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MODAL ANALYSIS AND DYNAMIC STRESSES FOR ACOUSTICALLY EXCITED SHUTTLE INSULATION TILES

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FOREWORD

The work reported herein was performed by the Grumman Aerospace Corporation under the NASA/Langley Master Agreement and Contract No. NAS 1-10635 for the Development and Implementation of Space Shuttle Structural Dynamics Modeling Technology. The Work Statement of Task Order No. 17-Modification No. 2, "Development of an Analytical Program to Analyze Reusable Surface Insulation for Shuttle," authorized and specified the items to be performed in this study. This report covers Items F through H of the subject Task Order, for which the period of performance was 12 months starting in September 1974. Items A through E were reported upon in NASA CR-132553, September 1974.

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ABSTRACT

This report describes improvements and extensions to the RESIST computer program, developed previously, for determining the normalized modal stress response of Shuttle insulation tiles. The new version of RESIST can accommodate primary structure panels with closed-cell stringers, in addition to the previously developed capability for treating open-cell stringers. In addition, the present version of RESIST numerically solves vibration problems several times faster than its predecessor.

A new digital computer program, titled ARREST (Acoustic Response of REusable Shuttle Tiles) is also described. Starting with modal information contained on output tapes from RESIST computer runs, ARREST determines RMS stresses, deflections and accelerations of Shuttle panels with reusable surface insulation tiles. Both programs are applicable to stringer stiffened structural panels with or without reusable surface insulation tiles.

CONTENTS

Section 1

INTRODUCTION

This report describes extensions to vibration and stress analysis work performed on the Space Shuttle thermal protection system (Reference 1). These extensions are concerned with improving the structural idealization and computational efficiency of the modal response program, and developing an associated acoustic response analysis capability.

In the initial work, an efficient iterative procedure for the vibration and modal stress analysis of Reusable Surface Insulation (RSI) of multi-tiled Space Shuttle panels was presented. The method, which is quite general, is rapidly convergent and highly useful for this application. A user-oriented computer program based upon this procedure and titled RESIST (REusable Surface Insulation STresses) was prepared for the analysis of soft-bonded Shuttle insulation tiles attached to stringer-stiffened panels. RESIST, which uses finite element methods, obtains three-dimensional tile stresses in the soft isolator and RSI materials. In addition, the program can treat non-uniform temperature-dependent material properties in the tiles. Two-dimensional stresses are obtained in the tile coating and the stringer-stiffened primary structure plate. A special feature of the program is that all the usual detailed finite element grid data is generated internally from a minimum of input data. The program can accommodate tile idealizations with up to 850 nodes (2550 degrees-of-freedom) per tile and primary structure idealization with 3000 nodes. The vibration capability of this program was made feasible through development of a new rapid eigenvalue program named ALARM (Automatic LArge Reduction of Matrices to tridiagonal form) which can handle primary structure idealizations with up to 15,000 degrees-of-freedom.

Because of the complex nature of the finite element idealizations and the large size of the associated matrices, computer running time was an important factor associated with operation of the RESIST program. Therefore, attention was given in the present study to identifying time-consuming computational areas and developing improved programming and numerical algorithms for certain portions of RESIST. These improvements, which are discussed in Section 2.1, resulted in efficiencies which have yielded computer cost-savings of over 75% for realistic tile problems.

Another basic improvement in the original version of RESIST was the development of an improved stiffened panel idealization. The version of RESIST described in Reference 1 could only accommodate compact, widely-spaced stringers, or open-section stringers attached along a single rivet (or weld) line. The present work, as described in Section 2.2, extends the RESIST modeling capability to the treatment of orthotropic plate idealizations, or closed-cell stringers attached to flat panels along double rivet lines. Thus, RESIST has been modified to treat configurations which are more representative of actual Shuttle structure.

The vibration analysis of RSI tiled panels by the RESIST program yields normalized deflections and tile stresses for each mode considered. For dynamic analyses, the results for each natural frequency may be multiplied by suitable modal participation factors and the results superimposed to yield useful engineering results. A computer program for obtaining the acoustic response of (spatially) uniformly loaded panels has been developed. The new program titled ARREST (Acoustic Response of REusable Shuttle Tiles) is described in Section 3.

Typical results for the combined usage of ARREST and the new version of RESIST are presented in Section 4. Preliminary results reveal that the RSI normal thickness stresses, near the isolator bond line, may be critical for portions of the orbiter which are subject to high acoustic launch loads. Users manuals for these programs are presented in Appendices A and B. Reference 2 is the Programmer's Manual for RESIST. Appendix C contains a programmer's manual for the newly developed ARREST program. The RESIST and ARREST computer programs have been developed on digital magnetic tape for both the CDC 6600- and the IBM 370-series machines.

Section 2
IMPROVEMENTS TO THE RESIST PROGRAM

A number of changes to the RESIST (REusable Surface Insulation STresses) program (References 1 and 2) have been made to improve its usefulness. The nature of these program changes have been to extend its applicability, reduce the program storage requirements, speed up the machine running time, and to provide additional information which is required for subsequent dynamic analyses (described in Section 3).

2.1 COMPUTATIONAL EFFICIENCIES

The reduced program storage requirements and the development of streamlined numerical algorithms have improved the program efficiency significantly. This is highlighted by a reduction in machine running time of a large sample problem, presented in Reference 1, from 68 to 16 CPU minutes on the IBM 370/168 computer. These program improvements will now be detailed.

2.1.1 Modification of The Large Eigenvalue Routine (ALARM)

The ALARM (Reference 1) routine computes the initial mode shapes and frequencies of the tiled plate. A modification to ALARM was effected to speed up this time consuming portion of the RESIST computer program. In the original version of ALARM, the number of eigenvalue reduction vectors (Reference 3) generated, $\{V_j\}$, $j = 1, 2. \ldots, m$, was approximately twice the number of desired modes $\{\phi^{(i)}\}$, $i = 1, 2, \ldots, q$. Since the generation of each V_j represents one of the most computationally costly portions of the ALARM algorithm, the subroutine logic was changed to initially compute only approximately 50% more reduction vectors than desired eigenvectors ($m \approx 3/2\ q$). The first q eigenvalues associated with the m reduction vectors are now computed along with their associated Newman-Pipano error bounds. Should any of the error bounds in frequency squared be greater than 2%*, an additional vector is computed and the first q eigenvalues and error bounds, using m + 1 reduction vectors this time, are checked again. This process is repeated, adding one new vector each step

*An error bound in frequency-squared of 2% corresponds to one of approximately 1% on frequency.

of the way, until the first q desired eigenvalues are accurate to within 2%. It has been found that this procedure is extremely efficient. Repeated solution of the reduced m x m eigenvalue problem, and error bound determination, requires a minute portion of the entire computation time, as long as 5 or more modes are required and the size of the original eigenvalue problem is large (i.e., of the order of 500 or more).

2.1.2 Nonpositive Definite Solution Algorithm

The efficient solution routine (PODSYM), used to solve the tile and primary structure banded large matrix equations, required that the symmetric coefficient matrices be positive definite. Since this condition could not be guaranteed a priori, Eqs. (6) and (11) of Reference 1 were converted to the equivalent positive definite forms of Eqs. (9) and (12), respectively. This conversion required excessive storage requirements and resulted in rather high computer usage costs. Therefore, PODSYM was modified to accommodate nonpositive definite equation systems through decomposition of the symmetric coefficient matrix [A] into the form

$$[A] = [\bar{L}]\,[\,^{\backslash}D_{\backslash}\,]\,[\bar{L}]^T$$

where $[\bar{L}]$ is a lower triangular matrix with elements $\bar{\ell}_{ij}$ and $[\,^{\backslash}D_{\backslash}\,]$ is a diagonal matrix with plus or minus ones, d_p, on the diagonal. The original algorithm is similar to the one outlined below except that the computation and inclusion of d_p, which is always plus one if [A] is positive definite, is not necessary. The elements of $[\bar{L}]$ are given by

$$\bar{\ell}_{ii} = \left[\left(a_{ii} - \sum_{p=1}^{i-1} d_p\,\bar{\ell}_{ip}^2\right) / d_i\right]^{\frac{1}{2}}$$

$$\bar{\ell}_{ij} = a_{ij} - \sum_{p=1}^{j-1} d_p\,\bar{\ell}_{ip}\,\bar{\ell}_{jp}$$

where $d_i = \text{sign}\,(a_{ii} - \sum_{p=1}^{i-i} d_p\, \bar{\ell}^2_{ip})$

and a_{ij} are the elements of [A].

The solution of

$$[A]\,\{x\} = \{b\}$$

for {x} (given {b}) then follows from the forward solution of

$$[\bar{L}]\,\{y\} = \{b\}$$

for {y}, and the backward solution of {x} from

$$[\bar{L}]^T\,\{x\} = [\grave{}D\acute{}]\,\{y\}\ .$$

2.1.3 Iterative Procedure for Changing Matrix Equations

The iterative solution of Eqs. (6) and (11) of Reference 1, both of which are of the form

$$[Z_i]\,\{\delta_{i+1}\} = \{p\,(\delta_i)\,\} \tag{1}$$

where

$$[Z_i] = [K] - \omega_i^2\,[M]$$

required the repetitive decomposition of $[Z_i]$ into $[\bar{L}_i]\,[\grave{}D\acute{}]\,[\bar{L}_i]^T$, since the frequency, ω_i, upon which $[Z_i]$ depends, changed from one iteration to the next. However, since ω_i may be a slowly changing value, an option, which is based upon an approximation, and which does not require the resplitting of $[Z_i]$, was introduced into RESIST. This approximation is based upon the following development.

Let

$$\omega_i^2 = \omega_o^2 + \Delta\omega_i^2$$

$$\{\delta_{i+1}^{(j+1)}\} = \{\delta_{i+1}^{(j)}\} + \{\Delta\delta_{i+1}^{(j)}\}$$

and substitute into Eq. (1) to obtain

$$[Z_o]\ \{\delta_{i+1}^{(j+1)}\} \approx \{p\ (\delta_i)\} + \Delta\omega_i^2\ [M]\ \{\delta_{i+1}^{(j)}\} \qquad (2)$$

where the higher order terms $\Delta\omega_i^2$ [M] $\{\Delta\delta_{i+1}^{(j)}\}$ have been dropped from the right-hand side of Eq. (2). Starting with $\delta_{i+1}^{(o)} = \delta_i$, Eq. (2) is solved in an iterative manner (this is an "inner" (j) iteration) until $\{\delta_{i+1}^{(j+1)}\}$ converges. Thus, $[Z_o]$ is only decomposed once, regardless of the number of "outer" (i) iterations.

2.2 PROGRAM EXTENSIONS

The extended applicability associated with the new version of RESIST involves improvement of the idealization for the stiffened-plate primary structure. The new plate idealizations permit the use of either orthotropic plate properties or a more detailed stringer model. The new finite element capability for the strain isolator includes the option for material orthotropy, which is required for the current baseline TPS isolator.

2.2.1 Orthotropic Strain Isolator

RESIST has been modified to permit an orthotropic material isolator between the RSI and primary structure. This latter modification was necessary because of the current baseline usage of Nomex felt (which has different properties in the transverse and planar directions) as the isolator material. The finite element modeling of the isolator layer is still based upon the three-dimensional orthotropic hexahedron element described in Reference 1.

2.2.2 Stiffened Plate Idealization

The stiffened-plate primary structure finite-element idealization, employed in the original version of RESIST, consisted of offset beam elements attached to flat plate elements (Figure 2-1). While it is felt that this idealization is adequate for compact widely-spaced long stringers, it is inappropriate for a "typical" Shuttle panel, such as that shown in Figure 2-2. To extend the capability of RESIST for application to such structural configurations, two new idealization options have been developed and incorporated into this program.

The first development consists of a new stringer idealization to permit a more accurate modeling for closed-section stringers attached along a double line of rivets (or welds). The new stringer model consists of a pair of plate elements, which form a "V" (Figure 2-3), below which an offset beam element is rigidly attached. The rationale used in selecting the "V" shape was that it permitted the modeling of a shear-flow path to resist local plate twisting (the previous offset beam idealization could not furnish this type of twisting restraint) while only adding a single row of element-nodes per stiffener.

The offset beam element placed below the "V" is used to compensate for the fact that the original stringer possesses more cross sectional beam properties than can be accommodated by the "V" elements alone. Thus, when an actual closed stringer to be idealized has a shape that is different from the one used in the finite element model, the program assigns properties to the offset beam below the "V" such that its section properties compensate for any mismatches. A count of the actual number of stringer section properties yields six geometric values (A, I_y, I_z, J_x, β, and e) in addition to the spacing variables P, a and b (Figure 2-2), whereas the new idealization permits seven independent properties in addition to P, a and b. The additional variable permitted by the present finite element idealization, $\bar{t}$, may thus be used to help improve correlation with test data.

The second structural idealization option incorporated within RESIST permits the combination of stringer properties into the flat plate elements. This is affected in a uniformly distributed manner through specification of

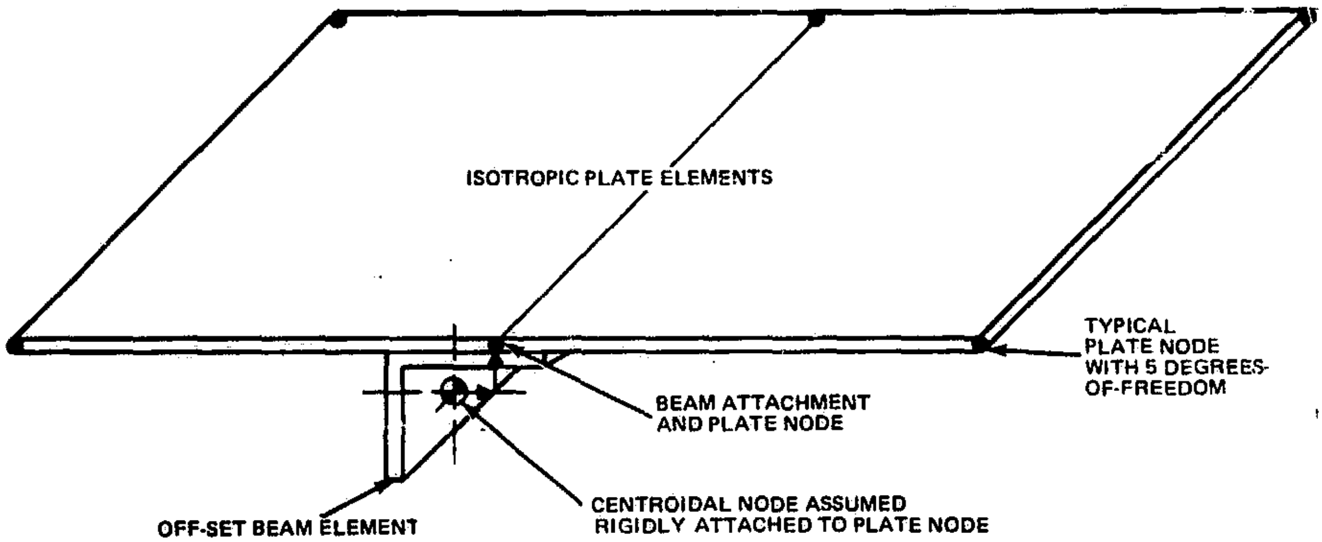


Figure 2-1 Stiffened-Plate Finite Element Idealization Employed in Original Version of RESIST Program

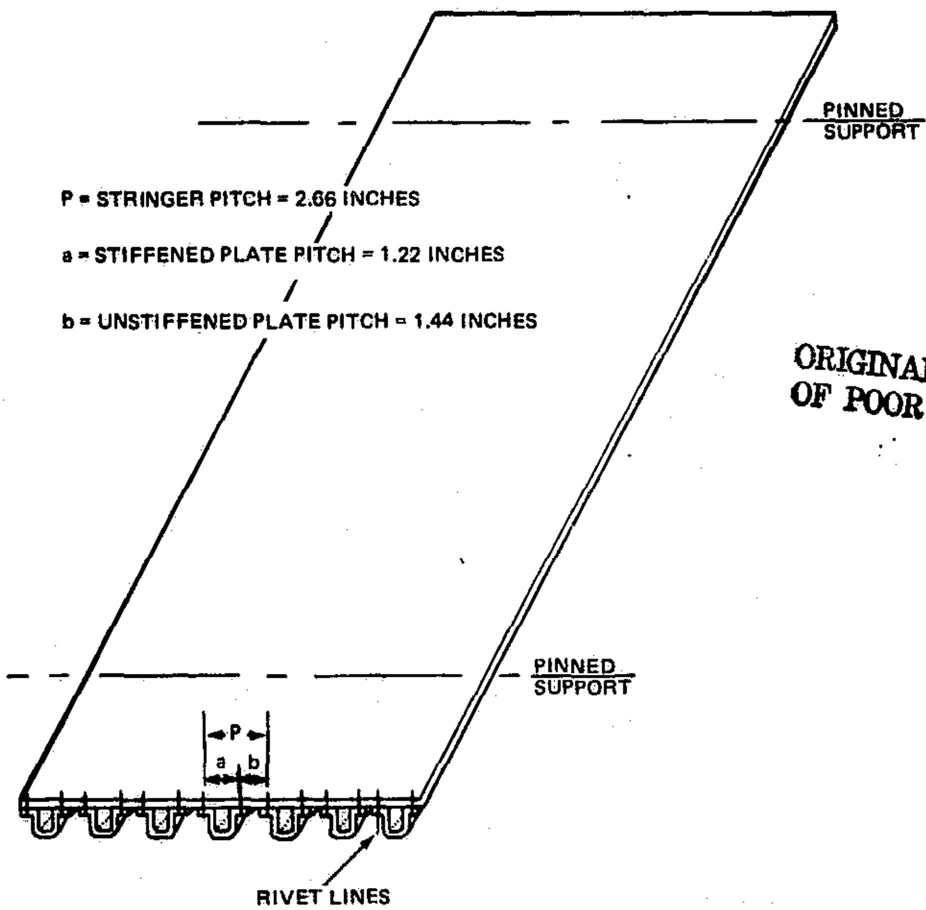


Figure 2-2 Typical Shuttle Panel

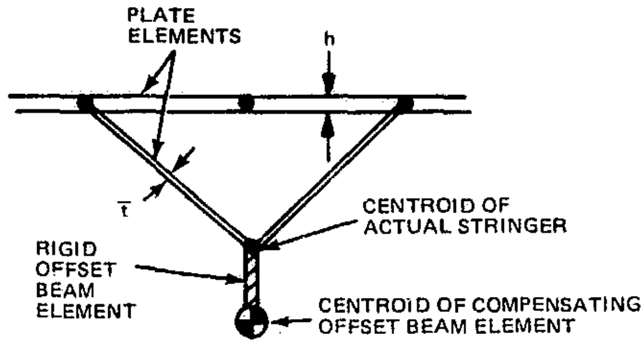
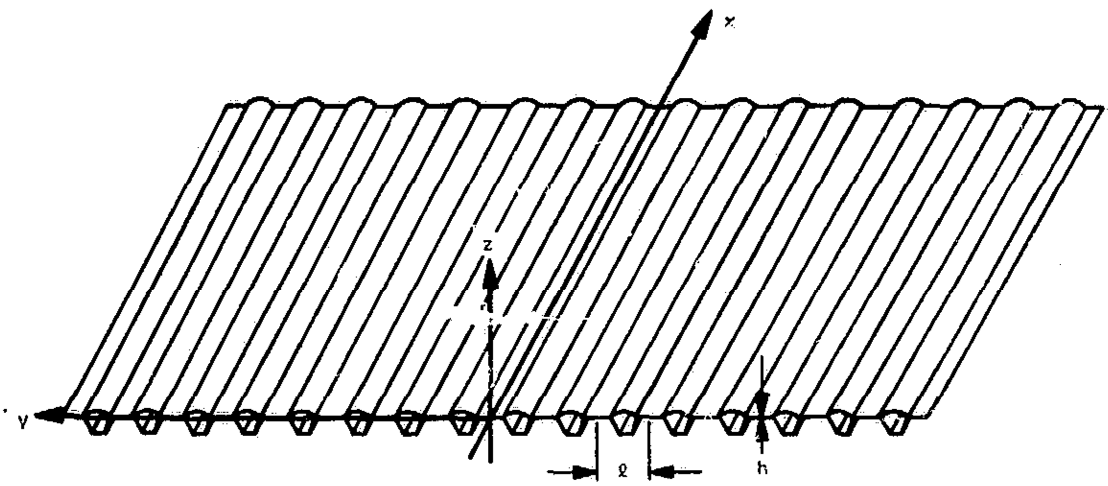


Figure 2-3 Idealization of New Stringer in RESIST Program



$$\frac{\overline{EI}}{\ell}\frac{\partial^4 w}{\partial x^4} + \left(\frac{GJ}{\ell} + D_y(1-\nu)\right)\frac{\partial^4 w}{\partial x^2 \partial y^2} + D_y\frac{\partial^4 w}{\partial y^4} = q$$

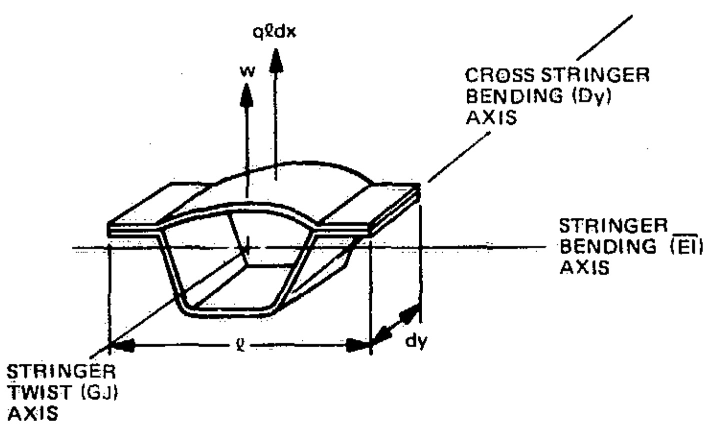


Figure 2-4 Fung's Corrugated Plate Theory (Reference 2)

appropriate orthotropic plate properties. Additional plate input required to describe the orthotropy includes the elastic constants A_{11}, A_{12}, A_{22} and A_{23} where

$$\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{Bmatrix} = \begin{bmatrix} A_{11} & A_{12} & 0 \\ A_{21} & A_{22} & 0 \\ 0 & 0 & A_{33} \end{bmatrix} \begin{Bmatrix} \varepsilon_x \\ \varepsilon_y \\ \gamma_{xy} \end{Bmatrix}$$

The general form of the above stress-strain law allows the use of various orthotropic plate theories depending upon the particular specification of the A_{ij}. The equivalent values of these elastic constants which were suggested by Timoshenko (Reference 5) and Fung (see Figure 2-4 and Reference 6) are compared with their isotropic counterparts in Table 2-1. The form of the governing orthotropic plate equations for these four theories is presented in Table 2-2.

2.2.3 Additional Modal Information

The new version of RESIST has been extended to output necessary input information for the ARREST program described in Section 3. The new version of RESIST computes the modal area terms required for Eqs. (13) and (14) of Section 3:

$$\left(\sum_j A_{z_j} \, \bar{\Phi}^{(i)}_{T,\, z_j} \right)^2$$

(note that this term is 0 for an antisymmetric mode), as well as the modal mass, M_i. This latter quantity is computed in discrete parts consisting of the primary structure modal mass for the i^{th} mode, $M^{(i)}_{Ps}$, and the r^{th} tile's modal mass, $M^{(i)}_{Tr}$, where

$$M^{(i)}_{PS} = \lfloor \phi^{(i)}_{PS} \rfloor \; [M_{PS}] \; \{\phi^{(i)}_{PS}\}$$

$$M^{(i)}_{Tr} = \lfloor \phi^{(i)}_{Tr} \rfloor \; [M_{Tr}] \; \{\phi^{(i)}_{Tr}\}$$

Table 2-1
Comparison of Orthotropic Plate Variables

ISOTROPIC PLATE	TIMOSHENKO (REF. 5)	FUNG (REF. 6) (see Figure 2-4)	RESIST PROGRAM
$E/(1-\nu^2)$	E'_x	$\frac{12\overline{EI}}{\ell h^3}$	A_{11}
$\gamma E/(1-\nu^2)$	E''	$\frac{6(1-\nu)D_y}{h^3}$	$A_{12}=A_{21}$
$E/(1-\nu^2)$	E'_y	$12D_y/h^3$	A_{22}
$G=\frac{E}{2(1+\nu)}$	G	$GJ/\ell h^3$	A_{33}

Table 2-2
Comparison of Orthotropic Plate Equations

Isotropic Plate Equation	$D\frac{\partial^4 w}{\partial y^4}+2\left(\nu D+2\frac{Gh^3}{12}\right)\frac{\partial^4 w}{\partial x^2\partial y^2}+D\frac{\partial^4 w}{\partial y^4}=q$ Note: $G=\frac{E}{2(1+\nu)}$, $D=\frac{Eh^3}{12(1-\nu^2)}$. Therefore, $\nu D+2\frac{Gh^3}{12}=D$
Timoshenko Plate Equation (Ref. 5)	$D_x\frac{\partial^4 w}{\partial x^4}+2\left(D_1+2D_{xy}\right)\frac{\partial^4 w}{\partial x^2\partial y^2}+D_y\frac{\partial^4 w}{\partial y^4}=q$ where $D_x=\frac{E_xh^3}{12(1-\nu^2)}$, $D_y=\frac{E_yh^3}{12(1-\nu^2)}$, $D_{xy}=\frac{Gh^3}{12}$, $D_1=\frac{\nu E_yh^3}{12(1-\nu^2)}$ $\nu=\sqrt{\nu_x\nu_y}$, $E=\frac{\nu_x E_y+\nu_y E_x}{2\nu}$
Fung Plate Equation (Ref. 6) (See Fig. 2-4)	$\frac{EI}{\ell}\frac{\partial^4 w}{\partial x^4}+\left(D_y(1-\nu)+\frac{GJ}{\ell}\right)\frac{\partial^4 w}{\partial x^2\partial y^2}+D_y\frac{\partial^4 w}{\partial y^4}=q$
RESIST Program	$\frac{h^3}{12}\left[A_{11}\frac{\partial^4 w}{\partial x^4}+2\left(A_{12}+2A_{33}\right)\frac{\partial^4 w}{\partial x^2\partial y^2}+A_{22}\frac{\partial^4 w}{\partial y^4}\right]=q$

The tile modal mass for all tiles vibrating in the i^{th} mode is given by

$$\bar{M}_T^{(i)} = \sum_r M_{Tr}^{(i)}$$

These quantities are related to M_i through the relationship

$$M_i = M_{PS}^{(i)} + \bar{M}_T^{(i)}$$

RESIST has also been modified to compute normalized modal stringer stresses along with the RSI and plate stresses. This data is output on magnetic tape, together with modal deflection data required for the acoustic response program.

Section 3

SHUTTLE TILE RESPONSE TO RANDOM PRESSURE FLUCTUATIONS

A computer program for calculation of the response of shuttle panels with surface insulation subjected to uniform, spatially-correlated acoustic excitation has been developed. This program, titled ARREST (Acoustic Response of REusable Shuttle Tiles) was designed to interface with RESIST. For a dynamics problem, the output of RESIST (which consists of modal frequencies and normalized stresses of stiffened panels with RSI tiles) serves as the input to ARREST. The output of ARREST is approximate in that the analysis is based upon a number of simplifying assumptions. As will be seen, these assumptions are the usual ones associated with the use of finite element analyses, modal methods, and a simplified characterization of the acoustic forcing function. Perhaps the most limiting approximation included within ARREST is that the normal pressure field is uniformly correlated over the entire structural panel. This is a conservative assumption that is justifiable for excitation where the pressure field correlation-length is of the order of the panel size. When the excitation is caused by jet noise, such as during Shuttle liftoff, the correlation length is of the order of the engine diameter (Reference 7). The theory upon which ARREST is based is summarized below.

3.1 MODAL DYNAMICS OF RSI TILES AND PRIMARY STRUCTURE

The finite element equations governing the dynamic response of RSI tiled panels are of the general form

$$\left[\begin{array}{c|c} M_{PS} & 0 \\ \hline 0 & \bar{\bar{M}}_T \end{array}\right]\left\{\begin{array}{c} \ddot{\delta}_{PS} \\ \hline \ddot{\bar{\bar{\delta}}}_T \end{array}\right\} + \left[\begin{array}{c|c} C_{PS} & 0 \\ \hline 0 & \bar{\bar{C}}_T \end{array}\right]\left\{\begin{array}{c} \dot{\delta}_{PS} \\ \hline \dot{\bar{\bar{\delta}}}_T \end{array}\right\}$$

$$+ \left[\begin{array}{c|c} K_{PS} & 0 \\ \hline 0 & \bar{\bar{K}}_T \end{array}\right]\left\{\begin{array}{c} \delta_{PS} \\ \hline \bar{\bar{\delta}}_T \end{array}\right\} = \left\{\begin{array}{c} P_{PS} \\ \hline \bar{\bar{P}}_T \end{array}\right\} \qquad (1)$$

where $\{\delta\}$ are the nodal degrees-of-freedom; $[M]$, $[C]$ and $[K]$ are the mass, damping and stiffness matrices, respectively; and $\{P\}$ is the dynamic loading vector. The subscripts "PS" and "T" denote the primary structure and tile components, respectively. The significance of the bar over the tile quantities is that they refer to the accumulation of all tiles rather than a single tile.

It should be noted that the primary structure and tile matrices have been cast in uncoupled form. The reason for this is that the iterative solution procedure employed to obtain the matrices and modal vectors of the coupled system was to treat each component separately. Their initial coupling is contained within the fact that the tile/primary structure interface degrees-of-freedom, a subset of $\{\delta_{PS}\}$ and $\{\bar{\delta}_T\}$, are kinematically dependent, as are the vectors $\{P_{PS}\}$ and $\{\bar{P}_T\}$, which contain their mutual reactions. Therefore, elements of $\{P_{PS}\}$ which correspond to $\{\bar{P}_T\}$ have, by Newton's Third Law, the same magnitudes but opposite signs.

The classical modal approximation is now made:

$$\begin{Bmatrix} \delta_{PS} \\ \hline \bar{\delta}_T \end{Bmatrix} \approx \begin{bmatrix} \Phi_{PS} \\ \hline \bar{\Phi}_T \end{bmatrix} \{q\} \tag{2}$$

where the number of orthogonal modes, $\begin{Bmatrix} \phi^{(i)}_{PS} \\ \hline \bar{\phi}^{(i)}_T \end{Bmatrix}$, and generalized coordinates q_i, are less than the number of nodal degrees-of-freedom. The modal vectors satisfy the matrix equations

$$[M_{PS}]\ \{\phi^{(i)}_{PS}\} - \omega_i^2\ [K_{PS}]\ \{\phi^{(i)}_{PS}\} = \begin{Bmatrix} 0 \\ \hline P_j \end{Bmatrix} \tag{3}$$

$$[\bar{M}_T]\ \{\bar{\phi}^{(i)}_T\} - \omega_i^2\ [\bar{K}_T]\ \{\bar{\phi}^{(i)}_T\} = \begin{Bmatrix} -P_j \\ \hline 0 \end{Bmatrix} \tag{4}$$

where $\{P_j\}$ are the tile boundary interface loads acting upon the primary structure and $\{-P_j\}$ are their reactions, which act upon the corresponding tile nodes. Thus, the degree-of-freedom magnitudes at these common nodes will be identical in the vector components $\{\phi_{PS}^{(i)}\}$ and $\{\bar{\phi}_T^{(i)}\}$.

The modal normalization condition selected is

$$\lfloor \phi_{PS}^{(i)} \rfloor \; \{\phi_{PS}^{(i)}\} = 1 \tag{5}$$

and the orthogonality of the modes yields

$$\lfloor \phi_{PS}^{(i)} \;\vdots\; \bar{\phi}_T^{(i)} \rfloor \begin{bmatrix} M_{PS} & 0 \\ 0 & \bar{M}_T \end{bmatrix} \begin{Bmatrix} \phi_{PS}^{(j)} \\ \bar{\phi}_T^{(j)} \end{Bmatrix} = M_i \; \delta_{ij}$$

$$\text{where } M_i = \lfloor \phi_{PS}^{(i)} \rfloor \, [M_{PS}] \, \{\phi_{PS}^{(i)}\} + \lfloor \bar{\phi}_T^{(i)} \rfloor \; [\bar{M}_T] \, \{\bar{\phi}_T^{(i)}\} \tag{6}$$

is the modal mass and δ_{ij} is the Kronecker delta with properties

$$\delta_{ij} \begin{cases} = 1 & \text{for } i = j \\ = 0 & \text{for } i \neq j \end{cases}$$

Substitution of Eq. (2) into Eq. (1), premultiplication by $\lfloor \phi_{PS}^{(i)} \;\vdots\; \bar{\phi}_T^{(i)} \rfloor$ and application of Eqs. (3), (4) and (6) yields the scaler equations

$$M_i \; (\ddot{q}_i + 2 \; \zeta_i \; \omega_i \; \dot{q}_i + \omega_i^2 \; q_i) = Q_i \tag{7}$$

where the generalized forces, Q_i, are given by

$$Q_i = \lfloor \phi_{PS}^{(i)} \rfloor \; \{P_{PS}\} + \lfloor \bar{\phi}_T^{(i)} \rfloor \; \{\bar{P}_T\} \tag{8}$$

The unknown damping matrix is assumed to yield uncoupled modal damping ratios, ζ_i (for which values are either assumed or are measured in test), where

$$2 \zeta_i M_i \omega_i \delta_{ij} = \lfloor \phi_{ps}^{(i)} \rfloor [C_{ps}] \{\phi_{ps}^{(j)}\} + \lfloor \bar{\phi}_T^{i} \rfloor [\bar{C}_T] \{\bar{\phi}^{(j)}\} \tag{9}$$

and use has been made of the relationship

$$M_i \omega_i^2 = \lfloor \phi_{ps}^{(i)} \rfloor [K_{ps}] \{\phi_{ps}^{(i)}\} + \lfloor \bar{\phi}_T^{(i)} \rfloor [\bar{K}_T] \{\bar{\phi}_T^{(i)}\} \tag{10}$$

3.2 ACOUSTIC RESPONSE TO UNIFORMLY CORRELATED PRESSURES

If the forcing function is a stationary, random, acoustic pressure and the system damping is very small, the mean square response, $(\bar{\delta}_m)^2$, in the m^{th} degree-of-freedom, δ_m, may be approximated as (References 7, 8)

$$\bar{\delta}_m^2 \approx \frac{\pi}{4} \sum_i \frac{(\delta_m^{(i)})^2}{M_i^2 \omega_i^3 \zeta_i} S_{ii} \tag{11}$$

S_{ii} is related to the pressure power spectral density, $[S_p(\omega_i)]$ through the relationship

$$S_{ii} = \lfloor A \bar{\phi}_T^{(i)} \rfloor [S_p(\omega_i)] \{A \bar{\phi}_T^{(i)}\} \tag{12}$$

where $[S_p(\omega_i)]$ (measured in psi^2/radian) may vary spatially over the structure,

and $\{A \bar{\phi}_T^{(i)}\}$ are the modal degrees-of-freedom multiplied by suitable terms which account for the local normal surface area over which the pressure excitation acts.

If the pressure distribution is assumed to be "uniformly correlated" (i.e., the time averaged mean square random pressure does not vary spatially over the structure) then $\left[S_p(\omega_i)\right]$ is a matrix with equal elements $S(\omega_i)$ and Eq. (12) simplifies to

$$S_{ii} = S(\omega_i) \left(\sum_j A_{z_j} \bar{\phi}^{(i)}_{T,z_j} \right)^2 \tag{13}$$

where $\bar{\phi}^{(i)}_{T,z_j}$ are the tile degrees-of-freedom, in the i^{th} mode, which are normal to the pressure loading and A_{z_j} are the corresponding areas over which the pressure loading acts.

A similar approximation for the stress component of a given tile at the j^{th} node, under uniformly correlated random pressure loading, yields

$$\bar{\sigma}_j^2 \approx \frac{\pi}{4} \sum_i \frac{\sigma_j^{(i)^2}}{M_i^2 \omega_i^3 \zeta_i} S(\omega_i) \left(\sum_j A_{z_j} \bar{\phi}^{(i)}_{T,z_j} \right)^2 \tag{14}$$

for the mean square tile stress. It should be noted that the coefficient for Eqs. (11) and (14) changes from $\pi/4$ to $1/8$ if S is given in psi^2/Hz, i.e.,

$$\frac{\pi}{4} S(\omega_i) = \frac{1}{8} S(f_i)$$

where f_i is the i^{th} modal natural frequency in Hz.

Section 4
NUMERICAL RESULTS

Finite element results were obtained for an 18x54-inch stringer-stiffened panel, with and without RSI tiles. Three different structural models were employed to idealize the panel without tiles. Based on modal results from RESIST, the most appropriate of these was then used to model the panel with tiles. Modal and acoustic response results were then obtained for an assumed loading spectrum associated with an aft section of the Shuttle orbiter fuselage at launch.

4.1 UNTILED PANELS

The three stiffened-panel options included in the new version of RESIST (Section 2.2.2) were used to analyze the Shuttle test panel of Figure 2-2. A comparison of the detailed stringer idealizations, with the actual cross section, is shown in Figure 4-1.

Partial frequency and mode shape results for the three models are presented in Table 4-1 and Figures 4-2 and 4-3. These results indicate that the structural stringer model selected is not critical for the "beam" type modes (m=0), but that the cross-stringer modes ($m \geq 1$) are sensitive to the stringer idealization, with the orthotropic (Figure 4-1b) and closed-cell stringer (Figure 4-1d) options agreeing more closely with one another, than the single attachment line stringers (Figure 4-1c). This is not surprising as the $m > o$ modes require the transmission of torsional load through differential shear, which the singly-attached stringer cannot model properly, whereas the m=0 modes primarily involve stringer bending effects.

4.2 TILED PANEL RESULTS

The RSI-tiled panel of Figure 4-4 was analyzed by the RESIST program using the stringer idealization of Figure 4-1d. There are 18 6x6-inch tiles between supports, each of which is 2.6 inches thick. There is a 0.01-inch thick coating over the top of each tile and the isolator thickness is 0.16 inch. Nine-inch extensions, over opposite edges of the supports, were assumed to act as rigid bodies with rotatory inertia properties comparable to the interior

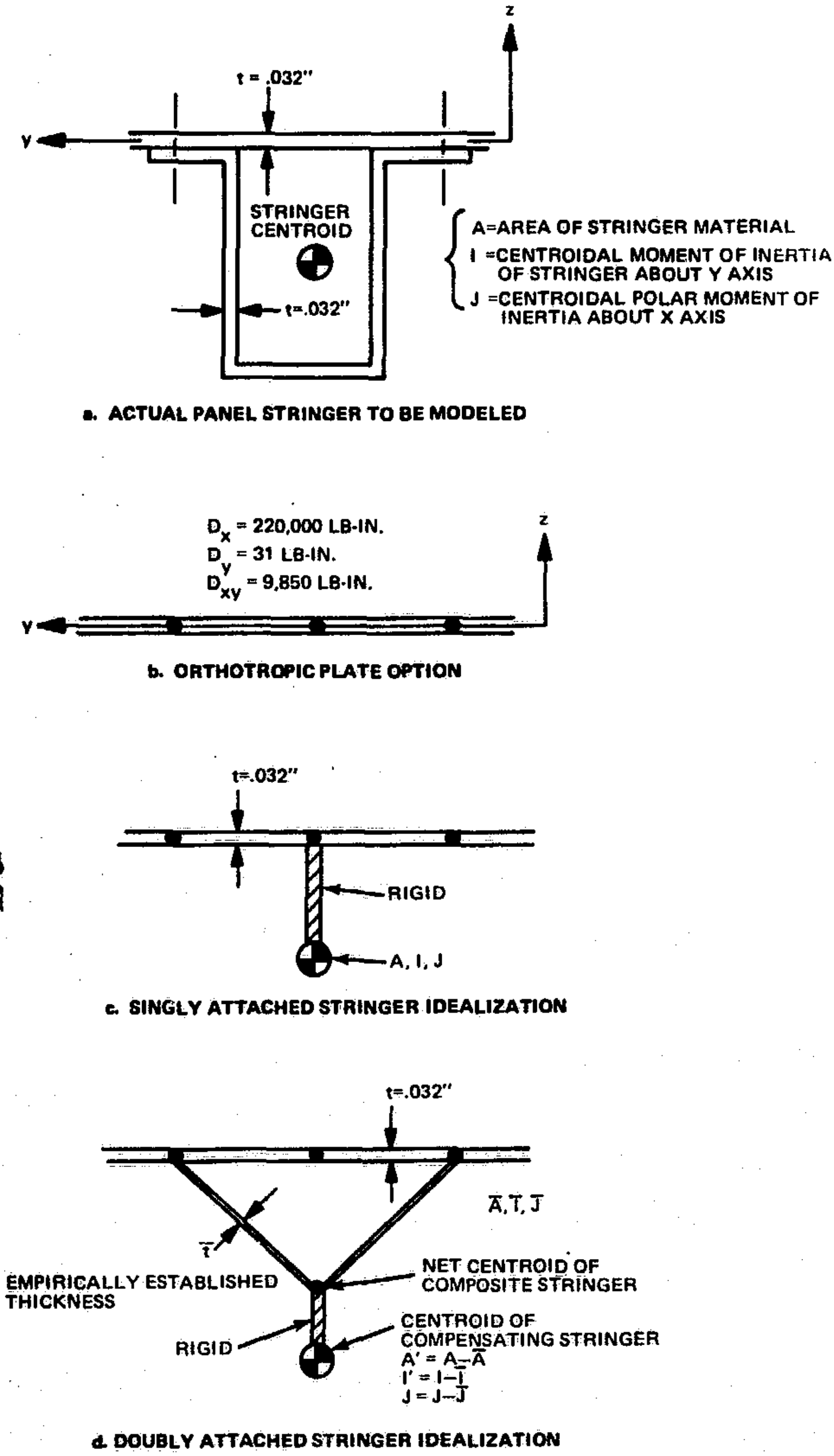


Figure 4-1 Panel Stringer Idealizations Used for the Shuttle Panel (Fig. 2-2) with the RESIST Program

Table 4–1 Natural Frequencies (Hz) for the Shuttle Panel (Figure 2-2) Computed by RESIST for Three Different Stringer Options

m*	n**	Stringer Attached to Plate Along Single Rivet Line	Closed-Cell Stringers Attached Along Double Rivet Lines $\tilde{t}$ = .008 in.	Orthotropic Plate Option D_x = 220,000 lb-in. D_y = 31 lb-in. D_{xy} = 9850 lb-in.
0	1	106	110	107
1	1	108	133	134
2	1	126	174	184
0	2	286	285	271

*m = number of nodes in cross-stringer direction
**n = number of ½ sine waves between spanwise supports

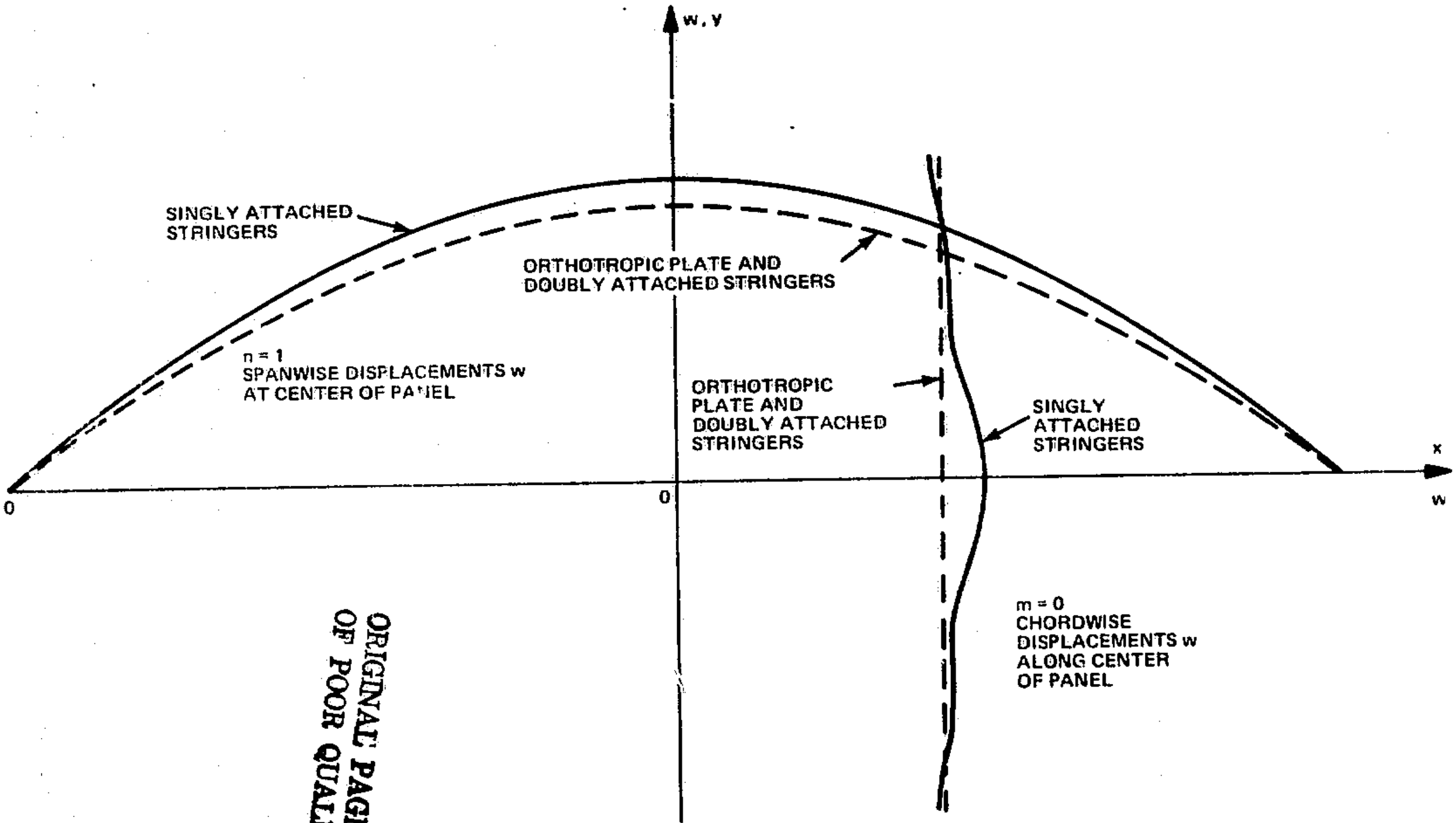


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Figure 4-2 Computed Fundamental "Beam" Modes for Shuttle Panel by Three Different RESIST Stringer Idealization Options

