNCTION	6.47592694E-02	1.619E+00	4.000E-02	1.000E+04
SIDE SKIN	2004	1	SHAPE FUNCTION	2.11828902E-01	5.296E+00	4.000E-02	1.000E+04
	2104	1	SHAPE FUNCTION	2.51223177E-01	6.281E+00	4.000E-02	1.000E+04
	2164	1	SHAPE FUNCTION	3.09698850E-01	7.742E+00	4.000E-02	1.000E+04
TOP SKIN FWD OF COCKPIT	2010	1	SHAPE FUNCTION	1.20588139E-01	3.015E+00	4.000E-02	1.000E+04
	2090	1	SHAPE FUNCTION	1.20724075E-01	3.018E+00	4.000E-02	1.000E+04
TOP SKIN AFT OF COCKPIT	2171	1	SHAPE FUNCTION	9.84373614E-02	2.461E+00	4.000E-02	1.000E+04
	2174	1	SHAPE FUNCTION	9.83484909E-02	2.459E+00	4.000E-02	1.000E+04
RND 175	2201	1	SHAPE FUNCTION	1.00347213E-01	2.509E+00	4.000E-02	1.000E+04
RND 195	2221	1	SHAPE FUNCTION	1.00017168E-01	2.500E+00	4.000E-02	1.000E+04
RND 228	2232	1	SHAPE FUNCTION	1.00075342E-01	2.502E+00	4.000E-02	1.000E+04
RND 269	2261	1	SHAPE FUNCTION	1.29964203E-01	3.249E+00	4.000E-02	1.000E+04
RND 282	2271	1	SHAPE FUNCTION	1.00725397E-01	2.518E+00	4.000E-02	1.000E+04
COCKPIT FLOOR	2301	1	SHAPE FUNCTION	1.01593100E-01	2.540E+00	4.000E-02	1.000E+04
	2311	1	SHAPE FUNCTION	1.28568038E-01	3.214E+00	4.000E-02	1.000E+04
	2317	1	SHAPE FUNCTION	1.58147722E-01	3.954E+00	4.000E-02	1.000E+04
CENTER FUSELAGE BOTTOM SKIN	3001	1	SHAPE FUNCTION	1.08814351E-01	2.720E+00	4.000E-02	1.000E+04
	3041	1	SHAPE FUNCTION	1.18270814E-01	2.957E+00	4.000E-02	1.000E+04
	3101	1	SHAPE FUNCTION	1.39609411E-01	3.490E+00	4.000E-02	1.000E+04

N382 STOVL FUS/WING2/POD STRUC // WING CANARD FUSELAGE AERO (02K)
 RH HALF MODEL SPARS PERPENDICULAR TO CENTERLINE - CANARD 24IN PWD
 FLUTTER M = 1.5 15000 FT ADD VERTICAL AERO BARS ON PODS

