



# THE DESIGN AND SIMILATION OF A TAKEOFF STABILIZATION SYSTEM FOR AN AIRCRAFT WITH AN AIR CUSHION LANDING SYSTEM

THESIS

GE/EE/77D-43

Edward A. Kenney Captain CAF

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THE DESIGN AND SIMULATION OF A TAKEOFF STABILIZATION SYSTEM FOR AN AIRCRAFT WITH AN AIR CUSHION LANDING SYSTEM

#### THESIS

Presented to the Faculty of the School of Engineering of the Air Force Institute of Technology

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#### Preface

When the Air Cushion System replaced the conventional takeoff and landing systems of the Jindivik remotely piloted vehicle, the possibility existed that instabilities in pitch, roll, and yaw could occur. As a result, this paper was intended as a design of a Takeoff Stabilization System for the Jindivik using existing autopilot sensors and incorporating an engine yaw thruster and vertical wing tip roll thrusters. When the design was completed, it was sufficiently general that the technique could be applied to any air cushion aircraft or VTOL aircraft. The Landing Stabilization System for the Jindivik using the same sensors and actuators is presently being designed by Captain Max Stafford as his thesis for the Air Force Institute of Technology (AFIT).

I wish to express my gratitude to my Thesis advisors, Dr. George Kurylowich of the Air Force Flight Dynamics Laboratory (AFFDL) and Major R. Potter of AFIT. Also, thanks are due to Captain James Negro of AFIT, Major Jack Randall and Mr. Jim Steiger of the Air Force Flight Dynamics Laboratory for their technical advice and assistance.

My wife, Jane, does not know how much she has contributed to this study, but her patience, understanding, and encouragement has definitely made the past eighteen months of work much easier. Edward Kenney

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#### List of Symbols

All symbols are in ft-lb-sec units unless indicated to the contrary.

# Alphanumeric Symbols Symbol Definition A Area $= b^2$ AR Aspect Ratio a Horizontal distance between the inner and outer trunk attachment points Ь Wing span С Wing chord CD Drag coefficient Coo Drag coefficient for zero angle of attack and zero elevator angle $= \frac{\partial C_{\rm D}}{\partial x}$ Cor Variation of drag coefficient with angle of attack CG Centre of gravity (of aircraft) CL Lift coefficient द्ग 5

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AFIT/GE/EE/77D-43 Symbol Definition CLO Lift coefficient for zero angle of attack and zero elevator angle  $= \frac{2U}{C} \frac{\partial C_{1}}{\partial q}$ Cré Variation of lift coefficient with pitch rate CLE Coefficient of lift of the tail CLK  $=\frac{\partial C_{L}}{\partial \alpha}$ Aircraft lift curve slope CLKF Lift curve slope of the vertical stabilizer CLE Lift curve slope of the horizontal stabilizer CLK2-D Theoretical two dimensional lift -curve slope of an airfoil at 0° absolute  $= \frac{2U}{C} \frac{\partial C_{L}}{\partial z}$ Ciz Variation of lift coefficient with rate of change of angle of attack Cł Cłp  $=\frac{\chi}{\overline{q}Sb}$ Rolling moment coefficient  $= \frac{2U}{b} \frac{\partial C_{L}}{\partial P}$ Variation of rolling moment coefficient with roll rate

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# Definition

Cer	$= \frac{2U}{n} \frac{\partial C_{L}}{\partial r}$	Variation of rolling moment coefficient with yaw rate
Cep	$= \frac{\partial C_L}{\partial \beta}$	Variation of rolling moment coefficient with sideslip angle
Cm Cmg	$=\frac{2n}{\bar{a}sc}$	Pitching moment coefficient
Cmq	$= \frac{2U}{C} \frac{\partial C_m}{\partial q}$	Variation of pitching moment coefficient with pitch rate
Cmz	$= \frac{2U}{C} \frac{\partial C_m}{\partial a}$	Variation of pitching moment coefficient with rate of change of angle of attack
Cm	$= \frac{n}{\overline{a}5b}$	Yawing moment coefficient
Стр	$= \frac{2U}{b} \frac{\partial C_m}{\partial p}$	Variation of yawing moment coefficient with roll rate
Ств	$= \frac{\partial C_n}{\partial \beta}$	Variation of yawing moment coefficient with sideslip angle
Cy Cyf	$= \frac{F_{y}}{\overline{q}'S}$	Side force coefficient
Cyf		Side force coefficient for the vertical stabilizer

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 $= \frac{2U}{b} \frac{\partial C_{Y}}{\partial p}$ 

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 $= \frac{2U}{b} \frac{\partial C_{y}}{\partial r}$ 

Cyp.  $= \frac{\partial C_{y}}{\partial \beta}$ 

Definition

Variation of side force coefficient with roll rate

Variation of side force coefficient with yaw rate

Variation of side force coefficient with sideslip angle

Drag

Distance between trunk inner attachment points

#### Force

Aerodynamic force in the x direction

Aerodynamic force in the y direction

Aerodynamic force in the z direction

Trunk damping force

Force from the roll thrusters

1x

Fx

Fxext

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Definition

Force in the x direction

External force in the x direction

Force in the y direction

External force in the y direction

Force from the yaw thrusters

Force in the z direction

External force in the z direction

Acceleration due to gravity

Distance between the ground tangent points on the sides of the-trunk

Height of trunk cross section

Incidence angle of the horizontal stabilizer

x

AFIT/GE/EE/77D-43 Symbol	Definition
I <sub>XX</sub>	Roll moment of inertia of the aircraft about the CG
Ixz	Product of inertia of the aircraft about the CG
Iyy	Pitch moment of inertia of the aircraft about the CG
Izz	Yaw moment of inertia of the aircraft about the CG
k	$C_L^2$ coefficient from drag polar
L	Lift
Ls	Length of the straight part of the trunk
<u></u>	Rolling moment
Σ <sub>A</sub> L <sub>ext</sub>	Aerodynamic rolling moment
	External rolling moment
LTHRUSTERS , LT	Rolling moment of the roll thrusters
	xi

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Lw

 $= \frac{b}{2}$ 

#### Definition

Distance from CG to mean aerodynamic chord of vertical stabilizer

Peripheral distance from inner trunk attachment to first row of trunk orifices

Distance from CG to mean aerodynamic chord of horizontal stabilizer

Length of one wing

Number of straight trunk segments in one quarter of trunk periphery

Mass

Pitching moment

Aerodynamic pitching moment

External pitching moment

Number of curved trunk segments in one quarter of trunk periphery

M

m

M

 $\mathcal{M}_{A}$ 

MEXT

Ν

# Definition

Number of trunk orifices per row

Number of rows of trunk orifices

Yawing moment

Aerodynamic yawing moment

External yawing moment

Yawing moment produced by yaw thrusters

1. Roll rate (about x axis) 2. Pressure

Atmospheric pressure

#### Average pressure

Cushion pressure

Trunk pressure

Pitch rate (about y axis)

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## Definition

Dynamic pressure

Yaw rate (about z axis)

Reference area (wing)

Vertical stabilizer reference area

Horizontal stabilizer reference area

Roll thruster switching curve

Yaw thruster switching curve

Trunk loop tension force

Time

Initial time

Final time

Velocity of CG along x axis

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#### Definition

Control variable

Maximum roll control

Maximum yaw thruster control

Velocity of CG along y axis (aircraft)

Trunk vertical velocity

Velocity of CG along z axis (aircraft)

Distance of trunk segment centre from CG along vehicle x axis

Distance along wing

Distance of trunk segment centre from CG along vehicle y axis

Mean height of the vertical stabilizer

XV

Greek Symbols

Symbol .

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#### Definition

Angle of attack of aircraft

Angle of attack of vertical stabilizer

- Sideslip angle
   Angle subtended by curved trunk segment from trunk centre of curvature

Downwash angle

Elevator angle

Flap angle

Angle of trunk curved segment from centre of curvature

Side excursion of trunk

Width of straight trunk segment

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Sweep angle of leading edge of wing (or horizontal stabilizer)

xvi

# Symbol

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## Definition

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 $\phi$ 

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Mathematical symbol meaning a small change

Air density

Pitch attitude angle

Inclination angle of lift and drag vectors

Roll angle

.

Yaw angle

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#### Abstract

The inherent instability in pitch and roll associated with an Air Cushion Landing System (ACLS) aircraft at low airspeeds was investigated, and a means to aid control in pitch and roll was developed. The control system required the use of vertical wing tip thrusters which provided thrust up or down depending on the control signal (similar to space vehicle thrusters). These thrusters could be activated alternately to control roll angle and roll rate with the use of a bang-bang optimal controller. As well, the thrusters would be set forward of the aircraft centre of gravity and could be activated in tandum to aid in pitch control.

The Jindivik Remotely Piloted Vehicle, an Australian target drone, was fitted with an ACLS and taxi tests showed the instability and need for a stabilization system. Subsequent use of Jindivik wind tunnel and taxi test data served as the basis for the development of the roll/pitch control system presented in this paper. Due to computational problems with the air cushion model of the computer program, the controller designs could not be completely verified; but expected trends in pitch, roll and yaw control were shown.

# THE DESIGN OF A TAKEOFF STABILIZATION SYSTEM FOR AN AIRCRAFT WITH AN AIR CUSHION LANDING SYSTEM

#### Chapter I

#### Introduction

In the low speed range of a takeoff roll, the normal aircraft controls are not aerodynamically effective; hence, the pilot must control the heading by differential braking and wait until the ailerons become effective to control roll. During this time, the landing gear dampens most of the pitch and roll oscillations so that the pilot has few corrections to make in the latter part of the takeoff roll. However, when the conventional landing gear is replaced by an Air Cushion Takeoff System (ACTS) the pitch and roll damping is greatly reduced. This paper will use the Jindivík Remotely Piloted Vehicle as an example of an air cushion vehicle that can be controlled in the low speed range with the use of small jet thrusters on the wing tips and a thrust deflector on the tail section.

The Jindivik Remotely Piloted Vehicle (RPV) is an Australian target drone that can be launched and recovered on a runway. At present, the takeoff is accomplished with a takeoff dolly, as shown in Fig. 1, that provides a wing level attitude and directional control. At lift off the Jindivik separates from the dolly and the dolly brakes to a stop. Recovery of the Jindivik is done by landing on a single, four inch wide metal skid attached to the fuselage. Directional control during landing is maintained with the ailerons, the rolling moment thus produced

and a



#### Fig. 1. Jindivik on a Takeoff Dolly

makes the drone ride up onto an edge of the skid and turn in the direction of the roll. For the last twelve years the Australian Air Force has used the Jindivik in this configuration with considerable success.

A joint project by the Australian Air Force and the United States Air Force was initiated in 1972 to incorporate an Air Cushion Landing System on the Jindivik. The objectives of this project were to convert the Jindivik to an all-terrain RPV and to advance air cushion technology. The drone end air cushion are shown in Fig. 2. Initial low speed taxi tests, completed in Australia, show that the aircraft fitted with the air cushion is unstable in roll, pitch, and directional control (yaw) (Ref. 13). Therefore, a Stability Augmentation System (SAS) will have

Fig. 2. Jindivik and Air Cushion Landing System to be designed and incorporated into the autopilot before the RPV is airworthy.

Since the drone was designed to be launched from a directionally controlled dolly, it was not designed with a rudder. Implementation of a rudder during this project would require extensive structural changes and major changes to the autopilot and ground control units. Therefore, a yaw thruster was designed and fitted to the rear of the fuselage to direct the jet exhaust, thus providing a yawing moment. Roll and pitch control will be provided by a vertical roll thruster on the front tip of each wing pod. The roll thrusters will be activated alternately to control rolling moments and in tandum to control pitch. Since the roll thrusters are on the tip

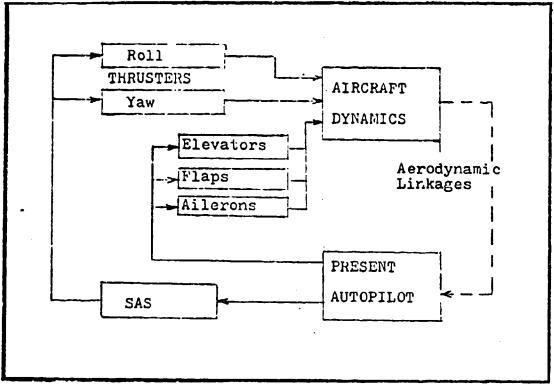


Fig. 3. Block Diagram of Autopilot and SAS Control Units of the wing pods, they are approximately six feet ahead of the centre of gravity of the drone and hence can produce a moment to control the pitch attitude to some degree. As well, the roll thrusters can be directed up or down to counteract positive or negative rolling and pitching moments.

At velocities near fifty knots, the ailerons and flaps become aerodynamically effective and the roll thrusters are phased out to ensure that the vehicle is not overcontrolled. An additional advantage of turning off the roll thrusters is that a smaller gas supply is required for the thrusters. Hence, they can be used with a gas bottle rather than bleed air from the engine. This arrangement will greatly reduce the airframe and engine modifications required for implementation.

The stability augmentation system will be designed to use the existing sensors in the autopilot to control the roll and pitch thrusters. The SAS unit will be placed in the feedback control loop between the autopilot and actuators, as shown in Fig. 3.

This thesis is organized in the following manner: Chapter II develops the equations of motion and aerodynamic stability derivatives, Chapter III describes the air cushion model, Chapter IV discusses the controller design, Chapter V contains a description of the computer program and the simulation results, and Chapter VI the conclusions and recommendations.

#### Chapter II

#### The Determination and Solution of the Jindivik Equations of Motion

The following six simultaneous non-linear differential equations fully describe the motion of the Jindivik RPV. The positive sense of the variables is in the direction of the arrows in Fig. 4.

$$m(\dot{u} - \vee R + \Psi Q) = -mg \sin \Theta + F_{AX} + F_{X \in XT}$$
<sup>(1)</sup>

$$m(\ddot{v} + UR - WP) = mgsiN\phi cos\phi + F_{Ay} + F_{YEXT}$$
<sup>(2)</sup>

$$m(\dot{w} - UQ + VP) = mg\cos\phi\cos\phi + FAZ + FZEXT$$
 (3)

$$I_{AA}\dot{P} - I_{XZ}\dot{R} - I_{XZ}PQ + (I_{ZZ} - I_{YY})RQ = \mathcal{L}_{A} + \mathcal{L}_{EXT}$$
(4)

$$I_{yy} \hat{Q} + (I_{xx} - I_{zz}) PR + I_{xz} (P^2 - R^2) = \mathcal{M}_A + \mathcal{M}_{EXT}$$
 (5)

$$I_{zz}\dot{R} - I_{xz}\dot{P} + (I_{yy} - I_{xx})PQ + I_{xz}QR = \mathcal{N}_{A} + \mathcal{N}_{EXT}$$
(6)

The equations are first order in U, V, W, P, Q, and R with the added kinematic relationships.

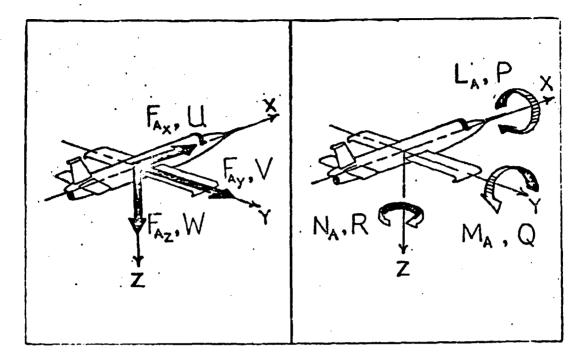
$$P = \dot{\phi} - \dot{\Psi} \sin \Theta \qquad (7)$$

$$Q = \dot{\Theta} \cos \phi + \dot{\Psi} \cos \Theta \sin \phi \qquad (8)$$

$$R = \dot{\Psi} \cos \Theta \cos \phi - \dot{\Theta} \sin \phi \qquad (9)$$

The assumptions used in the derivation of these equations were: (1) the aircraft is a rigid body, (2) the mass of the aircraft is constant for the duration of the analysis, (3) gravity is constant, (4) the earth is an inertial reference, (5) and there is body axis symmetry about the x-z plane (i.e.,  $I_{xy}=O=I_{yz}$ ).

Equations (1) to (9) are included in the subroutines of the "EASY Dynamic Analysis Computer Program to Aircraft Modeling"



# Fig. 4. Definitions of Vector Components in the Equations of Motion

(Ref. 5) which was used to simulate the takeoff motions of the Jindivik. The inputs required by EASY are the mass, inertias, geometry of the aircraft, and the aerodynamic and external forces acting on the drone. The air cushion system is considered to be a prime generator of the external forces and moments (aside from engine forces and moments) and is described in the next chapter. The mass, inertias and geometry are readily available from aircraft blue prints and reference manuals; and the aerodynamic forces and moments can be computed from wind tunnel model data and theoretical methods.

The aerodynamic forces and moments can be written as:

$$L = C_L \overline{q} 5 \tag{10}$$

$$D = C_{\mathbf{D}} \bar{q} S \qquad (11)$$

$$F_{y} = C_{y} \bar{g} S$$
<sup>(12)</sup>

$$\chi = C_{\ell} \bar{q} 5 \tag{13}$$

$$\mathcal{N} = C_m \bar{g} 5 \tag{14}$$

$$\mathcal{M} = C_m \bar{q} 5$$
 (15)

where

$$C_{L} = f(u_{3}x_{3}\dot{x}_{3}g_{3}\delta e_{3}\delta f)$$
 (16)

$$C_{\mathbf{p}} = f(u_{3}u_{3}u_{3}u_{3}g_{3}\delta e_{3}\delta e_{5}) \qquad (17)$$

$$C_{y} = f(\beta, \beta, \rho, r, S_{A})$$
(18)

$$C_{\ell} = f(\beta, \beta, p, r, \delta_{A})$$
(19)

$$C_{n} = f(\beta, \beta, p, r, \delta_{A}) \qquad (20)$$

$$C_m = f(u, x, \dot{x}, g, \delta e, \delta f) \qquad (21)$$

The coefficients  $C_L$ ,  $C_D$ ,  $C_\gamma$ ,  $C_\ell$ ,  $C_R$ , and  $C_M$ are non-dimensional. By determining the coefficients for every flight condition, the aerodynamic forces and moments can be calculated and added to the external forces and moments to produce the aircraft motions. These calculations are done by the EASY program but the program requires all the aerodynamic stability derivatives (all the functional relationships which determine the force and moment coefficients). The remainder of this chapter will deal with the derivation of the stability derivatives. These derivatives are derived in the stability axis system as defined by Blakelock (Ref. 2).

Reference 13 contains wind tunnel data for the Jindivik in various configurations, including one when fitted with the Air Cushion Recovery System (ACRS). The ACRS is the air cushion trunk with which the drone lands, but it also has an Air Cushion Takeoff System (ACTS) trunk with which it takes off. After takeoff, the ACTS is disengaged and drops to the ground. Both trunks are the same shape with the ACTS being about 21% larger in all dimensions. Since no wind tunnel data was available for the ACTS, the data for the ACRS was extrapolated by percentages and assumed to be fairly accurate for the ACTS. An example of the estimation technique is that the increase in the frontal area of the aircraft due to the replacement of the ACRS by the ACTS was 6%; therefore, the values of the coefficient of drag (  $C_{\rm D}$  ) were increased by 7%. Since the trunk does not generate lift, the coefficient of lift (  $C_L$  ) was not affected, nor was the coefficient of side force (  $C_y$  ); symmetry about the x-z axis meant that the coefficient of yawing moment (  $C_{\mathcal{M}}$  ) was not affected. The pitching moment coefficient (  $C_{m}$  ) and rolling moment coefficient (  $C_{\mathcal{L}}$  ) were affected by the percentage that the increased drag affected those moments. Thus,  $C_D$ ,  $C_L$ ,  $C_Y$ ,  $C_R$ ,  $C_m$ , and  $C_n$  can be empirically determined as functions of the angle of attack (  $\prec$  ), the sideslip ( $\beta$ ), and the elevator deflection ( $S_e$ ). In other words  $\frac{\partial C_D}{\partial x}$ ,  $\frac{\partial C_{D}}{\partial B}$ ,  $\frac{\partial C_{D}}{\partial s_{e}}$ ,  $\frac{\partial C_{L}}{\partial \alpha}$ ,  $\frac{\partial C_{L}}{\partial s_{e}}$ ,  $\frac{\partial C_{L}}{\partial B}$ ,  $\frac{\partial C_{R}}{\partial \beta}$ ,  $\frac{\partial C_{R}}{\partial \alpha}$ ,  $\partial C_{AB}$ , and  $\partial C_{AB}$  can be found from the wind tunnel data. Non-dimensional derivatives were calculated because they

provided a means of checking typical values and signs with

Roskam (Ref. 17) and Blakelock (Ref. 2). Before entering the derivatives into the EASY program, they were dimensionalized.

At low airspeeds the heave motion of the air cushion can create angles of attack beyond the stall limit, but at these speeds aerodynamic contributions to the aircraft dynamics are small.

#### Stability Derivative Derivation

<u>C</u>

From a curve of  $C_L$ vs.  $\propto$  of the wind tunnel data it can be shown that

$$C_{L} = C_{L_{0}} + \frac{\partial C_{L}}{\partial \alpha} \propto$$
(22)

 $C_{10}$  and  $C_{L_{4}} \stackrel{o}{=} \frac{\partial C_{L}}{\partial A}$  can be determined directly as the  $C_{L}$  intercept and slope of the curve.

From a drag polar of  $C_{L}$  vs.  $C_{D}$  it can be shown that  $C_{D} = C_{D_{O}} + K C_{L}^{2}$ (23)

where  $C_{D_0}$  and K are determined by a curve fit of wind tunnel data of  $C_D$  and  $C_L$ . Substituting for  $C_L$ 

$$C_{L} = C_{D_{0}} + K(C_{L_{0}} + C_{L_{x}}x)^{2}$$
$$= C_{D_{0}} + K(C_{L_{0}}^{2} + 2C_{L_{0}}C_{L_{x}}x + C_{L_{x}}^{2}x^{2}) \qquad (24)$$

differentiating

$$\frac{\partial C_0}{\partial x} = K \left( 2C_{L_0} C_{L_a} + 2C_{L_a}^2 x \right) \qquad (25)$$
$$= 2K C_{L_a} \left( C_{L_0} + C_{L_a} x \right)$$

$$C_{D_{K}} \stackrel{A}{=} \frac{\partial C_{D}}{\partial \kappa} = 2K C_{L_{K}} C_{L}$$
(26)

Roskam (Ref. 17, pgs 4.12, 1.18, 4.25) shows that for velocities below 300 ft/sec the variation of lift, pitch moment, and drag with velocity is zero. Thus,

$$\frac{\partial C_{D}}{\partial u} = O = \frac{\partial C_{L}}{\partial u} = \frac{\partial C_{m}}{\partial u} \qquad (27)$$

The quantities

$$\frac{\partial C_0}{\partial S_e}$$
,  $\frac{\partial C_0}{\partial S_c}$ ,  $\frac{\partial C_L}{\partial S_c}$ ,  $\frac{\partial C_m}{\partial S_c}$ ,  $\frac{\partial C_m}{\partial$ 

CLX

From Roskam (Ref. 17) it can be shown that the angle of attack of the tail in downwash is

$$\alpha_{+} = \alpha_{-} \mathbf{i} - \mathbf{\epsilon} \tag{28}$$

and for a particular angle of attack

$$\Delta d_{t} = -\Delta E$$

$$= \frac{\partial E}{\partial \alpha} \Delta \alpha$$

$$= \frac{\partial E}{\partial \alpha} \partial \alpha \Delta t$$

$$= \frac{\partial E}{\partial \alpha} \partial \alpha \frac{l_{t}}{U}$$
(29)

now the change in lift coefficient on the tail due to downwash is

$$\Delta C_{Lt} = C_{Lxt} \Delta^{x} t$$
$$= C_{Lxt} \overset{2}{\times} \frac{lt}{U} \frac{d\epsilon}{\partial x}$$
(30)

The change in aircraft lift is

$$\Delta C_{L} = \Delta C_{Lt} \frac{St}{S}$$
(31)

$$\frac{\partial C_{L}}{\partial x} = C_{L_{x_{t}}} \frac{l_{t}}{u} \frac{\partial \epsilon}{\partial x} \frac{S_{t}}{S}$$
(32)

thus 
$$(C_{L2})_{TAHL} \stackrel{\Delta}{=} \frac{\partial C_{L2} U}{\partial z} \stackrel{\Delta}{=} \stackrel{\Delta}{=} C_{LAL} \stackrel{lt}{=} \frac{5t}{5} \frac{\partial E}{\partial x}$$
 (33)

where 
$$C_{L,\ell} = \frac{AR \cos \lambda C_{L,\ell_2-D}}{AR \sqrt{1 + \left(\frac{C_{L,\ell_2-D} \cos \lambda}{TTAR}\right)^2 + \frac{C_{L,\ell_2-D} \cos \lambda}{TT}}}$$
 (34)

$$C_{L_{X_{2-D}}} = 5.73$$
 (35)

 $\lambda$  is sweep angle and AR is aspect ratio (Ref. 7)

The wing contribution to  $C_{L_{x}}$  is considerable but can not be estimated (using Roskam, DATCOM, etc.). So a "typical" value from Roskam of  $C_{L_{x}} \simeq 1.5 \text{ cmd}^{-1}$  was used; fortunately this derivative is of minor importance (Ref. 17, p. 4.114).

Coni

The contribution of the wing was neglected because it will be negligible with respect to the tail contribution. The correction to the pitching moment due to downwash on the tail is

$$(AC_{m})_{TAIL} = -AC_{Lt} \frac{St}{S} \frac{lt}{C}$$
$$= -C_{Lxt} \frac{\partial \epsilon}{\partial x} \frac{2}{C} \frac{lt}{L} \frac{St}{S}$$
(36)

and

$$\frac{\partial C_m}{\partial k} = -\frac{C_{Lut}}{c} \frac{\partial \epsilon}{\partial a} \frac{l_t}{u} \frac{5t}{5}$$
(37)

and

$$C_{m_{x}} \stackrel{\Delta}{=} \frac{2U}{C} \frac{\partial C_{m}}{\partial x} = - \frac{2C_{Lx} + l_{t}^{2} S_{t}}{C^{2} S} \frac{\partial E}{\partial x}$$
(38)

CLQ

 $\mathcal{G}$  changes the angle of attack on the tail by  $\mathcal{GL}$  radians  $\mathcal{U}$  . (for quasistatic conditions)

$$\Delta \alpha_t = \frac{q}{u} \frac{lt}{u} \tag{39}$$

and

now

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$$\Delta C_{L} = \underbrace{S_{t}}_{S} \Delta C_{L_{t}} = \underbrace{S_{t}}_{S} C_{L_{t}} = \underbrace{alt}_{U}$$
(40)

differentiating 
$$(\frac{\partial C_L}{\partial q})_{TAIL} = C_{L_{K_{t}}} \frac{St}{5} \frac{lt}{U}$$
 (41)

and the contribution of the wing body is negligible in comparison to the tail (Ref. 17, p. 153)

$$C_{Lq} \stackrel{\Delta}{=} \frac{24}{C} \frac{\partial C_{L}}{\partial q} = \frac{2C_{LAE} + S_{E} + l_{E}}{CS}$$
 (42)

Conq

The moment on the tail is

and the change in moment due to a change in angle of attack is

$$\Delta \mathcal{M}_{t} = -\bar{q} l_{t} S_{t} \Delta C_{Lt}$$

$$= -\bar{q} l_{t} S_{t} C_{Lt} \Delta d_{t}$$

$$= -\bar{q} \frac{l_{t}^{2} S_{t}}{U} C_{Lt} q$$
(44)

and

$$\Delta C_{mt} = -\frac{g l_t^2 C_{Lat} S_t}{UCS}$$
(45)

$$\begin{pmatrix} \partial C_m \\ \partial g \end{pmatrix}_{\text{TAIL}} = - \frac{l^2 C_{Lut} S_t}{UCS}$$
(46)

since the wing contribution is negligible with respect to the tail (Ref. 17, p. 153)

$$C_{mg} \stackrel{a}{=} \frac{2U}{C} \left( \frac{\partial C_{m}}{\partial g} \right) = - \frac{2l_{t}^{2}C_{La} + S_{t}}{c^{2}S}$$
(47)

<u>**B**</u> Derivatives

Wind tunnel data gave  $C_{\gamma}$ ,  $C_{\ell}$ , and  $C_{m}$  vs.  $\beta$  for values of  $|\beta| \leq 7^{\circ}$ , but in any takeoff with crosswind the sideslip will normally exceed 7°. The normal takeoff procedure will be to initially line the aircraft into the relative wind at the centerline and change the heading as the aircraft gains speed. This procedure should keep  $\beta$  within  $\pm 30^{\circ}$  and the present data can be curve fitted and extrapolated to this value. Consequently, expressions can be obtained for  $C_{\gamma\beta}$ ,  $C_{\ell\beta}$ , and  $C_{m\beta}$  from the data. The  $\beta$  derivatives have been assumed to be zero (Ref. 17). For the  $\beta$ , p, and  $\lambda$  derivatives the effect of sidewash on the tail has been neglected.

D Derivatives

Cnp

The change in  $C_{n}$  from the tail side force due to roll rate p is

$$(\Delta C_m) \operatorname{tacl} = - \frac{\Delta C_{YE} \leq F \int_{F}}{\leq b}$$
$$= - \frac{C_{LKE} p \, \beta_E \leq F \int_{F}}{4 \, \delta b}$$
(48)

$$\left(\frac{\partial C_{m}}{\partial p}\right)_{\text{tail}} = -\frac{C_{L}\alpha_{F}}{USb} \frac{S_{F}}{USb}$$
(49)

where  $\mathcal{J}_{\mathcal{F}}$  is the mean height of the fin, and the effect of sidewash has been neglected

so 
$$(C_{Mp})_{\text{tril}} \stackrel{\text{\tiny def}}{=} \frac{2U}{b} \left( \frac{\partial C_{M}}{\partial P_{\text{tril}}} \right) = - \frac{2C_{LXF} \partial F \int F \int F}{5b^{2}}$$
 (50)

The wing contribution is in two parts due to lift and drag. For positive p the angle of attack is increased on the right wing and decreased on the left; thus inclining and changing the lift and drag vectors of each wing section. The inclination angle is  $\Theta_p = \underbrace{PY}_{U}$  where y is the spanwise coordinate of the section. The change in lift is

$$\Delta_{Laft} = \overline{g} C_{L_X} \Delta_X C dy$$
  
=  $\overline{g} C_{L_X} \frac{py}{u} C dy$  (51)

and

OLright = - & CLX py Cdy (52)

where Cdy is the area of the wing section. So the change in the yawing moment due to lift is

$$\Delta \mathcal{H}_{left} = -Y \Delta L_{left} \underbrace{PY}_{U}$$
(53)

$$\Delta \mathcal{H}_{night} = y \Delta L_{night} \frac{py}{u}$$
(54)

$$\Delta \mathscr{R}_{\text{sections}} = - \frac{2\overline{g}cdy}{u^2} C_{L_{\alpha}} p^2 y^3 \qquad (55)$$

and the total yawing moment of the wing is

and

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$$\frac{\partial R}{\partial p} = -\frac{\overline{q} c p b^4 C_{La}}{16 u^2}$$
(57)

$$(C_{np})_{uing} lift \stackrel{e}{=} \frac{2U}{s\overline{g}b^2} \frac{\partial n}{\partial p} = -\frac{C_{Lx}pb^2c}{85U}$$
(58)

the change in drag is

$$\Delta Def = -\bar{g} C_{D_{\mathcal{X}}} \Delta x \, cdy$$
$$= -\bar{g} C_{D_{\mathcal{X}}} \frac{p_{\mathcal{Y}}}{\mu} \, cdy \qquad (59)$$

the corresponding change in yawing moment is

$$\Delta \mathcal{M}_{eft} = \mathcal{Y} \frac{\bar{q} c C_{D_{\alpha}} p \mathcal{Y} dy}{\mathcal{U}}$$
(61)

$$\Delta \mathcal{H}_{night} = \overline{g} \underbrace{C_{D_{x}} p y^{2} c dy}_{u} \qquad (62)$$

 $\Delta \mathscr{N}_{\text{sections}} = 2 \overline{g} C_{0\chi} p y^2 c dy \qquad (63)$ 

and

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Û

and

and

$$\Delta \mathcal{N}_{ttel} = 2\bar{g} \frac{c C_{DA} p \int_{0}^{b} y^{2} dy}{u}$$
$$= \frac{\bar{g} c C_{DA} p b^{3}}{12u}$$
(64)

now

$$= \frac{g_c C_{o_a} b^3}{12u}$$
(65)

ب اب ا

and

 $\frac{\partial \mathcal{N}}{\partial p} = \frac{\overline{g}_{c} C_{oa} b}{12u}$   $(C_{mp}) duag \stackrel{e}{=} \frac{2u}{S\overline{g} b^{2}} \frac{\partial \mathcal{N}}{\partial p} = \frac{C_{ba} bc}{6S}$ (66)

summing all effects  

$$C_{Mp} = -\frac{2C_{LKF} \partial_F l_F S_F}{5b^2} - \frac{C_{LK} p b x}{8U x} + \frac{C_{DK} b x}{6 x}$$

$$= -\frac{2C_{LKF} \partial_F l_F S_F}{5b^2} - \frac{C_{LK} p b}{8U} + \frac{C_{DK}}{6}$$
(67)

Cyp

 $C_{yp}$  is often negligible (Ref. 17, p. 170) and the tail is the major contributor. Let the mean change in angle of attack of the vertical stabilizer (fin) be

$$\Delta x_F = -\frac{P \beta F}{U} \tag{68}$$

where  $\mathcal{J}_F$  is the mean height of the fin

now

$$\Delta C_{yF} = C_{LKF} \Delta K_{F}$$

$$= -C_{LKF} \frac{P_{AF}}{P_{AF}}$$
(69)

so the change on the side force coefficient of the aircraft is (sidewash is neglected)

$$\Delta C_{\gamma} = \frac{S_{F}}{S} \Delta C_{\gamma F} = -\frac{S_{F} \rho A_{F}}{S} C_{L_{d,F}}$$
(70)

$$\frac{\partial C_Y}{\partial P} = -\frac{SF}{S} \frac{\partial F}{U} C_{LAF}$$
(71)

and

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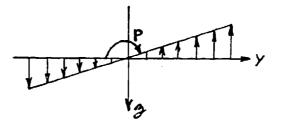
$$C_{yp} = \frac{2U}{b} \frac{\partial C_y}{\partial p} = -\frac{2S_F S_F C_{Ld} F}{S_b}$$
(72)

Clp

The wing is the only major contributor (Ref. 17, p. 170). Etkin (Ref. 9) shows that the rolling velocity, P, produces a change in the angle of attack of each wing section which is proportional to the span, i.e.,

$$\Delta \alpha = \frac{PY}{U}$$
(73)

where  $\gamma$  is the spanwise coordinate of the wing section. Then the lift distribution on the wing due to rolling is estimated to be



Etkin (Ref. 9) changes the triangular lift distribution to a sinusoidal distribution to account for the loss of lift at the wing tips due to spanwise flow around the wing tips. However, since the Jindivik has large tip tanks the lateral airflow will be minimized and the lift distribution will be closer to the triangular distribution shown.

The change in lift will be

$$\Delta L = 2\bar{g}C_{L_{x}}\Delta x cdy$$

$$= 2 \overline{g} C_{La} \frac{C p y}{u} dy \qquad (74)$$

and the change in rolling moment due to this lift will be

$$\Delta \chi = -y \bar{g} C_{La} \frac{c p y}{u} dy \qquad (75)$$

thus

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and

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$$\ell = -\bar{g} \frac{cC_{L_{\alpha}}p}{u} \int_{0}^{\frac{b}{2}} y^{2} dy$$
$$= -\bar{g} \frac{cC_{L_{\alpha}}pb^{3}}{24u}$$
(76)

$$\frac{\partial \mathcal{L}}{\partial p} = -\overline{q} \frac{cCL_{L}b^{2}}{24u}$$
(77)

$$\frac{\partial C_{L}}{\partial p} \stackrel{\Delta}{=} \frac{1}{g_{5b}} \frac{\partial \chi}{\partial p} = \frac{-C_{Lx}b}{\xi} \frac{\partial \chi}{24u}$$
(78)

$$C_{Lp} \stackrel{\leq}{=} \frac{2U}{b} \frac{\partial C_{L}}{\partial p} = -\frac{C_{Lx}bc}{12s} = -\frac{C_{Lx}}{12}$$
(79)

r Derivatives

Cyr

The tail is the prime contributor (Ref. 17, p. 174). The change in fin angle of attack due to a yaw rate is

$$\Delta \alpha_F = \frac{r l_F}{u} \tag{80}$$

so the change in side force due to the tail is

-

$$\Delta C_{y} = C_{L_{x_{F}}} \frac{S_{F} r l_{F}}{S u}$$
(81)

$$\frac{\partial C_Y}{\partial r} = C_{L_{d_F}} \frac{S_F L_F}{S_U}$$
(82)

$$C_{yr} \stackrel{\leq}{=} \frac{2U}{b} \frac{\partial C_y}{\partial r} = \frac{2C_{LaF}S_F l_F}{Sb}$$
(83)

Cer

Contributions are from the wing and tail. The side force on the Lail acts at  $\mathcal{J}_{\mathcal{F}}$ , the mean height of the fin

and 
$$\Delta F_{y} = \Delta C_{y} \overline{g} S$$
  
=  $\overline{g} S C_{L_{x}} \frac{S_{F_{x}} h_{F}}{S U}$  (84)

Δ

now

$$\mathcal{L} = \Delta F \gamma \mathcal{J} F$$
$$= \bar{g} S \hat{C}_{L \mathcal{L}_F} \frac{S F \mathcal{L}_F \mathcal{J}_F}{S \mathcal{U}}$$
(85)

differentiating

$$\frac{\partial \mathcal{L}}{\partial r} = \overline{g} S C_{LRF} \frac{SF LF BF}{S U}$$

$$(86)$$

$$(Cln) = \frac{2U}{b} \frac{1}{S\overline{g}b} \frac{\partial \mathcal{L}}{\partial r}$$

$$= \frac{2C_{LRF} SF LF BF}{Sb^{2}}$$

$$(87)$$

(87)

and

A positive A also increases lift on the left wing and decreases it on the right; the change in lift on each wing section is

$$\Delta L_{left section} = \Delta \bar{g} C_{L} c dy$$
  
=  $\frac{1}{2} p (\alpha y)^{2} C_{L} c dy$   
=  $\frac{1}{2} p (\alpha y)^{2} C_{L} c dy$  (88)

and

$$D \perp night section = -\Delta \overline{g} C_{L} C dy$$

$$= -\frac{1}{2} \rho (ny)^{2} C_{L} C dy \qquad (89)$$

now the change in rolling moment due to two sections at y is

DX = przy3 Cicdy (90)

and the total rolling moment change for the wing is

$$\Delta \chi = p r^{2} C_{L} C \int_{0}^{bh} y^{3} dy$$

$$= \frac{p r^{2} C_{L} C b^{4}}{64}$$

$$= \frac{\overline{q} r^{2} C_{L} C b^{4}}{32 u^{2}}$$
(91)

now

$$\frac{\partial \mathcal{L}}{\partial r} = \frac{\bar{q} r C_c c b^4}{16 u^2}$$
(92)

$$\begin{pmatrix} \partial C_{\theta} \\ \partial r_{wing} \\ S \bar{g} \\ b \\ \partial n \end{pmatrix} = \frac{r C_{L} b'}{16 u^{2}}$$
(93)

$$(Ce_n)_{uing} \stackrel{4}{=} \frac{2U}{b} \frac{\partial Cl}{\partial r} = \frac{rC_L b}{8U}$$
(94)

and

summing the components

$$C_{dr} = \frac{2C_{LAF}S_{F}l_{F}B_{F}}{5b^{2}} + \frac{rC_{L}b}{8U}$$
(95)

CAR

The tail and wing contribute to  $C_{M_{\mathcal{N}}}$ . Knowing that the change in the fin angle of attack is

$$\Delta x_F = -\frac{rl_F}{u} \tag{96}$$

and the moment arm of the tail is  $\mathcal{I}_{\mathcal{F}}$  then

$$(\Delta \mathcal{M})_{\text{tail}} = -\frac{l_F C_{L_{\alpha_F}} S_{F_r} l_F \overline{g} S}{S U}$$
 (97)

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 $\frac{\partial \eta}{\partial n}_{\text{tail}} = -\tilde{g} S C_{\text{Log}_F} \frac{S F l_F^2}{S U}$ 

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$$= -2C_{L_{q_{F}}} \frac{S_{F} L_{F}^{2}}{S b^{2}}$$
(99)

(98)

A positive  $\mathcal N$  increases the drag on the left wing and decreases drag on the right wing. The change in drag on each wing section is

$$\Delta D_{aft} = \Delta \bar{g} C_D c dy$$

$$= \frac{1}{2} P C_D (\delta u)^2 c dy$$

$$= \frac{1}{2} P C_D r^2 y^2 c dy$$

$$\Delta D_{ight function} = -\frac{1}{2} P C_D r^2 y^2 c dy$$
(101)

and

so the change in yawing moment is

$$\Delta \mathcal{H} = -\rho^{C_{O}} r^{2} c \int_{a}^{b} y^{3} dy$$
$$= -\rho^{C_{O}} r^{2} c b^{4} \qquad (102)$$

(101)

$$\frac{\partial n}{\partial r} = -\frac{\rho c_{D} r c b^{4}}{32} = -\frac{\bar{g} C_{D} r c b^{4}}{16 u^{2}}$$
(103)

$$(C_{n})_{wing} = \frac{24}{b} \frac{1}{s\bar{g}b} \frac{\partial n}{\partial r} = -\frac{C_{D}rb}{84}$$
(104)

summing the components

$$C_{MT} = -\frac{2C_{LAF}S_{F}l_{F}}{Sb^{2}} - \frac{C_{DT}b}{Bu}$$
(105)

Once all the derivatives had been determined or estimated, Ref. 15 was used to convert to dimentional body-axis derivatives. The derivatives were the written into the EASY program.