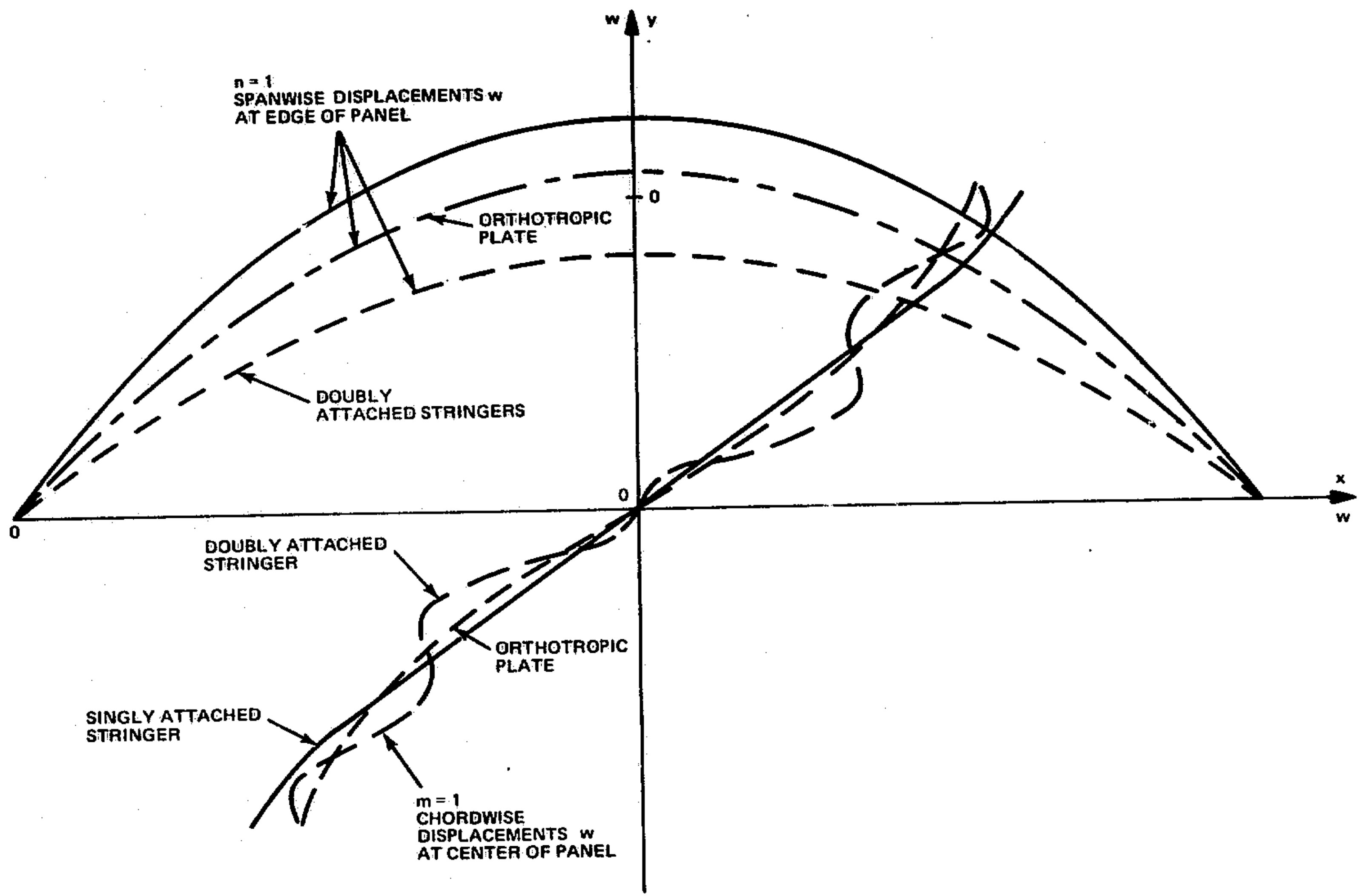


Figure 4-3 Computed First Chordwise Mode for Shuttle Panel by Three Different Stringer Idealization Options

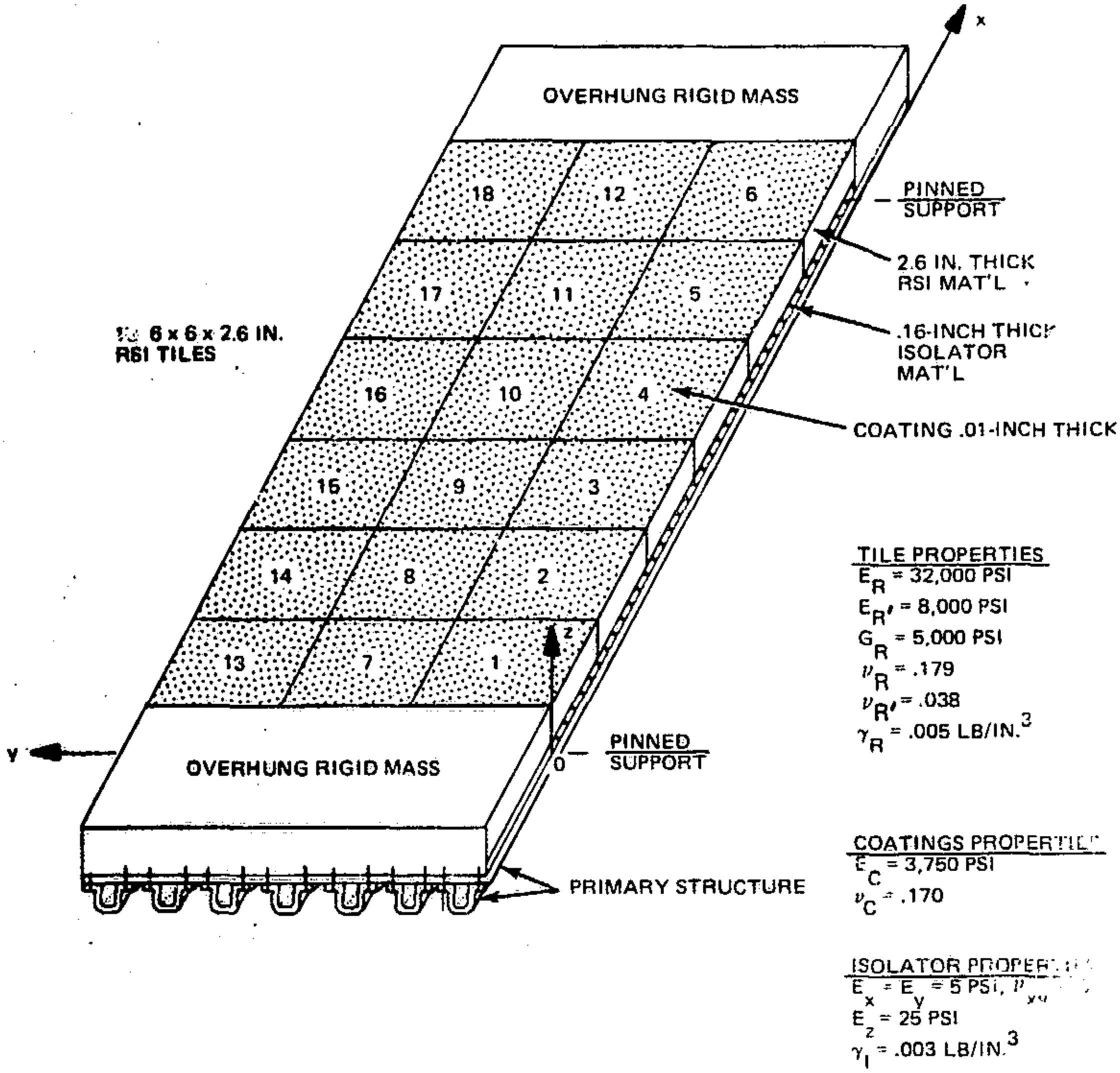


Figure 4-4 Idealized Shuttle Panel (36 x 18 Inches) with 18 RSI Tiles

(36-inch) section of tiled panel. The finite element idealization of a typical tile is shown in Figure 4-5. The resulting natural frequencies and modal data are given in Table 4-2.

The random sound pressure level curve used to simulate the panel's excitation (Figure 4-6) is thought to be representative of a structural region on the Shuttle orbiter base at liftoff. Detailed results are given for 3% modal damping. However, some results for 1% of critical damping are also presented in Table 4-3 because of the critical nature of the Shuttle TPS and the uncertainty associated with the damping parameter.

Since the ARREST program assumes uniform spatially-correlated random pressure, and the structure contains two planes of symmetry, only certain modes will contribute to the acoustic response. The contributing modes correspond to those for which the number of spanwise half-waves (n) is odd, and the number of chordwise-nodes (m) is either 0 or even. This effect is reflected by the modal terms $\left(\sum_j A_{z_j} \cdot \bar{\phi}^{(i)}_{z_j}\right)^2$ of Table 4-2 (see Eq. (11) and (14) of Section 3). As may be seen, this term decays rapidly beyond the fundamental, even for the symmetric modes. Thus, for most practical purposes, only the first couple of modes need be considered.

Normal-to-the-plate RMS acceleration and stress levels for this excitation are presented in Figures 4-7 and 4-8. As determined by an automatic search procedure of the results, which is incorporated within ARREST, the σ_{zz} tile stresses are highest. In addition, the lowest RSI Material allowables are also lowest for these stress components. Hence, only the σ_{zz} stresses are plotted in Figures 4-9 through 4-13. Smooth curves are not used for the tile RMS stress-plots as the plan-form idealization is composed of a finite element grid that is comparatively coarse (4x5), but adequate, for the present purposes. The RSI stresses are plotted for Z = .485 in. since these are the specific points within the highest stressed elements for which the stress components were actually calculated. As shown in Table 4-3, the peak stress levels become critical for a scatter-factor* of 3. This is especially true when the modal damping decreases to 1%.

*A scatter factor of 3, applied to the RMS value, simply means that the probability that a given stress component will be below this value at any instant is approximately 99.5%.

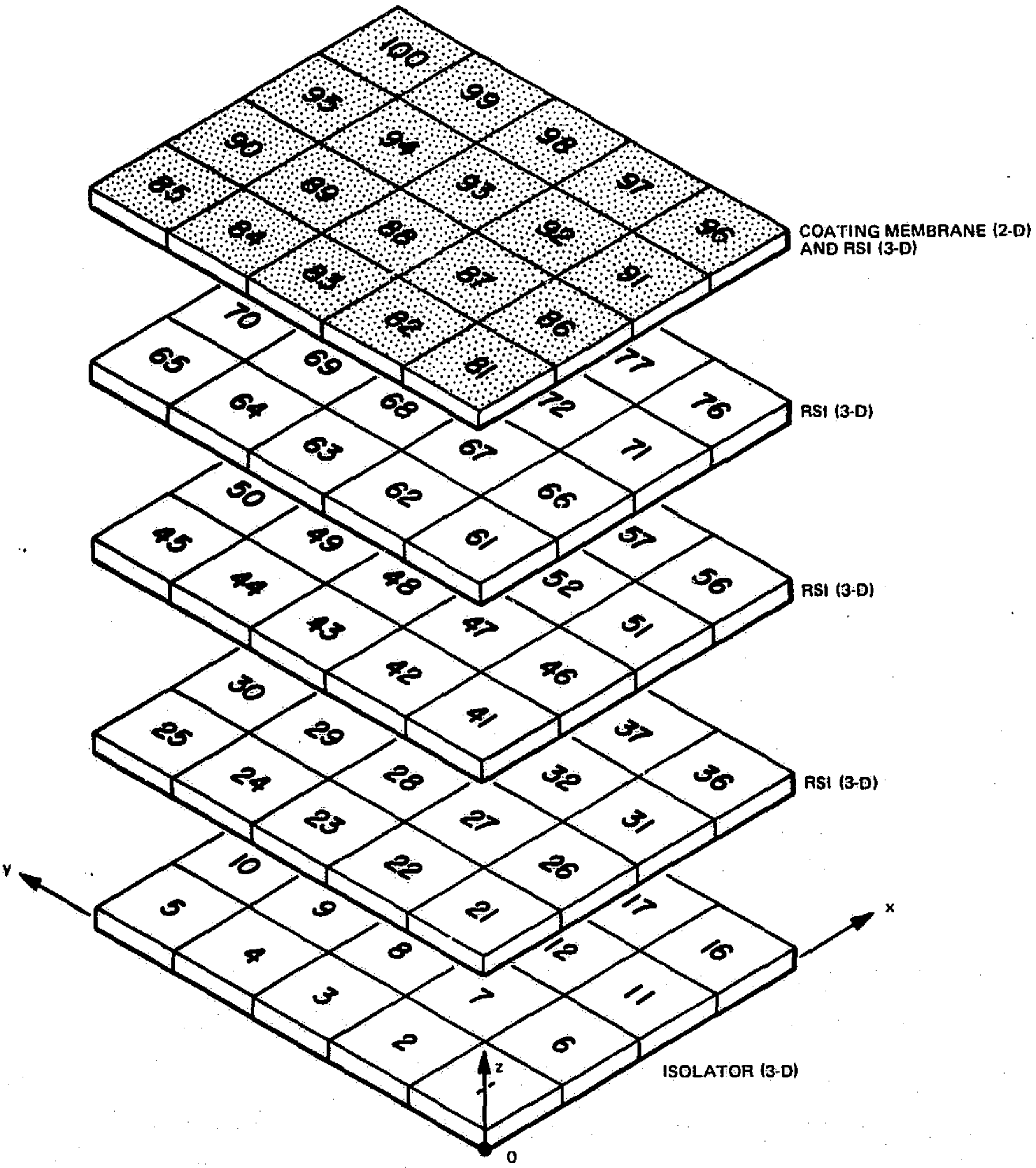


Figure 4-5 Finite Element Idealization of Typical RSI Tiles

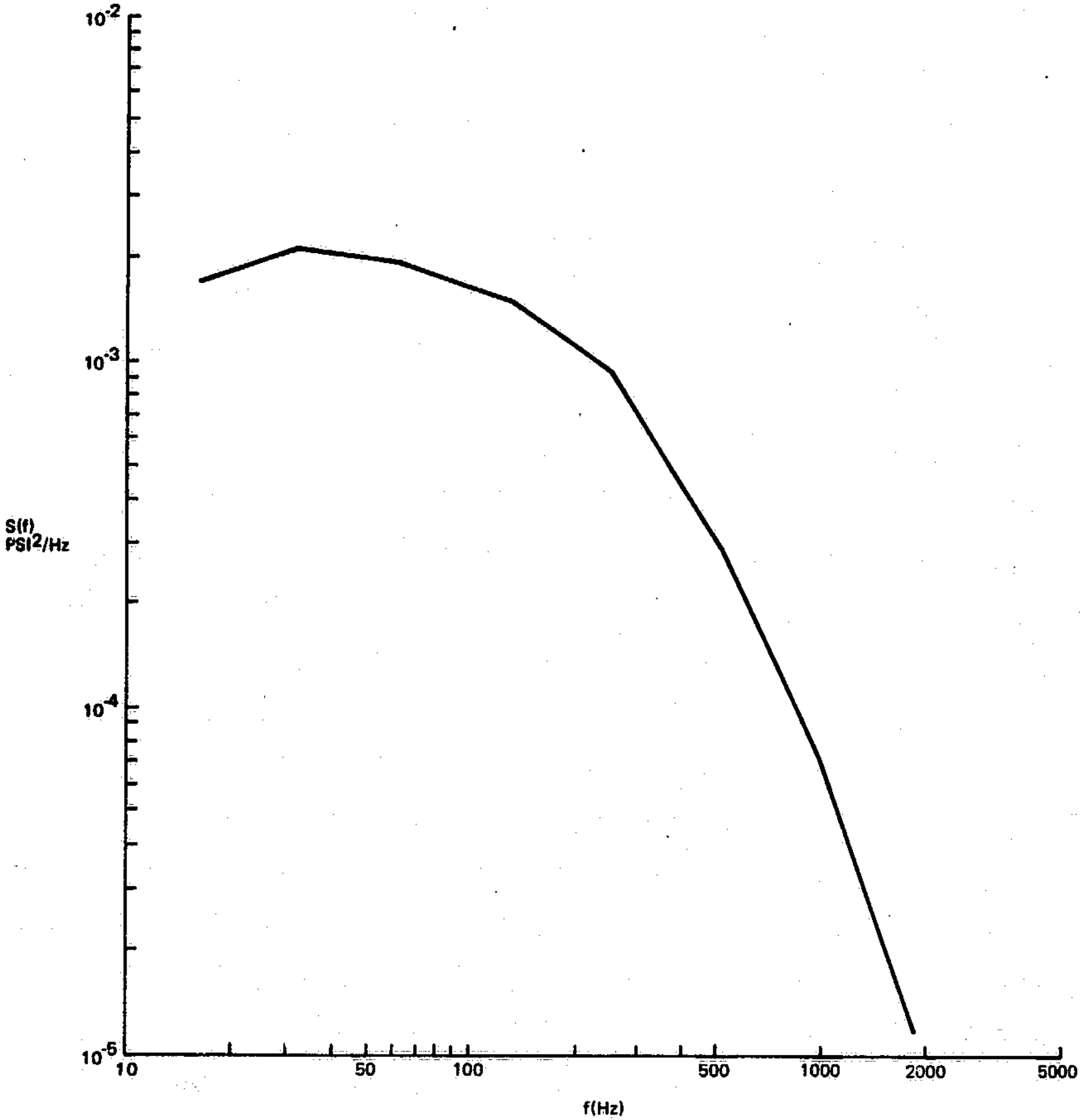


Figure 4-6 Assumed Sound Pressure Level Near Base of Orbiter at Shuttle Liftoff

Table 4-2
Computed Modal Data for the Shuttle Panel
with 2.6-Inch RSI Tiles (Figure 4-4)

Mode Number i	MODE m*	SHAPE n**	Frequency Hz	$(\sum_j A_{z_j} \phi_{Tz_j}^{(i)})^2$ (Reference Eqs. 13 and 14, Section 3)	Sound Pressure Level $S(f_i)$ (psi^2/Hz)
1	0	1	72	627.5	1.8×10^{-3}
2	1	1	81	0	—
3	2	1	92	1.186	1.68×10^{-3}
4	3	1	102	0	—

*m = number of nodes in cross-stringer direction
**n = number of ½ waves between spanwise supports

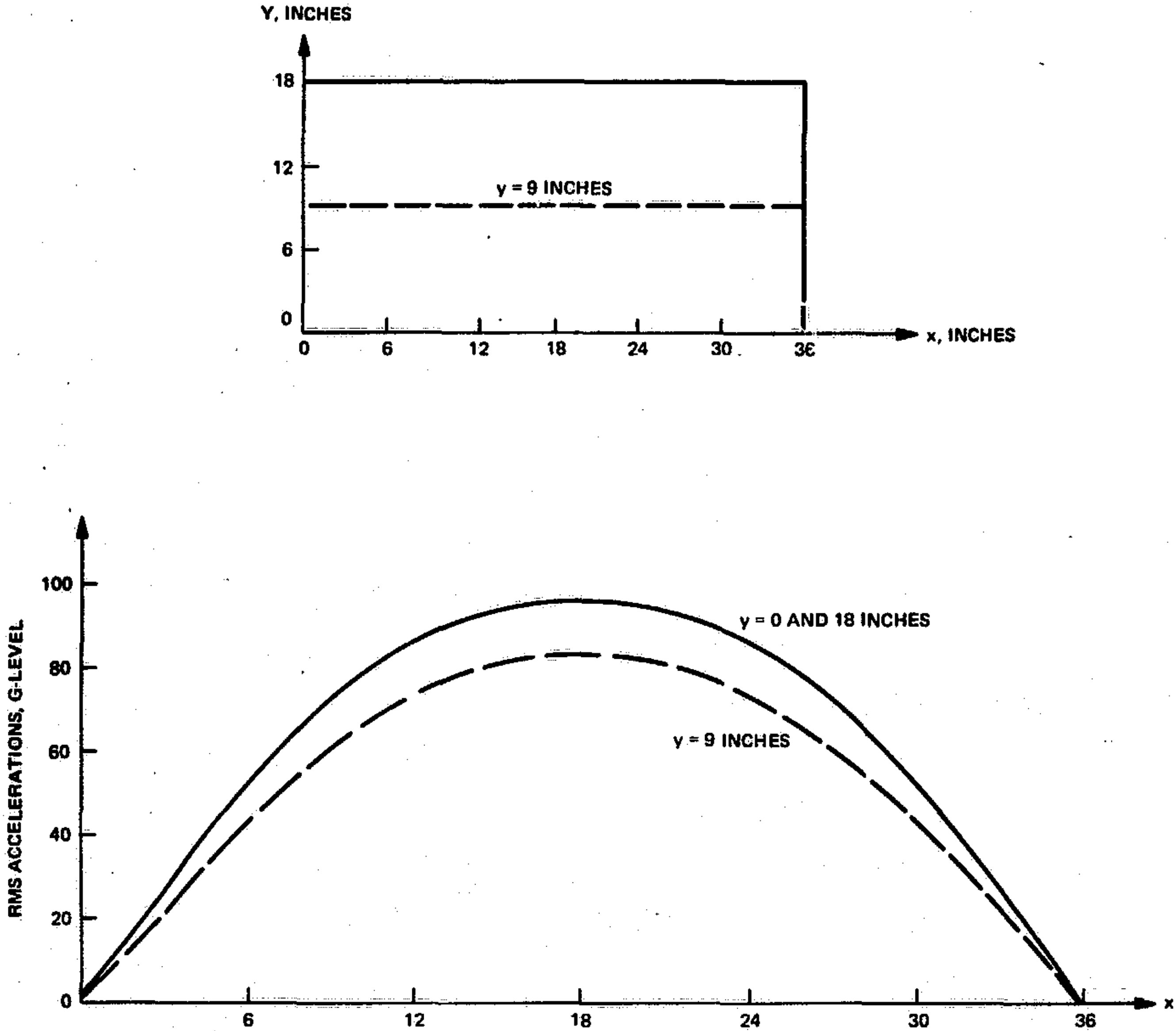


Figure 4-7 Acoustic Response of RSI-Tiled Panel, RMS Accelerations Normal to Plate

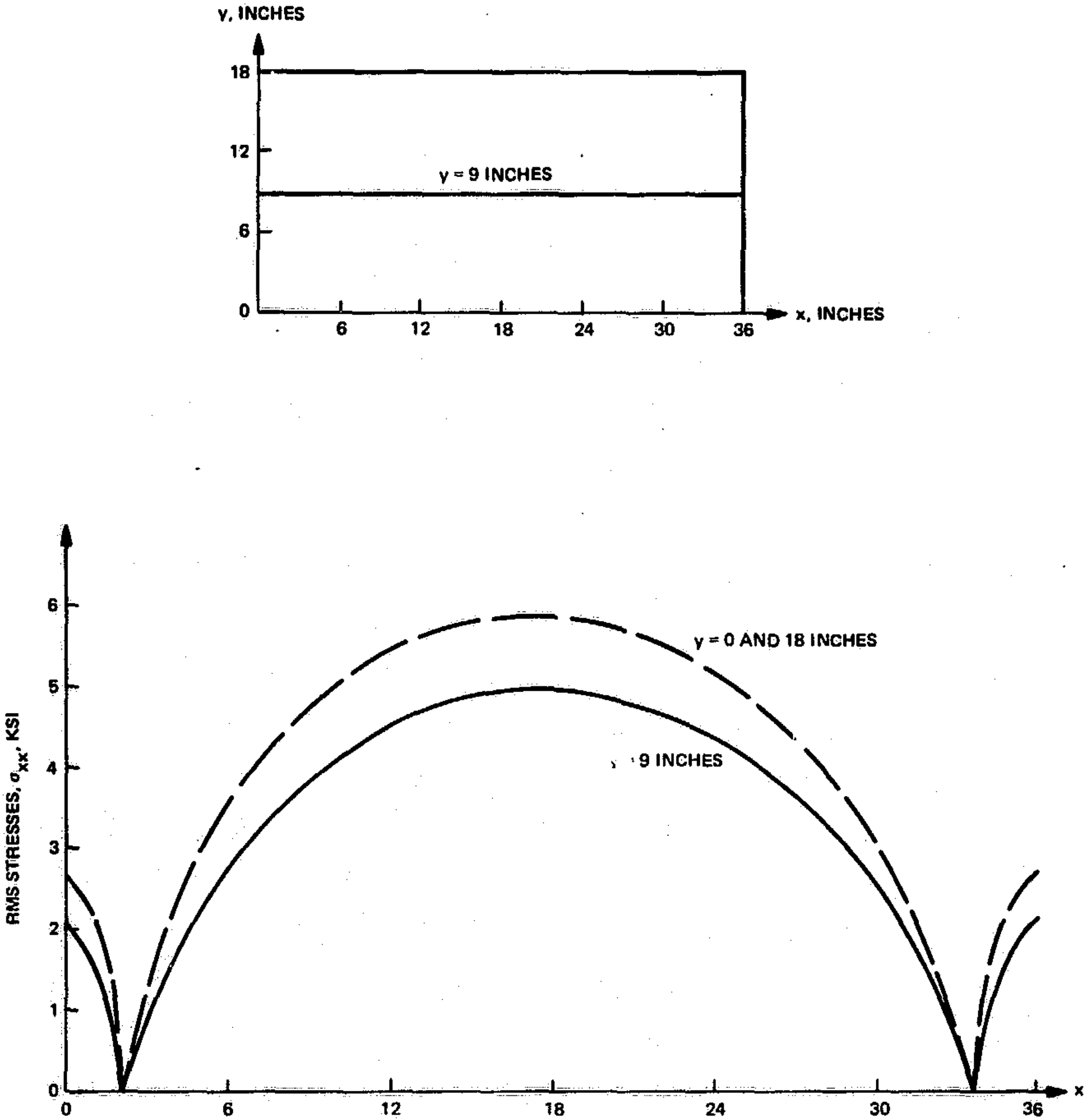
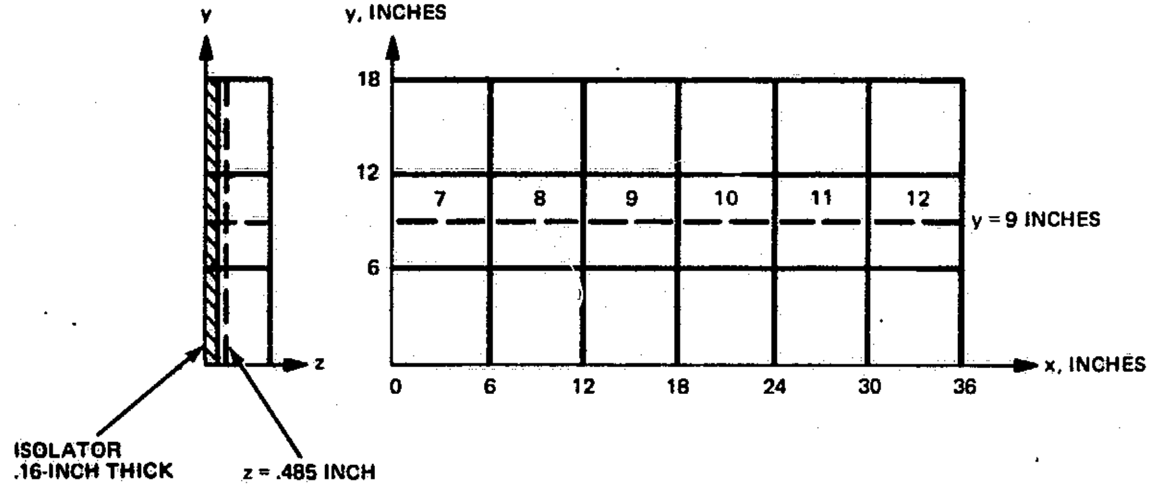


Figure 4-8 Acoustic Response of Tiled Shuttle Panel, Plate Stresses (σ_{xx}) at the Plate-Isolator Interface



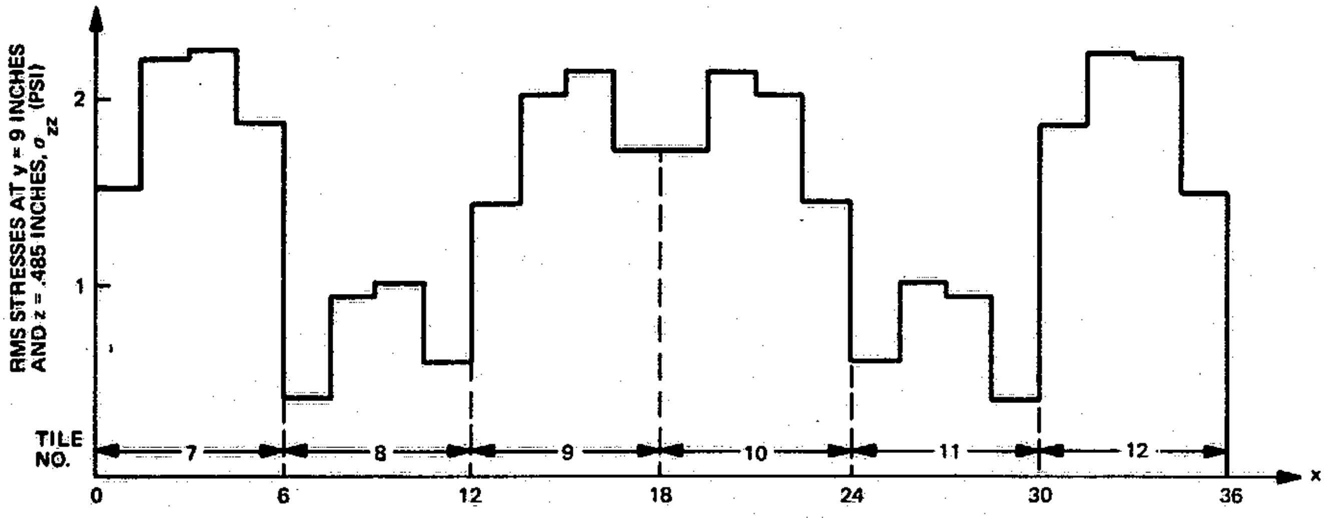


Figure 4-9 Critical Acoustic Stresses Along Center Tiles (7-12), 3% Modal Damping

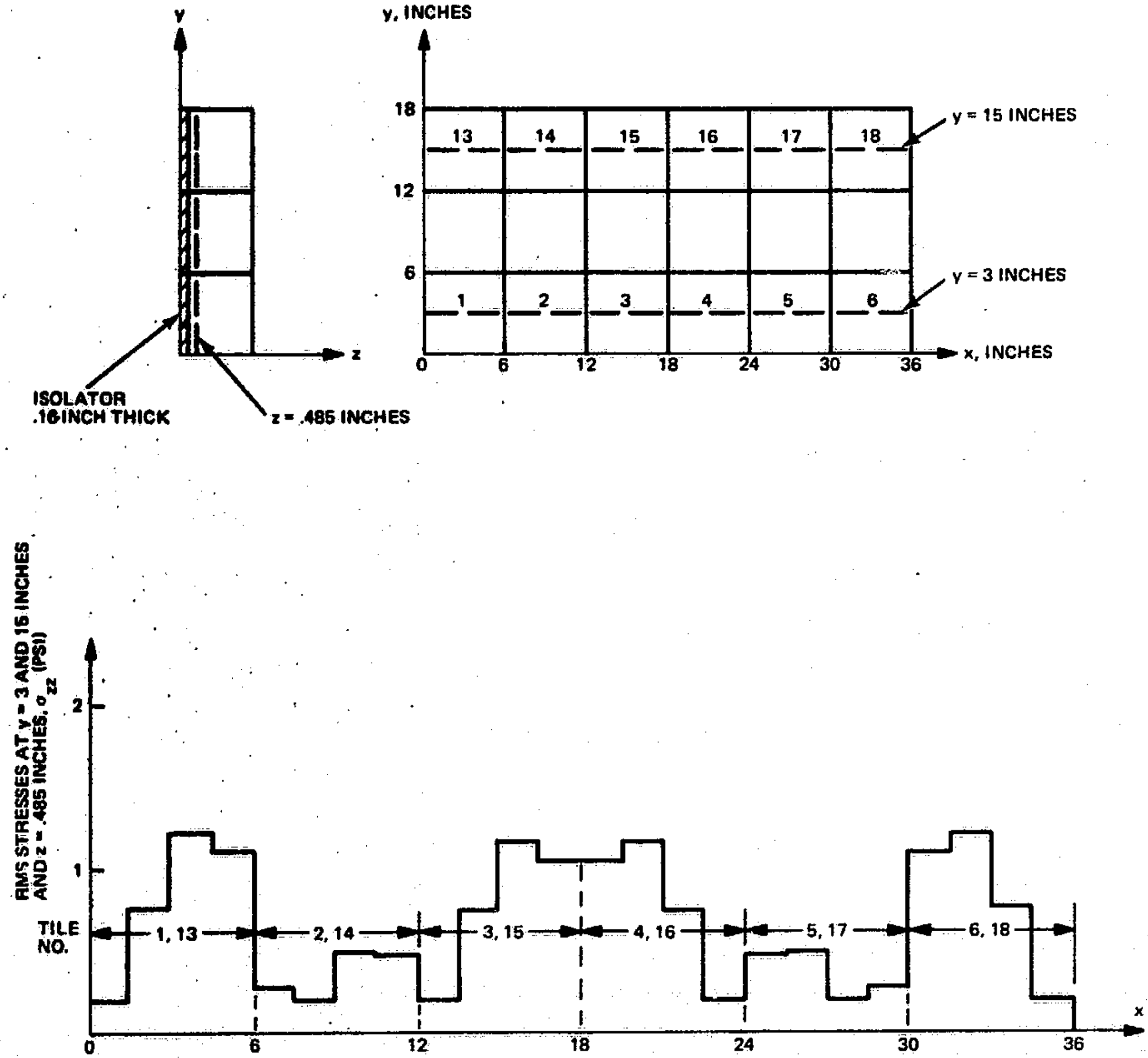


Figure 4-10 Critical Acoustic Stresses Along Outer Tiles, 3% Modal Damping

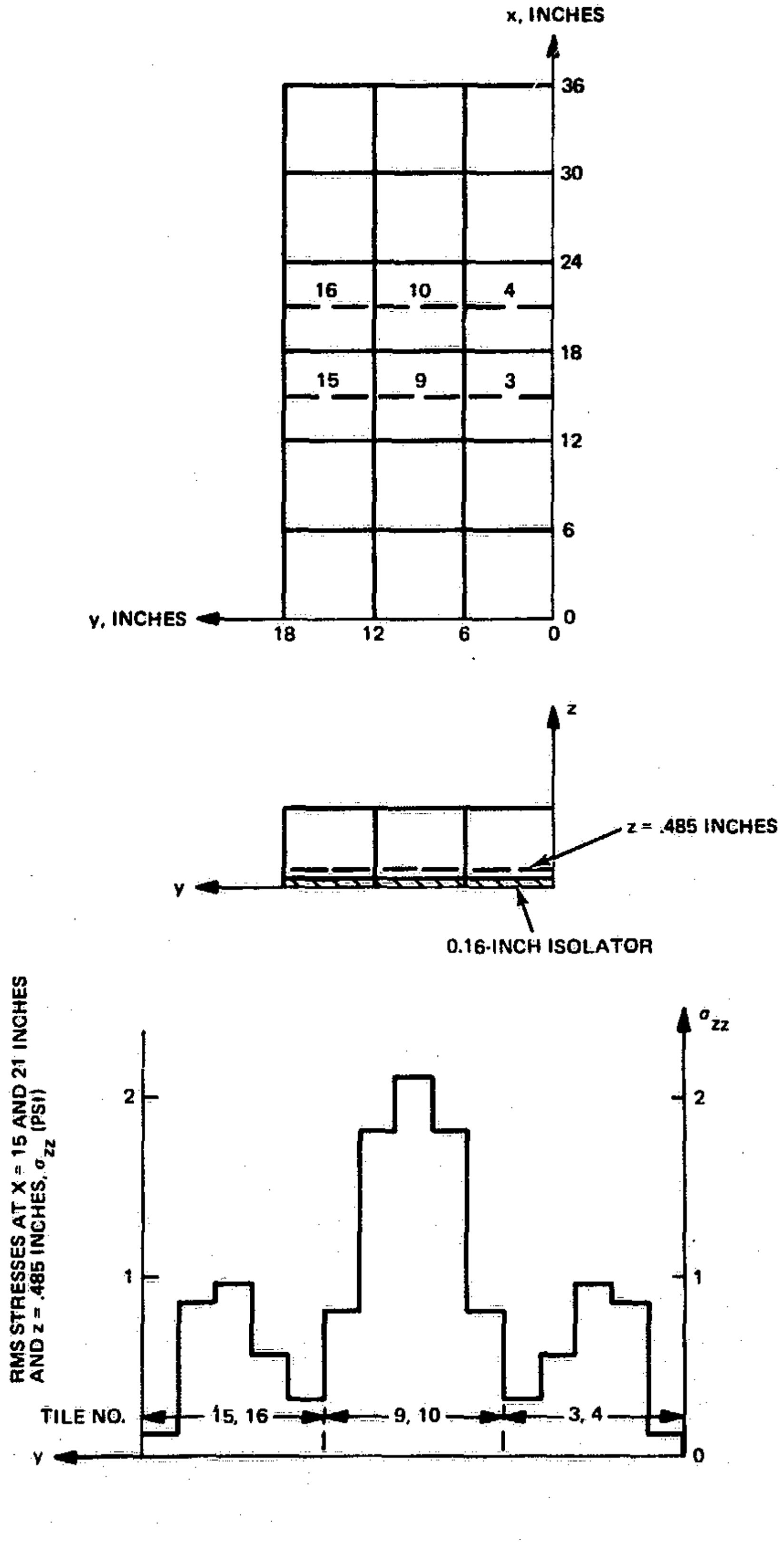


Figure 4-11 Critical Acoustic Stresses Across Center Tiles, 3% Modal Damping

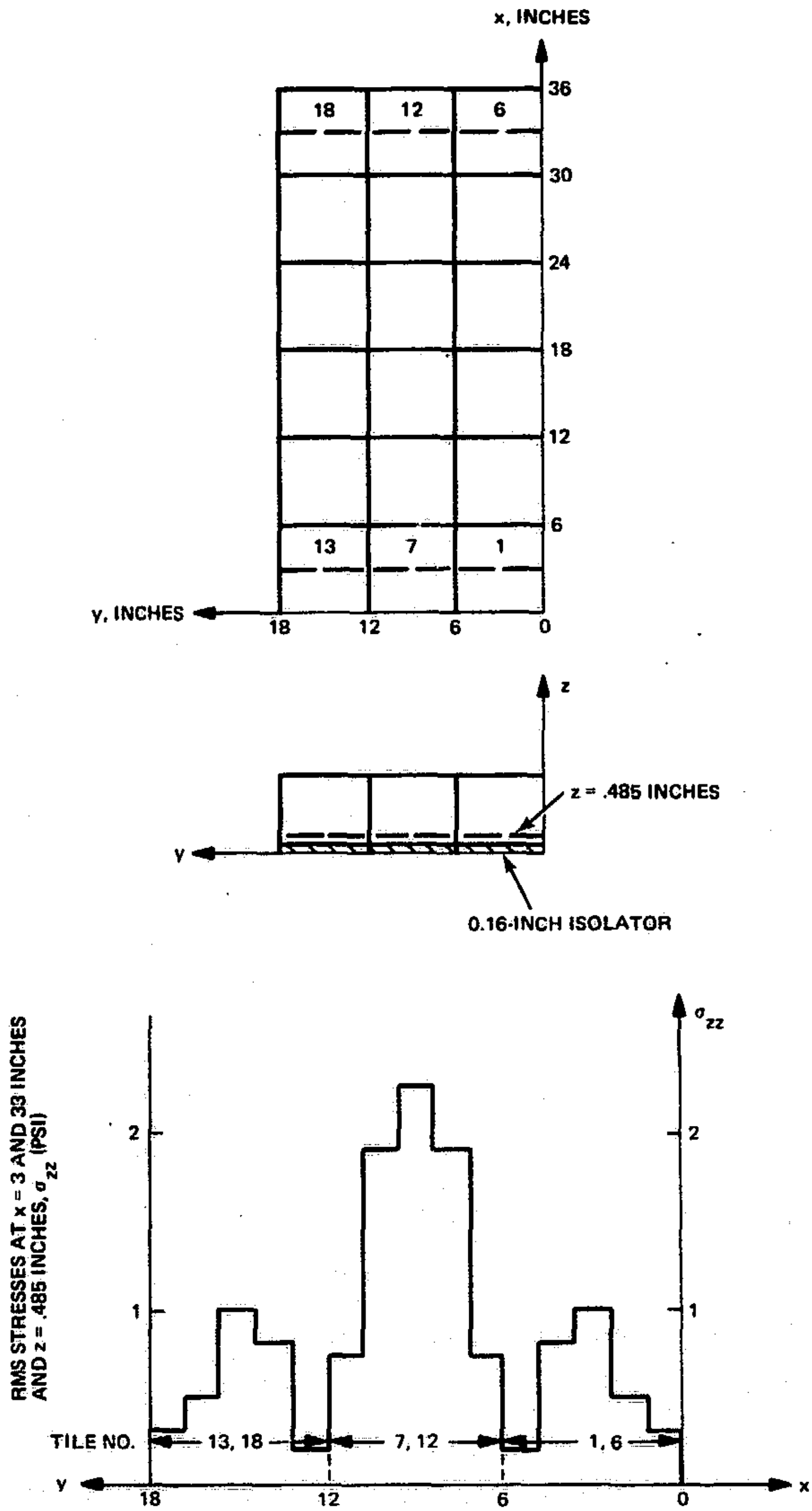


Figure 4-12 Critical Acoustic Stresses Across Tiles Near Supported-Edge of Panel

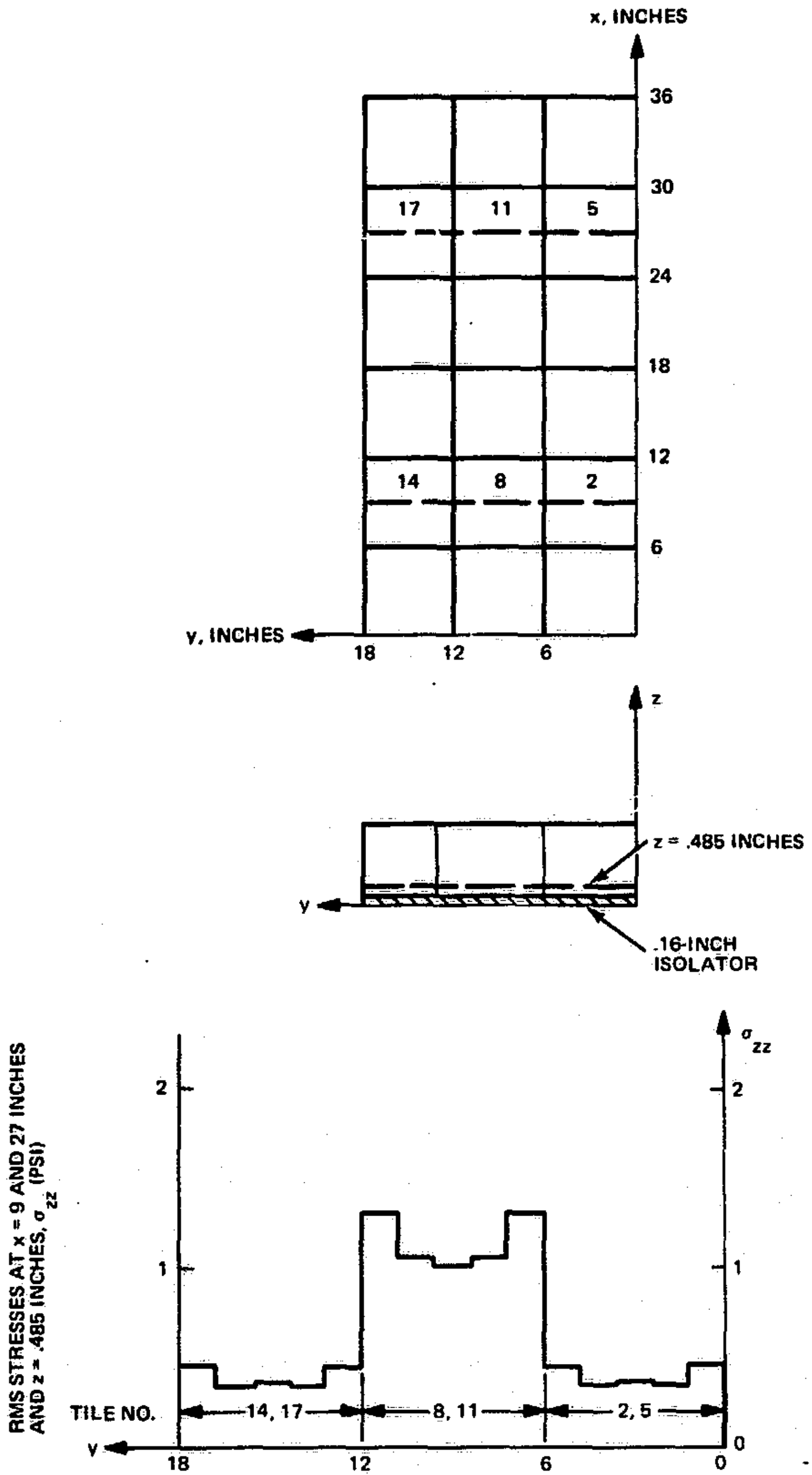


Figure 4-13 Acoustic Stresses Across Internal Tiles, 3% Modal Damping

Table 4-3
Critical Tile Stresses for Acoustic Launch Loads

Tile No. (See Figure 4-2)	Finite Element No. (See Figure 4-5)	σ_{zz} (psi)*			
		3% Modal Damping		1% Modal Damping	
		RMS	3σ**	RMS	3σ**
7	33	2.317	6.951	4.013	12.039
7	28	2.203	6.609	3.816	11.448
9	33	2.150	6.450	3.724	11.181
9	28	2.094	6.282	3.627	10.880

*The allowable σ_{zz} for the RSI at room temperature is approximately 8 psi
**The 3σ values correspond to a scatter factor of 3 (i.e., approximately 99.5% probability that the instantaneous stresses will be below this number)

Section 5

CONCLUSIONS AND RECOMMENDATIONS

A user-oriented program, RESIST, has been developed to compute the static, thermal, and normalized-modal stresses of arbitrarily heated RSI tiles affixed to typical Shuttle structural panels. The current phase of this effort reports upon improvements to the modal portion of RESIST and the development of a new program, ARREST. ARREST, which computes the response of the tiles and panels to uniformly-correlated random acoustic pressures, was designed to efficiently interface with the RESIST program.