ASTROS VERSION 4 10/14/89 P. 54
 ASTROS ITERATION 5

SUMMARY OF LOCAL DESIGN VARIABLES - ITERATION 5
 ACTIVE QUAD4 & TRIA3 ELEMENTS

	EID	LAYER	LINKING OPTION	THICKNESS	T/TMIN	MINIMUM	MAXIMUM
SIDE SKIN	3005	1	SHAPE FUNCTION	1.14072822E-01	2.852E+00	4.000E-02	1.000E+04
	3045	1	SHAPE FUNCTION	1.17169149E-01	2.929E+00	4.000E-02	1.000E+04
	3105	1	SHAPE FUNCTION	1.25590980E-01	3.140E+00	4.000E-02	1.000E+04
TOP SKIN	3008	1	SHAPE FUNCTION	1.09470971E-01	2.737E+00	4.000E-02	1.000E+04
	3053	1	SHAPE FUNCTION	1.19128324E-01	2.978E+00	4.000E-02	1.000E+04
	3112	1	SHAPE FUNCTION	1.40676320E-01	3.517E+00	4.000E-02	1.000E+04
BHD 330	3121	1	SHAPE FUNCTION	1.00424327E-01	2.511E+00	4.000E-02	1.000E+04
BHD 360	3141	1	SHAPE FUNCTION	1.02676034E-01	2.567E+00	4.000E-02	1.000E+04
BHD 390	3161	1	SHAPE FUNCTION	1.54217646E-01	3.855E+00	4.000E-02	1.000E+04
BHD 420	3191	1	SHAPE FUNCTION	1.07069001E-01	2.677E+00	4.000E-02	1.000E+04
BHD 454	3221	1	SHAPE FUNCTION	9.98710543E-02	2.497E+00	4.000E-02	1.000E+04
BHD 475	3251	1	SHAPE FUNCTION	1.45064816E-01	3.627E+00	4.000E-02	1.000E+04
FUEL TANK FLOOR	3271	1	SHAPE FUNCTION	9.72153917E-02	2.430E+00	4.000E-02	1.000E+04
	3281	1	SHAPE FUNCTION	1.17692359E-01	2.942E+00	4.000E-02	1.000E+04
ENGINE INLET OML SKIN	3304	1	SHAPE FUNCTION	9.84626710E-02	2.462E+00	4.000E-02	1.000E+04
	3352	1	SHAPE FUNCTION	1.33438110E-01	3.336E+00	4.000E-02	1.000E+04
INLET FRAMES							
1	3361	1	SHAPE FUNCTION	1.03164904E-01	2.579E+00	4.000E-02	1.000E+04
2	3381	1	SHAPE FUNCTION	1.78517848E-01	4.463E+00	4.000E-02	1.000E+04
3	3401	1	SHAPE FUNCTION	3.00445348E-01	7.511E+00	4.000E-02	1.000E+04
RAILS DUCT TUNNEL	3801	1	SHAPE FUNCTION	5.60697801E-02	1.402E+00	4.000E-02	1.000E+04
	3831	1	SHAPE FUNCTION	5.03776425E-02	1.509E+00	4.000E-02	1.000E+04
INLET IML SKIN	3902	1	SHAPE FUNCTION	4.98026945E-02	1.245E+00	4.000E-02	1.000E+04
	3981	1	SHAPE FUNCTION	8.01287889E-02	2.003E+00	4.000E-02	1.000E+04
AFT FUSELAGE							
BOTTOM SKIN	4001	1	SHAPE FUNCTION	8.34149271E-02	2.085E+00	4.000E-02	1.000E+04
	4041	1	SHAPE FUNCTION	9.22776312E-02	2.307E+00	4.000E-02	1.000E+04
	4081	1	SHAPE FUNCTION	1.07954949E-01	2.699E+00	4.000E-02	1.000E+04
SIDE SKIN	4004	1	SHAPE FUNCTION	8.30065459E-02	2.075E+00	4.000E-02	1.000E+04
	4044	1	SHAPE FUNCTION	9.14109722E-02	2.285E+00	4.000E-02	1.000E+04
	4084	1	SHAPE FUNCTION	1.06483877E-01	2.662E+00	4.000E-02	1.000E+04
TOP SKIN	4010	1	SHAPE FUNCTION	9.74599123E-02	2.436E+00	4.000E-02	1.000E+04
	4050	1	SHAPE FUNCTION	9.88721699E-02	2.472E+00	4.000E-02	1.000E+04
	4090	1	SHAPE FUNCTION	1.04077317E-01	2.602E+00	4.000E-02	1.000E+04
BHD 495	4101	1	SHAPE FUNCTION	3.69270295E-01	9.232E+00	4.000E-02	1.000E+04
	4107	1	SHAPE FUNCTION	3.70166600E-01	9.254E+00	4.000E-02	1.000E+04
	4113	1	SHAPE FUNCTION	3.71722668E-01	9.293E+00	4.000E-02	1.000E+04
FRAME 520	4121	1	SHAPE FUNCTION	2.44615778E-01	6.115E+00	4.000E-02	1.000E+04
BHD 545	4141	1	SHAPE FUNCTION	4.43633884E-01	1.109E+01	4.000E-02	1.000E+04
	4146	1	SHAPE FUNCTION	4.44488078E-01	1.111E+01	4.000E-02	1.000E+04
	4152	1	SHAPE FUNCTION	4.46148127E-01	1.115E+01	4.000E-02	1.000E+04
BHD 581	4181	1	SHAPE FUNCTION	3.03169489E-01	7.579E+00	4.000E-02	1.000E+04
	4186	1	SHAPE FUNCTION	3.02887261E-01	7.572E+00	4.000E-02	1.000E+04
	4192	1	SHAPE FUNCTION	3.02400887E-01	7.560E+00	4.000E-02	1.000E+04
FRAME 648.5	4201	1	SHAPE FUNCTION	1.12922318E-01	2.823E+00	4.000E-02	1.000E+04
MLG/VERTICAL FIN POD							
OML SKINS	5001	1	SHAPE FUNCTION	1.47071481E-01	3.677E+00	4.000E-02	1.000E+04
	5061	1	SHAPE FUNCTION	1.43629149E-01	3.591E+00	4.000E-02	1.000E+04
	5063	1	SHAPE FUNCTION	1.43629149E-01	3.591E+00	4.000E-02	1.000E+04
	5069	1	SHAPE FUNCTION	1.43629149E-01	3.591E+00	4.000E-02	1.000E+04
	5141	1	SHAPE FUNCTION	1.39421850E-01	3.486E+00	4.000E-02	1.000E+04
BHDS 545 581	5201	1	SHAPE FUNCTION	1.00724898E-01	2.518E+00	4.000E-02	1.000E+04
BHDS 615 633	5241	1	SHAPE FUNCTION	1.54409364E-01	3.860E+00	4.000E-02	1.000E+04
BHDS 655 680 695	5281	1	SHAPE FUNCTION	6.92035407E-02	1.730E+00	4.000E-02	1.000E+04
BHDS 735 751	5341	1	SHAPE FUNCTION	8.90274793E-02	2.226E+00	4.000E-02	1.000E+04