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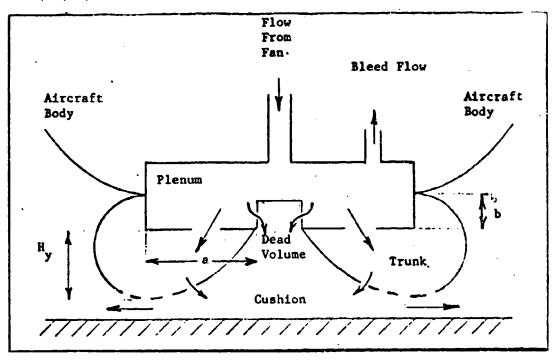
### Chapter III

## The Air Cushion Model

The air cushion model used in this analysis is a truncated version of an ACLS model that was designed by Foster-Miller Associates Inc. of Waltham, Massachusetts for the National Aeronautics and Space Administration (NASA) (Ref. 4).

The basic ACTS configuration is shown in Fig. 5. The model includes four primary subsystems: (1) the fan, (2) the feeding system, (3) the trunk, and (5) the cushion. Air from the fan flows through the ducts and plenum (feeding system) and enters the trunk. The trunk has several rows of orifices that exhaust both to the cushion and the atmosphere. Thus, the airflow from the trunk has two components, one entering the cushion and the other leading directly to the atmosphere. The cushion flow exhausts to the atmosphere through the clearance gap formed between the trunk and ground. In addition to the basic flows described above, two other flows have been included in the model. These are the plenum bleed flow and the direct cushion flow. Plenum bleeding causes some of the air to flow directly from plenum to atmosphere, and has been used in some designs to improve the dynamic characteristics of the air supply system. Direct flow from the plenum to the cushion can also improve dynamic response. A pressure relief valve is also included in the basic configuration. It allows additional flow to vent from the plenum whenever the pressure exceeds a preset level, and thus improves stability by reducing fan stall.

The support force acting on the aircraft is made up of two components. The first occurs due to the cushion pressure acting over the cushion area. The second, which comes about only during ground contact, is given by the



# Fig. 5. Basic ACTS Configuration

contact pressure acting over the trunk contact area. The support force, in general, also gives rise to a moment, given by the product of the force and its distance from the CG of the aircraft.

In plan, the cushion has an oval shape, made up of a rectangular section with semicircular ends. The lengths a and b are the horizontal and vertical spacing between the points of attachment of the trunk to the aircraft body. The initial (undeformed) trunk shape is defined by the above two parameters and the perimeter  $\mathcal{L}_P$ and height H<sub>y</sub> as shown. S<sub>h</sub> is the (uniform) spacing between the rows of peripherally distributed orifices. The number of the orifices is selected independently by the number of orifice rows N<sub>r</sub> and the number of orifices per row N<sub>h</sub>. The cushion volume consists of two parts: an active (dynamically varying) region and a dead (static)

region. The active volume depends on the trunk shape and ground profile. The dead volume, which is a design variable, includes recesses in the cushion cavity as shown.

The forces transferred to the aircraft act through the cushion and trunk. To help calculate these forces, the trunk and cushion are divided into segments as shown in Fig. 6. Each straight section of the cushion and trunk is divided into M rectangular segments, while each curved end is divided into N pie-shaped segments. Thus, the total number of segments is 2 (M + N). All cushion and trunk parameters are calculated first for each segment and then summed to give their total system values.

The dynamic analysis of the vehicle system is best derived with the help of two orthogonal coordinate frames of reference: a coordinate frame fixed in space (inertial frame), and a coordinate frame fixed to the vehicle (vehicle frame) with origin at the aircraft CG. The reason for two frames can be appreciated by recognizing that:

- (a) Newton's law for translation motion requires that the CG acceleration be expressed relative to the inertial frame.
- (b) The corresponding law for rotational motion, while valid in both inertial and vehicle frames, is applied more conveniently in the vehicle frame, because rotational inertia about any vehicle axis is constant, while the rotational inertia about any inertial (fixed) axis varies with aircraft position.

Accordingly, the two frames of reference have been defined as shown in Fig. 7. The vehicle frame with origin at the aircraft CG

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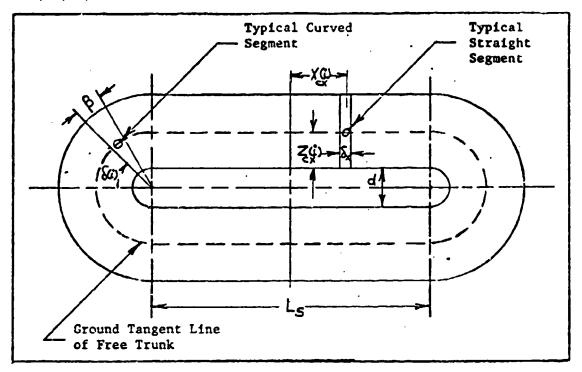
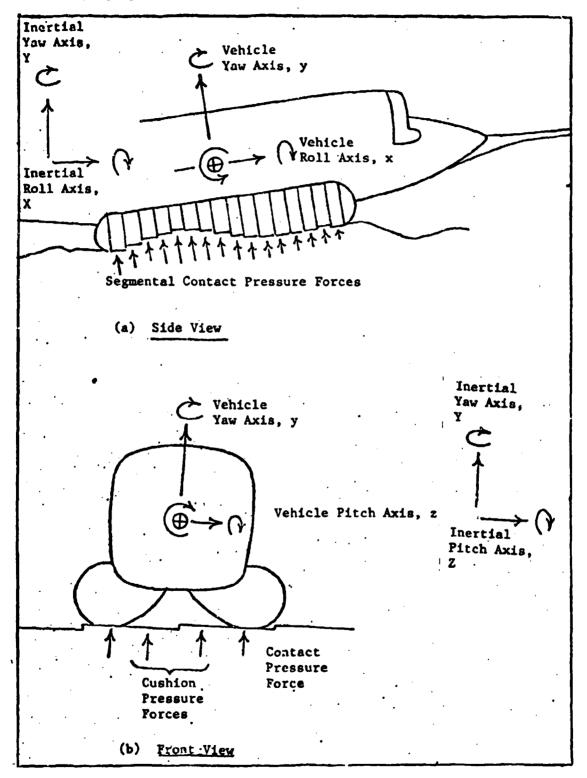


Fig. 6. Division of Trunk Into Segments has roll, yaw and pitch-axes x, y and z, respectively, fixed to the aircraft body as shown. The inertial frame has corresponding axes X, Y and Z fixed in space. The two frames coincide only when the aircraft has not undergone any rotation from equilibrium.

In the analysis, the actual runway profile underneath the ACTS is approximated by segments that coincide in plan with those of the trunk and are parallel to the cushion hard surface as shown in Fig. 7. With this model, all pressure forces act parallel to the vehicle yaw axis so that the segment torque components about the aircraft CG can be easily computed by multiplying the segment force by the fore-andaft and/or lateral separation between the segment and the CG.

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# Fig. 7. Inertial and Vehicle Coordinate Frames

The analytical model of the ACTS consists of a set of equations which when solved determines the pressures, flows, forces, and motion of the system for various aircraft and runway parameters. The overall ACTS system is divided into two interrelated systems: the flow system and the force system. These systems are shown in Fig. 8 and Fig. 9. The flow system establishes the pressure-flow relationship for various subsystems of the ACTS. The force system establishes the corresponding force-motion relationships. The interdependence of the two systems comes about because the trunk deflection obtained from the force system changes the volumes and orifice areas that form part of the flow system. Similarly, the cushion and trunk pressures found from the flow system give rise to forces and moments that form inputs to the force system.

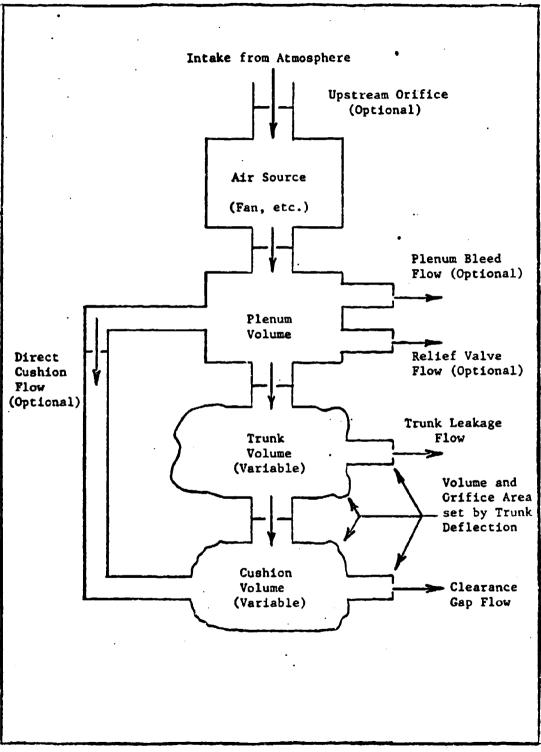
### The Trunk Model

The major component of the ACTS model is the trunk model because it determines the trunk shape parameters (volume, and orifice and contact areas), contact pressure distribution and damping that form inputs to the ACLS flow and force systems.

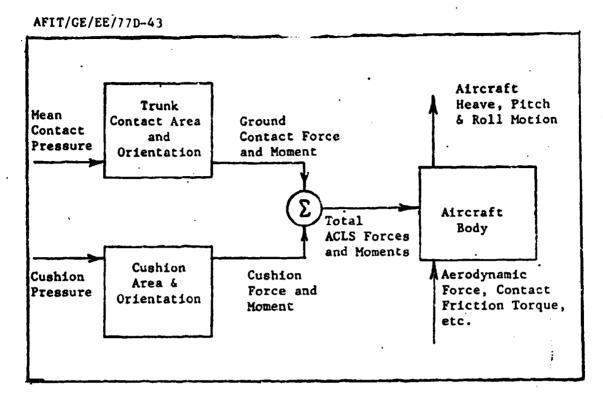
Trunk Shape. In past work, two analytical models have been developed for the trunk shape: the Membrane Trunk Model (Ref. 8) and the Frozen Trunk Model (Ref. 6). The shortcoming of both these analyses was that they modeled the side and end segments of the trunk in the same way while test data now confirm that the shorter curved end segments (front and rear) behave very differently from the longer, straight side segments. Fig. 10 shows the trunk cross section measured at the center of the side and end segments as the load on the cushion is increased. The entire side segment tends to bow outward and avoid ground contact, while the end segment remains virtually fixed, except for a flattening

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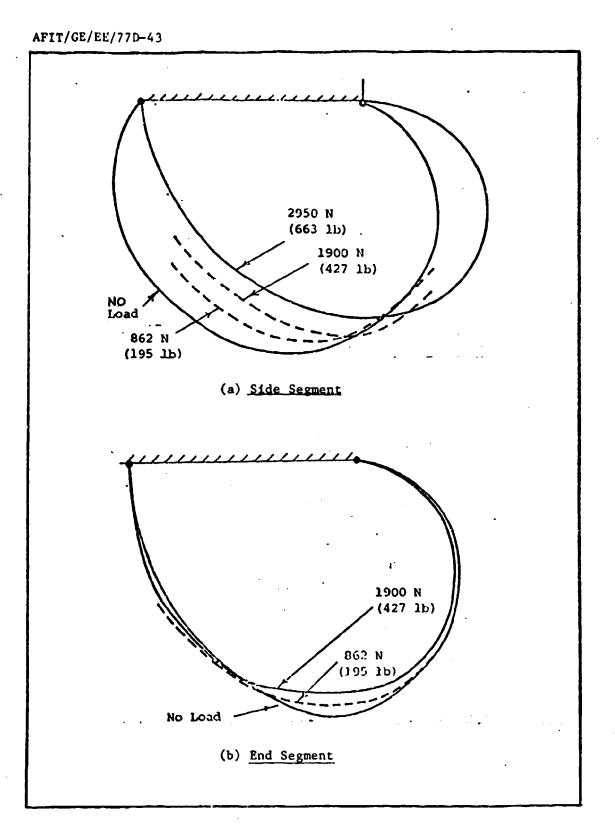
# Fig. 8. ACTS Flow System

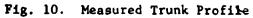


## Fig. 9. ACTS Force System

in the region that actually touches the ground. This difference in behavior occurs because the front segment is much smaller than the side segment and is curved. When the cushion pressure increases due to an increase in the load, the radially outward force causes the oval trunk planform to become more circular, as shown in Fig. 11. This causes a hoop tension force, T, to act around the trunk periphery. In the side segments, this force acts substantially normal to the side excursion,  $S_{\rm g}$ , so that its component resisting the motion is negligible and the side segment can chus bow outwards relatively unrestrained. In the end segments the situation is different, since the curvature of the segment causes the hoop tension to have a much higher component opposing the motion so that outward motion of the trunk ends is much smaller.

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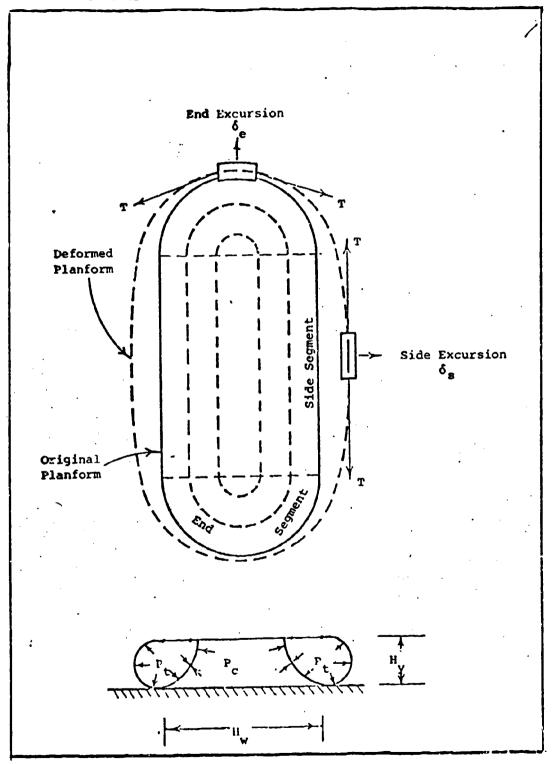


Fig. 11. Outward Excursion of Trunk Segments

Since hoop tension has very little effect on side trunk motion, the side segments can be considered as simple, two-dimensional membranes, as done in the Membrane Trunk Model. On the other hand, the fact that hoop tension restrains ("freezes") the trunk ends suggests that these segments be modeled by the Frozen Trunk Model. Thus, the logical step in trunk model improvement is to combine the two existing models and form the Hybrid Trunk Model, in which the sides are represented by the Membrane Model and the ends by the Frozen Model.

The Hybrid Trunk Model is essentially a limiting case analysis of trunk deflection. In general, best results will be obtained at the middle of the respective segments, i.e., at the center of the side segments, where the trunk behaves very much like an ideal membrane, and at the center of the end segments, where the trunk shape is truly fixed. In the transition region (at and near where the segments meet), the trunk will exhibit properties of both the membrane and frozen trunk approximations.

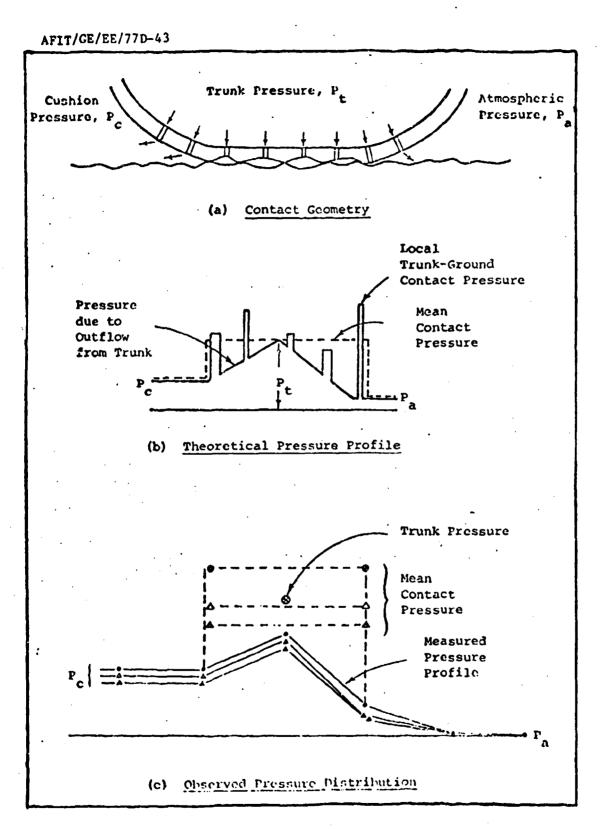
<u>Contact Pressure</u>. In addition to trunk and cushion shape, the trunk model also determines the pressure distribution in the ground contact zone. The analysis for pressure distribution is complicated by the fact that two separate effects must be considered: direct trunk-ground contact caused by the trunk pressure forcing the trunk against the ground, and airflow through the trunk holes into the interstices that remain in the contact zone.

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When two bodies in contact are acted upon by a force, F, the actual contact occurs at a number of discrete regions rather than over the whole area, due to the inherent roughness of the contacting surfaces as shown in Fig. 12. Because the number of contact



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Fig. 12. Pressure Distribution in Trunk Contact Zone

regions is large for a "smooth" surface, it was convenient to define an average contact pressure,  $P_{av} = F/A$ , acting as though the bodies were touching uniformly over the entire area, A. In fact,  $P_{av}$  equals the trunk pressure,  $P_t$ . For purposes of trunk outflow calculation, the pressure profile in the non-contacting regions is approximated by a linearly decreasing relationship as shown in Fig. 12. The driving pressure for flow through any trunk hole is thus given by the difference between the trunk pressure and the gap  $\frac{1}{2} E = \frac{1}{2} E^{-1}$  it that location. This pressure distribution model has been compared to experimental data and has been quite accurate (within 10%) (Ref. 4).

Trunk Damping. In dynamic operation, the trunk is deformed cyclically both in tension and flexure, and energy dissipation in the trunk material gives rise to a damping force which opposes the strain te. Because the present trunk analysis does not solve for strain (and hence strain rate), a damping model that links trunk material properties directly to trunk damping forces cannot be developed. An alternate approach in which the damping characteristics are modeled by dimensional analysis (similarity) based on test data thus appears more appropriate. In keeping with the method of approach outlined earlier, the trunk is divided into segments (Fig. 13) and a series of dashpots, one for each segment, is included in the model such that the segment damping force is proportional to the vertical velocity of the trunk segment.

Each dashpot models the energy dissipation characteristic of the trunk segment. Although all parts of the trunk dissipate energy, the major contributions will come from those parts that undergo high stress reversals, since the strain rate is highest in these sections. Observations of a trunk in dynamic operation suggest that the high

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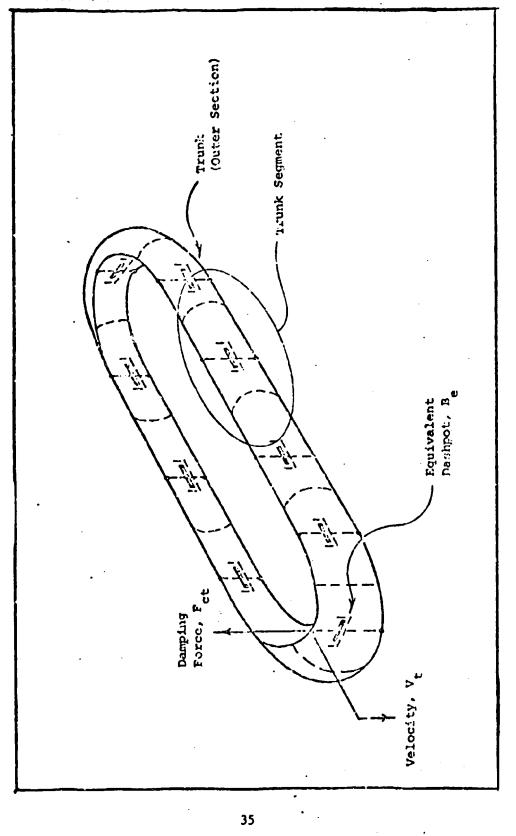


FIG. 13. The Trunk Damping Model

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stress reversal regions lie along the periphery of the trunk-ground contact zone, because it is here that the rate of change of trunk slope (and hence stress) is high and constantly changing with the time as the contact area changes. As a first order approximation, the damping model derived here assumes that all the energy dissipation in the trunk is concentrated along the trunk-ground contact periphery so that the damping coefficient of each dashpot depends on the perimeter of the ground contact zone. This means that when a segment is not contacting the ground it has zero damping and when it is contacting the ground it has a damping coefficient proportional to the contact perimeter.

#### Model Synopsis

## The Flow System

- (a) The fan is characterized by a static pressure rise element for forward and back flow in series with an inertance (duct) and a capacitance (volume).
- (b) The trunk and cushion volume are found from the Hybrid Trunk Model, which characterizes the side trunk segment as an ideal two-dimensional membrane and the end segment as a "frozen" trunk.
- (c) The orifice areas between the trunk and cushion, trunk and atmosphere and cushion and atmosphere are found from the trunk shape as predicted by the Hybrid Trunk Model, along with the cushion orientation and ground profile.
- (d) The pressure within the cushion, trunk and plenum is considered to be uniform.
- (e) The pressure in the trunk/ground contact zone is found from the triangular profile given by the Hybrid Trunk Model.

- (f) The flow through the plenum, trunk and cushion is governed by the unsteady state flow continuity equation in which the air is assumed to behave like a perfect gas and follow a polytropic expansion relationship.
- (g) The flow through all orifices is found from the incompressible flow square-law orifice equation.

#### The Force System

- (a) The mean contact pressure in the trunk/ground contact zone is equal to the trunk pressure.
- (b) The trunk contact area and location relative to the aircraft CG is found from the trunk shape predicted by the Hybrid Trunk Model.
- (c) The cushion area and location relative to the aircraft CG is found from the Hybrid Trunk Model. In width, the cushion extends between the lowest (ground tangent) points of the side trunk segments. In length, it extends between the ground tangent points of the end trunk segments, or, if in ground contact, between the inner edges of the contact zone.
- (d) The total forces and moments acting on the aircraft occur due to the mean trunk contact pressure acting over the contact area, the cushion pressure acting over the cushion area, aerodynamic drag and trunk damping losses caused by aircraft heave motion, and trunk-ground friction.
- (e) The forces and moments are found by dividing the cushion (and trunk) into segments, approximating the actual ground profile underneath the cushion by a similar set of segments parallel to the cushion, computing the cushion and contact pressure forces and moments for each segment, and then summing them to determine the total force

**i** 1

and moment about the sircraft CG.

- (f) The heave motion of the aircraft is found by applying Newton's law in the vertical direction to the aircraft CG.
- (g) Angular accelerations in pitch and roll are obtained by applying the theorem of moment of momentum about the aircraft pitch and roll axes.
- (h) A coordinate transformation is carried out to express vehicle frame velocities and accelerations in terms of Euler angles and their derivatives.
- (1) The moment of momentum equations, expressed in terms of Euler angles are integrated to give the angular position of the aircraft as a function of time.

# Chapter IV

# Controller Design

During the low speed portion of the takeoff roll (to approximately 50 knots), the controls available are a yaw thruster on the rear fuselage and vertical roll thrusters on each wing tip. The roll thrusters can be directed up or down. During the takeoff sequence, the most unstable mode of the aircraft is the roll mode. Therefore, it was decided to control this mode and observe the control that was applied to the pitch mode through the inertial cross-coupling. Also, during takeoff the yaw angle will be controlled by the yaw thruster on the rear of the fuselage. With roll and yaw controlled, Eqn (4), which is rewritten here, can be simplified.

$$I_{RA} \dot{P} - I_{A} (\dot{R} + PQ) + (I_{JJ} - I_{yy}) RQ = \chi$$
(106)

Controlling roll and yaw means that  $\tilde{R}$  will be small and PQ and RQ (products of small numbers) will be small. Q can be considered small because the takeoff starts with zero initial conditions on P, Q, and R. With the above simplification and assuming that any roll inputs from the ground profile are impulsive, then the roll moment generated by the roll thrusters can be written as

$$I_{XX} = \mathcal{L}_{THRUSTERS}$$

$$= \mathcal{L}_{W}F_{T} \qquad (107)$$

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$$\mathbf{F}(t) = \mathbf{C} \mathbf{F}_{\mathsf{T}}(t) \tag{108}$$

where

$$C = \frac{I_{W}}{I_{XX}} = 8.38 \times 10^{-3}$$

now let

$$\chi_1 = \phi \tag{109}$$

$$\mathcal{K}_{2} = \phi \tag{110}$$

$$u(t) = F_{T}(t) \tag{111}$$

and

so Eqn (108) can be rewritten as

$$\dot{x}_{2}(t) = C U(t) \qquad (112)$$

80

 $\dot{X}_{1}(t) = X_{2}(t) \qquad \text{from Eqn (110) (113)}$  $\dot{X}(t) = \begin{bmatrix} \circ & i \\ \circ & \circ \end{bmatrix} X(t) + \begin{bmatrix} \circ \\ c \end{bmatrix} U(t) \qquad (114)$ 

For a minimum time Performance Index and for  $|\mathcal{U}(t)| \leq \mathcal{U}_{max}$  an optimal control for this system can be shown to be a bang-bang control (Ref. 14, pgs 245-248). In other words, the control is a maximum (either positive or negative) whenever it is applied. Since the eigenvalues for  $\underline{A}$  are both zero, Theorems 5.4-1 and 5.4-3 of Kirk (Ref. 14) show that an optimal control exists, is unique and has at most one switching.

Therefore, the control for a specified initial state must be

$$U^{*}(t) = - \frac{1}{2} + U_{max}, t_{o} \leq t < t^{*}, g \text{ or}$$

$$U^{*}(t) = - \frac{1}{2} + U_{max} \text{ for } t_{o} \leq t < t^{*}, a \text{ ND} - U_{max} \text{ for } t_{i} \leq t < t^{*}, g \text{ or}$$

$$- U_{max} \text{ for } t_{o} \leq t < t, A \text{ ND} - U_{max} \text{ for } t_{i} \leq t < t^{*}, g \text{ or}$$

$$- U_{max} \text{ for } t_{o} \leq t < t, A \text{ ND} + U_{max} \text{ for } t_{i} \leq t < t^{*}, g \text{ or}$$

$$C \quad \text{for } \underline{X}(t) = 0$$

(115)

and

Integrating Eqns (112) and (113) with  $ll = \pm ll_{max}$  gives  $\mathcal{M}_{2}(k) = C \int \mathcal{U}(k) dk$  $= \pm C \cdot \mathcal{U}_{max} t + CC_{2}$  (116)

where  $C_{z}$  is the value of  $A_{z}$  at  $t = t_{o}$ 

$$x_{i}(t) = \int x_{2}(t) dt$$
  
=  $\int (=CU_{max}t + CC_{2}) dt$ 

 $= \underbrace{tCU_{max}}_{R} \underbrace{t} + CC_{t} + C_{1}$ 

where  $C_1$  is the value of  $X_1$  at  $t = t_0$ 

solving for t in (116)

$$t = \frac{X_2(t) - CC_2}{t C U_{max}}$$
(118)

(117)

substituting t into (117)

$$\chi_{1}(t) = \frac{\pm Cl_{max}}{2C^{2}l_{max}} \left(y_{2}^{2}(t) - 2CC_{2}\chi_{2}(t) + c^{2}C_{2}^{2}\right) \qquad (119)$$
for  $ll = \pm l_{max}$ 

$$\frac{\pm CC_{2}(\chi_{1}(t) - CC_{2})}{\pm C l_{max}} + C_{1}$$

$$\chi_{i}(t) = \underbrace{\prod_{\substack{\chi_{1}(t) \\ Q \in U_{max}}} \chi_{1}^{2}(t) - \underbrace{C_{2}\chi_{1}(t)}_{Mmax} + \underbrace{CC_{2}}_{2} + \underbrace{C_{3}\chi_{1}(t)}_{Mmax} - \underbrace{CC_{1}}_{U_{max}} + C_{1}$$

$$= \underbrace{\prod_{\substack{\chi_{1}(t) \\ Q \in U_{max}}} \chi_{1}^{2}(t) + C_{3} \qquad (120)$$

where

$$C_3 = C_1 - \frac{CC_2}{2Umax}$$
(121)

$$AFIT/GE/EE/77D-43$$
  
for  $U = -U_{max}$   
 $N_{1}(t) = \frac{-1}{2CU_{max}} \frac{N_{2}^{2}(t) + C_{2}N_{2}(t) - CC_{2}^{2} - C_{2}N_{2}(t) + CC_{2}^{2} + C}{U_{max}}$   
 $= \frac{-1}{2CU_{max}} \frac{N_{2}^{2}(t) + C_{4}}{U_{max}} \frac{U_{max}}{U_{max}} \frac{U_{max}}{U_{max}}$  (122)

$$C_4 = C_1 + \frac{CC_2}{2 U_{max}}$$
 (123)

where

the switching curve is

$$X_{1}(t) = -\frac{1}{2C U_{max}} X_{2}(t) | X_{2}(t) |$$
 (124)

$$SX = N(t) + \frac{1}{2C} N_2(t) N_2(t)$$
 (125)

Let

and the second second

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$$\begin{array}{c} - \ U_{max}, \ 5\chi > 0 \\ U_{max}, \ 5\chi < 0 \\ - \ U_{max}, \ 5\chi = 0, \ \chi_2(t) > 0 \\ U_{max}, \ 5\chi = 0, \ \chi_2(t) < 0 \\ 0, \ \chi(t) = 0 \end{array}$$
(126)

It can be noted that this controller design is almost completely independent of the aircraft type. In the low speed range where aerodynamic controls are not effective, this design will help stabilize the roll mode of any aircraft. The only relationship between the aircraft and controller is that the thruster force is a function of roll inertia and wing span. Thus, this design becomes very versatile

and applicable to stabilize the roll mode of any ACLS aircraft.

A somewhat similar analysis will be made for the controller of the yaw thruster. The criterion for directional control is to keep the aircraft on the runway centreline during takeoff; this can be accomplished by minimizing the lateral deviation, y, and rate of deviation from the centreline, ý. This deviation and rate will be minimized by yawing the aircraft in a direction to oppose the disturbance with the use of the yaw thruster.

Prior to the installation of the air cushion, the directional stability of the Jindivik was controlled by a batsman at the end of the runway. His job was to steer the dolly (Fig. 1) to keep the aircraft on the centreline. The same batsman will visually sense lateral deviation and deviation rate and control the yaw acceleration to indirectly control the lateral deviation and rate.

Assuming that the pitch and roll angles are kept small, then the lateral acceleration (to correct a lateral displacement) in the inertial frame of reference of the runway is a function of the thrust and yaw angle.

$$y \simeq \frac{THP,UST}{MASS} SIN \Psi$$
 (127)

and since  $\Psi$  will be small (<30°) to keep the aircraft on the runway centreline, then

$$\dot{y} \simeq \frac{THRUST}{MASS} \Psi$$
(128)

Equation 128 can be implemented as shown in Fig. 14. With these control loops the desired yaw angle to zero lateral displacement

can be determined. Referring to Fig. 14

$$\Psi_{d} = -K_{1} \dot{y} - K_{2} \dot{y}$$
 (129)

the inner loop open loop transfer function is

$$(GH)_{I} = \frac{KK_{I}}{S}$$
(130)

and the equivalent closed loop transfer function is

$$G_{I} = \frac{GH}{I+GH}$$

$$= \frac{KK_{I}}{S+KK_{I}}$$
(131)

the outer loop open loop transfer function is therefore

$$(GH)_{2} = \frac{G_{1}K_{2}}{S}$$
$$= \frac{KK_{1}K_{2}}{S(S+KK_{1})}$$
(132)

this gives a root locus as shown in Fig. 15. For a damping ratio of 0.7 the closed loop roots are located at  $\left(-\frac{KK_1}{2}, -\frac{KK_2}{2}\right)$ , which gives a closed loop transfer function of

$$G_{2} = \frac{K K_{1} K_{2}}{\left(S + \frac{K K_{1}}{2} \pm j \frac{K K_{1}}{2}\right)}$$
  
=  $\frac{K K_{1} K_{2}}{S^{2} + K K_{1} S + \frac{K^{2} K_{1}^{2}}{2}}$  (133)

but

$$G_{2} = \frac{(GH)_{2}}{1 + (GH)_{2}}$$

$$= \frac{KK_{1}K_{2}}{S^{2} + KK_{1}S + KK_{1}K_{2}}$$
(134)

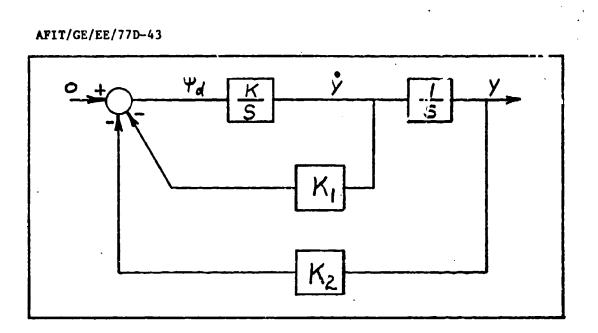
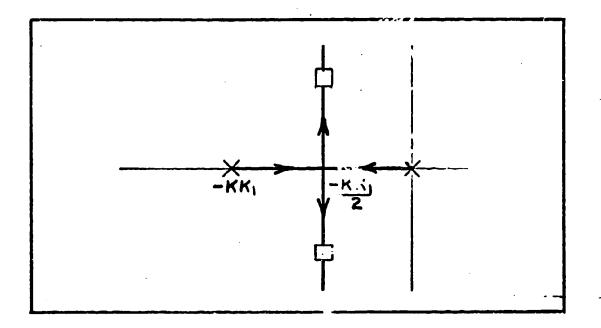
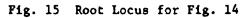


Fig. 14. Feedback Control Loops for Lateral Acceleration





therefore equating denominator coefficients gives

 $KK_{1}K_{2} = \frac{K^{2}K_{1}^{2}}{2}$   $K_{2} = \frac{KK_{1}}{2}$   $= 9 \cdot 1K_{1}$ (135)

or

Since K, is arbitrary, a value of 0.3 was selected, so

 $K_2 = 2.73$ 

$$K_1 = 0.3 \tag{136}$$

(137)

and

so the desired yaw angle is

$$\Psi d = -0.3 \dot{y} - 2.73 y$$
 (138)

The yaw angle is associated with the yaw thruster force by

$$I_{33} \ddot{\Psi} = \mathcal{N} = F_{\gamma T} L \omega$$
  
$$\ddot{\Psi} = C_5 F_{\gamma T}$$
(139)

where

 $C_5 = 2.73 \times 10^{-3}$  (140)

in matrix form

$$\begin{bmatrix} \dot{\Psi} \\ \dot{\Psi} \end{bmatrix} = \begin{bmatrix} 0 & I \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \Psi \\ \dot{\Psi} \end{bmatrix} + \begin{bmatrix} 0 \\ c \end{bmatrix} F_{YT}$$
(141)

This equation is the same as Eqn. 114 for the roll thruster, and similarly a bang-bang control exists for which the switching function

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$$SXYT = \Psi + \frac{\Psi}{\Psi} \frac{\Psi}{\Psi}$$

$$2C F_{YTMAX} \qquad (142)$$

and the optimal control law is

$$F_{YT} = -F_{YTMAX}, SXYT > 0$$

$$F_{YTMAX}, SXYT < 0$$

$$F_{YTMAX}, SXYT = 0, \Psi > 0$$

$$F_{YTMAX}, SXYT = 0, \Psi < 0$$

$$0, \Psi = 0, \Psi = 0$$
(143)

The implementation of this control law would drive the yaw angle and yaw rate to zero in the minimum time, but the directional control problem requires that the yaw angle be equal to the desired angle,  $\Psi_d$ . This can be accomplished by shifting the switch ing curve by the amount  $\Psi_d$ .

$$SXYT = \Psi - \Psi d + \frac{\dot{\Psi} \dot{\Psi}}{2CFYTMAX}$$
(144)

This change in the switching curve means that the yaw rate and the quantity ( $\Psi - \Psi_d$ ) will be driven to zero in the minimum time, or  $\Psi$  will equal  $\Psi_d$ .

#### Chapter V

# The Computer Program and Simulation Results

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# General

The EASY Dynamic Analysis Program to Aircraft Modelling (Ref. 5) formed the major portion of the computer analysis and simulation and the air cushion system was modelled by the Foster-Miller model, as described in Chapter III. The computer program is listed in Appendix B. In brief, the EASY program provided the means for an analysis of the six degree of freedom rigid body dynamics of the Jindivik drone and the Foster-Miller model estimated the ground forces and moments transferred by the air cushion to the airframe. Additional FORTRAN was used to reflect the Jindivik autopilot and the designed roll, pitch and yaw controllers in the EASY program. Simulations were performed to obtain time history comparisons of the uncontrolled and controlled aircraft models with a crosswind driving function and an initial pitch angle to simulate flying off of a 2 inch step.

### The Computer Program

Figures 16, 17, and 18 show the computer block diagrams of the aircraft dynamics, the longitudinal autopilot. and the lateral autopilot, respectively. Understanding the symbology used in these figures would require considerable referral to Reference 5, but a general description of the schematics will be given here.

In Figure 16, SD performs the six degree of freedom rigid body dynamics, AV calculates the aerodynamic variables, LO calculates the longitudinal force and moment sum, and LD calculates the lateral force and moment sum. The terms FX3S2, FZ3S2, TY3S2, TY3S2, TX3S2, and TZ3S2, shown feeding into LO and LD, are the sums of the engine and external

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Fig. 16. Block Diagram of Aircraft Dynamics

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Fig. 17. Block Diagram of Longitudinal Autopilot

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Fig. 18. Block Diagram of Lateral Autopilot

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and a state of the state of the

(i.e. air cushion system and controller) forces and moments.

The longitudinal and lateral autopilot functions shown in Figures 17 and 18 were developed from the elevator and aileron transfer functions given in Reference <sup>3</sup>. The maximum deflection of the control surfaces, the gearing ratios between control surfaces and servos, and the maximum slewing rates for the servos were also programmed into the model by FORTRAN.

#### Air Cushion Program

The air cushion system was programmed with ten subroutines to the EASY program and the flow chart of the subroutines is shown in Figure 19. The functions of the ten subroutines are as follows: FM is the main subroutine which calls and interacts with the remaining subroutines; it also determines the appropriate fan curve and contains the integration routine. HC, TK, SE, CO, PR, CL, S1, and SP form a set of subroutines which need the aircraft position, cushion and trunk pressures and ground profile as input parameters and they calculate various areas and volumes associated with those parameters. HC calculates the value of side trunk height for a given cushion to trunk pressure ratio. Subroutine TK takes that height and calculates trunk cross section parameters. From these parameters SE updates the trunk division parameters. Subroutine CO transforms position vectors for each trunk centre, from the vehicle frame to the ground frame, and then calculates the distance between each of the trunk segments and the ground, and it also calculates the ground coordinates above which each of the segments lie. Subroutine PR determines ground elevations (input by user) corresponding to the

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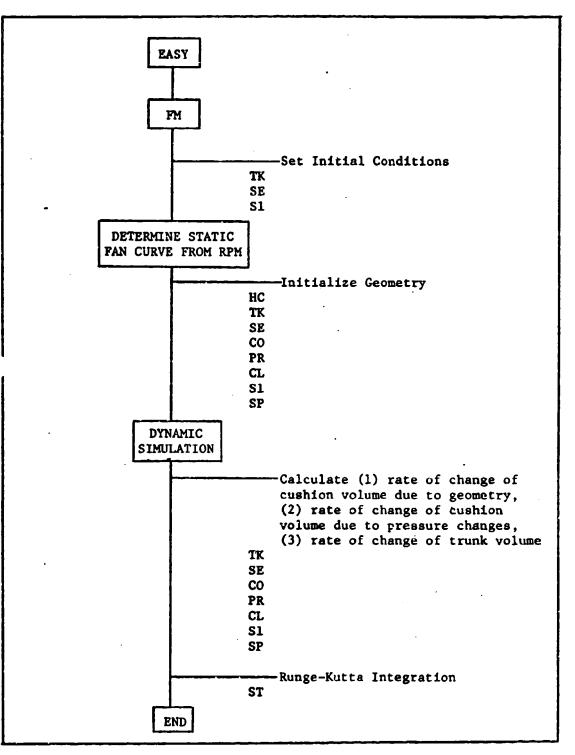


Fig. 19. Air Cushion Subroutine Flow Chart

ground coordinates generated by CO, and subroutine CL determines the hard surface clearance for each segment using (a) the ground elevation value and (b) the distance of the trunk segment from the ground. Finally, subroutine SP calculates values of different areas and volumes for each segment and adds them together to give total areas and volumes.

In addition to these seven subroutines, FM also calls subroutine ST. ST determines the value of fan flow for a given value of fan pressure rise and also calculates the forces and torques for a given ACTS orientation. Subroutine ST also incorporates all the system differential equations so that the value of the state differentials can be updated each time it is called by the Runge-Kutta integration routine. The forces and torques calculated by ST are passed to the EASY program via FM.