The present version of the RESIST program has been streamlined and runs about four times as fast as its predecessor. In addition, it has been extended to accommodate orthotropic plates or isotropic plates with uniformly spaced, arbitrarily shaped stringers which are either singly or doubly attached to the plate. It is believed that the orthotropic and doubly attached stringer options better represent the stringer twist-stiffening, which is required to accurately predict the plate cross-stringer modes ($m > o$).

Results from the ARREST computer program for a simulated Shuttle launch environment indicate potentially critical normal thickness stresses in the RSI. The other RSI stress components are generally lower and possess strength allowables which are 3 or 4 times as high as well.

Section 6

NOMENCLATURE

$[A]$	Symmetric matrix
$[C]$	Damping matrix
$[\text{D}]$	Diagonal matrix with plus or minus ones on diagonal
$[K]$	Stiffness matrix
$[\bar{L}]$	Lower triangular matrix
$[M]$	Mass matrix
$[S_p]$	Pressure power spectral density matrix
$[Z_i]$	Impedance matrix associated with ω_i
$[\Phi]$	Modal matrix
$\{b\}$	Right hand side of matrix equation $[A]\{x\} = \{b\}$
$\{P\}$	Forcing function vector
$\{q\}$	Generalized modal response vector
$\{V_j\}$	j^{th} eigenvalue reduction vector
$\{x\}$	Solution vector of equation $[A]\{x\} = \{b\}$
$\{y\}$	Forward solution of matrix equation $[\bar{L}]\{y\} = \{b\}$
$\{\delta_i\}$	Nodal displacements associated with i^{th} iteration
$\{\phi^{(i)}\}$	i^{th} modal vector
A	Stringer cross-sectional area
A_{ij}	Orthotropic plate stiffness properties
A_{z_j}	Area normal to z direction at j^{th} node
D	Plate bending stiffness
E	Plate modulus of elasticity

E'_x, E'_y, E''	Elastic constants associated with orthotropic plate theory (see Table 2-1)
G	Plate shear modulus
$I_{y'}$, $I_{z'}$	Stringer moment of inertias about local principal axes
$J_{x'}$	Stringer polar moment of inertia about principal axis
M_i	Modal mass for i^{th} mode
$M_{PS}^{(i)}$	Primary structure portion of i^{th} modal mass
Q_i	Generalized modal force
$S(\omega_i)$	Acoustic sound pressure level at i^{th} frequency
a, b, P	Stringer spacing parameters (see Figure 2-2)
a_{ij}	Element of [A] matrix
d_p	Plus or minus one
e	Stringer eccentricity
f	Frequency in Hz
h	Plate thickness
m	Number of reduction vectors
q	Number of modal vectors
$\bar{t}$	Thickness parameter associated with stringer idealization (see Figure 2-3)
w	Normal plate displacement
x, y, z	Cartesian plate axes
x', y', z'	Stringer principal axes
β	Angle between stringer principal axes and plate global axes
δ_{ij}	Kronecker delta
ε_x, ε_y, γ_{xy}	Plate membrane strains
ζ_i	Critical damping ratio associated with i^{th} mode

σ_x, σ_y, ζ_{xy}	Plate stress components
σ_{zz}	RSI direct stress component in thickness direction
$\bar{\phi}^{(i)}_{T, z_j}$	Normal (z) deflection of j^{th} tile node associated with i^{th} mode shape
ω_i	Natural frequency of i^{th} mode in radians per second
ℓ	Stringer pitch parameter (see Figure 2-4)
$\bar{\ell}_{ij}$	Element of $[\bar{L}]$ matrix

Section 7

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7. Dowell, E. H. and Vaicaitis, R., "A Primer for Structural Response to Random Pressure Fluctuations," Princeton U. AMS Report No. 1220, April 1975.

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APPENDIX A

USER'S MANUAL FOR

RE*S*I*ST

(STATIC AND DYNAMIC REUSABLE SURFACE INSULATION STRESS PROGRAM)

AUGUST 1975 VERSION

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A. INTRODUCTION

This Appendix describes the use of a finite element based structural computer program for determining the static response and natural vibrations of TPS protected shuttle panels. The program is titled "RESIST" for static and dynamic REusable Surface Insulation STresses. The logic flow for RESIST is presented in Figure A-1.

The basis for the method is that the TPS is nonstructural but its stress levels, which are critical, must be computed. Thus, it becomes possible to neglect the stiffness of the TPS initially, but not its mass in the vibration, to determine approximate primary structure deflections.

An iterative procedure is then performed where, for each step, the primary structure deflections are imposed individually upon each tile at the tile/primary-structure interface, and the tile deflections and interface boundary loads are obtained. For the vibration option, the frequency is updated by computing a Rayleigh quotient, using the latest non-rigid tile displacements in addition to the corresponding primary structure displacements. The individual tile boundary loads obtained are then assembled and their reactions are applied to the primary structure. New primary-structure deflections are obtained and compared to the previous set. This process is repeated until convergence is obtained.

B. PROGRAM LIMITATIONS

The usual assumptions for programs based upon the linear elastic finite element method are applicable to RESIST. However, to facilitate the preparation of program input, a number of simplifications regarding the configuration and loadings have been made. Thus, the generation of a voluminous quantity of finite element input data has been greatly reduced by inclusion of a series of data preprocessing subroutines within RESIST. The restrictions upon which these subroutines are based follows:

1. Boundary conditions and edge loadings are assumed uniform along the four rectangular plate edges defined by $x = 0$, L_x and $y = 0$, L_y.
2. The primary structure plate temperature and properties are all uniform.

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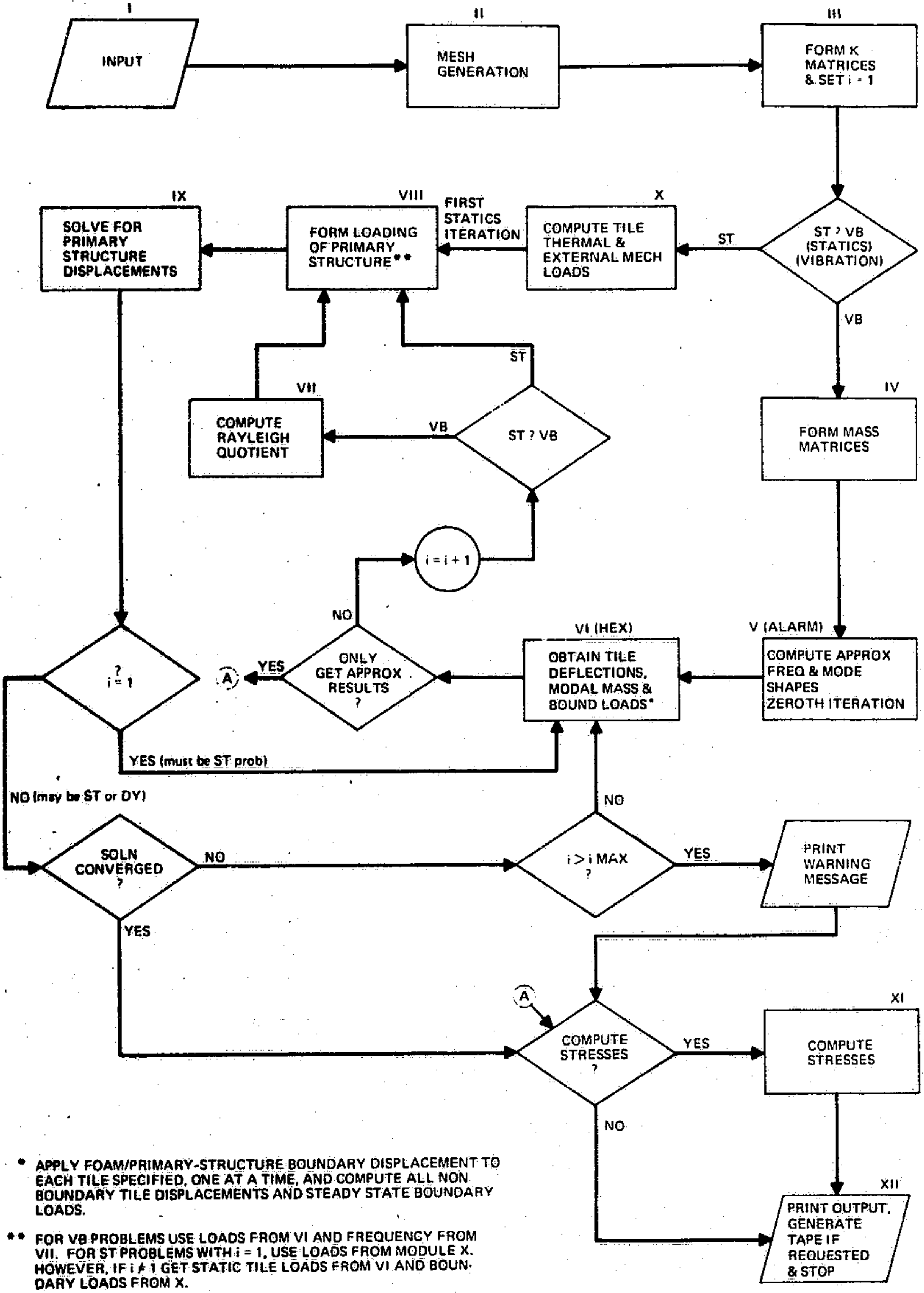


* APPLY FOAM/PRIMARY-STRUCTURE BOUNDARY DISPLACEMENT TO EACH TILE SPECIFIED, ONE AT A TIME, AND COMPUTE ALL NON BOUNDARY TILE DISPLACEMENTS AND STEADY STATE BOUNDARY LOADS.

** FOR VB PROBLEMS USE LOADS FROM VI AND FREQUENCY FROM VII. FOR ST PROBLEMS WITH i = 1, USE LOADS FROM MODULE X. HOWEVER, IF i ≠ 1 GET STATIC TILE LOADS FROM VI AND BOUNDARY LOADS FROM X.

Figure A-1 Flow Chart for RSI Stress Analysis Program "RESIST"

3. The stringers are equally spaced with temperatures and properties which are all uniform.

4. All tiles are geometrically identical as are their temperature distributions and uniform pressure loadings.

5. The boundary conditions must be selected such that the primary structure is statically stable.

The remaining limitations are primarily concerned with the program's capacity and should be adhered to by the user. These limitations are as follows:

6. Maximum number of nodes in a tile = 850.

7. Maximum number of finite elements running in any one direction in a tile = 20.

8. Maximum number of nodes in primary structure = 3000.

9. Maximum number of primary structure nodes along x or y direction = 1,000.

10. Maximum number of degrees of freedom in primary structure = 15,000.

11. Maximum number of natural mode shapes = 50.

12. Maximum number of stringers = 15.

A violation of restrictions 6-12, inclusive, will cause the program to stop and an appropriate warning message to appear.

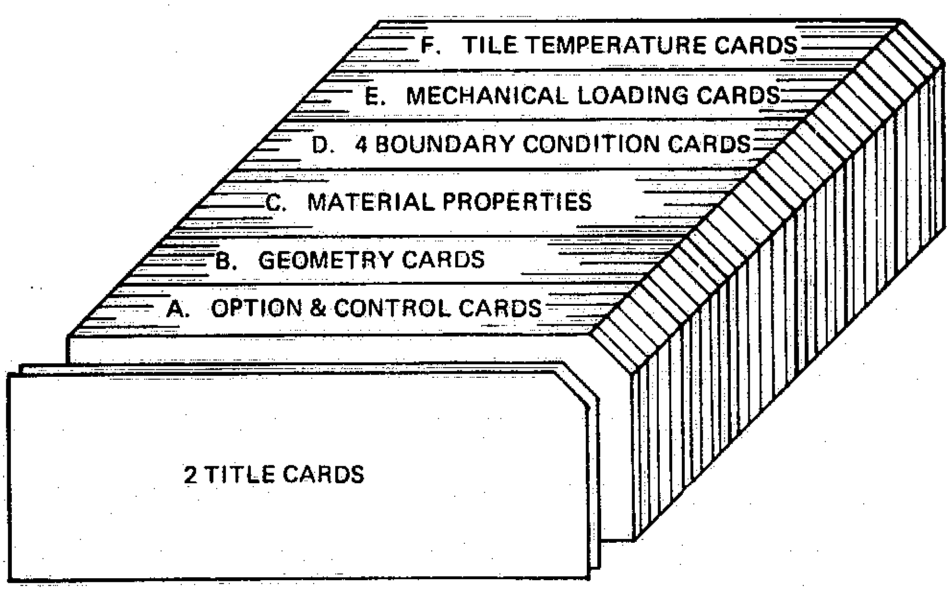
To insure symmetry of solutions for panels which are symmetric with regard to stringer locations about $y = L_y/2$, care should be taken with the input data to see that the plate nodes associated with the stringers are symmetric about $y = L_y/2$.

C. INPUT INSTRUCTIONS

A description of the card input for the IBM 370 and CDC 6600 versions of this program is presented in this section.

In addition to the first two input cards which contain literal data, such as special program title and date, in columns 1 through 80, inclusive; there are six groups of input cards containing the following information:

- Group A - Instructions regarding the type of problem being performed, number of iteratious desired, and type of output information.
- Group B - Details of the geometric configuration and finite element mesh of the primary structure and tiles. (Card B.4 is omitted if there are no tiles)
- Group C - Defines the primary structure and RSI temperature dependent material properties. If there is no TPS, cards C.3 through C.11 are omitted.
- Group D - Specifies the primary structure boundary conditions
- Group E - Describes the mechanical loading upon the primary structure as well as its temperature. These cards are omitted when the vibration option is used
- Group F - Defines the RSI temperature distribution. These cards are omitted if there is no TPS.



A. PROGRAM OPTIONS AND CONTROL — Sheet 1 of 4

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
A.1	1-5	I5	-	-	1 in col. 5 denotes that a statics problem is being treated. Skip cols. 6-25 in such cases 2 in col. 5 denotes that a natural vibration problem is being treated.
	6-10	I5	N_D	-	Number of desired mode shapes (50 is the maximum permitted).* Omit for statics option.
	16-20	I5	$\bar{s}$	-	Number of reorthogonalizations for eigenvalue algorithm. A min of 2 and a max. of 5 is suggested with 3 as an adequate compromise for most problems. The run should be repeated with greater values for $\bar{s}$ or N_D if the frequency error bound of a desired mode is greater than 1%. Omit for statics option.
	21-25	I5	-	-	Vibration mode number for which modal stresses are desired.** Omit for statics option.
	26-30	I5	i_{max}	-	Maximum number of iterations
	31-40	E10.0	ϵ	$in.^{-1}$ or rad.	Convergence parameter. Maximum primary structure deflection or rotation difference between iterations divided by magnitude of largest element.
	46-50	I5	-	-	0 in col. 50 indicates that primary structure stresses and strains are not required. 1 in col. 50 indicates that only midplate strains and stresses of primary structure are required. 2 in col. 50 indicates that only top of plate strains and stresses of primary structure are required. 3 in col. 50 indicates that only bottom of plate strains and stresses of primary structure are required. 4 in col. 50 indicates that only mid and top of plate strains and stresses of primary structure are required. 5 in col. 50 indicates that only mid and bottom of plate strains and stresses of primary structure are required. 6 in col. 50 indicates that only top and bottom of plate strains and stresses of primary structure are required. 7 in col. 50 indicates that top, bottom, and mid plate strains and stresses of primary structure are required.
	51-60	E10.0	—	$lb\text{-}in\text{-}sec^2$	Overhung rotatory mass inertia associated with each stringer. Used if plate overhange x = 0 and $x = L_x$ boundaries.

*If a restart run for a different mode number (i) is contemplated, a tape should be mounted as unit 2 to preserve the mode shapes generated with the present tape.

**If an ARREST run is to be made using information for this mode, provision should be made on control cards to mount tapes as units numbered 1 and 21 for storage and future usage.

A. PROGRAM OPTIONS AND CONTROL - Sheet 2 of 4

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
A.1 (Cont'd.)	61-65	I5	-	-	0 in Col. 65 indicates either no stringers on the plate or that the orthotropic option is being used. 1 in Col. 65 indicates that stringers are attached to plate along only a single rivet or weld line, or have an open cross section. 2 in Col. 65 indicates that stringers have a closed cross section and are attached at double rivet or weld lines.
	66-70	I5	-	-	0 in Col. 70 indicates that orthotropic plate properties are used. 1 in Col. 70 indicates that isotropic plate properties are used.
	71-75	I5	-	-	0 or a 1 in Col. 75 indicates that $K - \omega^2 M$ is decomposed for each primary structure and tile iteration frequency (ω). A 2 in Col. 75 indicates that an iteration procedure which avoids resplitting of $K - \omega^2 M$ is used. This procedure should always be used for statics problems. In addition this approach is generally faster for a vibration problem, but may not always converge.

A. PROGRAM OPTIONS AND CONTROL - Sheet 3 of 4

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
A.2	1-5	I5	-	-	0 in col. 5 indicates that tile stresses are not required. 1 in col. 5 indicates that tile stresses are to be computed after each iteration is performed. 2 in col. 5 indicates that tile stresses are to be computed only after last iteration is performed or only after convergence is obtained.
	6-10	I5	-	-	0 in col. 10 if primary structure stresses and strains were not requested in column 50 of Card A.1. 1 in col. 10 indicates that primary structure stresses and strains are required after each iteration. 2 in col. 10 indicates that primary structure stresses and strains are required only after last iteration or, only after convergence.
	11-15	I5	-	-	0 in col. 15 indicates no tiles on the primary structure. Skip card A.4* 1 in col. 15 indicates that there are tiles on the primary structure.
	16-20	I5	-	-	1 in col. 20 indicates tile node map printout desired. 0 = no node map printout.
	21-25	I5	-	-	1 in col. 25 indicates tile element map printout desired. 0 = no element map printout.
	26-30	I5	-	-	1 in col. 30 indicates tile nodal coordinate, temp. and nodes per element printout. 0 in col. 30 indicates suppression of this printout.
	31-35	I5	-	-	1 in col. 35 indicates printout of element stiffness matrices. 0 = no element stiffness matrices.
	36-40	I5	-	-	1 in col. 40 indicates printout of assembled stiffness matrices and ALARM reorthog. info. 0 in col. 40 indicates suppression of this printout.
	41-45	I5	-	-	1 in col. 45 indicates printout of unit no., file no., and matrix storage info. for program debugging. 0 in col. 45 indicates suppression of this printout.

* If there are no tiles then $\bar{n}_x$ and $\bar{n}_y$, together with n_{B2} and n_{D2}, are still required since they determine the primary structure finite element grid. In analyzing panels without tiles, leave out cards B.4, C.3 through C.10 and all "F" cards.

A. PROGRAM OPTIONS AND CONTROL - Sheet 4 of 4

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
A.3	1-5	I5	IRES	-	1 in Col. 5 if this is a vibration restart run which makes use of primary structure mode shape generated in a previous run.* 0 in Col. 5 if this is not a restart run or if this is a statics problem.
	6-10	I5	-	-	1 in Col. 10 saves a tape which contains a modal solution to be used in ARREST. 0 in Col. 10 does not save such a tape or if this is a statics problem.
	11-20	E10.0	ω	sec^{-1}	Input frequency if IRES = 1 in Col. 5. Leave blank if IRES = 0.
A.4	1-4, 5-8, 9-12, etc.	I4 I4 I4	- - -	- - -	This card is used to indicate which tile stress states are desired. User may specifically request up to 20 tile stress states (see Figure A-3 for tile numbering scheme). A zero in Col. 4 indicates that stress states for all tiles are desired.

*Be sure to indicate, on appropriate job control cards, that this run makes use of an existing tape, mounted as unit 2, which contains the requested mode shape. Provision must also be made on these control cards to have a ring inserted on this tape since it must be written upon in subsequent RESIST calculations.

B. GEOMETRIC CONFIGURATION - Sheet 1 of 2 (See Figure A-2)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
B.1	1-10	E10.0	L_x	in.	Panel dimension
	11-20	E10.0	L_y	in.	Panel dimension
	21-30	E10.0	t_p	in.	Panel thickness
	41-50	E10.0	$\bar{t}$	in.	Stringer effective wall thickness if attached along two plate rivet rows.
	51-60	E10.0	y_2	in.	Distance from $y = 0$ edge for second attachment row of first stringer.
	61-70	E10.0	Z'	in.	Distance below middle surface of plate at which stringer stress (σ_x) will be computed.

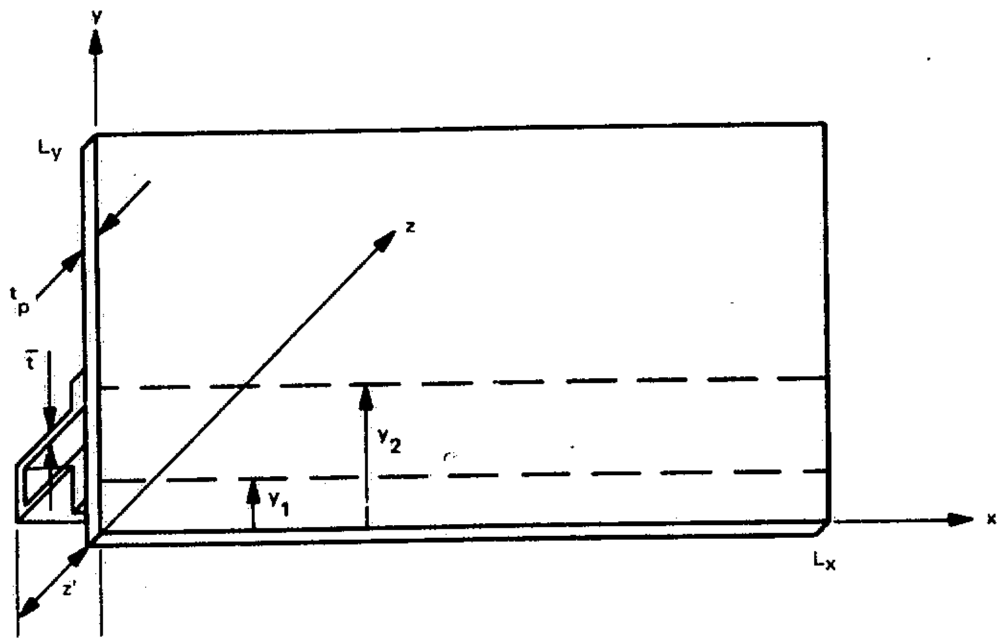


Fig. A-2 Doubly-Connected Stringer Idealization - Global Coordinates

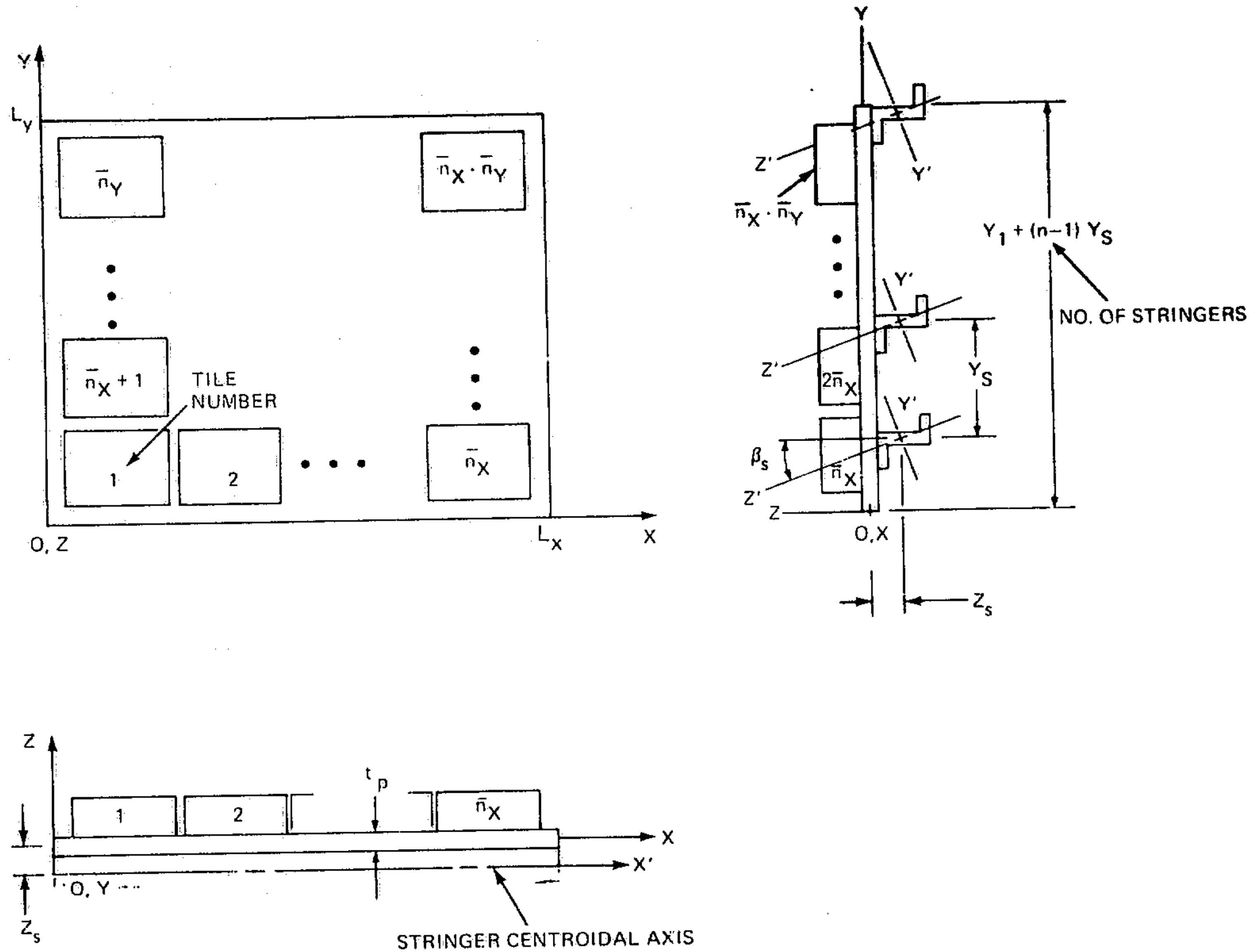
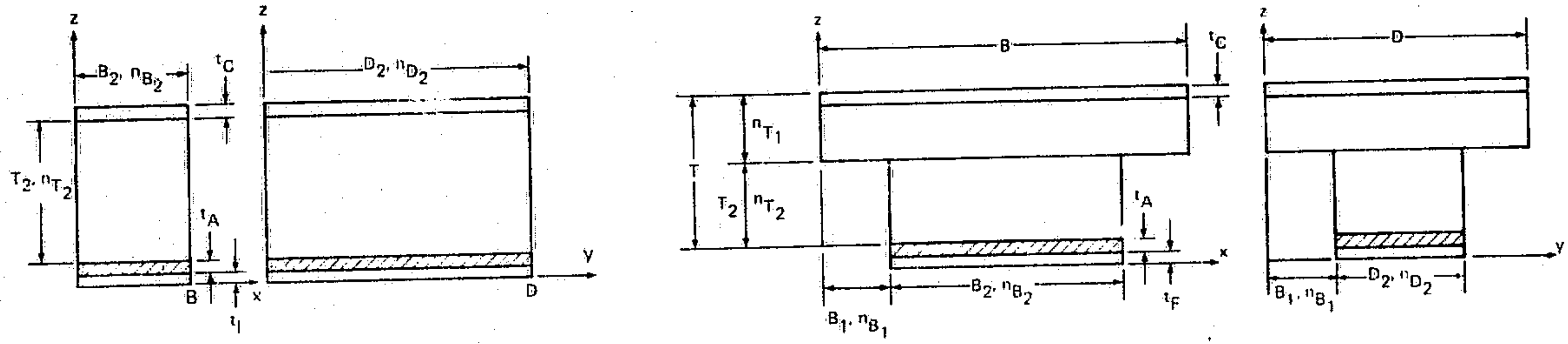


Figure A-3 TPS Configuration on Stiffened Primary Structure - Global Coordinates

B. GEOMETRIC CONFIGURATION - Sheet 2 of 2 (See Figure A-3)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
B.2	1-10	8E10.0	Y_1	in.	Position of first stringer attachment row. If there are no stringers, set $Y_1 > L_y$ and skip to the next card.
	11-20	↓	Z_s	in.	Distance of stringer centroid below plate middle surface.
	21-30	↓	Y_s	in.	Discrete stiffener spacing
	31-40	↓	A_s	$in.^2$	Stringer cross sectional area
	41-50	↓	$I_{y'}$	$in.^4$	Stiffener principal mom. of inertia about y' axis
	51-60	↓	$I_{z'}$	$in.^4$	Stiffener principal mom. of inertia about z' axis
	61-70	↓	$J_{x'}$	$in.^4$	Stiffener twisting stiffness geometric parameter
	71-80	↓	β_s	Degrees	Angle between z and z' axis measured positive clockwise along x.
B.3	1-10	I10	$\bar{n}_x$	-	Integer number of tiles between x = 0 and L_x*
	11-20	I10	$\bar{n}_y$	-	Integer number of tiles between y = 0 and L_y*

*If there are no tiles then n_x and n_y, together with n_{B2} and n_{D2}, are still required since they determine the primary structure element grid. In analyzing panels without tiles, leave out cards B.4, C.3 through C.10 and all "F" cards.



A. BRICK TILE

B. UNDERCUT TILE

NOTE: SUBSCRIPTED SYMBOLS BEGINNING WITH "n" ARE THE NUMBER OF ELEMENTS WHICH SUBDIVIDE THE INDICATED SPAN. THE OTHER SYMBOLS ARE DIMENSIONS.

Figure A-4 RSI Tile Parameters - Local Coordinates

B. GEOMETRIC CONFIGURATION — Sheet 2 of 2 (See Figure A-4)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
B.4	1-10	6E10.0	T	in.	Undercut RSI tile thickness. Leave blank if tile is brick shaped or if there are no tiles.
	11-20	↓	B_1	in.	Tile undercut dimension. Leave blank if tile is brick shaped.
	21-30	↓	T_2	in.	Tile undercut dimension or, height of brick shaped tile.
	31-40	↓	t_A	in.	Strain arrestor plate (SAP) thickness. May replace with layer of isolator, RSI or bond material if no SAP.
	41-50	↓	t_I	in.	Strain isolator thickness (SIP)
	51-60	↓	t_c	in.	Coating thickness. Leave blank if no tile coating.
B.5	1-5	I5	n_{B_1}	-	Number of elements along B_1. Leave blank if tile is brick shaped or if there are no tiles.
	6-10	↓	n_{B_2}	-	Number of elements along B_2.
	11-15	↓	n_{D_2}	-	Number of elements along D_2.
	16-20	↓	n_{T_1}	-	Number of elements along T-T_2. Leave blank if tile is brick shaped.
	21-25	↓	n_{T_2}	-	Number of elements along T_2. Leave blank if no tiles.

$$
\begin{Bmatrix} \epsilon_x \\ \epsilon_y \\ \epsilon_z \\ \gamma_{xy} \\ \gamma_{yz} \\ \gamma_{zx} \end{Bmatrix} =
\left[\begin{array}{ccc|ccc}
\frac{1}{E_x} & -\frac{\nu_{xy}}{E_y} & -\frac{\nu_{xz}}{E_z} & & & \\
-\frac{\nu_{yx}}{E_x} & \frac{1}{E_y} & -\frac{\nu_{yz}}{E_z} & & \text{NULL} & \\
-\frac{\nu_{zx}}{E_x} & -\frac{\nu_{zy}}{E_y} & \frac{1}{E_z} & & & \\
\hline
 & & & \frac{1}{G_{xy}} & 0 & 0 \\
 & \text{NULL} & & 0 & \frac{1}{G_{yz}} & 0 \\
 & & & 0 & 0 & \frac{1}{G_{zx}}
\end{array}\right]
\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \sigma_z \\ \sigma_{xy} \\ \sigma_{yz} \\ \sigma_{zx} \end{Bmatrix}
$$

NOTE: This matrix is symmetric; thus, the program insures that

$$\frac{\nu_{xy}}{E_y} = \frac{\nu_{yx}}{E_x}$$

$$\frac{\nu_{xz}}{E_z} = \frac{\nu_{zx}}{E_x}$$

$$\frac{\nu_{zy}}{E_y} = \frac{\nu_{yz}}{E_z}$$

Figure A-5 Orthotropic Stress-Strain Law for 3-Dimensional Elements

C. MATERIAL PROPERTIES - Sheet 1 of 3 (See Figure A-5)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
C.1	1-10	8E10.0	E_p	psi	Isotropic plate modulus of elasticity
	11-20	↓	ν_p	-	Poisson's ratio for plate
	21-30	↓	γ_p	$lb/in.^3$	Weight density for plate
	31-40	↓	α_p	$^oF^{-1}$	Coefficient of thermal expansion for plate
	41-50	↓	A_{11}	psi	Orthotropic plate constants associated with stress-strain law:
	51-60	↓	A_{22}	psi	$$\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{Bmatrix} = \begin{bmatrix} A_{11} & A_{12} & 0 \\ A_{21} & A_{22} & 0 \\ 0 & 0 & A_{33} \end{bmatrix} \begin{Bmatrix} \varepsilon_x \\ \varepsilon_y \\ \gamma_{xy} \end{Bmatrix}$$
	61-70	↓	A_{33}	psi	
	71-80	↓	$A_{12}=A_{21}$	psi	Comparable symbols used in Reference 5 are: $A_{11} = E'_x$, $A_{12} = E''$, $A_{22} = E'_y$, $A_{33} = G$
C.2	1-10	4E10.0	E_s	psi	Stringer modulus of elasticity (enter zero if no stringers)
	11-20	↓	ν_s	-	Poisson's ratio for stringer
	21-30	↓	γ_s	$lb/in.^3$	Weight density fcr stringer
	31-40	↓	α_s	$^oF^{-1}$	Coefficient of thermal expansion for stringer

C. MATERIAL PROPERTIES - Sheet 2 of 3 (See Figure A-5)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
C.3	1-10	6E10.0 ↓	E_x	psi	Arrestor x direction orthotropic stiffness
	11-20		E_y	psi	Arrestor y direction orthotropic stiffness
	21-30		E_z	psi	Arrestor z direction orthotropic stiffness
	31-40		ν_{xy}	-	See Figure A.5
	41-50		ν_{yz}	-	See Figure A.5
	51-60		ν_{zx}	-	See Figure A.5
C.4	1-10	7E10.0 ↓	G_{xy}	psi	See Figure A.5
	11-20		G_{yz}	psi	See Figure A.5
	21-30		G_{zx}	psi	See Figure A.5
	31-40		γ_A	$lb/in.^3$	Weight density for arrestor
	41-50		α_{AX}	$^oF^{-1}$	X coefficient of thermal expansion for arrestor
	51-60		α_{AY}	$^oF^{-1}$	Y coefficient of thermal expansion for arrestor
	61-70		α_{AZ}	$^oF^{-1}$	Z coefficient of thermal expansion for arrestor

C. MATERIAL PROPERTIES - Sheet 3 of 3 (See Figure A-5)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
C.5	1-10	E10.0	E_{Ix}	psi	Isolator x direction orthotropic stiffness
	11-20	E10.0	E_{Iy}	psi	Isolator y direction orthotropic stiffness
	21-30	E10.0	E_{Iz}	psi	Isolator z direction orthotropic stiffness
	31-40	E10.0	ν_{xy}	-	See Figure A.5
	41-50	E10.0	ν_{yz}	-	See Figure A.5
	51-60	E10.0	ν_{zx}	-	See Figure A.5
C.6	1-10	E10.0	G_{xy}	psi	See Figure A.5
	11-20	E10.0	G_{yz}	psi	See Figure A.5
	21-30	E10.0	G_{zx}	psi	See Figure A.5
	31-40	E10.0	γ_I	$lb/in.^3$	Weight density for isolator
	41-50	E10.0	α_I	$^oF^{-1}$	Coefficient of thermal expansion for isolator
C.7	1-10	E10.0	γ_R	$lb/in.^3$	Weight density of RSI material
	11-20	E10.0	α_y/α_x	-	RSI coefficient of thermal expansion in y direction ($^oF^{-1}$) divided by coefficient of thermal expansion in x direction (α_x).
	21-30	E10.0	α_z/α_x	-	RSI coefficient of thermal expansion ratio in z vs. x direction.

C. TEMPERATURE DEPENDENT MATERIAL PROPERTIES (Sheet 1 of 2)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
C.8.1	1-5	I5	-	-	Number of entry sets in the following table of E_R vs. temperature (°F).
C.9.1	1-10	E10.0	T_1	°F	Temperature (absolute, not relative) corresponding to following value of E_R
	11-20	E10.0	$E_R(T_1)$	psi	Value of E_R (RSI modulus - refer to equations below*) associated with previous temperature.
	31-30	E10.0	T_2	°F	Repeat above set of data as often as necessary, 4 sets to a card.
	etc.	etc.	etc.	etc.	Program uses closest 3 data pts. for 2nd order Langrangian interpolation of properties if element temperature is within data specified temperature range and at least 3 data-points are input. Program uses closest data-point properties for element temperature outside range. Uniform property value is used for any given property if only one value of that property is specified. Thus, program requires a minimum of 1 or 3 value(s) per property for proper execution.