N382 STOVL FUS/WING2/POD STRUC // WING CANARD FUSELAGE AERO (O2K) ASTROS VERSION 4 10/14/89 P. 55
 RH HALF MODEL SPARS PERPENDICULAR TO CENTERLINE - CANARD 24IN FWD ASTROS ITERATION 5
 FLUTTER M = 1.5 15000 FT ADD VERTICAL AERO BARS ON PODS

SUMMARY OF LOCAL DESIGN VARIABLES — ITERATION 5
 ACTIVE ROD ELEMENTS

	EID	LINKING OPTION	AREA	MINIMUM	MAXIMUM
LONGERONS AND STIFFENERS					
FWD FUSELAGE LONGERONS					
LOWER	2501	SHAPE FUNCTION	1.64299205E-01	1.200E-01	1.000E+04
	2511	SHAPE FUNCTION	1.62921518E-01	1.200E-01	1.000E+04
UPPER	2521	SHAPE FUNCTION	4.71130490E-01	1.200E-01	1.000E+04
	2531	SHAPE FUNCTION	5.64775348E-01	1.200E-01	1.000E+04
CENTER FUSELAGE LONGERONS					
LOWER	3501	SHAPE FUNCTION	1.79392830E-01	1.200E-01	1.000E+04
	3506	SHAPE FUNCTION	1.81376308E-01	1.200E-01	1.000E+04
UPPER	3511	SHAPE FUNCTION	1.94491833E-01	1.200E-01	1.000E+04
	3516	SHAPE FUNCTION	1.95437089E-01	1.200E-01	1.000E+04
DORSAL	3521	SHAPE FUNCTION	1.54374838E-01	1.200E-01	1.000E+04
	3526	SHAPE FUNCTION	1.55407414E-01	1.200E-01	1.000E+04
INLET LOWER	3551	SHAPE FUNCTION	1.51839986E-01	1.200E-01	1.000E+04
	3557	SHAPE FUNCTION	1.52759105E-01	1.200E-01	1.000E+04
INLET UPPER	3561	SHAPE FUNCTION	1.51585266E-01	1.200E-01	1.000E+04
	3567	SHAPE FUNCTION	1.51996478E-01	1.200E-01	1.000E+04
AFT FUSELAGE					
LOWER LONGERON	4501	SHAPE FUNCTION	1.55754492E-01	1.200E-01	1.000E+04
	4505	SHAPE FUNCTION	1.56366199E-01	1.200E-01	1.000E+04
UPPER LONGERON	4511	SHAPE FUNCTION	1.54315248E-01	1.200E-01	1.000E+04
	4515	SHAPE FUNCTION	1.54939950E-01	1.200E-01	1.000E+04
LOWER WING LUG STIFFENER	4531	SHAPE FUNCTION	1.48471281E-01	1.200E-01	1.000E+04
	4534	SHAPE FUNCTION	1.48246557E-01	1.200E-01	1.000E+04
UPPER WING LUG STIFFENER	4541	SHAPE FUNCTION	1.50670201E-01	1.200E-01	1.000E+04
	4544	SHAPE FUNCTION	1.50842860E-01	1.200E-01	1.000E+04
MLG/VERTICAL FIN POD STIFFENERS					
TOP/BOTTOM	5502	SHAPE FUNCTION	1.59251675E-01	1.200E-01	1.000E+04
SIDE	5522	SHAPE FUNCTION	1.47056922E-01	1.200E-01	1.000E+04