### Simulation Results

The results of the simulation to test the controller designs of Chapter IV are shown in Tables I and II. For initial conditions of  $-1^{\circ}$  in pitch,  $0^{\circ}$  in roll, and a constant 40 ft/sec crosswind, the uncontrolled model induces a roll angle and pitch angle that are lightly damped in comparison to the controlled model. Also, the restoring yaw angle is less than the controlled yaw angle and the lateral deviation, y, is subsequently greater for the uncontrolled model. The 1.5 second simulation for the uncontrolled model required 15,000 seconds of computation time and consequently the simulation was not continued to the extent

## Table I - Simulation Results Uncontrolled Model

TIME	PITCH	ROLL	YAW	ALTITUDE	LATERAL DEVIATION
0.0	-1.000	0.000	0.00	2.60	0.00
0.5	. 305	.113	63	1.52	3.84
1.0	.451	. 474	-1.94	1.02	8.78
1.5	.377	.142	-2.51	1.25	14.87

## Table II - Simulation Results Controlled Model

TIME	PITCH	ROLL	YAW	ALTITUDE	LATERAL DEVIATION
0.0	-1.000	0.000	0.0	2.60	0.00
0.5	· .273	.150	74	1.71	3.83
1.0	.282	.072	-2.05	1.25	8.77
1.5	.063	.023	-3.82	2.32	14.68
2.0	.038	.005	-5.99	2.31	21.23
2.5	.045		-8.52	2.27	27.87
3.0	.052		-11.37	2.23	34.12
-3.5	.048		-14.46	2.32	39.56
4.0			-17.70	2.32	43.74
4.5			-21.10	2.32	46.22
5.0		1	-24.50		46.52
5.5		1	-27.80		44.15
6.0	1	1	-30.90		38.56
6.5	J.	4	-33.40	4	29.21
7.0	Ŧ	T	-34.80		15.69

#### Chapter VI

Conclusions and Recommendations

The National Aeronautics and Space Administration (NASA) has accepted the Foster-Miller program as a valid air cushion model; however, in the course of the analysis of this thesis, several problems arose which prevent this program from becoming an effective design tool. The primary problem is the excessive computation time required for dynamic simulation when it is incorporated with the EASY Dynamic Analysis Program. The Fourth Order Runge-Kutta integration routine used in the air cushion model requires a time increment of 0.001 seconds for numerical stability. Since this integration routine is the prime reason for the excessive computation time, it is recommended that the routine be changed or augmented to reduce computation time.

The air cushion model assumes that the trunk is an elliptical shape rather than the actual shape, in which the aft end is 10% wider than the fore end. This discrepancy impinges on trunk and cushion volumes and areas, pitching and rolling moments, clearance and gap areas, etc. In other words, it requires considerable evaluation and extensive modification and verification of the program to change trunk shapes. It is recommended that Foster-Miller Associates be asked to modify their model to accommodate different trunk shapes as future designs may require.

The air cushion model has no provision to orient the trunk orifices other than perpendicular to the trunk surface. In fact, the Jindivik trunk orifices are drilled inward at a 45° angle to produce more cushion pressure in the region of trunk contact. Some adjustment should be made to the model to allow this orifice orientation as a design parameter. Also, the model uses a single curve to describe the fan characteristics of outflow vs. drive pressure, but the actual characteristics dependent on more variables; hence, a fan "map" is required or replace the single curve and adequately describe the fan during all phases of its operation.

A weak part of the computer simulation is the evaluation of the Jindivik Stability Derivatives due to the fact that the static wind tunnel data was extrapolated from the Recovery Trunk Data and was suspect from the beginning of the analysis. Consequently, it is recommended that wind tunnel tests be conducted in a moving belt tunne ith the takeoff trunk and with measurement of the rate variables p, q, and r. Barring this option, the development of the derivatives should be reviewed and ammended with the use of more sophisticated data reduction techniques. Once the computer program, shown in Appendix B, is changed to encompass the previous recommendations, it can be used to define the following parameters:

- a) Operational limits and directions of crosswinds.
- b) A "ground roughness" criteria above which the aircraft becomes unstable.

- c) A flap deflection schedule to provide minimum takeoff distance within pitch stability. The present two flap settings would provide a step input to pitch and hence should be changed.
- d) All of the above for different vertical thruster sizes and locations.

This thesis has integrated the EASY Dynamic Analysis Program and a truncated version of the Foster-Miller air cushion model to simulate an air cushion vehicle during takeoff. During the process of that integration and simulation, some major deficiencies in the Foster-Miller model maye been highlighted. This thesis has also developed and demonstrated a technique to control bangbang thrusters on the wing tips and a bang-bang thrust deflector on the tail section. Complete verification of the controller design was not possible due to the large computer resources that would have been required, but the results do show the control trends that are expected. The application of wing tip and yaw thrusters to other air cushion aircraft should provide comparable results. Also, these thrusters could be used on Vertical or Short Takeoff and Landing (V/STOL) aircraft because these aircraft also have marginal stability and require control enhancement in the low speed range.

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## Appendix A

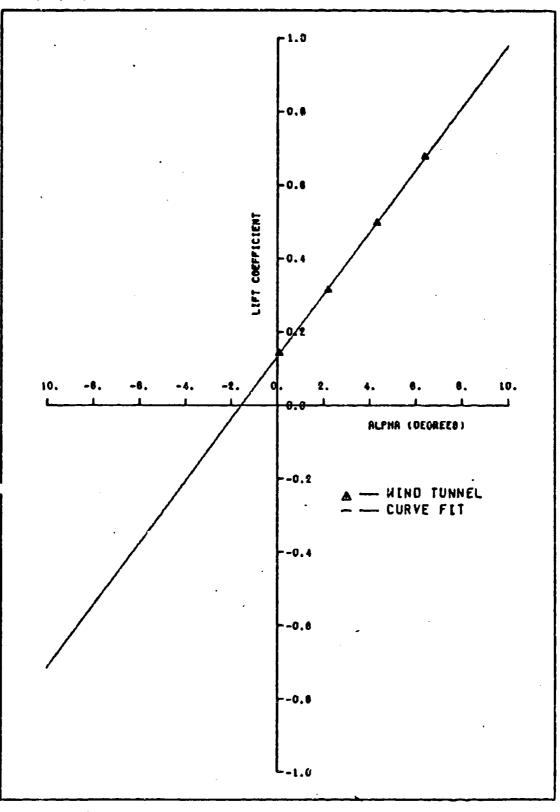
## Graphs of Aerodynamic Coefficients

Fig. A	-1	Lift Coefficient Versur Angle of Attack
Fig. A	-2	Pitching Moment Coefficient Versus Angle of Attack
Fig. A	1-3	Drag Coefficient Versus Angle of Attack
Fig. A	4-4	Side Force Coefficient Versus Sideslip Angle
Fig. A	∖-5 ·	Side Force Coefficient Versus Sideslip Angle - For Angle of Attack = 0.1 Deg
Fig. A	-6	Roll Moment Coefficient Versus Sideslip Angle - For Angle of Attack = 2.2 Deg
Fig. A	<b>-</b> 7	Roll Moment Coefficient Versus Sideslip Angle - For Angle of Attack = 4.3 Deg
Fig. A	<b>-</b> 8	Roll Moment Coefficient Versus Sideslip Angle - For Angle of Attack = 6.4 Deg
Fig. A	-9	Yaw Moment Coefficient Versus Sideslip Angle - For Angle of Attack = 0.1 Deg
Fig. A	-10	Yaw Moment Coefficient Versus Sideslip Angle - For Angle of Attack = 2.2 Deg
Fig. A	-11	Yaw Moment Coefficient Versus Sideslip Angle - For Angle of Attack = 4.3 Deg
Fig. A	-12	Yaw Moment Coefficient Versus Sideslip Angle - For Angle of Attack = 6.4 Deg

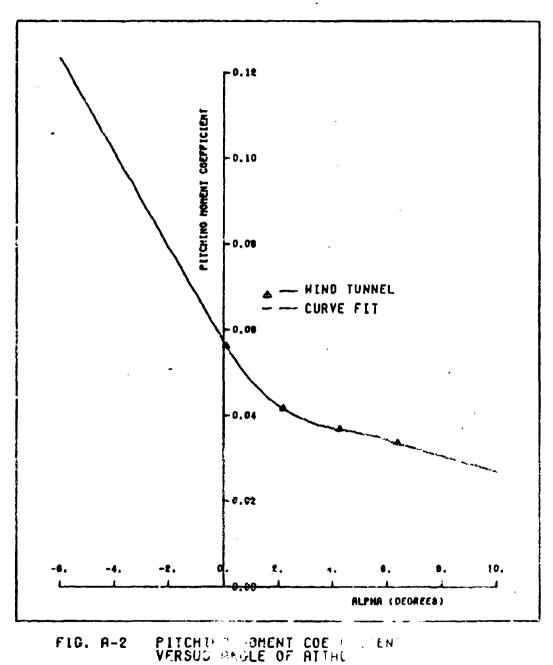
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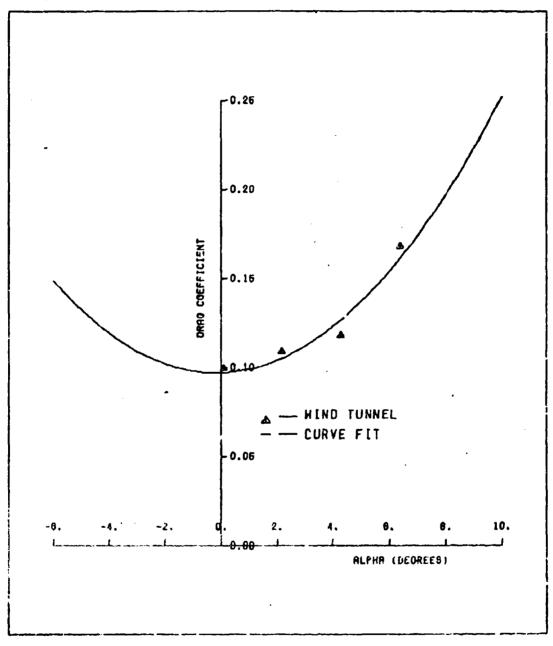
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## FIG. A-1 LIFT COEFFICIENT VERSUS ANGLE OF ATTACK

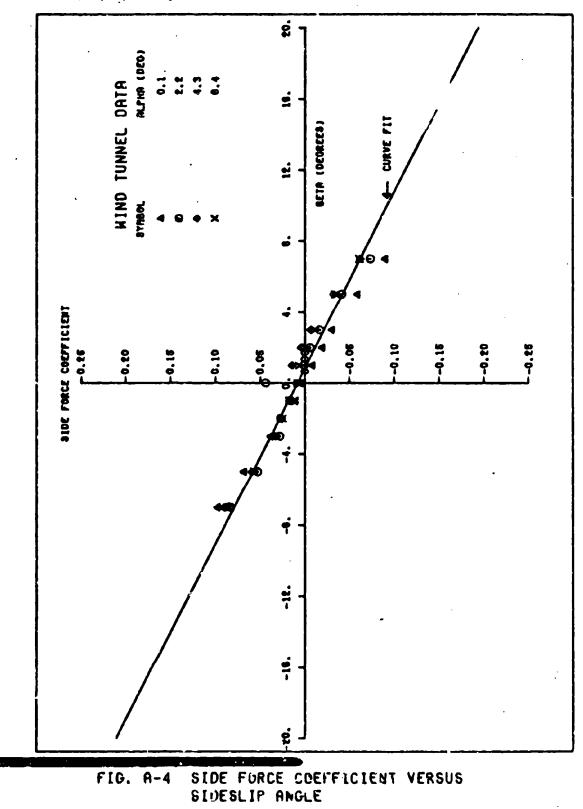


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## FIG. A-3 DRAG COEFFICIENT VERSUS ANGLE OF PITACK

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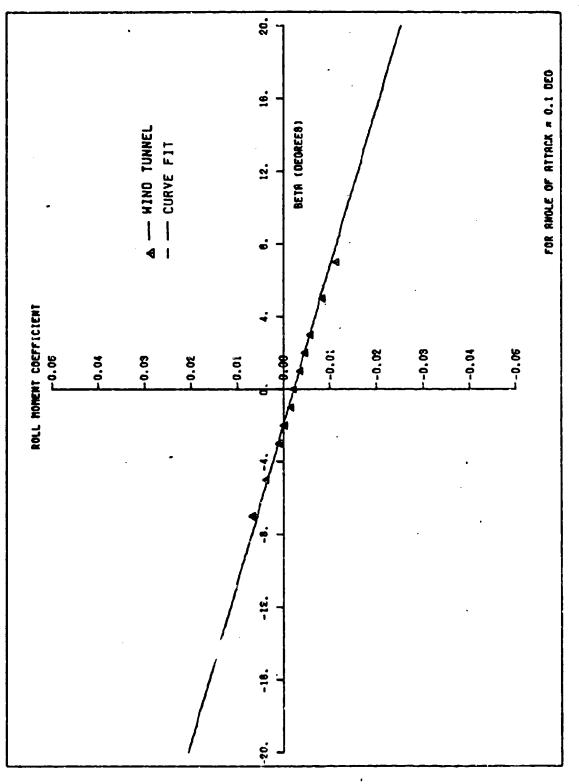
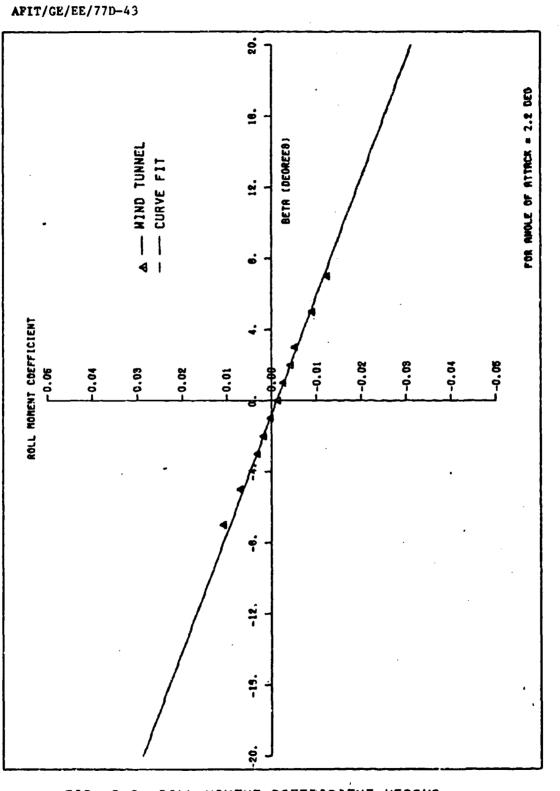


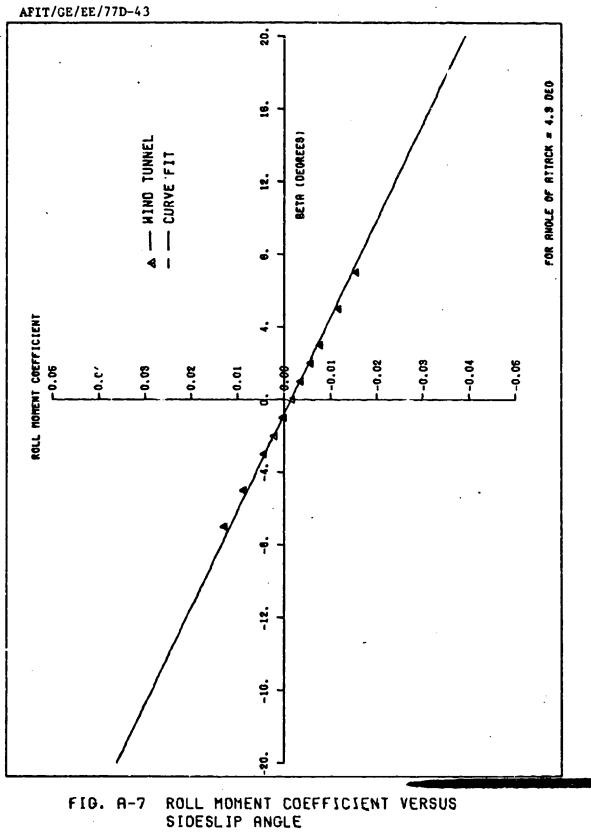
FIG. A-5 ROLL MOMENT COEFFICIENT VERSUS SIDESLIP ANGLE



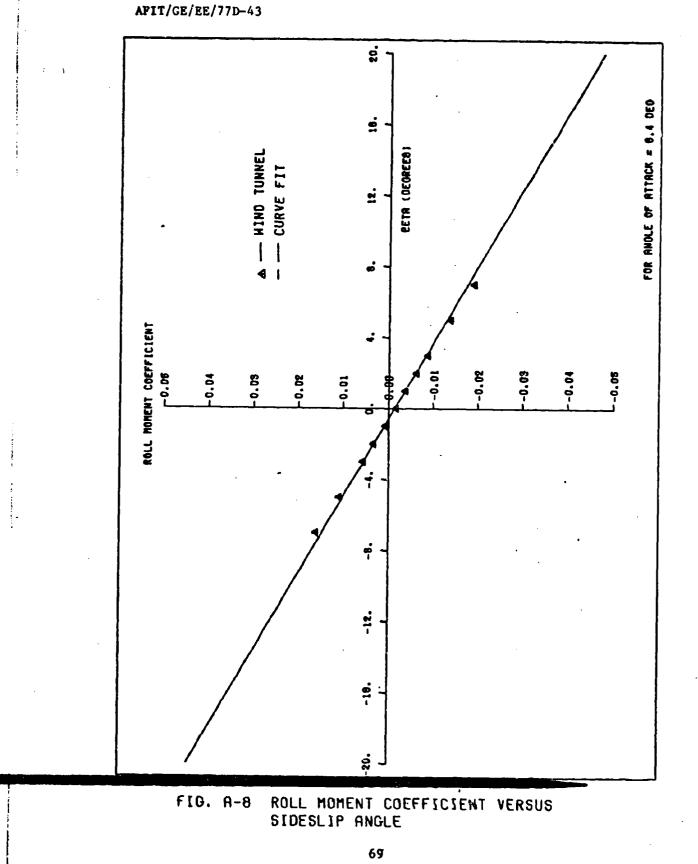
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## FIG. A-6 ROLL MOMENT COEFFICIENT VERSUS SIDESLIP ANGLE

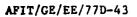


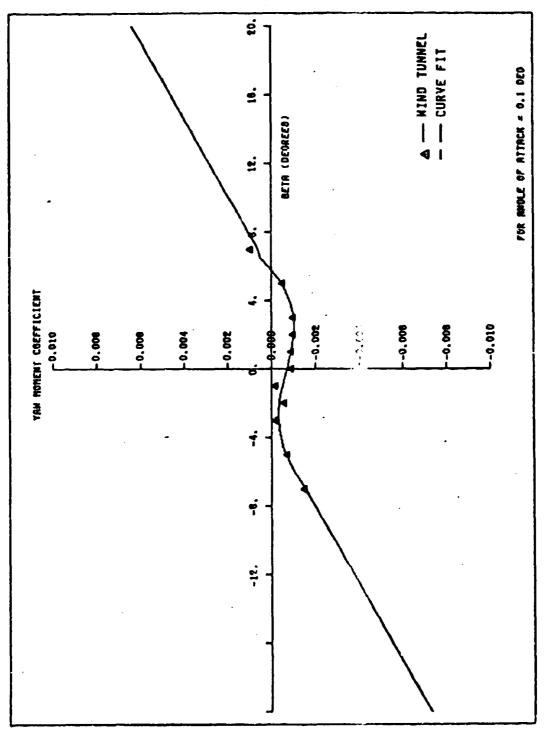
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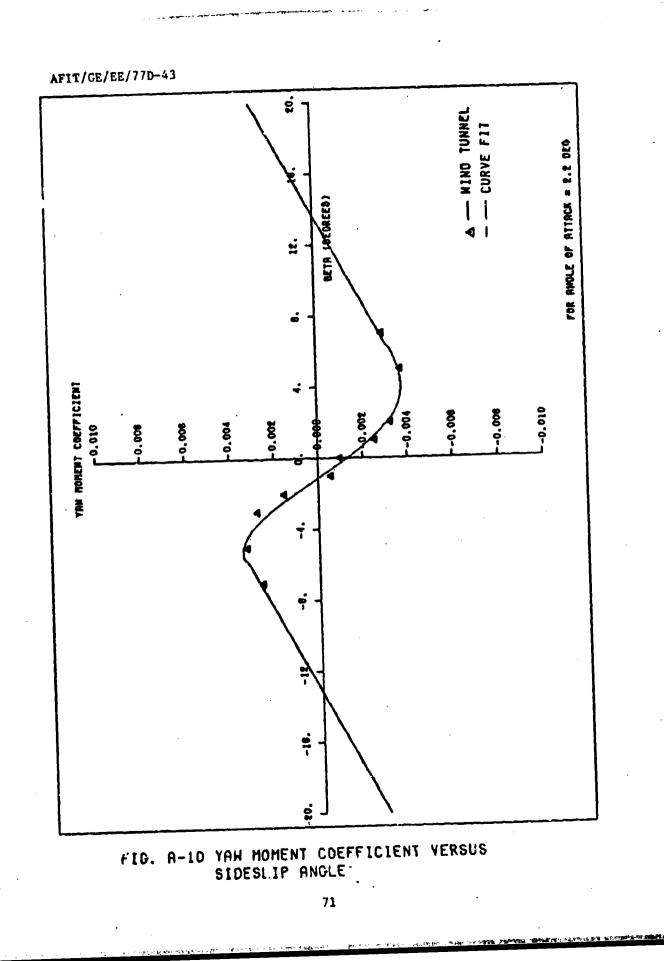


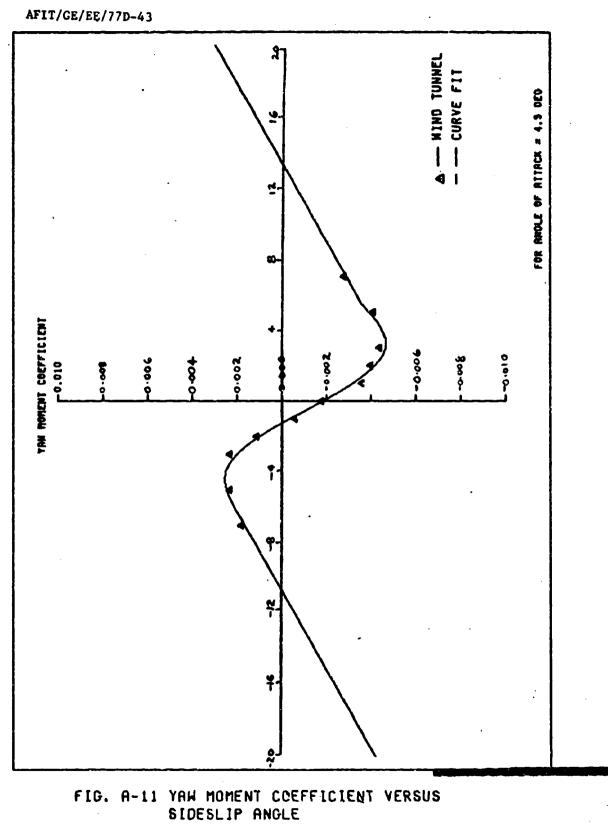
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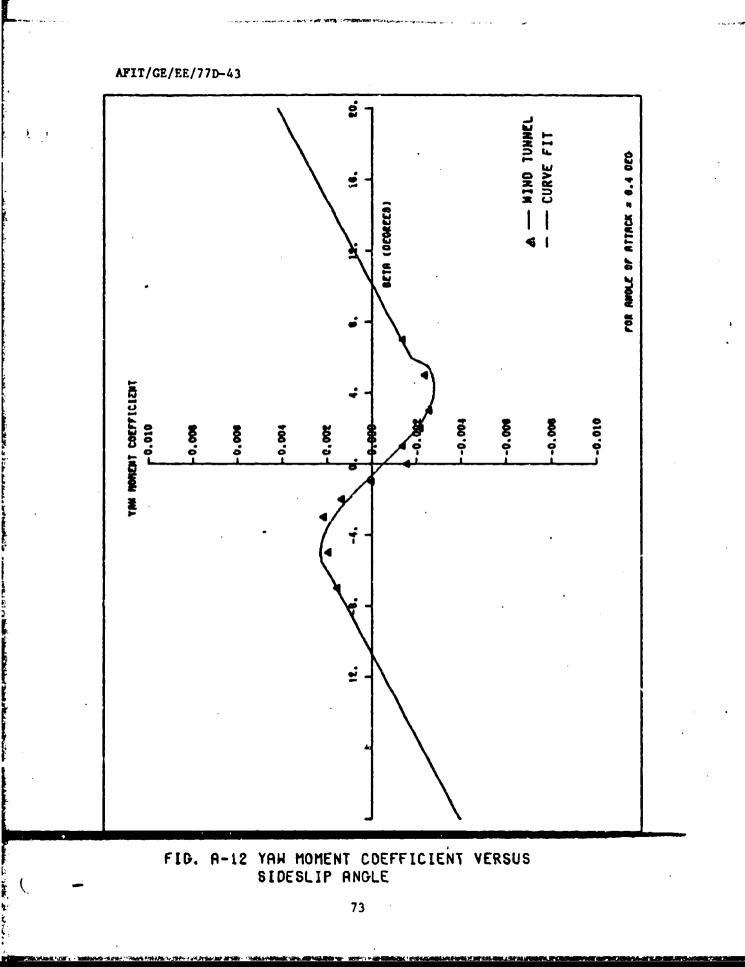


## FIG. A-9 YAH MOMENT COEFFICIENT VERSUS SIDESLIP ANGLE





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## Appendix B

## Computer Program Listing

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BEST A

	GY#=6,35E=3*3E**3+1.68E=5*3E**2=1.33E=2*8E+2.56E=3
	CROLL = 1. 1 495 - 3. 95 - 2. 355 - 3
	GO TC 2000
30	GYAN=+++2E-++9E+1+54E-3
	IF(A95(36).GT, 30.) GO TO 2000
	_CY#-4.39E+3*3E+3*3E+3.68E+5*3E <u>**2+1.33F+2*8E+2.56E+3</u> _CPOLL#+1.1%8E+3*9E+2.35#E+3
	GO TO 2000
	CYAN+4,42E+4+8E+, 0025
	1F(ABS(9E).GT.30.) GO TO 2000
	CY=+4, 38E-5*9E**3+1,68E-5*3E**2-1,33E-2*8E+2,56E-3
• •	CROLL == 1. 1485-3*8E-2. 3555-3
· · ·	GO TO 2000
_C A	NGLE OF ATTACK IS LESS THAN 3.0
- 180	CD=CC1+(-5.142-6*A9S(BE)**3+3.03E-4*A8S(BE)**2-2.37E+4*A8S(BE)) *C
	(98)
	IF (A25 (9E) . GE. 60.) GO TO 2000
	_IF(BE,LT,-?.)_GO_TO_50
	IF(92.62.7.) GO TO 60
•	GYA H=-7.0E-1-3E**5-1.07E-6*3E**4+1.85E-5*8E**3+7.42E-5*8E**2-1.13E
	X+3+8E+1,34E+3
	CY=3, 03=-7*3?**5+2, 14E-6*85**4-9, 83E-5*8E**3-1, 64E-6*8E**2-7, 21E-
	KJ*82+5.162-3
	CPOLL = 1.501E - 3*8E - 1,26E - 3 GO TO 2000
e á	GYANE+, 32++*95+5, 672-3
	IF(A25(35).67.3).) GO TO 2000
	CY=3.03=-7+35++5+2.14E+6+9=++4+9 .83E+5+8E++3-1.64E+4+9E++2+7.21E+
	X3*8E+8.16E+3
	CFOLL=-1.5715-3*9E-1.265-3
	GO TO 2000
60	CYAN= 4. 35- +*95-5. 895-3
	1F(A95(32).GT.30.) GO TO 2000
	GY#3.03E-7*8E**3+2.1+E-6*8E**+-9 .83E-5*8E**3-1.64E+4*8E**2-7.21E-
	X3*3E+8.16E-3
	GROLL==1.52:E=3*BE=1,26E=3
	60 10 2000
	NGLE OF ATTACK IS LESS THAN 5.3
190	GD+CD1+(-4,122+3*A9S(82)**3+2,52-4*A8S(8E)**2-2,34E-4*A8S(8E))*COS
	K(BR) 15 (A95 (82).55.60.) GO TO 2000
	IF(95.LT.+7.) GO TO 70 IF(85.GE.7.) GO TO 80
	CVAN=-4.141-7*81**5-7.876-7*86**4.44.36E-5*85**3+6.546-5*83**2-1.47
	XE+3*95-1.832+3
	CY=2,93=-6*3=**3+3,72E-7*8=**4-2,83E-4*8E**3-1,9E-5*8E**2 -4,86E-3
	K*BE+1, 36:-?
	GROLL =-1. 9775-3-95-1. 5555-3
	GO TO 2000
70	CVAH=4.3E-4*9=+4.82E+3
	IF (ABS (9E).GT. 30.) GO TO 2000
	CY=2,932-6+9E++5+3,72E-7+82++4-2,83E-4+0E++3-1,9E-5+8E++2-4,0 <u>6E-3</u>
	x+9=+1,,36=-2
	CPOLL == 1, 9*7 == 3*9 == 1, 555 == 3
	GO TC 2000
	CYANZ4.5E-4-3E-5.05E-3 IF (A95 (95),5T, 30.) 50 TO 2030
<del></del>	CY=2,93=6*3;**;*3,72E=7*9E**4=2,83E*4*3E**3=1,9E*5*8E**2 =4.06E=3 **8E*1,36E=2
	GPOLL==1.977E+3*8E=1.555E=3
	GO TO 2000
C A	NGLE OF ATTACK IS GREATER THAN 5.
ີ້ 1 95	CD=C01+(2,152-5*ANS (NE) ** 3+1,512+4*A85 (3E) **2+1.24E+3*A95 (8E) J*C05
	1F (ABS (32).65.60.1 GO TO 2000
	1F(NE+LT++7+) 60 TO 90

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IF(85.GE.7.) GO TO 100
GYAH=1.28E-5*RE**3+1.23E+5*3E**2-8.21E-4*8E-5.33E+4
GV41.765-6*32**5-1 .915-7*93**4-1.6E++*95**3+2.72E-5*8E**2-5.82E-3
X+ RE+1. 04E-2
GROLL = -2. 3925 - 3 + 95 + 1. 445 - 3 GO TO 2000 90 CVAN =
90 CYAN==,242+6+68++,0045
GY#1.76E-E*3E**5+1 .91E+7*9E**4+1.6E-4*3E**3+2.72E+5*8E**2-5.82E-3
X+PE+1.04E-2
CFOLL = -2. 302E - 3.8E - 1.445 - 3
6C TO 2000
108 CYANE4. 24E-4+9E-4. 35-3
IF(495(96).GT.30.) GO TO 2000
GV=1,7EI-6=8I**J-1 ,9IE-7*3I**4+1,8E+4*8E**3+2,7ZE+5*8E**2+5,8ZE+3
X+8=+1+04=-2
GEOLL = -2. 302 - 3*8E - 1.445E - 3
2000 CONTINUS
C DERIVATION OF DIMENTIONAL DERIVATIVES (STABILIT Y AXIS) ZMDS=-RH0+3+C/4++CLADR
ZOS=+OS/VI+C/2.+CLQR
ZČELS#-05*3LELR
HUDS= 9+ 0+ 5+ 0+ 2+ 0+ 4 0R/4.
MOS=05/VT+2++2+CHDR/2.
MDF1 5=C54C4F1 2410.
¥DR=25+ CY
NCR#US*3+CTAN
LC9+C5+3+C3OLL YK5+3HC+S3/4. #CYRR
TRS=4HU-S-374+-57R4
TF38880-3-3744-5-18
NPS=05/VT=3==2/4. *CHRR
NPS+CS/VT+3++2/4,+CNPP LPS+CS/VT+3++2+CL9P/2,
LPS+05/VT+3++2+0LP3/2
LOELS=OS+E+CLAIL
XOS=0. \$XW35=0. \$HDELS=0.
C DERIVATION OF DIMENTIONAL DERIVATIVES (BODY AXIS FROM STADILITY AXIS)
X0+CL+0S+SIV(AR)+CD+0S+COS(AR) Z0++CL+0S+CO5(AR)+CD+0S+SIN(AR)
20=+CL+03+303 (AR)+CD+05+SIN (AR)
ND=CH+CS+C
MD=CH+CS+C XHD=(XHDS+COS(AR)+*2-ZHDS+SIN(AR)+CDS(AR))+COS(BR)
ZAD=(ZHDS=005(AR) + 2+XHDS=SIN(AR)=COS(AR))=COS(BR)
MAD=+++05*C35(4R)+C35(3R)
YP=YFS+005(4R)+YRS+51H(AR) YR+YPS+C05(1R)+YP5+51H(4R)
x0Ev-Z0ELS+SIN(AR)+COS(3R)
XC=(XOS*CC3)(A2)-70S*S1)(A2))*COS(90)
Z0= (705*C03(4P)+X05*511(AR))*C05(BR)
202+202LS+335(AR)+335(9R)
LP= (LPS+CO3(AR)++2+(LP3+HPS)+SIH(AR1+COS(AR)+NRS+SIN(AR1++2)+COS(0
XK)
LDA+(LDELS*COS(3R)+NDELS*SIN(AR))*COS(0R)
LR= (LRS+CO3(AP)++2- (NP5+LP5)+5I4(AR)+COS(AR)+NP5+SIN(AR)++2)+COS(B
X61.
NP= (NPS+COS(AR)++2-(NPS-LPS)+SI4(AR)+COS(AR)+LRS+SIN(AR)++2)+COS(8
XR) NK= (NRS+C03(AR)++2+ (LPS+NPS)+SIN(AR)+C0S(AR)+LPS+SIN(AR)++2)+C05(B
XA)
MORNOS SHOELS
20 CONTINUE
NO LO+NO STOTLO+NDE 170 LO-ZO STADLO-ZAO TZO LO-ZO SZOTLO-ZOE
MO LOPMO SHADLOFMAD IMO LOPMO SHEELOFMOE SYR LDFYR SYD LOPYD
YP LOFYP SLA LOFLA SLP LOFLA SLA LOFLA SLALGELDA ANA LOFNA
NP LOANP SHE LOANP BOS AVEOS SELFLOACLE PALTSOFALT SAL AVEAL
HE AVIDE ITO AVIPO SFC AVIPO SVI AVIVI SOD AVIDO INSPIJZ
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LOCATION#142.EN FORTRAN STATEN, NTS APH=330+. 81+18.47\*TH EN-1.8.E-2"TH EN\*\*2+9.23E-6\*TH EN\*\*3-1.67E-9" XTH 5N++4 CALL FMINY FN.POHFM.PTKFH.PPLFH.VTKS2.PFNFH.OFNFH.QFXFH. 10 IPPF IN, CSSEN, RPT, VOSEN, RHOFN, JVKEN, VPLEN, DVPEN, 1H.CSSEN.RPY. VSSEN.RHOPH.JVKEN.VPLEN.DVFE. DVCEN.SKIEM. 2 ALTSJ.ROLSJ.PITSJ.PHEJOT.THEODT.VCHSZ.ACHSZ.U SD.N SD.AL AV.P X SD.G SD.A S.AH, MSS.AL, TEM.HTI, OP1,RI TK, RZ TK,LI XIK,LZ TK,PHIIK, IX ST.FY ST.TZ ST.YANSD.XZ IT 3,0PTFH.OTC XFF.OTAFH,ATKCH,ATKAT,ATKCHC,ATKATC,OCHAT,V SD.PH2TK1LIS1,LZIS1,L XSH40E1 SX=ROLSD+ (=0 AV) + ABS (PO AV) / (2. + UHAX+8.14E=3) \*\*\*\*\*\*\*\*\*\*\*\*\*\* IF(SX.GT.O.)TYCON=-UMAX+20. \_\_\_ IF(SX.LT. 0.)TXCON= UMAX+20. IF((SX.EQ. 0. ). AND. (PO AV. GT. 0. )) TXCON=-UHAX+20,\_ IF((SY.EC. J. I. ANJ. (PO AV. LT. 0. )) TYCON=UHAX+20. IF ( (A3S(RO\_SD) . :0. 7. 0) . AND. (4 3S(FO AV).EC. 0. 0) ) TXCON=0. UYTHAX=TH EN/23. SIECE-0.30 + 20 SJ- XZ IT 1 SYTX=94450-SIEQ+R S0+495 (R S0)+183.1F / UYTHAK ----IF(SYTX,GT.0,)TZCOVE-UYTHAX410, IFISTTA.LT. 0. ITTCON= UYTHAX .10. \*\*\*\*\*\*\*\*\*\*\* C+ IF(SXFITCH.GT. 0.) TYCON=-UMAX\*12. IF(SXPITCH.LT. 0.) TYCON= UHAX\*12. IF((5YPITC+.23.0.).ANC.(00 AV.GT.0.))TYCCN=-U4AX\*12. IF((5XPITC+.23.0.).AND.(00 AV.LT.C.))TYCCN= UHAX\*12. IF((495(PIT50).=0.0.0), AND. (ABS(00 AV).EC.0.0)) TYCON=0. **C** TX353=TXCOV STV353=TVCOV ST2353=TZCON SF2253=+FY ST STX253=TX ST TY253=72 ST LOCATION=124,53, INPUTS=EN LOCATION=12+LO, INPUTS=AV, S3.HC\_1(X=ELE) LGCATION=44.LD. IVPUTS=AV.LO.S3.HC 2(X=AIL) LOCATION=37.50.INPUTS=LO.LO FORTRAN STATEMENTS LLEC=.25\*(2 SD-0.)+.533\*(PITSD-0.) X1 TF+ELEC\_ LOCATION=149,TF LOCATION=147.11 7. INPUTS=TF LOCATION:157,MC 1.INPUTS:TF.IT 7.IT 8 FORTRAN STATEMENTS IF(X4 HC 1.55.10.) X4 HC 1=10. IF(X4 HC 1.15.10.) X4 HC 1=10. IF(X4 HC 1.16.-15.) X4 HC 1=-15. LOCATION=155.IT 3.INPUTS=HC 1 LOCATION=51.IT 3.INPUTS=S0((A=X)) LOCATION=39 .IT 1.INPUTS=SD(YD=X) FOPTRAIL STATEMENTS AILC# .196\*(P SD+0.)+.42\*(ROL50+0.)+.2\*R SD X1 TF Z=AILC LOCATION=248.IF 2 LOCATION=245.11 3.149415=17 2 LOCATION=266.46 2.149413=17 2.11 3.1110 FORTRAN STATENENTS 1FEX4 -0 2.56.8. 1 X4 HC 214. 1FEX- HC 2.LE. - A. 3 XL HC 21-8. LOCATION=254.IT1). INPUTS+HC 2 END OF HOCEL