*For RSI (refer to Figure B-4)

$$E_x = E_y = E_R \qquad \nu_{xy} = \nu_{yx} = \nu_R \qquad G_{xy} = G_{yx} = \frac{E_R}{2(1 + \nu_R)} \qquad \nu_{xz} = \nu_{yz} = \nu_R'$$

$$E_z = E_R' \qquad \nu_{zx} = \nu_{zy} = \frac{E_R}{E_R'}\nu_R' \qquad G_{yz} = G_{zy} = G_{xz} = G_{zx} = G_R'$$

C. TEMPERATURE DEPENDENT MATERIAL PROPERTIES - Sheet 2 of 2

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
C.8.2 & C.9.2	-	E10.0	E'_R	psi	Repeat above two card sets for E'^{*}_R
C.8.3 & C.9.3 through C.8.6 & C.9.6	-	E10.0	-	-	Repeat above card sets for remaining RSI properties in following order: G'_R, ν_R, ν'_R, and α_x where α_x = RSI coefficient of thermal expansion in x direction.
C.10.1 & C.11.1 through C.10.3 & C.11.3	-	E10.0	-	-	Repeat above card sets for coating properties in following order: Leave this card blank if there is no coating. E_c, ν_c, α_c

D. BOUNDARY CONDITIONS — Sheet 1 of 4 (See Figure A-6)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
D.1, D.2, D.3, D.4	1	A1	-	-	A denotes the x=0 edge of the plate (CARD D.1) B denotes the $x=L_x$ edge of the plate (CARD D.2) C denotes the y=0 edge of the plate (CARD D.3) D denotes the $y=L_y$ edge of the plate (CARD D.4)
These are four similar boundary condition cards	2	A1	-	-	0 indicates that the plate edge is <u>free</u> to deflect and rotate <u>out</u> of the z=0 plane (FREE) 1 indicates that the plate edge is <u>not free</u> to deflect or rotate <u>out</u> of the z=0 plane (CLAMPED) 2 indicates that the plate edge is <u>not free to deflect</u> but is <u>free to rotate</u> out of the z=0 plane (PINNED) 3 indicates that the plate edge is <u>flexibly held</u> with regard to <u>out</u> of plane motion
	3-11	E9.0	K_{ww}	$lb/in.^2$	Out-of-plane force per unit edge-length caused by out-of-plane unit deflection
	12-20	↓	$K_{w\theta}$ or $K_{\theta w}$	lb/in.	Out-of-plane force per unit edge-length caused by out-of plane unit rotation or Out-of-plane moment per unit edge-length caused by out-of-plane unit deflection
	21-29	↓	$K_{\theta\theta}$	lb	Out-of-plane moment per unit edge-length caused by out-of plane unit rotation

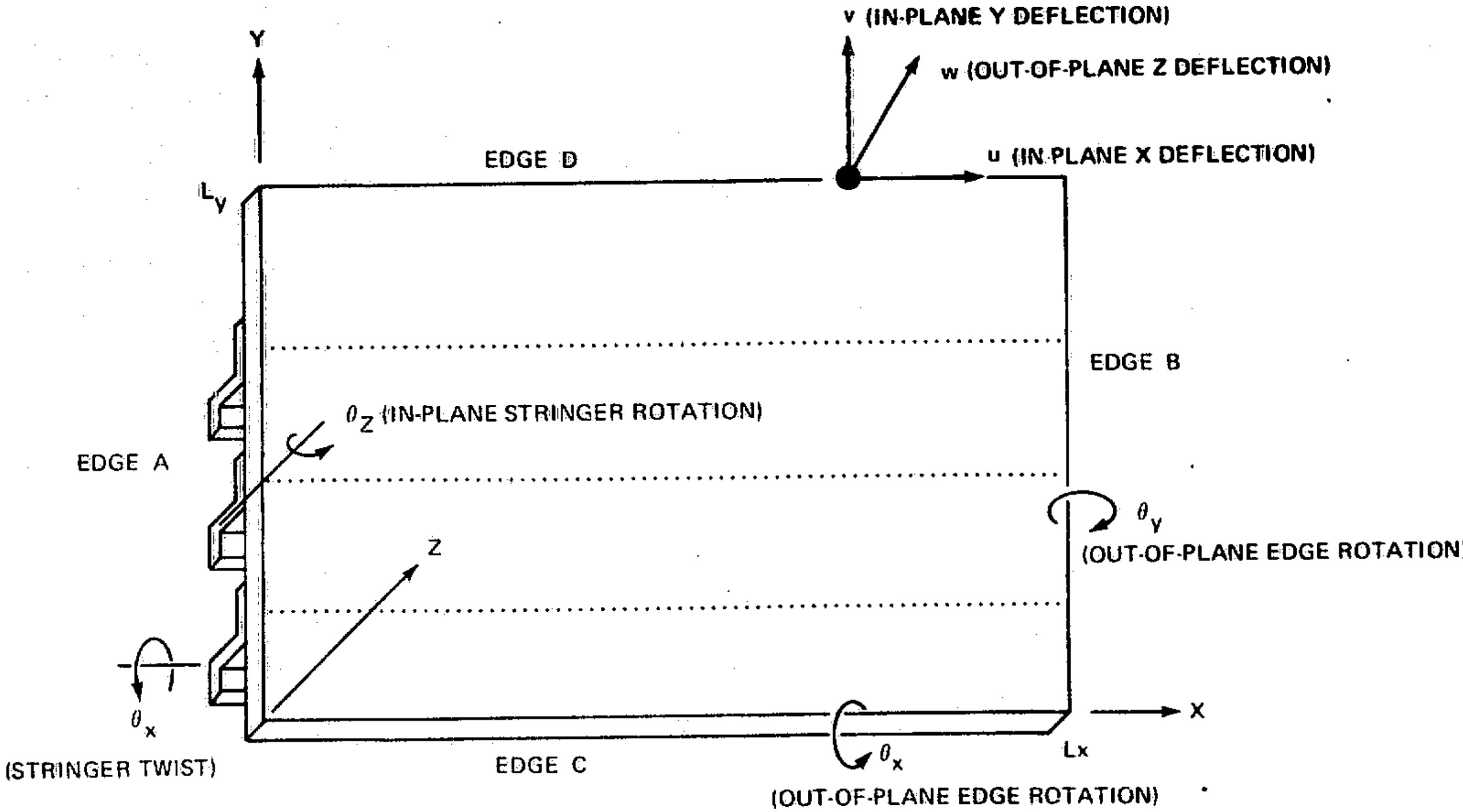


Figure A-6 Primary Structure Boundary Condition Notation - Global Coordinates

D. BOUNDARY CONDITIONS — Sheet 2 of 4 (See Figure A-6)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
D.1–D-4, (continued)	31	A1	-	-	0 denotes edge is not held from in-plane deflections 1 denotes edge is held from in-plane deflections 2 denotes edge is not held for y deflection, but is held for x deflection (PARTIALLY HELD) 4 denotes edge is not held for x deflection, but is held for y deflection (PARTIALLY HELD) 3 denotes edge is flexibly held for in-plane deflections NOTE: For non-vibratory heated or cooled primary structure problems, refer to special instructions on bottom of page A-23/24.
	32-40	E9.0	K_{uu}	lb/in.^{2}	In-plane x force per unit length on an edge caused by in-plane x direction unit deflection
	41-49	↓	K_{uv} or K_{vu}	lb/in.^{2}	In-plane x force per unit length on an edge caused by in-plane y direction unit deflection or In-plane y force per unit length on an edge caused by in-plane x direction unit deflection
	50-58	↓	K_{vv}	lb/in.^{2}	In-plane y force per unit length on an edge caused by in-plane y direction unit deflection

D. BOUNDARY CONDITIONS — Sheet 3 of 4 (See Figure A-6)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
Add'l info. for cards D1 and D2 only.	60	A1		-	0 denotes stringer edge not held for in-plane rotation (θ_z) 1 denotes stringer edge held for in-plane rotation ($\theta_z = 0$) 3 denotes stringer edge flexibly held for in-plane rotation (Note θ_z is not a primary structure degree of freedom unless a stringer element is also present at a particular plate node)
	61-69	E9.0	$K_{s\theta_z}$	in.-lb	In-plane stringer edge moment produced by unit rotation θ_z
	71	A1	-	-	0 denotes stringer edge free to twist (θ_x) 1 denotes stringer edge not free to twist ($\theta_x = 0$) 3 denotes stringer edge flexibly held against twist
-	72-80	E9.0	$K_{s\theta_x}$	in.-lb	Twist moment on end of stringer for a unit twist-rotation

Special Instructions for running a thermal stress problem, when the primary structure is at a uniform temperature other than the reference temperature, are required to permit free in-plane thermal straining; e.g.:

1. Permit the x=0 boundary to move freely or be elastically held in-plane
2. Permit the $x=L_x$ boundary to move freely in the y direction but not the x direction if free, or be elastically held if also elastically held along x=0.
3. Permit the y=0 boundary to move freely or be elastically held in-plane.
4. Permit the $y=L_y$ boundary to move freely in the x direction but not the y direction if free, or be elastically held if also elastically held along y=0.

D. BOUNDARY CONDITIONS - Sheet 4 of 4 (See Figure A-6)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
D.5*	1	A1	-	-	A denotes boundary condition for closed section stringer on $x = 0$ edge.
	5	I4	-	-	0 in Col. 5 indicates that the closed section stringer is not held against stretching at the $x = 0$ edge 1 in Col. 5 indicates it is held in stretching.
	10	I5	-	-	0 in Col. 10 indicates that the closed-section stringer is not held against twisting at the $x = 0$ edge. 1 in Col. 10 indicates it is held against twisting.
	15	I5	-	-	0 in Col. 15 indicates that the closed-section stringer is not held against out-of-plane bending at the $x = 0$ edge. 1 in Col. 15 indicates it is held against out-of-phase bending.
	26	A1	-	-	B denotes boundary condition for closed-section stringer on $x = L_x$ edge
	30	I4	-	-	Same as for Col. 5 on $x = L_x$ edge
	35	I5	-	-	Same as for Col. 10 on $x = L_x$ edge
	40	I5	-	-	Same as for Col. 15 on $x = L_x$ edge

*This card is required only if the stringer sections are closed and are attached at multiple plate rivet lines.

E. PRIMARY STRUCTURE LOADING (See Figure A-7)

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
E.1	1-10	8E10.0	N_x	lb/in.	Uniform, direct cover-plate running load in x direction on x = 0 edge (see Figure 7)
	11-20	↓	N_y	lb/in.	Uniform, direct cover-plate running load in y direction on y = 0 edge (see Figure 7)
	21-30	↓	N_{xy}	lb/in.	Uniform, shearing cover-plate running load on x = 0 edge (see Figure 7)
	31-40	↓	N_{yx}	lb/in.	Uniform, shearing cover-plate running load on y = 0 edge (see Figure 7)
	41-50	↓	P_z	psi	Uniform external normal pressure acting upon tiles
	51-60	↓	T	lb	Tension force acting upon centroid of each stiffener at x = 0
	61-70	↓	M	in.-lb	Out-of-plane bending moment acting upon each stiffener
	71-80	↓	V	lb	Shear load acting upon each stiffener
					Note, boundary conditions for B and D edges should be selected carefully to produce desired effect, e.g. to produce a uniform primary structure tension in the x direction, $\sigma_x = \bar{\sigma}$ and $\sigma_y = 0$: set $N_x = t_p \bar{\sigma}$, $T = A_s \bar{\sigma}$, and P_z, M and V all equal to zero; then hold plate edge B from in plane x, but not y, motion and also hold the stringers at edge B; next, make edges C and D free for x motion, and only hold one of these edges against y motion.
E.2	1-10	E10.0	ΔT_p	F^o	Temperature difference of plate from T_{Ref}.
	11-20	E10.0	ΔT_s	F^o	Temperature difference of stringers from T_{Ref}.

Note: Leave out cards E.1 and E.2 if vibration option is used

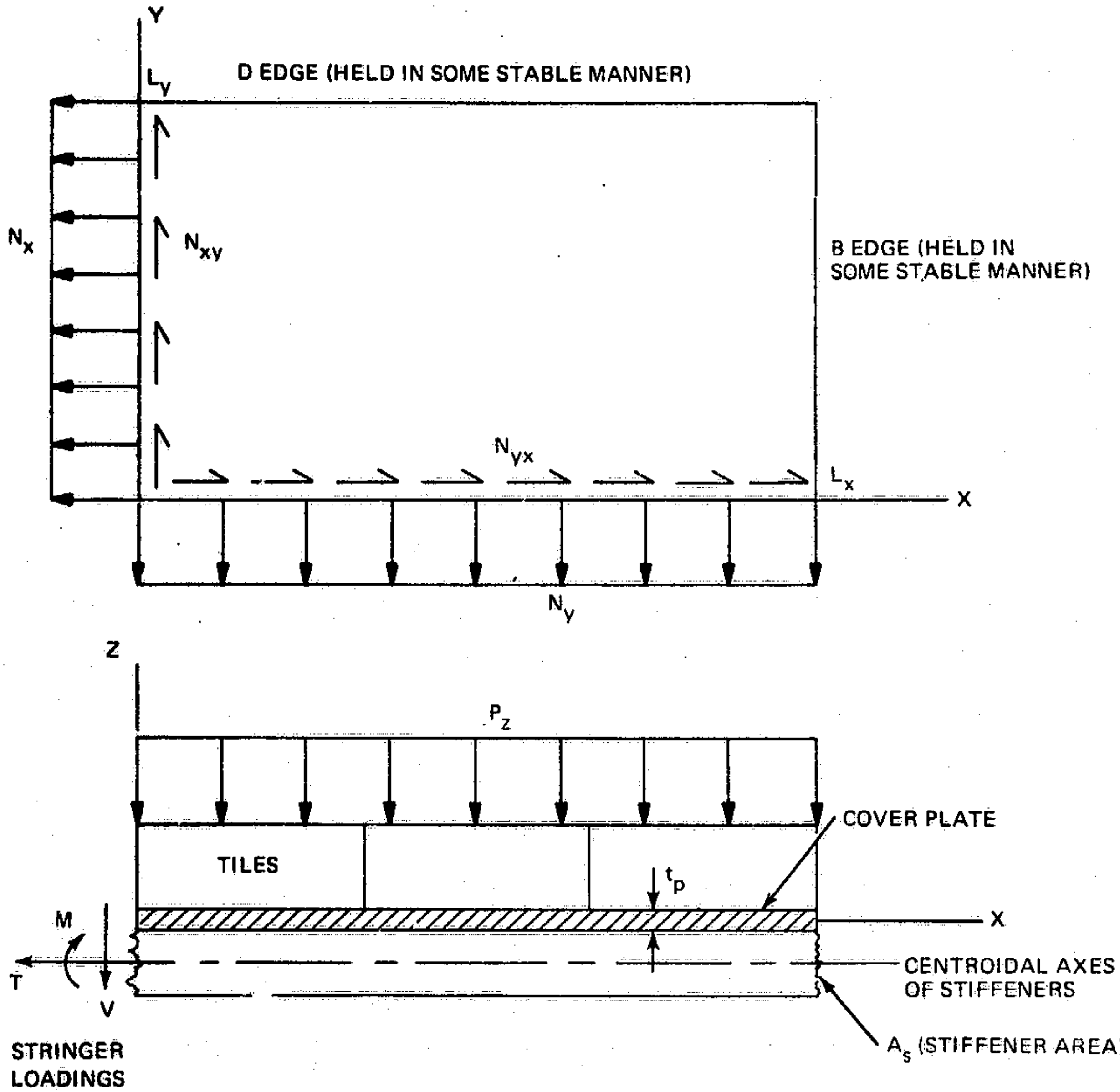


Figure A-7 Possible Static Mechanical Loadings Upon Panel - Global Coordinates

F. TILE TEMPERATURE DISTRIBUTIONS — Sheet 1 of 2

Each tile is assumed to have the same temperature distribution. There are 3 temperature distribution options, each of which is considered separately below. Tile temperature differences, rather than absolute tile temperatures, are required for each of these options (since thermal strains depend upon temperature differences). However, since temperature-dependent material property data are presented in terms of absolute temperature scales, a reference temperature (which is also input) is added to the differences to obtain absolute temperatures for internally computing material properties. Omit all F cards if there are no tiles.

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
F.1	5	I1	-	-	0 in col.5 of this card indicates no thermal static loading effects will be considered. But material properties used in forming the TPS stiffness properties will be based upon the specified temperature distribution. 1 in col. 5 indicates that thermal static loading will be considered in the analysis. In such cases, refer to bottom of following page for special instructions regarding boundary condition cards (D.1 through D.4).
	10	I1	-	-	1 in col. 10 indicates that each tile is at the same uniform temperature. 2 in Col. 10 indicates that each tile temperature distribution is governed by Lagrangian interpolation formulas. 3 in Col. 10 indicates that each tile temperature distribution is input by consecutive finite element node-temperature differences from the reference temperature.
	11-20	E10.0	T_{Ref}	^oF	Panel reference temperature (added to temp. differences when obtaining mat'l. properties)

F. TILE TEMPERATURE DISTRIBUTIONS — Sheet 2 of 2

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
					UNIFORM TEMPERATURE OPTION (1)
F.2	1-10	E10-1	ΔT_u	F°	Uniform temperature difference from T_{Ref}
					or LAGRANGIAN INTERPOLATION TEMPERATURE OPTION (2)
F.2.1	1-5	2I5	-	-	Number of x coordinates through which temperature differences will be interpolated.
	6-10		-	-	Order of Lagrangian interpolation polynominal in x direction. Must be at least 1 less than number of coords given in col. 5.
F.3.1	1-10	E10.0	x_i	in.	The local x coordinates used in the x direction temperature difference interpolation. Eight to a card until all are accounted for.
F.2.2-3.2					Repeat card types F.2.1 and F.3.1 for the y coordinates
F.2.3-3.3					Repeat card types F.2.1 and F.3.1 for the z coordinates
F.4	1-10 11-20 . . . 71-80	E10.0	ΔT_R	F°	Successive interpolation point temperature, maximum of eight to a card. Start with the first x, y, z point and index on x. Next, step up y coordinate and index on x once again. Continue until all y coordinates have been stepped up in this way. Repeat the above procedure for each value of z: e.g., the temperature input order would be $T_1 = T(x_1, y_1, z_1)$, $T_2 = T(x_2, y_1, z_1)$, . . . $T_n = T(x_n, y_1, z_1)$, $T_{n+1} = T(x_1, y_2, z_1)$, . . . $T_{n+m} = T(x_n, y_m, z_1)$ $T_{n+m+1} = T(x_1, y_1, z_2)$, ... , $T_{n+m+1} = T(x_n, y_m, z_\ell)$ Eight to a card until all data are accounted for.
					or ELEMENT NODE TEMPERATURE OPTION (3)
F.2	11-10 11-20 etc	E10.0	ΔT_R	F°	Temperature differences above reference temperatures, node by node, in consecutive order. Seven temperature differences to a card until all nodes are accounted for. Cols. 71-80 of each card are reserved for user's card identification.

D. DESCRIPTION OF OUTPUT

Output from a typical run of the ..SIST computer program is explained below in outline form. References in parentheses refer to pages in this Appendix.

1. Program title and date indicating latest update of program version which was run.

INPUT INFORMATION

2. Listing of input cards, the first two of which are the title assigned to any given run by the user.

3. User selected input options are listed (pp. A-5 - A-8).

4. Plate, stringer and tile geometry and specification of finite element grids for primary structure and tiles (pp. A-9 - A-11).

5. Plate, stringer, strain isolator and arrestor material properties (pp. A-14 - A-17). Note, if there is no strain arrestor, RSI or isolator material properties may be used for the arrestor. If this is done, the thickness dimension of the usual isolator or RSI should be appropriately reduced to compensate for this addition.

6. Temperature-dependent RSI material property data used for generating curves used internally by program to compute RSI average finite element properties (pp. A-18 - A-19).

7. Plate and stringer boundary conditions (pp. A-20 - A-25).

8. Applied primary structure static mechanical and thermal loading if not a vibration problem (A-26 - A-27).

9. RSI temperature distribution input data. Used for property data (item 6 above) and thermal loading if a statics problem (pp. A-28 - A-29).

OUTPUT INFORMATION

10. Map showing typical tiles three dimensional finite element ordering, by layers. Top, or first layer also corresponds to two-dimensional tile coating elements as well.

11. Map showing ordering of a typical tiles finite element nodes by layers.

12. Position and temperatures for a typical tile in a local coordinate system (reference Figure A-4, A and B).

13. Global geometry of primary structure nodes and plate nodal degree-of-freedom numbering. D_x, D_y and D_z refer to nodal deflections, and R_x and R_y are the nodal rotations. Nodes with no degrees-of-freedom are used to define the stringer centroids for singly-attached stringers only.

14.a. Statics Option: Primary structure nodal deflections by iteration number. Nodes with the same x coordinate are grouped together. These groups are separated with dashed lines.

14.b. Vibration Option: Mode numbers, approximate frequencies and corresponding modal error bound (which should be less than 2% to be a reliable approximate mode). This is followed by the primary structure mode shapes with a similar nodal deflection format as for the Statics Option.

15. If requested by the user, the computed convergence parameter is printed out along with the input quantity it was tested against. This is done for each iteration after the first for the Static Option. The primary structure degree-of-freedom with the largest change from the previous iteration is also identified.

16. Tile nodal displacements by tile and iteration number. For a vibration option, this calculation and the subsequent ones are performed only for the user-specified vibration mode.

17. Modal mass associated with each tile for given mode is printed out as DEN.

18. Three dimensional tile stresses and strains for the bottom two layers of elements by element number. These quantities are computed at each element's 8 Gauss integration points. Gauss point stresses are believed to be more accurate than nodal values and provide more detail than simply the element's average stresses.

19. Three dimensional element average stresses and strains (by tile and iteration number).

20. Two-dimensional element average coating stresses. Coating element numbers correspond to three dimensional element numbering directly below them.

21.a. Statics Option: Repeat of items 16-19 for each tile. Repeat of item 14.a and 15 for each iteration.

21.b. Vibrations Option: Computation of Rayleigh Quotient (OMEGA SQUARED) if all tiles have been treated. Repeat of items 16-19 for each iteration. Repeat of items 14.b, 15 and Rayleigh Quotient until convergence or last iteration is performed.

22. Plate element stresses and strains for mid and/or top and/or bottom surfaces. This computation is done after each iteration if requested by the user. Otherwise, it is computed only after convergence or the last iteration is performed.

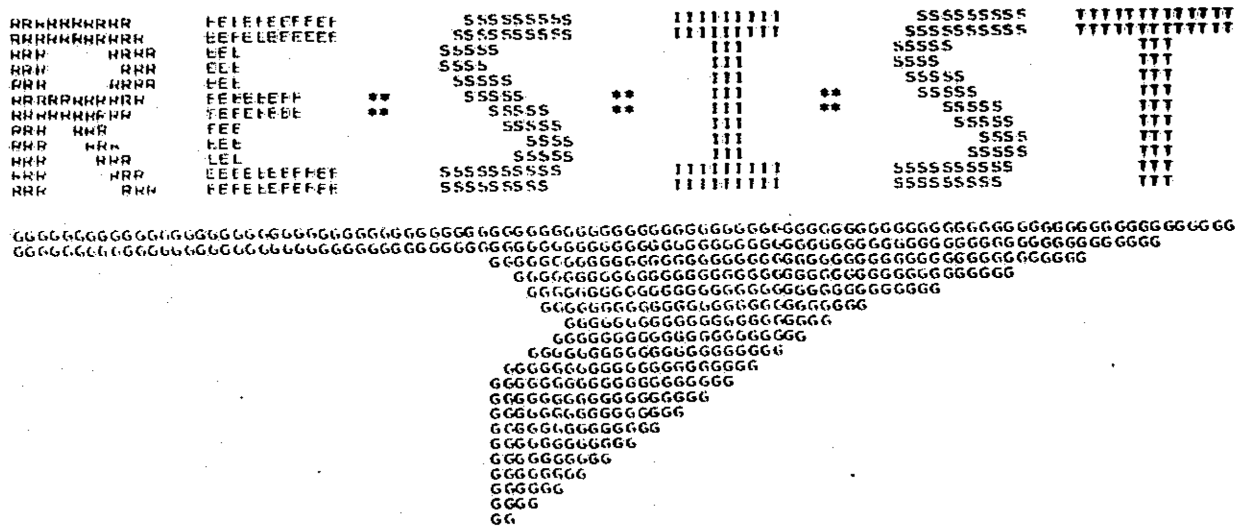
23. Vibrations Option: Stringer strains and stresses if requested in input, the quantity $(\sum_j A_{z_j} \bar{\Phi}_{T,zj})^2$ (printed out as SUM (AREA * DZ)** 2=), and the primary structure modal mass (printed out as P.S. M =).

E. SAMPLE PROBLEMS

Output for a sample statics and vibrations problem, are presented in the remaining pages of this Appendix. Only portions of the output are shown. However, the pages presented are representative of the types of information, and their respective formats, which the RESIST Program can deliver.

S T A T I C   A N D   D Y N A M I C

REUSABLE SURFACE INSULATION STRESSES



VERSION DATE

APRIL 1975

PREPARED BY

I. OJALVO, P. OGILVIE, A. LEVY AND F. AUSTIN

OF GRUMMAN AEROSPACE CORPORATION

FOR

THE LANGLEY RESEARCH CENTER

ORIGINAL PAGE IS
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PROGRAM LISTING OF INPUT DATA CARDS

```
........1.........2.........3.........4.........5.........6.........7.........8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

           TEST PROBLEM   -   NORMAL STATIC PRESSURE
  SEPTEMBER 23, 1975
   1                                 5     .05              7               0    1    2
   1     1     1     1     1     1    0     0     1
   0     0
 0
   6.0          1.0         0.5
  .026
         1          1
                             8.0         0.35         0.1
         6     1           4
  10.E  6        0.5         0.1
         0
  60.E  3     60.E  3     6.E  3       0.5         0.01         0.1
  20.E  3     32.E  3    32.E  3
      90.         90.        90.       .49          0.49         0.49
    30.2        30.2       30.2
         0
  1
       70.    60.E  3
  1
       70.     6.E  3
  1
       70.    22.E  3
  1
       70.       0.5
  1
       70.      0.01
  1
       70.
  1
       70.
  1
       70.
  1
       70.
A2                                 2
B2
C0                                 4
D0
                                                    10.

         1        70.
         0

........1.........2.........3.........4.........5.........6.........7.........8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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O P T I O N S

STATICS PROBLEM

MAXIMUM NO. ITERATIONS # 3 CONVERGENCE PARAMETER # 5.0000E-02

PRIMARY STRUCTURE PLATE STRESSES PRESENTED AFTER EACH ITERATION AT PLATE MID. TOP AND BOTTOM SURFACES

TILES ON PRIMARY STRUCTURE

TILE STRESSES PRESENTED AFTER EACH ITERATION

TILE NODE MAP REQUIRED

TILE ELEMENT MAP REQUIRED

TILE NODE COORDINATES REQUIRED

DO NOT PRINT ELEMENT STIFFNESS MATRICES

DO NOT PRINT ASSEMBLED STIFFNESS MATRICES

PRINT FILE DEBUGGING INFORMATION

COMPUTE STRESSES FOR ALL TILES

G E O M E T R Y

PLATE	LX =	6.0000E 00	LY =	1.0000E 00	TP =	5.0000E-01		
STRINGERS	YI =	2.0000E 00	ZS =	0.0	YS =	0.0	AS =	0.0
	IYo =	0.0	IZo =	0.0	JXo =	0.0	BETA S =	0.0
TILES	NXB =	1	NYB =	1				
	T =	0.0	BI =	0.0	TZ =	2.0000E 00		
	TA =	5.0000E-01	TI =	8.0000E-01	TC =	0.0		
BRICK	NB1 =	0	NB2 =	6	ND2 =	1		
	NT1 =	0	NT2 =	4				

M A T E R I A L   P R O P E R T I E S

PLATE	EP =	1.0000E 07	NU P =	3.0000E-01	GAMMA P =	1.0000E-01	ALPHA P =	0.0
STRINGERS	ES =	0.0	NU S =	0.0	GAMMA S =	0.0	ALPHA S =	0.0
ARRESTOR OR RSI	EX =	6.0000E 04	EY =	6.0000E 04	EZ =	6.0000E 03		
	NU XY =	5.0000E-01	NU YZ =	1.0000E-02	NU ZX =	1.0000E-01		
	GXY =	2.0000E 04	GYZ =	3.2000E 04	GZX =	3.2000E 04		
	GAMMA A =	0.0						
	ALPHA X =	0.0	ALPHA Y =	0.0	ALPHA Z =	0.0		
ISOLATOR	EX =	9.0000E 01	EY =	9.0000E 01	EZ =	9.0000E 01		
	NU XY =	4.9000E-01	NU YZ =	4.9000E-01	NU ZX =	4.9000E-01		
	GXY =	3.0200E 01	GYZ =	3.0200E 01	GZX =	3.0200E 01		
	GAMMA I =	0.0	ALPHA I =	0.0				
RSI	GAMMA R =	0.0						
			ALPHA RY / ALPHA RX =	0.0			ALPHA RZ / ALPHA RX =	0.0

TEMPERATURE DEPENDENT MATERIAL PROPERTIES

		TEMPERATURE	PROPERTY	TEMPERATURE	PROPERTY	TEMPERATURE	PROPERTY	TEMPERATURE	PROPERTY
1	ER	ALL	6.000E 04						
1	ER*	ALL	6.000E 03						
1	GR*	ALL	3.200E 04						
1	NU R	ALL	5.000E-01						
1	NU R*	ALL	1.000E-02						
1	ALPHA R	ALL	0.0						
1	EC	ALL	0.0						
1	NU C	ALL	0.0						
1	ALPHA C	ALL	0.0						

FROM PUTLAB.
NAME = GEOMETRY. I/O UNIT = 10. FILE = 1. ROWS = 14. COLUMNS = 5

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B O U N D A R Y   C O N D I T I O N S

EDGE	PLATE OUT OF PLANE	PLATE IN PLANE	STRINGERS	
A	PINNED	U HELD, V FREE	FREE	FREE
B	PINNED	FREE	FREE	FREE
C	FREE	V HELD, U FREE		
D	FREE	FREE		

```
FROM PUTLAB,
NAME = BND COND.,   I/O UNIT =  1,  FILE =  1,  ROWS =    14,  COLUMNS =   11
FROM PUTLAB,
NAME = MEMBERS  ,   I/O UNIT = 17,  FILE =  1,  ROWS =     6,  COLUMNS =  100
FROM PUTLAB,
NAME =  LOADS   ,   I/O UNIT =  3,  FILE =  1,  ROWS =    17,  COLUMNS =    1
```

S T A T I C   L O A D I N G

```
      NX =   0.0              NY =   0.0          NXY =   0.0          NYX =   0.0
      PZ =   1.0000E 01        T =   0.0            M =   0.0            V =   0.0

 DEL TEMP P =   0.0                          DEL TEMP S =   0.0
FROM PUTLAB,
NAME =  LOADS   ,   I/O UNIT =  4,  FILE =  1,  ROWS =    14,  COLUMNS =    6
```

R S I   T E M P E R A T U R E S

NO STATIC THERMAL LOADING

UNIFORM TEMPERATURE OPTION

T REFERENCE = 7.0000E 01

DEL T U = T - T REF = 0.0

FROM PUTLAB.
NAME = JEGGNYQL. I/O UNIT = 7. FILE = 1. ROWS = 36. COLUMNS = 81

NODE MAP

SURFACE 1

86	88	90	92	94	96	98
85	87	89	91	93	95	97

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NODE MAP

SURFACE 2

72	74	76	78	80	82	84
71	73	75	77	79	81	83

PRIMARY STRUCTURE — GLOBAL GEOMETRY / DEGREES OF FREEDOM

NODE	X	Y	Z	DX	DY	DZ	RX	RY	RZ
1	0.0	0.0	0.0	0	0	0	1	2	0
2	0.0	1.000000E 00	0.0	0	3	0	4	5	0
3	1.000000E 00	0.0	0.0	6	0	7	8	9	0
4	1.000000E 00	1.000000E 00	0.0	10	11	12	13	14	0
5	2.000000E 00	0.0	0.0	15	0	16	17	18	0
6	2.000000E 00	1.000000E 00	0.0	19	20	21	22	23	0
7	3.000000E 00	0.0	0.0	24	0	25	26	27	0
8	3.000000E 00	1.000000E 00	0.0	28	29	30	31	32	0
9	4.000000E 00	0.0	0.0	33	0	34	35	36	0
10	4.000000E 00	1.000000E 00	0.0	37	38	39	40	41	0
11	5.000000E 00	0.0	0.0	42	0	43	44	45	0
12	5.000000E 00	1.000000E 00	0.0	46	47	48	49	50	0
13	6.000000E 00	0.0	0.0	51	0	0	52	53	0
14	6.000000E 00	1.000000E 00	0.0	54	55	0	56	57	0

```
FROM SAMAIN. AFTER PROCES - CALCULATE D.O.F. AND ASSIGN B.C.
***** ELAPSED TIME IS ........    [illegible] MINUTES.    7.17  SECONDS *****
***** INCREMENTAL TIME IS ....    0 MINUTES.    0.12  SECONDS *****

FROM GETDIM.
NAME # MEMBERS .  I/O UNIT # 17.  FILE #  1.  ROWS #     6.  COLUMNS #  100

FROM PUTLAB.
NAME # EL STIFF.  I/O UNIT #  9.  FILE #  1.  ROWS #    12.  COLUMNS #    24
```

PRIMARY STRUCTURE DEFLECTIONS FOR ITERATION NO- 1

NODE	DX	DY	DZ	RX	RY	RZ
1				-2.571537E-06	6.399191E-04	
2		0.0		2.571835E-06	6.399254E-04	
3	0.0		-8.068923E-04	3.639201E-05	7.205624E-04	
4	0.0	0.0	-8.068995E-04	-3.640621E-05	7.205880E-04	
5	0.0		-1.386983E-03	5.817191E-05	4.083205E-04	
6	0.0	0.0	-1.386993E-03	-5.819020E-05	4.083209E-04	
7	0.0		-1.596349E-03	6.538162E-05	4.055849E-09	
8	0.0	0.0	-1.596359E-03	-6.539718E-05	4.417601E-09	
9	0.0		-1.386992E-03	5.817006E-05	-4.083160E-04	
10	0.0	0.0	-1.367002E-03	-5.819180E-05	-4.083167E-04	
11	0.0		-8.069030E-04	3.639559E-05	-7.205906E-04	
12	0.0	0.0	-8.069091E-04	-3.640531E-05	-7.205945E-04	
13	0.0			-2.571737E-06	-8.399326E-04	
14	0.0	0.0		2.571995E-06	-8.399368E-04	

FROM SBMAIN, AFTER MSOUT
***** ELAPSED TIME IS .... 0 MINUTES, 9.40 SECONDS *****
***** INCREMENTAL TIME IS ..... 0 MINUTES, 0.13 SECONDS *****

FROM GETDIM,
NAME # BND.COND. I/O UNIT # 1, FILE # 1, ROWS # 14, COLUMNS # 11

FROM GETDIM,
NAME # DEFLECT . I/O UNIT # 10, FILE # 2, ROWS # 57, COLUMNS # 1

FROM GETDIM,
NAME # LOADS . I/O UNIT # 4, FILE # 1, ROWS # 14, COLUMNS # 6

FROM PUTLAB,
NAME # LOADS . I/O UNIT # 3, FILE # 1, ROWS # 57, COLUMNS # 1

FROM PUTLAB,
NAME # LOADS . I/O UNIT # 14, FILE # 1, ROWS # 42, COLUMNS # 1

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PRIMARY STRUCTURE NODES ASSOCIATED WITH TILE NO. 1

1    3    5    7    9    11   13
2    4    6    8    10   12   14

     FROM PUTLAB.
     NAME = LOADS    .  I/O UNIT = 9.  FILE = 1.  ROWS =    1.  COLUMNS =    1

     FROM GETDIM.
     NAME = NAMEA    .  I/O UNIT = 11. FILE = 1.  ROWS =  252.  COLUMNS =   42

     FROM GETDIM.
     NAME = LOADS    .  I/O UNIT = 14. FILE = 1.  ROWS =   42.  COLUMNS =    1

     FROM PUTLAB.
     NAME = GO OA  C.   I/O UNIT = 17. FILE = 1.  ROWS =  252.  COLUMNS =    1

     FROM GETDIM.
     NAME = NAMEA    .  I/O UNIT = 13. FILE = 2.  ROWS =  252.  COLUMNS =    1

     FROM GETDIM.
     NAME = GO OA  C.   I/O UNIT = 17. FILE = 1.  ROWS =  252.  COLUMNS =    1

     FROM PUTLAB.
     NAME = NAMEA    .  I/O UNIT = 14. FILE = 2.  ROWS =  252.  COLUMNS =    1

     FROM GETDIM.
     NAME = NAMEA    .  I/O UNIT = 18. FILE = 1.  ROWS =  252.  COLUMNS =  252

     FROM PUTLAB.
     NAME =          .  I/O UNIT = 20. FILE = 3.  ROWS =  252.  COLUMNS =  252

     FROM PUTLAB.
     NAME =          .  I/O UNIT = 19. FILE = 1.  ROWS =  252.  COLUMNS =  252

     FROM PUDSYM, AFTER QFACT
     ***** ELAPSED TIME IS ........     4  MINUTES.   11.36  SECONDS *****
     ***** INCREMENTAL TIME IS ....     0  MINUTES.    1.90  SECONDS *****

     FROM GETDIM.
     NAME =          .  I/O UNIT = 20. FILE = 3.  ROWS =  252.  COLUMNS =  252

     FROM PUTLAB.
     NAME =          .  I/O UNIT = 2.  FILE = 1.  ROWS =  252.  COLUMNS =  252
```

PRIMARY STRUCTURE DEFLECTIONS FOR ITERATION NO. 2

NODE	DX	DY	DZ	RX	RY	RZ
1				-2.376204E-06	7.512970E-04	
2		9.143224E-08		2.376396E-06	7.513009E-04	
3	9.891772E-08		-7.206451E-04	3.386522E-05	6.405059E-04	
4	1.102952E-07	6.485760E-08	-7.206502E-04	-3.387472E-05	6.405097E-04	
5	2.095247E-07		-1.233010E-03	5.152416E-05	3.587529E-04	
6	2.175903E-07	3.885304E-08	-1.233016E-03	-5.153510E-05	3.587534E-04	
7	3.283773E-07		-1.416338E-03	5.696373E-05	4.555410E-09	
8	3.284314E-07	3.033570E-08	-1.416343E-03	-5.697386E-05	4.287930E-09	
9	4.472565E-07		-1.233019E-03	5.152341E-05	-3.587492E-04	
10	4.393011E-07	3.664118E-08	-1.233025E-03	-5.153648E-05	-3.587492E-04	
11	5.592888E-07		-7.206560E-04	3.386816E-05	-6.405131E-04	
12	5.456802E-07	6.329452E-08	-7.206594E-04	-3.387434E-05	-6.405157E-04	
13	6.644791E-07			-2.376334E-06	-7.513096E-04	
14	6.490829E-07	9.493925E-08		2.376626E-06	-7.513121E-04	

PRIMARY STRUCTURE DEFLECTIONS FOR ITERATION NO. 3

NODE	DX	DY	DZ	RX	RY	RZ
1		6.667693E-08		-2.398289E-06	7.614860E-04	
2				2.398601E-06	7.614903E-04	
3	9.557641E-08	6.494201E-08	-7.305669E-04	3.414995E-05	6.497325E-04	
4	1.056899E-07		-7.305718E-04	-3.415927E-05	6.497358E-04	
5	2.018373E-07	4.191661E-08	-1.250752E-03	5.229021E-05	3.644882E-04	
6	2.089645E-07		-1.250757E-03	-5.230139E-05	3.644875E-04	
7	3.156060E-07	3.446535E-08	-1.437097E-03	5.794145E-05	4.664160E-09	
8	3.156542E-07		-1.437103E-03	-5.795261E-05	4.409507E-09	
9	4.293984E-07	4.172981E-08	-1.250761E-03	5.228892E-05	-3.644833E-04	
10	4.223697E-07		-1.250766E-03	-5.230239E-05	-3.644831E-04	
11	5.369311E-07	6.354719E-08	-7.305788E-04	3.415275E-05	-6.497402E-04	
12	5.248264E-07		-7.305824E-04	-3.415921E-05	-6.497430E-04	
13	6.381047E-07	9.180695E-08		-2.398456E-06	-7.615001E-04	
14	6.243649E-07			2.398731E-06	-7.615027E-04	

FROM SBMAIN, AFTER MSOUT
***** ELAPSED TIME IS ******** 0 MINUTES. 20.36 SECONDS *****
***** INCREMENTAL TIME IS ***** 0 MINUTES. 0.13 SECONDS *****

FROM GETDIM,
NAME = DEFLECT , I/O UNIT = 10, FILE = 2, ROWS = 57, COLUMNS = 1

FROM GETDIM,
NAME = DEFLECT , I/O UNIT = 14, FILE = 1, ROWS = 57, COLUMNS = 1

MAXIMUM DEFLECTION = -1.43710E-03 FOR DOF 30

MAXIMUM DEFLECTION DIFFERENCE = 2.07599E-05 FOR DOF 30

MAXIMUM CONVERGENCE PARAMETER = 1.44456E-02

SOLUTION HAS CONVERGED

FROM GETDIM,
NAME = BND COND, I/O UNIT = 1, FILE = 1, ROWS = 14, COLUMNS = 11

FROM GETDIM,
NAME = DEFLECT , I/O UNIT = 10, FILE = 2, ROWS = 57, COLUMNS = 1

FROM GETDIM,
NAME = LOADS , I/O UNIT = 4, FILE = 1, ROWS = 14, COLUMNS = 6

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TPS DISPLACEMENTS FOR TILE NO. 1 AND ITERATION NO. 3

NODE	X COMPONENT(U)	Y COMPONENT(V)	Z COMPONENT(W)
1	1.0037165E-04	9.9957233E-07	0.0
2	1.0037258E-04	-5.1097339E-07	0.0
3	1.0252870E-04	-8.5374886E-06	-7.3056691E-04
4	1.0253963E-04	8.6047585E-06	-7.3057180E-04
5	9.1323891E-05	-1.3072553E-05	-1.2507518E-03
6	9.1330832E-05	1.3117266E-05	-1.2507574E-03
7	3.1677200E-07	-1.4485362E-05	-1.4370973E-03
8	3.1675660E-07	1.4522618E-05	-1.4371031E-03
9	-9.0691436E-05	-1.3072229E-05	-1.2507613E-03
10	-9.0696406E-05	1.3117327E-05	-1.2507678E-03
11	-1.0189812E-04	-8.5381671E-06	-7.3057879E-04
12	-1.0191092E-04	8.6033488E-06	-7.3058228E-04
13	-1.0973691E-04	9.9961394E-07	0.0
14	-1.0975130E-04	-5.0787588E-07	0.0
15	-2.4367115E-04	-2.3677043E-05	-9.4766752E-04
16	-2.4361900E-04	2.3652872E-05	-9.4762165E-04
17	-2.3468351E-04	-1.1854650E-05	-1.4202336E-03
18	-2.3463392E-04	1.1729229E-05	-1.4201760E-03
19	-1.3814602E-04	4.5058380E-06	-1.7951399E-03
20	-1.3810047E-04	-4.7274036E-06	-1.7950851E-03
21	3.7593543E-07	8.9210182E-06	-1.9353996E-03
22	4.1727407E-07	-9.2282435E-06	-1.9353414E-03
23	1.3889305E-04	2.4261781E-06	-1.7951517E-03
24	1.3893543E-04	-2.8061004E-06	-1.7950917E-03
25	2.3542752E-04	-1.2019112E-05	-1.4202539E-03
26	2.3546987E-04	1.1564553E-05	-1.4201917E-03
27	2.4441365E-04	-2.3930916E-05	-9.4769849E-04
28	2.4445672E-04	2.3403249E-05	-9.4763678E-04
29	-1.0217422E-04	-8.2324805E-06	-2.0492228E-03
30	-1.0212176E-04	8.1469989E-06	-2.0491474E-03
31	-7.6192548E-05	-4.3355949E-06	-2.3133457E-03
32	-7.6143100E-05	4.1409221E-06	-2.3132695E-03
33	-4.0805200E-05	6.1973833E-07	-2.5260609E-03
34	-4.0760715E-05	-9.0951846E-07	-2.5259813E-03
35	3.7973558E-07	2.6028129E-06	-2.6098564E-03
36	4.7081444E-07	-2.9805497E-06	-2.6097754E-03
37	4.1563384E-05	9.3679759E-07	-2.5260854E-03
38	4.1602761E-05	-9.9202589E-07	-2.5259992E-03
39	7.6947952E-05	-4.5048528E-06	-2.3133967E-03
40	7.6985918E-05	3.9712922E-06	-2.3133061E-03
41	1.0292359E-04	-8.4943449E-06	-2.0492954E-03
42	1.0296563E-04	7.8868507E-06	-2.0492096E-03
43	-1.9761619E-05	-1.0371151E-05	-3.0715843E-03
44	-1.9407879E-05	1.0200988E-05	-3.0714895E-03
45	-5.0682893E-06	-9.9306851E-06	-3.1826382E-03
46	-5.0188683E-06	9.6492649E-06	-3.1825465E-03
47	9.5457654E-07	-1.0531418E-05	-3.2865147E-03
48	1.0005779E-06	1.0154680E-05	-3.2864225E-03
49	3.8502208E-07	-1.0859121E-05	-3.3276265E-03
50	4.1782000E-07	1.0393533E-05	-3.3275315E-03