FORTRAN STATEMENTS
SUAROUTINE FACHA, PCH. PTK, PPL, VTK, PFN, OFN, OFX, IPP, CSS, PP4, VCS, R
1HO, DVK, VPL, DVP, DVR, SKT, YCG, THI, PHENOT, PHENOT, THEODT, VCHS2, ACHS2 ,U
1. N. AL . F. Q. R. AH. 455. PAT. TEN. HY OP1. RI TK. R? TK. LI TK. L
K2 TK.PHITK, TX ST.FY ST.TZ ST.SIE.XCG.OPTFM.OTCFM.QTAFM.ATCSZ.
XATAS2, 43052, 44032, 43447, V. PH2TK, L1151, L2151, ISHAPE1
REAL L.LS. MASS. LX.LIISI.LIX.L2ISI.LZTK.MSS
DINENSION Y(13), SY(13), DELTA(32), SL4CO(22), ZCXSE(32), YCXSE(32),
x.0ELSE(32),ITYSE(32),KCISE(32),ZCISE(32),ISGSE(32),VTIS1(32)
X.4CIS1(32),YGHCL(32),ACF52(32),ATIS2(32),PSRS2(32),ATRS2(32)
X, XCH52(32 1, XTK52(32 1, 2CH52(32 1, 2TK52(32 1, 0Y ST(13), YG PR(32 1,
XYO(13), Y1(13), Y2(13)
DATA 91.RAJIAN/J.141592553.0.0174532/
CTIME*+0003 STINC*1+
C ATP CUSHION LANDING SYSTEM PROGRAM
MSS=77.3 54+4 \$4+4 \$CKK=1.4 SCAF=.5 \$NSP=32 \$VCD=0. SCC=1.17 GG= 1.5 5F=0. SPAT=21.5.3 BLS+4.125 \$D=.417 \$A=.695 \$E
GG# 1.5 #FF#C. SPAT#2115.3 3LS#6.125 \$D=.417 \$A=.895 \$E
E= 524 6L=5.17 SHYI=1.0 SHX=3 SNH=195 SAH=3.4E=4 \$SH#.0933 \$LX=0.80
CG2#.5 SGCC#.1 SCCX# 1.17 \$TEM#70.
THEDOT=P \$2HEDOT=Q \$5KT=-H
NASS=MSS STEMPATATEM
THITAS THE SPHILS PHILS OF IS PHE COT SOTHETA THEOOT
NSTO®=NSE' SPPLM=PPL
C DATA ACOUISITION
VPLH=.313 5VFAN=.468
VPL=VPLN+VSAN
00 100 I=1,NSTOP
DELTA(I) = 0.0
100 CONTINUE
RH0+1.241/(450.0+TENPAT)
HA=HAI
C NINIPUM TRUNK HEIGHT IS PARKING ALATTER HEIGHT
WYEAMAX1(WY78)
HY=AHAX1(HY++73)
HYEANAX1(HY78) CALL TK(ISYTK,PH2TK,P2 TK,P1 TK,FH1TK,L1 TK,L2 TK,HY,A1E,L,LS)
HYEANAX1(HY78) CALL TK(ISYTK,PH2TK,P2 TK,P1 TK,FH1TK,L1 TK,L2 TK,HY,A1E,L,LS) ISHAPE=ISHTK
HYEANAX1(HY78) CALL TK(ISYTK,PH2TK,P2 TK,P1 TK,FH1TK,L1 TK,L2 TK,HY,A1E,L,LS) ISHAPE=ISHTK
HYEAHAAI(HY., 78) CALL TK(ISYTK, <u>PH2TK, P2 TK, P1 TK, PH1TK, L1 TK, L2 TK, HY, A1E, L, LS)</u> ISHAPE.ISHTK IF(ISHAPE.:0, 0) GO TO 199
HYEAHAXI(HY.,78) CALL TK(ISYTK, <u>PH2TK,P2 TK,P1 TK,PH1TK,L1 TK,L2 TK,HY</u> ,A <u>1E,L,LS</u> ISHAPE-ISHTK <u>IF(ISHAPE,:0,0) GO TC 199</u> ICLFP=0
HYEAHAAI(HY., 78) CALL TK(ISYTK, <u>PH2TK, P2 TK, P1 TK, PH1TK, L1 TK, L2 TK, HY, A1E, L, LS)</u> ISHAPE.ISHTK IF(ISHAPE.:0, 0) GO TO 199
HYEAHAXI (HY., 78) CALL TK(ISYTK, PH <u>2TK, PZ TK, PI TK, PHITK, LI TK, LZ TK, HY</u> , A <u>1E, L, LS</u> ) ISHAPE+ISHTK IF(ISHAPE, <u>30, 0)</u> GO TO 199 ICLFP=0 CALL SE(ITYSE, BE, DY SE, ZCXSE, XCXSE, DELSE, XCISE, ICLFM, RZ T
HYEAHAXI (HY., 78) CALL TK(ISHTK, PHZTK, PZ TK, PI TK, FHITK, LI TK, LZ TK, HY, A, E, L, LS) ISHAPE, ISHTK IF(ISHAPE, :0, 0) GO TO 199 ICLFMAD CALL SE(ITYSE, 95, SE, DY SE, ZCXSE, XCXSE, DELSE, XCISE, ZCISE, ICLFM, RZ T IK, PHZTK, DZISI, LS, M, N, O, ISGSE)
HY=AMAX1(HY,.73)         CALL TK(ISHTK, PH2TK, PZ TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS)         ISHAPE, ISHTK         IF(ISHAPE, IO, D) GO TO 139         ICLFP=0         CALL SI(ITYSE, 9] SE.DY SE.ZCXSE, XCXSE, DELSE, XCISE, ICLFM.RZ T         IK, PH2TK, DZISI, LS, M. N.O. (SGSZ)         CALL SI(021S1, A1 S1, A2 S1, SI S1, CI S1, DXIS1, 021S1, L2IS1, RAIS
HYEAHAXI (HY., 78) CALL TK(ISHTK, PHZTK, PZ TK, PI TK, FHITK, LI TK, LZ TK, HY, A, E, L, LS) ISHAPE, ISHTK IF(ISHAPE, :0, 0) GO TO 199 ICLFMAD CALL SE(ITYSE, 95, SE, DY SE, ZCXSE, XCXSE, DELSE, XCISE, ZCISE, ICLFM, RZ T IK, PHZTK, DZISI, LS, M, N, O, ISGSE)
HY#AMAX1(HY.,78)         CALL TK(ISYTK, PM2TK, PZ TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS)         ISHAPE.ISHTK         If(ISHAPE.:0, 0)         GALL SE(ITYSE.9]         SE.07 SE.20x3E, XCXSE, DELSE, XCISE. ZCISE.ICLFM.R2 T         IK.PH2TK.02IS1.LS, H.N.O.ISGS2)         CALL SI(02IS1.41 S1.42 S1.51 S1.01 S1.0XIS1.EIS1.L1IS1.L2IS1.R1IS         11.P2IS1.SNIS1.PH2TK.P2 TK.0X SE.EE SE.HY.R1 TK, PH1TK.ICLFM.L1 TK.L
$\begin{array}{c} HY=AMAX1(HY,,73)\\ CALL TK(ISYTK,PZTK,PZTK,PZTK,PLTK,L1TK,L2TK,HY,A_{F}E,L_{L}LS)\\ ISHAPE_{s}ISHY\\ If(ISHAPE_{s};O,O)  GO \; TC \; 139\\ IC(FPsO)\\ CALL \; S:(ITYSE,SI \; SE,OY \; SE,ZCXSE,ACXSE,OELSE,XCISE,ZCISE,ICLFM,RZ \; T\\ IK,PH2TK,O2IS1,LS,H,N,O,ISGSE)\\ CALL \; S:(O2IS1,LS,H,N,O,ISGSE)\\ CALL \; S:(O2IS1,A1 \; S1,A2 \; S1,S1 \; S1,CI \; S1,OXIS1,SIS1,L1IS1,L2IS1,RIIS\\ I1,PZIS1,SH1S1,OH2TK,P2 \; TK,OX \; S2,SE \; SE,HY,R1 \; TK,PH1TK,ICLFH,L1 \; TK,L\\ X2 \; TK,ITYS2,O,A,E,N, \; H,VTIS1,ACIS1,LS)\\ \end{array}$
HY#AMAX1(HY.,78)         CALL TK(ISYTK, PM2TK, PZ TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS)         ISHAPE.ISHTK         If(ISHAPE.:0, 0)         GALL SE(ITYSE.9]         SE.07 SE.20x3E, XCXSE, DELSE, XCISE. ZCISE.ICLFM.R2 T         IK.PH2TK.02IS1.LS, H.N.O.ISGS2)         CALL SI(02IS1.41 S1.42 S1.51 S1.01 S1.0XIS1.EIS1.L1IS1.L2IS1.R1IS         11.P2IS1.SNIS1.PH2TK.P2 TK.0X SE.EE SE.HY.R1 TK, PH1TK.ICLFM.L1 TK.L
$\begin{array}{c} HY=AMAX1(HY,,73)\\ CALL TK(ISYTK,PZTK,PZTK,PZTK,PLTK,L1TK,L2TK,HY,A_{F}E,L_{L}LS)\\ ISHAPE_{s}ISHY\\ If(ISHAPE_{s};O,O)  GO \; TC \; 139\\ IC(FPsO)\\ CALL \; S:(ITYSE,SI \; SE,OY \; SE,ZCXSE,ACXSE,OELSE,XCISE,ZCISE,ICLFM,RZ \; T\\ IK,PH2TK,O2IS1,LS,H,N,O,ISGSE)\\ CALL \; S:(O2IS1,LS,H,N,O,ISGSE)\\ CALL \; S:(O2IS1,A1 \; S1,A2 \; S1,S1 \; S1,CI \; S1,OXIS1,SIS1,L1IS1,L2IS1,RIIS\\ I1,PZIS1,SH1S1,OH2TK,P2 \; TK,OX \; S2,SE \; SE,HY,R1 \; TK,PH1TK,ICLFH,L1 \; TK,L\\ X2 \; TK,ITYS2,O,A,E,N, \; H,VTIS1,ACIS1,LS)\\ \end{array}$
HY=AMAX1(HY,,78) CALL TK(ISYTK,PH2TK,P2 TK,P1 TK,FH1TK,L1 TK,L2 TK,HY,A1E,L,LS) ISHAPE=ISHTK IF(ISHAPE=IG,0) GO TO 199 ICLFM=0 CALL SI(ITYSE.9I SE.07 SE.7CXSE,XCXSE,DELSE,XCISE,ZCISE.ICLFM.RZ T IK,PH2TK,D2ISI.LS,M.N.O.ISGS2) CALL S1(02IS1,A1 S1.42 S1,SI S1.0I S1.0XIS1.9EIS1.LIS1.L2IS1.RAIS 11.PZIS1.SNIS1.0H2TK.92 TK.OX SE.8E SE.HY.R1 TK,PHITK.ICLFM.L1 TK,L Y2 TK.ITYSI.5.4.IN.N.VIIS1.4CIS1.LS) FPLN=37.023-3.17E-2*RF4.5.33E-6*FPM**2-2.086E-10*RPM**3 PFANEPELM
HY#AMAX1(HY,.78)         CALL TK(ISYTK, PH2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS)         ISHAPE.ISHTK         IF(ISHAPE.iO, 0)         GO TO 199         ICLFP=0         CALL SI(ITYSE.9]         SE.10, 0)         GALL SI(ITYSE.9]         SE.07         CALL SI(ITYSE.9]         SE.07         CALL SI(ITYSE.9]         SE.10, 0)         ISST         CALL SI(1751.4]         SI(02151.4]         SI.42         SI.51.51.51.51.51.51.51.51.51.51.51.51.51.
HY=AMAX1(HY,,78) CALL TK(ISYTK,PH2TK,P2 TK,P1 TK,FH1TK,L1 TK,L2 TK,HY,A1E,L,LS) ISHAPE=ISHTK IF(ISHAPE=IG,0) GO TO 199 ICLFM=0 CALL SI(ITYSE.9I SE.07 SE.7CXSE,XCXSE,DELSE,XCISE,ZCISE.ICLFM.RZ T IK,PH2TK,D2ISI.LS,M.N.O.ISGS2) CALL S1(02IS1,A1 S1.42 S1,SI S1.0I S1.0XIS1.9EIS1.LIS1.L2IS1.RAIS 11.PZIS1.SNIS1.0H2TK.92 TK.OX SE.8E SE.HY.R1 TK,PHITK.ICLFM.L1 TK,L Y2 TK.ITYSI.5.4.IN.N.VIIS1.4CIS1.LS) FPLN=37.023-3.17E-2*RF4.5.33E-6*FPM**2-2.086E-10*RPM**3 PFANEPELM
HY=AMAX1(HY,.78) CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS) ISHAPE=ISHYK IF(ISHAPE.:0, 0) GO TC 139 ICLFF=0 CALL S:(ITYSE.9I SE.0Y SE.7CXSE, VCXSE, 0ELSE, XCISE, ZCISE, ICLFM, RZ T IK, PM2TK, D2IS1, LS, H.N.D, ISGSC) CALL S:(OZIS1, A1 S1, A2 S1, SI S1, CI S1, DXIS1, EIS1, L1IS1, LZIS1, RAIS II, PZIS1, SHIS1, OM2TK, P2 TK, DX SE, EE SE, HY, RI TK, PHITK, ICLFM, L1 TK, L X2 TK, ITYS:, 0, A, E, N, M, VTIS1, ACIS1, LS) FPLM=37, 023-3, 17E-2*RFM+5, 33E-6*FPM+*2-2, 086E-10*RPM**3 PFAN=PFLM C INPUT PRESSURE AND DUTPUT FLOW IF((PPM, GE, 11937.), AMC, (PPM, LT, 12075.)) GO TO 87
HY=AMAX1(HY,.78)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS)         ISHAPE:ISHTK         IF(ISHAPE.:O, 0)       GO TO 139         ICLFP=0         CALL S:(ITYSE.9]       SE.07 SE.272SE, XCXSE, DELSE, XCISE, ZCISE.ICLFM.R2 T         IK.PH2TK.02ISI.LS.H.N.O.ISGSE)         CALL S:(02IS1.A1 S1.42 S1.5I S1.0I S1.0XIS1.0EIS1.LIS1.L2IS1.R1IS         1.PZISI.SHIS1.0H2TK.22 TK.0X SE.0E SE.HV.R1 TK, PHITK.ICLFH.L1 TK, L         YZ TK.ITYS.0.4.F.N.M.VTIS1.ACIS1.LS)         FPLM:37.023-3.172-2*RFH45.33E=6*RPH**2-2.086E=10*RPH**3         PFAN:PFLM         C INPUT PRESSURE AND DUTPUT FLOW         IF((0PM.GE.11937.).AND.(PPM.LT.12075.)) GO TO 87         IF((0PM.GE.11937.).AND.(RPM.LT.12213.))
HY=AMAX1(HY,.78)         CALL TK(ISYTK, PH2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS)         ISHAPE, ISHTK         IF(ISHAPE, IG, D)         GOL SI(ITYSE, 9]         SE, DY SE, DY SE, ZCXSE, XCXSE, XCISE, ZCISE, ICLFM, RZ T         IK, PH2TK, D2ISI, LS, M, N, O, ISGSZ)         CALL SI(ITYSE, 9]         SE, DY SE, ZCXSE, XCXSE, VCISE, ZCISE, ICLFM, RZ T         IK, PH2TK, D2ISI, LS, M, N, O, ISGSZ)         CALL SI(02ISI, A1 S1, A2 S1, SI S1, CI S1, DXISI, PISI, LIISI, L2ISI, RAIS         11, PZISI, SNISI, 0H2TK, 22 TK, DX SE, EE SE, HY, R1 TK, PHITK, ICLFM, L1 TK, L         Y2 TK, ITYSE, JA, I, N, H, VTISI, ACISI, LS)         FPLN=J7, 023-3, 17E-2*RF14+5, 33E-6*FPM**2-2, 086E-10*RPH**3         PFAN*PFLM         C INPUT PRESSURE AND DUTPUT FLOM         IF((PPH, GE, 12075, ), ANC, (PPH, LT, 12075, )) GO TO 87         IF((PPH, GE, 12075, ), ANC, (PPH, LT, 12713, 1) GO TO 88         IF((PPH, GE, 12075, ), ANC, (PPH, LT, 1233, 1), GO TO 88
HY=AMAX1(HY,.78)         CALL TK(ISYTK, PH2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS)         ISHAPE, ISHTK         IF(ISHAPE, IG, D)         GOL SI(ITYSE, 9]         SE, DY SE, DY SE, ZCXSE, XCXSE, XCISE, ZCISE, ICLFM, RZ T         IK, PH2TK, D2ISI, LS, M, N, O, ISGSZ)         CALL SI(ITYSE, 9]         SE, DY SE, ZCXSE, XCXSE, VCISE, ZCISE, ICLFM, RZ T         IK, PH2TK, D2ISI, LS, M, N, O, ISGSZ)         CALL SI(02ISI, A1 S1, A2 S1, SI S1, CI S1, DXISI, PISI, LIISI, L2ISI, RAIS         11, PZISI, SNISI, 0H2TK, 22 TK, DX SE, EE SE, HY, R1 TK, PHITK, ICLFM, L1 TK, L         Y2 TK, ITYSE, JA, I, N, H, VTISI, ACISI, LS)         FPLN=J7, 023-3, 17E-2*RF14+5, 33E-6*FPM**2-2, 086E-10*RPH**3         PFAN*PFLM         C INPUT PRESSURE AND DUTPUT FLOM         IF((PPH, GE, 12075, ), ANC, (PPH, LT, 12075, )) GO TO 87         IF((PPH, GE, 12075, ), ANC, (PPH, LT, 12713, 1) GO TO 88         IF((PPH, GE, 12075, ), ANC, (PPH, LT, 1233, 1), GO TO 88
HY=AMAX1(HY,.78) CALL TK(ISYTK,PM2TK,P2 TK,P1 TK,FH1TK,L1 TK,L2 TK,HY,A,E,L,LS) ISHAPE=ISHYK IF(ISHAPE=:G,0) GO TC 199 ICLFF=0 CALL S:(ITYSE.BI SE.DY SE.ZCXSE,XCXSE,QELSE,XCISE,ZCISE.ICLFH,R2 T IK,PM2TK.D2IS1,LS,H.N.D,ISGSE) CALL S:(ITYSE.BI SE.DY SE.ZCXSE,XCXSE,QELSE,XCISE,ZCISE.ICLFH,R2 T IK,PM2TK.D2IS1,LS,H.N.D,ISGSE) CALL S:(OZIS1,A1 S1.A2 S1.SI S1.CI S1.DXIS1.EIS1.LIS1.LZIS1.R1IS II.PZIS1.SHIS1.0H2TK.P2 TK.DX SE.EE SE.HY.R1 TK,PHITK.ICLFH.L1 TK,L YZ TK.ITYS:,D:A.E,N.H.VIIS1.ACIS1.LS] FPLM=57.023-3.17E-2*RFH+5.53E-6*EPM*>2-2.086E-10*RPH**3 PFAN=9FLM C INPUT PRESSURE AND DUTPUT FLOW IF((PPH.GE.11937.).AND.(PPH.LT.12075.)) GO TO 88 IF((PPH.GE.12351.).AND.(PPH.LT.12351.)) GO TO 88 IF((PPH.GE.12351.).AND.(PPH.LT.12351.)) GO TO 89 IF((PPH.GE.12351.).AND.(PH.LT.12351.)) GO TO 89
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         If(ISHAPE=:D, 0)       GO TC 139         ICLFF=0         CALL SE(ITYSE.BI SE.DY SE.ZCXSE, XCXSE, NELSE, XCISE, ZCISE, ICLFH, R2 T         IK.PH2TK.D2ISI.LS.H.N.O.ISGSC)         CALL SE(ITYSE.BI SE.DY SE.ZCXSE)         CALL SE(ITYSE.BI SE.DY SE.ZCXSE)         YE         ICLFF=0         CALL SE(ITYSE.BI SE.DY SE.ZCXSE)         YE         ICLFF=0         CALL SE(ITYSE.BI SE.DY SE.ZCXSE)         YE         IF         IF         YE
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         If(ISHAPE=:D, 0)       GO TC 139         ICLFF=0         CALL SE(ITYSE.BI SE.DY SE.ZCXSE, XCXSE, NELSE, XCISE, ZCISE, ICLFH, R2 T         IK.PH2TK.D2ISI.LS.H.N.O.ISGSC)         CALL SE(ITYSE.BI SE.DY SE.ZCXSE)         CALL SE(ITYSE.BI SE.DY SE.ZCXSE)         YE         ICLFF=0         CALL SE(ITYSE.BI SE.DY SE.ZCXSE)         YE         ICLFF=0         CALL SE(ITYSE.BI SE.DY SE.ZCXSE)         YE         IF         IF         YE
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE:ISHTK         IF(ISHAPE::O, 0) GO TO 139         ICLFP=0         CALL S:(ITYSE.9] SE.DY SE.ZCXSE, XCXSE, DELSE, XCISE, ZCISE.ICLFM.R2 T         IK.PM2TK.02ISI.LS.H.N.O.ISGSE)         CALL S:(ITYSE.9] SE.DY SE.ZCXSE; XCXSE, DELSE, XCISE.ZCISE.ICLFM.R2 T         IK.PM2TK.02ISI.LS.H.N.O.ISGSE)         CALL S1(02IS1, A1 S1.42 S1, SI S1.01 S1.0XIS1.0EIS1.LIS1.L2IS1.R1IS         11.PZIS1.SHIS1.0M2TK.22 TK.0X SE.0E SE.HV.R1 TK, PHITK.ICLFH.L1 TK, L         X2 TK.ITYS:0.4.F.N.M.VTIS1.ACIS1.LS)         FPLM:37.023-3.172-2*RFH45.33E=6*RPH*2=2.086E=10*RPH**3         PFAN:PFLM         C INPUT PRESSURE AND DUTPUT FLOW         IF((0PM.GE.11037.).AND.(RPM.LT.12075.)) GO TO 87         IF((0PM.GE.11037.).AND.(RPM.LT.12075.)) GO TO 88         IF((12PF.GL.1217.).AND.(RPM.LT.12331.)) GO TO 88         IF((12PF.GL.1217.).AND.(RPM.LT.1249.)) GO TO 90         IF((12PF.GL.1217.).AND.(RPM.LT.12675.)) GO TO 91         IF((12PF.GL.12627.).AND.(RPM.LT.12675.)) GO TO 91         IF((RPM.GE.12627.).AND.(RPM.LT.12675.)) GO TO 91         IF((RPM.GE.12627.).AND.(RPM.LT.12675.)) GO TO 91
HY=AMAX1(HY.,78) CALL TK(ISYTK,PM2TK,P2 TK,P1 TK,FH1TK,L1 TK,L2 TK,HY.A,E.L,LS) ISHAPE*ISHYK IF(ISMAPE*ISHYK IF(ISMAPE*ISHYK IF(ISMAPE*ISHYK CALL SI(ITYSE.9I SE.DY SE.ZCXSE,XCXSE,DELSE,XCISE.ZCISE.ICLFM.R2 T IK.PM2TK.D2IS1.LS.M.N.D,ISGS2) CALL SI(0ZIS1.A1 S1.42 S1.SI S1.CI S1.DXIS1.0EIS1.L1IS1.L2IS1.R1IS I.P2IS1.SNIS1.0M2TK.92 TK.DX SE.EE SE.HY.R1 TK,PHITK.ICLFM.L1 TK,L Y2 TK.ITYS:,DLA.E.N.M.VTIS1.ACIS1.LS) FPLM=37.023-3.17E-2*RFM+5.33E-6*FPM*2-2.086E-10*RPM**3 PFAN=9FLM C INPUT PRISSURE AND DUTPUT FLOM IF((0PM.GE.11937.).AND.(PPM.LT.12075.)) GO TO 87 IF(0PM.GE.12351.).AND.(PM.LT.1275.)) GO TO 88 IF(12PM.GE.12351.).AND.(PM.LT.1249.)) GO TO 90 IF(12PM.GE.12351.).ANC.(PM.LT.12627.)) GO TO 91 IF(10PM.GE.12657.).ANC.(PM.LT.12675.)) GO TO 92 IF(10PM.GE.12657.).ANC.(PM.LT.12675.)) GO TO 93 IF(10PM.GE.12657.).ANC.(PM.LT.12675.)) GO TO 93 IF(10PM.GE.12657.).ANC.(PM.LT.12675.)) GO TO 93 IF(10PM.GE.12657.).ANC.(PM.LT.12675.)) GO TO 93 IF(10PM.GE.12657.).ANC.(PM.LT.1263.)) GO TO 93 IF(10PM.GE.12657.).ANC.(PM.LT.1267.)) GO TO 93 IF(10PM.GE.12657.).ANC.(PM.LT.1263.)) GO TO 93 IF(10PM.GE.12657.).ANC.(PM.LT.1263.)) GO TO 93 IF(10PM.GE.12765.).ANC.(PM.LT.1263.)) GO TO 93 IF(10PM.GE.12765.).ANC.(PM.LT.1263.)) GO TO 93 IF(10PM.GE.12765.).ANC.(PM.LT.1263.)) GO TO 93 IF(10PM.GE.12765.).ANC.(PM.LT.12763.)) GO TO 93 IF(10PM.GE.12765.).ANC.(PM.LT.12763.)] GO TO 93 IF(10PM.GE.12765.).ANC.(PM.LT.12763.)] GO TO 93 IF(10PM.GE.12765.).ANC.(PM.LT.12763.)] GO TO 93 IF(10PM.GE.12765.).ANC.(PM.LT.12763.)] GO TO 93 IF(10PM.GE.12
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         If(ISHAPE.:D, 0)       GO TC 139         ICLFF=0         CALL S: (ITYSE.9I SE.DY SE.ZCXSE, XCXSE, 0ELSE, XCISE, ZCISE.ICLFM, R2 T         IK.PM2TK.02IS1.LS, H.N.O.ISGSC)         CALL S: (ITYSE.9I SE.DY SE.ZCXSE)         ISIOPT         ICLFF=0         CALL S: (ITYSE.9I SE.DY SE.ZCXSE)         VICLS: NO 2IS1.LS, H.N.O.ISGSC)         CALL S: (OZIS1.AI S1.42 S1.SI S1.CI S1.OXIS1.0IS1.LIS1.LZIS1.RLIS         I.PZIS1.SHIS1.0H2TK.02 TK.0X SE.EE SE.HY.RI TK, PHITK.ICLFH.LI TK, L         YZ TK.ITYS2.0F.A.E.N.M.YVTIS1.ACIS1.LS)         FPLM=37.023-3.17E-2*RFH.5.35E-6*FPM**2-2.066E-10*RPM**3         PFANt*0FLH         C INPUT PRISSURE AND DUTPUT FLOW         IF((0PM.GE.11097.).AND.(RPM.LT.12075.)) GO TO 87         IF((0PM.GE.12075.).AND.(RPM.LT.12213.)) GO TO 86         IF((0PM.GE.12075.).AND.(RPM.LT.12213.)) GO TO 86         IF((0PM.GE.12075.).ANC.(PM.LT.12213.)) GO TO 86         IF((0PM.GE.12075.).AND.(RPM.LT.12249.)) GO TO 90         IF((PPM.GE.12075.).ANC.(PM.LT.1205.)) GO TO 91         IF((PM.GE.12075.).ANC.(PM.LT.12249.)) GO TO 91         IF((PM.GE.12075.).ANC.(PM.LT.12041.))         IF((PM.GE.12075.).ANC.(PM.LT.12041.))         IF((PM.GE.12075.).ANC.(PM.LT.1204
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         If(ISHAPE.:D, 0)       GO TC 139         ICLFF=0         CALL S: (ITYSE.9I SE.DY SE.ZCXSE, XCXSE, 0ELSE, XCISE, ZCISE.ICLFM, R2 T         IK.PM2TK.02IS1.LS, H.N.O.ISGSC)         CALL S: (ITYSE.9I SE.DY SE.ZCXSE)         ISIOPT         ICLFF=0         CALL S: (ITYSE.9I SE.DY SE.ZCXSE)         VICLS: NO 2IS1.LS, H.N.O.ISGSC)         CALL S: (OZIS1.AI S1.42 S1.SI S1.CI S1.OXIS1.0IS1.LIS1.LZIS1.RLIS         I.PZIS1.SHIS1.0H2TK.02 TK.0X SE.EE SE.HY.RI TK, PHITK.ICLFH.LI TK, L         YZ TK.ITYS2.0F.A.E.N.M.YVTIS1.ACIS1.LS)         FPLM=37.023-3.17E-2*RFH.5.35E-6*FPM**2-2.066E-10*RPM**3         PFANt*0FLH         C INPUT PRISSURE AND DUTPUT FLOW         IF((0PM.GE.11097.).AND.(RPM.LT.12075.)) GO TO 87         IF((0PM.GE.12075.).AND.(RPM.LT.12213.)) GO TO 86         IF((0PM.GE.12075.).AND.(RPM.LT.12213.)) GO TO 86         IF((0PM.GE.12075.).ANC.(PM.LT.12213.)) GO TO 86         IF((0PM.GE.12075.).AND.(RPM.LT.12249.)) GO TO 90         IF((PPM.GE.12075.).ANC.(PM.LT.1205.)) GO TO 91         IF((PM.GE.12075.).ANC.(PM.LT.12249.)) GO TO 91         IF((PM.GE.12075.).ANC.(PM.LT.12041.))         IF((PM.GE.12075.).ANC.(PM.LT.12041.))         IF((PM.GE.12075.).ANC.(PM.LT.1204
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         If(ISHAPE=:D, 0)       GO TC 139         ICLFF=0         CALL SI(ITYSE.9]       SE.07 SE.2CXSE, XCXSE, DELSE, XCISE, ZCISE.ICLFH, R2 T         IK.PH2TK.02ISI.LS.H.N.O.ISGSC)         CALL SI(OZISI.A1 SI.42 SI.SI SI.CI SI.0XISI.02ISI.LIISI.LZISI.04FH.11         TK.FH2TK.02ISI.A1 SI.42 SI.SI SI.CI SI.0XISI.02ISI.02HH.11         YZ TK.ITYS.D.J.E.N.4.VITSI.ACISI.LSI         FPLM=57.023-3.172-2*RFH.5.53E-6*FPM**2-2.086E-10*RPH**3         PFAN=9FLM         C TNPUT PRESSURE AND DUTPUT FLOW         IF((0PM.GE.11097.).AND.(0PM.LT.12075.)) GO TO 87         IF((0PM.GE.11097.).AND.(0PM.LT.12331.)) GO TO 88         IF((12PP.GL.1221.).ANC. (0PM.LT.12331.)) GO TO 89         IF((0PM.GE.12.59.).ANC. (0PM.LT.12275.)) GO TO 91         IF((0PM.GE.12627.).AND.(RPM.LT.12275.)) GO TO 91         IF((0PM.GE.12627.).ANC. (0PM.LT.12275.)) GO TO 92         IF((0PM.GE.12627.).ANC. (0PM.LT.12275.)) GO TO 93         IF((0PM.GE.12627.).ANC. (0PM.L
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PZ TK, PZ TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE:ISHTK         IF(ISHAPE:GO, 0) GO TO 139         ICLFP=0         CALL ST(ITYSE.9] SE.DY SE.ZCXSE, XCXSE, NCLSE, ZCISE.ZCISE.ICLFM.RZ T         IK.PHZTK, DZISI, LS, H.N.O. ISGSE0         CALL S1(02IS1, A1 S1.42 S1, SI S1.0I S1.0XIS1.0EIS1.LIS1.LZIS1.RNIS         11.PZIS1.SNIS1.0HZTK.22 TK.0X SE.0E SE.HY.RI TK, PHITK.ICLFM.L1 TK, L         X2 TK.ITYS1.0.4.F.N.M, VTIS1.ACIS1.LS)         FPLM:S7.023-3.172-2*RFH:5.332-6*FPH**2-2.086E=10*RPH**3         PFAN:PFLM         CINPUT PRESSURE AND DUTPUT FLOW         IF((0PM.GE.11937.).AND.(RPM.LT.12075.)) GO TO 87         IF((0PM.GE.11937.).AND.(RPM.LT.12331.)) GO TO 88         IF((127.GL.1211.).ANC.(PPM.LT.12213.)) GO TO 89         IF((127.GL.1211.).ANC.(RPM.LT.12275.)) GO TO 91         IF((127.GL.1211.).ANC.(RPM.LT.12276.)) GO TO 91         IF((127.GL.1211.).ANC.(RPM.LT.12276.)) GO TO 91         IF((127.GL.1211.).ANC.(RPM.LT.12276.)) GO TO 91         IF((127.GL.1211.).ANC.(RPM.LT.12276.)) GO TO 91         IF((0PM.GE.1207.).ANC.(RPM.LT.12765.)) GO TO 91         IF((0PM.GE.1207.).ANC.(RPM.LT.12765.)) GO TO 91         IF((0PM.GE.1207.).ANC.(RPM.LT.13179.)) GO TO 94         IF((0PM.GE.1203.).ANC.(RPM.LT.13179.)) GO TO 95         IF((0PM.GE.1203.).ANC.(RPM.LT.13317.)) GO TO 95
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         If(ISHAPE=:D, 0)       GO TC 139         ICLFF=0         CALL SI(ITYSE.9]       SE.07 SE.2CXSE, XCXSE, DELSE, XCISE, ZCISE.ICLFH, R2 T         IK.PH2TK.02ISI.LS.H.N.O.ISGSC)         CALL SI(OZISI.A1 SI.42 SI.SI SI.CI SI.0XISI.02ISI.LIISI.LZISI.04FH.11         TK.FH2TK.02ISI.A1 SI.42 SI.SI SI.CI SI.0XISI.02ISI.02HH.11         YZ TK.ITYS.D.J.E.N.4.VITSI.ACISI.LSI         FPLM=57.023-3.172-2*RFH.5.53E-6*FPM**2-2.086E-10*RPH**3         PFAN:*PELM         C TNPUT PRESSURE AND DUTPUT FLOW         IF((0PM.GE.11097.).AND.(0PM.LT.12075.)) GO TO 87         IF((0PM.GE.11097.).AND.(0PM.LT.12331.)) GO TO 88         IF((12PP.GL.1221.).ANC. (0PM.LT.12331.)) GO TO 89         IF((12PP.GE.1205.).ANC. (0PM.LT.12275.)) GO TO 91         IF((0PM.GE.12627.).ANC. (0PM.LT.1227.)) GO TO 91         IF((0PM.GE.12627.).ANC. (0PM.LT.1203.)) GO TO 92         IF((0PM.GE.12627.).ANC. (0PM.LT.1203.)) GO TO 93         IF((0PM.GE.12627.).ANC. (0PM.LT.1204.)) GO TO 94         IF((0PM.GE.12627.).ANC. (0PM.LT.1204
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         IF(ISHAPE=:]0,0)       GO TC 199         ICLFF=0         CALL S: (ITYSE.9]       SE.07 SE.27CXSE, XCXSE, QELSE, XCISE, ZCISE.ICLFH, R2 T         IK.PM2TK.02IS1.LS, H.N.O.ISGS2)         CALL S: (ITYSE.9]       SE.07 SE.27CXSE, XCXSE, QELSE, XCISE, ZCISE.ICLFH, R2 T         IK.PM2TK.02IS1.LS, H.N.O.ISGS2)         CALL S: (ITYSE.9]       SE.07 SE.27CXSE, XCXSE, QELSE, XCISE.ZCISE.ICLFH, R2 T         IK.PM2TK.02IS1.LS, H.N.O.ISGS2)         CALL S: (ITYSE.9]       SI.42 SI.SI SI.CI SI.0XISI.02IS1.LIS1.LZISI.RIS         I.PZISI.S.NIS1.0M2TK.02 TK.0X SE.00 SE.00 KNNRL       R.PHITK.ICLFH.LI TK.ICLFH.LI TK.L         YZ TK.ITYSE.0.A.E.N.M.YUTS1.ACISI.LS)       FPLN=37.023-3.17E-20RFH.5.35E-60EPM*02-2.2.086E-100RPH*03         PFAN=0PLM       FC       IMPUT PRESSURE AND DUTPUT FLOW         IF((100H, GE.11037.).AND.(R0.100H.LT.12075.))       GO TO 87         IF((100H, GE.11037.).AND.(R0.100H.LT.12075.))       GO TO 88         IF((100H, GE.11037.).AND.(R0.100H.LT.12075.))       GO TO 80         IF((100H, GE.12351.).AND.(R0.100H.LT.12075.))       GO TO 90         IF((100H, GE.12351.).AND.(R0.100H.LT.12075.))       GO TO 91         IF((100H, GE.12351.).AND.(R0.100H.LT.1200H.L)       GO TO 91         I
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         If(ISHAPE=:D, 0)       GO TC 139         ICLFF=0         CALL S:(ITYSE.9I SE.0Y SE.2CXSE, XCXSE, DELSE, XCISE, ZCISE, ICLFM, R2 T         IK.PM2TK.02IS1.LS, H.N.O.ISGSC)         CALL S:(ITYSE.9I SE.0Y SE.7CXSE)         ISIOPT         CALL S:(ITYSE.9I SE.0Y SE.7CXSE)         S:(ITYSE.9I SE.0Y SE.7CXSE)         CALL S:(ITYSE.9I SE.0Y SE.7CXSE)         I.P2IS1.SNIS1.0H2TK.92 TK.0X SE.6E SE.HY.R1 TK, PHITK, ICLFM, L1 TK, L         YZ         YZ         FPLM=37.023-3.17E-2*RFH.5.35E-6*FPM*72-2.086E-10*RPH**3         PFAN=7PLH         C         INPUT PRESSURE AND DUTPUT FLOW         IF((PPM.GE.11937.), ANC. (PPH.LT.12075.)) GO TO 87         IF((PPM.GE.121937.), ANC. (PPH.LT.12075.)) GO TO 80         IF((PPM.GE.121931.), ANC. (PPH.LT.12213.)) GO TO 80         IF((PPM.GE.121931.), ANC. (PH.LT.12213.)) GO TO 91         IF((PPM.GE.121931.), ANC. (PH.LT.12213.)) GO TO 91         IF((PPM.GE.12627.), ANC. (PH.LT.12213.)) GO TO 92         IF((PPM.GE.12627.), ANC. (PH.LT.12213.)) GO TO 93         IF((PPM.GE.12627.), ANC. (PH.LT.12213.)) GO TO 93         IF((PPM.GE.12627.), ANC. (PH.LT.12214.)) GO TO 95         IF((PPM.GE.1373.), ANC. (PH.LT.13317
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         IF(ISHAPE=:]0,0)       GO TC 199         ICLFF=0         CALL S: (ITYSE.9]       SE.07 SE.27CXSE, XCXSE, QELSE, XCISE, ZCISE.ICLFH, R2 T         IK.PM2TK.02IS1.LS, H.N.O.ISGS2)         CALL S: (ITYSE.9]       SE.07 SE.27CXSE, XCXSE, QELSE, XCISE, ZCISE.ICLFH, R2 T         IK.PM2TK.02IS1.LS, H.N.O.ISGS2)         CALL S: (ITYSE.9]       SE.07 SE.27CXSE, XCXSE, QELSE, XCISE.ZCISE.ICLFH, R2 T         IK.PM2TK.02IS1.LS, H.N.O.ISGS2)         CALL S: (ITYSE.9]       SI.42 SI.SI SI.CI SI.0XISI.02IS1.LIS1.LZISI.RIS         I.PZISI.S.NIS1.0M2TK.02 TK.0X SE.00 SE.00 KNNRL       R.PHITK.ICLFH.LI TK.ICLFH.LI TK.L         YZ TK.ITYSE.0.A.E.N.M.YUTS1.ACISI.LS)       FPLN=37.023-3.17E-20RFH.5.35E-60EPM*02-2.2.086E-100RPH*03         PFAN=0PLM       FC       IMPUT PRESSURE AND DUTPUT FLOW         IF((100H, GE.11037.).AND.(R0.100H.LT.12075.))       GO TO 87         IF((100H, GE.11037.).AND.(R0.100H.LT.12075.))       GO TO 88         IF((100H, GE.11037.).AND.(R0.100H.LT.12075.))       GO TO 80         IF((100H, GE.12351.).AND.(R0.100H.LT.12075.))       GO TO 90         IF((100H, GE.12351.).AND.(R0.100H.LT.12075.))       GO TO 91         IF((100H, GE.12351.).AND.(R0.100H.LT.1200H.L)       GO TO 91         I
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         IF(ISHAPE=:D, 0)       GO TC 139         ICLFP=0         CALL SI(ITYSE, 9]       SE, DY SE, ZCXSE, XCXSE, NCLSE, ZCISE, ICLFH, R2 T         IK, PH2TK, D2ISI, LS, H, N, O, ISGSC)         CALL SI(02ISI, A1 S1, A2 S1, SI S1, CI S1, DXISI, EISI, L1ISI, L2ISI, RBIS         11, P2ISI, SNISI, OHZTK, P2 TK, DX SE, EE SE, HY, R1 TK, PHITK, ICLFH, L1 TK, L         Y2       TK, ITYS: D, A: N, N, N, VT ISI, ACISI, LS)         FPLM=57, 023-3, 172-2*RFH+5, 332-6*FPM**2-2, 086E-10*RPH**3         PFAN=*PLH         C TNPUT PRESSURE AND DUTPUT FLOW         IF((PPM, GE, 110*97, ), AND, (PPH, LT, 12075, )) GO TO 87         IF((PPM, GE, 12075, ), AND, (PPH, LT, 12075, )) GO TO 88         IF((PPM, GE, 12075, ), AND, (PPH, LT, 12075, )) GO TO 89         IF((PPM, GE, 12075, ), AND, (PPH, LT, 12075, )) GO TO 89         IF((PPM, GE, 12075, ), ANC, (PPH, LT, 12075, )) GO TO 89         IF((PPM, GE, 12075, ), ANC, (PH, LT, 12075, )) GO TO 91         IF((PPM, GE, 12075, ), ANC, (PH, LT, 12075, )) GO TO 91         IF((PPM, GE, 12075, ), ANC, (PH, LT, 12075, )) GO TO 91         IF((PPM, GE, 12627, ), ANC, (PH, LT, 12351, )) GO TO 91         IF((PPM, GE, 12637, ), ANC, (PH, LT, 12043, )) GO TO 93         IF((PPM, GE, 12051, ), ANC, (PH, LT, 12041, )) GO TO 95
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE*ISHTK         IF(ISMAPE*ISHTK         If(ISMAPE*ISHTK         CALL SI(ITYSE.9] SE.DY SE.ZCXCE, XCXSE, DELSE, XCISE.ZCISE.ICLFM.R2 T         IK.PM2TK.02IS1.LS, M.N.O, ISGS2)         CALL SI(ITYSE.9] SE.DY SE.ZCXCE, XCXSE, DELSE, XCISE.ZCISE.ICLFM.R2 T         IK.PM2TK.02IS1.LS, M.N.O, ISGS2)         CALL SI(02IS1.A1 S1.42 S1.SI S1.CI S1.0XIS1.01S1.LIS1.LZIS1.R1IS         I.P2IS1.SNIS1.042TK.02 TK.0X SE.0E SE.HY.R1 TK, PHITK.ICLFM.L1 TK, L         Y2 TK.ITYS:OLA.E.N.M.YVTIS1.ACIS1.LS)         FPLM=57.023-3.17E-2*RFM+5.33E-6*FPM*2-2.006E-10*RPH**3         PFAN:0PELM         C INPUT PRESSURE AND DUTPUT FLOW         IF((0PM.GE.11937.).AND.(PPM.LT.12075.)) GO TO 87         IF(0PM.GE.11937.).AND.(PPM.LT.12075.)) GO TO 88         IF(12PM.GE.1127.).AND.(PPM.LT.12075.)) GO TO 89         IF(12PM.GE.1137.).AND.(PPM.LT.12075.)) GO TO 90         IF(12PM.GE.127.).AND.(PPM.LT.12075.)) GO TO 91         IF(12PM.GE.1137.).AND.(PM.LT.12075.)) GO TO 91         IF(12PM.GE.1137.).AND.(PM.LT.12075.)) GO TO 91         IF(12PM.GE.1203.).AND.(PM.LT.12075.)) GO TO 93         IF(10PM.GE.12075.).AND.(PM.LT.12075.)) GO TO 93         IF(10PM.GE.1203.).AND.(PM.LT.12075.)) GO TO 94         IF(10PM.GE.1203.).AND.(PM.LT.13179.)) GO TO 95
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         If(ISMAPE=10, 0)       GO TC 199         ICLFF=0         CALL S:(ITYSE.BI SE.DY SE.ZCXSE, XCXSE, QELSE, XCISE, ZCISE.ICLFM, R2 T         IK.PM2TK.D2IS1.LS, M.N.O, ISGS2)         CALL S:(ITYSE.BI SE.DY SE.ZCXSE, XCXSE, QELSE, XCISE, ZCISE.ICLFM, R2 T         IK.PM2TK.D2IS1.LS, M.N.O, ISGS2)         CALL S:(ICZIS1, A1 S1.42 S1.SI S1.CI S1.DXIS1.EIS1.LIS1.LZIS1.R1IS         I.PZIS1.SNIS1.PM2TK.P2 TK.DX SE.EE SE.HY.R1 TK, PHITK.ICLFM.L1 TK, L         YZ TK.ITYS2.GLA.E.N.H.VITS1.ACIS1.LS)         FPLM=37.023-3.17E-2*RFH+5.51E-6*EPM*>2-2.086E-10*RPH**3         PFANt*PELM         C INPUT PRESSURE AND DUTPUT FLOM         IF((1PPM.GE.11937.).AND.(RPH.LT.12075.)) GO TO 87         IF((1PPM.GE.12351.).AND.(RPH.LT.12731.)) GO TO 88         IF((1PPM.GE.12351.).AND.(RPH.LT.12731.)) GO TO 90         IF((1PPM.GE.12351.).ANC.(PPH.LT.1275.)) GO TO 91         IF((PPM.GE.1256.).ANC.(PPH.LT.12765.)) GO TO 92         IF((PPM.GE.12627.).ANC.(PPH.LT.12765.)) GO TO 93         IF((PPM.GE.12903.).ANC.(PH.LT.12765.)) GO TO 94         IF((PPM.GE.13017.).ANC.(RPH.LT.12765.)) GO TO 95         IF((PPM.GE.13017.).ANC.(RPH.LT.12765.)) GO TO 95         IF((PPM.GE.13017.).ANC.(RPH.LT.13177.)) GO TO 95         IF((PPM.GE.13177.).ANC.(RPH.LT.1275
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE*ISHTK         IF(ISMAPE*ISHTK         If(ISMAPE*ISHTK         CALL SI(ITYSE.9] SE.DY SE.ZCXCE, XCXSE, DELSE, XCISE.ZCISE.ICLFM.R2 T         IK.PM2TK.02IS1.LS, M.N.O, ISGS2)         CALL SI(ITYSE.9] SE.DY SE.ZCXCE, XCXSE, DELSE, XCISE.ZCISE.ICLFM.R2 T         IK.PM2TK.02IS1.LS, M.N.O, ISGS2)         CALL SI(02IS1.A1 S1.42 S1.SI S1.CI S1.0XIS1.01S1.LIS1.LZIS1.R1IS         I.P2IS1.SNIS1.042TK.02 TK.0X SE.0E SE.HY.R1 TK, PHITK.ICLFM.L1 TK, L         Y2 TK.ITYS:OLA.E.N.M.YVTIS1.ACIS1.LS)         FPLM=57.023-3.17E-2*RFM+5.33E-6*FPM*2-2.006E-10*RPH**3         PFAN:0PELM         C INPUT PRESSURE AND DUTPUT FLOW         IF((0PM.GE.11937.).AND.(PPM.LT.12075.)) GO TO 87         IF(0PM.GE.11937.).AND.(PPM.LT.12075.)) GO TO 88         IF(12PM.GE.1127.).AND.(PPM.LT.12075.)) GO TO 89         IF(12PM.GE.1137.).AND.(PPM.LT.12075.)) GO TO 90         IF(12PM.GE.127.).AND.(PPM.LT.12075.)) GO TO 91         IF(12PM.GE.1137.).AND.(PM.LT.12075.)) GO TO 91         IF(12PM.GE.1137.).AND.(PM.LT.12075.)) GO TO 91         IF(12PM.GE.1203.).AND.(PM.LT.12075.)) GO TO 93         IF(10PM.GE.12075.).AND.(PM.LT.12075.)) GO TO 93         IF(10PM.GE.1203.).AND.(PM.LT.12075.)) GO TO 94         IF(10PM.GE.1203.).AND.(PM.LT.13179.)) GO TO 95
HY=AMAX1(HY,.73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS)         ISHAPE=ISHTK         If(ISHAPE=:D, 0)       GO TC 139         ICLFF=0         CALL SI(ITYSE.9]       SE.07 SE.2CXSE, XCXSE, DELSE, XCISE, ICLFH, R2 T         IK.PM2TK.02ISI.LS, H.N.O.ISGSC)         CALL SI(OZISI.A1 SI.42 SI.5I SI.CI SI.0XISI.02ISI.LIISI.LZISI.RAIS         II.PZISI.SNISI.0M2TK.02 TK.0X SE.00 SE.00 SE.000 SI.000 SI.000 SI.000 SI.000 SI.000 SI.0000 SI.0000 SI.0000 SI.0000 SI.0000 SI.0000 SI.0000 SI.0000 SI.00000 SI.0000 SI.0000 SI.0000 SI.0000 SI.00000 SI.00000 SI.0000 SI.0000 SI.00000 SI.00000 SI.00000 SI.00000 SI.00000 SI.000000 SI.00000 SI.00000 SI.0000000 SI.00000000 SI.000000000 SI.000000000 SI.0000000000
MYEAMAX1(MY., 78) CALL TK(ISYTK, PY2TK, 92 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, LS) ISMAPE=ISMTK IF(ISMAPE, 30, 0) GO TC 139 ICLFF=0 CALL S: (ITYSE, 9I SE, DY SE, ZCXGE, XCXSE, DELSE, XCISE, ICLFM, RZ T IK, PH2TK, D2ISI, LS, M, N, O, ISGSE) CALL S1(D2ISI, AL SI, AZ SI, SI SI, CI SI, DXISI, 0EISI, LIISI, L2ISI, RAIS II, P2ISI, SHISI, 0H2TK, 92 TK, 0X SE, 6E SE, HY, RI TK, PHITK, ICLFM, L1 TK, L Y2 TK, ITYSE, 0, A, E, N, H, VTISI, ACISI, LS) FPLM=57, 023-3, 17E-2*RF4+5; 33E-6*FPM**2-2; 0666E-10*RPM**3 PFAM=PFLM C INPUT PRESSURE AND DUTPUT FLOM IF(10PM, GE, 11937, ), AND, (RP4, LT, 12075, )) GO TO 87 IF(10PM, GE, 12075, ), AND, (RP4, LT, 12275, 1) GO TO 88 IF(12PM, GE, 12351, ), AND, (RP4, LT, 12499, )) GO TO 90 IF(12PM, GE, 12351, ), AND, (RP4, LT, 12499, )) GO TO 91 IF(10PM, GE, 1267, ), AND, (RP4, LT, 12499, )) GO TO 93 IF(10PM, GE, 1267, ), AND, (RP4, LT, 1275, 1) GO TO 94 IF(10PM, GE, 12765, ), AND, (RP4, LT, 1275, 1) GO TO 95 IF(10PM, GE, 12765, ), AND, (RP4, LT, 1275, 1) GO TO 94 IF(10PM, GE, 12765, ), AND, (RP4, LT, 1275, 1) GO TO 95 IF(10PM, GE, 12765, ), AND, (RP4, LT, 1275, 1) GO TO 94 IF(10PM, GE, 12765, ), AND, (RP4, LT, 1377, 1) GO TO 95 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1377, 1) GO TO 96 IF(10PM, GE, 13573, 1, AND, (RP4, LT, 1355, 1) GO TO 97 IF(10PM, GE, 13573, 1, AND, (RP4, LT, 1359, 1) GO TO 96 IF(10PM, GE, 13573, 1, AND, (RP4, LT, 1359, 1) GO TO 96 IF(10PM, GE, 13573, 1, AND, (RP4, LT, 1355, 1) GO TO 99 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1355, 1) GO TO 99 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1355, 1) GO TO 99 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1355, 1) GO TO 99 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1735, 1) GO TO 99 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1735, 1) GO TO 96 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1735, 1) GO TO 99 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1735, 1) GO TO 97 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1735, 1) GO TO 98 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1735, 1) GO TO 99 IF(10PM, GE, 1373, 1, AND, (RP4, LT, 1735, 1) GO TO 82
MYEAMAX1(MY., 78) CALL TK(ISYTK, P2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS) ISMAPE=ISMTK IF(ISYA2E, 30, 0) GO TC 199 ICLFP=0 CALL SE(ITYSE, 9I SE, DY SE, ZCXCE, XCXSE, DELSE, XCISE, ICLFM.R2 T IK, PM2TK, D2IS1, LS, M, N, O, ISGS2) CALL S1(02IS1, A1 S1, A2 S1, SI S1, CI S1, DXIS1, PEIS1, LIIS1, L2IS1, R1IS I1, P2IS1, SNIS1, OM2TK, P2 TK, DX SE, EE SE, HY, R1 TK, PM1TK, ICLFM, L1 TK, L X2 TK, ITYSE, 0, A, E, N, M, VTIS1, ACIS1, LS) FPLM=37, 023-3, 17 E-2*RF4-5, 3 SE-6*FPM*22-2, 086E-10*RPM**3 PFAMEPELM C INPUT PRESSURE AND DUTPUT FLOM IF((PPM, GE, 11937, ), ANC, (PPM, LT, 12075, )) GO TO 87 IF((PPM, GE, 12375, 1, AN), (RPM, LT, 12213, 1) GO TO 88 IF((PPM, GE, 12351, 1, AND, (RPM, LT, 12231, 1) GO TO 89 IF((RPM, GE, 12351, 1, AND, (RPM, LT, 1249, 1) GO TO 91 IF((RPM, GE, 12627, 1, ANC, (PPM, LT, 1267, 1) GO TO 93 IF((RPM, GE, 12627, 1, ANC, (PPM, LT, 1267, 1) GO TO 94 IF((PPM, GE, 12627, 1, ANC, (PPM, LT, 1267, 1) GO TO 95 IF((PPM, GE, 12627, 1, ANC, (PPM, LT, 1263, 1) GO TO 95 IF((PPM, GE, 12765, 1, ANC, (PPM, LT, 12765, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1317, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 13317, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 13317, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 97 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1357, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1357, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1357, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 11365, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 11365, 1) GO TO 82 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 11385, 1) GO TO 83 IF((PPM, GE, 1173, 1, ANC, (PPM, LT, 11385, 1) GO TO 83
MYEAMAX1(MY., 78) CALL TK(ISYTK, P2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS) ISMAPE=ISMTK IF(ISYA2E, 30, 0) GO TC 199 ICLFP=0 CALL SE(ITYSE, 9I SE, DY SE, ZCXCE, XCXSE, DELSE, XCISE, ICLFM.R2 T IK, PM2TK, D2IS1, LS, M, N, O, ISGS2) CALL S1(02IS1, A1 S1, A2 S1, SI S1, CI S1, DXIS1, PEIS1, LIIS1, L2IS1, R1IS I1, P2IS1, SNIS1, OM2TK, P2 TK, DX SE, EE SE, HY, R1 TK, PM1TK, ICLFM, L1 TK, L X2 TK, ITYSE, 0, A, E, N, M, VTIS1, ACIS1, LS) FPLM=37, 023-3, 17 E-2*RF4-5, 3 SE-6*FPM*22-2, 086E-10*RPM**3 PFAMEPELM C INPUT PRESSURE AND DUTPUT FLOM IF((PPM, GE, 11937, ), ANC, (PPM, LT, 12075, )) GO TO 87 IF((PPM, GE, 12375, 1, AN), (RPM, LT, 12213, 1) GO TO 88 IF((PPM, GE, 12351, 1, AND, (RPM, LT, 12231, 1) GO TO 89 IF((RPM, GE, 12351, 1, AND, (RPM, LT, 1249, 1) GO TO 91 IF((RPM, GE, 12627, 1, ANC, (PPM, LT, 1267, 1) GO TO 93 IF((RPM, GE, 12627, 1, ANC, (PPM, LT, 1267, 1) GO TO 94 IF((PPM, GE, 12627, 1, ANC, (PPM, LT, 1267, 1) GO TO 95 IF((PPM, GE, 12627, 1, ANC, (PPM, LT, 1263, 1) GO TO 95 IF((PPM, GE, 12765, 1, ANC, (PPM, LT, 12765, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1317, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 13317, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 13317, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 97 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1357, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1357, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1357, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 11365, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 11365, 1) GO TO 82 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 11385, 1) GO TO 83 IF((PPM, GE, 1173, 1, ANC, (PPM, LT, 11385, 1) GO TO 83
MYZAMAX1(MY., 73)         CALL TK(ISYTK, PM2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A, E, L, L5)         ISHAPETSHTK         If(ISHA2E, 30, 0)         GALL SE(ITYSE, SI SE, DY SE, 2CXSE, XCXSE, DELSE, XCISE, ICLFM.R2 T         IK, PM2TK, D2IS1, LS, M, N, O, ISSG3         CALL SI(IZYSE, SI SE, DY SE, 2CXSE, XCXSE, DELSE, XCISE, ICLFM.R2 T         IK, PM2TK, D2IS1, LS, M, N, O, ISSG3         CALL SI(IZYSE, SI SE, OY SE, 2CXSE, XCXSE, DELSE, XCISE, ICLFM.R2 T         IK, PM2TK, D2IS1, LS, M, N, O, ISSG3         CALL SI(IZYSE, SI SE, N, N, N, VIS1, ACIS1, E1S), EIS1, LIIS1, L2IS1, R1IS         II, P2ISI, SNIS1, NOTK, SZ TK, OX SE, EE SE, HY, R1 TK, FMITK, IICFM, L1 TK, L         YZ TK, ITYSE, GJ, A, E, N, N, VTI31, ACIS1, LS)         FPLM.SE, D23, ITE-22RFM.S. SIZE-6*FPM*Z-2,086E-10*RPM**3         PFAN, PELM         C INPUT PRESSURE AND DUTPUT FLOW         IF((IPPM, GE, 11937, ), AND, (PM, LT, 12075, )) GO TO 87         IF((IPPM, GE, 12075, ), AND, (PM, LT, 12175, )) GO TO 89         IF(IPPM, GE, 12075, ), AND, (PM, LT, 12075, )) GO TO 87         IF(IPPM, GE, 12075, ), AND, (PM, LT, 12075, )) GO TO 87         IF(IPPM, GE, 12075, ), AND, (PM, LT, 12075, )) GO TO 87         IF(IPPM, GE, 12075, ), AND, (PM, LT, 12075, )) GO TO 87         IF(IPPM, GE, 12075, ), AND, (PM, LT, 12075, )) GO TO 99         IF(IPPM, GE, 12075, ), AND, (PM, LT, 12075, )) GO TO 99         IF((PPM,
MYEAMAX1(MY., 78) CALL TK(ISYTK, P2TK, P2 TK, P1 TK, FH1TK, L1 TK, L2 TK, HY, A1E, L, LS) ISMAPE=ISMTK IF(ISYA2E, 30, 0) GO TC 199 ICLFP=0 CALL SE(ITYSE, 9I SE, DY SE, ZCXCE, XCXSE, DELSE, XCISE, ICLFM.R2 T IK, PM2TK, D2IS1, LS, M, N, O, ISGS2) CALL S1(02IS1, A1 S1, A2 S1, SI S1, CI S1, DXIS1, PEIS1, LIIS1, L2IS1, R1IS I1, P2IS1, SNIS1, OM2TK, P2 TK, DX SE, EE SE, HY, R1 TK, PM1TK, ICLFM, L1 TK, L X2 TK, ITYSE, 0, A, E, N, M, VTIS1, ACIS1, LS) FPLM=37, 023-3, 17 E-2*RF4-5, 3 SE-6*FPM*22-2, 086E-10*RPM**3 PFAMEPELM C INPUT PRESSURE AND DUTPUT FLOM IF((PPM, GE, 11937, ), ANC, (PPM, LT, 12075, )) GO TO 87 IF((PPM, GE, 12375, 1, AN), (RPM, LT, 12213, 1) GO TO 88 IF((PPM, GE, 12351, 1, AND, (RPM, LT, 12231, 1) GO TO 89 IF((RPM, GE, 12351, 1, AND, (RPM, LT, 1249, 1) GO TO 91 IF((RPM, GE, 12627, 1, ANC, (PPM, LT, 1267, 1) GO TO 93 IF((RPM, GE, 12627, 1, ANC, (PPM, LT, 1267, 1) GO TO 94 IF((PPM, GE, 12627, 1, ANC, (PPM, LT, 1267, 1) GO TO 95 IF((PPM, GE, 12627, 1, ANC, (PPM, LT, 1263, 1) GO TO 95 IF((PPM, GE, 12765, 1, ANC, (PPM, LT, 12765, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1317, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 13317, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 13317, 1) GO TO 95 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 97 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1357, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1357, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1357, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 1355, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 11365, 1) GO TO 99 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 11365, 1) GO TO 82 IF((PPM, GE, 1373, 1, ANC, (PPM, LT, 11385, 1) GO TO 83 IF((PPM, GE, 1173, 1, ANC, (PPM, LT, 11385, 1) GO TO 83

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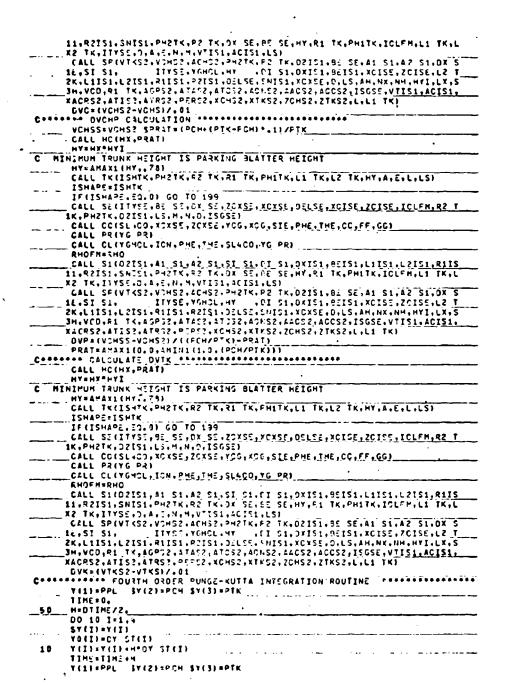
			-	•			
z	PRINT 3				•		
3		OFF LOWER	SND OF F	AN_MAP+).			
	GO TO 19	9				۰.	
. <b>*_</b>	PRINT 5	OLE Aboel					
5	GO TO 19		END OF	PAN MAPY)			
TELEAN	CURVE FOR		TERATION	š <u></u>			
- 42	QFAN=15.		353	+>FAN+1.345-	3 +PFAN+	+2-1.69E-5	*PFAN
		SGD TO 11					
83	QFAN=13.	0e:	339	#PFAN+3.84E-	3 *PFAN*	+2-1.39E-5	•PFAN
· . ·		SGO TO 110	)				
	QFAN <u>F11</u> .		54	*PFAN+1.74E-	3 OFAN	+2-6.35-6	*PFAN
		\$GO TO 11	29	+PFAN+1.29E-		+2-4,562-6	*PFAN
_ 67 .	CFAN=10.	10 TO 11			<u> </u>	-1-46,702-0	
<b>A</b> 6	QFAN+9.7	• • • • •	77	*PFAN+7.15E-	4 PFAN*	+2-2.65-6	*PFAN
		5 GO TO 11					
_87_	OFAN=9.9		77	+>FAN+++95E-	4 PFAN*	+2-2.4E-6	*PFAN
		\$GD TO 11					
88	QFAN#12.	39!		•PFAN+1.32E-	3 OFAN	<u>+2-3.965-6</u>	*PFAN
	X++3 QFAN=18,	SG3 TO 11	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	** FAN+ 2. 87E-	-	•2-7.79E-6	+PFAN
89		367 TO 11			<u> </u>		
90	QFAN= 15.		211	+>FAN+1.74E-	3	*2-4.67E-6	PPFAN
		\$G) TO 110	)				
91	GFANE12.			* PFAN+ 1. 0 3E-	3 +PFAN+	+2+2.78E-6	*PFAN
	-	SG3 TO 11				47-1 445-4	PFAN.
_ 92	QFAN=13.	78 -•: \$63 to 11	53	+>FAN+1.17E-	S PPAN	•2-3.01E-6	PPPAN.
93	QFAN=13.		42	**FAN+1.05E-	3 + PFAN+	+2-2.65-6	+PFAN
		5G2 TO 11					
- 94	QFAN=12.		086	+#FAN+5.92E-	4 PFAN	•2-1.55-6	+PFAN
		SGO TO 11	)				
_95_	GFAN=12.		104	*PFAN+E.93E-	4PFAN*	+2-1.63E-6	+PFAN
		363 TO 11		+>FAN+3.78E-	-	+2-9.232-7	+PFAN
<u>2</u> ¢	OFAN=11. X++3	5G2 TO 11	162	THAT STOLES			
97	OFANE12.		79.	+ + FAN+ 4 . 7 96-	4 *PFAN*	+2-1.095-6	+PFAN
	X++3	3GD TO 11	)				
_ 9.6	OFAN=18.		205	+PFAN+1+29E-	3PFAN*	+2-2.61E-6	*PFAN
		5G9 TO 11					*PFAN
99	OFAN=19. X++3		213	* 3FAN+1.29E-	3 OUF ART	*2-2.53E-8	- PFAN
			32	*>FAN+2.98E+	3 *PFAH*	+2-5.63E-6	*PFAN
101_	X++3	· · · · · · · · · · · · · · · · · · ·	<u></u>				
_C				LOW TO VOLUH	<u>FLON</u>		
110		N/(RH0+32,	2)				
	_OFANX=OF						
•	OFX=JFAN OFN=OFAN			•			
	PENEPEAN						
	PPLAPPLA						
C		DESREËS TI	RADIANS	· · · · · · · · · · · · · · · · · · ·			
	_THETAEST	HETATORAD					
	PHIEsPHI				-		
• • • • •		THETA*RAD I*RADIAN					
	ICLN=0	1-48014N					
	ICN=ICL'			· · · · · · · · · · · · · · · · · · ·			
Ç		NITIAL VA	LUF OF 00	CHP AND INIT	IALIZE GEO	METRY	
	PCHSS= (P	CH+(PTK-PI					
	CSS=PCHS						
	GALL HCE		)			-	
с <u>н</u> т	HYTHY 147	HC HETCHT	TE DUART	ING BLATTER H	STONT		
0 41	NIPUM TRU	uv uttout	1. T. S. S. M. K. P. M	1099 BEALTER P			

80

and the second se

CALL ΤΚ(ISHTK,PHZTK,RZ TK,R1 TK,PH1TK,L1 TK,L2 TK,HY,A,E,L,LS)
ISHAPE=ISHTK
IF(ISHAPE, 10, 0) 60 TO 199
ICLFM=1
CALL SEILTYSE, BE SE. DX SE. 22X3E, XCXSE, DELSE, XCISE, ZCISE, ICLEN, RZ T
1K.PH2TK.02151.LS.M.N.D.ISG3E1
CALL CCISL.CO.XCISE.ZCXSE.YGG,XCG.SIE,PHE.THE.GC.FF.GG
CALL PR(YG PR)
CALL CL (YGHCL, ICN, PHE, THE, SLACO, YG PR)
CALL SI(02151, A1 51, A2 51, SI 51, 01 51, 0X151, 0E151, L1151, L2151, R115
11,RZIS1,SNIS1,PHZTK.PZ TK.DX SE.CS SE.HY,PL TK.PHITK,ICLFH,LI TK.L
X2 TK-ITYSE-0-4-E-N-4-VICS1-4CIS1-LS)
AC TREITSENDALINE TVESTALISTEST
CALL SFIVTKS2, VC4S2, ACHS2, PH2TK, 62 TK, D2IS1, 8E SE. A1 S1. A2 S1. DX S
14,SI S1, ITYSE,YGHOL,HY ,CI 31.0XIS1.82IS1.XCISE.2CISE.L2 T
2K,L1151,L2I51,R1151,R2I51,JLSE,SNI51,XCXSE,0,LS,AH,NX,NH,HYI,LX,S
3H.VCC.P1 T<.AGPS2.ATAS2.ATOS2.ACC:S2.ACCS2.ACCS2.ISGSE.VTIS1.ACIS1.
XACRS2, ATIS2, ATRS2, PERS2, XCHS2, XIKS2, ZCHS2, ZTKS2, L, L1 TK)
ACH22=ACH25
CALL HC(Z HC, (PCH/PTK))
HA=HAI=S HC
C MINIPUM TRUNK HEIGHT IS PARKING BLATTER HEIGHT
HV=AHAX1(HY,.78)
CALL TREISHTE, PHETE, FE TRAPITE, LI TRALE TRANSALE, LAS
ISHAPE=ISHTK
IF(154AP1. 22.0)60 TO 199
CALL SEITTYSE, 95 SE. DX SE. ZCXSE. XCXSE. DELSE. XCISE. ZCISE. TCLFH. R2 T
1K, PH2TK, D2IS1, LS, M, N, D, ISGSE)
CALL CO(SL+CO, XCYST, ZCXST, YCG, XCG, SIF, PHE, THE, CC, FF, GG)
CALL PRIVE ORI
CALL CL (YGHCL, ICN.PHE, THE, SL4CO, YG PP)
CALL S1(02:31, A1 31, A2 31, 31 51, 1 51, 0XIS1, 0EIS1, L1IS1, L2IS1, 4115
11.RZIS1.SNIS1.PH2TK.PZ TK. JK SE.65 SE.HY.CI TK, PHITK, ICLCH.LI TK.L
X2 TK, ITYSE, J, A, E, N, H, VTIS1, 4CIS1, LSI
CALL SPIVT (52. VCH52, ACH52. PH2TK, F2 TK, D2IS1, BE SE, A1 S1, A2 S1, DX S
1E.SI SI, ITYSE, YGHOL, HY , (I SI, DXISI, REISI, XCISE, ZCISE, LZ T
2K,L1151,L2151,R1151,R2151,D2LSE,Ch151,XCXSE,D,LS,AH,NX,NH,HY1,LX,S
3H.VCC.R1 T<.AG932.ATAS2.ATG32.A3N52.AAGS2.AGCS2.ISGSE.VTIS1.ACIS1.
DVCHP=(VCH32+VCHSS)/((PCH/PTK)+PCHSS)
0 VP = 0 VCHP
CONVERSE STATION CONCERNMENT CONCERNMENT CONCERNMENT
INUM= 0
DV TK = 0.0
DVK+DVTK
GVCH=SKT=AGHS2
DVC=0VCH
CALL STIFY ST.TZ ST.TY ST. 37. 37. 37. JPP. FPL. VPL. VTKS2. GFX. DVK. PTK. DVC.
SYCG, CVP, PCH, VCHS2, SKT, PHE, PHEDOT, THE, THE COT, CKK, PAT. GG, HY I, SEC. HSS
Z, RPH, U, SIE, HO, AGPS2, ACHS2, ATAS2, ATOS2, ACNS
32. AACS2, ACS2, CAF, CFX.CGP. ACF22. ATIS2. ATRS2. PERS2. XCHS2, 2CHS2.
3XTKS2.ZTKS2.ACIS1.YGHCL.2PTFH.OTCFH.CTAFH.OCHAT)
C CALCULATE DUCH, DUCH, DUTK AS EVC, EVP, DVK
JF (INUM) 200.1,200
_ 1 VCHS=VCHS2 BVTKS=VTKS2
200 CALL TKIISHTK, PH2TK, RZ TK, RI TK, FHITK, LI TK, LZ TK, HY, A, E, L, LS)
1 SHAPE = 1 SHIK
1CLFF=1
CALL SEITTYST, HE SE , DY ST , ZONSE , YONSE , DELSE , MOISE , ZOISE , ICLEH , RZ T
1K,PH2TK,D2IS1,LS,H,N,C,ISGSE)
CALL_COISLICO.WCXSC.7CVSE.YCG.KCC.SIF.PHE.THE.CC.FF.GGI
CALL PO(YG P2)
CALL CLIVENCLIIN, PHE, THE, SLACO, YE PRI
PHOP = 2400 A FI - CHARDZICK, AK, CK, AZ, CK, CK, CK, CK, CK, CK, CK, CK, L, LTCL, LZTCL, Q1TC

81



82

	,	
	CALL ST(FY ST.TZ ST.TX ST.JY ST.IFP.PPL.VPL.VTKS2.0FX	.DVK.PTK.DVC.
	LYCG, OVF, PCH, VCH52, SKT, PHE, PHEDOT, THE, THEDDT, CKK, PAT. O	G.HYT.GEC.HSS
	C. RPN. U. SI' RHOLAGPSZLACHSZLATA	S2, ATCS2, ACNS
	32+AACS2+ACJ52+CAF+CFX+CGP+ ACF52+ATIS2+ATR52+PER52	
	SXTKS2, ZTKS2, ACIS1, YGHCL, OPTFH, OTCFH, GTAFH, OCHAT)	
	CO 20 1=1,4	
<u> </u>	¥1(I)=DY ST(I)	
20.	Y(I): SY(I)+H+DY ST(I)	
	Y(1) = PFL SY(2) = PCH SY(3) = PTK	
	CALL STIFY ST.TZ ST.TX ST.JY ST.JPP.PPL.VPL.VTKSZ.OFA	DUE BTE.OVC
	LYCG.DVF.PCH.VCHSZ.SKT.PHE.PHEDDT.THE.THEDDT.CKK.PAT.G	
•		
	RPM. U. SIE, PHO. AGPSZ, AGHSZ.ATA BZ, AACSZ.ACCSZ.CAF.CFX.CSP. AGFSZ.ATISZ.ATRSZ.PERSZ	SCALLSCALNS
	SZYARUSZYAUJSZYUAPYUPYYYY AVYYYYY AVYSZYAIISZYAIRSZYPERSZ	*******************
	SKTKS2+21KS2+ACIS1, YGHCL, OPTEH+OTCEH, OTAEH, OCHATE	
	CO 30 I=1.4	
	Y2(1)=0Y ST(1)	
30	Y(I)=SY(I)+JTIME+DY ST(I)	
	Y(1)=PPL 3Y(2)=PCH 5Y(3)=PTK	
	CALL STIFY ST, TT ST, TX ST, DY ST, JPP, PPL, VPL, VTKS2, OFX	HOVK.PIK.DVC.
	LYCG.CVP.PCH.VCH32.SKT.PHE,PHEDOT.THE.THEDOT.CKK.PAT.G	G.H.Y.I.GEC.HSS
	IN REMI UN SILIRHONAGESZIACHSZIATA	S2, ATCS2, ACNS
	32, AACS2, ACCS2, CAF, OF¥, CGP, ACFS2, ATIS2, ATRS2, PERS2	XCHS2, ZCHSZ,
	XTKSZ.ZTKS?, ACIS1, YGHCL, OPTFM, OT CFM, OTAFM, OCHAT)	
	TINE=TINE+H	
	H=H/3.	
	00 40 1=1.4	
	PFT1+2.0*(Y1(T)+Y2(I))	
	PRT2=Y0(1)+DY ST(1)	
	Y(1)=SY(1)+++PRT1++PRT2	
+ 0	CONTINUE	
	FPL=Y(1) 300H=Y(2) \$PTK=Y(3)	~ <u>~</u> ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
	CALL STIFY ST.TZ ST.TX ST.JY ST.JPP.PPL.VPL.VTKS2.OFX	DVK BTY DVC.
	YCG. OVF.PCH. VCHSZ.SKT.PHE.PHECOT.THE.THEOCT.CKK.PAT.G	
		+ * UM3 2 + 2UM32 +
	ATKS2.ZTKS2.ACTS1.YGHCL.OPTEH.OTCF4.GTAFH.OCHAT)	
	IF((PPL-SY(1)).LT.1.) GO TO 60	
	1FITIME.LT. (INC) 50 10 50	*- <del></del>
60	CONTINUE	
	INUM=1	
		•••••
	IF([NUM)201.11,201	
11	VCHS=VCHS2 3VTKS=VTKS2	
2,0,1	CALL TRIISHTK, PHETK, R2 TK, R1 TK, PHITK, L1 TK, L2 TK, HY,	A_E_L_L <u>S1</u>
	ISHAPEIISHTK	•
	ICLF#=1	· _ <del> </del>
	CALL SETTITYSE. DE SE. DX SE. ZCXSE. XCXSE, DELSE. XCISE. ZCI	SE, ICLEM.RZ T
	K.PH?TK, D2131, LS. M.N. D, ISGSE)	
	CALL COISL +CO, XCXSE + 2CXSE + YCG + XCG + SIE + PHE + THE + CC + FF + G	G)
	CALL PRING PR)	
	CALL CLIYGHOL, ICH. PHS, THE, SLACO, YG PR)	
	RHOFHEGHO	
	CALL SI102151, A1 S1. A2 S1. S1 S1. D1 S1. 0XIS1. BEIS1. L11	SI.LZISI.RIIS
	1. RZISI. SNISI, PHZTK. PZ TK. DX SE. PE SE. HY. RI TK, PHITK,	ICLFH.L1 TK.L
	2 TK.ITYSE, D.A.E.N.H. VT131. 10151.LS1	
	CALL SELVIKSZ, VOHSZ, ACHOZ, PHZIK, FZ TK. OZISI, BE SE, AL	S1.42 51.01 S
	LISI SI. ITYSE, YGHOL. HY ,UI SI. DXISI. DEISI. XCI	SE.70158-12 T
	K.L1IS1.L2IS1.R1IS1.R7IS1.01L35.SNIS1.XCXSE.D.LS.AH.N	
-	W.VCO.RI TK.AGPS2.AJAC2.AJGS2.AJNS2.AAGS2.ACC52.ISGSE	
	4CPS2+ATIS2+ATRS2+PEPS2+XCHS2+X1KS2+ZCHS2+ZTK52+L+L1_	1 T 1 & 3 & 3 & 4 & 4 & 3 & 4 & 4 & 4 & 4 & 4
	UVC=(VCHS2-VCHS)/.01	·M
	** DACHD CTCONTILON ************************************	
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
	VCHS3=VCHS? 3PR4T=(PCH+(PTK-PCH)+,1)/PTK	
	CALL HC(HX,PRAT)	
	HAFHX AHAI	
	CALL TRIISHTR, PHOTR, RO TR, RI TR, FHITR, LI TR, LO TR, HY,	A+2+L+L5}

ISHAPEEISHTK	
IF(ISHAPE. :0.0) GO TO 193	
CALL SELITYST. DE SE. DX ST. 70X56, XCXSE, DELSE, XCISE, ZCISE, ICLFN,	RZT
1K, PH2TK, 02151, LS, H, H, D, IS651)	
CALL COISLICO, XCXSE, 7CXSE, YIG, XCG, SIE, PHE, THE, CC, FF, GG)	
CALL P3(YG P9)	
CALL CLIYGHGL, ICH, PHE, THE, SL4CO, YG PR)	
RHOF#ERHO	
CALL \$1(02151.41 \$1.42 \$1.51 \$1.01 \$1.0×151.8E1\$1.L1151.L2151.	RIIS
11, RZISI, SNISI, PHZTK, FZ TK, DX SE, FZ SE, HY, RI TK, PHITK, ICLEN, LL	TKIL
· X2 TK, ITYSE, D, A, E, N, M, VTIS1, ACIS1, LS)	
CALL SPITKS2. VCHS2. PH2TKIF2 TKIDZIS1.8: SEAAL SAA2 SA	
12+SI S1+ ITYSE+YGHOL+HY +CI S1+DXIS1+BLIS1+XCISE+ZCISE+	L2 T
2K.LIISI.LZISI.RIISI.RZISI.OTLSE.ENISI.YCXSE.D.LS.AH.NX.NH.HYI.	LX. <u>S</u>
3H,VCD,R1 TK,AGP32,ATAS2,ATG32,ACNS2,AACS2,ACCS2,ISGSE,VTIS1,AC	IS1,
KACRS2+ATIS2+ATRS2+PERS2+XEHS2+XEHS2+ZEHS2+ZEHS2+L+L1_TK)	
DVP = (VCHSS - VCHS?) / ((CCH/27K) - 2RLT)	
PRAT= AMAX1(0.0,4MIN1(1.0,(PCH/PTK)))	
Construct ONLY	
CALL HC(HX,PRAT)	
HARHX+HAI	
CALL TKIISHTK, PHZTK, RZ TK, R1 TK, PHITK, L1 TK, LZ TK, HY, A, E, L, LS)	
ISHAPE=ISHIK	
IF (ISHAPE.ED.0) GD TO 199	
CALL SECTIVES . 3: SI.OF SE. 20XSE, XCXSE, DELSE, XCISE, ZCISE, ICLFM,	RZT
1K,FH2TK,G2IS1,L3,H,N,P,ICG52)	
CALL COISLADO, KOXSE, ZCXSU, YOG, XGG, SIE, PHE, THE, CC, FF, GG)	
CALL PRITE PRI	
CALL CLIVGHCL, ICN, PHE, THE, SL4CO, YG PR)	
RHOF MARHO	
CALL S1(02IS1.A1 S1.A2 S1.SI S1.GI S1.OXIS1.8:IS1.L1IS1.L2IS1.	RIIS
11. RZIS1. SHIS1, PHETK, RZ TK. DK SE. BE SE. HY, P1 TK. PHITK, ICLEM, L1	TKIL
12 TK, ITYSE, D, 4, E, N, 4, VT IS1, 4CIS1, LS)	
CALL SPIVT432, VCHS2, 4CHS2, PHZTK, F2 TK, DZISI, BE SE, A1 S1, 42 S1,	ox s
12.51 SI, ITYSE.YCHOL.HY .CI SI.DYIE1.82ISI.XCISE.ZCISE.	L2 T
2K, L1151, L2151, R1151, P2151, 27L52, 5N151, XCX55, D, L5, 4H, NX, NH, HYI,	LX.S
JH .VCD.R1 TK, AGPS2, ATAS2, ATOS2, ACHS2, FACS2, ACUS2, ISGSE, VTIS1, AC	
KACRS2.ATIS2.JTRS2.PERS2, XCHS2, XTKS2. ZCHS2. ZTKS2, L.L1_TK)	
DVK= (VTKS2-VTKS)/.01	
C CONVERT PADIANS TO DEGREES	
PHIERPHIC/RADIAN	
DTHETA=DTHETA/RAOIAN	•••••
DPHIE=CPHIC/RADIAN	
SIE=SYE/RADIAN	
RETURN JEN'J	
SUSPCUTINE SETTTYP, 9274, DELX, ZCX, YCX, DELTA, XCHI, ZCHI, ICALL, RZ,	PHT2
X.DZI.LS.H.V.D.ISEG	
G DIVISION OF THE TRUNK INTO SEGMENTS	
PEAL LS DIMENSION ZCX(32), XCX(32), ITYP(32), DELTA(32), ISEG(32), XCHI(32)	704
X1 (32)	
UATA PI/J.141592653/	
NSTOP=32	
C IF FIPST CALL, COMPUTE PARTIAL TIPMS AND NUMBER SEGMENTS	
IF (ICALL) 20,30,20	
30 KLSHIN, SALS	
C AETA IS CURVED SCRHENT ARC ANGLE	
82TA=P1/2+/FLOAT(N)	
C DELX IS STPAIGHT SEGMENT LENGTH	
D[LX+LS/FL]+T(2*4)	
ACTA2=1.33333+SIN(7=14/2.)/7ETA	
C NUMBERING OF SECTENTS ACCORDING TO THEIR POSITION IN THE TRUNK	
00 11 I=1+NSTOP	

•
IF(I.LE.N) ISEG(I)=1
1F(I.GT.N. 447. I.LE. 4.M) ISES(1)=2
IF (I. GT. N. 4. AND. I. L. N. 20H) IS [G(I)=3
IF(I.GT.N+2+N,AND.I.LE.2+(N+H))ISEG(I)=4
1F(1.51.2.*(N+M).AND.1.L1.3.*N+2*M) ISEG(1)=5
IF(I.GT. 3* 1+2* 1.4N*. I.L.2.2* (1+*1) ISEG(I)=6
1F(1.6T.3*(N+M).AND.1.LE.3*N+4*1) ISEG(1)=7
IF(I.GT.3*464*H.4ND.I.LE.4*(N+H)) ISEC(I)=6
11 CONTINUE
C EVALUATING PROPERTIES OF SEGMENTS
C ITYP=1 FOR CURVED SEGMENT.=0 FOR STRAIGHT SEGMENT
C XCX AND 7CX ART X AND 7 COORDINATTS FESP. OF THE SESMENT CENTER C XCHI AND 7CHI ART X AND 7 COORDINATES RESP. OF THE CUSHION
C PRESSURE CENTER FOR A SEGMENT. AHEN IT IS OUT OF GROUND CONTACT
C DELTA IS SEGMENT CENTER ANGLE RELATIVE TO CG
20 CONTINUE
02+0,5+0+62+SIN(PHI2)
K60+1566(1)
GO TO (1,2,3,4,5,6,7,8) + KGO
C CURVED SEGMENT
C CURVED SEGMENT C IF NOT INITIAL CALL SKIP CALCULATIONS 1 IF(ICALL) 3,100,3
TELEVILLE CALL SALE CALCOLATIONS
DELTA(I) = (=LOAT(I-1)+0.5)*3ETA
XCX (I) +- (9: 54+021+COSDEL)
ZCX(I)=92I*SIN(3ELTA(2)) XCHI(I)=-(3LSH+32I*BETA2*COSDEL)
XCHI(I)=-(1LSH+92I+8ETA2+COSOSL) ZCHI(I)=ZCX(I)+3ETA2 GO TO 9
C STRAIGHT SEGHENT
XCX(1) == RL3H+ (FLQAT (1-1-N)+0.5)+ DELX
XCHI(])=XC(1)
2CHI(1)=2CX(1)=0.5
GO TO 9 C STRAIGHT SEGMENT
J ITYP(I)=0 XCX(I)=(FL)AT(I+N-M-1)+0.5)*DELX
XCX(1)=(FL)=((I+N+H=1)+0.5)*DELX
2CX(1)+02
xCHI(I)=xCx(!)
ZCHI(I)=ZCX(I)=0, F
60 T0 9
C CURVEC SEGMENT
C IF NOT INITIAL CALL SKIP CALCULATIONS
4 IF(ICALL) 3.400.9
600 DELTA(I)=.(=L)AT(I=N=2+M=1)+0.5)+PETA
SINDEL*SIN(DELTA(I))
XCX111=RLS1+021+SINDEL
ZCX(I)=021+305()=LTA(I))
xCH1(1)+PL3H+D21+DETA2+SINJEL
G CURVER SEGMENT
C IF NOT INITIAL CALL SKIP CALCULATIONS
5 IF(ICALL) 3,500,9
500 ITVP(I)=1
DELTA(1) = (FLOAT(1-2*N-2*M-1) + 0.5)*BETA
COSDEL=COS(J=LTA(I))
#C#(1)=7L5407210COSDEL
2Cx(1)x+D2[*51N(D]LTA(1))
XGHI (I)=RL5H+D2T+COSDEL+95T42
ZCH1(1)+2C(1)+15TA2
6 OT 03