STRESSES FOR ISOLATOR AND ARRESTOR FOR TILE NO. 1 AND ITERATION NO. 3

	LOCAL COORDINATES X	Y	Z	STRESSES XX	YY	ZZ	XY	YZ	ZX
			ELEMENT NUMBER	1					
1	7.8868E-01	7.8868E-01	7.8867E-02	-1.0912E 01	-1.0913E 01	-1.1364E 01	-1.2966E-04	1.3100E-03	-1.4141E-01
2	7.8868E-01	2.1132E-01	7.8867E-02	-1.0913E 01	-1.0913E 01	-1.1365E 01	1.2962E-04	-1.3606E-03	-1.4141E-01
3	2.1132E-01	7.8868E-01	7.8867E-02	-1.3104E 01	-1.3104E 01	-1.3646E 01	-1.2967E-04	3.4308E-03	-1.5655E-01
4	2.1132E-01	2.1132E-01	7.8867E-02	-1.3104E 01	-1.3105E 01	-1.3646E 01	1.2962E-04	-3.4677E-03	-1.5655E-01
5	7.8868E-01	7.8868E-01	2.1132E-02	-1.1002E 01	-1.1001E 01	-1.1451E 01	8.1706E-05	1.3090E-03	-1.4591E-01
6	7.8868E-01	2.1132E-01	2.1132E-02	-1.1003E 01	-1.1001E 01	-1.1452E 01	-8.1798E-05	-1.3616E-03	-1.4591E-01
7	2.1132E-01	7.8868E-01	2.1132E-02	-1.3215E 01	-1.3214E 01	-1.3754E 01	8.1578E-05	3.4300E-03	-1.6104E-01
8	2.1132E-01	2.1132E-01	2.1132E-02	-1.3215E 01	-1.3214E 01	-1.3754E 01	-8.1926E-05	-3.4666E-03	-1.6105E-01
			ELEMENT NUMBER	2					
1	1.7887E 00	7.8868E-01	7.8867E-02	-8.4071E 00	-8.4104E 00	-8.7581E 00	-1.8815E-04	-2.0784E-03	-9.2245E-02
2	1.7887E 00	2.1132E-01	7.8867E-02	-8.4076E 00	-8.4109E 00	-8.7586E 00	1.8141E-04	2.0053E-03	-9.2252E-02
3	1.2113E 00	7.8868E-01	7.8867E-02	-9.6305E 00	-9.6331E 00	-1.0032E 01	-1.8146E-04	-1.6615E-04	-1.2149E-01
4	1.2113E 00	2.1132E-01	7.8867E-02	-9.6310E 00	-9.6337E 00	-1.0033E 01	1.8148E-04	1.0567E-04	-1.2150E-01
5	1.7887E 00	7.8868E-01	2.1132E-02	-8.5362E 00	-8.5329E 00	-8.8814E 00	9.0236E-06	-2.0795E-03	-9.4778E-02
6	1.7887E 00	2.1132E-01	2.1132E-02	-8.5367E 00	-8.5334E 00	-8.8819E 00	-9.2113E-06	2.0042E-03	-9.4785E-02
7	1.2113E 00	7.8868E-01	2.1132E-02	-9.7784E 00	-9.7751E 00	-1.0174E 01	9.0939E-06	-1.6723E-04	-1.2403E-01
8	1.2113E 00	2.1132E-01	2.1132E-02	-9.7789E 00	-9.7756E 00	-1.0175E 01	-9.1408E-06	1.0480E-04	-1.2403E-01
			ELEMENT NUMBER	3					
1	2.7887E 00	7.8868E-01	7.8867E-02	-7.3880E 00	-7.3938E 00	-7.7003E 00	-8.3640E-05	-3.8694E-03	-1.9151E-02
2	2.7887E 00	2.1132E-01	7.8867E-02	-7.3885E 00	-7.3943E 00	-7.7008E 00	8.3597E-05	3.7732E-03	-1.9156E-02
3	2.2113E 00	7.8868E-01	7.8867E-02	-7.7736E 00	-7.7790E 00	-8.1019E 00	-8.3556E-05	-3.0707E-03	-5.9172E-02
4	2.2113E 00	2.1132E-01	7.8867E-02	-7.7741E 00	-7.7796E 00	-8.1025E 00	8.3680E-05	2.9879E-03	-5.9179E-02
5	2.7887E 00	7.8868E-01	2.1132E-02	-7.5546E 00	-7.5509E 00	-7.8589E 00	-4.4759E-05	-3.8705E-03	-1.9954E-02
6	2.7887E 00	2.1132E-01	2.1132E-02	-7.5552E 00	-7.5515E 00	-7.8595E 00	4.3638E-06	3.7721E-03	-1.9962E-02
7	2.2113E 00	7.8868E-01	2.1132E-02	-7.9480E 00	-7.9442E 00	-8.2683E 00	-4.3651E-06	-3.0716E-03	-5.9975E-02
8	2.2113E 00	2.1132E-01	2.1132E-02	-7.9485E 00	-7.9448E 00	-8.2689E 00	4.4749E-06	2.9869E-03	-5.9982E-02
			ELEMENT NUMBER	4					
1	3.7887E 00	7.8868E-01	7.8867E-02	-7.7735E 00	-7.7790E 00	-8.1019E 00	8.3707E-05	-3.0898E-03	5.9227E-02
2	3.7887E 00	2.1132E-01	7.8867E-02	-7.7741E 00	-7.7796E 00	-8.1025E 00	-8.3514E-05	2.9690E-03	5.9219E-02
3	3.2113E 00	7.8868E-01	7.8867E-02	-7.3880E 00	-7.3938E 00	-7.7002E 00	8.3719E-05	-3.8746E-03	1.9206E-02
4	3.2113E 00	2.1132E-01	7.8867E-02	-7.3885E 00	-7.3943E 00	-7.7008E 00	-8.3502E-05	3.7681E-03	1.9199E-02
5	3.7887E 00	7.8868E-01	2.1132E-02	-7.9480E 00	-7.9442E 00	-8.2683E 00	4.4068E-06	-3.0910E-03	6.0031E-02
6	3.7887E 00	2.1132E-01	2.1132E-02	-7.9485E 00	-7.9448E 00	-8.2689E 00	-4.4261E-06	2.9678E-03	6.0022E-02
7	3.2113E 00	7.8868E-01	2.1132E-02	-7.5546E 00	-7.5509E 00	-7.8589E 00	4.4992E-06	-3.8757E-03	2.0010E-02
8	3.2113E 00	2.1132E-01	2.1132E-02	-7.5552E 00	-7.5515E 00	-7.8595E 00	-4.3334E-06	3.7670E-03	2.0002E-02
			ELEMENT NUMBER	5					
1	4.7887E 00	7.8868E-01	7.8867E-02	-9.6306E 00	-9.6332E 00	-1.0032E 01	1.8161E-04	-2.1006E-04	1.2155E-01
2	4.7887E 00	2.1132E-01	7.8867E-02	-9.6311E 00	-9.6337E 00	-1.0033E 01	-1.8134E-04	6.1926E-05	1.2154E-01
3	4.2113E 00	7.8868E-01	7.8867E-02	-8.4070E 00	-8.4104E 00	-8.7581E 00	1.8163E-04	-2.1079E-03	9.2301E-02
4	4.2113E 00	2.1132E-01	7.8867E-02	-8.4076E 00	-8.4110E 00	-8.7587E 00	-1.8132E-04	1.9759E-03	9.2292E-02
5	4.7887E 00	7.8868E-01	2.1132E-02	-9.7784E 00	-9.7751E 00	-1.0174E 01	-9.1178E-06	-2.1122E-04	1.2408E-01
6	4.7887E 00	2.1132E-01	2.1132E-02	-9.7790E 00	-9.7757E 00	-1.0175E 01	9.1204E-06	6.0757E-05	1.2407E-01
7	4.2113E 00	7.8868E-01	2.1132E-02	-8.5362E 00	-8.5329E 00	-8.8814E 00	-9.0371E-06	-2.1091E-03	9.4834E-02
8	4.2113E 00	2.1132E-01	2.1132E-02	-8.5368E 00	-8.5334E 00	-8.8820E 00	9.2010E-06	1.9747E-03	9.4825E-02

ORIGINAL PAGE IS OF POOR QUALITY

STRESSES AND DIRECT STRAINS FOR TILE NO. 1 AND ITERATION NO. 3

MEM	TEMP	LOCAL COORDINATES X	Y	Z	* STRAINS XX	YY	ZZ	* STRESSES XX	YY	ZZ	XY	YZ	ZX *
1	0.	0.50	0.50	0.05	1.557E-05	2.174E-05	-8.186E-03	-1.206E 01	-1.206E 01	-1.255E 01	-6.606E-08	-2.232E-05	-1.512E-01
2	0.	1.50	0.50	0.05	1.266E-05	1.542E-05	-6.170E-03	-9.088E 00	-9.088E 00	-9.462E 00	-4.176E-08	-3.389E-05	-1.081E-01
3	0.	2.50	0.50	0.05	2.375E-05	7.954E-06	-5.213E-03	-7.666E 00	-7.667E 00	-7.983E 00	1.022E-08	-4.530E-05	-3.957E-02
4	0.	3.50	0.50	0.05	2.375E-05	7.953E-06	-5.213E-03	-7.666E 00	-7.667E 00	-7.983E 00	6.918E-08	-5.741E-05	3.961E-02
5	0.	4.50	0.50	0.05	1.266E-05	1.542E-05	-6.170E-03	-9.088E 00	-9.088E 00	-9.462E 00	9.240E-08	-7.064E-05	1.082E-01
6	0.	5.50	0.50	0.05	1.557E-05	2.174E-05	-8.187E-03	-1.206E 01	-1.206E 01	-1.255E 01	8.614E-08	-8.509E-05	1.513E-01
7	0.	0.50	0.50	0.35	4.248E-05	2.394E-05	-1.995E-03	1.969E 00	1.228E 00	-1.194E 01	-3.403E-05	-5.960E-05	-5.873E-01
8	0.	1.50	0.50	0.35	6.596E-05	6.324E-06	-1.624E-03	3.591E 00	1.205E 00	-9.696E 00	-1.122E-05	-7.451E-05	-1.215E 00
9	0.	2.50	0.50	0.35	8.985E-05	-7.624E-06	-1.405E-03	5.210E 00	1.311E 00	-8.367E 00	-2.998E-06	-4.470E-05	-4.699E-01
10	0.	3.50	0.50	0.35	8.985E-05	-7.624E-06	-1.405E-03	5.210E 00	1.311E 00	-8.367E 00	5.731E-05	-3.725E-05	4.698E-01
11	0.	4.50	0.50	0.35	6.596E-05	6.324E-06	-1.624E-03	3.590E 00	1.205E 00	-9.696E 00	5.566E-05	-5.960E-05	1.215E 00
12	0.	5.50	0.50	0.35	4.248E-05	2.394E-05	-1.995E-03	1.969E 00	1.228E 00	-1.194E 01	9.177E-05	-1.416E-04	5.873E-01
13	0.	0.50	0.50	0.85	2.044E-05	1.625E-05	-1.892E-03	1.468E-02	-1.527E-01	-1.135E 01	-7.421E-05	-2.960E-05	-1.096E 00
14	0.	1.50	0.50	0.85	2.070E-05	1.180E-05	-1.630E-03	1.727E-01	-1.833E-01	-9.779E 00	-8.476E-06	-5.960E-05	-1.453E 00
15	0.	2.50	0.50	0.85	2.031E-05	6.707E-06	-1.478E-03	1.987E-01	-2.652E-01	-8.870E 00	-1.222E-05	-2.980E-05	-6.620E-01
16	0.	3.50	0.50	0.85	2.031E-05	6.707E-06	-1.478E-03	1.987E-01	-2.652E-01	-8.870E 00	3.314E-05	1.490E-05	6.619E-01
17	0.	4.50	0.50	0.85	2.070E-05	1.180E-05	-1.630E-03	1.726E-01	-1.834E-01	-9.779E 00	-1.264E-05	1.490E-05	1.453E 00
18	0.	5.50	0.50	0.85	2.043E-05	1.625E-05	-1.892E-03	1.449E-02	-1.528E-01	-1.135E 01	3.183E-05	-1.043E-04	1.096E 00
19	0.	0.50	0.50	1.35	1.310E-05	2.064E-05	-1.788E-03	-2.723E-01	2.935E-02	-1.073E 01	-7.034E-05	-3.725E-05	-8.589E-01
20	0.	1.50	0.50	1.35	1.850E-06	2.271E-05	-1.647E-03	-9.220E-01	-6.784E-02	-9.894E 00	1.186E-05	-1.490E-05	-1.227E 00
21	0.	2.50	0.50	1.35	-6.942E-06	2.511E-05	-1.560E-03	-1.426E 00	-1.444E-01	-9.377E 00	1.717E-05	-2.235E-05	-5.270E-01
22	0.	3.50	0.50	1.35	-6.943E-06	2.511E-05	-1.560E-03	-1.426E 00	-1.444E-01	-9.377E 00	2.343E-05	-7.451E-06	5.268E-01
23	0.	4.50	0.50	1.35	1.854E-06	2.271E-05	-1.647E-03	-9.221E-01	-6.785E-02	-9.894E 00	-3.565E-06	2.980E-05	1.226E 00
24	0.	5.50	0.50	1.35	1.310E-05	2.064E-05	-1.788E-03	-2.725E-01	2.920E-02	-1.074E 01	4.366E-07	-5.960E-05	8.585E-01
25	0.	0.50	0.50	1.85	1.088E-05	2.106E-05	-1.713E-03	-3.430E-01	6.416E-02	-1.028E 01	-4.906E-05	-1.192E-04	-5.085E-01
26	0.	1.50	0.50	1.85	-2.705E-06	2.577E-05	-1.660E-03	-1.179E 00	-4.036E-02	-9.969E 00	2.485E-05	2.235E-05	-7.603E-01
27	0.	2.50	0.50	1.85	-1.393E-05	3.025E-05	-1.622E-03	-1.855E 00	-8.714E-02	-9.751E 00	2.308E-05	1.490E-05	-3.419E-01
28	0.	3.50	0.50	1.85	-1.393E-05	3.025E-05	-1.622E-03	-1.855E 00	-8.716E-02	-9.751E 00	1.171E-05	-7.451E-06	3.415E-01
29	0.	4.50	0.50	1.85	-2.706E-06	2.577E-05	-1.660E-03	-1.179E 00	-4.035E-02	-9.969E 00	7.822E-06	3.725E-05	7.598E-01
30	0.	5.50	0.50	1.85	1.088E-05	2.106E-05	-1.713E-03	-3.432E-01	6.394E-02	-1.028E 01	2.094E-05	0.0	5.078E-01
31	0.	0.50	0.50	2.35	1.070E-05	2.072E-05	-1.675E-03	-3.210E-01	7.734E-02	-1.005E 01	-5.874E-05	-7.451E-05	-1.519E-01
32	0.	1.50	0.50	2.35	-2.841E-06	2.626E-05	-1.664E-03	-1.176E 00	-1.211E-02	-9.997E 00	-1.384E-05	5.960E-05	-2.767E-01
33	0.	2.50	0.50	2.35	-1.509E-05	3.153E-05	-1.655E-03	-1.936E 00	-7.102E-02	-9.944E 00	-2.918E-05	7.451E-05	-1.299E-01
34	0.	3.50	0.50	2.35	-1.509E-05	3.153E-05	-1.655E-03	-1.936E 00	-7.099E-02	-9.949E 00	-8.549E-07	3.725E-05	1.293E-01
35	0.	4.50	0.50	2.35	-2.839E-06	2.626E-05	-1.664E-03	-1.176E 00	-1.211E-02	-9.997E 00	-3.385E-05	2.235E-05	2.759E-01
36	0.	5.50	0.50	2.35	1.070E-05	2.072E-05	-1.675E-03	-3.211E-01	7.721E-02	-1.005E 01	2.332E-05	6.706E-05	1.510E-01

FROM GETDIM.
NAME # LOADS . I/O UNIT # 9. FILE # 1. ROWS # 1. COLUMNS # 1

FROM GETDIM.
NAME # NAMEA . I/O UNIT # 14. FILE # 2. ROWS # 42. COLUMNS # 1

FROM GETDIM.
NAME # DEFLECT . I/O UNIT # 10. FILE # 2. ROWS # 57. COLUMNS # 1

FROM PUTLAB.
NAME # DEFLECT . I/O UNIT # 14. FILE # 1. ROWS # 57. COLUMNS # 1

FROM SBMAIN. AFTER LUCDEF
***** ELAPSED TIME IS ********* 0 MINUTES. 24.22 SECONDS *****
***** INCREMENTAL TIME IS****** 0 MINUTES. 1.22 SECONDS *****

TOP-POINT PLATE MEMBER STRAINS AND STRESSES FOR ITERATION NO. 3

MEMBER	COORDINATES X	Y	STRAINS EPS X	EPS Y	EPS XY	STRESSES SIG X	SIG Y	SIG XY
1	5.0000E-01	5.0000E-01	-2.7838E-05	8.0158E-06	-2.3667E-09	-2.7949E 02	-3.6671E 00	-1.6905E-0[illegible]
2	1.5000E 00	5.0000E-01	-7.1207E-05	2.1666E-0[illegible]	-1.1691E-09	-7.1107E 02	3.3405E 00	-8.3510E-05
3	2.5000E 00	5.0000E-01	-9.1011E-05	2.7599E-05	-1.2947E-10	-9.0913E 02	3.2496E 00	-9.2634E-04
4	3.5000E 00	5.0000E-01	-9.1012E-05	2.7599E-05	2.0106E-10	-9.0914E 02	3.2446E 00	1.4362E-03
5	4.5000E 00	5.0000E-01	-7.1210E-05	2.1666E-05	7.2554E-11	-7.1110E 02	3.3260E 00	5.1624E-04
6	5.5000E 00	5.0000E-01	-2.7840E-05	8.0170E-06	-1.5391E-10	-2.7950E 02	-3.6797E 00	-1.0651E-03

FROM GETDIM.
NAME # BND COND. I/O UNIT # 1. FILE # 1. ROWS # 1?. COLUMNS # 11

FROM GETDIM.
NAME # DEFLECT . I/O UNIT # 10. FILE # 2. ROWS # 57. COLUMNS # 1

ORIGINAL PAGE IS
OF POOR QUALITY

BOTTOM-POINT PLATE MEMBER STRAINS AND STRESSES FOR ITERATION NO. 3

MEMBER	COORDINATES X	COORDINATES Y	STRAINS EPS X	STRAINS EPS Y	STRAINS EPS XY	STRESSES SIG X	STRESSES SIG Y	STRESSES SIG XY
1	5.0000E-01	5.0000E-01	2.6039E-05	-7.6622E-06	-4.4440E-09	2.6220E 02	6.0387E 00	-3.1743E-02
2	1.5000E 00	5.0000E-01	7.1416E-05	-2.1559E-0[illegible]	-1.7221E-09	7.1372E 02	-1.4755E 00	-1.2301E-02
3	2.5000E 00	5.0000E-01	9.1241E-05	-2.7523E-05	-9.0035E-12	9.1181E 02	-1.6835E 00	-6.4310E-05
4	3.5000E 00	5.0000E-01	9.1242E-05	-2.7523E-05	-5.9151E-11	9.1182E 02	-1.6805E 00	-4.2180E-04
5	4.5000E 00	5.0000E-01	7.1420E-05	-2.1560E-05	1.2194E-09	7.1375E 02	-1.4708E 00	9.0675E-03
6	5.5000E 00	5.0000E-01	2.6040E-05	-7.6617E-06	1.3[illegible]96E-09	2.6222E 02	6.0485E 00	9.7111E-03

FROM SAMAIN, AFTER SBMAIN - STACK STIFNESS, SOLVE FOR DEFL.,C.F.
***** ELAPSED TIME IS .... 0 MINUTES, 24.53 SECONDS *****
***** INCREMENTAL TIME IS .... 0 MINUTES, 0.32 SECONDS *****

FROM MAIN, AFTER SAMAIN - STRENGTH ANALYSIS
***** ELAPSED TIME IS .... 0 MINUTES, 24.53 SECONDS *****
***** INCREMENTAL TIME IS .... 0 MINUTES, 0.0 SECONDS *****

S T A T I C   A N D   D Y N A M I C

REUSABLE SURFACE INSULATION STRESSES

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RRRRRRRRRR    EEEEEEEEEEE       SSSSSSSSS          IIIIIIIII       SSSSSSSSS    TTTTTTTTTTTT
RRRRRRRRRRR   EEEEEEEEEEE      SSSSSSSSSS          IIIIIIIII      SSSSSSSSSS    TTTTTTTTTTTT
RRR     RRRR  EEE             SSSSS                   III        SSSSS               TTT
RRR      RRR  EEE             SSSS                    III        SSSS                TTT
RRR     RRRR  EEE              SSSSS                  III         SSSSS              TTT
RRRRRRRRRRR   EEEEEEEE   **     SSSSS       **        III     **   SSSSS             TTT
RRRRRRRRRR    EEEEEEEE   **       SSSSS     **        III     **     SSSSS           TTT
RRR   RRR     EEE                  SSSSS              III             SSSSS          TTT
RRR    RRR    EEE                   SSSS              III               SSSS         TTT
RRR     RRR   EEE                  SSSSS              III              SSSSS         TTT
RRR      RRR  EEEEEEEEEEE     SSSSSSSSSS           IIIIIIIII     SSSSSSSSSS          TTT
RRR       RRR EEEEEEEEEEE     SSSSSSSSS            IIIIIIIII     SSSSSSSSS           TTT

GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG
GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG
                                    GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG
                                      GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG
                                       GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG
                                        GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG
                                          GGGGGGGGGGGGGGGGGGGGGGGGGGG
                                         GGGGGGGGGGGGGGGGGGGGGGGGGGG
                                       GGGGGGGGGGGGGGGGGGGGGGGGGGG
                                     GGGGGGGGGGGGGGGGGGGGGGGGGGG
                                    GGGGGGGGGGGGGGGGGGGGGGGGGGG
                                    GGGGGGGGGGGGGGGGGGGGGGG
                                    GGGGGGGGGGGGGGGGGGGG
                                    GGGGGGGGGGGGGGGGG
                                    GGGGGGGGGGGGGGG
                                    GGGGGGGGGGG
                                    GGGGGGGGG
                                    GGGGGG
                                    GGGG
                                    GG
```

VERSION DATE

APRIL 1975

PREPARED BY

I. OJALVO, P. OGILVIE, A. LEVY AND F. AUSTIN

OF GRUMMAN AEROSPACE CORPORATION

FOR

THE LANGLEY RESEARCH CENTER

PROGRAM LISTING OF INPUT DATA CARDS

```
.........1.........2.........3.........4.........5.........6.........7.........8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

CHECK PROBLEM FOR CLOSED STRINGERS  -  WITH TILES
    JANUARY 17, 1975
    2    3         1    1    2       .05         7        .3    2    1
    1    1    1    1    1    1    0    0    1
         1
   0
      10.       10.       .25                 .01       1.8       2.0
      0.1        .5       4.0        .1       .02       .02      .005        0.
        2         1
       0.        0.        2.        1.        .1       .01
        1    9         1
    10.E6        .3        .1
    10.E6        .3        .1
    60.E3     60.E3      6.E3        .5        .1       .01
    20.E3     32.E3     32.E3      .005
      90.       90.       90.       .49       .49       .49
  30.2013   30.2013   30.2013      .035
     .005
    1
      70.     60.E3
    1
      70.      6.E3
    1
      70.     32.E3
    1
      70.        .5
    1
      70.       .01
    1
      70.        0.
    1
      70.     12.E6
    1
      70.       .25
    1
      70.        0.
A2                            0
B2                            2
C0                            0
D0                            4
A   0    0    0    0    B    0    0    0    0
    0    1         0
       0.
      0.1        .5       4.0        .1     .0001     .0001     .0005        0.

.........1.........2.........3.........4.........5.........6.........7.........8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

OPTIONS

FREE VIBRATION MODES   NO. DESIRED MODES = 3   NO. REORTHOGONALIZATIONS = 1   MODE NO. = 1

MAXIMUM NO. ITERATIONS = 2   CONVERGENCE PARAMETER = 5.0000E-02

OVERHUNG ROTATORY MASS INERTIA ASSOCIATED WITH EACH STRINGER = 3.0000E-01

PRIMARY STRUCTURE PLATE STRESSES PRESENTED AFTER EACH ITERATION AT PLATE MID. TOP AND BOTTOM SURFACES

STRINGER STRESSES PRESENTED AFTER EACH ITERATION

TILES ON PRIMARY STRUCTURE

TILE STRESSES PRESENTED AFTER EACH ITERATION

TILE NODE MAP REQUIRED

TILE ELEMENT MAP REQUIRED

TILE NODE COORDINATES REQUIRED

DO NOT PRINT ELEMENT STIFFNESS MATRICES

DO NOT PRINT ASSEMBLED STIFFNESS MATRICES

PRINT FILE DEBUGGING INFORMATION

COMPUTE STRESSES FOR ALL TILES

C. 2

GEOMETRY

```
PLATE        LX =  1.0000E 01      LY =  1.0000E 01      TP =  2.5000E-01

STRINGERS    Y1 =  1.0000E-01      ZS =  5.0000E-01      YS =  4.0000E 00      AS =  1.0000E-01
            IY* =  2.0000E-02     IZ* =  2.0000E-02     JX* =  5.0000E-03  BETA S =  0.0
             Y2 =  1.8000E 00    TBAR =  1.0000E-02

TILES       NXB =  2              NYB =  1
              T =  0.0             B1 =  0.0             T2 =  2.0000E 00
             TA =  1.0000E 00      T1 =  1.0000E-01      TC =  1.0000E-02
BRICK       NB1 =  0              NB2 =  1              ND2 =  9
            NT1 =  0              NT2 =  1
```

MATERIAL PROPERTIES

```
PLATE          EP =  1.0000E 07      NU P =  3.0000E-01   GAMMA P =  1.0000E-01   ALPHA P =  0.0

STRINGERS      ES =  1.0000E 07      NU S =  3.0000E-01   GAMMA S =  1.0000E-01   ALPHA S =  0.0

ARRESTOR       EX =  6.0000E 04        EY =  6.0000E 04        EZ =  6.0000E 03
 OR RSI     NU XY =  5.0000E-01     NU YZ =  1.0000E-01     NU ZX =  1.0000E-02
              GXY =  2.0000E 04       GYZ =  3.2000E 04       GZX =  3.2000E 04
          GAMMA A =  5.0000E-03
          ALPHA X =  0.0          ALPHA Y =  0.0          ALPHA Z =  0.0

ISOLATOR       EX =  9.0000E 01        EY =  9.0000E 01        EZ =  9.0000E 01
            NU XY =  4.9000E-01     NU YZ =  4.9000E-01     NU ZX =  4.9000E-01
              GXY =  3.0201E 01       GYZ =  3.0201E 01       GZX =  3.0201E 01
          GAMMA I =  3.5000E-02   ALPHA I =  0.0

RSI       GAMMA R =  5.0000E-03                                 ALPHA RZ / ALPHA RX =  0.0
                    ALPHA RY / ALPHA RX =  0.0
```

TEMPERATURE DEPENDENT MATERIAL PROPERTIES

		TEMPERATURE	PROPERTY	TEMPERATURE	PROPERTY	TEMPERATURE	PROPERTY	TEMPERATURE	PROPERTY
1	ER	ALL	6.000E 04						
1	ER*	ALL	6.000E 03						
1	GR*	ALL	3.200E 04						
1	NU R	ALL	5.000E-01						
1	NU R*	ALL	1.000E-02						
1	ALPHA R	ALL	0.0						
1	EC	ALL	1.200E 07						
1	NU C	ALL	2.500E-01						
1	ALPHA C	ALL	0.0						

FROM PUTLAB,
NAME = GEOMETRY, I/O UNIT = 10, FILE = 1, ROWS = 51, COLUMNS = 5

BOUNDARY CONDITIONS

EDGE	PLATE OUT OF PLANE	PLATE IN PLANE	STRINGERS	
A	PINNED	FREE	FREE	FREE
B	PINNED	U HELD, V FREE	FREE	FREE
C	FREE	FREE		
D	FREE	V HELD, U FREE		

```
FROM PUTLAB.
NAME = BND COND.  I/O UNIT =  1.  FILE =  1.  ROWS =   51.  COLUMNS =   11
FROM PUTLAB.
NAME = MEMBERS .  I/O UNIT = 17.  FILE =  1.  ROWS =   36.  COLUMNS =  100
FROM PUTLAB.
NAME =  LOADS  .  I/O UNIT =  3.  FILE =  1.  ROWS =  162.  COLUMNS =    1
FROM PUTLAB.
NAME =  LOADS  .  I/O UNIT =  4.  FILE =  1.  ROWS =   39.  COLUMNS =    6
FROM PUTLAB.
NAME =  LOADS  .  I/O UNIT =  1.  FILE =  2.  ROWS =    3.  COLUMNS = 1000
```

R S I   T E M P E R A T U R E S

NO STATIC THERMAL LOADING

UNIFORM TEMPERATURE OPTION

T REFERENCE =   0.0

DEL T U = T - T REF =   0.0

FROM PUTLAB.
NAME = JEGENYOE.   I/O UNIT = 7. FILE = 1. ROWS =   27. COLUMNS =   81

N O D E   M A P

SURFACE 1

70	80
69	79
68	78
67	77
66	76
65	75
64	74
63	73
62	72
61	71

N O D E   M A P

SURFACE 4

10	20
9	19
8	18
7	17
6	16
5	15
4	14
3	13
2	12
1	11

NODE	LOCAL TILE COORDINATES X	Y	Z	TEMPERATURE
1	0.0	0.0	0.0	0.0
2	0.0	1.11111E 00	0.0	0.0
3	0.0	2.22222E 00	0.0	0.0
4	0.0	3.33333E 00	0.0	0.0
5	0.0	4.44444E 00	0.0	0.0
6	0.0	5.55555E 00	0.0	0.0
7	0.0	6.66666E 00	0.0	0.0
8	0.0	7.77777E 00	0.0	0.0
9	0.0	8.88889E 00	0.0	0.0
10	0.0	1.00000E 01	0.0	0.0
11	5.00000E 00	0.0	0.0	0.0
12	5.00000E 00	1.11111E 00	0.0	0.0
13	5.00000E 00	2.22222E 00	0.0	0.0
14	5.00000E 00	3.33333E 00	0.0	0.0
15	5.00000E 00	4.44444E 00	0.0	0.0
16	5.00000E 00	5.55555E 00	0.0	0.0
17	5.00000E 00	6.66666E 00	0.0	0.0
18	5.00000E 00	7.77777E 00	0.0	0.0
19	5.00000E 00	8.88889E 00	0.0	0.0
20	5.00000E 00	1.00000E 01	0.0	0.0
21	0.0	0.0	1.00000E-01	0.0
22	0.0	1.11111E 00	1.00000E-01	0.0
23	0.0	2.22222E 00	1.00000E-01	0.0
24	0.0	3.33333E 00	1.00000E-01	0.0
25	0.0	4.44444E 00	1.00000E-01	0.0
26	0.0	5.55555E 00	1.00000E-01	0.0
27	0.0	6.66666E 00	1.00000E-01	0.0
28	0.0	7.77777E 00	1.00000E-01	0.0
29	0.0	8.88889E 00	1.00000E-01	0.0
30	0.0	1.00000F 01	1.00000E-01	0.0
31	5.00000E 00	0.0	1.00000E-01	0.0
32	5.00000E 00	1.11111E 00	1.00000E-01	0.0
33	5.00000E 00	2.22222E 00	1.00000E-01	0.0
34	5.00000E 00	3.33333E 00	1.00000E-01	0.0
35	5.00000E 00	4.44444E 00	1.00000E-01	0.0
36	5.00000E 00	5.55555E 00	1.00000E-01	0.0
37	5.00000E 00	6.66666E 00	1.00000E-01	0.0
38	5.00000E 00	7.77777E 00	1.00000E-01	0.0
39	5.00000E 00	8.88889E 00	1.00000E-01	0.0
40	5.00000E 00	1.00000E 01	1.00000E-01	0.0
41	0.0	0.0	1.10000E 00	0.0
42	0.0	1.11111E 00	1.10000E 00	0.0
43	0.0	2.22222E 00	1.10000E 00	0.0
44	0.0	3.33333E 00	1.10000E 00	0.0
45	0.0	4.44444E 00	1.10000E 00	0.0
46	0.0	5.55555E 00	1.10000E 00	0.0
47	0.0	6.66666E 00	1.10000E 00	0.0
48	0.0	7.77777E 00	1.10000E 00	0.0
49	0.0	8.88889E 00	1.10000E 00	0.0
50	0.0	1.00000E 01	1.10000E 00	0.0

PRIMARY STRUCTURE — GLOBAL GEOMETRY / DEGREES OF FREEDOM

NODE	X	Y	Z	DX	DY	DZ	RX	RY	RZ
1	0.0	0.0	0.0	1	2	0	3	4	0
2	0.0	1.111111E 00	0.0	10	11	0	12	13	0
3	0.0	2.222221E 00	0.0	14	15	0	16	17	0
4	0.0	3.333332E 00	0.0	18	19	0	20	21	0
5	0.0	4.444443E 00	0.0	22	23	0	24	25	0
6	0.0	5.555553E 00	0.0	31	32	0	33	34	0
7	0.0	6.666664E 00	0.0	35	36	0	37	38	0
8	0.0	7.777775E 00	0.0	39	40	0	41	42	0
9	0.0	8.888885E 00	0.0	48	49	0	50	51	0
10	0.0	9.999996E 00	0.0	52	0	0	53	54	0
11	5.000000E 00	0.0	0.0	55	56	57	58	59	0
12	5.000000E 00	1.111111E 00	0.0	65	66	67	68	69	0
13	5.000000E 00	2.222221E 00	0.0	70	71	72	73	74	0
14	5.000000E 00	3.333332E 00	0.0	75	76	77	78	79	0
15	5.000000E 00	4.444443E 00	0.0	80	81	82	83	84	0
16	5.000000E 00	5.555553E 00	0.0	90	91	92	93	94	0
17	5.000000E 00	6.666664E 00	0.0	95	96	97	98	99	0
18	5.000000E 00	7.777775E 00	0.0	100	101	102	103	104	0
19	5.000000E 00	8.888885E 00	0.0	110	111	112	113	114	0
20	5.000000E 00	9.999996E 00	0.0	115	0	116	117	118	0
21	1.000000E 01	0.0	0.0	0	119	0	120	121	0
22	1.000000E 01	1.111111E 00	0.0	0	127	0	128	129	0
23	1.000000E 01	2.222221E 00	0.0	0	130	0	131	132	0
24	1.000000E 01	3.333332E 00	0.0	0	133	0	134	135	0
25	1.000000E 01	4.444443E 00	0.0	0	136	0	137	138	0
26	1.000000E 01	5.555553E 00	0.0	0	144	0	145	146	0
27	1.000000E 01	6.666664E 00	0.0	0	147	0	148	149	0
28	1.000000E 01	7.777775E 00	0.0	0	150	0	151	152	0
29	1.000000E 01	8.888885E 00	0.0	0	158	0	159	160	0
30	1.000000E 01	9.999996E 00	0.0	0	0	0	161	162	0
31	0.0	1.111111E 00	-5.000000E-01	5	6	7	8	9	0
32	0.0	4.999998E 00	-5.000000E-01	26	27	28	29	30	0
33	0.0	8.888885E 00	-5.000000E-01	43	44	45	46	47	0
34	5.000000E 00	1.111111E 00	-5.000000E-01	60	61	62	63	64	0
35	5.000000E 00	4.999998E 00	-5.000000E-01	85	86	87	88	89	0
36	5.000000E 00	8.888885E 00	-5.000000E-01	105	106	107	108	109	0
37	1.000000E 01	1.111111E 00	-5.000000E-01	122	123	124	125	126	0
38	1.000000E 01	4.999998E 00	-5.000000E-01	139	140	141	142	143	0
39	1.000000E 01	8.888885E 00	-5.000000E-01	153	154	155	156	157	0
40	0.0	1.111111E 00	-5.805503E-01	0	0	0	0	0	0
41	5.000000E 00	1.111111E 00	-5.805503E-01	0	0	0	0	0	0
42	1.000000E 01	1.111111E 00	-5.805503E-01	0	0	0	0	0	0
43	0.0	4.999998E 00	-5.439394E-01	0	0	0	0	0	0
44	5.000000E 00	4.999998E 00	-5.439394E-01	0	0	0	0	0	0
45	1.000000E 01	4.999998E 00	-5.439394E-01	0	0	0	0	0	0
46	0.0	8.888885E 00	-5.805503E-01	0	0	0	0	0	0
47	5.000000E 00	8.888885E 00	-5.805503E-01	0	0	0	0	0	0
48	1.000000E 01	8.888885E 00	-5.805503E-01	0	0	0	0	0	0
49	-5.000000E-01	-5.000000E-01	-5.805503E-01	0	0	0	0	0	0
50	-5.000000E-01	-5.000000E-01	-5.439394E-01	0	0	0	0	0	0
51	-5.000000E-01	-5.000000E-01	-5.805503E-01	0	0	0	0	0	0

```
FROM GETDIM.
NAME =        .  I/O UNIT = 14.  FILE =  1.  ROWS =  162.  COLUMNS =    1

FROM GETDIM.
NAME = VT     .  I/O UNIT =  2.  FILE =  7.  ROWS =    1.  COLUMNS =  162

FROM GETDIM.
NAME = VT     .  I/O UNIT =  2.  FILE =  7.  ROWS =    1.  COLUMNS =  162

FROM GETDIM.
NAME = VT     .  I/O UNIT =  2.  FILE =  1.  ROWS =    1.  COLUMNS =  162

FROM GETDIM.
NAME = VT     .  I/O UNIT =  2.  FILE =  2.  ROWS =    1.  COLUMNS =  162

FROM GETDIM.
NAME = VT     .  I/O UNIT =  2.  FILE =  3.  ROWS =    1.  COLUMNS =  162

FROM GETDIM.
NAME = VT     .  I/O UNIT =  2.  FILE =  4.  ROWS =    1.  COLUMNS =  162

FROM GETDIM.
NAME = VT     .  I/O UNIT =  2.  FILE =  5.  ROWS =    1.  COLUMNS =  162

FROM GETDIM.
NAME = VT     .  I/O UNIT =  2.  FILE =  6.  ROWS =    1.  COLUMNS =  162

FROM GETDIM.
NAME = VT     .  I/O UNIT =  2.  FILE =  7.  ROWS =    1.  COLUMNS =  162

FROM PUTLAB.
NAME =        .  I/O UNIT =  9.  FILE =  2.  ROWS =    3.  COLUMNS =    8
```

MODE NUMBER	FREQUENCY (RAD / SEC)	FREQUENCY (HERTZ)	FREQ. SQRD. ERROR BOUND (PERCENT)
1	4.709976E 02	7.496158E 01	3.589739E-04
2	5.008137E 02	7.970697E 01	2.090346E-03
3	5.809937E 02	9.246800E 01	4.275488E-02
4	6.504746E 02	1.035262E 02	7.602181E-01
5	6.551184E 02	1.042653E 02	2.213668E-01

```
FROM PUTLAB.
NAME = YT     .  I/O UNIT = 14.  FILE =  1.  ROWS =    3.  COLUMNS =    7

FROM GETDIM.
NAME = YT     .  I/O UNIT = 14.  FILE =  1.  ROWS =    3.  COLUMNS =    7

FROM GETDIM.
NAME = GT     .  I/O UNIT = 12.  FILE =  1.  ROWS =    7.  COLUMNS =  162

FROM PUTLAB.
NAME = GO 0A C.  I/O UNIT = 11.  FILE =  1.  ROWS =    3.  COLUMNS =  162

FROM GETDIM.
NAME = GO 0A C.  I/O UNIT = 11.  FILE =  1.  ROWS =    3.  COLUMNS =  162
```

PRIMARY STRUCTURE MODE SHAPE 1 ITERATION NO. 0

NODE	DX	DY	DZ	RX	RY	RZ
1	4.919000E-03	-1.678641E-03		-2.942944E-04	7.682043E-02	
2	4.084107E-03	-1.411957E-03		3.290614E-04	7.425910E-02	
3	4.074112E-03	-1.144710E-03		2.396555E-04	7.221657E-02	
4	3.765260E-03	-9.881251E-04		1.063764E-04	7.108957E-02	
5	4.106555E-03	-8.362408E-04		8.907168E-05	7.044405E-02	
6	4.086573E-03	-6.735038E-04		-8.306053E-05	7.043189E-02	
7	3.702899E-03	-5.379352E-04		-1.053204E-04	7.105976E-02	
8	3.954943E-03	-4.132716E-04		-2.363409E-04	7.217294E-02	
9	3.875989E-03	-1.966808E-04		-3.249678E-04	7.420176E-02	
10	4.563630E-03			2.940050E-04	7.675540E-02	
11	2.097166E-03	-9.901584E-04	-2.680329E-01	2.344633E-02	-3.134768E-08	
12	2.131586E-03	-9.291884E-04	-2.496006E-01	1.402737E-02	-1.744088E-08	
13	2.041864E-03	-8.977237E-04	-2.387212E-01	8.703038E-03	5.209143E-08	
14	2.031667E-03	-7.627569E-04	-2.317519E-01	5.108826E-03	1.375964E-07	
15	1.960457E-03	-6.208771E-04	-2.285588E-01	1.541893E-03	1.842143E-07	
16	1.945788E-03	-4.772986E-04	-2.285184E-01	-1.453199E-03	1.524410E-07	
17	1.986003E-03	-3.251850E-04	-2.316149E-01	-5.009666E-03	9.771708E-08	
18	1.959547E-03	-1.698416E-04	-2.384981E-01	-8.637246E-03	1.210317E-07	
19	2.005836E-03	-1.053311E-04	-2.493345E-01	-1.399677E-02	8.570913E-08	
20	1.926900E-03		-2.677398E-01	-2.341651E-02	4.749148E-08	
21		-1.192592E-03		-2.939166E-04	-7.682115E-02	
22		-9.815630E-04		3.291129E-04	-7.425970E-02	
23		-7.683667E-04		2.395659E-04	-7.221717E-02	
24		-6.721639E-04		1.064152E-04	-7.109010E-02	
25		-5.828871E-04		8.922491E-05	-7.044441E-02	
26		-4.861078E-04		-8.316951E-05	-7.043225E-02	
27		-4.064254E-04		-1.048868E-04	-7.106000E-02	
28		-3.310554E-04		-2.362609E-04	-7.217282E-02	
29		-1.549540E-04		-3.248467E-04	-7.420152E-02	
30				2.941429E-04	-7.675517E-02	
31	-3.482082E-03	-8.990327E-04	1.755957E-02	2.289671E-02	1.324103E-01	
32	-9.391796E-03	-7.365609E-04	3.793820E-03	6.920351E-05	1.126416E-01	
33	-3.630102E-03	-6.871806E-04	1.737801E-02	-2.091876E-02	1.321325E-01	
34	2.142476E-03	5.162228E-03	-2.696783E-01	-7.941522E-03	-7.358296E-07	
35	1.988815E-03	-5.415280E-04	-2.315412E-01	4.442794E-06	-1.806144E-06	
36	2.021304E-03	-6.195616E-03	-2.692632E-01	7.128641E-03	-2.998483E-06	
37	7.812794E-03	-4.809673E-04	1.747533E-02	2.083176E-02	-1.323642E-01	
38	1.341105E-02	-5.309936E-04	3.766571E-03	1.038217E-06	-1.126223E-01	
39	7.719863E-03	-6.472273E-04	1.732934E-02	-2.111608E-02	-1.320989E-01	

ORIGINAL PAGE IS OF POOR QUALITY

PRIMARY STRUCTURE MODE SHAPE 2 ITERATION NO. 0

NODE	DX	DY	DZ	RX	RY	RZ
1	-4.849359E-03	2.190239E-03		2.817500E-03	-7.034642E-02	
2	-3.123762E-03	1.676313E-03		-2.747379E-03	-5.914012E-02	
3	-2.340957E-03	1.121387E-03		-3.363060E-03	-4.378993E-02	
4	-1.167115E-03	9.899046E-04		-3.560045E-03	-2.755198E-02	
5	-2.878823E-04	7.504032E-04		-4.871536E-03	-9.572677E-03	
6	7.095241E-04	5.275749E-04		-4.873313E-03	9.855520E-03	
7	1.487008E-03	3.142832E-04		-3.566462E-03	2.783487E-02	
8	2.448856E-03	-2.489719E-05		-3.364457E-03	4.407348E-02	
9	2.868306E-03	2.637331E-05		-2.743658E-03	5.942281E-02	
10	4.037179E-03			2.823376E-03	7.063395E-02	
11	-1.710623E-03	-5.561649E-04	3.482147E-01	-8.466661E-02	3.857993E-07	
12	-1.428446E-03	-3.688750E-04	2.706286E-01	-7.299274E-02	6.701354E-07	
13	-9.322513E-04	-6.900168E-05	1.983790E-01	-7.625324E-02	1.348645E-06	
14	-4.600434E-04	-1.585163E-04	1.191365E-01	-8.246887E-02	1.973407E-06	
15	3.577724E-05	-1.085944E-04	3.841567E-02	-8.041823E-02	2.362180E-06	
16	4.817040E-04	-5.182569E-05	-3.943432E-02	-8.037889E-02	2.12248[illegible]E-06	
17	9.171893E-04	1.434729E-05	-1.200892E-01	-8.239686E-02	1.918270E-06	
18	1.238738E-03	2.243814E-04	-1.992781E-01	-7.623649E-02	1.698577E-06	
19	1.506382E-03	5.325566E-05	-2.715546E-01	-7.305592E-02	1.469363E-06	
20	1.461302E-03		-3.492326E-01	-8.478177E-02	1.219348E-06	
21		-1.105369E-03		2.819831E-03	7.034189E-02	
22		-1.497205E-03		-2.746097E-03	5.913816E-02	
23		-1.905987E-03		-3.364791E-03	4.378918E-02	
24		-1.829202E-03		-3.560601E-03	2.755109E-02	
25		-1.786382E-03		-4.870985E-03	9.572532E-03	
26		-1.648711E-03		-4.875410E-03	-9.856660E-03	
27		-1.420960E-03		-3.564668E-03	-2.783646E-02	
28		-1.239074E-03		-3.365011E-03	-4.407473E-02	
29		-5.934353E-04		-2.742795E-03	-5.942386E-02	
30				2.823716E-03	-7.063478E-02	
31	4.182588E-03	-9.196824E-04	-4.253948E-02	-1.182591E-01	-1.777000E-01	
32	1.992079E-04	-2.785766E-03	-1.037227E-04	-4.222771E-02	2.069016E-04	
33	-4.257739E-03	-2.504498E-03	4.131025E-02	-1.103268E-01	1.774374E-01	
34	-1.516406E-03	-3.153683E-02	3.145481E-01	3.740518E-02	7.183909E-06	
35	2.091186E-04	-3.177073E-02	-5.012995E-04	-3.270023E-02	-6.138333E-07	
36	1.550204E-03	-3.116889E-02	-3.151799E-01	3.555856E-02	-7.593579E-05	
37	-7.338256E-03	-4.010994E-03	-4.233489E-02	-1.029906E-01	1.775679E-01	
38	1.500498E-04	-5.009990E-03	8.602838E-05	-4.149028E-02	-3.117353E-04	
39	7.395674E-03	-3.111151E-03	4.290842E-02	-1.073307E-01	-1.781062E-01	