C 21)	RAIGHT SEGNENT
6	ITYP(I)=0
	X(X(I)=RLSH-(FLOAT(I-3*N-2*N-1)+0.5)*DELX
	2Ck(I)=-32
• •	xCH1(1)=xC((1)
	2CH1(1)+7Ct(1)+0.5
	GO TO 9
C STR	RAIGHT LEGMENT
7	1770.7.**
•	XCX (I) =+ (FLOAT (I+3*N+3*H+1)+0.5)*D2LX
•	2CX(1)=-02
	xCHI(I)=xCK(I)
	2CHI(I)=2CX(I)=0.5
	6 OT 03
- cuie	NED SEGMENT
	NOT INITIAL CALL SKIP CALCULATIONS
8	IF(ICALL) 9,800,9
600	1TYP(1)+1
	05LTA(1)+(FLOAT(7-T+N-4+H-1)+0.5)+8ETA
	SINCELESIN (DELTA(I))
	XCX(I) =- (P_SH+D2I*SINDEL)
	ZCX(I)=-021+COS(02LTA(T))
	XCHI(I)=-(RLSH+DZI+SINDEL+JITAZ)
	ZCHI(I)=ZCX(I)+35TA2
3	CONTINUE
i h	CONTINUE
	RETURN
	END
	SUBRCUTINE TK (ISHAPE, PHI2, R2, R1, FHI1, L1, L2, HY, A, B, L, LS)
C TRU	INK GEOMETRY CALCULATIONS
	REAL LILILZIS
	RTOL . 1
	RTOL*.1. If (Hy.(E.0.7) GO TO 111
	······································
<b>C 11E</b>	RATICN FOR 32
<b>C 11E</b>	RATICN FOR R2 IPUTE INNER RADIUS OF CURVATURE
C ITE C COM	RATICN FOR R2 IPUTE INNER RADIUS OF CURVATURE R2#SORT (A+140+2+HY+HY)
C ITE C COM	RATICN FOR R2 IPUTE INNER RADIUS OF CURVATURE R2#SORT (A+140+2+HY+HY)
C ITE C COM	RATICN FOR R2 IPUTE INNER RADIUS OF CURVATURE R2#SORT (A+140+2+HY+HY)
C ITE C COM C ITE	RATICN FOR R2 PUTE INNER RADIUS OF CURVATURE R2#SORT(A+140+2;+HY+HY) RATION LOOP FOR L2.60,P1.82
C ITE C COM C ITE	RATICN FOR R2       IPUTE INNER RADIUS OF CURVATURE       R2#SORT (A+1*0.2:+HY*HY)       RATION LOOP FOR L2.60,P1.72       C0 102 I=1.50
C ITE C COM C ITE	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT(A+140.2:+HY*HY)         RATION LOOP FOR L2.60,P1.72         C0 102 I=1.50         PHI2#APS(A)25 (A*5X1(-1.0.441N1(1.0.((R2-HY)/R2))))
C ITE	RATICN FOR R2         IPUTE INNER RADIUS OF CURVATURE         R2=SORT(A+140.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHI2=AQS(L2)S(AM4X1(-1.0.AMIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PHI2)
C ITE	RATICN FOR R2         IPUTE INNER RADIUS OF CURVATURE         R2=SORT (A+140, 2; +HY+HY)         RATION LOOP FOR L2, 50, P1, 72         G0 102 I=1,50         PHI2=AQS(L2)S(A+1(-1, 3, A+1N1(1, 0, ((R2-HY)/R2))))         SINPH2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE
C ITE	RATICN FOR 32         IPUTE INNER RADIUS OF CURVATURE         RESORTIA 440.2: +HY*HY         RATION LOOP FOR L2.6U, P1.R2         D0 102 I=1.50         PHI2=A85(L205(A*5X1(-1.0.A*1N1(1.0.((R2-HY)/R2)))))         SINPM2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         R1=((A+R2*SIN(PH2)**2+(R+HY))*21/(2.*(B+HY)))
C ITE	RATICN FOR 32         IPUTE INNER RADIUS OF CURVATURE         RESORTIA 440.2: +HY*HY         RATION LOOP FOR L2.6U, P1.R2         D0 102 I=1.50         PHI2=A85(L205(A*5X1(-1.0.A*1N1(1.0.((R2-HY)/R2)))))         SINPM2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         R1=((A+R2*SIN(PH2)**2+(R+HY))*21/(2.*(B+HY)))
C ITE	RATICN FOR 32         PDUTE INNER RADIUS OF CURVATURE         R2#SORT (A * 140, 2: + HY* HY)         RATION LOOP FOR L2,60, P1.72         D0 102 I=1,50         PHI2#A85(A 255 (A*5X1(-1, 2, A*1N1(1, 0, ((K2-HY)/R2))))         SINPH2#SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A+R2*SIN(PH2)** 2* (A+HY)**2)/(2,*(B+HY))         PHI1#APS(A 205 (A*10) ** 2* (A+HY)**2)/(2,*(B+HY))
C ITE	RATICN FOR 32         IPUTE INNER RADIUS OF CURVATURE         RESORT (A * 140, 2; + HY*HY)         RATION LOOP FOR L2,6U,P1.R2         CO 102 I=1.50         PHI2*AQS(L)S(A*X1(-1,0,AMIN1(1.0,((R2-HY)/R2))))         SINPH2*SIN(PHI2)         IPUTE CUTER RADIUS OF CUPVATURE         R4 = ((A-R2*SINPH2) + 0 + (R+HY) + 2)/(2,*(B+HY))         PHII*APS(L)SOS(AMAX1(-1,0,AMIN1(1,0,((R1-HY-B)/R1)))))         XS*A-R2*SINPH2
	RATICN FOR 32         PDUTE INNER RADIUS OF CURVATURE         R2#SORT(A*4*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHIZ=R05(L2)S(A*4X1(-1.0.A*(N1(1.0.((K2-HY)/R2)))))         SINPH2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1=((A*R2*SINPH2)+*2+(A*HY)*2)/(2.*(B*HY))         PHI1=R05(A3S)(A*AX1(-1.0.A*(N1(1.0.((R1-HY-B)/R1)))))         X5*A-R2*SINPH2         IF (XS_LE:3.0) PHI1=6.2831552-PHI1
	RATICN FOR 32         PDUTE INNER RADIUS OF CURVATURE         R2#SORT(A*4*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHIZ=R05(L2)S(A*4X1(-1.0.A*(N1(1.0.((K2-HY)/R2)))))         SINPH2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1=((A*R2*SINPH2)+*2+(A*HY)*2)/(2.*(B*HY))         PHI1=R05(A3S)(A*AX1(-1.0.A*(N1(1.0.((R1-HY-B)/R1)))))         X5*A-R2*SINPH2         IF (XS_LE:3.0) PHI1=6.2831552-PHI1
	RATICN FOR 32         PDUTE INNER RADIUS OF CURVATURE         R2#SORT(A*4*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHIZ=R05(L2)S(A*X1(-1.0,A*(N1(1.0,((K2-HY)/R2)))))         SINPM2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1=((A*R2*SI*PH2)+*2+(A*HY)*2)/(2.*(B*HY))         PHIT=APS(L2)S(A*AX1(-1.0,A*(N1(1.0,((R1-HY-B)/R1)))))         XS*A-R2*SI*PH2         IF (XS_LE:0.0) PHI1=6.2831552*PHI1         L2=L-PHI1*Q1         IS R2:SULTANT RAD:US FO? COMPUTED L2LIN LIGRATION
	RATICN FOR 32         PDUE INNER RADIUS OF CURVATURE         R2#SORT(A*1*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHI2#AGS(A)25 (A#4X1(-1.0.AMIN1(1.0.((R2-HY)/R2))))         SINPH2=SIN(PHI2)         IPUTE CUTER RADIUS OF CUPVATURE         K1#((A+R2*SINPH2))**2+(R+HY)**2)/(2.*(B+HY))         PHI1#AGS(A)25 (AMAX1(-1.0.AMIN1(1.0.((R1-HY-B)/R1))))         XS#A-R2*SINPH2         IF (XS.L5.0.0) PHI1=6.2831952-PHI1         L2=L-PHI1*PL         IS RESULTANT RADIUS FOR COMPUTED L2LIN ITERATION         IF (ASS(PHI2).L1.1.05-2), PHI2=1.0F-2
C ITE C COP C ITE C ITE C COP	RATICN FOR 32         IPUTE INNER RADIUS OF CURVATURE         R2=SORT(A+140.2;+HY+HY)         RATION LOOP FOR L2.6U,P1.72         G0 102 I=1.50         PHI2=A85(1:35(A*X1(-1.3,A*IN1(1.0,((K2-HY)/R2))))         SINPH2=SIN(PHI2)         PUTE CUTCR RADIUS OF CUPVATURE         K1=((A+R2+SIN(PH12))         PUTE CUTCR RADIUS OF CUPVATURE         K1=((A+R2+SIN(PH2)++2+(A+HY)+2)/(2.+(B+HY))         YS=A+R2+SIN(PH2)         IF (X5.L5.3.0) PHI1=6.2831952+PHI1         L2=L-PH11*Q1         IS RESULTANT RADIUS FOR COMPUTED L2LIN ITERATION         IF (APS(PH12), LT.1.05-2) PH12=1.05-2         PRS=L2/PH12
C ITE C COP C ITE C ITE C COP	RATICN FOR 32         PDUE INNER RADIUS OF CURVATURE         R2#SORT(A*1*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHI2#AGS(A)25 (A#4X1(-1.0.AMIN1(1.0.((R2-HY)/R2))))         SINPH2=SIN(PHI2)         IPUTE CUTER RADIUS OF CUPVATURE         K1#((A+R2*SINPH2))**2+(R+HY)**2)/(2.*(B+HY))         PHI1#AGS(A)25 (AMAX1(-1.0.AMIN1(1.0.((R1-HY-B)/R1))))         XS#A-R2*SINPH2         IF (XS.L5.0.0) PHI1=6.2831952-PHI1         L2=L-PHI1*PL         IS RESULTANT RADIUS FOR COMPUTED L2LIN ITERATION         IF (ASS(PHI2).L1.1.05-2), PHI2=1.0F-2
C ITE C COP C ITE C ITE C COP	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT (A * 140.2: + HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHI2 = A85(A 205 (A*5X1(-1.0,A*1N1(1.0,((K2-HY)/R2))))         SINPH2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1=((A-R2*SINPH2) + 2+ (A+HY) + 2)/(2.*(B+HY))         PHI1=A85(A 205 (A*AX1(-1.0,A*1N1(1.0,((R1-HY+B)/R1)))))         XS*A-R2*SINPH2         IF (XS.L5.3.0) PHI1=6.2831952-PHI1         L2=L=PH11*Q1         IS RESULTANT RADIUS FOR CONPUTED L2EIN ITERATION         If (A95(PH12).LT.1.0E-2) PHI2=1.0E-2         P25=L2/PHI2         IF IF OLSRAWCE .6T. ERPOR
C ITE C COP C ITE C ITE C COP	RATICN FOR 32         PDUE INNER RADIUS OF CURVATURE         R2#SORT(A*1*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHI2#AGS(L3)S(AMSX1(-1.0.ANIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A+R2*3I)PH2)**2+(A+HY)*2)/(2.*(B+HY))         PHI1#AGS(A30S(ANAX1(-1.0.ANIN1(1.0.((R1-HY-B)/R1)))))         XS*A-R2*SINPH2         IF (XS_LE:0.0) PHI1=6.2831952-PHI1         L2=L-PH1************************************
C TTE	RATICN FOR 32         PDUE INNER RADIUS OF CURVATURE         R2#SORT (A*140, 2: +HY*HY)         RATION LOOP FOR L2,6U,P1.R2         C0 102 I=1.50         PHI2#ABS(L2)S(AMAX1(-1, 0, AMIN1(1,0,((R2-HY)/R2))))         SINPH2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1=((A+R2*SINPH2)+*2+(R+HY)*2)/(2.*(B+HY))         PHI1#ABS(ADS)(AMAX1(-1,0,AMIN1(1,0,((R1-HY-B)/R1))))         XS=A-R2*SINPH2         IF (XS.L5.0.0) PHI1=6.2831952-PHI1         L2=L-PHI1*91         IF (XS.L5.0.0) PHI1=6.2831952-PHI1         L2=L-PHI1*91         IF (ASCLPH12.1.1.05-2) PHI2=1.0F-2         PZS=L2/PHI2         TI F 10L5RANCE of . ERPOR         IF (AS(R2-R2S).LE.PTOL) GO TO 50         R2=(R2-R2S).0_5
C TTE	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT(A*3*0.2:+HV*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PMJ2#45(L2)S(A*5X1(-1.0,A*[N1(1.0,((K2-HY)/R2)])))         SINPH2#51Y(PH12)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A*R2*J1YPH2)**2+(R+HY)*2)/(2.*(B+HY))         PHI:#APS(L2)S(A*LX1(-1.0,A*[N1(1.0,((R1-HY*B)/R1)])))         XS*A-R2*SINPH2         PH (XS.L5.3.0) PHI1=6.2831952-PHI1         L2=L=PH11*Q1         IS RESULTANT RAD:US FO? COMPUTED L2LIN ITERATION         If (ASS(PH12).LT.1.0E-2) PHI2*1.0F-2         P2S#LZ/PHI2         IT IF TOLERANCE .GT. ERPOR         IF (A*S(R2-R2S).LE.PIOL) G3 TO 50         R2*=(R2*R2S)*0.5         CONTINUE
C ITE C OF C ITE C OF C COF C COF C COF C COF C COF C COF C COF C COF C C C C C C C C C C C C C C C C C C C	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT(A*4*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHI2#A85(A205(A*4X1(-1.0,A*(N1(1.0,((K2-NY)/R2)))))         SINPM2#SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A*R2*SIN(PH2)**2+(R+HY)**2)/(2.*(B+HY))         PMIT#A85(A205(A*AX1(-1.0,A*(N1(1.0,((R1-HY-B)/R1)))))         XS*A-R2*SINPH2         FH I*#A85(A205(A*AX1(-1.0,A*(N1(1.0,((R1-HY-B)/R1))))))         XS*A-R2*SINPH2         IF (XS.LE.3.0) PHI1*=6.2831952-PHI1         L2=L-PH1************************************
C TTE C COP C TTE C TTE C COP C C TTE C C COP C C TTE C C COP C C TTE C C C C C C C C C C C C C C C C C C C	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT(A*1*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHI2#ABS(L3)S(AMSX1(-1.0.AMIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A+R2*31)PH2)**2*(A+HY)**2)/(2.*(B+HY))         PHI1#ABS(A)S(AMAX1(-1.0.AMIN1(1.0.((R1-HY-B)/R1))))         XS*A-R2*SINPH2         IF (XS_LE:0.0) PHI1=6.2831952-PHI1         L2:L-PH1************************************
C ITE C OF C ITE C OF C COF C COF C COF C COF C COF C COF C COF C COF C C C C C C C C C C C C C C C C C C C	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT(A*1*0.2:+HV*HY)         RATION LOOP FOR L2.6U,P1.R2         G0 102 I=1.50         PHI2:A85(A:DS(A*X1(-1.0,A*IN1(1.0,((K2-HY)/R2))))         SINPH2:SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1=((A*R*5)IPH2)*2+(A+HY)*2)/(2.*(B+HY))         PHI1:APS(A:DS(A*AX1(-1.0,A*IN1(1.0,((R1-HY-B)/R1)))))         x5:A-R2*SINPH2:         IF (XS.L5:0.0)         PHI1:=6.2031952-PHI1         L2:L-PH1:*1         L2:L-PH1:*1         IF (XS.L5:0.0)         PH1:=6.2031952-PHI1         L2:L-PH1:*1         IF (XS.L5:0.0)         PH1:=6.2031952-PHI1         L2:L-PH1:*1         IF (XS.L5:0.0)         PH1:=6.2031952-PHI1         L2:L-PH1:*1         IF (XS.L5:0.0)         PH1:=6.2031952-PHI1         L2:L-PH1:*1         IF (AS:CR2-R25).L2:PH12         IF TOLERANCE .GT. ERPOR         IF (AS:CR2-R25).L2:PT0L)         GONTINUE         RATED 50 TI1*ES WITHOUT SUCCESS,ERROR RETURN         GONTINUE
C TTE C COP C TTE C TTE C COP C C TTE C C COP C C TTE C C COP C C TTE C C C TTE C C C C C C C C C C C C C C C C C C C	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT(A*1*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHI2#ABS(L3)S(AMSX1(-1.0.AMIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A+R2*31)PH2)**2*(A+HY)**2)/(2.*(B+HY))         PHI1#ABS(A)S(AMAX1(-1.0.AMIN1(1.0.((R1-HY-B)/R1))))         XS*A-R2*SINPH2         IF (XS_LE:0.0) PHI1=6.2831952-PHI1         L2:L-PH1************************************
C TTE C COP C TTE C TTE C COP C C TTE C C COP C C TTE C C COP C C TTE C C C TTE C C C C C C C C C C C C C C C C C C C	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT (A * 1*0.2: + HV* HY)         RATION LOOP FOR L2.6U,P1.R2         CO 102 I=1.50         PMJ2#ASS(A 205 (A*5X1(-1.0,A*IN1(1.0,((K2-HY)/R2))))         SINPH2#SIN(PH12)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A+R2*SINPH2) ** 2* (A+HY) * 2)/(2**(B+HY))         PHI #ASS(A 205 (A*AX1(-1.0,A*IN1(1.0,((R1-HY*B)/R1)))))         XS*A-R2*SINPH2         IF (XS.LE.3.0) PHI1=6.2031952-PHT1         L2=L=PH11*Q1         IS RESULTANT RADIUS FO? COMPUTED L2EIN ITERATION         If (ASS(PH12).LT.1.0E-2) PH12=1.0E-2         P2S=L2/PH12         T IF 10LSRANCE .GT. ERPOR         IF (A*S(R2-R2S)*LE.PTOL) G3 TO 30         R2=(R2+R2S)*0.5         CONTINUE         RATED 50 TI 1ES MITHOUT SUCCESS.ERROR RETURN         CONTINUE
C TTE C TTE C TTE C TTE C COH C COH C COH C COH C COH C COH C COH C C TTE C C TTE C TTE C TTE C TTE C TTE	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT (A * 4*0, 2: + HY*HY)         RATION LOOP FOR L2.6U, P1.R2         C0 102 I=1,50         PHIZ=R05(A 205 (A*X1(-1, 0, AMIN1(1, 0, ((K2-HY)/R2))))         SINPM2=SIN(PMI2)         PUTE CUTER RADIUS OF CUPVATURE         K1=((A+R2*SINPM2)+*2+(A+HY)-*2)/(2.*(B+HY))         PMIZ=A05(A 205 (A*AX1(-1, 0, AMIN1(1, 0, ((R1-HY-B)/R1))))         XS*A-R2*SINPH2         FMII=A05(A 205 (A*AX1(-1, 0, AMIN1(1, 0, ((R1-HY-B)/R1))))         XS*A-R2*SINPH2         IF (XS_LE: 0, 0) PHI1=6.2831952-PHI1         L2=L-PH11*Q1         IS RESULTANT RADIUS FO? COMPUTED L2LIN ITERATION         IF (ASSIPH2)_LT.1.0E-2) PHI2=1.0E-2         P25=L22PHI2         IF IF TOLERANCE OFT. ERPOR         IF (AMS(R2-R2S).LE.PTOL) G0 TO 00         R2= (R2-R2S).LE.PTOL) G0 TO 00         R2= (R2-R2S).LE.PTOL) G0 TO 00         RATED 00 TIME         WRITE(6.9011)         FOPMAT(101, INFEASANCE TRUNK GEOMETRY *//>
C TTE C TTE C TTE C TTE C COH C COH C COH C COH C COH C COH C COH C C TTE C C TTE C TTE C TTE C TTE C TTE	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT(A*1*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHI2#A85(4:2)S(AMSX1(-1.0.ANIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PH12)         PUTE CUTER RADIUS OF CUPVATURE         K1=((A+R2*3INPH2)***(A+HY)**2)/(2.*(B+HY))         PHI1=A85(A:2)S(AMAX1(-1.0.ANIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PH12)         PHI1=A85(A:2)S(AMAX1(-1.0.ANIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PH12)         PHI1=A85(A:2)S(AMAX1(-1.0.ANIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PH12)         PHI1=A85(A:2)S(AMAX1(-1.0.ANIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PH12)         PHI1=A85(A:2)S(AMAX1(-1.0.ANIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PH12)         PHI1=A85(A:2)S(AMAX1(-1.0.ANIN1(1.0.((K2-HY)/R2))))         SINPH2=SIN(PH12)         PHI1=A85(A:2)S(AMAX1(-1.0.ANIN1(1.0.(K2-HY)/R2)))         SINPH2=SIN(PH12)         If (X:SLE.0:0) PHI1=E6.2831952-PHI1         L2:L-PH11*Q1         If (AS(PH12).LT.1.0.0:-2) PH12=1.0F-2         PZ:E2/PHI2         If (AS(ANCE .GT. ERPOR         IF (AS(ANCE .GT. ERPOR         IF (AS(ANCE .GT. ERPOR         IF (AS(ANCE .GT. ERPOR
C ITE C OFF C TTE C COFF C TTE C COFF C C TTE C COFF C C TTE C COFF C C TTE C COFF C C TTE C C COFF C C C COFF C C C C C C C C C C C C C C C C C C C	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT(A+3*0.2:+HV*HY)         RATION LOOP FOR L2.6U,P1.R2         GO 102 I=1.50         PHI2#ASS(A)DS (A*X1(-1.0,A*IN1(1.0,((R2-HY)/R2))))         SINPH2=SIN(PH12)         PUTE CUTCR RADIUS OF CUPVATURE         R1#(A+R2*SIN(PH12))         PHI1*APS(A)DS (A*AX1(-1.0,A*IN1(1.0,((R1-HY*B)/R1))))         SINPH2=SIN(PH2)         PH1*APS(A)DS (A*AX1(-1.0,A*IN1(1.0,((R1-HY*B)/R1))))         XS*A-R2*SINPH2         IF (XS,L5:0,0) PHI1=6.283I952-PHI1         L2=L-PH11*Q1         IS RESULTANT RADIUS FOR COMPUTED L2&IN ITERATION         IF (ASLE2/PHI2).L1.1.05-2) PH12=1.0F-2         P2S=L2/PH12         T IF TOLERANCE .GT. ERPOR         IF (A*SLR2-R2S).LE.PTOL) GJ TO 50         R2*(R2+R2S).LE.PTOL) GJ TO 50         R2*(R2+R2S).LE.PTOL) GJ TO 50         R2*(R2+R2S).LE.PTOL) GJ TO 50         R2*(R2+R2S).LE.PTOL) GJ TO 50         RATED 50 TI 14S WITHOUT SUCCESS.ERROR RETURN         CONTINUE         WRITE(6,9011)         FOPMAT(1)1X,* INFEASANLE TRUNK GEOMETRY *//)         ISHAPE=0         RETURN
C TTE C TTE C TTE C TTE C COH C TTE C COH C TES C TES C TES C TES C TTE C TTE	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT (A * 140.2: + HY*HY)         RATION LOOP FOR L2.6U,P1.R2         CO 102 I=1.50         PMJ2#45(L2)S(A*5X1(-1.0,A*[N1(1.0,([K2-HY]/R2]])))         SINPH2#SIN(PH12)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A+R2*J1VPH2)**2+(A+HY)*2)/(2.*(B+HY))         PHIECUTER RADIUS OF CUPVATURE         K1#((A+R2*J1VPH2)**2+(A+HY)*2)/(2.*(B+HY))         PHII#APS(A)S(A*AX1(-1.0,A*[N1(1.0,([R1-HY+B]/R1])]))         XS*A-R2*SINPH2         IF (XS.LE.3.0) PHI1#6.2831952-PHI1         L2=L=PH1**1         IS RESULTANT RAD: US FO? COMPUTED L2LIN ITERATION         IF (ASS(PH12).LT.1.0E-2) PHI2*1.0E-2         P2S*L2/PH12         IS RESULTANT RAD: US FO? COMPUTED L2LIN ITERATION         IF (ASS(R2-R2S).LE.PIOL) GJ TO 50         R2*E(R2-R2S).LE.PIOL) GJ TO 50         R2*E(R2-R2S).LE.PIOL) GJ TO 50         RATED 50 TI4ES MITHOUT SUCCESS.ERROR RETURN         CONTINUE         WRITE(6,9011)         FOPMAT(10X, * INFEASANLE TRUNK GEOMETRY *//S         ISHAPE*0         NK OK, RETURN
C ITE C OFF C TTE C COFF C TTE C COFF C C TTE C COFF C C TTE C COFF C C TTE C COFF C C TTE C C COFF C C C COFF C C C C C C C C C C C C C C C C C C C	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT(A*4*0.2:+HY*HY)         RATION LOOP FOR L2.6U,P1.R2         C0 102 I=1.50         PHIZ#A85(A:DSC(A*4X1(-1.0,A*(N)(1.0,((K2-HY)/R2))))         SINPM2#SIN(PHI2)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A*R2*SIN(PHI2))         PUTE CUTER RADIUS OF CUPVATURE         K1#((A*R2*SIN(PHI2))         PUTE CUTER RADIUS OF CUPVATURE         K1#((A*R2*SIN(PHI2))         PHI1#A85(A:DSC(A*AX1(-1.0,A*(N)(1.0,((R1-HY-8)/R1)))))         XS*A-F2*SINPH2         IF (XS.LE: 3.0) PHI1=6.283IS52-PHI1         L2:L-PH11*Q1         IS RESULTANT RADIUS FOR COMPUTED L2LIN ITERATION         IF (ASSCHT RADE FOR COMPUTED L2LIN ITERATION         RATED 50 TI 142S WITHOUT SUCCESS, ERROR RETURN         CONTINUE         WRITE(6,9011)         FORMATING         MRITE (6,9011)         FORMATION         ISHAPE*0
C TTE C TTE C TTE C TTE C COH C TTE C COH C TES C TES C TES C TES C TTE C TTE	RATICN FOR 32         PUTE INNER RADIUS OF CURVATURE         R2#SORT (A * 140.2: + HY*HY)         RATION LOOP FOR L2.6U,P1.R2         CO 102 I=1.50         PMJ2#45(L2)S(A*5X1(-1.0,A*[N1(1.0,([K2-HY]/R2]])))         SINPH2#SIN(PH12)         PUTE CUTER RADIUS OF CUPVATURE         K1#((A+R2*J1VPH2)**2+(A+HY)*2)/(2.*(B+HY))         PHIECUTER RADIUS OF CUPVATURE         K1#((A+R2*J1VPH2)**2+(A+HY)*2)/(2.*(B+HY))         PHII#APS(A)S(A*AX1(-1.0,A*[N1(1.0,([R1-HY+B]/R1])]))         XS*A-R2*SINPH2         IF (XS.LE.3.0) PHI1#6.2831952-PHI1         L2=L=PH1**1         IS RESULTANT RAD: US FO? COMPUTED L2LIN ITERATION         IF (ASS(PH12).LT.1.0E-2) PHI2*1.0E-2         P2S*L2/PH12         IS RESULTANT RAD: US FO? COMPUTED L2LIN ITERATION         IF (ASS(R2-R2S).LE.PIOL) GJ TO 50         R2*E(R2-R2S).LE.PIOL) GJ TO 50         R2*E(R2-R2S).LE.PIOL) GJ TO 50         RATED 50 TI4ES MITHOUT SUCCESS.ERROR RETURN         CONTINUE         WRITE(6,9011)         FOPMAT(10X, * INFEASANLE TRUNK GEOMETRY *//S         ISHAPE*0         NK OK, RETURN

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FND
SUBROUTINE SI(D2I.A1.A2.S:,D2024PI.OXAHABI.BI.LII.LII.LII.RII.R2I
X, SINFHRI, PHI2, R2, DILX, BETA, KY, PI, PHI1, ICALL, L1, L2, ITYP, D, A, E, N, N, Y
XIKI,ACHI,LS)
C INITIAL ASSESSMENT OF AREAS, VOLUMES ASSUMING
C NO SECUND CONTAST
REAL LILLZILLILLZILLS
0141NSIDN 1179(32), ATKI(32), VTKI(32), ACHI(32)
NSTOP # 32 \$9=E
C COMPUTE GEOVETRY TERMS
SINPHZEIN(PHIZ)
SINPHRESINGHIEF
D2=D/2++SINPHR
U02=0?LX+D2
BCD2+3ETA+32+32+32+32+32+32+32+32+32+32+32+32+32+
X=3+(A+SIN0HD)/(3+HY-01)
C COMPUTE AREAS OF TRUNK SECTORS
A1=PHI2/2. 1+32++2
AZ= (92-HY)/2.04 SINPHR
A3=PWI1/2.J*R1##2
A4=X*9/2.0
A5= (A-STIF47-X)/2.0*(HY-21)
X1=SINFHR- 4. 0* (SIN(PH12/2. 3))**2*R2/(3.0*PH12)
X2=0.66567+51NPHR
X2=SINPHP+L.D+(SIN(PHI1/2.0))+*2*21/(3.0*PHI1)
X4=A-0,333333=X
X5=SIN=HR+0.333333*(A=SINPHR+X)
LA=A1+A3+A3-A2-A4
£¥=£1+x1+2=x2+A3+x3+2+44+45+x5
IF(ICALL.GT.0) 50 TO 20
C SAVE TRUNK GEOTITRY TERMS FOR END TRUNK CALGULATIONS
RII=RI
R21462
PHI1IzPHI1
PHI21=PHI2
11-11 12I#12
A11=41
A 2 I = A 2
SINPHZI=SINPHZ
SINPHRI SINPH?
X1I=X1 -
X3I=x2
A1MA2I=A1-42
021=02
SI=5
8ET402I=3ET402
x12=(x1*A1+x2*A2)/A1H#2I
DYA 4 11 + (D+0.5+X12) + A 1M 42 I + TETA
0021+0ELX+)2
BDD21=02TA+02+02+0.5
20 CONTINUE
C COMPUTE TRUNK SEGRENT AREA, VOLUTE, CUSHION AREA
00 103 I*1,NSTOP
IF(ITYP(1).53.1)60 TO 112
C STRAIGHT PART OF TRUNK
131 ATKI(I)=AA
VTK1(1)=OELX*ATK1(1)
ACH111+305
GO TO 102
C CURVED PART OF TRUNK
\$12 IF(ICALL.GT.0) GO TO 102
A1K1(1)=AA XE=A¥/A1K1(1)

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	WTKI(I)=0ETA+(0/2++XE)+ATKI(I)
	ACHI111=8032
102	CONTINUE
103	CONTINUE
	RETURN SENJ
	SUBROUTINE HC(Z,K)
C .SU8	ROUTINE TO CALCULATE POSITIONS OF
	E TPUNK LOBIS
C THE	POSITION (EXPRESSED BY MY) CEPENOS ON PRESSURES
C I.E	• HY/HYI=F(75H/PTK)
C FOR	CE INPUT PRESSURE RATIO RETHEEN 0.0 AND 1.0 -
	_AH0=1.003_3441=865_\$442+.328_\$AH3=463
	X#AMIN1(1.).444(1(0.0.*))
-	Z=AH0+AH1+X+AH2+X+AH3+X+X+X
	IF(7.L7.0.1)Z=0.L
	IF (2.GT.1.0) Z=1.0
	RETU9N
	ENO
	SUBPOUTINE CL (YSH, ICLN, PHIE, THETAE, SL4, YG)
	DIHENSION 3L+ (32 ), VG (32 ), VG (32 )
	NSTOF = 32
_C CAL	CULATION OF TRUNK GROUND CLEARANCE FOR EACH SEGHENT
	ICLNS=ICLN
	COSCOS=COS(PHIE)+COS(THETAE)
C CAL	CULATE SEGMENT GAP
	00 161 I=1,NSTOP
	YGH(1)=SL4(1)-Y3(1)*COSCOS
_C_IF_	NEGATIVE SET GAP TO 75RO
	YGH(I)=2H4X1(YGH(I)+0+0)
	_ IF (VGH(I), LE, 0, 0) _ ICLH=ICLN+1
161	
	_ICLH=ICLNS
	8 C T 11 C 11
	RETURN
	FND
	END SUBROUTINE COISLA.XCX.7CX.YCG.XCG.STE.PHIE.THETAE.CC.FF.GG)
	END SUBROUTINE COISLA, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) S SUBROUTINE CALCULATES X AND Z CORDINATES OF THE GROUND
C POI	END SUBROUTINE COISLA, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) S SUBROUTINE GALGULATES X AND Z CCORDINATES OF THE GROUND NT CORRESPONDING TO ÉACH SEGRENT, FOR A PAPTICULAR ACLS
C POI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) S SUBROUTINE CALCULATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAP ACLS ENTATION
C POI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALCULATES X AND Z COROINATES OF THE GROUND NT CORRESPONDING TO EACH SEGRENT, FOR A PAPTICULAP ACLS ENTATION DIMENSION SLE(32), YCX (32), ZCX (32), XG (32)
C POI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALCULATES X AND Z CCORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAP ACLS ENTATION DIMENSION SLE(32), YCX(32), 2CX(32), XG(32), ZG(32) NSTOP=32
C POI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) S SUBROUTINE CALCULATES X AND Z COROINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLE(32), YCY (32), ZCX (32), XG (32), ZG (32) NSTOP=32 L PHAIRY FOR SPACIAL TRANSFORMATION
C POI C_ORI C CAL C SHA	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALCULATES X AND Z CCORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAP ACLS ENTATION DIMENSION SLE(32), YCX(32), 2CX(32), XG(32), ZG(32) NSTOP=32
C POI C ORI C CAL C SMA C	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) S SUBROUTINE CALCULATES X AND Z COROINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLE(32), YCY (32), ZCX (32), XG (32), ZG (32) NSTOP=32 L PHAIRY FOR SPACIAL TRANSFORMATION
C POI C_ORI C CAL C_SMA C	END SUBROUTINE COISLE.XCX.7CX.7CG.XCG.SIE.PHIE.THETAE.CC.FF.GG) SUBROUTINE CALCULATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT. FOR A PAPTICULAP ACLS ENTATION DIMENSION SLE(32).YCXI32 1.7CX(32 1.XG(32).7G(32) NSTOP=32 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX TRANSFORMS A VECTOR FROM VEMICLE FREAME TO INERTIAL FRAME
C POI C ORI C CAL C SHA C C C CAL	END SUBROUTINE COISLE.XCX.7CX.YCG.XCG.SIE.PHIE.THETAE.CC.FF.GG) S SUBROUTINE CALCULATES X AND Z COORDINATES OF THE GROUND NT CORRESPONDING TO ÉACH SEGMENT. FOR A PAPTICULAR ACLS ENTATION DIMENSION SLE(32).YCYITZ J.ZCX(32).XG(32).ZG(32) NSTOP=32 L CHAIRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4 VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS
C POI C ORI C CAL C SHA C C C CAL	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) S SUBROUTINE CALCULATES X AND Z COROINATES OF THE GROUND NT CORRESPONDING TO ÉACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLE(32), YCX(32), ZCX(32), ZG(32), ZG(32) NSTOP=32 L CHAIRX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS A VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCS(SIT)
C POI C ORI C CAL C SHA C C CAL	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALCULATES X, AND Z, CCORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLE(32), YCXI32, 1, 2CX(32), XG(32), 7G(32) NSTOP=32 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX TRANSFORMS A VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCS(SII) CPMEECOS(MIE)
C POI C ORI C CAL C SHA C C CAL	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALCULATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGNENT, FOR A PAPTICULAP ACLS ENTATION DIMENSION SLE(32), YCXI32, 1, 2CX(32), 7G(32), 7G(32) NSTOP=32 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS A VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCS(SIT) CPHIE=COS(THE) CTHETAE=COS(THETAE]
C POI C_ORI C_CAL C_SHA C_C_C C_CAL	END SUBROUTINE COISLE.XCX.YCG.XCG.SIE.PHIE.THETAE.CC.FF.GG) SUBROUTINE CALCULATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT. FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETIZZ J.YCXITZ J.ZCXIZZ J.XGIZZ J.ZGIZZ J NSTOP=22 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4_VEGTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSII=CCSISTI CPHIE=COSIMISE] CTMETAE=COSITESI
C POI C_ORI C_CAL C_SHA C_C_C C_CAL	END SUBROUTINE COISLE.XCX.YCG.XCG.SIE.PHIE.THETAE.CC.FF.GG) SUBROUTINE CALCULATES X AND Z CORNENTES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT. FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETIZ J.YCXITZ J.ZCXIZZ J.XGIZZ J.ZGIZZ J NSTOP=22 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4 VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSII=CCSISTI CPHIE=COSIMIED CTMETAE=COSIMIED SFMIE=SIN(SHIE) SFMIE=SIN(PHIE)
C POI C_ORI C CAL C SHA C C C CAL	END SUBROUTINE COISLE.XCX.YCG.XCG.SIE.PHIE.THETAE.CC.FF.GG) SUBROUTINE CALCULATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT. FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETIZZ J.YCXITZ J.ZCXIZZ J.XGIZZ J.ZGIZZ J NSTOP=22 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4_VEGTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSII=CCSISTI CPHIE=COSIMISE] CTMETAE=COSITESI
C POI C_ORI	END SUBROUTINE COISLE, XCX, 7CX, 7CG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALCULATES X AND Z COORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLE(32), YCXIV2], 2CXI32), XG(32), ZG(32) NSTOP=32 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4 VEGTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCSISTI CPHIE=COSIMIE) CTHETAE=COSIMIES STHEISIN(SHE) STHETAE=SIN(THETAE)
C POI C_ORI	END SUBROUTINE COISLE.XCX.YCG.XCG.SIE.PHIE.THETAE.CC.FF.GG) SUBROUTINE CALCULATES X AND Z CORNINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT. FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETIZ J.YCXITZ J.ZCXIZZ J.XGIZZ J.ZGIZZ J NSTOP=22 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4 VEGTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSII=CCSISTI CPHIE=COSIMIED SIGESINISIES SIGESINISIES SFMETESINICHETAED PUTE TRANSLATION MATRIX CLEMENTS
C POI C_ORI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALGULATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETZZ J, YCTITZ J, ZCX(32 ), XG(32 ), ZG(32 ) NSTOP=32 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX TRANSFORMS A VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCS(SIE) CPHEE=COS(THEE) CTHETAE=COS(THETAE) STHETAE=CSITHETAE) STHETAE=SIN(THETAE) PUTE TRANSLATION MATRIX CLEMENTS BLI=CSIE=CPHIE+STHETAESSIE
C POI C_ORI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE COIGLEATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGRENT, FOR A PAPTICULAP ACLS ENTATION DIMENSION SLEGZED, YCXITZ 1, 2CXIZZ 1, XGTZZ ), ZGIZZ ) NSTOP 32 L CHATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS A VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCSISIT CHATESINISTED SSIE=SINISTED SSIE=SINISTED STHETAE=COSITHETAED PUTE TRANSTED NATRIX CLEMENTS B11+CSIE+COMIC+STHETAGESPHIZ=SSIE B12+SSPHIZ+STHETAE
C POI C_ORI	END SUBROUTINE COISLE.XCX.7CX.7CG.XCG.SIE.PHIE.THETAE.CC.FF.GG) SUBROUTINE CALCULATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT. FOR A PAPTICULAR ACLS ENTATION DIMENSION SLEIZ ).YCXITZ ).ZCXIZZ ).XGTZ ).ZGTZ ) NSTOP=22 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4 VEGTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCSISTI CPHIE=COSIMIES STHETAE=COSIMES STHETAE=COSIMES STHETAE=COSIMETAES SHIE=SIN(SHE) SHIE=SIN(THETAE) STHETAE=SIN(THETAE) STHETAE=SIN(THETAE) SHIE=SIN(THETAE) SHIE=SIN(THETAE) SHIE=SIN(THETAE) SHIE=SIN(THETAE) BI1=CSIE=CHE+SIN(THETAE) BI1=CSIE=CHE+SIN(THETAE) BI1=CSIE=CHE+SIN(THETAE) BI1=SIE=SIN(THETAE) BI1=SIE=SIN(THETAE) STHETAE=SIN(THETAE) STHETAE=SIN(THETAE) STHETAE=SIN(THETAE) STHETAESIN(THETA
C POI C_ORI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALGULATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETZZ ), YCXITZ ), ZCXIZZ ), XGTZ ), ZGTZ ) NSTOP=22 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS A VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCSISIC) CPMEE=COSISIES CTMETAE=COSITHESAEL SSIE=SIN(SIE) SFMIE=SIN(FMIE) STHETAE=SIN(THETAEL) STHETAE=SIN(THETAEL) PUTE TRANSLATION MATRIX CLEMENTS B11=CSIE=COMIC+STHETAE=SPHIE=SSIE B12=SPHIE=STHETAETAESFHIE=CSIE B21=SPHIE=SIE=COMIC+STHETAESFHIE=SIE B21=SDIE=CSIE=CSIE=COMIC+SIE=COMIC+SIMETAE
C POI C_ORI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALGULATES X, AND Z, CCORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETZZ ), YCXITZ ), 7CXIZZ ), XGTZZ ), 7G(32 ) NSTOP=32 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX TRANSFORMS A VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCS(SIE) CHATELECOS(THES) CTHETAE=COS(THES) CTHETAE=COS(THES) STHETAE=SIN(THETAE) PUTE TRANSLATION MATRIX CLEMENTS B11=CSIE+CPHIE+STHETAE, SPHIE+CSIE B12=SSIF+OPHIE+STHETAE+SFHIE+CSIE B21=-SPHIE+CSIF+SSIE+CPHIE+STHETAE B22=CPHIE+CSIF=SSIE+CPHIE+STHETAE B22=CPHIE+CSIF=SSIE+CPHIE+STHETAE
C POI C_ORI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALCULATES X AND Z CORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLE(32), YCYIT2], 2CX(32), XG(32), ZG(32) NSTOP=32 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4 VEGTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCS(STI) CPHIE=COS(THETAE) SSTE:SIN(SIE) SPHIE=SIN(THETAE) STHETAE=COS(THETAE) STHETAE=SIN(THETAE) PUTE TRANSLATION MATRIX SLEMENTS B12=SIN(FHETAE) B12=SIN(FTAE
C POI C_ORI	END SUBROUTINE COISLE.XCX.7CX.7CG.XCG.SIE.PHIE.THETAE.CC.FF.GG) SUBROUTINE CALCULATES X AND Z CORNINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT. FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETZZ J.YCXITZ J.ZCXIZZ J.XGTZZ J.ZGTZZ J NSTOP=22 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4 VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSII=CCSISTI CPHIE=COSIMENTIALS CSII=CCSISTI CPHIE=COSITHETAEL SSIE=SIN(SIE) SFMETESIN(FHETAEL STHETAE=COSITHETAEL PUTE TRANSLATION MATRIX CLEMENTS B11=CSIC=OPHIE+STHETAESSIE B12=SPHIE+STHETAESFHIE*SSIE B12=SPHIE+STHETAESFHIE*STHETAE B22=CPHIE+CSIE+SSIE*CPHIE*STHETAE B23=SPHIE+SSIE+CSIE*CFHIE*STHETAE B23=SPHIE+SSIE+CSIE*CFHIE*STHETAE B31=SSIE*SISE+CSIE*CFHIE*STHETAE B31=SSIE*CFHIE*SIE*CFHIE*STHETAE B23=SPHIE*SISE+CSIE*CFHIE*STHETAE B31=SSIE*CFHIE*SIE*CFHIE*STHETAE B31=SSIE*CFHIE*SIE*CFHIE*STHETAE B31=SSIE*CFHIE*SIE*CFHIE*STHETAE
C POI C_ORI	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALGULATES X, AND Z, CCORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETZZ ), YCTITZ ), 7CX(32 ), XG(32 ), 7G(32 ) NSTOP=32 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX TRANSFORMS A VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCS(SIC) CPHIE=COS(THETAE) CTHETAE=CCS(THETAE) STHETAE=CCS(THETAE) STHETAE=SIN(THETAE) PUTE TRANSLATION MATRIX CLEMENTS B11=CSIE=CPHIE+STHETAESPHIE=SSIE B12=SSI=STHSIE=SIE=CPHIE+STHETAE B13=SSI=CPHIE+STHETAESFHIE=STHETAE B21=SPHIE+SIE=SIE=CPHIE+STHETAE B21=STHETAE= B31=SSI=CTHETAE B31=SSI=CTHETAE B31=SSI=CTHETAE B31=SSI=CTHETAE B31=SSI=CTHETAE
C POI C_ORI C_ORI C_ORI C_ORI C_ORI C_CAL C_CAL C_CAL C_CAL	END SUBROUTINE COISLE.XCX.7CX.7CG.XCG.SIE.PHIE.THETAE.CC.FF.GG) SUBROUTINE CALCULATES X AND Z CORNINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT. FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETZZ J.YCXITZ J.ZCXIZZ J.XGTZZ J.ZGTZZ J NSTOP=22 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4 VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSII=CCSISTI CPHIE=COSIMENTIALS CSII=CCSISTI CPHIE=COSITHETAEL SSIE=SIN(SIE) SFMETESIN(FHETAEL STHETAE=COSITHETAEL PUTE TRANSLATION MATRIX CLEMENTS B11=CSIC=OPHIE+STHETAESSIE B12=SPHIE+STHETAESFHIE*SSIE B12=SPHIE+STHETAESFHIE*STHETAE B22=CPHIE+CSIE+SSIE*CPHIE*STHETAE B23=SPHIE+SSIE+CSIE*CFHIE*STHETAE B23=SPHIE+SSIE+CSIE*CFHIE*STHETAE B31=SSIE*SISE+CSIE*CFHIE*STHETAE B31=SSIE*CFHIE*SIE*CFHIE*STHETAE B23=SPHIE*SISE+CSIE*CFHIE*STHETAE B31=SSIE*CFHIE*SIE*CFHIE*STHETAE B31=SSIE*CFHIE*SIE*CFHIE*STHETAE B31=SSIE*CFHIE*SIE*CFHIE*STHETAE
C POI C CAL C PAL C PAL C CAL C CAL C CAL C CAL C CAL C CAL	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALGULATES X AND Z CORNENTES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETZZ ), YCXITZ ), ZCXIZZ ), XGTZZ ), ZGTZZ ) NSTOP=22 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX_TRANSFORMS 4 VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSII=CCSISTI CPHIE=COSIMENTALS CSII=CCSITETAE SSIESIN(SIE) SFMIE=SIN(FMIE) SFMIE=SIN(FMIE) SFMIE=SIN(FMIE) SFMIE=SIN(FMIE) STHETAE=SIN(FMIE) B11=CSIC=OHIC+SINETAE B11=CSIC=OHIC+SINETAE B11=CSIC=OHIC+SINETAE B11=CSIC=OHIC+SINETAE B21=SPMIE+CSIC=SSIE+CPHIC=SINETAE B22=CPMIC+CINETAE B23=SPMIE+SSIE+CFHIC=SINETAE B33=CSIC=CINETAE B33=CSIC=CINETAE B33=CSIC=CINETAE
C POI C CAL C PAL C PAL C CAL C CAL C CAL C CAL C CAL C CAL	END SUBROUTINE COISLE, XCX, 7CX, YCG, XCG, SIE, PHIE, THETAE, CC, FF, GG) SUBROUTINE CALGULATES X, AND Z, CCORDINATES OF THE GROUND NT CORRESPONDING TO EACH SEGMENT, FOR A PAPTICULAR ACLS ENTATION DIMENSION SLETZZ ), YCTITZ ), 7CX(32 ), XG(32 ), 7G(32 ) NSTOP=32 L EMATRIX FOR SPACIAL TRANSFORMATION TRIX TRANSFORMS A VECTOR FROM VEHICLE FREAME TO INERTIAL FRAME CULATE TRANSCENDENTALS CSIE=CCS(SIC) CPHIE=COS(THETAE) CTHETAE=CCS(THETAE) STHETAE=CCS(THETAE) STHETAE=SIN(THETAE) PUTE TRANSLATION MATRIX CLEMENTS B11=CSIE=CPHIE+STHETAESPHIE=SSIE B12=SSI=STHSIE=SIE=CPHIE+STHETAE B13=SSI=CPHIE+STHETAESFHIE=STHETAE B21=SPHIE+SIE=SIE=CPHIE+STHETAE B21=STHETAE= B31=SSI=CTHETAE B31=SSI=CTHETAE B31=SSI=CTHETAE B31=SSI=CTHETAE