PRIMARY STRUCTURE MODE SHAPE 3 ITERATION NO. 0

NODE	DX	DY	DZ	RX	RY	RZ
1	1.440777E-03	-1.119106E-03		-4.570793E-03	5.573228E-03	
2	1.624142E-04	-4.370969E-04		2.624766E-03	-1.100598E-02	
3	-5.472475E-04	2.891463E-04		1.690917E-03	-3.225750E-02	
4	-1.165792E-03	1.625708E-04		-1.468539E-03	-4.888947E-02	
5	-2.147410E-03	1.447766E-04		-1.348339E-03	-5.723066E-02	
6	-2.194189E-03	-6.905717E-04		1.341424E-03	-5.721913E-02	
7	-1.314473E-03	-7.647618E-04		1.446157E-03	-4.881894E-02	
8	-8.433086E-04	-1.002437E-03		-1.670264E-03	-3.214024E-02	
9	-3.857373E-04	-4.469284E-04		-2.664737E-03	-1.082548E-02	
10	4.624191E-04			4.554048E-03	5.832419E-03	
11	-3.371746E-05	9.339631E-04	-1.726429E-01	1.321144E-01	1.567243E-05	
12	-1.113062E-04	3.719314E-04	-4.480283E-02	1.252103E-01	2.441082E-05	
13	-3.403467E-04	-2.925592E-04	8.147979E-02	1.309879E-01	4.466578E-05	
14	-5.688309E-04	-1.248497E-04	2.110773E-01	1.194575E-01	6.370520E-05	
15	-6.459360E-04	-1.051082E-04	3.028250E-01	5.086844E-02	7.549513E-05	
16	-6.751809E-04	6.938558E-04	3.027269E-01	-5.104968E-02	6.996890E-05	
17	-6.643559E-04	7.467316E-04	2.107910E-01	-1.196688E-01	6.441805E-05	
18	-5.255986E-04	9.813425E-04	8.096701E-02	-1.312417E-01	5.758159E-05	
19	-4.110897E-04	4.211799E-04	-4.562734E-02	-1.255643E-01	5.143791E-05	
20	-4.555786E-04		-1.739107E-01	-1.326334E-01	4.390840E-05	
21		2.561873E-04		-4.496794E-03	-5.699601E-03	
22		8.055761E-04		2.647607E-03	1.093957E-02	
23		1.382763E-03		1.648316E-03	3.221468E-02	
24		1.058621E-03		-1.483989E-03	4.884711E-02	
25		8.149024E-04		-1.333982E-03	5.720918E-02	
26		-2.403597E-04		1.281461E-03	5.717062E-02	
27		-5.068167E-04		1.492866E-03	4.875606E-02	
28		-8.832654E-04		-1.691775E-03	3.208101E-02	
29		-4.004922E-04		-2.644882E-03	1.076647E-02	
30				4.564971E-03	-5.889494E-03	
31	3.031981E-04	3.891068E-03	6.2[illegible]0049E-02	1.891831E-01	1.112527E-01	
32	1.437840E-02	-2.297782E-04	-3.3[illegible]2555E-02	7.198621E-05	-2.592007E-01	
33	-1.087585E-04	-4.727535E-03	6.2[illegible]6758E-02	-1.841992E-01	1.114822E-01	
34	-2.687154E-05	5.324684E-02	-1.0[illegible]8506E-01	-6.197943E-02	-2.552111E-05	
35	-8.343183E-04	2.276191E-04	3.3[illegible]0413E-01	-8.017979E-05	1.048351E-05	
36	-3.239524E-04	-5.265106E-02	-1.085351E-01	5.973361E-02	-2.520144E-05	
37	-2.398443E-04	5.102742E-03	6.211504E-02	1.831992E-01	-1.110014E-01	
38	-1.622823E-02	2.916779E-04	-3.340165E-02	-1.009951E-04	2.592830E-01	
39	-4.348725E-04	-4.685048E-03	6.200104E-02	-1.844091E-01	-1.113570E-01	

```
FROM SBMAIN, AFTER ALARM
***** ELAPSED TIME IS ********      0  MINUTES.   22.80  SECONDS *****
***** INCREMENTAL TIME IS ****      0  MINUTES.   11.23  SECONDS *****

FROM GETDIM,
NAME = EL MASS ,  I/O UNIT =  8,  FILE =  1,  ROWS =   66,  COLUMNS =   24

FROM PUTLAB,
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TPS DISPLACEMENTS FOR TILE NO. 1 AND ITERATION NO. 1

NODE	X COMPONENT(U)	Y COMPONENT(V)	Z COMPONENT(W)
1	1.4521554E-02	-1.6418539E-03	0.0
2	1.3366494E-02	-1.4530898E-03	0.0
3	1.3101183E-02	-1.1746674E-03	0.0
4	1.2651455E-02	-1.0014221E-03	0.0
5	1.2912061E-02	-8.4737455E-04	0.0
6	1.2890559E-02	-6.6312123E-04	0.0
7	1.2585368E-02	-5.2477000E-04	0.0
8	1.2976561E-02	-3.8372888E-04	0.0
9	1.3151206E-02	-1.5605979E-04	0.0
10	1.4158055E-02	-3.6750629E-05	0.0
11	2.0971624E-03	-3.9209463E-03	-2.6803291E-01
12	2.1315834E-03	-2.6826099E-03	-2.4960065E-01
13	2.0418698E-03	-1.9856035E-03	-2.3872119E-01
14	2.0316844E-03	-1.4013601E-03	-2.3175192E-01
15	1.9604799E-03	-8.1361365E-04	-2.2855884E-01
16	1.9458069E-03	-2.9564858E-04	-2.2851843E-01
17	1.9860149E-03	3.0102325E-04	-2.3161489E-01
18	1.9595618E-03	9.0981391E-04	-2.3849809E-01
19	2.0058465E-03	1.6442654E-03	-2.4933445E-01
20	1.9269059E-03	2.9270635E-03	-2.6773977E-01
21	1.3824742E-02	1.0686202E-03	-1.0676635E-03
22	1.3977084E-02	1.0104205E-03	-1.1566849E-04
23	1.[illegible]2741E-02	7.2293472E-04	4.8008095E-04
24	1.4999684E-02	2.2081166E-04	8.5003814E-04
25	1.5229274E-02	-4.2262604E-04	1.0329369E-03
26	1.5197363E-02	-1.1164320E-03	1.0372908E-03
27	1.4902957E-02	-1.7609710E-03	8.6393929E-04
28	1.4398605E-02	-2.2655549E-03	5.0398335E-04
29	1.3741247E-02	-2.5576295E-03	-8.1166741E-05
30	1.3508987E-02	-2.6236884E-03	-1.0212364E-03
31	1.3631355E-02	4.7174469E-03	-2.5761354E-01
32	1.4170222E-02	3.3567357E-03	-2.4827802E-01
33	1.5245069E-02	2.3656536E-03	-2.4012083E-01
34	1.6090564E-02	1.2458430E-03	-2.3470795E-01
35	1.6528927E-02	3.8121419E-05	-2.3207068E-01
36	1.6497560E-02	-1.1945327E-03	-2.3203206E-01
37	1.5995774E-02	-2.4030686E-03	-2.3459196E-01
38	1.5083637E-02	-3.5241782E-03	-2.3993725E-01
39	1.3936576E-02	-4.5141764E-03	-2.4804688E-01
40	1.3317052E-02	-5.8703721E-03	-2.5734198E-01
41	6.3435376E-02	6.9727886E-05	-1.1213662E-03
42	6.3240051E-02	4.8966380E-05	-7.9698457E-06
43	6.3074350E-02	-4.9270166E-05	1.078747[illegible]E-03
44	6.3002586E-02	-2.7375016E-04	1.9070492E-03
45	6.2956691E-02	-5.9890025E-04	2.3576319E-03
46	6.292003[illegible]E-02	-9.6111232E-04	2.3691989E-03
47	6.289[illegible]781E-02	-1.2871982E-03	1.9422688E-03
48	6.288838[illegible]E-02	-1.5137123E-03	1.1389153E-03
49	6.2976360E-02	-1.6150840E-03	7.9181438E-05
50	6.3089967E-02	-1.6390858E-03	-1.0066775E-03

TPS DISPLACEMENTS FOR TILE NO. 1 AND ITERATION NO. 1

NODE	X COMPONENT(U)	Y COMPONENT(V)	Z COMPONENT(W)
51	6.3418806E-02	-5.5278535E-04	-2.4607307E-01
52	6.3360274E-02	-9.1702491E-04	-2.4367160E-01
53	6.3405454E-02	-1.0075432E-03	-2.4102080E-01
54	6.3535988E-02	-8.7207789E-04	-2.3875445E-01
55	6.3617170E-02	-6.9233938E-04	-2.3748064E-01
56	6.3580453E-02	-5.1717227E-04	-2.3745221E-01
57	6.3425422E-02	-3.3566589E-04	-2.3867118E-01
58	6.3219965E-02	-1.9620273E-04	-2.4088722E-01
59	6.3097000E-02	-2.8219167E-04	-2.4349177E-01
60	6.3073516E-02	-6.4337021E-04	-2.4584794E-01
61	1.6025227E-01	-1.5453077E-03	-4.5048096E-04
62	1.6031277E-01	-1.5162232E-03	3.9623864E-04
63	1.6034198E-01	-1.4140457E-03	1.2079391E-03
64	1.6034472E-01	-1.2199103E-03	1.8549871E-03
65	1.6032624E-01	-9.5796958E-04	2.2182909E-03
66	1.6028547E-01	-6.7172968E-04	2.2340242E-03
67	1.6022265E-01	-4.1003129E-04	1.9027090E-03
68	1.6013825E-01	-2.1614447E-04	1.2892468E-03
69	1.6002822E-01	-1.1389445E-04	5.1291427E-04
70	1.5988767E-01	-8.4504092E-05	-2.9721670E-04
71	1.6017270E-01	-1.8224693E-03	-2.4138254E-01
72	1.6019386E-01	-1.7314292E-03	-2.4138808E-01
73	1.6013730E-01	-1.5516283E-03	-2.4137712E-01
74	1.6005665E-01	-1.2582142E-03	-2.4128991E-01
75	1.5998858E-01	-8.5866917E-04	-2.4117053E-01
76	1.5994775E-01	-4.1683507E-04	-2.4114913E-01
77	1.5993410E-01	-1.6824677E-05	-2.4122542E-01
78	1.5993327E-01	2.7706288E-04	-2.4126971E-01
79	1.5990889E-01	4.5702001E-04	-2.4123794E-01
80	1.5980804E-01	5.4797600E-04	-2.4119043E-01

FROM GETDIM.
NAME = C-MATRIX. I/O UNIT = 13. FILE = 1. ROWS = 240. COLUMNS = 240

NUM = 1.04529D 01

FROM GETDIM.
NAME = MASS MAT. I/O UNIT = 20. FILE = 2. ROWS = 1. COLUMNS = 240

DEN = 9.01206D-05

FROM PUTLAB.
NAME = TILE DEF. I/O UNIT = 21. FILE = 1. ROWS = 1. COLUMNS = 240

FROM GETDIM.
NAME = J&GGNYOG. I/O UNIT = 7. FILE = 1. ROWS = 27. COLUMNS = 81

STRESSES FOR ISOLATOR AND ARRESTOR FOR TILE NO. 1 AND ITERATION NO. 1

	LOCAL COORDINATES X	Y	Z	STRESSES XX	YY	ZZ	XY	YZ	ZX
			ELEMENT NUMBER	1					
1	3.9434E 00	8.7631E-01	7.8867E-02	3.5308E 01	3.5301E 01	3.6842E 01	1.9191E-02	1.9755E 00	1.3492E 00
2	3.9434E 00	2.3481E-01	7.8867E-02	9.4784E 01	9.4781E 01	9.8753E 01	2.1999E-02	2.3421E 00	1.1950E 00
3	1.0566E 00	8.7631E-01	7.8867E-02	5.4946E 00	5.5133E 00	5.7861E 00	1.0462E-02	1.1005E 00	-6.7304E-01
4	1.0566E 00	2.3481E-01	7.8867E-02	1.5405E 01	1.5428E 01	1.6109E 01	1.3271E-02	1.2302E 00	-9.0807E-01
5	3.9434E 00	8.7631E-01	2.1132E-02	3.4862E 01	3.5002E 01	3.6476E 01	-5.5921E-03	2.0850E 00	1.3368E 00
6	3.9434E 00	2.3481E-01	2.1132E-02	9.4255E 01	9.4403E 01	9.8309E 01	-7.5189E-03	2.4515E 00	1.1624E 00
7	1.0566E 00	8.7631E-01	2.1132E-02	4.0040E 00	4.1270E 00	4.3764E 00	-2.1596E-02	1.1189E 00	-6.8547E-01
8	1.0566E 00	2.3481E-01	2.1132E-02	1.3832E 01	1.3962E 01	1.4620E 01	-2.3523E-02	1.2486E 00	-9.4072E-01
			ELEMENT NUMBER	2					
1	3.9434E 00	1.9874E 00	7.8867E-02	-9.8098E 00	-9.8161E 00	-1.0135E 01	2.7483E-02	1.4400E 00	1.7066E 00
2	3.9434E 00	1.3459E 00	7.8867E-02	7.3824E 00	7.3790E 00	7.7654E 00	2.9109E-02	1.6930E 00	1.4863E 00
3	1.0566E 00	1.9874E 00	7.8867E-02	6.1899E-01	6.2732E-01	7.0530E-01	2.0846E-02	8.4118E-01	-3.2919E-01
4	1.0566E 00	1.3459E 00	7.8867E-02	1.4446E 00	1.4559E 00	1.5707E 00	2.2473E-02	9.8121E-01	-5.1793E-01
5	3.9434E 00	1.9874E 00	2.1132E-02	-1.0771E 01	-1.0650E 01	-1.1014E 01	8.6361E-04	1.4718E 00	1.7107E 00
6	3.9434E 00	1.3459E 00	2.1132E-02	6.4538E 00	6.5761E 00	6.9170E 00	2.3087E-04	1.7247E 00	1.4837E 00
7	1.0566E 00	1.9874E 00	2.1132E-02	-8.4000E-01	-7.2503E-01	-6.7226E-01	-2.9321E-03	8.4284E-01	-3.2508E-01
6	1.0566E 00	1.3459E 00	2.1132E-02	1.7836E-02	1.3449E-01	2.2403E-01	-3.5647E-03	9.8286E-01	-5.2050E-01
			ELEMENT NUMBER	3					
1	3.9434E 00	3.0985E 00	7.8867E-02	-2.9601E 01	-2.9620E 01	-3.0737E 01	2.0566E-02	9.2819E-01	2.0186E 00
2	3.9434E 00	2.4570E 00	7.8867E-02	-1.9856E 01	-1.9872E 01	-2.0588E 01	2.1962E-02	1.1874E 00	1.8492E 00
3	1.0566E 00	3.0985E 00	7.8867E-02	-2.5205E-01	-2.5840E-01	-2.0191E-01	1.4051E-02	5.5629E-01	-2.4497E-02
4	1.0566E 00	2.4570E 00	7.8867E-02	-8.6842E-03	-1.2148E-02	5.7288E-02	1.5447E-02	7.1196E-01	-1.9697E-01
5	3.9434E 00	3.0985E 00	2.1132E-02	-3.0542E 01	-3.0433E 01	-3.1596E 01	1.3071E-03	9.4622E-01	2.0304E 00
6	3.9434E 00	2.4570E 00	2.1132E-02	-2.0800E 01	-2.0688E 01	-2.1450E 01	6.3195E-04	1.2055E 00	1.8572E 00
7	1.0566E 00	3.0985E 00	2.1132E-02	-1.6495E 00	-1.5461E 00	-1.5176E 00	-5.4879E-03	5.5687E-01	-1.2644E-02
8	1.0566E 00	2.4570E 00	2.1132E-02	-1.4093E 00	-1.3029E 00	-1.2615E 00	-6.1630E-03	7.1254E-01	-1.8899E-01
			ELEMENT NUMBER	4					
1	3.9434E 00	4.2096E 00	7.8867E-02	-3.7915E 01	-3.7941E 01	-3.9390E 01	1.1134E-02	3.9100E-01	2.1872E 00
2	3.9434E 00	3.5681E 00	7.8867E-02	-3.4517E 01	-3.4542E 01	-3.5852E 01	1.2367E-02	6.6729E-01	2.1091E 00
3	1.0566E 00	4.2096E 00	7.8867E-02	-1.4617E-01	-1.6023E-01	-8.9979E-02	9.6507E-03	2.3880E-01	7.0889E-02
4	1.0566E 00	3.5681E 00	7.8867E-02	-3.9179E-01	-4.0519E-01	-3.4428E-01	1.0883E-02	4.1463E-01	4.7277E-02
5	3.9434E 00	4.2096E 00	2.1132E-02	-3.8856E 01	-3.8746E 01	-4.0245E 01	2.7059E-03	3.9727E-01	2.2025E 00
6	3.9434E 00	3.5681E 00	2.1132E-02	-3.5402E 01	-3.5294E 01	-3.6654E 01	1.9289E-03	6.7356E-01	2.1230E 00
7	1.0566E 00	4.2096E 00	2.1132E-02	-1.5294E 00	-1.4271E 00	-1.3885E 00	6.1203E-03	2.3838E-01	8.6194E-02
8	1.0566E 00	3.5681E 00	2.1132E-02	-1.7195E 00	-1.6188E 00	-1.5895E 00	5.3433E-03	4.1421E-01	6.1095E-02
			ELEMENT NUMBER	5					
1	3.9434E 00	5.3207E 00	7.8867E-02	-3.9209E 01	-3.9237E 01	-4.0735E 01	-2.1803E-04	-1.4222E-01	2.2123E 00
2	3.9434E 00	4.6792E 00	7.8867E-02	-3.9206E 01	-3.9233E 01	-4.0731E 01	1.0181E-03	1.3088E-01	2.2148E 00
3	1.0566E 00	5.3207E 00	7.8867E-02	-6.4839E-02	-8.0983E-02	-4.0321E-03	-2.4749E-04	-9.7237E-02	7.6909E-02
4	1.0566E 00	4.6792E 00	7.8867E-02	-9.1543E-02	-1.0767E-01	-3.1801E-02	9.8865E-04	8.8019E-02	7.8830E-02
5	3.9434E 00	5.3207E 00	2.1132E-02	-4.0183E 01	-4.0076E 01	-4.1624E 01	9.3395E-04	-1.4221E-01	2.2281E 00
6	3.9434E 00	4.6792E 00	2.1132E-02	-4.0180E 01	-4.0072E 01	-4.1620E 01	4.1323E-04	1.3088E-01	2.2307E 00
7	1.0566E 00	5.3207E 00	2.1132E-02	-1.4255E 00	-1.3229E 00	-1.2793E 00	8.4774E-04	-9.7285E-02	9.2775E-02
8	1.0566E 00	4.6792E 00	2.1132E-02	-1.4528E 00	-1.3502E 00	-1.3076E 00	3.2703E-04	8.7972E-02	9.4685E-02

STRESSES FOR ISOLATOR AND ARRESTOR FOR TILE NO. 1 AND ITERATION NO. 1

	LOCAL COORDINATES X	Y	Z	STRESSES XX	YY	ZZ	XY	YZ	ZX
			ELEMENT NUMBER	6					
1	3.9434E 00	6.4318E 00	7.8867E-02	-3.4676E 01	-3.4701E 01	-3.6017E 01	-1.1566E-02	-6.7965E-01	2.0980E 00
2	3.9434E 00	5.7903E 00	7.8867E-02	-3.7964E 01	-3.7989E 01	-3.9441E 01	-1.0353E-02	-4.0255E-01	2.1809E 00
3	1.0566E 00	6.4318E 00	7.8867E-02	-3.0856E-01	-3.2219E-01	-2.5761E-01	-1.0145E-02	-4.2157E-01	3.8861E-02
4	1.0566E 00	5.7904E 00	7.8867E-02	-9.3462E-02	-1.0772E-01	-3.5021E-02	-8.9317E-03	-2.4739E-01	6.6196E-02
5	3.9434E 00	6.4318E 00	2.1132E-02	-3.5554E 01	-3.5447E 01	-3.6813E 01	-5.2830E-04	-6.8572E-01	2.1119E 00
6	3.9434E 00	5.7904E 00	2.1132E-02	-3.8901E 01	-3.8791E 01	-4.0293E 01	-1.3732E-03	-4.0862E-01	2.1963E 00
7	1.0566E 00	6.4319E 00	2.1132E-02	-1.6408E 00	-1.5407E 00	-1.5075E 00	-4.1155E-03	-4.2120E-01	5.2780E-02
8	1.0566E 00	5.7904E 00	2.1132E-02	-1.4824E 00	-1.3807E 00	-1.3393E 00	-4.9603E-03	-2.4702E-01	8.1546E-02
			ELEMENT NUMBER	7					
1	3.9434E 00	7.5430E 00	7.8867E-02	-2.0198E 01	-2.0214E 01	-2.0944E 01	-2.1202E-02	-1.2036E 00	1.8305E 00
2	3.9434E 00	6.9015E 00	7.8867E-02	-2.9838E 01	-2.9857E 01	-3.0983E 01	-1.9851E-02	-9.4195E-01	2.0041E 00
3	1.0566E 00	7.5430E 00	7.8867E-02	1.2908E-01	1.2517E-01	2.0076E-01	-1.4769E-02	-7.1405E-01	-2.0961E-01
4	1.0566E 00	6.9015E 00	7.8867E-02	-1.4926E-01	-1.5603E-01	-9.4774E-02	-1.3419E-02	-5.6152E-01	-3.5039E-02
5	3.9434E 00	7.5430E 00	2.1132E-02	-2.1125E 01	-2.1012E 01	-2.1789E 01	8.3156E-04	-1.2215E 00	1.8386E 00
6	3.9434E 00	6.9015E 00	2.1132E-02	-3.0767E 01	-3.0657E 01	-3.1831E 01	-5.7133E-07	-9.5980E-01	2.0160E 00
7	1.0566E 00	7.5430E 00	2.1132E-02	-1.2787E 00	-1.1735E 00	-1.1254E 00	7.3531E-03	-7.1469E-01	-2.0144E-01
8	1.0566E 00	6.9015E 00	2.1132E-02	-1.5560E 00	-1.4538E 00	-1.4200E 00	6.5210E-03	-5.6216E-01	-2.3043E-02
			ELEMENT NUMBER	8					
1	3.9434E 00	8.6541E 00	7.8867E-02	7.0749E 00	7.0715E 00	7.4447E 00	-2.8406E-02	-1.7152E 00	1.4617E 00
2	3.9434E 00	8.0126E 00	7.8867E-02	-1.0170E 01	-1.0176E 01	-1.0510E 01	-2.6860E-02	-1.4589E 00	1.6851E 00
3	1.0566E 00	8.6541E 00	7.8867E-02	1.7018E 00	1.7124E 00	1.8384E 00	-2.1920E-02	-9.7544E-01	-5.2906E-01
4	1.0566E 00	8.0126E 00	7.8867E-02	7.9504E-01	8.0270E-01	8.8873E-01	-2.0374E-02	-8.4043E-01	-3.4199E-01
5	3.9434E 00	8.6541E 00	2.1132E-02	6.1735E 00	6.2959E 00	6.6229E 00	1.3363E-03	-1.7470E 00	1.4594E 00
6	3.9434E 00	8.0126E 00	2.1132E-02	-1.1109E 01	-1.0988E 01	-1.1368E 01	4.5686E-04	-1.4907E 00	1.6895E 00
7	1.0566E 00	8.6541E 00	2.1132E-02	2.6645E-01	3.8092E-01	4.8265E-01	4.5491E-03	-9.7724E-01	-5.3139E-01
8	1.0566E 00	8.0126E 00	2.1132E-02	-6.7746E-01	-5.6441E-01	-5.0270E-01	3.6696E-03	-8.4223E-01	-3.3765E-01
			ELEMENT NUMBER	9					
1	3.9434E 00	9.7652E 00	7.8867E-02	9.4658E 01	9.4655E 01	9.8621E 01	-2.1361E-02	-2.3700E 00	1.1661E 00
2	3.9434E 00	9.1237E 00	7.8867E-02	3.5060E 01	3.5053E 01	3.6582E 01	-1.8670E-02	-2.0003E 00	1.3226E 00
3	1.0566E 00	9.7652E 00	7.8867E-02	1.5835E 01	1.5856E 01	1.6556E 01	-1.2967E-02	-1.2131E 00	-9.0743E-01
4	1.0566E 00	9.1237E 00	7.8867E-02	5.8150E 00	5.8327E 00	6.1198E 00	-1.0276E-02	-1.0903E 00	-6.8056E-01
5	3.9434E 00	9.7652E 00	2.1132E-02	9.4172E 01	9.4318E 01	9.8217E 01	9.2896E-03	-2.4797E 00	1.1337E 00
6	3.9434E 00	9.1237E 00	2.1132E-02	3.4646E 01	3.4786E 01	3.6248E 01	7.0403E-03	-2.1099E 00	1.3104E 00
7	1.0566E 00	9.7652E 00	2.1132E-02	1.4261E 01	1.4387E 01	1.5065E 01	2.4012E-02	-1.2317E 00	-9.3984E-01
8	1.0566E 00	9.1237E 00	2.1132E-02	4.3130E 00	4.4329E 00	4.6979E 00	2.1763E-02	-1.1089E 00	-6.9274E-01
			ELEMENT NUMBER	10					
1	3.9434E 00	8.7631E-01	8.8867E-01	5.0916E 00	7.2975E 00	2.9560E 01	-1.0425E-01	-2.5326E 01	8.9576E 00
2	3.9434E 00	2.3481E-01	8.8867E-01	1.8065E 01	3.5437E 01	5.1213E 01	1.1570E 00	-3.9995E 01	8.7200E 00
3	1.0566E 00	8.7631E-01	8.8867E-01	1.9082E 00	1.3579E 00	8.1846E 00	-2.0743E 00	-6.7408E 00	9.3294E 00
4	1.0566E 00	2.3481E-01	8.8867E-01	3.7295E 00	7.5219E 00	1.3438E 01	-8.1305E-01	-1.1177E 01	6.4278E 00
5	3.9434E 00	8.7631E-01	3.1132E-01	-1.3819E 01	-3.0728E 01	2.5738E 01	1.3673E 01	6.5031E 01	-1.3206E 01
6	3.9434E 00	2.3481E-01	3.1132E-01	-2.2322E 00	-3.3596E 00	4.7313E 01	1.6213E 01	5.0366E 01	-2.8580E 01
7	1.0566E 00	8.7631E-01	3.1132E-01	-3.6770E 00	-1.0069E 01	7.0364E 00	1.0205E 01	1.5508E 01	-1.2834E 01
8	1.0566E 00	2.3481E-01	3.1132E-01	-3.2417E 00	-4.6762E 00	1.2211E 01	1.2745E 01	1.1072E 01	-3.0872E 01

STRESSES FOR ISOLATOR AND ARRESTOR FOR TILE NO. 1 AND ITERATION NO. 1

	LOCAL COORDINATES X	Y	Z	STRESSES XX	YY	ZZ	XY	YZ	ZX
			ELEMENT NUMBER	11					
1	3.9434E 00	1.9874E 00	8.8867E-01	-3.1796E 00	-1.4728E 01	3.9903E-01	2.1904E 00	-2.8019E 00	-1.1655E 00
2	3.9434E 00	1.3459E 00	8.8867E-01	5.7680E 00	6.5678E 00	1.7221E 01	2.5197E 00	-1.6663E 01	6.3094E 00
3	1.0566E 00	1.9874E 00	8.8867E-01	8.8207E-01	-6.6373E 00	2.0134E 00	-6.1224E-01	9.4604E-01	4.2368E 00
4	1.0566E 00	1.3459E 00	8.8867E-01	4.0448E-01	-3.9147E 00	4.9748E 00	-2.8304E-01	-5.3276E 00	8.7425E 00
5	3.9434E 00	1.9874E 00	3.1132E-01	-1.8427E 01	-4.9205E 01	-3.0639E 00	1.8634E 01	6.7681E 01	-3.1098E-01
6	3.9434E 00	1.3459E 00	3.1132E-01	-1.1023E 01	-2.8768E 01	1.3671E 01	1.9912E 01	5.3819E 01	-5.6305E 00
7	1.0566E 00	1.9874E 00	3.1132E-01	-4.4815E 00	-2.1386E 01	5.3319E-01	1.4161E 01	1.3857E 01	5.0917E 00
8	1.0566E 00	1.3459E 00	3.1132E-01	-6.5028E 00	-1.9523E 01	3.4071E 00	1.5439E 01	7.5831E 00	-3.1970E 00
			ELEMENT NUMBER	12					
1	3.9434E 00	3.0985E 00	8.8867E-01	-8.4075E 00	-3.0840E 01	-1.7877E 01	2.9835E 00	7.1468E 00	-9.7413E 00
2	3.9434E 00	2.4570E 00	8.8867E-01	-4.2781E 00	-1.9363E 01	-8.4648E 00	2.6293E 00	-1.2228E 01	-5.4657E 00
3	1.0566E 00	3.0985E 00	8.8867E-01	-2.7853E-01	-1.4916E 01	-1.2360E 00	4.2823E-01	4.3755E 00	-2.4724E-01
4	1.0566E 00	2.4570E 00	8.8867E-01	-1.8147E 00	-1.4603E 01	-1.5507E-01	7.4082E-02	-4.5708E 00	1.8282E 00
5	3.9434E 00	3.0985E 00	3.1132E-01	-2.8709E 01	-7.8469E 01	-2.2660E 01	1.4187E 01	4.6795E 01	6.3017E 00
6	3.9434E 00	2.4570E 00	3.1132E-01	-2.5725E 01	-6.7629E 01	-1.3313E 01	1.5136E 01	2.7422E 01	2.8867E 00
7	1.0566E 00	3.0985E 00	3.1132E-01	-6.9956E 00	-3.5429E 01	-3.2941E 00	1.0394E 01	9.4216E 00	1.5796E 01
8	1.0566E 00	2.4570E 00	3.1132E-01	-9.6768E 00	-3.5754E 01	-2.2780E 00	1.1343E 01	4.7505E-01	1.0181E 01
			ELEMENT NUMBER	13					
1	3.9434E 00	4.2096E 00	8.8867E-01	-1.2238E 01	-4.2301E 01	-2.6871E 01	2.1300E 00	1.0395E 01	-1.3990E 01
2	3.9434E 00	3.5681E 00	8.8867E-01	-1.0852E 01	-3.7608E 01	-2.2872E 01	1.4859E 00	-1.1065E 01	-1.2025E 01
3	1.0566E 00	4.2096E 00	8.8867E-01	-1.5558E 00	-2.1422E 01	-2.6371E 00	6.3008E-01	5.3869E 00	-2.4998E 00
4	1.0566E 00	3.5681E 00	8.8867E-01	-2.7335E 00	-2.1781E 01	-2.4074E 00	-1.4155E-02	-4.6678E 00	-1.4069E 00
5	3.9434E 00	4.2096E 00	3.1132E-01	-3.4218E 01	-9.4772E 01	-3.2141E 01	7.4644E 00	2.7334E 01	9.6212E 00
6	3.9434E 00	3.5681E 00	3.1132E-01	-3.3285E 01	-9.0332E 01	-2.8167E 01	8.2458E 00	5.8742E 00	8.1066E 00
7	1.0566E 00	4.2096E 00	3.1132E-01	-8.6796E 00	-4.4240E 01	-4.9261E 00	5.4741E 00	6.6677E 00	2.1112E 01
8	1.0566E 00	3.5681E 00	3.1132E-01	-1.0310E 01	-4.4852E 01	-4.7220E 00	6.2555E 00	-3.3867E 00	1.8725E 01
			ELEMENT NUMBER	14					
1	3.9434E 00	5.3207E 00	8.8867E-01	-1.3412E 01	-4.5349E 01	-2.8500E 01	4.3207E-01	1.0921E 01	-1.4737E 01
2	3.9434E 00	4.6792E 00	8.8867E-01	-1.3394E 01	-4.5314E 01	-2.8474E 01	-2.8378E-01	-1.0885E 01	-1.4716E 01
3	1.0566E 00	5.3207E 00	8.8867E-01	-2.5004E 00	-2.4037E 01	-2.9805E 00	4.3124E-01	5.1342E 00	-2.9190E 00
4	1.0566E 00	4.6792E 00	8.8867E-01	-2.5107E 00	-2.4057E 01	-2.9947E 00	-2.8467E-01	-5.1939E 00	-2.9050E 00
5	3.9434E 00	5.3207E 00	3.1132E-01	-3.5676E 01	-9.8632E 01	-3.3851E 01	-1.9408E-01	1.1025E 01	1.0199E 01
6	3.9434E 00	4.6792E 00	3.1132E-01	-3.5662E 01	-9.8600E 01	-3.3824E 01	5.2512E-01	-1.0782E 01	1.0182E 01
7	1.0566E 00	5.3207E 00	3.1132E-01	-9.8098E 00	-4.7471E 01	-5.3312E 00	-1.9845E-01	5.0758E 00	2.2017E 01
8	1.0566E 00	4.6792E 00	3.1132E-01	-9.8236E 00	-4.7493E 01	-5.3456E 00	5.2083E-01	-5.2524E 00	2.1994E 01
			ELEMENT NUMBER	15					
1	3.9434E 00	6.4318E 00	8.8867E-01	-1.0897E 01	-3.7708E 01	-2.2990E 01	-1.3408E 00	1.1116E 01	-1.2122E 01
2	3.9434E 00	5.7903E 00	8.8867E-01	-1.2249E 01	-4.2326E 01	-2.6932E 01	-1.9901E 00	-1.0380E 01	-1.4042E 01
3	1.0566E 00	6.4318E 00	8.8867E-01	-2.7061E 00	-2.1739E 01	-2.3519E 00	1.5374E-01	4.6287E 00	-1.4771E 00
4	1.0566E 00	5.7904E 00	8.8867E-01	-1.5511E 00	-2.1417E 01	-2.6074E 00	-4.9549E-01	-5.4387E 00	-2.5368E 00
5	3.9434E 00	6.4318E 00	3.1132E-01	-3.3366E 01	-9.0524E 01	-2.8294E 01	-7.9247E 00	-5.5789E 00	8.1799E 00
6	3.9434E 00	5.7904E 00	3.1132E-01	-3.4271E 01	-9.4893E 01	-3.2211E 01	-7.1451E 00	-2.7080E 01	9.6619E 00
7	1.0566E 00	6.4319E 00	3.1132E-01	-1.0285E 01	-4.4834E 01	-4.6690E 00	-5.9466E 00	3.2426E 00	1.8826E 01
8	1.0566E 00	5.7904E 00	3.1132E-01	-8.6837E 00	-4.4264E 01	-4.8992E 00	-5.1670E 00	-6.8245E 00	2.1168E 01

STRESSES FOR ISULATOR AND ARRESTOR FOR TILE NO. 1 AND ITERATION NO. 1

	LOCAL COORDINATES X	Y	Z	STRESSES XX	YY	ZZ	XY	YZ	ZX
			ELEMENT NUMBER	16					
1	3.9434E 00	7.5430E 00	8.8867E-01	-4.3269E 00	-1.9478E 01	-8.6534E 00	-2.4934E 00	1.2281E 01	-5.6227E 00
2	3.9434E 00	6.9015E 00	8.8867E-01	-8.4311E 00	-3.0901E 01	-1.8024E 01	-2.8592E 00	-7.1697E 00	-9.8653E 00
3	1.0566E 00	7.5430E 00	8.8867E-01	-1.7682E 00	-1.4532E 01	-5.0059E-02	5.8228E-02	4.5639E 00	1.7108E 00
4	1.0566E 00	6.9015E 00	8.8867E-01	-2.5710E-01	-1.4890E 01	-1.1638E 00	-3.0750E-01	-4.4093E 00	-3.3820E-01
5	3.9434F 00	7.5430E 00	3.1132E-01	-2.5855E 01	-6.7936E 01	-1.3520E 01	-1.4855E 01	-2.7201E 01	3.0231E C0
6	3.9434E 00	6.9015E 00	3.1132E-01	-2.8819F 01	-7.8726E 01	-2.2827F 01	-1.3911E 01	-4.6653E 01	6.4021E 00
7	1.0566E 00	7.5430E 00	3.1132E-01	-9.6442E 00	-3.5742E 01	-2.1789E 00	-1.1069E 01	-6.1655E-01	1.0357E 01
8	1.0566E 00	6.9015E 00	3.1132E-01	-6.9926E 00	-3.5465E 01	-3.2280E 00	-1.0125E 01	-9.5900E 00	1.5930E 01
			ELEMENT NUMBER	17					
1	3.9434E 00	8.6541E 00	8.8867E-01	5.7361E 00	6.4876E 00	1.7034E 01	-2.4168E 00	1.6663E 01	6.1140E 00
2	3.9434E 00	8.0126E 00	8.8867E-01	-3.2165E 00	-1.4821E 01	2.0235E-01	-2.1041E 00	2.7447E 00	-1.3412E 00
3	1.0566E 00	8.6541E 00	8.8867E-01	4.7033E-01	-3.8061E 00	5.1537E 00	3.8768E-01	5.3718E 00	8.5818E 00
4	1.0566F 00	8.0126E 00	8.8867E-01	9.1533E-01	-6.5954E 00	2.1418E 00	7.0036E-01	-9.3627E-01	4.1006E 00
5	3.9434E 00	8.6541E 00	3.1132F-01	-1.1110E 01	-2.8984E 01	1.3470E 01	-1.9696E 01	-5.3864E 01	-5.4556E 00
6	3.9434E 00	8.0126E 00	3.1132E-01	-1.8518E 01	-4.9433E 01	-3.2749E 00	-1.8432E 01	-6.7782E 01	-1.5414E-01
7	1.0566E 00	8.6541E 00	3.1132E-01	-6.4638E 00	-1.9494E 01	3.5780E 00	-1.5219E 01	-7.7484E 00	-2.9872E 00
8	1.0566E 00	8.0126F 00	3.1132F-01	-4.4732E 00	-2.1423E 01	6.5376E-01	-1.3955E 01	-1.4056E 01	5.2885E 00
			ELEMENT NUMBER	18					
1	3.9434E 00	9.7652E 00	8.8867E-01	1.8035E 01	3.5369E 01	5.1064F 01	-1.1150F 00	3.9963E 01	8.5814E 00
2	3.9434E 00	9.1237E 00	8.8867E-01	5.0459E 00	7.1921E 00	2.9382E 01	1.2879E-01	2.5301E 01	8.7727E 00
3	1.0566E 00	9.7652E 00	8.8867E-01	3.8227E 00	7.6917E 00	1.3702E 01	8.5905E-01	1.1320E 01	6.3162E 00
4	1.0566F 00	9.1237E 00	8.8867E-01	1.9688E 00	1.4582E 00	8.3956E 00	2.1027E 00	6.8228E 00	9.1759E 00
5	3.9434E 00	9.7652E 00	3.1132F-01	-2.2444E 00	-3.4127E 00	4.7165E 01	-1.6092E 01	-5.0524E 01	-2.8303E 01
6	3.9434E 00	9.1237E 00	3.1132E-01	-1.3846E 01	-3.0817E 01	2.5562E 01	-1.3578F 01	-6.5187E 01	-1.2998E 01
7	1.0566E 00	9.7652E 00	3.1132E-01	-3.2146E 00	-4.6588F 00	1.2460E 01	-1.2617E 01	-1.1150E 01	-3.0568E 01
8	1.0566E 00	9.1237E 00	3.1132E-01	-3.6809E 00	-1.0120E 01	7.2321E 00	-1.0103E 01	-1.5647E 01	-1.2595E 01

FROM GETDIM.
NAME = JGGENYQ6. I/O UNIT = 7. FILE = 1. ROWS = 27. COLUMNS = 81

FROM GETDIM.
NAME = GONOOO6a. I/O UNIT = 20. FILE = 1. ROWS = 27. COLUMNS = 1

FROM PUTLAB.
NAME = T STRESS. I/O UNIT = 21. FILE = 2. ROWS = 27. COLUMNS = 6

STRESSES AND DIRECT STRAINS FOR TILE NO. 1 AND ITERATION NO. 1

MEM	TEMP	LOCAL COORDINATES X	Y	Z	* STRAINS XX	YY	ZZ	* STRESSES XX	YY	ZZ	XY	YZ	ZX *
1	0.	2.50	0.56	0.05	-1.183E-03	1.843E-06	2.640E-02	3.724E 01	3.732E 01	3.891E 01	8.367E-04	1.694E 00	2.295E-01
2	0.	2.50	1.67	0.05	-1.071E-03	-6.821E-05	7.179E-04	-6.880E-01	-6.274E-01	-5.800E-01	1.181E-02	1.247E 00	5.868E-01
3	0.	2.50	2.78	0.05	-9.953E-04	-1.945E-04	-7.565E-03	-1.302E 01	-1.297E 01	-1.341E 01	7.789E-03	8.506E-01	9.166E-01
4	0.	2.50	3.89	0.05	-9.590E-04	-2.496E-04	-1.146E-02	-1.881E 01	-1.877E 01	-1.944E 01	7.517E-03	4.294E-01	1.111E 00
5	0.	2.50	5.00	0.05	-9.648E-04	-2.755E-04	-1.239E-02	-2.023E 01	-2.019E 01	-2.092E 01	5.079E-04	-5.150E-03	1.154E 00
6	0.	2.50	6.11	0.05	-9.576E-04	-2.516E-04	-1.147E-02	-1.883E 01	-1.878E 01	-1.946E 01	-6.497E-03	-4.392E-01	1.103E 00
7	0.	2.50	7.22	0.05	-9.919E-04	-1.971E-04	-7.622E-03	-1.310E 01	-1.305E 01	-1.350E 01	-6.817E-03	-8.599E-01	9.025E-01
8	0.	2.50	8.33	0.05	-1.064E-03	-7.199E-05	6.781E-04	-7.421E-01	-6.822E-01	-6.369E-01	-1.094E-02	-1.256E 00	5.695E-01
9	0.	2.50	9.44	0.05	-1.169E-03	-4.533E-06	2.646E-02	3.735E 01	3.742E 01	3.901E 01	-1.458E-04	-1.700E 00	2.140E-01
10	0.	2.50	0.56	0.60	5.174E-06	-4.059E-04	4.050E-03	7.273E-01	3.470E-01	2.434E 01	6.375E 00	7.342E 00	-6.507E 00
11	0.	2.50	1.67	0.60	6.635E-05	-3.301E-04	1.103E-03	-4.570E 00	-1.720E 01	4.894E 00	8.995E 00	1.489E 01	1.759E 00
12	0.	2.50	2.78	0.60	1.319E-04	-3.850E-04	-8.227E-04	-1.074E 01	-3.713E 01	-8.660E 00	7.147E 00	9.855E 00	2.692E 00
13	0.	2.50	3.89	0.60	1.792E-04	-4.492E-04	-1.769E-03	-1.423E 01	-4.966E 01	-1.559E 01	3.958E 00	4.567E 00	3.456E 00
14	0.	2.50	5.00	0.60	1.960E-04	-4.755E-04	-2.043E-03	-1.535E 01	-5.387E 01	-1.766E 01	1.181E-01	5.126E-03	3.639E 00
15	0.	2.50	6.11	0.60	1.794E-04	-4.495E-04	-1.772E-03	-1.425E 01	-4.971E 01	-1.562E 01	-3.733E 00	-4.539E 00	3.458E 00
16	0.	2.50	7.22	0.60	1.322E-04	-3.854E-04	-8.290E-04	-1.076E 01	-3.721E 01	-8.706E 00	-6.946E 00	-9.850E 00	2.700E 00
17	0.	2.50	8.33	0.60	6.664E-05	-3.306E-04	1.100E-03	-4.582E 00	-1.726E 01	4.870E 00	-8.842E 00	-1.495E 01	1.768E 00
18	0.	2.50	9.44	0.60	5.386E-06	-4.067E-04	4.056E-03	7.357E-01	3.376E-01	2.437E 01	-6.302E 00	-7.387E 00	-6.452E 00
19	0.	2.50	0.56	2.10	-4.735E-06	-5.960E-05	1.006E-03	-1.566E 00	-3.760E 00	5.984E 00	-2.856E 00	1.031E 01	-4.222E 00
20	0.	2.50	1.67	2.10	6.393E-06	2.098E-05	3.076E-04	1.728E 00	2.311E 00	1.886E 00	-2.943E 00	1.568E 01	-5.887E-01
21	0.	2.50	2.78	2.10	1.859E-05	8.967E-05	-3.518E-04	4.676E 00	7.520E 00	-1.989E 00	-1.819E 00	1.460E 01	1.864E 00
22	0.	2.50	3.89	2.10	2.841E-05	1.161E-04	-8.021E-04	5.986E 00	9.494E 00	-4.658E 00	-8.614E-01	8.460E 00	3.162E 00
23	0.	2.50	5.00	2.10	3.228E-05	1.217E-04	-9.577E-04	6.335E 00	9.913E 00	-5.584E 00	7.238E-03	1.252E-02	3.605E 00
24	0.	2.50	6.11	2.10	2.840E-05	1.164E-04	-8.032E-04	5.993E 00	9.511E 00	-4.664E 00	8.745E-01	-8.442E 00	3.176E 00
25	0.	2.50	7.22	2.10	1.859E-05	9.016E-05	-3.532E-04	4.694E 00	7.557E 00	-1.997E 00	1.832E 00	-1.461E 01	1.889E 00
26	0.	2.50	8.33	2.10	6.396E-06	2.134E-05	3.069E-04	1.742E 00	2.340E 00	1.882E 00	2.952E 00	-1.570E 01	-5.431E-01
27	0.	2.50	9.44	2.10	-4.731E-06	-5.959E-05	1.007E-03	-1.564E 00	-3.759E 00	5.988E 00	2.851E 00	-1.033E 01	-4.106E 00

FROM GETDIM.
NAME = JLGCNYOL, I/O UNIT = 7. FILE = 1. ROWS = 27. COLUMNS = 81

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STRESSES AND TOTAL STRAINS FOR COATING FOR TILE NO. 1 AND ITERATION NO. 1

MEM	TEMP	LOCAL COORDINATES X	Y	Z	* STRAINS XX	STRAINS YY	STRAINS XY	* STRESSES XX	STRESSES YY	STRESSES XY *
19	0.	2.50	0.56	3.10	-1.985E-05	5.406E-05	-1.249E-05	-6.108E 01	6.284E 02	-9.992E 01
20	0.	2.50	1.67	3.10	-3.236E-05	1.269E-04	-4.759E-05	-8.151E 00	1.521E 03	-3.807E 02
21	0.	2.50	2.78	3.10	-4.928E-05	2.194E-04	-5.265E-05	7.135E 01	2.651E 03	-4.212E 02
22	0.	2.50	3.89	3.10	-6.257E-05	2.977E-04	-3.285E-05	1.516E 02	3.610E 03	-2.628E 02
23	0.	2.50	5.00	3.10	-6.754E-05	3.276E-04	-1.300E-06	1.839E 02	3.978E 03	-1.040E 01
24	0.	2.50	6.11	3.10	-6.263E-05	2.978E-04	3.040E-05	1.512E 02	3.611E 03	2.432E 02
25	0.	2.50	7.22	3.10	-4.935E-05	2.195E-04	5.029E-05	7.068E 01	2.652E 03	4.023E 02
26	0.	2.50	8.33	3.10	-3.243E-05	1.270E-04	4.593E-05	-8.737E 00	1.522E 03	3.674E 02
27	0.	2.50	9.44	3.10	-1.990E-05	5.416E-05	1.171E-05	-8.137E 01	6.295E 02	9.368E 01

FROM GETDIM,
NAME = LOADS . I/O UNIT = 9. FILE = 2. ROWS = 1. COLUMNS = 1

FROM GETDIM,
NAME = NAMEA . I/O UNIT = 14. FILE = 2. ROWS = 60. COLUMNS = 1

FROM PUTLAB,
NAME = NAMEA . I/O UNIT = 14. FILE = 1. ROWS = 60. COLUMNS = 1

PRIMARY STRUCTURE DEFLECTIONS FOR ITERATION NO. 1

NODE	DX	DY	DZ	RX	RY	RZ
1	4.804365E-03	-1.674674E-03		5.973264E-05	7.386667E-02	
2	4.036073E-03	-1.398893E-03		2.006021E-04	7.305038E-02	
3	4.082311E-03	-1.133196E-03		1.707556E-04	7.283503E-02	
4	3.818149E-03	-9.693746E-04		4.060654E-05	7.321954E-02	
5	4.226379E-03	-8.176223E-04		5.731522E-05	7.346296E-02	
6	4.210100E-03	-6.545833E-04		-5.699675E-05	7.346410E-02	
7	3.760333E-03	-5.215430E-04		-4.458879E-05	7.322794E-02	
8	3.979169E-03	-3.951103E-04		-1.721941E-04	7.285196E-02	
9	3.844014E-03	-1.897095E-04		-1.998738E-04	7.307297E-02	
10	4.453167E-03			-5.699808E-05	7.389611E-02	
11	2.079282E-03	-9.284776E-04	-2.448226E-01	9.487666E-03	4.795204E-08	
12	2.123745E-03	-8.883520E-04	-2.398865E-01	7.877322E-04	-2.491538E-08	
13	2.049722E-03	-8.640229E-04	-2.419297E-01	-3.537915E-03	-5.626872E-08	
14	2.055865E-03	-7.441358E-04	-2.457325E-01	-3.718347E-03	-6.521071E-08	
15	1.990440E-03	-6.080298E-04	-2.487135E-01	-1.707430E-03	-9.121601E-08	
16	1.977348E-03	-4.685631E-04	-2.487319E-01	1.677107E-03	-1.075873E-07	
17	2.014890E-03	-3.187272E-04	-2.457681E-01	3.706621E-03	-1.374130E-07	
18	1.976049E-03	-1.710572E-04	-2.419814E-01	3.507455E-03	-1.601567E-07	
19	2.013590E-03	-1.016970E-04	-2.399851E-01	-8.456632E-04	-2.198697E-07	
20	1.938463E-03		-2.449861E-01	-9.557497E-03	-2.224022E-07	
21		-1.299982E-03		5.951744E-05	-7.386780E-02	
22		-1.071978E-03		2.005496E-04	-7.305157E-02	
23		-8.499143E-04		1.707435E-04	-7.283628E-02	
24		-7.319441E-04		4.073138E-05	-7.322067E-02	
25		-6.254234E-04		5.733727E-05	-7.346392E-02	
26		-5.106605E-04		-5.711164E-05	-7.346493E-02	
27		-4.173571E-04		-4.470549E-05	-7.322878E-02	
28		-3.277611E-04		-1.721034E-04	-7.285279E-02	
29		-1.549412E-04		-1.998862E-04	-7.307374E-02	
30				-5.690729E-05	-7.389671E-02	
31	-3.246599E-03	-1.332033E-03	1.731810E-02	3.473107E-03	1.278385E-01	
32	-1.040359E-02	-7.202774E-04	4.199851E-03	3.139628E-05	1.228974E-01	
33	-3.389714E-03	-2.359805E-04	1.713035E-02	-1.704332E-03	1.277174E-01	
34	2.128990E-03	-2.972099E-04	-2.594957E-01	-1.792656E-03	-1.069129E-06	
35	2.031946E-03	-5.564226E-04	-2.520680E-01	-2.315131E-05	-4.011691E-06	
36	2.020454E-03	-7.328810E-04	-2.594339E-01	8.364939E-04	-2.160103E-06	
37	7.544737E-03	-1.014138E-03	1.725082E-02	1.903430E-03	-1.278018E-01	
38	1.452222E-02	-5.634816E-04	4.186004E-03	-2.064962E-05	-1.228822E-01	
39	7.468767E-03	-2.019049E-04	1.708957E-02	-1.872152E-03	-1.276930E-01	

MID-POINT PLATE MEMBER STRAINS AND STRESSES FOR ITERATION NO. 1

MEMBER	COORDINATES X	COORDINATES Y	STRAINS EPS X	STRAINS EPS Y	STRAINS EPS XY	STRESSES SIG X	STRESSES SIG Y	STRESSES SIG XY
1	2.5000E 00	5.5556E-01	-4.6374E-04	1.4216E-04	-1.0003E-04	-4.6274E 03	3.3363E 01	-7.1446E 02
2	2.5000E 00	1.6667E 00	-3.9449E-04	1.3051E-04	3.2734E-05	-3.9041E 03	1.3368E 02	2.3382E 02
3	2.5000E 00	2.7778E 00	-3.7949E-04	1.2767E-04	-3.3334E-05	-3.7493E 03	1.5190E 02	-2.3810E 02
4	2.5000F 00	3.8889E 00	-3.9982E-04	1.2954E-04	9.8872E-05	-3.9666E 03	1.0538E 02	7.0623E 02
5	2.5000E 00	5.0000E 00	-4.4687E-04	1.3613E-04	1.3172E-05	-4.4619E 03	2.2716E 01	9.4087E 01
6	2.5000F 00	6.1111E 00	-3.9842E-04	1.2729E-04	-7.1959E-05	-3.9586E 03	8.5370E 01	-5.1399E 02
7	2.5000E 00	7.2222E 00	-3.7546F-04	1.2335E-04	6.0492E-05	-3.7193E 03	1.1769E 02	4.3209E 02
8	2.5000E 00	8.3333E 00	-3.8335E-04	1.2364E-04	-6.3598E-06	-3.8051E 03	9.4903E 01	-4.5427E 01
9	2.5000E 00	9.4444E 00	-4.3451E-04	1.3113E-04	1.2456E-04	-4.3425E 03	8.5658E 00	8.8969E 02
10	7.5000E 00	5.5556E-01	-4.2030E-04	1.2066E-04	-1.7752E-05	-4.2209E 03	-5.9696E 01	-1.2680E 02
11	7.5000E 00	1.6667E 00	-4.1735E-04	1.1088F-04	-2.5131E-05	-4.2207E 03	-1.5744E 02	-1.7951E 02
12	7.5000E 00	2.7778E 00	-4.1056E-04	1.0704E-04	2.6972E-06	-4.1588E 03	-1.7727E 02	1.9266E 01
13	7.5000E 00	3.8889E 00	-4.0463E-04	1.0918E-04	-1.4981E-05	-4.0865E 03	-1.3414E 02	-1.0701E 02
14	7.5000E 00	5.0000E 00	-3.9678E-04	1.1440E-04	-5.9202E-06	-3.9830E 03	-5.0881E 01	-4.2287E 01
15	7.5000E 00	6.1111E 00	-3.9922F-04	1.0941E-04	1.4106E-06	-4.0264E 03	-1.1378E 02	1.0076E 01
16	7.5000E 00	7.2222E 00	-3.9909E-04	1.0677E-04	-2.1506E-05	-4.0337E 03	-1.4240E 02	-1.5361E 02
17	7.5000E 00	8.3333E 00	-3.9896E-04	1.0898E-04	-2.0505E-06	-4.0249E 03	-1.1767E 02	-1.4647E 01
18	7.5000E 00	9.4444E 00	-3.9520E-04	1.1549E-04	-1.9566E-05	-3.9622E 03	-3.3783E 01	-1.3976E 02

FROM GETDIM.
NAME = BND COND. I/O UNIT = 1. FILE = 1. ROWS = 51. COLUMNS = 11

FROM GETDIM.
NAME = XTN . I/O UNIT = 10. FILE = 2. ROWS = 162. COLUMNS = 1

TUP-POINT PLATE MEMBER STRAINS AND STRESSES FOR ITERATION NO. 1

MEMBER	COORDINATES X	COORDINATES Y	STRAINS EPS X	STRAINS EPS Y	STRAINS EPS XY	STRESSES SIG X	STRESSES SIG Y	STRESSES SIG XY
1	2.5000E 00	5.5556E-01	-2.3002E-03	6.2361E-04	-1.8558E-04	-2.3221E 04	-7.3027E 02	-1.3256E 03
2	2.5000E 00	1.6667E 00	-2.2181E-03	3.7551E-04	4.6186E-05	-2.3136E 04	-3.1858E 03	3.2990E 02
3	2.5000E 00	2.7778E 00	-2.2052E-03	1.4514E-04	2.4153E-05	-2.3754E 04	-5.6748E 03	1.7252E 02
4	2.5000E 00	3.8889E 00	-2.2334E-03	1.5482E-05	1.4024E-04	-2.4491E 04	-7.1926E 03	1.0017E 03
5	2.5000E 00	5.0000E 00	-2.2835E-03	-4.7823E-05	1.3395E-05	-2.5251E 04	-8.0534E 03	9.5679E 01
6	2.5000E 00	6.1111E 00	-2.2321E-03	1.2436E-05	-1.1288E-04	-2.4487E 04	-7.2218E 03	-8.0632E 02
7	2.5000E 00	7.2222E 00	-2.2015E-03	1.4173E-04	3.4741E-06	-2.3725E 04	-5.7001E 03	2.4815E 01
8	2.5000E 00	8.3333E 00	-2.2074E-03	3.7006E-04	-1.9107E-05	-2.3037E 04	-3.2106E 03	-1.3648E 02
9	2.5000E 00	9.4444E 00	-2.2716E-03	6.1314E-04	2.1112E-04	-2.2942E 04	-7.5112E 02	1.5080E 03
10	7.5000E 00	5.5556E-01	-2.2568E-03	6.0210E-04	6.7796E-05	-2.2815E 04	-8.2353E 02	4.8426E 02
11	7.5000E 00	1.6667E 00	-2.2409E-03	3.5587E-04	-3.8587E-05	-2.3453E 04	-3.4771E 03	-2.7562E 02
12	7.5000E 00	2.7778E 00	-2.2363E-03	1.2450E-04	-5.4789E-05	-2.4164E 04	-6.0042E 03	-3.9135E 02
13	7.5000E 00	3.8889E 00	-2.2382E-03	-4.8661E-06	-5.6348E-05	-2.4611E 04	-7.4321E 03	-4.0248E 02
14	7.5000E 00	5.0000E 00	-2.2334E-03	-6.9539E-05	-6.1413E-06	-2.4772E 04	-8.1270E 03	-4.3866E 01
15	7.5000E 00	6.1111E 00	-2.2329E-03	-5.4453E-06	4.2335E-05	-2.4555E 04	-7.4210E 03	3.0240E 02
16	7.5000E 00	7.2222E 00	-2.2251E-03	1.2514E-04	3.5510E-05	-2.4039E 04	-5.9604E 03	2.5364E 02
17	7.5000E 00	8.3333E 00	-2.2230E-03	3.5541E-04	1.0695E-05	-2.3257E 04	-3.4231E 03	7.6390E 01
18	7.5000E 00	9.4444E 00	-2.2323E-03	5.9748E-04	-1.0613E-04	-2.2561E 04	-7.9356E 02	-7.5805E 02

FROM GETDIM.
NAME = BND COND. I/O UNIT = 1. FILE = 1. ROWS = 51. COLUMNS = 11

FROM GETDIM.
NAME = XTN . I/O UNIT = 10. FILE = 2. ROWS = 162. COLUMNS = 1

BOTTOM-POINT PLATE MEMBER STRAINS AND STRESSES FOR ITERATION NO. 1

MEMBER	COORDINATES X	COORDINATES Y	STRAINS EPS X	STRAINS EPS Y	STRAINS EPS XY	STRESSES SIG X	STRESSES SIG Y	STRESSES SIG XY
1	2.5000E 00	5.5556E-01	1.3727E-03	-3.3929E-04	-1.4471E-05	1.3966E 04	7.9700E 02	-1.0336E 02
2	2.5000E 00	1.6667E 00	1.4291E-03	-1.1448E-04	1.9282E-05	1.5327E 04	3.4532E 03	1.3773E 02
3	2.5000E 00	2.7778E 00	1.4462E-03	1.1020E-04	-9.0820E-05	1.6256E 04	5.4786E 03	-6.4872E 02
4	2.5000E 00	3.8889E 00	1.4337E-03	2.4359E-04	5.7504E-05	1.6558E 04	7.4033E 03	4.1074E 02
5	2.5000E 00	5.0000E 00	1.3897E-03	3.2008E-04	1.2949E-05	1.6327E 04	8.0988E 03	9.2494E 01
6	2.5000E 00	6.1111E 00	1.4352E-03	2.4215E-04	-3.1033E-05	1.6570E 04	7.3925E 03	-2.2166E 02
7	2.5000E 00	7.2222E 00	1.4505E-03	1.0497E-04	1.1751E-04	1.6286E 04	5.9355E 03	8.3936E 02
8	2.5000E 00	8.3333E 00	1.4407E-03	-1.2278E-04	6.3875E-06	1.5427E 04	3.4004E 03	4.5625E 01
9	2.5000E 00	9.4444E 00	1.4026E-03	-3.5087E-04	3.7992E-05	1.4257E 04	7.6825E 02	2.7137E 02
10	7.5000E 00	5.5556E-01	1.4162E-03	-3.6078E-04	-1.0330E-04	1.4373E 04	7.0414E 02	-7.3787E 02
11	7.5000E 00	1.6667E 00	1.4062E-03	-1.3412E-04	-1.1675E-05	1.5011E 04	3.1622E 03	-8.3394E 01
12	7.5000E 00	2.7778E 00	1.4152E-03	6.9573E-05	6.0183E-05	1.5846E 04	5.6497E 03	4.2988E 02
13	7.5000E 00	3.8889E 00	1.4289E-03	2.2323E-04	2.6386E-05	1.6438E 04	7.1638E 03	1.8847E 02
14	7.5000E 00	5.0000E 00	1.4398E-03	2.9835E-04	-5.6991E-06	1.6806E 04	8.0252E 03	-4.0708E 01
15	7.5000E 00	6.1111E 00	1.4344E-03	2.2427E-04	-3.9514E-05	1.6502E 04	7.1934E 03	-2.8224E 02
16	7.5000E 00	7.2222E 00	1.4269E-03	8.8400E-05	-7.8522E-05	1.5972E 04	5.6756E 03	-5.6087E 02
17	7.5000E 00	8.3333E 00	1.4251E-03	-1.3744E-04	-1.4796E-05	1.5207E 04	3.1878E 03	-1.0568E 02
18	7.5000E 00	9.4444E 00	1.4419E-03	-3.6651E-04	6.6995E-05	1.4637E 04	7.2599E 02	4.7853E 02

FROM GETDIM.
NAME = BND COND, I/O UNIT = 1, FILE = 1, ROWS = 51, COLUMNS = 11

FROM GETDIM.
NAME = XTN , I/O UNIT = 10, FILE = 2, ROWS = 162, COLUMNS = 1

STRINGER STRAINS AND STRESSES FOR ITERATION NO. 1

MEMBER	STRINGER NO.	X-COORDINATE	EPS X	SIG X
1	1	2.5000E 00	2.8865E-02	2.8865E 05
2	2	2.5000E 00	2.8939E-02	2.8939E 05
3	3	2.5000E 00	2.8898E-02	2.8898E 05
4	1	7.5000E 00	2.8928E-02	2.8928E 05
5	2	7.5000E 00	2.8989E-02	2.8989E 05
6	3	7.5000E 00	2.8958E-02	2.8958E 05