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•
2CXFF+(2CX(1)-FF)
C CALCULATE VECTOR DA FOR SEGMENT
SL4(I)=(YC3+XCXCC+312+7CXFF+642)/B22-GG
<b>SL+GG={SL+(1)+GG</b> }
C CALCULATE X-GEDUND COORDINATE
C CALCULATE X-GEDUND CODMOINALE XG(1)+XCXCC+911-5L45G+021+2CXFF+P31+XCG
C
C CALCULATE Z-GROUND SOUPDINATE
ZG(1)=XCXC2+313-SL4GG+323+ZCXFF+833
106_CONTINUE
RETURN
SUBROUTINE PR(YG)
C HISER SPECIETED GROUPD PROFILE.
C ELEVATION YG(I) IS EXPRESSED AS A FUNCTION OF X AND 2 COORDINATRES
_C OF GROUND FOINT 1, I+E, EG(I) AND ZG(I)
DIMENSION AC(35.)
ASTOP # 32
DO 105 I+1,45TOP _C_SET_FC9_FLAT_TERAIN
YG(1)=0.
105 CONTINUE
RETURN
END SUBROUTINE SP(VTK, VCH, ACH, PHI2, R2, D21, BETA, A1, A2, DELX, SI, ITYP, YGH,
XHY,0202461,0X44491,95 1021,XC41,7C41,42,621,41,42,621,41,42,621,41,42,621,41,42,621,41,42,621,41,42,621,41,42,6
XHPI,XCX.0.LS, AH. XX. YH. HYI.LX. SH. VCHD.R1. AGAP.ATKAT.ATKCH.ATKCN.ATK
XATC.AIKCHC.ISEG.VTKI.ACHI.KCHP.ATKCNI.ATKCNA.PERI.XCH.XTK.ZCH.ZTK.
x(,(1))
C CALCULATION OF AREAS AND VOLUMES ASSOCIATED WITH ACLS, KNOWING ITS
C ORIENTATION REAL L2.LS.LV.LII.L2I.L.LI
DIMENSION 11499132 1.VTKRA132 1.VTKR0132 1.PERI 132 1.XCH132 1.ZCH1
x32 }.4TKCH1(32 ).ATKCH2(32 ).ATKAT1(32 ).ATKAT2(32 ).VCHI(32 ).AGA
YPT(32), AG3P2(32), XTK(32), 7TK(32), ATKP(32), ACHI(32), XCHI(32).
X2CH1(32 1, YGH(32 ), TSFG( 32), VTK1( 32), XCY(32), ITYP(32), DELTA(32),
XACHR(32), V74R(32), V1KF(32), A1KCHF(32), ATKCHI(32)
NSTOP=32 SPI=3.141592653
C COMPUTE PARTIAL TERMS
SINPH2=SIN(PHI2)
SINPHR=SINPH?#R2
02+0*0.5+S INPHR
621S0=021+021 
6ETA2=1,33333=SIN(9ETA/2,)/3ETA
RLSH+LS+0.30
ADS=AH+DELX/SI
ABD5I=44+0714+021/51
kiinzf LGAT (NX+NH) Caadaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
C DADT 1 T VALUE OF VAL AND SCAP
DO 17 TAL.NSTOP
C TEST FOR TRUNK SIGNINT, WHETHER CURVED OR STRAIGHT
1F(11YP(1),20,1)60 TO 11
C STRAIGHT PART <u>7</u> F TPU4K
C CALCULATE CUSHION SECHENT INITIAL VOLUME
13 VCHI(I)=(Y)+(I)+02-41MA2)+02LX
C CALCULATE SEGMENT GIP AREA
AGAP1(1)+(YG4(1)-HY)"NELX
GO TO 10

AFIT/GE/EE/77D-43

and the second se

CURVED PART OF TRUNK	
11 VCHI(I)=YGH(I)=0202H01-0XA440I	
AGAP1(1)+ (YGH(1)+HY1)+95TA321	
PART 2 R VALUE GALCULATIONS	
•••••••••••••••••••••••••••••••••••••••	
n an	
THE PAR CRAINS CANTLET IT FACH CICKENT	
TEST FOR GROUND CONTACT, AT SACH SEGNENT	
16 CONTINUE	
FORCE VOLUME AREAS .GE. 0	
VCHI(I)=AM1X1(0.0.VCHI(I))	
ACAPI(1)=AVAV1(0, 0, AGAPI(1))	
TEST SEGMENT FOR CONTACT	
IF(ITYP(I),E0.1.AND.YGH(I),LE.HVI) GO TO 14	
JF(ITYP(1),50.0.4NO.YGH(1).LE.HY) GO TO 23	
NO GROUND CONTACT	
SET CONTACT AND REMOVE TERMS TO ZERO	
ATKR (I)=0.0	
ACHR(1)+0.)	
VTKR(I)=0.0	
VCHR (1)=0.9	
AGAP4 (1)=0.0	
ATKCNI(1)=0.0	
ATKCN9(1)=).0	
ATKCHR(T)=0.0	
ATKATR(I)=).0	
PERI(I)=0.5	
SET DISTANCES X,7 TO FREE TRUNK VALUES	
XCH(I)+XCH((I) ZCH(I)+ZCHI(I)	
• • • • • • • • • • • •	
2TK(1)+2CH(1)	
XTK(1)=XCH(1)	
COMPUTE TRUNK-SUSHIDH-ATHOSPHERE BLEED APEAS	
IF(ITYP(I)) 16.16.18	
16 CONTINUT	<u> </u>
NO CONTACT STRAIGHT SECTIONS	
ATKCHI(I)=FLOAT(I/IX((LZ-LX)/SH+1,0)*NH)*ADS	
ATKCHI(1)=FLOAT(1FIX((L2-LX)/SH+1.0)*NH)*ADSATKATI(1)=XNN*ADS_ATKCHI(1)	
ATKCHI(1)=FLOAT(3/IX((L2-LX)/ <u>5H+1</u> ,0) <u>*NH)*ADS</u> ATKATI(1)=FNN*ADS-ATKCHI(1) GO TC 17	
ATKCHI(1)=FLOAT(1)TX((L2-LX)/ <u>5H+1.0)*NH)*ADS</u> ATKATI(1)=NN*ADS-ATKCHI(1) GO TC 17 18 CONTINUE	
ATKCHI(1)=FLOAT(1) IX((L2-LX)/ <u>5H+1</u> ,0) <u>*NH)*ADS</u> ATKAT(1)=FNN*ADS-ATKCHI(1) 	
ATKCHI(1)=FLOAT(1) IX((L2-LX)/ <u>5H+1</u> ,0) <u>*NH)*ADS</u> ATKAT(1)=FNN*ADS-ATKCHI(1) 	
ATKCHI(1)=FLOAT(1) IX((L2-LX)/ <u>5H+1.0) MH) *ADS</u> ATKATI(1)=RNN*ADS-ATKCHI(1) GO TC 17 SB CONTINUE NO_CONTACT CURV/D SECTIONS ATKCHI(1)=FLOAT(1FIX((L21-LX)/5H+1.0)*NH)*ABOSI	
ATKCHI(1)=FLOAT(1) IX((L2-LX)/ <u>5H+1.0)*NH)*ADS</u> ATKATI(1)=RN*ADS-ATKCHI(1) GO TC 17 18 CONTINUE NO_CONTACT CURVED SECTIONS ATKCHI(1)=FLOAT(1FIX((L21-LX)/54+1.0)*NH)*ABOSI ATKATI(1)=RNH*A3DSL-ATKCHIJL)	
ATKCHI(1)=FLOAT(1) IX((L2-LX)/ <u>5H+1.0)*NH)*ADS</u> ATKATI(1)=RN*ADS-ATKCHI(1) GO TC 17 18 CONTINUE NO_CONTACT CURVED SECTIONS ATKCHI(1)=FLOAT(1FIX((L21-LX)/54+1.0)*NH)*ABOSI ATKATI(1)=RNH*A3DSL-ATKCHIJL)	
ATKCHI(1)=FLOAT(1FIX((LZ-LX)/ <u>5H+1.0)*NH)*ADS</u> ATKATI(I)=RNY*ADS-ATKCHI(I) GO TC 17 18 CONTINUE NO CONTACT CURVCO SECTIONS ATKCHI(I)=FLOAT(IFIX((LZI-LX)/5H+1.0)*NH)*ABOSI ATKATI(I)=FLOAT(IFIX((LZI-LX)/5H+1.0)*NH)*ABOSI ATKATI(I)=FLOAT(IFIX((LZI-LX)/5H+1.0)*NH)*ABOSI	
ATKCHI(1)=/LOAT(1/1/1/(L2-LX)/ <u>5H+1.0)*NH)*ADS</u> ATKATI(1)= XNY*ADS-ATKCHI(1) GO TC 17 18 CONTINUE NO_CONTACT CURV(2) SECTIONS ATKCHI(1)=COAT(1//1/(L21-LX)/SY+1.0)*NH)*ABOSI ATKATI(1)=XNH*AJJ <u>I-ATKCHIJI)</u> GO TO 17	
ATKCHI(1)=FLOAT(1/ IX((L2-LX)/SH+1.0)*NH)*ADS ATKATI(I)=NN*ADS-ATKCHI(I) GO TC 17 18 CONTINUE NO_CONTACT CURVED SECTIONS ATKCHI(1)=CLOAT(1/FIX((L21-LX)/SH+1.0)*NH)*ABOSI ATKATI(I)=NH*AJDSI-ATKCHIJI) GO TO 17	
ATKCHI(1)=FLOAT(1/ IX((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(I)=TNN*ADS-ATKCHI(I)         GO TC 17         18 CONTINUE         NO_CONTACT CURVED SECTIONS         ATKCFI(I)=COAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABOBI         ATKCFI(I)=COAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABOBI         GO TO 17         TRUNK GROUND CONTACT	
ATKCH [[]==[LAT []= [(((2-(x)/2H+1.0)*NH)*ADS])       ATKAT [[]== [N]*ADS-ATKCH [[]]       GO TC 17       INO_CONTACT CURVED SECTIONS       ATKAT [[]== [LAT []= [(((21-(x)/2H+1.0)*NH)*ABOS])       ATKAT [[]== [LAT []= [((((21-(x)/2H+1.0)*NH)*ABOS])       ATKAT [[]== [LAT []= [(((((21-(x)/2H+1.0)*NH)*ABOS])       ATKAT [[]== [((((((((((((((((((((((((((((((((	
ATKCH [[]==[CAT[]=](([2-[X])/SH+1.0)*NH]*ADSATKAT [[]]=TNY*ADS_ATKCH [[]]         GO TC 17         IB CONTINUE         NO_CONTACT CURVED SECTIONS         ATKAT [[]==COAT [[]=[X](([2]-[X])/SY*1.0)*NH]*ABOSI         ATKAT [[]==NH*430 SI-ATKCH []])         GO TO 17         TRUNK GROUND CONTACT         CURVED PART OF TRUNK         CALCULATE DEFORMATION ANGLES FOR SEGMENT	
ATKCHI(1)=FLOAT(1FIX((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(I)=TNN*ADS-ATKCHI(I)         GO TC 17         18 CONTINUE         NO CONTACT CURVED SECTIONS         ATKCFI(I)=FLOAT(IFIX((L2I-LX)/SH+1.0)*NH)*ABOSI	····
ATKCHI(1)=FLOAT(1) IX((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(I)=TNN*ADS-ATKCHI(I)         GO TC 17         18 CONTINUE         NO_CONTACT CURVCD SECTIONS         ATKCFI(I)=CLAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABOBI	
ATKCHI(1)=FLOATIFIX((L2-LX)/SH-1.0)*NH)*ADS         ATKATI(1)=TNN*ADS-ATKCHI(1)         GO TC 17         18 CONTINUE         NO_CONTACT CURVED SECTIONS         ATKATI(1)=COAT(IFIX((L2I-LX)/SN+1.0)*NH)*ABOSI         ATKATI(1)=COAT(IFIX((L2I-LX)/SN+1.0)*NH)*ABOSI         ATKATI(1)=COAT(IFIX((L2I-LX)/SN+1.0)*NH)*ABOSI         ATKATI(1)=COAT(IFIX((L2I-LX)/SN+1.0)*NH)*ABOSI         ATKATI(1)=COAT(IFIX((L2I-LX)/SN+1.0)*NH)*ABOSI         ATKATI(1)=COAT(IFIX((L2I-LX)/SN+1.0)*NH)*ABOSI         ATKATI(1)=COAT(IFIX((L2I-LX)/SN+1.0)*NH)*ABOSI         ATKATI(1)=COAT(IFIX((L2I-LX)/SN+1.0)*NH)*ABOSI         TRUNK GROUND CONTACT         GO TO 17         COURVED PART OF TRUNK         CALCULATE DIFORMATION ANGLES FOR SEGMENT         14       PHI3=ACOS((02I-INTI-YGH(1))/RZI)         PHI4=ACOS((01I-(NTI-YGH(1))/RII)         SINPH3=SIN(PHI3)	
ATKCH [[] = FLOAT [] F [ X ( (L2-LX) / SH+1.0) * NH] * ADS         ATKAT [ (]) = TNY* ADS - ATKCH [ (])         GO TC 17         18 CONTINUE         NO CONTACT CURVED SECTIONS         ATKCF [ (]) = COAT [ [F [ X ( (L2]-LX) / SY*1.0) * NH] * ABOST	
ATKCHI(1)=FLOAT(1) [X((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(1)=TNN*ADS-ATKCHI(1)         GO TC 17         18 CONTACT CURVED SECTIONS         ATKATI(1)=COAT(1) [X((L21-LX)/SN+1.0)*NH)*ABOSI         TRUNK GROUND CONTACT         CORVED PART OF TRUNK         CURVED PART OF TRUNK         CALCULATE DEFORMATION ANGLES FOR SEGMENT         14       PHI3*ACOS((R21-(HY1-YGH(1)))/R21)         PHI3*ACOS((R21-(HY1-YGH(1)))/R11)       SINPM3*SIN(PHI3)         SINPM3*SIN(PHI3)       SINPM4*SIN(PHI4)         COMDUCE PARTICL TEME       COMDUCE PARTICL TEME	···
ATKCHI(1)=FLOAT(1) [X((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(1)=TNH*ADS-ATKCHI(1)         GO TC 17         18 CONTACT CURVED SECTIONS         ATKATI(1)=COAT(1) [X((L21-LX)/SH+1.0)*NH)*ABOSI         TRUNK GROUND CONTACT         CORVED PART OF TRUNK         CALCULATE DIFORMANION ANGLES FOR SEGMENT         14       PHI3*ACOS(1011-1HY1-YGH(1))/RE1)         PHI3*ACOS(1011-1HY1-YGH(1))/RE1)       PHI3*SIN(PHI3)         SINPM3*SIN(PHI3)       SINPM3*SIN(PHI3)         COHOUT( PARTIAL TERMS       OPSP*(021-321*SINPH3)	
ATKCHI(1)=FLOAT(1) [Y((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(1)=TNY*ADS-ATKCHI(1)         GO TC 17         18 CONTINUE         NO_CONTACT CURVED SECTIONS         ATKATI(1)=COAT(1) [X((L21-LX)/SY*1.0)*NH)*ABOSI         TRUNK GROUND CONTACT         COURVED PART OF TRUNK         CALCULATE OFFORMATION ANGLES FOR SEGMENT         ATKATI(1) = CONTACT         CHUNK GROUND CONTACT         PHI3*ACOS((101-(HY I = YGH(1)))/REI)         PHI4*ACOS((101-(HY I = YGH(1)))/REI)         PHI4*ACOS((101-(HY I = YGH(1)))/REI)         SINPM3*SIN(PHI3)         SINPH4*SIN(PHI3)         SINPH4*SIN(PHI3)         CHPUTE PARTIEL TERMS         ODPSP (021-2121*SIN*H3)         CRSP2*ORSP*2RSP	
ATKCHI(1)=FLOATIFIX((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(1)=THY*ADS-ATKCHI(1)         GO TC 17         18 CONTINUE         NO CONTACT CURVED SECTIONS         ATKCHI(1)=COAT(FIX((L21-LX)/SH+1.0)*NH)*ABOST         ATKCHI(1)=THI*ADSL-ATKCHI(1)         GO TO 17         GO TO 17         CURVED PART OF TRUNK         GALCULATE DEFORMATION ANGLES FOR SECHENT         14PHI3*ACOS((R21-(HYI-YGH(1)))/REI)         PHI4*ACOS((R11-(HYI-YGH(1)))/REI)         SIMPM3*SIN(PHI3)         SIMPM3*SIN(PHI3)         COMOUT PARTILL TERMS         OPSP*(021-R21*SIN#H3)         CRSCL=CUS(DELTA(1))	<b>•••</b>
ATKCHI(1)=FLOAT(1FIX((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(I)=TNY*ADS-ATKCHI(I)         GO TC 17         18 CONTINUE         NO CONTACT CURVCD SECTIONS         ATKCFI(I)=CLOAT(IFIX((L2I-LX)/SY*1.0)*NH)*ABOBI         ATKCFI(I)=CLOAT(IFIX((L2I-LX)/SY*1.0)*NH)*ABOBI         ATKCFI(I)=CLOAT(IFIX((L2I-LX)/SY*1.0)*NH)*ABOBI         TKUNK (I)=CLOAT(IFIX((L2I-LX)/SY*1.0)*NH)*ABOBI         GO TO 17         GO TO 17         CURVLD PART OF TRUNK         CALCULAT( DIFOHANION ANGLES FOR SEGHENT         14 FHI3=ACOS((R2I-(HYI-YGH(I))/R2I)         PHI4=ACOS((R1I-(HYI-YGH(I))/R2I)         PHI5=SLN(PHI3)         SINPH=3IN(PHI3)         SINPH=3IN(PHI3)         OPSP=(021-22I*SIN*H3)         CHPUTF PARTIAL TERMS         DPSP=(021-32I*SIN*H3)         CASDEL=CUS(CITA(I))         SINCEL-SIN(DELTA(I))	
ATKCHI(1)=FLOAT(1) [X((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(1)=TNN*ADS-ATKCHI(1)         GO TC 17         18 CONTINUE         NO_CONTACT CURVED SECTIONS         ATKATI(1)=COAT(1) [X((L21-LX)/SN+1.0)*NH)*ABOSI         TRUNK GROUND CONTACT         GO TO 17         COURVED PART OF TRUNK         CALCULATE DEFORMAN ION ANGLES FOR SEGMENT         14         PHI3=ACOS((021-(HYI-YGH(1))/R21)         PHI3=ACOS((021-(HYI-YGH(1))/R21)         PHI3=SIN(PHI3)         SINPH3=SIN(PHI3)         SINPH3=SIN(PHI3)         OPSP=(021-321*SINPH3)         CASP2=ORSP=DRSP         COSOEL=COS(02LACI)         COSOEL=COS(02LACI)         UF (PSN=01142*ORSP*SINDEL	
ATKCHI(1)=FLOAT(1FIX((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(1)=TNY*ADS-ATKCHI(1)         GO TC 17         18 CONTINUE         NO CONTACT CURVCD SECTIONS         ATKATI(1)=COAT(1FIX((L21-LX)/SY*1.0)*NH)*ABOSI         ATKATI(1)=COAT(1FIX((L21-LX)/SY*1.0)*NH)*ABOSI         ATKATI(1)=COAT(1FIX((L21-LX)/SY*1.0)*NH)*ABOSI         ATKATI(1)=COAT(1FIX((L21-LX)/SY*1.0)*NH)*ABOSI         ATKATI(1)=COAT(1FIX((L21-LX)/SY*1.0)*NH)*ABOSI         ATKATI(1)=COAT(1)         GO TO 17         CORVED PART OF TRUNK         CALCULATE OFFORMATION ANGLES FOR SEGMENT         AL	
ATKCHI(1)=FLOAT(1) [X((L2-LX)/SH+1.0)*NH)*ADS         ATKATI(1)=TNN*ADS-ATKCHI(1)         GO TC 17         18 CONTINUE         NO_CONTACT CURVED SECTIONS         ATKATI(1)=COAT(1) [X((L21-LX)/SN+1.0)*NH)*ABOSI         TRUNK GROUND CONTACT         GO TO 17         COURVED PART OF TRUNK         CALCULATE DEFORMAN ION ANGLES FOR SEGMENT         14         PHI3=ACOS((021-(HYI-YGH(1))/R21)         PHI3=ACOS((021-(HYI-YGH(1))/R21)         PHI3=SIN(PHI3)         SINPH3=SIN(PHI3)         SINPH3=SIN(PHI3)         OPSP=(021-321*SINPH3)         CASP2=ORSP=DRSP         COSOEL=COS(02LACI)         COSOEL=COS(02LACI)         UF (PSN=01142*ORSP*SINDEL	