```
FROM GETDIM.
NAME = BND COND.  I/O UNIT =  1.  FILE =  1.  ROWS =   51.  COLUMNS =  11
FROM GETDIM.
NAME = XTN     .  I/O UNIT = 10.  FILE =  2.  ROWS =  162.  COLUMNS =   1
FROM GETDIM.
NAME =  LOADS  .  I/O UNIT =  4.  FILE =  1.  ROWS =   39.  COLUMNS =   6
FROM PUTLAB.
NAME =  LOADS  .  I/O UNIT =  3.  FILE =  1.  ROWS =  162.  COLUMNS =     1
FROM PUTLAB.
NAME =  LOADS  .  I/O UNIT = 14.  FILE =  1.  ROWS =   60.  COLUMNS =     1
```

STRINGER STRAINS AND STRESSES FOR ITERATION NO. 1

MEMBER	STRINGER NO.	X-COORDINATE	EPS X	SIG X
1	1	2.5000E 00	2.8865E-02	2.8865E 05
2	2	2.5000E 00	2.8939E-02	2.8939E 05
3	3	2.5000E 00	2.8898E-02	2.8898E 05
4	1	7.5000E 00	2.8928E-02	2.8928E 05
5	2	7.5000E 00	2.8989E-02	2.8989E 05
6	3	7.5000E 00	2.8958E-02	2.8958E 05

```
FROM GETDIM.
NAME = BND COND.  I/O UNIT =  1.  FILE =  1.  ROWS =   51.  COLUMNS =  11

FROM GETDIM.
NAME = XTN      .  I/O UNIT = 10.  FILE =  2.  ROWS =  162.  COLUMNS =   1

FROM GETDIM.
NAME =  LOADS   .  I/O UNIT =  4.  FILE =  1.  ROWS =   39.  COLUMNS =   6

FROM PUTLAB.
NAME =  LOADS   .  I/O UNIT =  3.  FILE =  1.  ROWS =  162.  COLUMNS =    1

FROM PUTLAB.
NAME =  LOADS   .  I/O UNIT = 14.  FILE =  1.  ROWS =   60.  COLUMNS =    1
```

```
                              STRINGER STRAINS AND STRESSES FOR ITERATION NO.  2
                 MEMBER     STRINGER NO.     X-COORDINATE          EPS X                SIG X
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  FROM PUTLAB.
  NAME = ST STRES.  I/O UNIT = 21.  FILE =  8.  ROWS =        6.  COLUMNS =      2
                 1              1    2.5000E 00          2.9123E-02          2.9123E 05
                 2              2    2.5000E 00          2.7446E-02          2.7446E 05
                 3              3    2.5000E 00          2.9119E-02          2.9119E 05
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                 4              1    7.5000E 00          2.9197E-02          2.9197E 05
                 5              2    7.5000E 00          2.7482E-02          2.7482E 05
                 6              3    7.5000E 00          2.9193E-02          2.9193E 05
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  FROM GETDIM.
  NAME = BND COND.  I/O UNIT =  1.  FILE =  1.  ROWS =   51.  COLUMNS =   11

  FROM GETDIM.
  NAME = XTN     .  I/O UNIT = 10.  FILE =  2.  ROWS =  162.  COLUMNS =    1

  FROM GETDIM.
  NAME =  LOADS  .  I/O UNIT =  1.  FILE =  2.  ROWS =    3.  COLUMNS = 1000


(SUM(AREA*DZ))**2 =      1.44247E 02

  FROM GETDIM.
  NAME = XTN     .  I/O UNIT = 10.  FILE =  2.  ROWS =  162.  COLUMNS =    1

  FROM GETDIM.
  NAME = EL MASS .  I/O UNIT =  8.  FILE =  1.  ROWS =  162.  COLUMNS =    1

P.S. M =    2.91112D-02

  FROM SAMAIN, AFTER SAMAIN - STACK STIFNESS, SOLVE FOR DEFL..C.F.
  ***** ELAPSED TIME IS ........     0  MINUTES.   50.75  SECONDS *****
  ***** INCREMENTAL TIME IS ....     0  MINUTES.    1.07  SECONDS *****

  FROM MAIN. AFTER SAMAIN - STRENGTH ANALYSIS
  ***** ELAPSED TIME IS ........     0  MINUTES.   50.75  SECONDS *****
  ***** INCREMENTAL TIME IS ....     0  MINUTES.    0.0   SECONDS *****
```

APPENDIX B

USER'S MANUAL FOR

A*R*RE*S*T

(Acoustic Response of REusable Shuttle Tiles)

This Appendix describes the input and output of the structural acoustic response program ARREST. It is designed for operation with the RESIST computer program discussed in Appendix A. The program computes the RMS stresses and deflections of stiffened rectangular panels, with or without RSI shuttle tiles, subject to uniform correlated (spatially) random acoustic pressures. When there are TPS tiles, the RSI tile stresses and deflections are also computed. The computation procedure is based upon linear modal methods and assumes well-separated lightly damped modes.

The program card input effort is small compared with that for the RESIST program, as most of the input is on tapes generated by the RESIST program. Each time information for ARREST is generated by RESIST, it is contained on tape as units 1 and 21. Unit 21 contains modal data and unit 1 contains structural idealization data. Since the idealization data is the same for each mode, only one unit 1 need be input in ARREST. This tape should be mounted as unit 9 for an ARREST run. The tapes containing modal data should be mounted, in succession, as units 1, 2, 3, 4, 7 and 8. A minimum of one tape with one mode and a maximum of 6 modes may be used in a given ARREST run. If information for more than one mode is being combined on unit 1, then unit 1 must be mounted with a ring and the added modes are assigned unit numbers 2, 3, etc.

INPUT DATA FOR ARREST - Sheet 1 of 4

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
1 and 2	1-80	20A4	-	-	These are title cards which are used to identify the problem being run.
3	1-5	I5	N	-	The total number of modes superposed to obtain acoustic response results (not to be confused with the mode-numbers, which identify the individual modes).
	6-10	I5	LIMDP	-	The number of peak RMS primary structure accelerations which are identified. Used to help locate critical primary structure regions.
	11-15	I5	LIMSP	-	The number of peak RMS primary structure stresses to be identified in output.
	16-20	I5	LIMDT	-	The number of peak RMS tile deflections identified in output.
	21-25	I5	LIMST	-	The number of peak RMS tile stresses identified in output.
	26-30	I5	NTIL	-	The number of tiles for which modal information is stored on the magnetic input tapes generated by the previously run RESIST program.

INPUT DATA FOR ARREST - Sheet 2 of 4

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
3 (cont)	31-35	I5	NSTR	-	The stringer type associated with the idealization: 0 denotes either no stringers, orthotropic plate, or isotropic plate with singly attached stringers 2 denotes doubly attached stringers
	36-40	I5	KSTR	-	Defines whether or not stringer stress information is contained on input modal tapes: 0 denotes no stringer stress data on input tapes 1 denotes that there is stringer stress data on input tapes
	41-45	I5	IRES	-	Defines whether this run contains new modes or uses the same modes used in a previous run: 0 denotes that new mode tapes are used 1 denotes that a rerun using an existing single tape with all necessary modal data is being used

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
3 (cont)	46-50	I5	IMRES	-	Number of combined modes already on input tape if this is a restart run. Leave blank if not a restart run.
	51-55	I5	NAMLST	-	Debug printout clue: 0 denotes print debug information 1 denotes do not print debug information
4	1-10	I10	i	-	Mode number
Input as many cards of this type as there are modes in the acoustic response calculations.	11-20	E10.0	$\left(\sum_j A_{z_j} \bar{\Phi}_{T,z_j}\right)^2$		See Section 3 of report for definition of this quantity. It is printed output from a RESIST* run for the i^{th} mode.
	21-30	E10.0	$S(\omega_i)$	psi^2/Hz	Power spectral density at natural frequency of i^{th} mode.

*Denoted as (SUM (AREA*DZ))**2 on RESIST run output. This quantity is printed out at the end of the RESIST runs.

INPUT DATA FOR ARREST - Sheet 4 of 4

CARD(S)	COL(S)	FORMAT	SYMBOLS	UNITS	DESCRIPTION
4 (cont)	31-40	E10.0	M_i	$lb\text{-}sec^2\text{-}in.$	Modal mass of i^{th} mode. Obtained from printed output from RESIST run for i^{th} mode. Composed of modal mass for each tile** plus modal mass of primary structure***
	41-50	E10.0	ω_i	rad/sec	Natural frequency of present mode
	51-60	E10.0	ζ_i	$\frac{lb\text{-}sec}{in.}$	Damping ratio associated with i^{th} mode

See pages C-15 through C-36 for typical output from the ARREST program.

**Denoted as DEN on RESIST run output. This quantity is printed out after each tile displacement.

***Denoted as P.S.M on RESIST run output. This quantity is printed out at the end of the RESIST runs.

APPENDIX C

PROGRAMMERS MANUAL FOR

A*R*RE*S*T

(Acoustic Response of REusable Shuttle Tiles)

C.1 INTRODUCTION

This Appendix contains the overall flow chart of the program, data set allocation and subprogram calling sequence, along with a brief description of the individual subprograms and typical subprogram output for the ARREST program described in Section 4. Two versions of the program exist, one of which is written completely in FORTRAN. This version is compatible with both the IBM 370/168 and CDC 6600 machines. A more efficient second version, which runs only on the IBM computer, exists. This version contains an assembly language subroutine called DINIT with entry points: DREAD, DWRITE, DFIND, and DCLOSE.

C.2 FLOW CHART

The overall logic for the ARREST computer program is displayed in Figure C-1. The main modules of this program combine all the modal data (Module 1) contained on RESIST output tapes onto a single tape and compute the RMS deflections and stresses (Module 2). The remainder of the logic is concerned with locating the peak tile and primary structure responses for rapid identification.

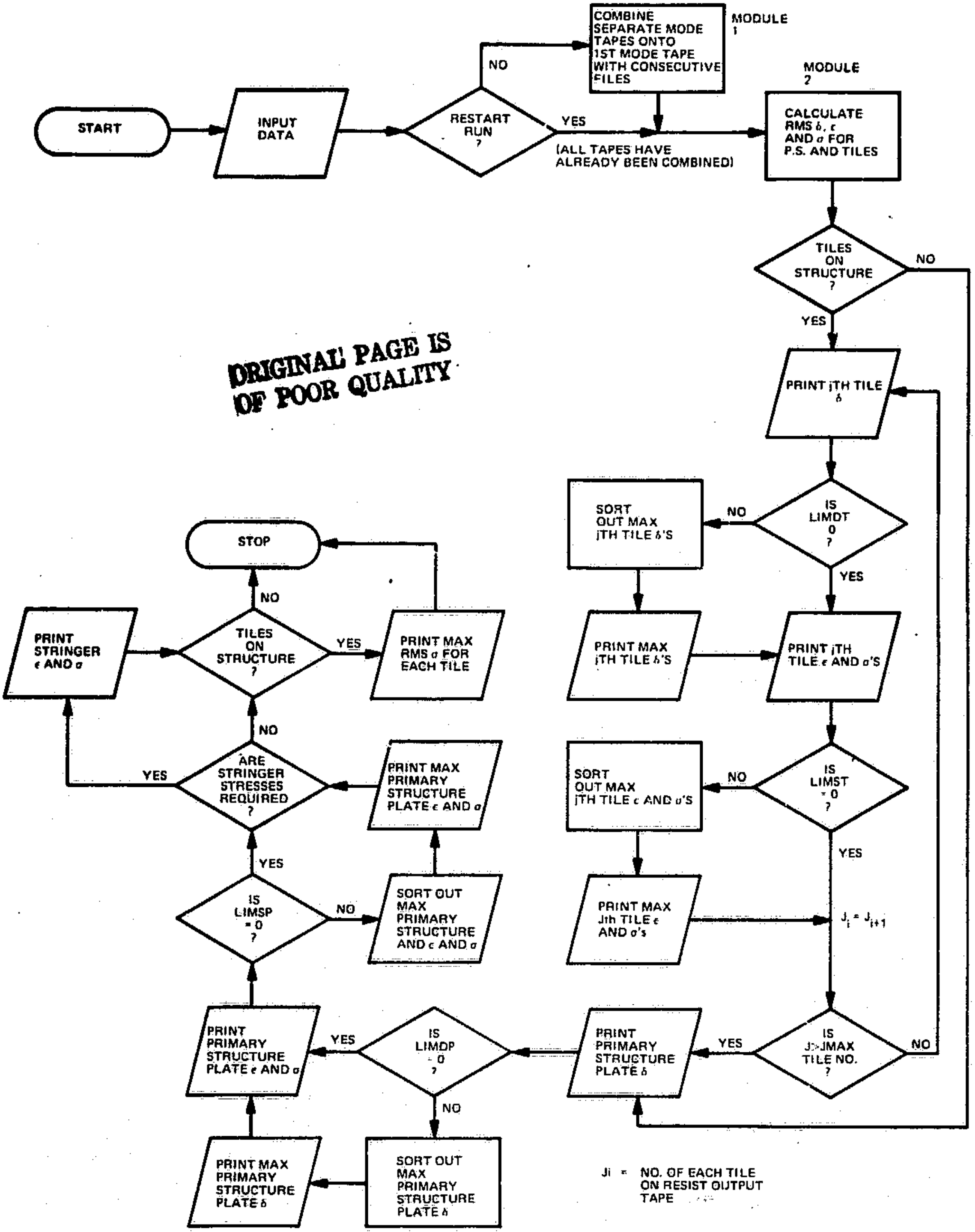

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Figure C-1 Arrest Program

C.3 DATA SET ALLOCATIONS

The following chart identifies the unit and file number assignments for each data set. Symbols used in the chart are:

- δ Deflections
- ϵ Strains
- σ Stresses

DATA SET ALLOCATIONS

UNIT NO.	UNIT NAME	FILE 1	FILE 2	FILE 3	FILE N (N_{max}=)
1	MAT1	δ, ε and σ's for a particular mode saved from RESIST run	Copy of MAT(1)*		Copy of MAT(N-1)*
2	MAT(1)	δ, ε and σ's for another mode*			
3	MAT(2)	δ, ε and σ's for another mode*			
4	MAT(3)	δ, ε and σ's for another mode*			
6	ITAPEW	Output to printer			
7	MAT(4)	δ, ε and σ's for another mode*			
8	MAT(5)	δ, ε and σ's for another mode*			
9	NTAPBC	Primary structure boundary conditions (No. Nodes x 11)	External tile numbers	Geometry	
10	ITAPER	1) Input data set in card image format (20A4)			
	NTAP	2) RMS δ, ε and σ's			

*If it exists

C.4 SUBPROGRAM CALLING SEQUENCE AND COMMON BLOCKS UTILIZED

The following table lists the subprograms that are called by each parent routine. The common blocks used in each routine are also tabularized. The subprograms listed under the "Calls" heading appear in the order in which they are called. The order of the subprograms listed in the "Subroutine" column corresponds to the order in which they appear in the FORTRAN listing. An alphabetical index which cross-references this order-of-appearance number is provided in Section C.5

NO.	SUBROUTINE	CALLED FROM	CALLS	COMMON
1	MAIN	-	IODATA	CTAPES
			GETDIM	DIMEN
			GETROW	FILE
			DCLOSE	PROPER
			COMPAK	
			RMS	
			SIGDEF	
			TSTMAX	
2	IODATA	MAIN	BIGBRD	CTAPES
			LBD	FILE
				PROPER
3	COMPAK	MAIN	GETDIM	CTAPES
			PUTLAB	FILE
			GETROW	
			PUTROW	
			DCLOSE	
4	RMS	MAIN	GETDIM	FILE
			GETROW	PROPER
			DCLOSE	
			PUTLAB	
			PUTROW	
			SQRT	
5	SIGDEF	MAIN	GETDIM	CTAPES
			GETROW	DIMEN
			DCLOSE	FILE
			DPRIME	PROPER
			SORT	
			DPMAX	
			DTILE	
			DTMAX	
			STILE	
			STMAX	

NO.	SUBROUTINE	CALLED FROM	CALLS	COMMON
5 (cont)			SPRIME SPMAX STRNGR	
6	DTILE	SIGDEF	-	CTAPES
7	DTMAX	SIGDEF	-	CTAPES
8	STILE	SIGDEF	-	CTAPES
9	STMAX	SIGDEF	-	CTAPES
10	DPRIME	SIGDEF	GETDIM GETROW DCLOSE	CTAPES DIMEN FILE
11	DPMAX	SIGDEF	GETDIM GETROW DCLOSE	CTAPES DIMEN FILE
12	SPRIME	SIGDEF	GETDIM GETROW DCLOSE	CTAPES FILE DIMEN
13	SPMAX	SIGDEF	-	CTAPES DIMEN
14	STRNGR	SIGDEF		FILE DIMEN CTAPES
15	SORT	SIGDEF	-	DIMEN
16	TSTMAX	MAIN	-	CTAPES DIMEN FILE
17	BIGBRD	IODATA	-	CTAPES
18	LDB	IODATA	EOFOI PLB	-
19	PLB	LDB	-	-
20	EOFOI	LDB	-	-

NO.	SUBROUTINE	CALLED FROM	CALLS	COMMON
21	PUTLAB	COMPAK	DFIND	CTAPES
		RMS	DWRITE	FILE
				PUTGET
22	PUTROW	COMPAK	DWRITE	-
		RMS	PACK	
			UNPACK	
			DCLOSE	
23	GETDIM	MAIN	DFIND	CTAPES
		COMPAK	DREAD	FILE
		RMS		PUTGET
		SIGDEF		
		DPRIME		
		DPMAX		
		SPRIME		
24	GETROW	MAIN	DREAD	-
		COMPAK	UNPACK	
		RMS	PACK	
		SIGDEF		
		DPRIME		
		DPMAX		
		SPRIME		
25	DWRITE	PUTLAB	PUT	-
		PUTROW		
26	PUT	DWRITE	-	-
27	DREAD	GETDIM	GET	-
		GETROW		
28	GET	DREAD	-	-
29	DFIND	PUTLAB	-	-
		GETDIM		
30	DCLOSE	MAIN	-	-

NO.	SUBROUTINE	CALLED FROM	CALLS	COMMON
30 (cont)		COMPAK		
		RMS		
		SIGDEF		
		DPRIME		
		DPMAX		
		SPRIME		
31	PACK	PUTROW	-	-
		GETROW		
32	UNPACK	PUTROW	-	-
		GETROW		

C.5 BRIEF DESCRIPTION OF SUBROUTINES

An alphabetical and numerical index, cross-referencing the 32 subroutines contained in ARREST, appears in Figure C-2. A brief description of each subroutine is also presented in the order in which it appears in the FORTRAN program.

SUBROUTINE	ORDER	SUBROUTINE	ORDER	SUBROUTINE	ORDER
ALPHABETICAL LISTING OF SUBROUTINES					
BIGBRD	17	COMPAK	3	DCLOSE	30
DFIND	29	DPMAX	11	DPRIME	10
DREAD	27	DTILE	6	DTMAX	7
DWRITE	25	EOF01	20	GET	28
GETDIM	23	GETROW	24	IODATA	2
LDB	18	MAIN	1	PACK	31
PLB	19	PUT	26	PUTLAB	21
PUTROW	22	RMS	4	SIGDEF	5
SORT	15	SPMAX	13	SPRIME	12
STILE	8	STMAX	9	STRNGR	14
TSTMAX	16	UNPACK	32		
NUMERICAL INDEX					
MAIN	1	IODATA	2	COMPAK	3
RMS	4	SIGDEF	5	DTILE	6
DTMAX	7	STILE	8	STMAX	9
DPRIME	10	DPMAX	11	SPRIME	12
SPMAX	13	STRNGR	14	SORT	15
TSTMAX	16	BIGBRD	17	LDB	18
PLB	19	EOF01	20	PUTLAB	21
PUTROW	22	GETDIM	23	GETROW	24
DWRITE	25	PUT	26	DREAD	27
GET	28	DFIND	29	DCLOSE	30
PACK	31	UNPACK	32		

Figure C-2 Subroutine Cross-Reference

DESCRIPTION OF SUBROUTINES

1 MAIN - Initializes input/output unit numbers and calls all input and data processing routines.

2 IODATA - Reads all data from input stream and prints user options.

3 COMPAK - Incorporates modal data from all tapes onto the tape for the first mode in a non-restart job.

4 RMS - Generates all RMS deflections, strains and stresses and stores them for future printout.

5 SIGDEF - Supervisor that calls routines for printout of RMS results.

6 DTILE - Prints RMS TPS displacements for tile.

7 DTMAX - Prints maximum RMS TPS displacements for tile.

8 STILE - Prints RMS stresses for tile.

9 STMAX - Prints maximum RMS stresses for tile.

10 DPRIME - Prints primary structure RMS deflections.

11 DPMAX - Prints maximum primary structure RMS deflections.

12 SPRIME - Prints mid-point plate member RMS strains and stresses.

13 SPMAX - Prints maximum mid-point plate member RMS strains and stresses.

14 STRNGR - Prints stringer strains and stresses.

15 SORT - Sorts set of RMS results into decreasing order.

16 TSTMAX - Prints maximum RMS stress for each tile.

17 BIGBRD - Prints ARREST title sheet before program output.

18 LDB - Reads and lists data from input stream and generates data file for user's program.

19 PLB - Starts a new page and/or skips a number of lines.

20 EOFOI - Checks for an end of file on input data set unit, sets end of file control word option to its proper value and reads a two card problem title.

21 PUTLAB - Puts label on data set containing matrix dimensions and prints out label information, if requested.

22 PUTROW - Writes row of matrix on data set in format designated by packing factor.

23 GETDIM - Gets label of matrix from data set and prints out label information, if requested.

24 GETROW - Reads row of matrix from data set in format designated by packing factor.

25 DWRITE - Converts number of bytes in array into words by dividing by four.

26 PUT - Writes singly-dimensioned array onto data set.

27 DREAD - Converts number of bytes in array into words by dividing by four.

28 GET - Reads singly-dimensioned array from data set.

29 DFIND - Rewinds data set to appropriate file.

30 DCLOSE - Rewinds data set.

31 PACK - Packs rows of matrix so they may be written on a data set in an efficient manner. This is done by representing strings of zeros by a single fixed point negative integer where the value of the integer represents the number of zeroes in the string. Non-zero numbers are preceded by a fixed point number indicating the number of non-zero numbers that follow.

32 UNPACK - Unpacks rows of matrices that have been packed by subroutine PACK.

C.6 TYPICAL SUBPROGRAM OUTPUT

The following listings display subprogram output with all the debugging clues turned on. The name of the particular subprogram which generated each set of output is printed in bold type on the rotated right hand side of each photographed computer page.

ACOUSTIC RESPONSE OF REUSABLE SHUTTLE TILES

VERSION DATE

APRIL 1975

PREPARED BY

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OF GRUMMAN AEROSPACE CORPORATION

FOR

THE LANGLEY RESEARCH CENTER

PROGRAM LISTING OF INPUT DATA CARDS

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.........1.........2.........3.........4.........5.........6.........7.........8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

ARREST TEST PROBLEM  -  CLOSED STRINGERS WITH TILES
   APRIL 20, 1975
    2   30   25   20    15     2    2      1      0    0    1
         1   123.295         .002  .0262866   471.887        .05
         1   123.295         .002  .0262866   471.887        .05
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ORIGINAL PAGE IS
OF POOR QUALITY

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.........1.........2.........3.........4.........5.........6.........7.........8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
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ARREST TEST PROBLEM - CLOSED STRINGERS WITH TILES
APRIL 20, 1975

OPTIONS

INPUT MODAL DATA IS STORED ON 2 TAPE(S)

NUMBER OF PEAK RMS ITEMS IDENTIFIED IN EACH CATEGORY

30 PRIMARY STRUCTURE ACCELERATIONS
25 PRIMARY STRUCTURE STRESSES
20 TILE DEFLECTIONS PER TILE
15 TILE STRESSES PER TILE

INPUT MODE	INTEGRATED PRESSURE SPECTRAL DENSITY FUNCTION ((PSI**2/HZ)*(AREA*DZ)**2)	MODAL MASS (IN-LB-SEC**2)	MODAL FREQUENCY (RAD/SEC)	DAMPING RATIO
1	2.59592E-01	2.62866E-02	4.71887E 02	5.00000E-02
1	2.59592E-01	2.62866E-02	4.71887E 02	5.00000E-02