		•	
	ATE (821-67	/1=VGH(1)) "0.5=R21+S1NPH3	
	A4	A <b>4</b>	
		1°04[4°0.5	
	- <b>Week214431</b>	1 H 2 4 - 0 • 2	
	A9=(R11-H1	Y1+YGH(I))+0,5+R11+SINPH4	
	A10=49		
	A11+A5		
· . · · · · · · · · · · · · · · · · · ·			
C C 0 1	PUTE SICIUM	P CINTROIDS	*
	X6=SINPHRI	1-1. 333333 (514 (PH13+0. 5)+2)+21/PH13	
•	<b>X78</b> 517/PH41	140,333,337,82,*31,020,3	
		1+1.3333333. (SIN (PH14+0.5) +2) +R11/PH14	
• · · · ·	A		
	XA=21MLUVI	1+0.3333333*R11*SINPH4	
_	X10+X9		
	X11+18		
		. 1	
		3 1. 11 21 GO 10 30	
	14 (bh1412)	1 1127 60 19 79	
- C I7	PHI4 GREATE	THAN 90 DEGREES, SET TO 90 DEGREEN	
	PH14=P112		
		N (ONT L)	
		N(04)65 HYI&YGHIJJ#RII DIAD.46817	
	WI06[411-4	1 1 - T 0 - T 1	
	X10=SINPHA	RI+0.5*R\$\$	·
	A114811*81	R[+0.5*R1]	
	XIINCTLONE	R+1.313333*(STH(PHT6+0.6)++2)+R11/PHT6	
a	CANT	11*PH14*0.5 R+1,333333*(53H)[PH144046}**2)*B11/PHI4	
	CONTINUE		
LE COM	PUTE TPLNK	4 <u>74</u> <u>CMANGT</u> 6447445-49	
	_ATKR([)=A6	6147+45-49 .	
	AT	LAMA7+A11-A10	•
-	********	L6417+111+10 E-14++1++10 E-14++1++1++10+10+10+10+10+10+10+10+10+10+10	
	AT 49 1 # C * A C	x4-47-47+411-410-4107/4168/11	
C COM			
		* ***** / * * * * * * * * / * * / *	
		6-47 4 4 1 1 - 47 4 4 7 1 1 1 6-47 4 4 7 1 / 46 4 4 7	
•	A1K4(1)=C		
	- XCF#(A6*X6	6-A7-X73/A6HA7	
C COM	SILTS TOINK	JYTT ABFAC	
C _COM	SILTS TOINK	JYTT ABFAC	
с _сон	DUTE TRUNK	ATT AREAS ==LOAT(IFIX((L2I-LT-R2I*PHI3)/SH+1.0)*NH)*ABUSI	
	DIE TRUNK ATKOHI(I) ATKATI(I)	JYTT ABFAC	
• •	PUTE TRUNK ATKOMI(I): ATKATI(I): 1):ANDSI	ARIAS ==C_OAT(I^_X\(L2I-LX-R2I*PHI3)/SH+L=0)*NHI*ABUSI =^LQAT(I#IX((L1-L+LX+FLQA)(NX-1)*SH-R1J=PHIL)/S	(H+1.0) PNH
• •	DUTE TRUNK LTKCHI(I): ATKLTI(I): 1)*AJOSI ATKCHR(I):	ARIAS ==C_OAT(IFIX((L2I-LX-R2I*PHI3)/SH+L_0)*NHI*ABUSI ==L_QAT(IFIX((L1-L+LX+FLQA)(NX-1)*SH-R1J*PHIL)/3 ==L_QAT(IFIX((L2I-LX)/SH+1+C)*NH)*ADOSI-ATKCHI(1)	(H+1.0) PNH
• •	PUTE TPUNK ATKCHI(I) ATKATI(I) 1) * A0081 ATKCHR(I) ATKCHR(I)	<pre>/*IT AREAS **COAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABUST *LOAT(IFIX((L2I-LX)*LOA((NX-1)*SH-R1)*PHIL)/3 **COAT(IFIX((L2I-LX)*SH+1.C)*NH)*ABUSI-ATKCHI(1) =*COAT(IFIX((L2I-LX)*SH+1.C)*NH)*ABUSI-ATKCHI(1)</pre>	(H+1.0) PNH
• •	PUTE TPUNK ATKCHI(I) ATKATI(I) 1) * A0081 ATKCHR(I) ATKCHR(I)	<pre>/*IT AREAS **COAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABUST *LOAT(IFIX((L2I-LX)*LOA((NX-1)*SH-R1)*PHIL)/3 **COAT(IFIX((L2I-LX)*SH+1.C)*NH)*ABUSI-ATKCHI(1) =*COAT(IFIX((L2I-LX)*SH+1.C)*NH)*ABUSI-ATKCHI(1)</pre>	(H+1.0) PNH
· · · · · · · · ·	PUTE TPUNK LTKSHI(I): ATKLTI(I): L)=AJOSI ATKCHR(I): ATKLTR(I): PERI(I):950	<pre>/XIT AREAS **COAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABUST *LOAT(IFIX((L2I-LX)/SH*I.0A)(NX-1)*SH-R1J*PHIL)/3 **COAT(IFIX((L2I-LX)/SH*1.C)*NH)*AUDSI-ATKCHI(1) *NH*ASDSI-ATKCHI(1)-ATKATI(1)*ATKCHR(1) EIA*(0RS*02I*R11*QINPHL)</pre>	(H+1.0) PNH
· · · · · · · · ·	>UTE         TPUNK           LTKCHI(I):           ATKLTI(I):           LTKCHR(I):           ATKCHR(I):           ATKCHR(I):           PERI(I):           PERI(I):	[XIT AREAS = COAT(IFIX((L2I-LX-R2I*PHI3)/SH*LOI*NHI*ABUST = COAT(IFIX((L2I-LX-R2I*PHI3)/SH*LOI*NH)*ABUST = COAT(IFIX((L2I-LX)/SH+1.CI*NH)*ADDSI-ATKCHI( <u>1</u> ) = RH*A9351-ATKCHI(I)=ATKATI(1)=ATKCHR(I) ETA*(0R5*02I*R1I* <u>SIYPHL)</u> CT PTRIVETER	(H+1.0) PNH
с сон	>UTE         TPUNK           LTKCHI(I):           ATKATI(I):           ATKCHR(I):           ATKCHR(I):           ATKATR(I):           PERI(I):           PUTE           CONTAC           ATKCNI(I):	[XIT AREAS = COAT(IFIX((L2I-LX-R2I*PHI3)/SH-LOI*NHI*ABUST = COAT(IFIX((L2I-LX-R2I*PHI3)/SH-LOI*NH)*ABUST = COAT(IFIX((L2I-LX)/SH+1.CI*NH)*ADDSI-ATKCHI(1) = RH4*A9331-ATKCHI(I)=ATKATI(1)=ATKCHR(1) ETA*(0R5*02J*R11*EJYPHL) CT FIRITIR CT FIRITIR = CO25*02J*R11*EJYPHL) CT FIRITIR = CO25*0-02J*R10*EJYPHL)	(H+1.0) PNH
с"сон с сон	>UTE TPUNK           LTKCPIII)           ATKCPIII)           ATKCPIII)           ATKCPIII)           ATKCPIII)           PERI(I)           PERI(I)           PUTE COMFAC           ATKCNII)           PUTE TRUNK	<pre>/XIT AREAS **COAT(IFIX(L2I-LX-REI*PHI3)/SH*I.0)*NH)*ABUST *LQAT(IFIX(LL2I-LX)/SH*I.0)*NH)*ABUSI-ATKCHI(1) **LQAT(IFIX(LL2I-LX)/SH*I.C)*NH)*ABUSI-ATKCHI(1) **NH*A935I-ATKCHI(I)-ATKATI(1)-ATKCHR(1) EIA*(0RS*02I*RII*SINPHL) CI *TRINEISR **JETA*3.5*(D2150-DRS*2) CONTACI AREA</pre>	<u></u>
с"сон с сон	>UTE TPUNK           LTKCPIII)           ATKCPIII)           ATKCPIII)           ATKCPIII)           ATKCPIII)           PERI(I)           PERI(I)           PUTE COMFAC           ATKCNII)           PUTE TRUNK	<pre>/XIT AREAS **COAT(IFIX(L2I-LX-REI*PHI3)/SH*I.0)*NH)*ABUST *LQAT(IFIX(LL2I-LX)/SH*I.0)*NH)*ABUSI-ATKCHI(1) **LQAT(IFIX(LL2I-LX)/SH*I.C)*NH)*ABUSI-ATKCHI(1) **NH*A935I-ATKCHI(I)-ATKATI(1)-ATKCHR(1) EIA*(0RS*02I*RII*SINPHL) CI *TRINEISR **JETA*3.5*(D2150-DRS*2) CONTACI AREA</pre>	<u></u>
с"сон с сон	+UTE TRUNK ATKCHIII ATKCHIII ATKCHRIII ATKCHRIII PERI(I)=92 PUTE CONTAC ATKCNIII UTE TRUNK ATKCNRII	<pre>{XIT AREAS **COAT(IFIX(L2I-LX-REI*PHI3)/SH*I.0)*NHI*ABUST *LQAT(IFIX(LL2I-LX)/SH*I.0)*NHI*ABUSI *LQAT(IFIX(LL2I-LX)/SH*I.CI*NH)*AUDSI-ATKCHI(1) *RH*A9391-ATKCHI(I)-ATKCHI(1)-ATKCHI(1) EIA*(0RS*02I*RII*JYHL) CI *[RI%[CIS0-02]*RII*SIYHL) *374*3,5*(02150-0852) CONTACI AREA *3174*0.5*((021*011*SIYHL)**2-D2150)</pre>	<u></u>
с"сон "С соч	>UTE TRUNK           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           PERICIS           PERICIS           PERICIS           ATKGNIII           ATKGNIII           ATKGNIII	<pre>[XIT AREAS =*LOAT(IFIX(L2I-LT-REI*PHI3)/SH*LOI*NHI*ABUST =*LQAT(IFIX(LL2I-LT-REI*PHI3)/SH*LOI*NHI*ABUST =*LOAT(IFIX((L2I-LY)/SH*LOAI(NX-1)*SH-R1J*PHIL)/S =*LOAT(IFIX((L2I-LY)/SH*LOI*NH)*ADDSI-ATKCHI(1) =*LOAT(IFIX((L2I-LY)/SH*LOI)*NH)*ADDSI-ATKCHI(1) =*LOAT(IFIX((L2I-LY)/SH*LOI)*NHO*ADDSI-ATKCHI(1) ETA*(0780-021*31*\$199HL) CT #INITER =&gt;2TA*0.5*(1021\$Q-QR\$#2) CONTACT AREA =&gt;3TA*0.5*(1021\$Q-QR\$#2) TYCHI(1)</pre>	
с"сон "С соч	>UTE TRUNK           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           PERICIS           PERICIS           PERICIS           ATKGNIII           ATKGNIII           ATKGNIII	<pre>[XIT AREAS =*LOAT(IFIX(L2I-LT-REI*PHI3)/SH*LOI*NHI*ABUST =*LQAT(IFIX(LL2I-LT-REI*PHI3)/SH*LOI*NHI*ABUST =*LOAT(IFIX((L2I-LY)/SH*LOAI(NX-1)*SH-R1J*PHIL)/S =*LOAT(IFIX((L2I-LY)/SH*LOI*NH)*ADDSI-ATKCHI(1) =*LOAT(IFIX((L2I-LY)/SH*LOI)*NH)*ADDSI-ATKCHI(1) =*LOAT(IFIX((L2I-LY)/SH*LOI)*NHO*ADDSI-ATKCHI(1) ETA*(0780-021*31*\$199HL) CT #INITER =&gt;2TA*0.5*(1021\$Q-QR\$#2) CONTACT AREA =&gt;3TA*0.5*(1021\$Q-QR\$#2) TYCHI(1)</pre>	
с"сон С соч С соч	+UTE TRUNK ATKCHIII ATKCHIII ATKCHIII ATKCHIII PERI(1)=50 PUTE CONTAC ATKCNIII PUTE TRUNK ATKCNR(I)=A PUTE CUSHIC VCHR(I)=-7	<pre>{XIT AREAS **COAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABUST *LQAT(IFIX((L2I-LX)/SH*I.C)*NH)*ADDSI-ATKCHI(1) **LOAT(IFIX((L2I-LX)/SH+1.C)*NH)*ADDSI-ATKCHI(1) ETA*(0RS*02I*AII*IYHL) CI #XY*ASDSI-ATKCHI(1)-ATKCHR(1) ETA*(0RS*02I*AII*IYHL) CI #XY*ASDSI-ATKCHI(1) ETA*(0RS*02I*AII*IYHL) CI #XY*ASDSI-ATKCHI(1) ETA*(0RS*02I*AII*IYHL) CI #XY*ASDSI-ATKCHI(1) ETA*(0RS*02I*AII*SINPHL)**Z=DZISQ) TCONICI CI X*ASNA7*(0*0.5*XCR)</pre>	
с"сон С соч С соч	+UTE TRUNK ATKGHIII ATKGHIII ATKGHRIII ATKGHRIII PERI(I)=52 PUTE CONTAC ATKCNIII PUTE TRUNK ATKCNRIII PUTE CUSHIC VCHR(I)=-7	<pre>{XIT AREAS **COAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABUST *LQAT(IFIX((L2I-LX)/SH*I.C)*NH)*ADDSI-ATKCHI(1) **LOAT(IFIX((L2I-LX)/SH+1.C)*NH)*ADDSI-ATKCHI(1) ETA*(0RS*02I*AII*IYHL) CI #XY*ASDSI-ATKCHI(1)-ATKCHR(1) ETA*(0RS*02I*AII*IYHL) CI #XY*ASDSI-ATKCHI(1) ETA*(0RS*02I*AII*IYHL) CI #XY*ASDSI-ATKCHI(1) ETA*(0RS*02I*AII*IYHL) CI #XY*ASDSI-ATKCHI(1) ETA*(0RS*02I*AII*SINPHL)**Z=DZISQ) TCONICI CI X*ASNA7*(0*0.5*XCR)</pre>	
с"сон С соч С соч	>UTE TRUNK           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           PERICIO           PUTE CONTAC           ATKCNIII           VITE TRUNK           ATKCNIII           ATKCNIII           PUTE CONTAC           ATKCNIII           ATKCNIII           PUTE CUSNIC           VCHR(I)           PUTE GAS	<pre>[YIT AREAS = COAT(IFIX(L2I-LX-R2I*PHI3)/SH*I.0)*NHI*ABUST = LQAT(IFIX(L2I-LX)/SH*I.CI*NH)*AUDSI-ATKCHI(1) = COAT(IFIX((L2I-LX)/SH*I.CI*NH)*AUDSI-ATKCHI(1) = TUAT(IFIX((L2I-LX)/SH*I.CI*NH)*AUDSI-ATKCHI(1) = TUAT(IFIX((L2I-LX)/SH*I.CI*NH)*AUDSI-ATKCHI(1) = TUAT(IFIX((L2I-LX)/SH*I.CI*NH)*AUDSI-ATKCHI(1) = TUATATITIS = TUATATIT</pre>	
с сон с сон с сон с сон	>UTE TRUNK           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           PERI(I)           PERI(I)           PUTE COMFAC           ATKGHIII           PUTE COMFAC           ATKGHIIII           PUTE COMFAC           ATKCHRIIII           ACHRIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	STIT AREAS         **LOAT(IFIX((L21-LX-R21*PMI3)/SH*I.01*NH)*ABUST         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ABUSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         *TA*(075*.021*01*SINPHL)         **TA*(075*.021*01*SINPHL)         **TA*0.5*1(021\$00*SINPHL)**2-D21\$0]         **TA*0.5*1(020.5*XCR)         **TA*0.47*(0*0.5*XCR)         **TA*0.47*(10*0.5*XCR)	
С <sup>-</sup> СОН С СОЧ С СОП С СОП С DIS	+UTE TRUNK ATKCHIII ATKCHIII ATKCHRIII ATKCHRIII PERI(I)=92 PUTE COMTAC ATKCNI(I)=92 PUTE COMTAC ATKCNI(I)=7 PUTE COMTAC VCHR(I)=7 PUTE COMTAC VCHR(I)=7 PUTE COMTAC	[1]T       AREAS         **LOAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABOST         **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1)         *TA*0.51         *TA*0.7*(021:91:91:91:91:91:91:92:021:90)         *TCAT(II)         **LOAT(II)         **LO	
0 COM 0 COM 0 COM 0 COM 0 COM	>UTE TRUNK           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           PERICIS           PERICIS           PUTE CONTAC           ATKGNIII           ATKGNIII           ATKGNIII           PUTE CUSHIC           VCHR(I)           PUTE GAN ARA           AGAPR(I)           AGAPR(I)	[XIT AREAS         *COAT(IFIX((L2I-LT-REI*PHI3)/SH*L.01*NH)*ABOST         *LQAT(IFIX((L2I-LT-REI*PHI3)/SH*L.01*NH)*ABOST         *LQAT(IFIX((L2I-LT)/SH*L.C1*NH)*ADDSI-ATKCHI(1)         *TOAT(IFIX((L2I-LT)/SH*L.C1*NH)*ADDSI-ATKCHI(1)         *TOAT(IFIX((L2I-LT)/SH*L.C1*NH)*ADDSI-ATKCHI(1)         *TOAT(IFIX((L2I-LT)/SH*L.C1*NH)*ADDSI-ATKCHI(1)         *TOAT(IFIX((L2I-LT)/SH*L)(1)-ATKCHI(1)         *TOATAF         *TOAT	
0 COM 0 COM 0 COM 0 COM 0 COM	>UTE TRUNK           ATKGHIII           PITICONTAC           ATKGNIIII           ATKGNIIII           ATKGNIIIIIIIII           ATKGNRIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	STIT AREAS         **LOAT(IFIX((L21-LX-R21*PHI3)/SH*I.01*NH)*ABOST         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ABOSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **Totationalistic         **N**********************************	SH + 1 . 0 ) * NH
0 COM 0 COM 0 COM 0 COM 0 COM	>UTE TRUNK           ATKGHIII           PITICONTAC           ATKGNIIII           ATKGNIIII           ATKGNIIIIIIIII           ATKGNRIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	STIT AREAS         **LOAT(IFIX((L21-LX-R21*PHI3)/SH*I.01*NH)*ABOST         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ABOSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **Totationalistic         **N**********************************	SH + 1 . 0 ) * NH
0 COM C COM 0 COM C COM C DIS 29	+UTE TRUNK ATKCHIII ATKCHIII ATKCHRII ATKCHRII ATKCHRII PERI(I)=92 PUTE COMTAC ATKCNI(I)=92 PUTE COMTAC VCHR(I)=4 PUTE COMTAC VCHR(I)=4 PUTE COMTAC VCHR(I)=4 AGAPR(I)=4 A	111       AREAS         **LOAT(IFIX((L21-LX-R2I*PHI3)/SH*I.01*NH)*ABUST         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ABUST-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **N**********************************	SH + 1 . 0 ) * NH
0 COM C COM 0 COM C COM C DIS 29	+UTE TRUNK ATKCHIII ATKCHIII ATKCHRII ATKCHRII ATKCHRII PERI(I)=92 PUTE COMTAC ATKCNI(I)=92 PUTE COMTAC VCHR(I)=4 PUTE COMTAC VCHR(I)=4 PUTE COMTAC VCHR(I)=4 AGAPR(I)=4 A	111       AREAS         **LOAT(IFIX((L21-LX-R2I*PHI3)/SH*I.01*NH)*ABUST         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ABUST-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L21-LX)/SH*1.01*NH)*ADDSI-ATKCHI(1)         **N**********************************	SH + 1 . 0 ) * NH
с сон с сон с сон с сон с сон с оп с оп с оп с л т с е т	>UTE TRUNK           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTRIII           ATKGTRIII           ATKGTRIII           PERICIS           PUTE CONTAC           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNAIII           ATKCNAIIII           ATKCNAIIII           ATKCNAIIII           ATKCNAIIIIII           ATKCNAIIIIII           ATKCNAIIIIII           ATKCNAIIIIIIIII           ATKCNAIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	[XIT AREAS         **LQAT(IFIX(L2I-LX-REI*PHI3)/SH*L.01*NHI*ABUST         *LQAT(IFIX((L2I-LX-REI*PHI3)/SH*L.01*NHI*ABUST         *LQAT(IFIX((L2I-LX)/SH*L.C1*NH)*AUDSI-ATKCHI(1)         *TUAASS         **LQAT(IFIX((L2I-LX)/SH*L.C1*NH)*AUDSI-ATKCHI(1)         *TUAASS         *TUAASS         *TUAASS         *TUAASS         **LQAT(IFIX((L2I-LX)/SH*LO)         *TUAASS	SH + 1 . 0 ) * NH
с сон с сон с сон с сон с сон с оп с оп с оп с л т с е т	>UTE TRUNK           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           PERI(I)           PERI(I)           PUTE COMFAC           FUTE TRUNK           ATKGHIII           ATKGHIII           PUTE COMFAC           PUTE COMFAC           PUTE CUSHIC           VCHR(I)=           PUTE CUSHIC           VCHR(I)=           TAURE GF           PUTE CISHIC           SGAPR(I)=           AGAPR(I)=           TAURE GF           SGO=           SGO=           SCH(I)=	STT AREAS         **LOAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*PHI+ABOST         **LOAT(IFIX((L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX((L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX((L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX((L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX((L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX((L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX((L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX((L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX((L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX(L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX(L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX(L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX(L2I-LX)/SH*1.0)*PHI-L)/3         **LOAT(IFIX)*PHI-L)         **LOAT(IFIX)*PHI-L21         **LOAT(IFIX)*PHI-L21 <th>SH + 1 . 0 ) * NH</th>	SH + 1 . 0 ) * NH
с сон с сон с сон с сон с сон с оп с оп с оп с л т с е т	>UTE TRUNK           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTRIII           ATKGTRIII           PERICIONE           PUTE CONTAC           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ACHRIII           ATKCNIII           ATKCNRIII           ACHRIII           ATKCNRIII           ACHRIII           ATKCNRIII           ACHRIIII           ATKCNRIII           ACHRIIII           ATKCNRIIII           ACHRIIII           ATKCRIIII           ACHRIIIIII           ACHRIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	<pre>{\\IT AREAS **COAT(IFIX(L2I-LT-REI*PHI3)/SH*I.01*NHI*ABUST *LQAT(IFIX(LL2I-LT-REI*PHI3)/SH*I.01*NHI*ABUST *LQAT(IFIX((L2I-LY)/SH*1.C1*NH)*AUDSI-ATKCHI(1) *H'*A9351-ATKCHI(1)-ATKATI(1)-ATKCHR(1) CI FIQINETER *JTA*0.5*(1215Q-QRS#2) CONTACT AREA *JTA*0.5*(1215Q-QRS#2) CONTACT AREA *JTA*0.5*(10?1+#11*SINPH4)**2=D2ISQ] TCNI(I) ON VOLUME CHANGE TIA*ASHAT*(10*0.5**CR) PIA CHANGE FIA*ASHAT*(10*0.5**CR) PIA CHANGE FIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*CHANGE 21*SINPH6</pre>	SH + 1 + 0 ) * NH
с сон с сон с сон с сон с сон с оп с оп с оп с л т с е т	>UTE TRUNK           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTRIII           ATKGTRIII           PERICIONE           PUTE CONTAC           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ACHRIII           ATKCNIII           ATKCNRIII           ACHRIII           ATKCNRIII           ACHRIII           ATKCNRIII           ACHRIIII           ATKCNRIII           ACHRIIII           ATKCNRIIII           ACHRIIII           ATKCRIIII           ACHRIIIIII           ACHRIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	<pre>{\\IT AREAS **COAT(IFIX(L2I-LT-REI*PHI3)/SH*I.01*NHI*ABUST *LQAT(IFIX(LL2I-LT-REI*PHI3)/SH*I.01*NHI*ABUST *LQAT(IFIX((L2I-LY)/SH*1.C1*NH)*AUDSI-ATKCHI(1) *H'*A9351-ATKCHI(1)-ATKATI(1)-ATKCHR(1) CI FIQIYITER *JTA*0.5*(1215Q-QRS#2) CONTACT AREA *JTA*0.5*(1215Q-QRS#2) CONTACT AREA *JTA*0.5*(10?1+#11*SINPH4)**2=D2ISQ] TCNI(I) ON VOLUME CHANGE TIA*ASHAT*(10*0.5**CR) PIA CHANGE FIA*ASHAT*(10*0.5**CR) PIA CHANGE FIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*CHANGE 21*SINPH6</pre>	SH + 1 + 0 ) * NH
с сон с сон с сон с сон с сон с оп с оп с оп с л т с е т	>UTE TRUNK           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTIII           ATKGTRIII           ATKGTRIII           PERICIONE           PUTE CONTAC           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ATKCNIII           ACHRIII           ATKCNIII           ATKCNRIII           ACHRIII           ATKCNRIII           ACHRIII           ATKCNRIII           ACHRIIII           ATKCNRIII           ACHRIIII           ATKCNRIIII           ACHRIIII           ATKCRIIII           ACHRIIIIII           ACHRIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	<pre>{\\IT AREAS **COAT(IFIX(L2I-LT-REI*PHI3)/SH*I.01*NHI*ABUST *LQAT(IFIX(LL2I-LT-REI*PHI3)/SH*I.01*NHI*ABUST *LQAT(IFIX((L2I-LY)/SH*1.C1*NH)*AUDSI-ATKCHI(1) *H'*A9351-ATKCHI(1)-ATKATI(1)-ATKCHR(1) CI FIQIYITER *JTA*0.5*(1215Q-QRS#2) CONTACT AREA *JTA*0.5*(1215Q-QRS#2) CONTACT AREA *JTA*0.5*(10?1+#11*SINPH4)**2=D2ISQ] TCNI(I) ON VOLUME CHANGE TIA*ASHAT*(10*0.5**CR) PIA CHANGE FIA*ASHAT*(10*0.5**CR) PIA CHANGE FIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*ASHAT*(0*0.5**CR) PIA*CHANGE 21*SINPH6</pre>	SH + 1 + 0 ) * NH
0 COM C COM C COM C COM C DIS 29 61	+UTE TRUNK ATKGHIII ATKGHIII ATKGHRIII ATKGHRIII ATKGHRIII PERI(II=50 PUTE COMTAC ATKCNI(I)=50 PUTE COMTAC VCHR(II=71 PUTE CUSHIC VCHR(I)=71 AGAPR(I)=71 AFGPR(I	STT AREAS         **LOAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABOST         **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABOSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ADDSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ADDSI-ATKCHI(1)         *TA*0.591(ATKCHI(1)-ATKKTI(1)-ATKCHR(1)         **TA*0.591(ATKCHI(1)-ATKKTI(1)-ATKCHI(1)         **TA*0.591(ATKCHI(1)-ATKKTI(1)-ATKCHI(1)         **TA*0.591(ATKCHI(1)-ATKKTI(1)-ATKCHI(1)         **TA*0.591(ATKCHI(1)-ATKKTI(1)-ATKCHI(1)         **TA*0.591(ATKCHI(1)-ATKKTI(1)-ATKCHI(1)         **TA*0.591(ATKCHI(1)-ATKKTI(1)-ATKCHI(1)         **TA*0.591(ATKCHI(1)-ATKKTI(1)-ATKCHI(1)         **TA*0.591(ATKCHI(1)-ATKKTI(1)-ATKCHI(1)         **TA*0.591(ATKTING	SH + 1 + 0 ) * NH
0 COM 0 COM 0 COM 0 COM C DIS 29 61	>UTE TRUNK           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           PERICISSE           PUTE CONTAC           ATKGNRIII           ATKGNRIII           ATKGNRIII           ATKGNRIII           ATKGNRIII           ACHRIII           ATKGNRIII           ACHRIII           ATKGNRIII           ACHRIII           ATKGNRIII           ACHRIIII           ACHRIIII           ACHRIIII           ACHRIIIIII           ACHRIIIIII           ACHRIIIIIIIII           ACHRIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	<pre>{XIT AREAS **COAT(IFIX(L2I-LX-R2I*PHI3)/SH*I.0)*NHI*ABUST *LQAT(IFIX(L2I-LX)/SH*I.CI*NH)*AUDSI-ATKCHI(1) **LQAT(IFIX((L2I-LX)/SH*1.CI*NH)*AUDSI-ATKCHI(1) **H**A9391-ATKCHI(I)-ATKCHI(1)-ATKCHI(1) CI*(QS**02I*A1I*SIMPHL) CI*(QS**02I*A1I*SIMPHL) **JTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(000.5**CR) *14 CHANGE CITA*ASMAT*(0*0.5**CR) *14 CHANGE 2114EX 215TNPH5 215TNPH5 215TNPH5 215TNPH5 21725.6C.657.2J,2J,661.KG0 L3**7E0CS CTS*</pre>	SH + 1 - 0 ) * NH
0 COM 0 COM 0 COM 0 COM C DIS 29 61	>UTE TRUNK           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           PERICISSE           PUTE CONTAC           ATKGNRIII           ATKGNRIII           ATKGNRIII           ATKGNRIII           ATKGNRIII           ACHRIII           ATKGNRIII           ACHRIII           ATKGNRIII           ACHRIII           ATKGNRIII           ACHRIIII           ACHRIIII           ACHRIIII           ACHRIIIIII           ACHRIIIIII           ACHRIIIIIIIII           ACHRIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	<pre>{XIT AREAS **COAT(IFIX(L2I-LX-R2I*PHI3)/SH*I.0)*NHI*ABUST *LQAT(IFIX(L2I-LX)/SH*I.CI*NH)*AUDSI-ATKCHI(1) **LQAT(IFIX((L2I-LX)/SH*1.CI*NH)*AUDSI-ATKCHI(1) **H**A9391-ATKCHI(I)-ATKCHI(1)-ATKCHI(1) CI*(QS**02I*A1I*SIMPHL) CI*(QS**02I*A1I*SIMPHL) **JTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(02I\$Q-QS*2) CONTACT AREA *3TTA*0.5*(000.5**CR) *14 CHANGE CITA*ASMAT*(0*0.5**CR) *14 CHANGE 2114EX 215TNPH5 215TNPH5 215TNPH5 215TNPH5 21725.6C.657.2J,2J,661.KG0 L3**7E0CS CTS*</pre>	SH + 1 - 0 ) * NH
0 COM 0 COM 0 COM 0 COM C DIS 29 61	>UTE TRUNK           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           PERICISIONE           PUTE CONTAC           ATKCNIIII           ATKCNIIII           ATKCNIIII           ATKCNIIII           ATKCNIIII           ACHRIIII           PUTE CUSHIC           VCHR (IIIIII)           ATHCE OF SE           NPIE C2I-81           KGO=ISEGII           GO TO (61)           XCH(IIII)           XCH(IIII)           TK(III)           ACHIIII           YZ           AFICE           ACHIIIII           ACHIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	111       AREAS         **LQAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABUST         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LOAT(IFIX(LEII-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         CI *ATKCHI(I)         **L041(1)         **L14(1)         **L14(1)         **L14(1)         **L14(1)         **L14(1)         **L14(1)         **L14(1)	SH + 1 + 0 ) * NH
0 COM 0 COM 0 COM 0 COM C DIS 29 61	>UTE TRUNK           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           PERICISIONE           PUTE CONTAC           ATKCNIIII           ATKCNIIII           ATKCNIIII           ATKCNIIII           ATKCNIIII           ACHRIIII           PUTE CUSHIC           VCHR (IIIIII)           ATHCE OF SE           NPIE C2I-81           KGO=ISEGII           GO TO (61)           XCH(IIII)           XCH(IIII)           TK(III)           ACHIIII           YZ           AFICE           ACHIIIII           ACHIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	111       AREAS         **LQAT(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABUST         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LQAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         **LOAT(IFIX(LEII-LX)/SH*1.0)*NH)*ABUSI-ATKCHI(1)         CI *ATKCHI(I)         **L041(1)         **L14(1)         **L14(1)         **L14(1)         **L14(1)         **L14(1)         **L14(1)         **L14(1)	SH + 1 + 0 ) * NH
0 COM 0 COM 0 COM 0 COM C DIS 29 61	>UTE TRUNK           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           PUTE COMTAC           ATKGNIII           ATKGNIII           PUTE COMTAC           VCHRIII           ACHRIII           ACHRIIII           ACHRIIII           ACHRIIII           ACHRIIII           ACHRIIIII           ACHRIIIIIIIII           ACHRIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	111       AREAS         **LOAT(IFIX((L21-LX-R21*PMI3)/SH*I.01*NH)*ABOST         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ABOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LTA*0.5*!(021\$         **LTA*0.5*!(021\$         **LTA*0.5*!(021\$         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOATKCHI         **LOATKCHI	SH + 1, 0) PHH
0 COM 0 COM 0 COM 0 COM C DIS 29 61	>UTE TRUNK           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           PERICIS           PUTE COMTAG           PUTE COMTAG           PUTE COMTAG           VCHRIIIIIII           ATGARCIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	111       AREAS         **LOAT(IFIX((L21-LX-R21*PMI3)/SH*I.01*NH)*ABOST         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ABOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX((L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LOAT(IFIX(L21-LY)/SH*1.01*NH)*ADOSI-ATKCHI(1)         **LTA*0.5*!(021\$         **LTA*0.5*!(021\$         **LTA*0.5*!(021\$         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOAT(IFIX)         **LOATKCHI         **LOATKCHI	SH + 1, 0) PHH
С Сон С Соч О Сон С Сон С ОЛS 29 61	>UTE TRUNK           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           ATKGHIII           PERI(I)           PUTE COMTAC           ATKGNIII           ATKGNIII           PUTE COMTAC           VCHR(I)           ACHR(I)	<pre>Stit AREAS **Coat(IFIX((L2I-LX-R2I*PHI3)/SH*I.0)*NH)*ABOST **LOAT(IFIX((L2I-LX)/SH*1.0)*NH)*ABOSI-ATKCHI(1) **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1) **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1) **LOAT(IFIX((L2I-LX)/SH*1.C)*NH)*ADDSI-ATKCHI(1) CI * (0RS*+02I*R1I*SIMPHL) CI * (0RS*+02I*R1I*SIMPHL) CI * (0RS*+02I*R1I*SIMPHL)**Z=DZISQ) CI * (0RS*+02I*R1I*SIMPHL)**Z=DZISQ) TCNI(I) CON VOLUME CHANGE PIA *ASMA7*(D*0.5*KCR) PIA *ASMA7*(D*0.5*KCR) PIA *ASMA7*(D*0.5*KCR) PIA *ASMA7*(D*0.5)/3ETA*(RR**J-RRI**J)/(RR*RR-RRI) 1*SIMPHL 21*SINPHS 23*SIN(0ETA*0.5)/3ETA*(RR**J-RRI**J)/(RR*RR-RRI) 1*SINPHS 23*SIN(0ETA*0.5)/3ETA*(RR**J-RRI**J)/(RR*RR-RRI) 1*SINDEL SH*7EDRESDEL **SINDEL **SINDEL</pre>	SH + 1, 0) PHH

		· · · · · · · · · · · · · · · · · · ·
	ZCH(I)=-BEDRSN	
	X7K(I)=RLS4+XX2*CO	SOEL
	ZTK(I) +- KY 1* SINCEL	
	GO TO 17	,
	60 XCH(I)=-RL3H-9EORS	
	2CH(I) == 9E 2805	·
	XTK(I)=-RLS4-XX2+S	INDFL
	ZTK(I)=-XX2+GOSOFL	
•	GO TO 17	· · · · · · · · · · · · · · · · · · ·
~		
č		
	C TRUNK GROUND CONTACT	
<u> </u>	C STRAIGHT PART OF TRUNK	
	23 CONTINUE	
C	C COMPUTE DEFORMATION AND	
	RHY=((R2-(4Y-YGH()	111/R21
	PHI 3= ACOS (44A)1(-1	0,4MIN1(1.0,RMY)))
		1)]/R1]
	PHIARACOS (AMAX1(+1)	0,44IN1(1.0,2HY)))
୍ରୁପ	C DO TRANSCENDENTALS DHL'	
	SINPH3=SIN(PHI3)	·
	SINPH-#SIN(PHI4)	
C	C COMPUTE PARTIAL TERMS	
	DPSP=(D2-R?*SINPH3)	·
	EPSP2+DRSP+D2SP	•
	COSCIL=COS (DILTA(I)	)) <u> </u>
	SINGEL=SIN (DELTA(I)	))
	BEDRSNIETAZODASPO	SINGEL
••••	BECRCS#95TA2*0RSP*(	COSDEL
C	C COMPUTE REMOVAL SECTOR	
-T.	A6=R2+R2+P413+0.5	
	A7= (R2-HY +YGH(1))	0. 5+RZ+SINPH3
	A6HA7+16+A7	
	£8=#1+71+P414+0.5	
	A9= (71-HY -YGH(I))	0.5*R1*STNPH4
	A10=49	
	A11=A8	
~	_C COMPUTE SICTOR CENTROIS	16
		(SIN(PHI3+0.5)++2)+R2/PHI3
	X7=SINFHR-1.333333	1314(F011) 0007 27 REFF 020
- •		3 • (SIN (PAI4 • 0, 5) • • 2) • R1/PHI4
	X9= SINPHR+0.333333	
	X10:x39	7.31.9 (nend
-	X11=X8 PII2=01=0.5	
-		D TO TO N 90 DEGREES
G	G IF PHIA IS GREATER THAT	A AN DICKIES, SET TO AN DECKEES
	FHIGEPII2	
	SINPH4=SIN(PHI4)	
	A10= (R1-HY+YGH(1))	· Ž1
	X10 # SINPH + 0. 5 + 31	
•	A11##1+91+0HI4+0.\$	
	X11#SINPHP+1,33334	53+ (SIN (PHI4+0.5)++2)+R1/PHI4
	TO CONTINUE	
C	C COMPUTE TRUNK AREA CHAI	
	ATK#111=AE447+A3-A4	· · · · · · · · · · · · · · · · · · ·
	ATKP?(I)=A54A7+A11	- A10
C	C COMPUTE TRUNK VOLUME C	IANGE
	VTKP\$([)+ATKR([)+O	
	VTKP?(I) #ATK??(I) *!	NEL7.
	VTKG(1)+7. VTKRA(1)	-VTKR3(])
C	C COMPUTE CUSHIOI VOLUHE	CHANGE
	VCHR(1)=-0(LX*A54A)	
C	C COMPUTE TRUNK EXIT AREA	
	ATKATI(I)=FLOAT(IF)	[X   {L   ~L +L X+FL OAT (NX-1) *SH-R1*PH14}/SH+1.0)*NH}
	1* ADS -	•

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	•
	ATKCHI(I)==LOLT(IFIY((L2-LX-F2+>HI3)/SH+1,)+NH)+ADS
	ATKCHR(I)==LOAT(IFIX((L2-LX)/5H+1.Q)+NH)+ADS-ATKCHI(I)
-	ATKATR(I)= ?"\\*A75-#TKCHI(I)-ATKATI(I)+ATKCHR(I)
	PERI(1)=2. * )5LX
C COM	PUTE TRUNK CONTACT PERIMETER PUTE TRUNK CONTACT APEA
C COM	PUTE TRUNK CONTACT APEA
• • • • •	ATKCN1(1)=324514043+CELX
	ATKCN911)= 81+SINPH6+CELX
C COM	PUTE GAP ARIA CHANGE
6 604	
· ·	ACHRIIIATICNIII
•	AGAPP(I)=ASAPI(I)
	KG0=ISEG(I)
C C04	PUTE SIGNENT CONTACT CENTER OF PRESSUPE FOR CUSHION AND TRUNK
	GO TO (17, 12, 62, 17, 17, 66, 66, 17), KGO
62	xCH(I)=xCx(I)
	ZCH(I)=0,5*()2-92*SINPH3)
	XTK(I)=XCX(I)
	2TK(I)=02+)+5+(R1+5INPH4-92+5INPH3)
	GO TO 17
. 66	xCH(1)=XGX(1)
	ZCH(1)=-0, 3*(02- 22*SINPH3)
<b>_</b>	XTK(1)=XCX(1)
	2TK(1)=-(02+0.5+(R1+SINPH4-32+3INPH3))
_ 17	CONTINUE
C++++	
C PAR	T 3 SUMMATION OF SEGMENT AREAS VOLUMES
C	
ē	-
C SET	TOTAL AREA AND VOLUMES TO ZERO
• •••	ATKCN=0.0
· ·	Y*K+0.0
	_ACH=0.0
	ATKCH=0.0
	_ATKAT=0, g
	VCH=0.0
	_AGAP=C.0
	ATKATC=0.
	ATKCHC+0. P CN SIGHENTS TO FIND TOTALS OF AREAS AND VOLUMES.
6 100	
	_DO 30 1=1,NSTOP
	VTK=VTK+ (VTKI(I)-VTKP(I))
	ACH=ACH+ (ACHI(I)-ACHR(I))
	ATKCH=ATKCH-ATKCHI(I)
	ATKAT#ATKAT+ATKATI(I)
	VCH=VCH+ (VCHI(I)+VCHP(I))
	_6TKCN=ATKCN+ATKCNI(I)+ATKCNI(I)
	AGAP=LGAP+ (AGAPI(I)-AGAPR(I))
	ATKCHC+ATKCHC+ATKCHR(I)
30	
	AGAP=AH4X1 (AGAP, J. 0)
	¥TK=&%&%%{{}}
	VCH=AHA11(J.0, (VCH+VCH9))
	VCH= AMAX1 (), 0, VCH?
	ATKCH=AMAX1(0,000,ATKCH)
	ATKAT=44AX1(0.000.4TKAT)
•	"CH+AMAX1().0.ACH)
	ATKATC+AMA11{0.0.ATKATC}
<del></del> .	ATKCHC=AMAX1(C, 3, ATKCHC)
. <b>9_</b> F(	DRGE SUM OF NO7ZLE AREAS TO BE EQUAL TO TOTAL NOZZLE AREA
	SUM=ATKAT+STKCH+ATKATC+ATKCHC
	ATKCH=ATKCH/SUH+ATOTAL SATKAT/SUH+ATOTAL
	ATKCHC+ATK3HC/SUN+ATOTAL SATKATC+ATKATC/SUH+ATCTAL
•	KETURN
	END '
	SUBRCUTINE ST(FY.TZ.TX.DERY.IPP.PPLM.VPLM.VTK.BFANX.OVTK.PTK.DVCH.

XYCG.CVCHP.@CH.VSH.SINKPT.PHIE.DPHI .THETAE.OTHETA.CKK.PAT.GG.HY1.G
VEC, MASS. RPH, VELX, SIE, RHO, & GAP, ACH, ATK
XAT, ATKCH, ATKCH, ATKATC ATKCHS, CAF, CE'YFX, CGAP, ACHR, ATKCHI, ATKCH
CA.PERI, JCH. 7CH. VTK. 2TK. ACHI. JGH. CPLTK. OTKCH. OTKAT. OCHAT)
C DYNAMIC FAN VERSION FOR FMA.
C STATE EQUATIONS FOR THE DYNAMIC SYSTEM
REAL MASS
C FOLLOWING SUBRUUTINIS ARE CALLED TO UPDATE VALUES OF
C FORCES, TORCUES AND FLOWS, GIVEN THE NEW VALUES OF THE
C STATE VARIABLES
DINENSION DERY (13) . ACHI (32) . ACHR (32) . ATKCNI (32) . ATKCNR (32) . PERI (32
X1, XCH (32), ZCH (32), XTK (32), ZTK (32), YGH (32) CC+-1, 173A4TFN×, 796 3CPT=.6 \$CTA=.4 SQVENT=0.
CTC=, 4 3FF=0. HDC=1. 3PHA=155. \$U=0.03 APITK=, 69A \$DAMPC=1.2 \$ATFAM=.072
HOLE1. 19HAT155. 1000.01
APLTK:.698 SDAMPC=3.2 SAIFAN=.072
CENF2=0. ENSTOP=32
C SUBROUTING TO FIND FLOW AND PRESSURE VALUES DURING DYNAMIC SIMULATION
11RH0+2,0/3H0
C PLEMUN TO TRUNK FLOM
15((PPLM-P*K).LT.0.0) SIGN=+1.0
OPLTK#SIGH*CPT#APLTK*SORT (ARS (TIFHO* (PPLH-PTK)))
UTEINSIDE OF ATENTIATINATINATINTEDUTETUTETUTETUTETUTET
C TRUNK TO CUSHION FLOM
SIGN#1. IF((PTK-PC4).LT.O.) SIGN#+1.
0TKCH+SIGN*CTC+SORT (ABS (TIRHO* (PTK-PCH)))* (ATKCH+0.66667*ATKCHC)
C TRUNK TO ATNOSPHERE FLON
SIGN=1.0
IF(PTK,LT,0.0)SIGN=-1.
QTKAT=SIGN+CYA+SORT (11240= 135 (PTK)) * (ATKAT+0. 66667*ATKATC)
C CUSHION TO ATHOSPHERE FLOM
SIGN=1.0
IF (PCH.LT. ). 0) SIGN=-1.0
QCHAT=#JAP+CGAP+SORT (TICHO+ABS(PCH))+SIGN
C FORCES AND TOPOUES ASSOCIATED WITH A PARTICULAR ACLS ORIENTATION
C ARE CALCULATED
C CALCULATE TRANSCENDENTALS ONLY ONCE
CSSCS=COS(PHIE) * SIN(THETAE) *SIN(SIE) =COS(SIE) *SIN(PHIE)
CPCT=COS(FHIE)+COS(THETAE)
C CLEAR TOTAL FORCES AND TORQUES TO ZERO
F09CT=0.0
1TPX=0.0
TTP2=0,0
1CPx=0.0
TCP 2+0.0
TORFZ=Q+B
TOROTX+0. 0
TOROT7=0,0 SFORGEY=0. STOF JUEX=0. STCRCUEZ=0.
_C_ FORCES AND TORDUES INDEPENDENT OF BEGMENTS_INDIVIDUALLY
C HEAVE FORCES CUSHION AND TRUNK
FCP=PCH*ACH
FTP=PTK+AT <cn< td=""></cn<>
C COMPUTE VELOCITY FOR DRAG FORCE
V=VELX+CSS3S+S1HKRT+CPCT
1+ (V. GT. D. ); SIGN==1.
C HEAVE DRAG FORCE
FDF=0,5*H03*PH4*RH0*V*V*SIGN
C DRAG TOROUE
10F7+FCF+C [NFX
TDFX==FDF="CENFZ
TOFX=-FOF*JENFZ C FOPCLS AND TORDUSS DEPENDENT ON SEGMENTS INDIVIDUALLY
C FORCES AND TORDUSS OCPENDENT ON SEGMENTS INDIVIDUALLY

TCP7#TCP2+(XCH(1)-CC)+PCH+(ACHI(1)-ACHR(1))
TCPX=TCPX-(75H(I)-FF)*PCH*(AC4I(I)-ACHR(I))
T1P2+TT02+(XTK(1)-CC)+(0TK+(ATKC),1(1)+ATKC)(R(1)))
TTPX+TTPX-(7T(11-FF)*(PTK*(ATKCH111)+ATKCNR(1)))
IF ( (ATKCNI (1), GT, 0., ). CR. (ATKCNR(1), GT. 0. )) GO TO 111
GO TO 101
FCPC=-VILT+DAHPC+PERI(I)
SORCT=FORCT+FORD
104012+10+312+ (X1K(1)+CC)+FORD
TOROTX+TOROTX+(ZTK(I)-FF)+FORO
IF (VELX.E0.0.0) GO TO 101
TORF 2= YORF 2= (YCJ* CPCT* *PTK* (ATKCNIII)+ATKCNR(I))*U
101 CONTINUE
C CUNNATION OF FACE AND TOROUT COMPONENTS
C TOTAL HEAVE FORCE
FORCEY# (FC>+FTP+FORCT+FDF1+CPCT
FY=AHAX1(F79CEYt0.)
C TOTAL TOPOUE X AXIS
TORQUEX+TC>X+TTPX+TOPOTX+TOFX
TX=TOQUEX
C JOTAL TORQUE Z ANIS
TORCUE 2 = TC > 2 + TTP 2 + TOPOT 2 + TOF 2 + TOF FZ
1Z=109CU2Z
C STATE EQUATIONS
C 1)PFLM.FLEMUN PRESSUPE (GAGE)
C 2) PCH CUSHION PRESSURE (GAGE)
G BIPTKTHUNK PHISSUHE (GBGE)
C 4)SINKRT. VERTICAL SINK RATE, POSITIVE UPWARDS
C SIYCGCG ELEVATION
C STOPHI., PITCH RATE, VEHICLE FRAME
C 7) DTHETA ROLL RATE. VEHICLE FRAME
C BITHETAE. SULFAIN AOLL ANGLE
C OIPPIS. EULERIAN PITCH ANGLE
U VIFFILA-EULERIAN FILL ANGL
C_10ISIE SULERIAN YAW ANGLE (APPROX. JERO)
G 111XVDISPLN OF PRESSURE RELIEF VALVE
C 12) VV. VILCITY OF PPESSURE RELIEP VALVE
C 1312FENXFAN AIR INERTANCE FLOW
0ERY (1) = (CKK+ (P=LH+PAT) / VPLH) + (7FANX+QPLTK)
DERV(1)=(CXX*(P1C+PAT)/VPL+)*(DFANX+QPLTK) DERV(3)=(CXX*(PTK+PAT)/VTK)*(UPL1K+OTKCH+OTKAT+OVTK) C CUS+ION_FLOW_ADOVE (GOUND)=FFFETT TRANSITION_ZONE
C CUSHION FLOW ABOVE GEOUND EFFECT TRANSITION ZONE
QCHFT=QPLC++QTKCH-OVCH
C. CALCULATE GROUND SPESCE TRANSITION ZONE
C. CALCOLATE COULD STREET TON AUNC
190UND=GG+HY1*(1.+GEC)
BEOUND = GG + NYI
C DETERMINE IF ALLS IN TRANSITION ZONE
IF (YCG. GT. T30UND) GO TO 13
. IF (YCG.GT.BROUND) GO YO 14
GO TO_16
C ABOVE TRANSITION 2018
13 QCHAT=OCHFT
IFLAGA0
10-0
NOAD
GO TO 15
C IN TRANSITION CONT
_141FLAG+1N0+100
10+1FIX(AD3((19)UND+TCG)/(100UND+B90UND)+FLOAT(NO)))
JF(IO.GI.N))IO=N2
60 TO 17

BEST ..... LABLE COPY

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1 :

16	NG#1	
	10=1	
	JFLAG+2	
COM	PUTE CUSHION TO ATMOSPHERE FLOW	
17	QCHAT+FLOAT(HO-IO)/FLOAT(NO) +OCHFT+FLOAT(IO)/FLOAT(NO)+OC	HAT
	MION PRESSURE DERIVATIVE	
25	DERY (Z) = 10-LCH+ STKCH-CCHAT-DVCH+ CVCHF+PCH+DERY (3)/ (PTK+P)	K117
2.5	1 (VCH/ (CKK* (PCH+PAT))+DVCHP/PTK)	~~~~
	THE PRESENT PERCENT AND THE TRANSTROM TONE	
; çus	HICH PRESSURE IS ZERO ABOVE TRANSITION ZONE	
	1F(IFLAG. E7.0.0) PCH=0.0	· · · · · · · · · · · · · · · · · · ·
66	RETURN	
	END	
ARAM	ETER VALUES*ID1AV#0	
	UHAX=20.	
	HSS#77.5	CC=-1.17
	GG= 1.5 .FF=0. , PHA=155. ,HOC=1. ,LS=4.175 .D=.417 .A=.	595
	E=.524,L=5.17 .HYI=1.00 . AH=3.4E=4 .SH=.083	
	AIF=.072	
	4PC=0 APT=. 698 . APA=0 AAT=. 796 VC	
	_DPV=8,FAT=2115.8 .TEM=70, .CKK#1.4 .CPA+0. ,CAF=.5 .CPC+0. ,CP7=.	6 CTCe.L
	ILREISA SURANUS SURTAN SUPURAL S	
	CTA=.4 .CG=.5 .GEC=.1 CFX= 1.17 .CFZ=0OPC=3.2	
A LO	=0XU LO=9ZA LO=0. ,MALLO=0	.0 <b>=</b> +2
	Y90LD=0 Y8 LD=0 YDALD=0	.D*0
BLD	*0NOLD*0N3 LC*0NDALD*0RUDLD*1B ( *0.4. THREN=2353X0 FN=-6.1.GAXEN=1	0=19.
COEN	= 0.4 .THREN=2353X0 FN=-6.1.GAXEN=1GAZEN=0PO	F=158.73.
1 TF	#17.46.20 TF=0. ,Z1 *F=158.73	
-	.70 TF 2#15#.73	
	2=0., PO TF 2=153.73, P1 TF 2=17.46.	
KIII.	3=1GKLIT 3=1. 1=1.2.C2 NJ 1=3.75.C3 MC 1=2.5.04 MC 1=0GKIIT V=1GKL	X 7.4
1 110	1=1,2+C2 7, 1=3+75+C3 75 1=2+5+54 76 1=0+64111 +11+640	1 /=1.
KIIT	6=-1.,GKLIT 8=1.,C1 MC 2=1.94.C2 MC 2=5.75.C3 MC 2=2.5.C	• MC <u>2=0,,</u>
KIIT	5=1,.GKLIT 3=1GKIIT10=-1,GKLIT10=1. ,ALSAV=0S	V=76.
H_AV	=0 VH AV=+0	V=0+
AILO	#77.5.0 LG#45KLIT 1#15KIIT 1#1IXXSD=2414IYY	50=1840. ·
2250	*+062.,IXZSD==203. ,70 EN=0. ,70 LO=0.	
	FY153=0, , FY253=0, , T2253+0, , FX253=0, , TX153+A, , TZ153=0	)
	fx353+0, ,fy353=7, ,F2353=0,	-
	X0 L0=-39.692.740L0=17366.YP L0=035692.20 L0	a-A. 0257.
	x75699.YR LD=.12081.LP LD=-113.74.X02L0=065052.HQ L0=-	
	= 350, 17, LR L0=+12, 316, NP L0=+11,851,20 L0=+10,957,202L0=+	
	=607 NR LOT100, 33, 40 LOT13, 725, 402LOT-865, 13, LOALC=-3.674	
	**117.	
	AL CONDITIONS.	
PLFM	*137.93.PTKFH=126.06.PCHFH+0. ,TH EN=1515.8.U SD=17.0	53.
50	#6.5235.W \$3#0. •P \$9#0. •O \$0#0.0 R \$0#0	) <b>.</b>
OLSO	■0, ,PITSD=-1.0 ,YAWSD=0. ,ALTSD=2.6 0.XI TF=0. ■0, ,X2 IT 7=0. ,X2 IT 3=0. ,X2 IT 3=0.	
2 TF	+0X2 IT 7=0X2 IT 5=0X2 IT 3=0.	
2 11	1=0KI TF 2=0X2 TF 2=0X2 IT 9=0K2 IT10=0.	
	NT CONTPOL *+. TINJ=0.3 .THAX+10., OUTRATE=1 .PRATE=_1.SIM	IL ATE
-1-14	HE AND AN ANTIMATER STRUCTOR AND	<u></u>
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Vita

Edward Arthur Kenney was born 18 July 1948 in London, Ontario, Canada to James A. and Evelyn V. Kenney. After graduating from G. A. Wheable Secondary School in 1967, he entered the Royal Military College (RMC) in Kingston, Ontario. He graduated from RMC in 1971 with the degree of Bachelor of Science in Electrical Engineering, and a commission in the Canadian Armed Forces. After graduating from the Primary Flying School and attending the Flying Training School at CFB Moosejaw, Saskatchewan, he reclassified to be an Aerospace Engineer. Subsequent tours of duty included CFB Shearwater, Nova Scotia, as the Deputy Maintenance Records Officer and Heavy Maintenance Repair Officer; H.M.C.S. Preserver as the Fleet Air Maintenance Officer; and National Defence Headquarters, Ottawa, in the Directorate of Avionics and Armament Subsystems Engineering. Capt Kenney was assigned to the United States Air Force Institute of Technology in June 1976 in the Graduate Guidance and Control Program.

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VAs well, the thrusters would be set forward of the aircraft center of gravity and could be activated in tandum to aid in pitch control.

The Jindivik Remotely Filoted Vehicle, an Australian target drone, was fitted with an ACLS and taxi tests showed the instability and need for a stabilization system. Subsequent use of Jindivik wind tunnel and taxi test data served as the basis for the development of the roll/pitch control system presented in this paper. Due to computational problems with the air cushion model of the computer program, the controller designs could not be completely verified; but expected trends in pitch, roll, and yaw control were shown.

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