```
FROM GETDIM,
NAME = TILE DEF,   I/O UNIT =  2,  FILE =  1,  ROWS =    1,  COLUMNS =  240

FROM PUTLAB,
NAME = TILE DEF,   I/O UNIT =  1,  FILE =  9,  ROWS =    1,  COLUMNS =  240

COPYING MODE 2 FILE   1  MATRIX TILE DEF      1 ROWS    240 COLUMNS

FROM GETDIM,
NAME = T STRESS,   I/O UNIT =  2,  FILE =  2,  ROWS =   27,  COLUMNS =    6

FROM PUTLAB,
NAME = T STRESS,   I/O UNIT =  1,  FILE = 10,  ROWS =    1,  COLUMNS =  162

COPYING MODE 2 FILE   2  MATRIX T STRESS     27 ROWS      6 COLUMNS

FROM GETDIM,
NAME = TILE DEF,   I/O UNIT =  2,  FILE =  3,  ROWS =    1,  COLUMNS =  240

FROM PUTLAB,
NAME = TILE DEF,   I/O UNIT =  1,  FILE = 11,  ROWS =    1,  COLUMNS =  240

COPYING MODE 2 FILE   3  MATRIX TILE DEF      1 ROWS    240 COLUMNS

FROM GETDIM,
NAME = T STRESS,   I/O UNIT =  2,  FILE =  4,  ROWS =   27,  COLUMNS =    6

FROM PUTLAB,
NAME = T STRESS,   I/O UNIT =  1,  FILE = 12,  ROWS =    1,  COLUMNS =  162

COPYING MODE 2 FILE   4  MATRIX T STRESS     27 ROWS      6 COLUMNS

FROM GETDIM,
NAME = PS DEFLS,   I/O UNIT =  2,  FILE =  5,  ROWS =    1,  COLUMNS =  162

FROM PUTLAB,
NAME = PS DEFLS,   I/O UNIT =  1,  FILE = 13,  ROWS =    1,  COLUMNS =  162

COPYING MODE 2 FILE   5  MATRIX PS DEFLS      1 ROWS    162 COLUMNS

FROM GETDIM,
NAME = PS STRES,   I/O UNIT =  2,  FILE =  6,  ROWS =   18,  COLUMNS =    6

FROM PUTLAB,
NAME = PS STRES,   I/O UNIT =  1,  FILE = 14,  ROWS =    1,  COLUMNS =  108

COPYING MODE 2 FILE   6  MATRIX PS STRES     18 ROWS      6 COLUMNS

FROM GETDIM,
NAME = PS STRES,   I/O UNIT =  2,  FILE =  7,  ROWS =   18,  COLUMNS =    6

FROM PUTLAB,
NAME = PS STRES,   I/O UNIT =  1,  FILE = 15,  ROWS =    1,  COLUMNS =  108

COPYING MODE 2 FILE   7  MATRIX PS STRES     18 ROWS      6 COLUMNS

FROM GETDIM,
NAME = ST STRES,   I/O UNIT =  2,  FILE =  8,  ROWS =    6,  COLUMNS =    2
```

```
FROM PUTLAB,
NAME = ST STRES,  I/O UNIT =  1,  FILE = 16,  ROWS =    1,  COLUMNS =    12
COPYING MODE 2 FILE   8  MATRIX ST STRES       6 ROWS      2 COLUMNS
FROM GETDIM,
NAME =  LOADS  ,  I/O UNIT =  9,  FILE =  2,  ROWS =   3,  COLUMNS = 1000
FROM GETDIM,
NAME = TILE DEF,  I/O UNIT =  1,  FILE =  1,  ROWS =   1,  COLUMNS =  240
FROM PUTLAB,
NAME = TILE DEF,  I/O UNIT = 10,  FILE =  1,  ROWS =    1,  COLUMNS =   240
FROM GETDIM,
NAME = TILE DEF,  I/O UNIT =  1,  FILE =  9,  ROWS =   1,  COLUMNS =  240
FROM GETDIM,
NAME = T STRESS,  I/O UNIT =  1,  FILE =  2,  ROWS =  27,  COLUMNS =    6
FROM PUTLAB,
NAME = T STRESS,  I/O UNIT = 10,  FILE =  2,  ROWS =    1,  COLUMNS =   162
FROM GETDIM,
NAME = T STRESS,  I/O UNIT =  1,  FILE = 10,  ROWS =   1,  COLUMNS =  162
FROM GETDIM,
NAME = TILE DEF,  I/O UNIT =  1,  FILE =  3,  ROWS =   1,  COLUMNS =  240
FROM PUTLAB,
NAME = TILE DEF,  I/O UNIT = 10,  FILE =  3,  ROWS =    1,  COLUMNS =   240
FROM GETDIM,
NAME = TILE DEF,  I/O UNIT =  1,  FILE = 11,  ROWS =   1,  COLUMNS =  240
FROM GETDIM,
NAME = T STRESS,  I/O UNIT =  1,  FILE =  4,  ROWS =  27,  COLUMNS =    6
FROM PUTLAB,
NAME = T STRESS,  I/O UNIT = 10,  FILE =  4,  ROWS =    1,  COLUMNS =   162
FROM GETDIM,
NAME = T STRESS,  I/O UNIT =  1,  FILE = 12,  ROWS =   1,  COLUMNS =  162
FROM GETDIM,
NAME = PS DEFLS,  I/O UNIT =  1,  FILE =  5,  ROWS =   1,  COLUMNS =  162
FROM PUTLAB,
NAME = PS DEFLS,  I/O UNIT = 10,  FILE =  5,  ROWS =    1,  COLUMNS =   162
FROM GETDIM,
NAME = PS DEFLS,  I/O UNIT =  1,  FILE = 13,  ROWS =   1,  COLUMNS =  162
FROM GETDIM,
NAME = PS STRES,  I/O UNIT =  1,  FILE =  6,  ROWS =  18,  COLUMNS =    6
FROM PUTLAB,
NAME = PS STRES,  I/O UNIT = 10,  FILE =  6,  ROWS =    1,  COLUMNS =   108
```

```
FROM GETDIM,
NAME = PS STRES,  I/O UNIT =  1,  FILE = 14,  ROWS =   1,  COLUMNS = 108
FROM GETDIM,
NAME = PS STRES,  I/O UNIT =  1,  FILE =  7,  ROWS =  18,  COLUMNS =   6
FROM PUTLAB,
NAME = PS STRES,  I/O UNIT = 10,  FILE =  7,  ROWS =   1,  COLUMNS = 108
FROM GETDIM,
NAME = PS STRES,  I/O UNIT =  1,  FILE = 15,  ROWS =   1,  COLUMNS = 108
FROM GETDIM,
NAME = ST STRES,  I/O UNIT =  1,  FILE =  8,  ROWS =   6,  COLUMNS =   2
FROM PUTLAB,
NAME = ST STRES,  I/O UNIT = 10,  FILE =  8,  ROWS =   1,  COLUMNS =  12
FROM GETDIM,
NAME = ST STRES,  I/O UNIT =  1,  FILE = 16,  ROWS =   1,  COLUMNS =  12
FROM GETDIM,
NAME = TILE DEF,  I/O UNIT = 10,  FILE =  1,  ROWS =   1,  COLUMNS = 240
FROM GETDIM,
NAME = JEGGNYOG,  I/O UNIT =  9,  FILE =  3,  ROWS =   1,  COLUMNS = 108
FROM GETDIM,
NAME = TILE DEF,  I/O UNIT = 10,  FILE =  1,  ROWS =   1,  COLUMNS = 240
```

RMS

SIGDEF

DTILE

RMS TPS DISPLACEMENTS FOR TILE NO. 1 (IN.)

NODE	X COMPONENT (U)	Y COMPONENT(V)	Z COMPONENT(W)
1	5.9237558E-05	7.0984488E-06	0.0
2	5.5564858E-05	6.0089887E-06	0.0
3	5.5646393E-05	4.8720331E-06	0.0
4	5.4734468E-05	4.1120729E-06	0.0
5	5.6585573E-05	3.4805089E-06	0.0
6	5.6517471E-05	2.7322048E-06	0.0
7	5.4520249E-05	2.1773340E-06	0.0
8	5.5220365E-05	1.5764927E-06	0.0
9	5.4766308E-05	6.9512282E-07	0.0
10	5.7771074E-05	3.0065699E-08	0.0
11	8.7743692E-06	8.9226887E-06	1.0331247E-03
12	8.9619571E-06	4.1642643E-06	1.0122946E-03
13	8.6495738E-06	1.7798811E-06	1.0209167E-03
14	8.6754935E-06	1.1787943E-06	1.0369641E-03
15	8.[illegible]3909E-06	1.6651720E-06	1.0495435E-03
16	8.3[illegible]1364E-06	2.8619352E-06	1.0496213E-03
17	8.5[illegible]25440E-06	3.3001852E-06	1.0371145E-03
18	8.3336249E-06	2.5719764E-06	1.0211349E-03
19	8.4970152E-06	1.6925622E-08	1.0127111E-03
20	8.1799844E-06	5.0414483E-06	1.0338146E-03
21	6.4894426E-05	3.8360722E-06	2.2953673E-06
22	6.4820430E-05	4.1197536E-06	2.1754568E-06
23	6.4450956E-05	4.1980866E-06	1.8317451E-06
24	6.3934727E-05	3.9556899E-06	1.3138315E-06
25	6.3520289E-05	3.3869464E-06	9.2732779E-07
26	6.3384708E-05	2.6814714E-06	9.2242493E-07
27	6.3527477E-05	2.1139349E-06	1.2990604E-06
28	6.3771033E-05	1.8739574E-06	1.8087303E-06
29	6.3867759E-05	1.9531135E-06	2.1320693E-06
30	6.3679079E-05	2.2253389E-06	2.2219519E-06
31	6.4476306E-05	5.0234648E-06	1.0262330E-03
32	6.4756183E-05	5.0043936E-06	1.0230064E-03
33	6.4077467E-05	5.3772328E-06	1.0267857E-03
34	6.2663763E-05	5.0469516E-06	1.0362570E-03
35	6.1514307E-05	3.5066914E-06	1.0437467E-03
36	6.1379615E-05	1.4247480E-06	1.0437986E-03
37	6.2260719E-05	1.1391808E-07	1.0363928E-03
38	6.3405081E-05	4.3762361E-07	1.0270244E-03
39	6.3810716E-05	5.5398008E-08	1.0233922E-03
40	6.3266343E-05	5.3035812E-08	1.0267822E-03
41	2.7135178E-04	3.6026277E-06	4.9070980E-06
42	2.7136807E-04	3.6273987E-06	4.1563953E-06
43	2.7134363E-04	3.5388002E-06	3.2709358E-06
44	2.7133804E-04	3.3529850E-06	2.4708534E-06
45	2.7129939E-04	3.1318268E-06	1.974526[illegible]E-06
46	2.7117017E-04	2.9040702E-06	1.9549861E-06
47	2.7094898E-04	2.6825783E-06	2.4117298E-06
48	2.7069543E-04	2.4951005E-06	3.1682666E-06
49	2.7046329E-04	2.4021847E-06	4.0045152E-06
50	2.7019205E-04	2.4211622E-06	4.7000840E-06

RMS TPS DISPLACEMENTS FOR TILE NO. 1 (IN.)

NODE	X COMPONENT(U)	Y COMPONENT(V)	Z COMPONENT(W)
51	2.7106493E-04	4.5645584E-06	1.0304670E-03
52	2.7102255E-04	3.7419040E-06	1.0325070E-03
53	2.7083326E-04	2.4105857E-06	1.0345688E-03
54	2.7070916E-04	1.7066350E-06	1.0367774E-03
55	2.7060322E-04	2.0371172E-06	1.0383709E-03
56	2.7047447E-04	2.8281520E-06	1.0384086E-03
57	2.7032080E-04	3.1586387E-06	1.0368945E-03
58	2.7018569E-04	2.4518840E-06	1.0347688E-03
59	2.7011870E-04	1.1204056E-06	1.0327883E-03
60	2.6990403E-04	3.0322326E-07	1.0308239E-03
61	6.8716402E-04	2.2644463E-06	5.5545916E-06
62	6.8705130E-04	2.2795548E-06	4.6792966E-06
63	6.8696239E-04	2.3721150E-06	3.8891549E-06
64	6.8684993E-04	2.5589561E-06	3.3479537E-06
65	6.8672420E-04	2.8161212E-06	3.0812589E-06
66	6.8659848E-04	3.0995025E-06	3.0522651E-06
67	6.8647345E-04	3.3566739E-06	3.2597736E-06
68	6.8633258E-04	3.5438816E-06	3.7407554E-06
69	6.8616820E-04	3.6367892E-06	4.4696326E-06
70	6.8602362E-04	3.6522724E-06	5.2823816E-06
71	6.8716006E-04	1.5263486E-06	1.0354891E-03
72	6.8706570E-04	1.6237964E-06	1.0367541E-03
73	6.8704574E-04	1.8333485E-06	1.0373548E-03
74	6.8703922E-04	2.0606230E-06	1.0370614E-03
75	6.8699219E-04	2.2748127E-06	1.0365502E-03
76	6.8685570E-04	2.4847832E-06	1.0365848E-03
77	6.8665227E-04	2.6982616E-06	1.0371646E-03
78	6.8641587E-04	2.9249941E-06	1.0375218E-03
79	6.8618311E-04	3.1340487E-06	1.0369809E-03
80	6.8602082E-04	3.2307653E-06	1.0357725E-03

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OF POOR QUALITY

DTMAX

MAXIMUM RMS TPS DISPLACEMENTS FOR TILE NO. 1 (IN.)

NODE	X COMPONENT(U)	Y COMPONENT(V)	Z COMPONENT(W)
14			1.0369641E-03
15			1.0495435E-03
16			1.0496213E-03
17			1.0371145E-03
34			1.0362570E-03
35			1.0437467E-03
36			1.0437986E-03
37			1.0363988E-03
54			1.0367774E-03
55			1.0383709E-03
56			1.0384026E-03
57			1.0368945E-03
72			1.0367541E-03
73			1.0373548E-03
74			1.0370614E-03
75			1.0365502E-03
76			1.0365848E-03
77			1.0371646E-03
78			1.0375218E-03
79			1.0369809E-03

FROM GETDIM,
NAME = T STRESS, I/O UNIT = 10, FILE = 2, ROWS = 1, COLUMNS = 162

SIGDEF

STILE

RMS STRESSES FOR TILE NO. 1 (PSI)

MEM	TEMP	LOCAL COORDINATES X	Y	Z	XX	YY	ZZ	XY	YZ	ZX
1	0.	2.50	0.55	0.05	3.24628E-03	2.87579E-03	2.85342E-03	2.53015E-05	7.82585E-04	3.35432E-03
2	0.	2.50	1.67	0.05	5.27409E-02	5.24152E-02	5.43558E-02	4.35315E-06	2.28125E-04	3.58958E-03
3	0.	2.50	2.78	0.05	1.41104E-02	1.37981E-02	1.41289E-02	1.34646E-05	6.77903E-04	3.39310E-03
4	0.	2.50	3.89	0.05	2.55901E-02	2.59153E-02	2.72051E-02	5.41731E-06	5.51230E-04	3.00980E-03
5	0.	2.50	5.00	0.05	4.28792E-02	4.32141E-02	4.52162E-02	1.58773E-06	2.75454E-05	2.73181E-03
6	0.	2.50	6.11	0.05	2.56367E-02	2.59613E-02	2.72536E-02	2.16743E-06	5.12735E-04	2.96616E-03
7	0.	2.50	7.22	0.05	1.42964E-02	1.39852E-02	1.43230E-02	1.67289E-05	6.43089E-04	3.31364E-03
8	0.	2.50	8.33	0.05	5.29318E-02	5.26083E-02	5.45565E-02	7.50200E-06	1.96821E-04	3.49343E-03
9	0.	2.50	9.44	0.05	2.99156E-03	2.62622E-03	2.59434E-03	2.83990E-05	8.04843E-04	3.27597E-03
10	0.	2.50	0.56	0.60	9.85529E-03	1.27259E-02	1.49974E-02	2.33919E-03	2.18510E-02	5.68949E-03
11	0.	2.50	1.67	0.60	1.16251E-02	1.50459E-02	2.23114E-02	6.72844E-03	7.85865E-03	6.42496E-03
12	0.	2.50	2.78	0.60	3.06430E-03	1.07188E-02	7.49202E-03	8.76662E-03	3.30328E-02	3.54349E-03
13	0.	2.50	3.89	0.60	1.00183E-02	4.73369E-02	1.53321E-02	6.15737E-03	2.64147E-02	4.01434E-04
14	0.	2.50	5.00	0.60	1.58452E-02	6.35917E-02	2.56433E-02	7.05044E-05	3.16922E-05	2.17267E-03
15	0.	2.50	6.11	0.60	9.99259E-03	4.72520E-02	1.52934E-02	6.00477E-03	2.64438E-02	4.38660E-04
16	0.	2.50	7.22	0.60	3.12541E-03	1.05158E-02	7.60331E-03	8.60707E-03	3.31032E-02	3.47105E-03
17	0.	2.50	8.33	0.60	1.16658E-02	1.52309E-02	2.23982E-02	6.55460E-03	7.67554E-03	6.34698E-03
18	0.	2.50	9.44	0.60	9.84041E-03	1.27706E-02	1.49192E-02	2.20067E-03	2.20286E-02	5.49079E-03
19	0.	2.50	0.56	2.10	2.49288E-03	9.90334E-03	5.94999E-03	7.23983E-04	4.13205E-03	7.31787E-03
20	0.	2.50	1.67	2.10	5.19473E-03	1.77698E-02	4.17943E-03	7.49658E-04	1.03925E-02	2.74766E-03
21	0.	2.50	2.78	2.10	5.95499E-04	6.60809E-03	1.10925E-03	2.69159E-03	1.47117E-02	7.06786E-04
22	0.	2.50	3.89	2.10	8.20535E-03	1.16982E-02	2.44140E-03	2.35238E-03	1.12130E-02	7.91801E-04
23	0.	2.50	5.00	2.10	1.21172E-02	1.99164E-02	4.06628E-03	3.51312E-05	3.11891E-05	1.42615E-03
24	0.	2.50	6.11	2.10	8.19898E-03	1.16821E-02	2.42541E-03	2.29740E-03	1.12472E-02	8.23996E-04
25	0.	2.50	7.22	2.10	6.42140E-04	6.69211E-03	1.12898E-03	2.63852E-03	1.47006E-02	6.43401E-04
26	0.	2.50	8.33	2.10	6.24929E-03	1.78584E-02	4.19035E-03	6.94909E-04	1.03412E-02	2.63598E-03
27	0.	2.50	9.44	2.10	2.50356E-03	9.91825E-03	5.94595E-03	7.56731E-04	4.07571E-03	7.15287E-03

MAXIMUM RMS STRESSES FOR TILE NO. 1 (PSI)

STMAX

MFM	TEMP	LOCAL COORDINATES X	Y	Z	XX	YY	ZZ	XY	YZ	ZX
2	0.	2.50	1.67	0.05	5.27409E-02	5.24152E-02	5.43558E-02			
5	0.	2.50	5.00	0.05	4.28792E-02	4.32141E-02	4.52162F-02			
6	0.	2.50	6.11	0.05			2.72536E-02			
8	0.	2.50	8.33	0.05	5.29318E-02	5.25083E-02	5.45565E-02			
12	0.	2.50	2.78	0.60					3.30328E-02	
13	0.	2.50	3.89	0.60		4.73369E-02				
14	0.	2.50	5.00	0.50		6.35917E-02				
15	0.	2.50	6.11	0.60		4.72520E-02				
16	0.	2.50	7.22	0.60					3.31032E-02	

FROM GETDIM,
NAME = TILE OFF. I/O UNIT = 10. FILE = 3. ROWS = 1. COLUMNS = 240

SIGDEF

RMS TPS DISPLACEMENTS FOR TILE NO. 2 (IN.)

NODE	X COMPONENT(U)	Y COMPONENT(V)	Z COMPONENT(W)
1	8.7743592E-06	8.9226887E-06	1.0331247E-03
2	8.9619571E-06	4.1642643E-08	1.0122946E-03
3	8.6495738E-06	1.7798811E-06	1.0209167E-03
4	8.6754935E-06	1.1787943E-06	1.0369641E-03
5	8.3993909E-06	1.6651720E-06	1.0495436E-03
6	8.3441364E-06	2.8619352E-06	1.0496213E-03
7	8.5025440E-06	3.8001852E-06	1.0371146E-03
8	8.3386249E-06	2.5719764E-06	1.0211349E-03
9	8.4970152E-06	1.6925622E-08	1.0127111E-03
10	8.1799844E-06	5.0414483E-06	1.0338146E-03
11	3.8964252E-05	5.6171740E-06	0.0
12	3.8533704E-05	4.6294163E-06	0.0
13	3.8420141E-05	3.6766105E-06	0.0
14	3.8622908E-05	3.1102090E-06	0.0
15	3.8751212E-05	2.6694624E-06	0.0
16	3.8751750E-05	2.1248052E-06	0.0
17	3.8627186E-05	1.7376187E-06	0.0
18	3.8428843E-05	1.2923329E-06	0.0
19	3.8545404E-05	5.4839757E-07	0.0
20	3.8979502E-05	3.0017819E-08	0.0
21	4.6149304E-05	5.0261970E-06	1.0262586E-03
22	4.6576024E-05	5.0128501E-06	1.0230080E-03
23	4.6048415E-05	5.3874201E-06	1.0267778E-03
24	4.4781744E-05	5.0592198E-06	1.0362421E-03
25	4.3775595E-05	3.5211842E-06	1.0437367E-03
26	4.3791809E-05	1.4408333E-06	1.0437872E-03
27	4.4802335E-05	9.5884388E-08	1.0363772E-03
28	4.6084751E-05	4.1658069E-07	1.0270018E-03
29	4.6625180E-05	2.9745589E-08	1.0233743E-03
30	4.6220186E-05	1.8770251E-08	1.0267808E-03
31	4.6553207E-05	3.1883510E-06	2.2803770E-06
32	4.6638481E-05	3.4727045E-06	2.1709566E-06
33	4.6420828E-05	3.5570756E-06	1.8287574E-06
34	4.6052563E-05	3.3215229E-06	1.3090712E-06
35	4.5772365E-05	2.7595124E-06	9.1664231E-07
36	4.5777706E-05	2.0603457E-06	9.1074918E-07
37	4.6069152E-05	1.4990155E-06	1.2918099E-06
38	4.6448957E-05	1.2645214E-06	1.7988004E-06
39	4.6580230E-05	1.3478166E-06	2.1231872E-06
40	4.6619214E-05	1.6222048E-06	2.2067134E-06
41	2.5272742E-04	4.5807392E-06	1.0304535E-03
42	2.5282940E-04	3.7579648E-06	1.0324840E-03
43	2.5278982E-04	2.4259798E-06	1.0345357E-03
44	2.5281101E-04	1.7212342E-06	1.0367366E-03
45	2.5284826E-04	2.0526459E-06	1.0383262E-03
46	2.5285990E-04	2.8460572E-06	1.0383634E-03
47	2.5284733E-04	3.1777645E-06	1.0368493E-03
48	2.5285082E-04	2.4709043E-06	1.0347248E-03
49	2.5292020E-04	1.1394177E-06	1.0327497E-03
50	2.5284663E-04	3.2306735E-07	1.0307913E-03

DTILE

RMS TPS DISPLACEMENTS FOR TILE NO. 2 (IN.)

NODE	X COMPONENT(U)	Y COMPONENT(V)	Z COMPONENT(W)
51	2.5301543E-04	2.9685680E-06	4.8641377E-06
52	2.5317958E-04	2.9928015E-06	4.1231942E-06
53	2.5330274E-04	2.9053899E-06	3.2429116E-06
54	2.5344129E-04	2.7229116E-06	2.4456194E-06
55	2.5354442E-04	2.5063582E-06	1.9525933E-06
56	2.5355506E-04	2.2840359E-06	1.9352146E-06
57	2.5347644E-04	2.0670068E-06	2.3918410E-06
58	2.5335281E-04	1.8825494E-06	3.1486798E-06
59	2.5326759E-04	1.7910052E-06	3.9837778E-06
60	2.5313464E-04	1.8102437E-06	4.6769565E-06
61	6.6879042E-04	1.5550559E-06	1.0354568E-03
62	6.6884048E-04	1.6520489E-06	1.0367145E-03
63	6.6896458E-04	1.8605379E-06	1.0373075E-03
64	6.6910079E-04	2.0862717E-06	1.0370067E-03
65	6.6919765E-04	2.2984168E-06	1.0364896E-03
66	6.6921441E-04	2.5064328E-06	1.0365224E-03
67	6.6915038E-04	2.7182214E-06	1.0371031E-03
68	6.6904491E-04	2.9437042E-06	1.0374626E-03
69	6.6895108E-04	3.1518430E-06	1.0369229E-03
70	6.6892896E-04	3.2479693E-06	1.0357157E-03
71	6.6880346E-04	1.6450258E-06	5.4966531E-06
72	6.6883606E-04	1.6599624E-06	4.6275800E-06
73	6.6889008E-04	1.7528564E-06	3.8426242E-06
74	6.6892221E-04	1.9406798E-06	3.3073447E-06
75	6.6893827E-04	2.1990536E-06	3.0454321E-06
76	6.6895480E-04	2.4836590E-06	3.0193587E-06
77	6.6897180E-04	2.7419319E-06	3.2286080E-06
78	6.6897180E-04	2.9296816E-06	3.7099071E-06
79	6.6894605E-04	3.0227984E-06	4.4393819E-06
80	6.6894409E-04	3.0381307E-06	5.2522000E-06

DTMAX

MAXIMUM RMS TPS DISPLACEMENTS FOR TILE NO. 2 (IN.)

NODE	X COMPONENT(U)	Y COMPONENT(V)	Z COMPONENT(W)
4			1.0369641E-03
5			1.0495435E-03
6			1.0496213E-03
7			1.0371145E-03
24			1.0362421E-03
25			1.0437367E-03
26			1.0437872E-03
27			1.0363772E-03
44			1.0367366E-03
45			1.0383262E-03
46			1.0383634E-03
47			1.0368493E-03
62			1.0367145E-03
63			1.0373075E-03
64			1.0370067E-03
65			1.0364896E-03
66			1.0365224E-03
67			1.0371031E-03
68			1.0374626E-03
69			1.0369229E-03

FROM GETDIM.
NAME = T STRESS. I/O UNIT = 10. FILE = 4. ROWS = 1. COLUMNS = 162

SIGDEF

RMS STRESSES FOR TILE NO. 2 (PSI)

STILE

MEM	TEMP	LOCAL COORDINATES X	Y	Z	XX	YY	ZZ	XY	YZ	ZX
1	0.	2.50	0.56	0.05	3.35064E-03	2.98856E-03	2.97060E-03	1.02625E-05	6.56183E-04	3.33518E-03
2	0.	2.50	1.67	0.05	5.28802E-02	5.25542E-02	5.44922E-02	5.23627E-06	3.26621E-04	3.36756E-03
3	0.	2.50	2.78	0.05	1.42203E-02	1.39068E-02	1.42325E-02	9.51545E-06	7.49186E-04	3.10355E-03
4	0.	2.50	3.89	0.05	2.55451E-02	2.58682E-02	2.71622E-02	5.33412E-06	5.94951E-04	2.77164E-03
5	0.	2.50	5.00	0.05	4.29692E-02	4.32948E-02	4.52996E-02	6.46357E-07	3.56773E-05	2.61073E-03
6	0.	2.50	6.11	0.05	2.56283E-02	2.59506E-02	2.72474E-02	6.86339E-06	5.24522E-04	2.75713E-03
7	0.	2.50	7.22	0.05	1.43248E-02	1.40128E-02	1.43442E-02	1.17164E-05	6.77912E-04	3.07268E-03
8	0.	2.50	8.33	0.05	5.29513E-02	5.26278E-02	5.45707E-02	8.49976E-06	2.52455E-04	3.31744E-03
9	0.	2.50	9.44	0.05	2.93426E-03	2.57612E-03	2.54288E-03	1.49170E-05	7.29354E-04	3.26753E-03
10	0.	2.50	0.56	0.60	9.86644E-03	1.28038E-02	1.49924E-02	2.25341E-03	2.18580E-02	5.65988E-03
11	0.	2.50	1.67	0.60	1.17395E-02	1.52410E-02	2.23374E-02	6.63526E-03	7.92978E-03	6.27846E-03
12	0.	2.50	2.78	0.60	3.19570E-03	1.04808E-02	7.50955E-03	8.72639E-03	3.30761E-02	3.34861E-03
13	0.	2.50	3.89	0.60	9.92814E-03	4.71190E-02	1.53540E-02	6.20088E-03	2.65161E-02	5.57142E-04
14	0.	2.50	5.00	0.60	1.58085E-02	6.34168E-02	2.56988E-02	9.44115E-05	5.56322E-05	2.26846E-03
15	0.	2.50	6.11	0.60	9.92066E-03	4.70657E-02	1.53299E-02	6.03018E-03	2.65224E-02	5.70528E-04
16	0.	2.50	7.22	0.60	3.23305E-03	1.03227E-02	7.58868E-03	8.56012E-03	3.31190E-02	3.33196E-03
17	0.	2.50	8.33	0.60	1.17609E-02	1.53997E-02	2.23834E-02	6.47854E-03	7.74739E-03	6.25861E-03
18	0.	2.50	9.44	0.60	9.87556E-03	1.29131E-02	1.48840E-02	2.13056E-03	2.19731E-02	5.50498E-03
19	0.	2.50	0.56	2.10	2.39999E-03	9.87419E-03	5.95025E-03	7.08935E-04	4.11922E-03	7.32408E-03
20	0.	2.50	1.67	2.10	6.08594E-03	1.77176E-02	4.18572E-03	7.89684E-04	1.04034E-02	2.71422E-03
21	0.	2.50	2.78	2.10	4.78330E-04	6.52212E-03	1.11537E-03	2.70394E-03	1.47376E-02	6.51530E-04
22	0.	2.50	3.89	2.10	8.33842E-03	1.18279E-02	2.43894E-03	2.35066E-03	1.12405E-02	8.39253E-04
23	0.	2.50	5.00	2.10	1.22561E-02	2.00814E-02	4.06733E-03	2.49327E-05	5.90970E-06	1.45899E-03
24	0.	2.50	6.11	2.10	8.32577E-03	1.18139E-02	2.42944E-03	2.29972E-03	1.12137E-02	8.52851E-04
25	0.	2.50	7.22	2.10	5.20101E-04	6.60177E-03	1.12420E-03	2.65957E-03	1.46815E-02	6.16790E-04
26	0.	2.50	8.33	2.10	6.12561E-03	1.77886E-02	4.18178E-03	7.23721E-04	1.03147E-02	2.63210E-03
27	0.	2.50	9.44	2.10	2.39207E-03	9.85955E-03	5.92795E-03	7.52783E-04	4.04834E-03	7.16198E-03

STMAX

MAXIMUM RMS STRESSES FOR TILE NO. 2 (PSI)

MEM	TEMP	LOCAL COORDINATES X	Y	Z	XX	YY	ZZ	XY	YZ	ZX
2	C.	2.5C	1.67	C.05	5.28802E-02	5.25542E-02	5.44922E-02			
5	C.	2.5C	5.00	0.05	4.29692E-02	4.32948E-02	4.52996E-02			
6	C.	2.5C	6.11	0.05			2.72474E-02			
8	C.	2.5C	8.33	C.05	5.29513E-02	5.26278E-02	5.45707E-02			
12	C.	2.5C	2.78	0.60					3.30761E-02	
13	0.	2.50	3.89	0.60		4.71180E-02				
14	0.	2.50	5.00	0.60		6.34168E-02				
15	0.	2.50	6.11	0.60		4.70657E-02				
16	0.	2.5C	7.22	0.60					3.31190E-02	

FROM GETDIM,
NAME = RMS DEFLS, I/O UNIT = 10, FILE = 5, ROWS = 1, COLUMNS = 162 SIGDEF

FROM GETDIM,
NAME = BND COND, I/O UNIT = 9, FILE = 1, ROWS = 51, COLUMNS = 11 DPRIME

PRIMARY STRUCTURE RMS ACCELERATIONS

NODE	DX(G*S)	DY(G*S)	DZ(G*S)	RX/G	RY/G
1	1.199731E-02	4.083421E-03		8.708262E-04	1.858769E-01
2	9.947237E-03	3.419011E-03		8.726218E-04	1.794451E-01
3	9.918872E-03	2.754986E-03		5.773020E-04	1.741698E-01
4	9.161912E-03	2.380018E-03		2.244726E-04	1.712080E-01
5	9.982064E-03	2.016577E-03		2.124809E-04	1.694791E-01
6	9.935733E-03	1.621441E-03		1.948416E-04	1.694434E-01
7	9.016853E-03	1.300638E-03		2.198377E-04	1.711181E-01
8	9.638924E-03	1.009471E-03		5.674113E-04	1.740365E-01
9	9.452268E-03	4.789154E-04		8.601656E-04	1.792688E-01
10	1.113973E-02			8.686858E-04	1.856741E-01
11	5.096253E-03	2.390543E-03	6.551701E-01	5.861452E-02	2.479148E-07
12	5.187143E-03	2.255432E-03	6.087717E-01	3.576408E-02	2.641586E-07
13	4.970454E-03	2.192051E-03	5.804051E-01	2.334302E-02	2.785179E-07
14	4.946131E-03	1.858130E-03	5.612002E-01	1.445306E-02	2.864523E-07
15	4.774462E-03	1.508630E-03	5.519450E-01	4.555974E-03	3.482865E-07
16	4.740537E-03	1.161367E-03	5.518240E-01	4.290767E-03	4.310352E-07
17	4.840411E-03	7.854404E-04	5.607947E-01	1.415952E-02	4.952738E-07
18	4.779249E-03	3.989208E-04	5.797406E-01	2.313492E-02	3.345991E-07
19	4.894689E-03	2.500680E-04	6.079589E-01	3.564506E-02	3.434177E-07
20	4.701886E-03		6.542451E-01	5.848853E-02	2.553824E-07
21		2.950237E-03		8.708290E-04	1.858785E-01
22		2.423306E-03		8.725843E-04	1.794471E-01
23		1.890348E-03		5.774281E-04	1.741718E-01
24		1.650761E-03		2.246683E-04	1.712099E-01
25		1.448924E-03		2.125454E-04	1.694812E-01
26		1.208051E-03		1.948191E-04	1.694458E-01
27		1.017056E-03		2.195391E-04	1.711205E-01
28		8.369649E-04		5.670532E-04	1.740381E-01
29		3.927536E-04		8.601446E-04	1.792704E-01
30				8.687465E-04	1.856759E-01
31	8.468080E-03	2.113395E-03	4.411950E-02	5.813891E-02	3.247737E-01
32	2.262286E-02	1.774390E-03	9.384897E-03	1.728802E-04	2.728852E-01
33	8.811451E-03	1.729574E-03	4.363184E-02	5.333984E-02	3.239828E-01
34	5.215697E-03	1.328261E-02	6.588442E-01	2.019968E-02	2.284266E-05
35	4.840776E-03	1.307767E-03	5.593598E-01	1.801504E-05	4.077022E-08
36	4.932560E-03	1.576727E-02	6.576377E-01	1.813272E-02	9.518637E-06
37	1.901357E-02	1.144714E-03	4.391549E-02	5.335383E-02	3.246638E-01
38	3.240195E-02	1.315759E-03	9.319872E-03	2.092846E-05	2.728429E-01
39	1.879151E-02	1.645736E-03	4.354679E-02	5.375675E-02	3.239169E-01

FROM GFTDIM,
NAME = BND COND, I/O UNIT = 9, FILE = 1, ROWS = 51, COLUMNS = 11

DPMAX

DPMAX

MAXIMUM PRIMARY STRUCTURE RMS ACCELERATIONS

NODE	DX(G*S)	DY(G*S)	DZ(G*S)	RX/G	RY/G
1					1.858769E-01
2					1.794451E-01
3					1.741698E-01
5					1.792688E-01
10					1.856741E-01
11			6.551701E-01		
12			6.087717E-01		
13			5.804051E-01		
14			5.612002E-01		
15			5.519450E-01		
16			5.518240E-01		
17			5.607947E-01		
18			5.797406E-01		
19			6.079589E-01		
20			6.542451E-01		
21					1.858785E-01
22					1.794471E-01
23					1.741718E-01
28					1.740381E-01
29					1.792704E-01
30					1.856759E-01
31					3.247737E-01
32					2.729852E-01
33					3.239828E-01
34			6.588442E-01		
35			5.593598E-01		
36			6.576377E-01		
37					3.246638E-01
38					2.728429E-01
39					3.239169E-01

FROM GETDIM,
NAME = PS STRES, I/O UNIT = 10, FILE = 6, ROWS = 1, COLUMNS = 108 **SIGDEF**

FROM GETDIM,
NAME = LOADS , I/O UNIT = 9, FILE = 2, ROWS = 3, COLUMNS = 1000 **SPRIME**

TOP-POINT PLATE MEMBER RMS STRAINS AND STRESSES (PSI) **SPRIME**

MEMBER	COORDINATES X	COORDINATES Y	RMS STRAINS EPS X	RMS STRAINS EPS Y	RMS STRAINS EPS XY	RMS STRESSES SIG X	RMS STRESSES SIG Y	RMS STRESSES SIG XY
1	2.5000E 00	5.5556E-01	9.9475E-06	2.6845E-06	1.8545E-06	1.0046E 02	3.2939E 00	1.3247E 01
2	2.5000E 00	1.6667E 00	9.3548E-06	1.8092E-06	8.2865E-07	9.6835E 01	1.0958E 01	5.9189E 00
3	2.5000E 00	2.7778E 00	9.0817E-06	1.4557E-06	7.5668E-07	9.4999E 01	1.3943E 01	5.4048E 00
4	2.5000E 00	3.8889E 00	9.0249E-06	1.5239E-06	5.6735E-08	9.4151E 01	1.3006E 01	4.0525E-01
5	2.5000E 00	5.0000E 00	9.1566E-06	1.4830E-06	4.8264E-08	9.5732E 01	1.3890E 01	3.4474E-01
6	2.5000E 00	6.1111E 00	9.0132E-06	1.5098E-06	4.2145E-08	9.4069E 01	1.3123E 01	3.0103E-01
7	2.5000E 00	7.2222E 00	9.0546E-06	1.4392E-06	8.5503E-07	9.4757E 01	1.4035E 01	6.1074E 00
8	2.5000E 00	8.3333E 00	9.2975E-06	1.7802E-06	9.2239E-07	9.6302E 01	1.1089E 01	6.5885E 00
9	2.5000E 00	9.4444E 00	9.8238E-06	2.6302E-06	1.9370E-06	9.9283E 01	3.4931E 00	1.3836E 01
10	7.5000E 00	5.5556E-01	9.7[illegible]5E-06	2.5772E-06	1.3098E-06	9.8191E 01	3.6856E 00	9.3555E 00
11	7.5000E 00	1.6667E 00	9.4328E-05	1.7069E-06	8.0977E-07	9.8030E 01	1.2340E 01	5.7840E 00
12	7.5000E 00	2.7778E 00	9.2123E-06	1.3422E-06	5.7957E-07	9.6809E 01	1.5521E 01	4.1398E 00
13	7.5000E 00	3.8889E 00	9.0765E-06	1.4071E-06	2.4123E-07	9.5103E 01	1.4460E 01	1.7231E 00
14	7.5000E 00	5.0000E 00	9.0026E-06	1.3610E-06	7.4993E-09	9.4443E 01	1.4723E 01	5.3566E-02
15	7.5000E 00	6.1111E 00	9.0496E-05	1.4084E-06	2.6253E-07	9.4803E 01	1.4357E 01	1.8752E 00
16	7.5000E 00	7.2222E 00	9.1559E-06	1.3524E-06	6.2030E-07	9.6156E 01	1.5322E 01	4.4307E 00
17	7.5000E 00	8.3333E 00	9.3421E-06	1.7128E-06	8.8268E-07	9.7014E 01	1.1976E 01	6.3049E 00
18	7.5000E 00	9.4444E 00	9.5311E-06	2.5629E-06	1.4213E-06	9.6838E 01	3.4224E 00	1.0152E 01

MAXIMUM TOP-POINT PLATE MEMBER RMS STRAINS AND STRESSES (PSI) **SPMAX**

MEMBER	COORDINATES X	COORDINATES Y	RMS STRAINS EPS X	RMS STRAINS EPS Y	RMS STRAINS EPS XY	RMS STRESSES SIG X	RMS STRESSES SIG Y	RMS STRESSES SIG XY
1	2.5000E 00	5.5556E-01				1.0046E 02		
2	2.5000E 00	1.6667E 00				9.6835E 01		
3	2.5000E 00	2.7778E 00				9.4599E 01	1.3943E 01	
4	2.5000E 00	3.8889E 00				9.4151E 01		
5	2.5000E 00	5.0000E 00				9.5732E 01		
6	2.5000E 00	6.1111E 00				9.4069E 01		
7	2.5000E 00	7.2222E 00				9.4757E 01	1.4035E 01	
8	2.5000E 00	8.3333E 00				9.6302E 01		
9	2.5000E 00	9.4444E 00				9.9283E 01		
10	7.5000E 00	5.5556E-01				9.8191E 01		
11	7.5000E 00	1.6667E 00				9.8030E 01		
12	7.5000E 00	2.7778E 00				9.6809E 01	1.5621E 01	
13	7.5000E 00	3.8889E 00				9.5103E 01	1.4460E 01	
14	7.5000E 00	5.0000E 00				9.4443E 01	1.4723E 01	
15	7.5000E 00	6.1111E 00				9.4803E 01	1.4357E 01	
16	7.5000E 00	7.2222E 00				9.6156E 01	1.5322E 01	
17	7.5000E 00	8.3333E 00				9.7014E 01		
18	7.5000E 00	9.4444E 00				9.6838E 01		

FROM GETDIM.
NAME = PS STRES. I/O UNIT = 10. FILE = 7. ROWS = 1. COLUMNS = 108

SIGDEF

SPRIME

BOTTOM-POINT PLATE MEMBER RMS STRAINS AND STRESSES (PSI)

MEMBER	COORDINATES X	Y	RMS STRAINS EPS X	EPS Y	EPS XY	RMS STRESSES SIG X	SIG Y	SIG XY
1	2.5000E 00	5.5556E-01	5.9006E-06	1.4359E-06	8.2035E-07	6.0108E 01	3.6734E 00	5.8596E 00
2	2.5000E 00	1.6667E 00	5.9855E-06	6.7321E-07	3.3689E-07	6.3555E 01	1.2334E 01	6.6920E 00
3	2.5000E 00	2.7778E 00	5.9012E-06	3.4862E-07	3.3484E-07	6.3659E 01	1.5624E 01	2.3917E 00
4	2.5000E 00	3.8889E 00	5.7545E-06	4.1049E-07	6.2834E-07	6.1883E 01	1.4460E 01	4.4881E 00
5	2.5000E 00	5.0000E 00	5.5463E-06	3.2356E-07	5.7123E-08	5.9882E 01	1.4729E 01	4.0802E-01
6	2.5000E 00	6.1111E 00	5.7508E-06	4.2166E-07	5.1252E-07	6.1915E 01	1.4358E 01	3.6609E 00
7	2.5000E 00	7.2222E 00	5.9186E-06	3.8081E-07	2.2169E-07	6.3784E 01	1.5327E 01	1.5835E 00
8	2.5000E 00	8.3333E 00	6.0293E-06	7.1914E-07	8.3234E-07	6.3885E 01	1.1974E 01	5.9453E 00
9	2.5000E 00	9.4444E 00	6.0079E-06	1.4917E-06	7.3019E-07	6.1103E 01	3.4137E 00	5.2156E 00
10	7.5000E 00	5.5556E-01	6.1397E-06	1.5432E-06	1.3650E-06	6.2381E 01	3.2820E 00	9.7503E 00
11	7.5000E 00	1.6667E 00	5.9076E-06	7.7554E-07	9.5575E-07	6.2362E 01	1.0953E 01	6.8268E 00
12	7.5000E 00	2.7778E 00	5.7707E-06	4.6214E-07	5.1196E-07	6.1891E 01	1.3946E 01	3.6568E 00
13	7.5000E 00	3.8889E 00	5.7030E-06	5.2732E-07	3.3032E-07	6.0932E 01	1.3006E 01	2.3595E 00
14	7.5000E 00	5.0000E 00	5.7004E-06	4.4558E-07	1.6305E-08	6.1173E 01	1.3896E 01	1.1647E-01
15	7.5000E 00	6.1111E 00	5.7245E-06	5.2299E-07	2.9215E-07	6.1183E 01	1.3125E 01	2.0868E 00
16	7.5000E 00	7.2222E 00	5.8174E-06	4.6754E-07	4.5634E-07	6.2386E 01	1.4040E 01	3.2596E 00
17	7.5000E 00	8.3333E 00	5.9849E-06	7.8659E-07	8.7206E-07	6.3174E 01	1.1086E 01	6.2290E 00
18	7.5000E 00	9.4444E 00	6.2506E-06	1.5590E-06	1.2459E-06	6.3549E 01	3.4748E 00	8.8996E 00

SPMAX

MAXIMUM BOTTOM-POINT PLATE MEMBER RMS STRAINS AND STRESSES (PSI)

MEMBER	COORDINATES X	COORDINATES Y	RMS STRAINS EPS X	RMS STRAINS EPS Y	RMS STRAINS EPS XY	RMS STRESSES SIG X	RMS STRESSES SIG Y	RMS STRESSES SIG XY
1	2.5000E 00	5.5556E-01				6.0108E 01		
2	2.5000E 00	1.6667E 00				6.3555E 01		
3	2.5000E 00	2.7778E 00				6.3699E 01	1.5524E 01	
4	2.5000E 00	3.8889E 00				6.1883E 01	1.4460E 01	
5	2.5000E 00	5.0000E 00				5.9882E 01	1.4729E 01	
6	2.5000E 00	6.1111E 00				6.1915E 01	1.4358E 01	
7	2.5000E 00	7.2222E 00				6.3784E 01	1.5327E 01	
8	2.5000E 00	8.3333E 00				6.3885E 01		
9	2.5000E 00	9.4444E 00				6.1103E 01		
10	7.5000E 00	5.5556E-01				6.2381E 01		
11	7.5000E 00	1.6667E 00				6.2362E 01		
12	7.5000E 00	2.7778E 00				6.1891E 01	1.3946E 01	
13	7.5000E 00	3.8889E 00				6.0932E 01		
14	7.5000E 00	5.0000E 00				6.1173E 01		
15	7.5000E 00	6.1111E 00				6.1183E 01		
16	7.5000E 00	7.2222E 00				6.2386E 01	1.4040E 01	
17	7.5000E 00	8.3333E 00				6.3174E 01		
18	7.5000E 00	9.4444E 00				6.3549E 01		

FROM G=TDIM.
NAME = ST STRES. I/O UNIT = 10. FILE = 8. ROWS = 1. COLUMNS = 12

SIGDEF

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STRNGR

STRINGER STRAINS AND STRESSES

MEMBER	STRINGER NO.	X-COORDINATE	EPS X	SIG X
1	1	2.5000E 00	1.2290E-04	1.2290E 03
2	2	2.5000E 00	1.1582E-04	1.1582E 03
3	3	2.5000E 00	1.2288E-04	1.2288E 03
4	1	7.5000E 00	1.2321E-04	1.2321E 03
5	2	7.5000E 00	1.1597E-04	1.1597E 03
6	3	7.5000E 00	1.2319E-04	1.2319E 03

TSTMAX

MAXIMUM RMS STRESS FOR EACH TILE

TILE	MEMBER	STRESS COMPONENT	RMS STRESS
1	14	YY	6.35917E-02
2	14	YY	6.34168E-02